

carapace length agrees very well with the illustration of *A. scabra* herein (Figure 47) except that the dark distal part of the third pereiopod is not so strikingly conspicuous, and there are a few dark spots on the lateral surface of the carapace that are not present in the illustration of *A. scabra*. Whether or not there is a dorsomedian longitudinal stripe cannot be determined from the transparency because of the position of the animal in the photograph. The uniform, very dark-blue coloration, even extending onto the basal section of the eyestalks of an animal with a 30 mm carapace length suggests that an encrustation of some kind is at least partly responsible for the intensity of the dark color.

SIZE.—Of the 98 males measured, the largest specimen has a carapace length of 38.0 mm; the average was 18.6 mm. The largest of 54 females has a corresponding length of 24.4 mm, the average 14.3 mm. The smallest and largest ovigerous females have carapace lengths of 7.3 and 20.8, average 12.7 mm.

DISTRIBUTION AND SPECIMENS EXAMINED.—Disregarding the almost certain erroneous data (New Caledonia) recorded by A. Milne-Edwards for his types as well as for those reported for Argentina and Australia, this American species ranges from Baja California southward on the Pacific versant to Peru (Figures 38, 39).

Records for the known localities are listed below. Collections that we have examined are marked with an asterisk if they have been previously reported and with a dagger if they are reported herein for the first time. Numbers following the specimens listed are measurements, in mm, of the carapace length or, if followed by "t.l.," total length. Some listings lack dates and/or collectors; if so, these could not be determined.

MEXICO: (1) †USNM, La Paz, Baja California Sur, 1♀ (9.6), Jun 1882, L. Belding. (2) †MCZ, San José, Baja California Sur, 2♂ (6.1, 8.2), 2♀ (7.5, 7.9), 3 juv, Gustav Eisen. (3) †BM, San Ramón, 3♂ (28.8–35.6), 1♀ (22.7), A.C. Butler. (4) †USNM, Río San Nicolás between Chamela and Tomatlán, Jalisco, 8♂ (6.1–12.0), 2♀ (7.8–9.9), 4 ovig ♀ (7.3–8.4), 1 juv (3.1), 6 Apr 1965, R.R. Miller and Sable. (5) †BM, San Isidro, 3♂

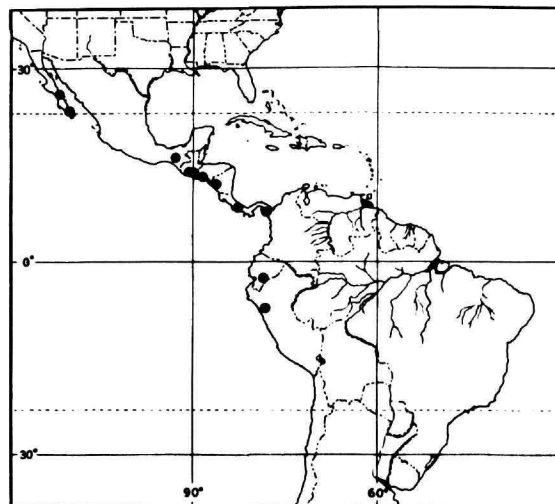


FIGURE 38.—Distribution of *Aya margaritacea* (for locality records in Costa Rica and Panama, see Figure 39).

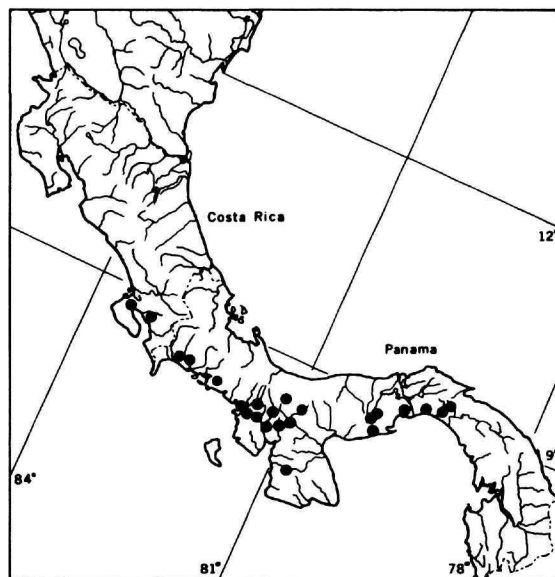


FIGURE 39.—Distribution of *Aya margaritacea* in Costa Rica and Panama.

(14.8–19.3), F.D. Godman. (6) †BM, Río Machiro, trib to Río Grande, near San Mateo, Oaxaca, alt 300 m, 2♂ (27.9, 28.3), H. Pittier de Fahega.

GUATEMALA: (1) †BM, Pentalion, 10♂ (13.1–

22.5), 10♀ (9.1–16.8), Champion. (2) †USNM, Río La Paz at San Diego on Carretera Interamericana, 20+ km W of Jutiapa, 4♂ (14.6–30.8), 13 Mar 1946, R.R. Miller and Holloway.

EL SALVADOR: †USNM, Santo Tomás in flooded river, 7♂ (11.8–15.0), 1♀ (8.4), 13 Mar 1939, Calderón.

NICARAGUA: †MCZ, El Polvón, 4 specimens (syntypes of *Atya rivalis*, in very poor condition), 1871, J.A. McNeil.

COSTA RICA: (1) †USNM, Río Riryto, 13.6 km from Rincón de Osa, 4♂ (10.6–17.5), 3♀ (11.4–17.3), 1 ovig ♀ (10.1), 15 Sep 1966, S.B. Peck. (2) †USNM, Río de los Platanales, Golfo Dulce, 1 ovig ♀ (9.5), Apr 1896, H. Pittier.

PANAMA: *Provincia de Chiriquí*—(1) †USNM, rivers flowing from Mt. Chiriquí, alt 426 m, 8°27'N, 82°24'W, 17♂ (20.3–30.6), 1♀ (20.6), 1 ovig ♀ (20.8), Jul 1883. (2) †USNM, 17 km W of Río David at Carretera Interamericana, 2♂ (16.6, 23.0), 1♀ (24.4), 15 Apr 1962. (3) †USNM, Río Tinta, 4.8 km W of Río Tabasará on Soná-Remedios Rd (Tabasará Basin), 1 ovig ♀ (9.1), 11 Nov 1961, H. Loftin. (4) †USNM, upper trib of Río Jacaque, 8♂ (10.2–23.4), 1♀ (11.6), HL and Dean. (5) Mt. Sapo, Piñas Bay (Coventry, 1944:534), 1 specimen, 21 May 1941, Fifth George Vanderbilt Expedition. *Provincia de Coclé*—(6) †MCZ, Río Las Lajas, 3♂ (7.3–8.1), 3♀ (11.1–12.6), 3 ovig ♀ (11.6–13.1), 22 Oct 1939, G.B. Fairchild. (7) †LGA, Río Cocoli (Coclé?) at K-6 crossing, 2♂ (14.0, 21.6), 3♀ (9.1–12.8), 26 Feb 1973, L.G. Abele, M.H. Robinson. (8) †LGA, El Vallé, Masso Charro?, 1♂ (13.3), 14 Apr 1973, LGA, L.R. Abele; 1♂ (22.5), 1♀ (19.9), 18 Apr 1973, LGA, LRA. (9) †LGA, El Vallé in fast riffles, 1 ovig ♀ (14.0), May 1978, LGA, B.E. Felgenhauer, L. Deaton. *Provincia de Panamá*—(10) †LGA, 12 km N of El Llano on Cartí Rd, 6♂ (10.2–21.8), 2♀ (10.2, 12.7), 10 Mar 1973, McPhail, R.L. Dressler. (11) †USNM, creek 1.7 km E of El Llano (Bravana Basin), 1♀ (16.0), 17 Mar 1962, HL. (12) †LGA, Río Mamoni (Bayano Basin), 2♂ (25.6, 26.1), 2♀ (10.2, 14.7), 16 Apr 1973, LGA, RLD; 1♂ (29.0), 16 May 1973, LGA, RLD; 2♂ (11.8, 13.1), Apr 1974, J. Gee, D. Kramer; 1♂ (20.0), 1♀ (13.3), 3 Aug 1974, LGA, K.L.

Heck. (13) †LGA, first stream on Cartí Rd, km 11, 2♂ (15.3, 18.3), 15 Jan 1975, DK. (14) †LGA, second stream on rd to Chepo, 3♂ (7.0–31.2), 1♀ (approx 8.5), May 1978, LGA, BEF, LD. *Provincia de Los Santos*—(15) †USNM, Río Tonosi, halfway between Llano de Piedra and Tonos Plain, 1♂ (16.0), 1♀ (14.4), Mar 1963, HL. *Provincia de Veraguas*—(16) †USNM, creek 13.6 km W of El María on Soná-Remedios Rd (Tabasará Basin), 6♂ (7.6–21.4), 4♀ (about 10.0–15.2), 2 ovig ♀ (9.3, 11.4), 11 Nov 1961, HL. (17) †USNM, Río Calixto, 11.9 km W of El María on Soná-Remedios Rd (Tabasará Basin), 1♂ (10.7), 11 Nov 1961, HL. (18) †USNM, creek just before entering Santa Fe (Santa María Basin), 5♂ (17.4–28.0), 1♀ (12.5), 9 Feb 1962, HL. (19) †LGA, Río San Pablo, 3♂ (20.4–23.2), 2♀ (12.1, 13.9), 30 Mar 1973, LGA, P. Campanella, J.B. Graham. (20) †USNM, 8.5 km E of Soná on San Remedios Rd (San Pablo Basin), 2♂ (13.4, 15.8), 1♀ (14.0), 28 Jan 1962. (21) †USNM, Río San Martín Grande, 6.8 km S of Santiago on Montigo Rd, 3♂ (13.3–25.6), 14 Jan 1962, HL. (22) †USNM, Río Curvibora, 3.4 km E of Santiago on Carretera Interamericana (San Pedro Basin), 2♂ (16.8, other injured), 21 Oct 1961, HL. (23) †LGA, Río Las Guías at Rd from Calobre, 2♂ (8.2, 28.9), 4♀ (15.3–17.7), 21 Feb 1973, LGA, MHR. (24) †LGA, Río Vigui [= Río Tabasará], 1♂ (26.9), 29 Mar 1973, LGA, PC, JBG.

ECUADOR: (1) †RNHL, Chula, 3♂ (14.5–17.7), 2♀ (11.1, 14.6), 3 ovig ♀ (11.2, 14.1, 19.1), Sep 1956, W. Forster. (2) †BM, Río Sapayo, NW Ecuador, 3♂ (23.9–24.7).

PERU: (1) †RNHL, Río Tumbes, 1♂ (24.3), Mario Peña. (2) †RNHL, “don Museo Historia Natural de Lima, Peru,” 1♂ (28.6). (3) †USNM, Río Chicama, near Trujillo, 1♂ (27.4), Jul 1970, F. Ancieta. (4) *USNM, purchased at market in Salaverry, 1♂ (26.7), 24 Oct 1926. (5) Río Jequetepeque, near Pacasmayo (Solar, 1972:8). (6) Río Chicama, near Pacasmayo (Solar, 1972:8). In addition to the rivers listed here, Méndez (1981:70) also reported its occurrence in ríos Chira, Supe, and Huaura, but no specific localities were cited.

There is every reason to believe that the follow-

ing locality data are erroneous:

ARGENTINA: *BM, Buenos Aires, 1♂ (38.0), 1♀ (13.4), March 1892, H. Pittier. (Perhaps pertinent is the fact that H. Pittier collected in Oaxaca, Mexico; see locality 6 under "Mexico," above.)

NEW CALEDONIA: *MHNP, syntypes of *Atya margaritacea*, 2♂ (24.5, 30.6), 1♀ (16.6).

AUSTRALIA: *MHNP, Victoria, 1♂ (21.8), von Müller.

VARIATIONS.—The carapace of freshly molted individuals is studded with a dense pile of short, comparatively stiff setae, but frequently specimens are encountered in which the pile is so abraded as to be hardly noticeable. Among other variations are features of the rostrum, the margins of which may be very weakly or strongly concave, and whereas always angular at the base of the acumen are sometimes produced with acute or rounded apices. The apex of the acumen always lies at or near the articulation of the basal and penultimate podomeres of the antennule, and the high to moderately low concave dorsal carina almost or quite reaches the apex; the ventral carina may lack or possess a small preapical tooth. The posteroventral angle of the pleuron of the third abdominal segment may be angular or rounded, and the number of denticles on the ventral margin of the third, fourth, and fifth pleura are quite variable, at least in part due to loss of one or more of them. The number of spines in each of the curved rows on the dorsal side of the telson varies from five to seven, and the posteromedian tubercle, always premarginal, may or may not overreach the caudal margin. The preanal spine appears usually to be proportionately longer in smaller individuals; with respect to the dorsal base of the carina, becoming shorter with increase in size of the animal. The basal podomere of the antennule may bear one, two, or no corneous spinules among the plumose setae on the dorsal surface, and the number of spinules in the transverse distal row varies from six to 10; even more variable is the number of spinules on the dorsodistal margin of the penultimate podomere; frequently gaps occur in both rows suggesting a loss due perhaps to injury. The

same is true of the two distal rows of spinules on the ultimate podomere of the peduncle. Variations in the arrangement of tubercles on the flexor surface of the propodus and dactyl of the third pereopod are illustrated in Figures 37*f,h,i,k*, 40*b*, 41. The merus of the fourth and fifth pereopods of most small individuals bears two or three movable ventral spines and a subterminal ventrolateral one, and there is a large one present on or near the distal ventrolateral extremity of the carpus; any one or all may be lacking in larger representatives of the species.

None of the variations noted have been discovered to be helpful in recognizing the geographical source of a specimen. Virtually all of the limits of variations noted are exhibited by a series of specimens from a single Panamanian locality.

ECOLOGICAL NOTES.—Ecological observations pertaining to this shrimp are indeed few. Smith (1871) noted that his specimens of *Atya rivalis* were collected in freshwater streams, and Abele and Blum (1977) stated that it is found only in riffle areas of fast-flowing, clear streams. In their study of the freshwater decapods in the Archipiélago de las Perlas, the latter found that *A. rivalis* seemed to be limited to the larger islands where such a habitat exists throughout the year.

Of the specimens examined by us, all of them that are accompanied by data other than that citing the locality include a reference to a creek, river, or stream. The greatest altitude at which specimens are known to have been obtained was in Panama where they were found at 426 m above sea level.

We have discovered no comb-bearing scrapers among the terminal clusters of setae on the fingers of the first and second pereopods of this shrimp, and the terminal brush on the "bristles," like those of *A. scabra*, are comparatively inconspicuous as compared with those of *A. innocous*. As pointed out in the introductory section of this study, Fryer (1977:93) associated these features with the feeding behavior of the shrimp, correlating (p. 73) such bristles as those possessed by *A. margaritacea* with predominance of filtering over scraping.

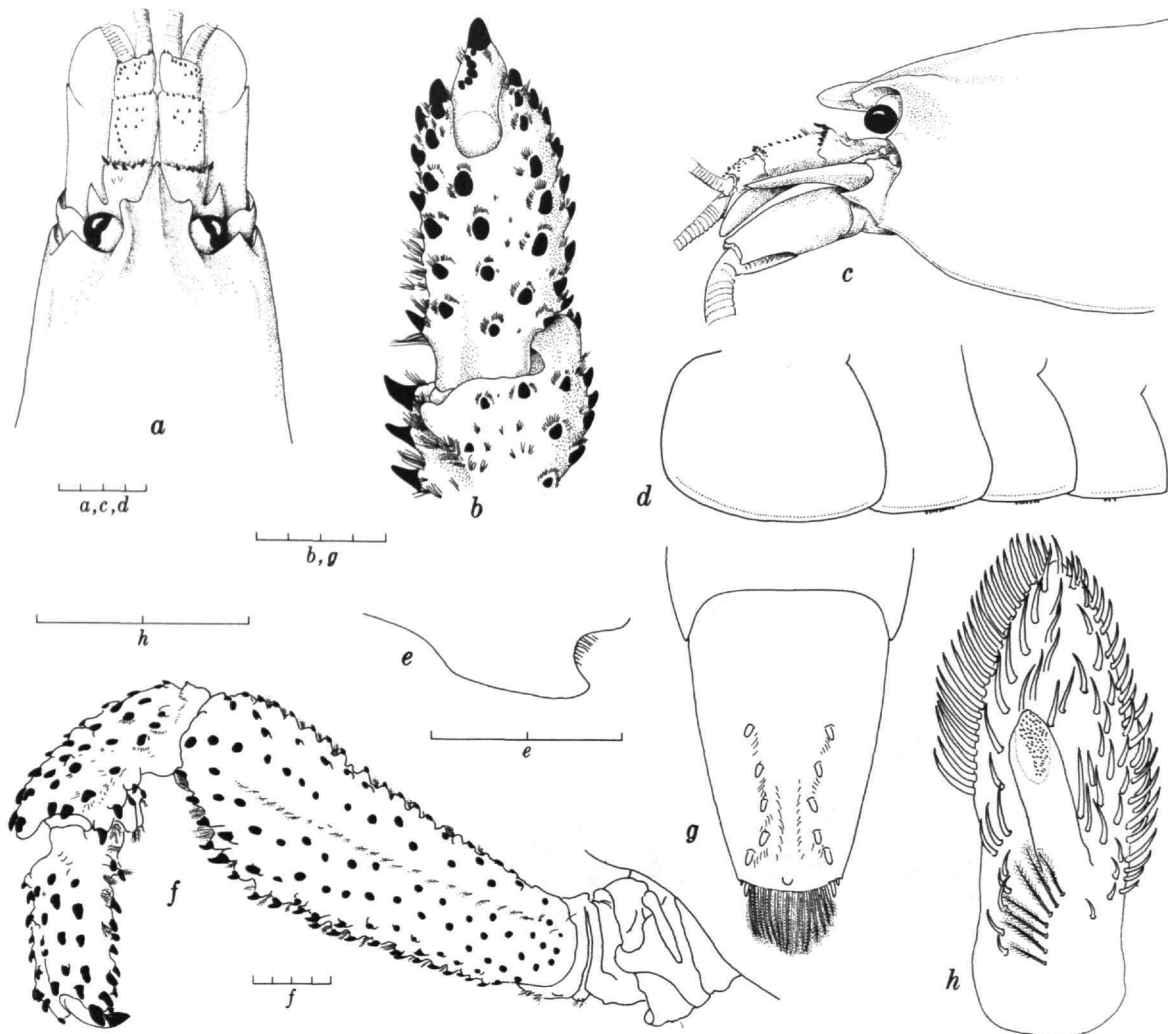


FIGURE 40.—*Atya margaritacea* (all from male from Mt. Chiriquí, Panama): a, dorsal view of cephalic region; b, flexor surface of distal part of third pereiopod; c, lateral view of cephalic region; d, lateral view of second through fifth pleura; e, lateral view of preanal carina; f, lateral view of third pereiopod; g, dorsal view of telson; h, mesial view of appendices masculina and interna. (Scales marked in 1 mm increments.)

LIFE HISTORY NOTES.—Even less is known of the life history of this shrimp than about the habitats in which it lives. Ovigerous females have been collected in April, May, July, September, October, and November. The numbers of eggs carried by three females were as follows: carapace length 9.3 mm, 1770 eggs; 9.5 mm, 1798 eggs;

11.4 mm, 3010 eggs. Such a high biotic potential suggests that like *Micratya poeyi* and *Atya innocous*, studied by Hunte (1979a,b), which require an increased salinity in their early larval stage, the hatchlings of members of this species probably travel downstream for at least a temporary sojourn in an estuarine, if not marine, habitat. The



FIGURE 41.—*Atya margaritacea*, variations in flexor surface of distal part of third pereiopod (numbers in parentheses = carapace length in mm): a, Río Machiro, San Mateo, Mexico (♂, 28.5); b, San Ramón, Mexico (♀, 33.5); c, Pentalion, Guatemala (♂, 22.7); d, Río Riryto, Costa Rica (♂, 17.5); e, Río San Martín Grande, Panama (♂, 25.6); f, Río Chicamo, Peru (♂, 27.4).

dimensions of the eggs carried by the syntypic female of *A. margaritacea* were reported by Bouvier (1925:315) to be 0.51 by 0.31 mm, measurements that are in keeping with those noted among the ovigerous females examined by us.

REMARKS.—Because of the confusion surrounding the identity and range of this shrimp, we are illustrating both a syntypic male of Milne-Edwards' species and a male specimen from the Pacific watershed of Guatemala. The syntypes of *Atya rivalis* are in such poor condition, and we have no specimens from Nicaragua, that this specimen from Guatemala has been chosen to represent Smith's species. Inasmuch as the syntypes of *A. margaritacea* appear to us to be indistinguishable from the syntypes of *A. rivalis* as well as from other specimens collected on the Pacific versant from Baja California to Peru and are obviously different from specimens of *Atya scabra* from throughout its range, we are convinced that the name *Atya rivalis* should be removed from the synonymy of *A. scabra* and treated as a junior subjective synonym of Milne-Edwards' *Atya margaritacea*.

In our opinion, *A. margaritacea* is more closely related to *A. scabra* than to any other member of the genus. It may be distinguished from the latter by several features, among the most conspicuous of which are (1) the arrangement of the tubercles on the flexor surface of the propodus of the third pereopod; in the former the tubercles are scattered over the entire surface, and if a few tend to lie in a linear series they are never contiguous or overlapping (cf. Figures 41, 53), (2) the distomesial extremity of the merus of the third pereopod is produced in a prominent rounded lobe in *A. margaritacea*, one that is far more conspicuous than the comparatively small corresponding bulge in *A. scabra*, and (3) spinules are never present on the ventral margin of the second abdominal pleuron in *A. margaritacea* but in the Western Hemisphere are rarely absent in *A. scabra*.

Atya ortmannioides Villalobos

FIGURES 1*b*, 9, 10, 12*c*, 42-44

Atya ortmannioides Villalobos, 1956:459-475, pls. 1-6 [type-locality: Río de las Truchas, La Mira, 52.5 km SSE of

Arteaga, Michoacán, Mexico; types: IBM 21153, holotype (♀), allotype (♂); paratypes, USNM 99527 (1♂, 1♀); Instituto Politécnico Nacional (2 specimens)].

The above citation is the only reference that we have encountered to this shrimp; it consists of a description and illustrations that were based upon four males and five females from the type-locality. Villalobos did not account for three of the specimens listed in his measurements but which were not included among the types (see pp. 472, 474).

PUBLISHED ILLUSTRATIONS.—The excellent illustrations provided with the original description depict a lateral view of the entire female, a lateral view of the carapace, dorsal view of the cephalic region and of the telson and uropods, drawings of the gnathal and ambulatory appendages, the first and second pleopods of the male, and mesial views of the appendix interna and appendix masculina. Setae from the scaphognathite, second maxilla, and first and second pereopods, including those with biserial arrangement of denticles, are also presented.

DIAGNOSIS.—Cephalic region of carapace not conspicuously sculptured, with anteriorly converging flat (not convex), glabrous lateral surfaces; antennal and pterygostomial spines prominent. Rostrum projecting anteriorly, not arched or directed ventrally, with margins suddenly contracted at base of acumen forming angular to subangular bends; angles never produced anteriorly; acumen longer than remainder of rostrum. Ventral margin of third through fifth abdominal pleura lacking rows of sclerotized denticles; caudoventral angle of fourth and fifth pleura weakly obtuse to acute but not produced. Sternum of sixth abdominal segment distinctly more than half as long as wide; compressed median tubercle on sternum of fifth abdominal segment small and comparatively inconspicuous. Preanal carina with compressed spine reaching to or beyond caudal extremity of basal part of sclerite. Telson slightly more or less than twice as long as wide with 6 to 8 denticles in each of 2 dorsal rows. Antennular peduncle with dorsal surface of proximal article devoid of sclerotized denticles proximal to distal row; penultimate article 1.5 to 1.8

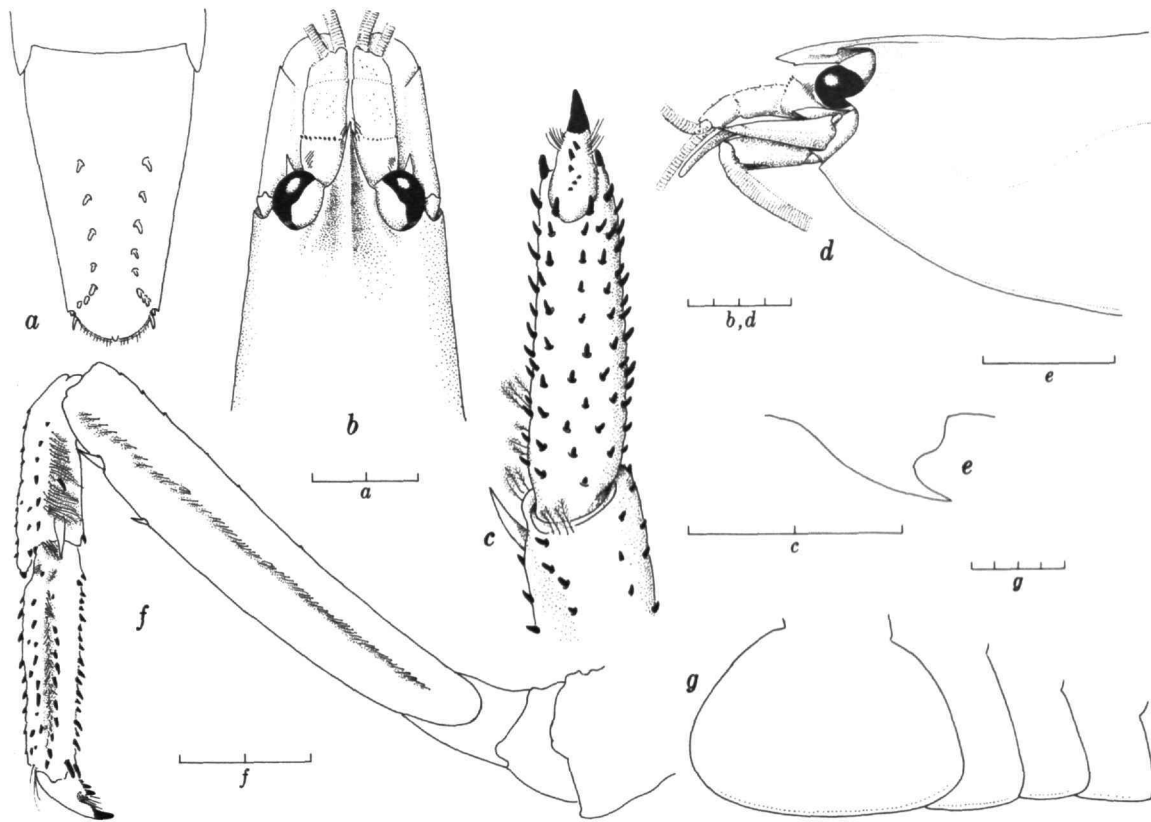


FIGURE 42.—*Atya ortmannioides* (all from paratypic female): *a*, dorsal view of telson; *b*, dorsal view of cephalic region; *c*, flexor surface of distal podomeres of third pereiopod; *d*, lateral view of cephalic region; *e*, preanal carina; *f*, lateral view of third pereiopod; *g*, lateral view of second through fifth pleura. (Scales marked in 1 mm increments.)

times as long as wide, and dorsal surface with about 15 scattered spinules. Coxae of third and fourth pereiopods lacking prominent anterolateral spines. Third pereiopod with merus rounded ventrally, approximately 5.5 to 6.5 times as long as high, entire podomere bowed, never parallel to merus of other member of pair, and lateral surface bearing weakly sclerotized (none cornified) tubercles, some of which sublinearly arranged; propodus about 3 times as long as wide, its extensor surface studded with acute to subacute cornified denticles, and flexor surface with similar denticles, some linearly arranged but those in rows neither contiguous nor overlapping; flanking setae not conspicuous; dactyl freely movable and bearing 2 irregular rows of sclerotized denticles.

MALE (Río Murga, Estado de Guerrero, Mexico).—Rostrum with margins strongly contracted at base of acumen forming angle of slightly more than 90 degrees; acumen about 1.5 times as long as basal part of rostrum and reaching distal end of proximal third of penultimate podomere of antennule; dorsal median carina gently curved, not excavate dorsally (not dipping below level of lateral carinae posterior to acumen), and reaching base of corneous tip of acumen; ventral carina with single small preapical tooth; ocellar beak largely hidden by eyes, falling short of midlength of stylocerite, its cephalic margin vertical, and dorsal one subtruncate, abutting shallow ventral rostral groove. Antennal spine strong, pterygostomian spine less conspicuous. Surface of cara-

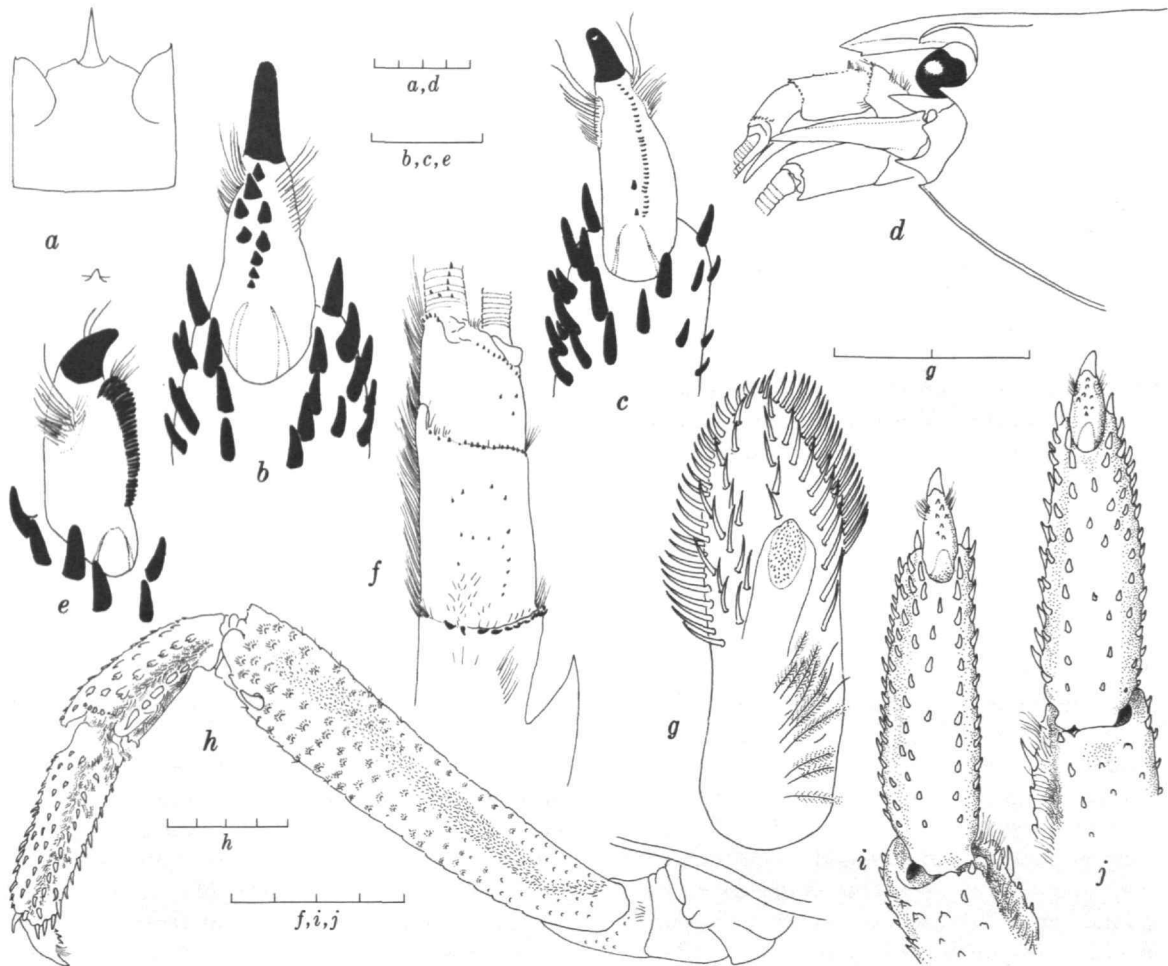


FIGURE 43.—*Atya ortmannioides* (all from male from Río Murga, Estado de Guerrero, Mexico): a, preanal carina, sternum of sixth abdominal segment, and median tubercle of fifth; b, c, flexor surface of distal part of fourth and fifth pereiopods, respectively; d, lateral view of cephalic region; e, preaxial view of distal part of fifth pereiopod; f, dorsal view of antennular peduncle; g, mesial view of appendices masculina and interna; h, lateral view of third pereiopod; i, j, flexor surface of distal part of right and left third pereiopods. (Scales marked in 1 mm increments.)

pace glabrous, densely but finely punctate, punctations bearing very short fine setae except just dorsal to ventral marginal sulcus where setae long; ridges and spines other than those just mentioned lacking.

Pleura of first 4 abdominal segments with rounded to subacute posteroventral extremities, corresponding part of fifth forming almost right angle, not produced. Third through fifth pleura

lacking denticles on ventral margin and fifth with moderately conspicuous fringe of plumose setae. Fourth abdominal tergum 1.2 times as long as fifth, latter subequal in length to sixth and almost 0.9 as long as telson. Sternum of fifth abdominal segment with small compressed median tubercle (Figure 43a); that of sixth 1.2 times as broad as long. Free part of preanal carina spiniform, curved, and only slightly overreaching angle of

basal part of sclerite. Telson about twice as long as broad, its dorsal surface bearing paired concave rows of 6 corneous denticles and posteromedian tubercle, latter overreaching caudal margin of telson.

Proximal podomere of antennule (Figure 43*f*) with stylocerite reaching about distal fifth of segment; dorsal surface with linear cluster of setae but lacking corneous denticles; distal margin bearing row of 13 (right) or 12 (left) corneous denticles; penultimate podomere about 1.5 times as long as wide and provided with 15 (right) or 16 (left) corneous denticles on dorsal surface and row of 18 on distal margin; ultimate podomere with 3 (right) or 2 (left, one of which broken) denticles on dorsal surface and row of 11 (right) or 9 (left) at base of lateral flagellum and 4 at base of mesial flagellum. Antenna with ventrolateral spine on basis reaching much farther anteriorly than pterygostomian spine but not quite so far as stylocerite; lateral spine on scaphocerite almost reaching lateral extremity of antennular peduncle; lamella far surpassing latter; flagella broken but in accompanying female reaching third abdominal tergum.

Third maxilliped only slightly overreaching antennular peduncle; tip of exopod attaining base of distal podomere of endopod; penultimate segment about 1.1 times as long as ultimate.

First pereopod reaching base of distal third of penultimate podomere of antennular peduncle, second almost attaining end of same podomere. Terminal brush of both fingers with some bristles bearing scraping denticles. Third pereopod (Figure 43*h-j*) with lateral distoventral spine on merus and carpus, ventral spine lacking on both podomeres; when appendage extended anteriorly overreaching antennular peduncle by dactyl and slightly more than half length of propodus. Merus with ventromesial margin bowed, about 5.4 times as long as high, 2.3 times as long as carpus, and 2.2 times as long as propodus. Latter 3.1 (right) or 3.3 (left) times as long as wide and 0.9 as long as carpus; distoventral margin of coxa entire, mesial caudoventral prominence and distal ventrolateral spine lacking. Lateral, dorsal, and ven-

tral surfaces of merus studded with sublinear series of prominent but noncornified tubercles flanked by arcs of plumose setae; moderately conspicuous longitudinal band of short setae present laterally; mesial extremity of podomere produced in small rounded lobe at level of mesial articular condyle of carpus. Latter bearing strong tubercles capped with corneous discs, tubercles flanked distally by arcs of plumose setae, setae on ventrolateral surface somewhat longer but not forming conspicuous tufts. Propodus also strongly tuberculate, tubercles capped with corneous spines; some tubercles on flexor surface forming mesial and lateral series and with more irregularly dispersed ones between, those in rows neither contiguous nor overlapping; lateral and ventrolateral surfaces with tufts of plumose setae. Dactyl movable, its flexor surface with denticles forming 2 irregular oblique rows flanked by paired setal clusters.

Fourth pereopod with dactyl reaching end of proximal fourth of propodus of third pereopod; merus about twice as long as carpus and latter only slightly shorter than propodus. Fifth pereopod reaching distal end of proximal fourth of propodus of fourth pereopod, merus 1.4 times as long as carpus and latter 0.65 length of propodus. Ornamentation of merus, carpus, and propodus of fourth pereopod consisting of distal ventrolateral spine and 1 more proximal ventral spine on merus, and distal ventrolateral and 2 smaller distolateral spines on carpus; lateral surface of distal part of merus and of carpus and propodus with longitudinal narrow band of plumose setae. Ornamentation of corresponding podomeres of fifth pereopod similar but with 3 distolateral spines on carpus instead of 2 and lacking setal band on distal part of merus.

Diagnosis of lateral ramus of uropod flanked proximally by row of 20 (right) or 19 (left) articulated, corneous denticles, and fixed spine present at lateral end of row.

COLOR NOTES.—No observations on the color of this shrimp have been reported.

SIZE.—Among the measurements recorded by Villalobos (1956:472) of four males and five fe-

males were the total length and carapace length (the latter was apparently made from the tip of the rostrum to the posterior margin of the carapace). His largest specimen was a female having a carapace length of 21.0 mm and a total length of 59.0 mm. Corresponding measurements of the largest male were 11.5 and 32.7 mm. Among the specimens measured by us, the largest was a male having a carapace length (measured from the orbit to the posterior margin of the carapace) of 24.6 mm, and that of the largest female was the holotype with a carapace length of 15.9 mm. No ovigerous females have been reported.

DISTRIBUTION AND SPECIMENS EXAMINED.—This shrimp has been found in four localities between Estado de Guerrero, to La Paz, Baja California.

Records for the known localities are listed below. Collections that we have examined are marked with an asterisk if they have been previously reported and with a dagger if they are reported herein for the first time. Numbers following the specimens listed are measurements, in mm, of the carapace length. One lot lacks the date it was collected; this could not be determined.

MEXICO: *Estado de Baja California Sur*—(1) †USNM, La Paz, 2♂ (9.9–10.0), Jun 1882, L. Belding. *Estado de Guerrero*—(2) †USNM, Aca-

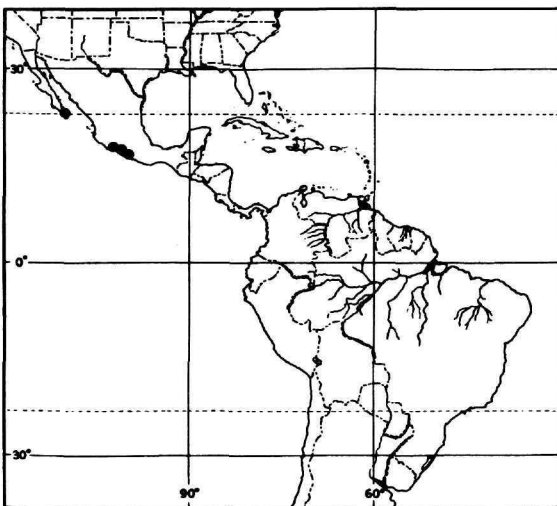


FIGURE 44.—Distribution of *Atya ortmannioides*.

pulco, 1♀ (14.2), 22 Jan 1895, Nelson and Goldman. (3) †IBM, Río Murga, 16 km de la carretera Petatlán-Zihuatanejo, 3♂ (9.7–24.6), 1♀ (15.0). G. Malagrino J. *Estado de Michoacán*—(4) *IBM, Río de las Truchas, La Mira (Villalobos, 1956:474), holotypic ♀ (15.9), paratypic ♂ (8.8); *USNM, paratypic ♀ (12.9), paratypic ♂ (7.7), 11 Feb 1953, B.F. Osorio-Tafall, R. Ramírez, T. Gutiérrez.

VARIATIONS.—The variations noted in the specimens of this shrimp just listed are hardly noteworthy. In all of them, the rostrum reaches to at least the base of the penultimate podomere of the antennule, and the acumen, although poorly delimited (the angles rather strongly obtuse) basally in the smaller specimens, is clearly longer than the basal part. The spine on the ventral carina may or may not be present. As might be expected, fewer denticles are present on the antennular peduncle of the small individuals than on those of the comparatively large male described. As has been observed in other species, the number of spines on the ventral surface of the merus of the ambulatory appendages, especially that of the fourth and fifth pereopods, in small specimens is greater than in larger individuals; in *A. ortmannioides* the small individuals have three, whereas the male that is described has only one.

We are unable to discover a single feature in the two specimens from Baja California Sur that serves to distinguish them from the specimens from the more southern localities in Guerrero and Michoacán.

ECOLOGICAL NOTES.—Except that two of the lots examined by us bore labels noting that the specimens had been collected in rivers, there are no ecological data available other than those recorded by Villalobos (1956:474). The following is a free translation of the information quoted from the collectors by Villalobos: The exact place where the shrimp were collected lies at the foot of Las Truchas hill, which seems to be the site of the most important iron-ore deposit in Mexico. The river before entering onto the alluvial plain courses through a series of canyons carved through granite, forming rapids, small cataracts, and extensive potholes. At the edge on which the

slope begins, in the rapids and cataracts, plants are firmly rooted among the rocks, and their leaves are constantly drenched by the flowing water. The crustacean (shrimp) clings firmly to the leaves of these plants. In order to dislodge it, it is necessary to shake the leaves over a ring net or, exerting pressure, to run the net over the mats of such plants several times. In this section of Las Truchas River, the so-called trout, which are freshwater mugilids belonging to *Agonostoma monticola*, were also collected. Moreover several large specimens of *Macrobrachium* were obtained.

Whereas there are records of other *Atya* occurring among aquatic vegetation, this is the only account of their clinging to leaves of plants. Whether or not a search for specimens among the rocks was undertaken was not stated, thus one cannot be certain that this microhabitat of *Atya ortmannioides* is occupied to the exclusion of others by this shrimp.

LIFE HISTORY NOTES.—No ovigerous females have been reported, and nothing is known about aspects of its life cycle.

REMARKS.—Villalobos (1956:474) compared *Atya ortmannioides* with *A. scabra* and *A. occidentalis* (= *A. innocous*), stating that it differs from them in (1) lacking any sculpture of the carapace and the proportions of the latter, (2) by the strong development of the abdominal pleural region, (3) by the sharp, long rostrum, (4) by the presence of dentiform bristles among the terminal clusters of the first and second pereopods, (5) by the pectinate series of spines on the dactyl of the fifth pereopods, (6) by the absence of spines on the external margin of the endopodite of the first pleopod of the male, and (7) by the form of the appendices masculina and interna of the second pleopod of the male.

Of these features, except for certain proportions, the first is not unique, and many specimens of *A. innocous* lack any visible sculpture other than punctations that are also present in *A. ortmannioides*; the pleural region seems to be no more strongly developed than are those of some *A. innocous*, particularly those of members of the species occurring on the Pacific versant of Middle

America, the form that was designated *A. tenella* by Smith. As shown by Fryer (1977), *A. innocous* also exhibits dentiform bristles among the terminal setal clusters of the first and second pereopods. The males available to Villalobos were rather small (carapace lengths, 7.7 and 8.8 mm, tip of rostrum to posterior margin of carapace) and perhaps juvenile; if so, it is not surprising that the spines on the margin of the endopod of the first pleopod were not evident. The spines are present on the largest male examined by us.

The most distinctive features of this shrimp occur in the rostrum and in the dactyl of the fifth pereopod. The rostrum extends almost horizontally instead of being arched or directed anteroventrally, and the acumen is longer than the basal part. The consistent pectinate arrangement of the denticles on the flexor surface of the dactyl of the fifth pereopod seems to be unique among the American members of the genus, but such an arrangement has been observed on a few individuals of *A. innocous* and on several specimens of other species. Slightly less conspicuous are the anteriorly converging, rather than arched, lateral surfaces of the cephalic region of the carapace of *A. ortmannioides*. As for the apparently unique features of the appendix masculina, there are too few males available to be confident that such features are unique.

Atya scabra (Leach)

FIGURES 1*k,l*, 8–10, 11*b,c*, 45–53

- Guaricuru.—Marcgrave, 1648:187, unnumbered fig.; 1942:187, unnumbered fig.—Jonstonus, 1650:35, 36, pl. ix: fig. 16; 1657:27, 28, pl. ix: fig. 16; 1665:27, 28, pl. ix: fig. 16; 1767:35, 36, pl. ix: fig. 16.—Piso, 1658:78.—Jonston, 1660, pl. ix: fig. 16.—Ruysch, 1718:27, 28, pl. ix: fig. 16.—Sawaya, 1942:LXIII.—Lemos de Castro, 1962:41, pl. 4: fig. 26.
- Poti.—Piso, 1658:78, fig; 1957:188, fig.
- Gaurikuru.—Jonston, 1660:27.
- Guaricuru.—Jonston, 1660:27.
- Atya scaber* Leach, 1815:345 [type-locality: unknown ("Habitat _____"; Leach, 1815:345); restricted to "the area of Veracruz, Mexico" (Holthuis, 1966:234); fixed by the present neotype selection to Misantla, Estado de Veracruz, Mexico, 19°56'N, 96°50'W; types: not known to exist,

- neotype designated herein].—Holthuis, 1955a:208, 221; 1955b:26; 1957:167, 180.—Hemming, 1957:133, 150, 167, 180.
- Atya scabra*.—Leach, 1816, pl. 21; 1817:29, 30, pl. 131; 1824:421, pl. 21.—H. Milne Edwards, 1816:138, 139, pl. 51: fig. 4; 1837:348, pl. 24: figs. 15–19; 1838:352; 1839:386; 1840, pl. 51: fig. 4–4^o; 1842:138.—Latreille, 1817:37.—Desmarest, 1823:313, pl. 37: fig. 2; 1825:217, pl. 37: fig. 2.—Guilding, 1825:338.—Guérin-Méneville, 1825:329; 1837, vol. 2, pl. 20: fig. 2; 1844, vol. 3, p. 15; 1856–1857a:xlvi, xlvii, pl. 2: fig. 7c; 1856–1857b:xviii, pl. 2: fig. 7c.—P. Roux, 1831:27.—Lucas, 1833–1834:333; 1840:182, pl. 11: fig. 1; 1842:182, pl. 11: fig. 1; 1851:182, pl. 11: fig. 1.—Griffith and Pidgeon, 1833:190.—Broderip, 1835:71, fig.—Griffith, 1835:223, lxiii.—Wiegmann, 1836:146, 147.—White, 1847:74.—Newport, 1847:158, 159.—Stimpson, 1857:498.—A. Milne-Edwards, 1864:146, 147.—Costa, 1864:89.—Capello, 1867, explanation of pl. 1: fig. 1f.—Giebel, 1875:53, 54.—Brocchi, 1875:32, figs. 33, 34.—Vilanova y Piera, 1875:385.—Kingsley, 1878a:92; 1878b:56, 57.—Greeff, 1882:35–37; 1884:54.—Albert, 1883a:469–471, 534, pl. 29: figs. 4–6; 1883b:27–29.—Mocquard, 1883:190–199, 307, pl. 8: figs. 183–191.—Claus, 1885:57, 107, pl. 4: fig. 35.—Gundlach, 1887:131.—Osorio, 1887:222, 230; 1888:188; 1889:129, 137, 139; 1891a:47; 1891b:140; 1892:200; 1895a:249; 1895b:251; 1898:186, 187, 194; 1905:102; 1906:150.—Bate, 1888:693, 694, 698.—Pocock, 1889:16.—Ortmann, 1890:466; 1895:408–410, 415, 416 [in part]; 1897:183–185 [in part].—Sharp, 1893:111.—Stebbing, 1893:240.—Nobili, 1897:5.—Rathbun, 1897:44; 1900:313–314 [in part]; 1901:119 [in part].—Doflein, 1900:127.—Young, 1900:473.—Thompson, 1901:22.—Bouvier and Lesne, 1901:13 (or 332).—Gerstaecker and Ortmann, 1881–1901, pl. 91: figs. 5, 6, 6a; pl. 115: figs. 8–11.—Bouvier, 1904:138 [in part]; 1905:110, 112, 119–123, 128 [in part], fig. 25s; 1906:492; 1909:333; 1925:22, 27, 29, 293, 312–319, 322, 323, 356, 358 [in part], figs. 55–67.—Johnston, 1906:862.—Bass, 1914:97, 98; 1925:239.—Tesch, 1914:247, 250.—Pearse, 1915:551.—Torralbas, 1917, fig. 60.—De Man, 1925:27–28 [in part], fig. 4a–c.—J. Roux, 1926a:238, 253; 1926b:217, 218.—Allee and Torvik, 1927:67.—Monod, 1928:121, 205; 1933:461, 462 [in part]; 1967:110, 119, 135, pl. ix: figs. 11, 12, 15–17 [not figs. 13, 14 as noted in explanation of plate]; 1980:375, 376, figs. 5, 6.—Schmitt, 1935:135, 136 [in part].—Villalobos, 1943:1–67, pls. 1–22; 1956:474; 1959:328, 329.—Oliveira, 1945:177–189 [in part], pl. 1: figs. 1–4; pl. 2.—Holthuis, 1951:9, 22, 24, 25 [in part]; 1955b:26; 1959:16; 1966:233, 234, 238 [in part]; 1974:231; 1980:70, 181.—Parodiz, 1960:38, 39 [in part], figs. 1–3.—Rioja, Ruiz, and Larios, 1955, fig. 316.—Darnell, 1956:131–138, 3 figs.; 1962:440.—Hart, 1961b:61–64, 67, 73, fig. 11; 1980:845, 846, 848.—Lemos de Castro, 1962:41, pl. 4: fig. 27.—
- Davant, 1963:42–44, 98–100, figs. 27, 28 [both figs. on pp. 43 and 49].—Chapa, 1964:34.—Pericchi Lopez, 1965:25.—Holthuis and Rosa, 1965:9.—Pinchon, 1967:161.—Coelho and Ramos, 1968:3.—Fausto Filho, 1968:28.—Straskraba, 1969:17, 25.—Chace and Hobbs, 1969:5, 15, 19, 33, 36, 57, 61, 63–66 [in part], 73, figs. 9, 10d–f, 14d,e.—Cendrero, 1971:524.—Disney, 1971:84, 85; 1975:69.—Hobbs, 1971:27.—Chace, 1972:14.—Lemasson, 1973:68.—Bonnely de Calventi et al., 1973:1338; 1974:104, 106, 111, 123, fig. 17.—Léveque, 1974:42, fig. 1j.—Bonnely de Calventi, 1974b:35, 38, 40, 54, fig. 7.—Alayo, 1974:22, pl. vi: fig. 11.—Scelzo, 1974:12.—Abele, 1975:56, 57.—Hunte, 1975:66; 1978:135, 136, 139, 144, 145, 147, fig. 7; 1979c:70.—Carvacho and Carvacho, 1976:213, pl. 2: fig. 8.—Villamil and Clements, 1976:5, 59.—Fryer, 1977:57, 58, 62, 63, 72, 73, 90, 93, 94, 98, 125, figs. 3, 45, 49, 50, 52, 74, 79–82.—Burkenroad, 1981:261.—Rodríguez, 1981:46.
- Atya Scabra*.—Leach, 1816:421.—A. Milne-Edwards, 1864:150.—Valdés Ragués, 1909:180.—Hart and Hart, 1974:142.
- Atia scabra*.—Latreille, 1817:37 [erroneous spelling, combination by implication]; 1837:xvii, Crustacea pl. 31 (bis): fig. 2 [erroneous spelling].
- Atie épineuse.—Audouin and H. Milne Edwards, 1829:14, pl. 25: fig. 1.
- Atya*.—Broderip, 1835:71.—Capello, 1866:6.—Gerstaecker and Ortmann, 1881–1901:886, 887, 1127.—Johnston, 1906:843.—Sawaya, 1942:LXIII.—Darnell, 1962:440.
- Astacus (Atya) scabra*.—Voigt, 1836:178.
- Atya mexicana* Wiegmann, 1836:145 [type-locality: Misantla, Estado de Veracruz, Mexico; types: ZBM, 2 specimens].—Newport, 1847:158, 159.—Guérin-Méneville, 1856–1857a:xlvi.—A. Milne-Edwards, 1864:147.—Martens, 1868:49.—Giebel, 1875:52.—Bate, 1888:693.—Holthuis, 1966:234.
- Athys scabra*.—H. Milne Edwards, 1838:352; 1839:386 [erroneous spelling].
- "*Atya sulcatipes*?" Newport, 1847:159, pl. 8: fig. 1 [type-locality: São Nicolau, Cape Verde Islands; types: stated to be in the British Museum but could not be located in April 1980].
- Atya sulcatipes*.—White, 1847:74.—A. Milne-Edwards, 1864:147.—Martens, 1868:49.—Giebel, 1875:52, 55.—Gerstaecker and Ortmann, 1881–1901, pl. 73: fig. 6a–c; pl. 74: figs. 4, 5.—Bate, 1888:693–699, 701–704, pls. 118, 119: fig. 1, 1p, 1q.—Hickson, 1889:222, 223, 362.—Stebbing, 1893:240.—Oliveira, 1945:179, 180, 188.—Holthuis, 1966:232–237, fig. 4; 1980:71, 181.—Rutherford, 1971:87, 88, 90, fig. 2a,b.—Disney, 1975:69.
- Atya Mexicana*.—Stimpson, 1857:498.
- Atya scalva*.—Martens, 1872:135 [erroneous spelling].
- Atya scaber*.—Giebel, 1875:52 [erroneous spelling].
- Atya punctata* Kingsley, 1878a:91–92 [type-locality: Haiti;

- type: ?USNM 84327, ♀; 1878b:57.—Pocock, 1889:16.—Oliveira, 1945:179.—Holthuis, 1966:237.—Chace and Hobbs, 1969:63.
- Atya sculptipes*.—Ortmann, 1890:466 [erroneous spelling].
- Atya margaritacea* var. *claviger* Aurivillius, 1898:14–16, pl. 3: figs. 5–8 [type-locality: “Etome, in Bächen,” Cameroon; types: SMNH, 2 specimens].
- “*Atya scabra*, type de *margaritacea*.”—Bouvier, 1925, figs. 703, 704 [not 705, 706 as indicated].
- Atya sacabra*.—Villalobos, 1943:66 [erroneous spelling].
- Atya margaritaria claviger*.—Holthuis, 1966:234 [erroneous spelling].
- Atya scabra*.—Vélez, 1967:42.—Ponnely de Calventi, 1974a:16.—Alayo, 1974:25 [erroneous spelling].
- Atya innocous*.—Chace and Hobbs, 1969:66 [lapsus for *Atya scabra*].
- Atya sulcatipes*.—Rutherford, 1971:90 [erroneous spelling].
- Atya sulcaltipes*.—Rutherford, 1971:89 [erroneous spelling].
- Atya scabra*.—Bonnely de Calventi, 1974b:54 [erroneous spelling].

REVIEW OF LITERATURE.—The first record of the existence of a member of the genus *Atya* is that of Marcgrave (1648), who recorded it by the vernacular name “Guaricuru” in his “*Historia Naturalis Brasiliae*,” presenting an illustration of an unmistakable member of the genus. Lemos de Castro (1962) pointed out that this figure almost certainly depicts a representative of *Atya scabra*. The description, which is in Latin, was republished by Jonstonus (1665) along with a slightly modified figure.

This shrimp, from an unknown locality, was briefly described by Leach (1815) as *Atys scaber*; the whereabouts of the type, if extant, is also unknown. Apparently Leach discovered that the name “*Atys*” had been employed by De Montfort (1810:343) for a gastropod mollusk, and in 1816 Leach illustrated and referred to his shrimp as *Atya scabra*. The latter designation was adopted the same year by H. Milne Edwards (1816:138), who presented an expanded description and well-executed illustration of a specimen. The only addition of significance offered by Leach (1817) is the hand-colored dorsosinistral view of an entire animal. Latreille (1817) introduced the synonym *Atia* in stating that although Leach’s species was unknown to him, it “appears to connect the penaeids and alpheids.” He also called attention

to Herbst’s “*canc. innocous*.” Desmarest (1823 and 1825) added no new information but presented a lateral view of an entire animal in both publications. The earliest locality cited is that by Guilding (1825) who recorded the presence of the species in mountain streams of Saint Vincent “in incredible numbers.” Whereas there is no reason to doubt that the species occurs on this island, we suspect that most of the shrimps that Guilding identified as *Atya scabra* were members of the more common *A. innocous*. Guérin-Méneville (1825) presented a brief diagnosis of his “*Atye Raboteuse*,” and in a subsequent work (1829–1844) included a lateral view of a specimen and reported (p. 15) the presence of the species in “les côtes du Mexique.” Polydore Roux (1831), Griffith and Pidgeon (1833), Lucas (1833–1834), Broderip (1835), Griffith (1835), and Voigt (1836) added nothing to our knowledge of the species. Wiegmann (1836) described this shrimp, employing the name *Atya mexicana*, from Misantla, Veracruz, Mexico. The following year, H. Milne Edwards (1837) cited previous references, briefly described the species, and under “*Habite*” listed only “côtes du Mexique.” The latter, together with the similar reference by Guérin-Méneville, led several subsequent authors to assume that this shrimp frequents marine habitats. Nothing new related to *A. scabra* appeared in H. Milne Edwards’ 1838 and 1839 publications, but in that of 1840 he included a hand-colored lateral view of a specimen along with detailed illustrations of several body parts. Latreille (1837) also presented a hand-colored dorsolateral view of an entire animal. Lucas (1840, 1842, 1851) included additional features in his diagnosis of the species and presented a lateral view of an entire animal; otherwise he added nothing new. Newport (1847), apparently with hesitation, described *Atya sulcatipes* from San Nicolas, Cape Verde Islands, stating that “it may prove to be only a variety” of *Atya scabra*. In the same year, White (1847), in listing the Crustacea in the British Museum, included *A. scabra* from Mexico (from the Leach collection) and another lot from the Cape Verde Islands (from the collection of Newport). Whereas

he listed *A. sulcatipes*, he gave no locality and made no comment concerning the collection. Guérin-Méneville (1856–1857a,b) contrasted this shrimp with his *Atya poeyi* (= *Micratya poeyi*). Stimpson (1857) “ventured to cite Wiegmann’s name [*Atya mexicana*] as a synonym” of *A. scabra*. To Wiegmann’s locality, he added western Mexico as a new record for the species, and he also expressed the belief that no member of the genus is found in the sea. On what basis the “western Mexico” record is founded is not known; perhaps he had specimens of *A. margaritacea* or *A. ortmannioides* that were misidentified. That *A. mexicana* and *A. scabra* are conspecific was pointed out by A. Milne-Edwards (1864), who also stated that except for the occurrence of *A. sulcatipes* in the Cape Verde Islands, “one would not hesitate to see in it a variety of *A. scabra*; in effect it seems to differ only in the legs which are slightly grooved, by the rostrum which exhibits a more marked depression, and by the antennae which are not more than half the length of the body” (p. 147, translation). In this work he presented a key to all of the species belonging to the genus. Costa (1864) and Capello (1867) provided no new information. Von Martens (1868) added more complete data for the specimens on which Wiegmann described *Atya mexicana*: a small coastal stream flowing into the Gulf of Mexico south of Tecolutla, about 20 km from the sea. Giebel (1875) summarized the composition of the genus *Atya* and in his description of *A. gabonensis* made comparisons with *A. scabra*. In Brocchi’s study (1875) of the genital organs of decapod Crustacea, he mentioned and figured the first and another (no statement as to which) pleopod of *A. scabra*. Kingsley (1878a) described *Atya punctata* from Haiti and in the same year (1878b) listed *A. scabra* among the North American caridean shrimps, reporting it from fresh water in western Mexico (perhaps a misidentification of *A. margaritacea*); *A. mexicana* was cited as a synonym. Greeff (1882, 1884) reported the occurrence of *A. scabra* on São Tomé. Mocquard (1883), in an investigation of the stomachs of a number of crustaceans, described and illustrated that of *A. scabra*, and Al-

bert (1883a) also provided an anatomical description of this organ. In an excellently illustrated study of the branchial apparatus of crustaceans, Claus (1885) presented the gill formula of *A. scabra* and a well-executed drawing of the branchiae. The presence of this shrimp in a tributary of Río Añasco and in the San Juan, Puerto Rico, market was noted by Gundlach (1887) who also mentioned its occurrence in Cuba and Mexico. In a series of reports dealing with the fauna of the then Portuguese West Africa (1887–1906), Osorio listed *A. scabra* from a number of localities in Angola, Annobón, Ihla do Príncipe, and São Tomé. Bate (1888) reported *A. sulcatipes* from San Antonia, “San Iago,” Cape Verde Islands, presented a detailed description accompanied by illustrations, and stated that it differs from *A. scabra* “in having a prominent tooth on the inner distal angle of the carpus,” (p. 694) and a longer second antenna (p. 698). Hickson (1889) added no new information on the species. Pocock (1889) commented that the only features selected by Kingsley (1878a) to distinguish his *A. punctata* from other species were probably individual variations or due to differences in age.

Ortmann (1890) included *Atya scabra* and *A. sulcatipes* in his *margaritacea* group on the basis of the shape of the rostrum. In his study of the family Atyidae (1895), he grouped the following in his synonymy of *A. scabra*: *A. mexicana* Wiegmann, *A. sulcatipes* Newport, *A. occidentalis* Newport, *A. rivalis* Smith, *A. tenella* Smith, and *A. punctata* Kingsley. This synonymy set the stage for repeated erroneous interpretations of the species involved. The range cited for *A. scabra* by him was based, at least in part, as follows: Nicaragua on records for *A. rivalis* (= *A. margaritacea*) and *A. tenella* (= *A. innocous*) by Smith (1871); Jamaica on that for *A. occidentalis* (= *A. innocous*) by Newport (1847); and Dominica on that for *A. occidentalis* by Pocock (1889). The Haitian record is that of Kingsley (1878a) for *A. punctata*, and the Cape Verde Islands localities are those for *A. sulcatipes* reported by Newport (1847) and Bate (1888). Inasmuch as both *A. scabra* and *A. occidentalis* (= *A. innocous*) occur on Tobago, which of the two

was examined by him is not known. Stebbing (1893) expressed the opinion that *A. sulcatipes* "is perhaps only a variety of the older *Atya scabra*." Ortmann continued to recognize *A. margaritacea* as a distinct species in his 1895 report but stated: "The differences between the New Caledonian species *A. margaritacea* and *robusta* and the West Indian *A. scabra* are very doubtful . . ." (p. 408).

Except for a diagnosis of the species in Portuguese, nothing new relative to *A. scabra* was recorded by Ortmann (1897). The occurrence of this shrimp in Río Macuto, near La Guaira, Venezuela, was noted by Nobili (1897). In the same year, Rathbun (1897) cited Jamaica as a locality for it, but her statement, "This species is probably identical with *A. occidentalis* Newport," leaves some doubt as to the identity of the material before her. Aurivillius (1898) described and illustrated *A. margaritacea* var. *claviger*, another synonym of *A. scabra*, from Cameroon.

In her study of the West African decapods, Rathbun (1900) erred in several respects: she apparently agreed with Ortmann's synonymy for *A. scabra* adding *A. gabonensis* and Aurivillius' *A. margaritacea* var. *claviger* to the list. One of the specimens cited from St. Paul River, Mount Coffee, and that from Beulah were misidentified. The Costa Rican record is new and may or may not be based upon a correct identification. All of the specimens from Costa Rica now in the Smithsonian collection that would have been available to her are members of *A. margaritacea*. The only record of *Atya* from the Orinoco of which we are aware is that of Koelbel (1884) for *Atya sculptilis* (= *A. gabonensis*). Therefore, in all probability her inclusion of Costa Rica, Nicaragua, and Orinoco in the range was based on erroneous determinations. The Liberian and "Gabun" records seem to have been founded, at least in part, on collections of *A. africana* and *A. gabonensis*, respectively. The inclusion of Cameroon, Iha do Principe, São Tomé, and Rolas, cited originally by other authors (and some based on records previously given for *A. sulcatipes*) have been confirmed. In her study of the Brachyura and Macrura of Puerto Rico, Rathbun (1901) almost certainly treated

three species under *A. scabra*. Her statement that "this species is extremely variable in the form of the rostrum and more noticeably in the shape of the last three pairs of thoracic feet which may all be slender and nearly equal in length; and their spines very feeble and appressed" suggests that among her material were *A. scabra*, *A. lanipes*, and, in all probability, *A. innocous*. Specimens of *A. lanipes* from Puerto Rico collected by the *Fish Hawk* in 1899 may not have been examined by Rathbun until much later, for they were not entered in the Smithsonian catalogue until 1913, at that time identified by her as *A. occidentalis*. Her summary of the distribution of *A. scabra* was almost identical to that recorded by her in 1900.

The first report of the occurrence of *Atya scabra* in Panama was that of Doflein (1900), who recorded it from the Atlantic watershed. No original data were offered by Young (1900), Thompson (1901), or Bouvier and Lesne (1901). Gerstaecker and Ortmann (1901) illustrated a lateral view of an animal together with several appendages. Bouvier (1904), considering *A. margaritacea* and *A. sulcatipes* as synonyms of *A. scabra*, recorded the species from the following localities, several of which were new: New Caledonia; Victoria, Australia; Darién, Colombia; San Esteban and Naricual, Venezuela; Valley Nacional, Oaxaca, Mexico; Cape Verde Islands; Fernando Poo; and São Tomé. In his synoptic treatment of this shrimp (1905), Bouvier included the following as synonyms: *A. sulcatipes*, *A. rivalis*, *A. tenella*, *A. punctata*, and *A. margaritacea*. This list differed from Ortmann's in the recognition of *A. occidentalis* as a valid species and relegating *A. margaritacea* to the synonymy of *A. scabra*. Its range, essentially the same as that presented in 1904, differed only by the addition of the Antilles and west Africa. He noted that many of the specimens from the Antilles probably belong to *A. occidentalis* and that several of the African specimens should be referred to *A. intermedia* and *A. africana*. *Atya margaritacea* var. *claviger* was considered by him to be an unquestioned synonym of *A. scabra* (p. 122).

Nothing of importance was added to our knowledge of this shrimp by Bouvier or by John-

ston in 1906, or by the former or Valdés Ragués in 1909. Balss (1914), following Rathbun, included in the range of the species the Atlantic versant of the Americas, the West Indies, and in and off Africa: Gabon, São Tomé, Príncipe, Anobón, and Rolas. Tesch (1914) predicted that *A. scabra* would be found in Surinam. Pearse (1915) recorded 79 specimens from Santa Marta, Colombia. Other than presenting a lateral view of the entire animal, Torralbas (1917) offered no information.

Bouvier's (1925) monograph of the family Atyidae has served as the principal source for all subsequent work on members of the family. In it he reviewed the previously reported localities, adding a number of new ones, and in his key and text contrasted and compared *A. scabra* with related species. Balss (1925) reported the presence of the species in Victoria, Cameroon, and cited Valdivia as a new locality, and De Man (1925) recorded its occurrence in the Belgian Congo. Jean Roux (1926a) stated that if the species occurs in Australia it must be rare. Working on Isla Barro Colorado, Panama, Allee and Torvik (1927) found this shrimp in Shannon Creek, and Monod (1928), in a report on the fisheries of Cameroon, noted that *A. scabra* was of economic importance and pointed out its occurrence in the Bimbia River. Later (1933), he recorded two new localities in Cameroon and cited a more precise station on the Bimbia River. Schmitt's review (1935) of the Macrura and Anomura of Puerto Rico contains no new data on the species. In a note on Marcgrave's treatment of "Guaricuru," Sawaya (1942) suggested that the shrimp was a member of the genus *Atya*.

The beautifully illustrated morphological study by Villalobos (1943), together with locality and ecological data, is an invaluable contribution. Oliveira (1945) compared *A. sulcatipes* with *A. scabra*, including a list of differences that subsequently have not proven to be consistent. Holthuis (1951) presented the most nearly complete synonymy previously available and cited all of the localities offered by earlier investigators. In this study, *Atya sulcatipes* and *A. margaritacea clavi-*

ger are the only synonyms listed for *A. scabra* other than Leach's original combination *Atya scaber*. No new data were offered by Holthuis (1955b): in his synopsis of the recent caridean and stenopodidean genera; however, he (1955a) requested the International Commission on Zoological Nomenclature to place "*Atya*," of which *Atya scaber* Leach is the type, on the "Official List of Generic Names." This was done by the Commission in Opinion 470 (Hemming, 1957). Villalobos' (1943) illustration of a specimen in lateral view was reproduced by Rioja, Ruiz, and Larios (1955). In his description of *A. ortmannioides*, Villalobos (1956) contrasted it with *A. scabra*. Darnell (1956) analyzed a population of *A. scabra* frequenting a small stream in Tamaulipas, Mexico, the most northern locality known for the species. In this study, he presented observations of their habitat, distribution, population structure, food, and life history and related his findings to those of Villalobos (1943).

Holthuis (1959:16) pointed out that "Tesch's supposition that *Atya scabra* (Leach) might be found in Surinam has not yet been substantiated." Villalobos (1959) reported capturing juvenile forms of *Atya scabra* in the Río Papaloapan, and stated that the earlier part of their development occurs near the coast, and afterward they migrate upriver into areas far removed from the mouths of the streams, in this respect resembling *Potimirim mexicana* (De Saussure, 1857:505). Parodiz (1960) cited a new locality for *A. scabra* in Brazil and provided illustrations. In his study of the freshwater shrimps of Jamaica, Hart (1961b) presented photographs of a specimen and reported three new localities. Darnell (1962) tabulated data from his previous study (1956). *Atya scabra* was the only member of the family Atyidae considered by Davant (1963) to be of economic importance in Venezuela, and he reported it to be a common inhabitant of the Río Manzanares. Lemos de Castro (1962), in reviewing the Crustacea included by Marcgrave in his "História Naturalis Brasiliae," called attention to the inclusion of "Guaricuru" with which Lemos de Castro associated *Atya scabra*. The illustration of Marc-

grave is reproduced and is accompanied by a photograph of *A. scabra* from Rio Serinhaem, Estado de Pernambuco, Brazil. Holthuis and Rosa (1965) noted that this shrimp is used for food in Mexico, Costa Rica, Panama, Nicaragua, British Caribbean Federation, Cuba, Haiti, Puerto Rico, Netherlands West Indies, Venezuela, and Peru. The lattermost is based on the misidentification of *A. margaritacea*. No new information was added by Pericchi Lopez (1965).

Even though Holthuis (1966) found that the differences between *A. sulcatipes* and *A. scabra* compiled by Oliveira were not reliable when larger series were compared, on the basis of differences noted in the shape of the antennule, he assigned the West African collections that had been designated as *A. scabra* by him in 1951, and earlier by Bouvier and others, to *A. sulcatipes*. He also considered *A. margaritaria clavipes* [sic] to be a synonym of *A. sulcatipes*, and cited the known West African localities, including a number of new ones, for the latter. The type of *Atya scabra* was discussed by him, and he concluded that it is not among the specimens in the British Museum. The type-locality was restricted to "the area of Veracruz," Mexico. *Atya mexicana*, *A. margaritacea*, and *A. punctata* were recognized as synonyms of *A. scabra*. He also listed four differences between the latter and *A. rivalis* (p. 234). Monod (1967) recorded *A. scabra* from the Cape Verde Islands, Fernando Poo, São Tomé, and Annobón; his illustrations were taken from Bouvier (1925) and De Man (1925). Neither Vélez (1967) nor Straskraba (1969) added to our knowledge of the species in pointing out its occurrence on Puerto Rico or Cuba, respectively. Except for recording the common name "Bouc," no new data were added by Pinchon (1967). Coelho and Ramos (1968) reported that this shrimp is sold in the markets of Recife, Brazil, and Fausto Filho (1968) noted its use as a food item in northeastern Brazil.

Chace and Hobbs (1969) followed Holthuis (1966) in their synonymy of *A. scabra*. They diagnosed and illustrated the species, described the color pattern, reviewed its range, and commented on its ecological distribution on Dominica. They

also pointed out a number of characteristics in which this shrimp differs from the sympatric *A. innocous*. Disney (1971) noted that he had found this shrimp in limited numbers in two localities in the vicinity of Kumba, Cameroon: the Bille River (a tributary of the Meme River) and the Blackwater River (a tributary of the Mungo River). It was infested with the larvae and pupae of the blackfly *Simulium atyophilum*. Rutherford (1971) reported the occurrence of *A. sulcatipes* in Ghana, noting that in addition to frequenting the Cape Verde Islands, São Tomé and Annobón, it ranges on the African continent from Liberia to Congo-Kinshasa. He stated that this dark greenish gray shrimp occurs in rocky stream rapids. Cendrero (1971) added no new data. In considering the possibility that individuals of *A. scabra* occurring in a small stream at Tapalapan, Santiago Tuxtla, Veracruz, serve as a host to the entocytherid ostracod *Uncinocythere zaruri*, Hobbs (1971) reported a new locality for the shrimp. Lemasson (1973) pointed out that *A. scabra* attains lengths of eight to 10 centimeters. Bonnelly de Calventi et al. (1973) cited its presence in the Haina, Mana, Isa, and Nigua rivers and Cañada Madrigal in the Dominican Republic. They also noted that it "yields relatively little edible mass (13% total body weight) as compared with penaeids, but has a comparable content of water (74.5%) and protein (16.99%). Lipids represent 0.82–2.94%, ash 31.0%, calcium 0.232%, phosphorus 1.033%, and iron 0.25%. *Atya scabra* muscle provides 88.3 dietary calories per 100 g while penaeid muscle provides 78.3." In their joint study (1974), Bonnelly de Calventi et al. pointed out that in the Dominican Republic this shrimp is eaten only in some regions of the southern part of the country. Bonnelly de Calventi (1974a) listed two additional rivers (Río Jurá and Río Nizao) where it occurs in the Dominican Republic. In another report (1974b) she presented a diagnosis of the species, illustrations, notes on color, size, habitat, life history, and distribution in the Dominican Republic.

Holthuis (1974) recorded a new locality in the province of Pinar del Río, Cuba. The following

references to *A. scabra* contain no new data: Chace (1972), Hart and Hart (1974), Scelzo (1974), Hunte (1975), and Abele and Blum (1977). Lévêque (1974) noted the occurrence of this shrimp on the island of Guadeloupe and stated that ovigerous females had been found in June. It was reported to be common in the eastern part of Cuba by Alayo (1974). Abele (1975) recorded the presence of the species in streams of the Atlantic Basin in Panama, and, the following year, Villamil and Clements (1976) stated that on Puerto Rico it appears to be ecologically the most restricted and the most specialized of the crustaceans occurring in the area. Fryer (1977), in his impressive study of the Dominican atyids, related the presence on the chelae of the first and second pereopods of bristles with scraping denticles to "scraping" and "sweeping" for food. Their absence in *A. scabra* is correlated with the infrequency of its resorting to scraping; it usually employs filter techniques. He included a brief but exhaustive summary of available knowledge of their ecological distribution and habits. The excellent illustrations, particularly photographs of sections through the mouth parts and of a living animal, greatly enhance his contribution. Among the most recent references to this shrimp are those of Hunte (1978, 1979c). Although the latter introduces no new information, the former provides not only additional locality records but also contains valuable ecological data. *Atya scabra* was found by him on Jamaica only in the eastern parishes where there is a mountainous terrain. Data on tolerance of individuals to lowered temperature and oxygen concentrations were offered in his effort to determine what environmental factors affected their distribution. In discussing relationships among the Decapoda, Burkenroad (1981:261) mentioned that *A. scabra* does not possess "tack-like" sperm.

PUBLISHED ILLUSTRATIONS.—The earliest illustration of this shrimp is that of Marcgrave (1648), who presented a lateral view of the entire animal (presumably from Brazil), identifying it by the vernacular name "guaricuru." This drawing was later employed by Piso (1658) and others. Almost

two centuries elapsed before Leach (1816) presented a dorsodextral view of the shrimp. Much better executed and more detailed illustrations were furnished by H. Milne Edwards (1816); these consist of a lateral view of the entire animal, a dorsal view of the cephalic region, the mandible, the first pleopod together with another unidentified one, and a dorsal view of the sixth abdominal segment, telson, and uropods. The following year, Leach (1817) published a hand-colored dorsosinistral view of a shrimp that appears to have been redrawn in reverse from the figure in his 1816 publication. In his "Dictionary of Natural Science," Desmarest (1823) included a dorsodextral view of an entire animal and in 1825 republished the same figure. Guérin-Méneville's (1829–1844) illustration of an entire animal was apparently redrawn from Desmarest's figure, Broderip's (1835) from Leach (1817), and Latreille (1837) used a hand-colored reproduction of Desmarest's illustration. The figures included in H. Milne Edwards (1837 and 1842) are the same as those published by him in 1816. Lucas' (1851) illustration of an entire animal was apparently redrawn from Desmarest (1823). A small likeness of the cephalic region in lateral aspect was depicted by Guérin-Méneville (1856–1857a,b). Capello (1867) included sketches of the first (or second?) pereopod. Mocquard (1883) and Albert (1883 a,b) presented several figures illustrating the anatomy of the stomach of this shrimp.

Claus (1885) presented an excellent rendition of the gills and basal parts of the thoracic appendages. Bate's (1888) figures of *A. sulcatipes* include a lateral view of an entire animal, others of the first and second antennae, mandible, second maxilla, first through third maxillipeds, first pereopod, telson, uropod, branchiae, and first and second pleopods of a male. Aurivillius (1898) illustrated his *A. margaritacea* var. *claviger* as follows: the telson, the third pereopod, and dorsal and lateral views of the carapace. Gerstaecker and Ortmann (1901) figured an animal in lateral aspect along with views of the antenna, mandible, first and third maxillipeds, and first pereopod. Bouvier (1905) presented drawings of the rostrum

of *A. scabra* in dorsal aspect and a lateral view of the cephalic part of the carapace. The drawing of Torralbas (1917) was of a specimen in lateral view. In his monograph, Bouvier (1925) illustrated the eyes, basal segment of the antennule, the antennular carina (= ocellar beak), the first and second maxillae, dactyls of the fourth and fifth pereopods, and reprinted drawings of the rostrum in dorsal aspect and a lateral view of the cephalic region of the carapace. The latter two are mislabeled, for figures 705 and 706 (not 703 and 704) correspond to figure 25s of *A. scabra* in Bouvier (1905). Monod (1967), employing Bouvier's (1925) figures, repeated the latter's error. Illustrations of a specimen of *A. scabra*, presumably from the Belgian Congo, by De Man (1925) include the rostrum in dorsal and lateral aspects and the telson in dorsal view.

The most completely illustrated work on *Atya scabra* is that of Villalobos (1943) in which virtually the entire exoskeleton is depicted. Oliveira (1945) presented drawings of the animal in lateral aspect, a dorsal view of the carapace, the caudal area in dorsal and ventral aspects, and the maxillae and maxillipeds. Rioja, Ruiz, and Larios (1955) reproduced the lateral view of the entire animal as illustrated by Villalobos (1943). The illustrations provided by Parodiz (1960) include the cephalic region in lateral aspect, a lateral view of the third pereopod from the merus distally, and the distal part of the first or second (not third as labeled) pereopod.

Hart (1961b) presented a photograph of a Jamaican specimen in lateral aspect. A similar photograph along with a dorsal view of the rostrum and a lateral view of the cephalic region are recorded by Davant (1963). Chace and Hobbs (1969) included a lateral view of a male from Dominica showing the color pattern, a dorsal view of the cephalic region, lateral views of the preanal carina and of the ventral margin of the second abdominal pleuron, and mesial views of the distal part of the second pleopod of the male and of the appendix masculina. Rutherford (1971) presented illustrations of the rostrum in dorsal view and of the cephalic region in lateral aspect. Bonnelly de Calventi (1974b) included a

photograph of an entire animal in lateral and dorsal views along with drawings of the rostrum, appendices masculina and interna, and of the antennular peduncles. Bonnelly de Calventi et al. (1974) provided a photograph of a shrimp in lateral view. Lévêque (1974) figured the rostrum in dorsal aspect as did Alayo (1974). Fryer's (1977) illustrations include a lateral view of a specimen, setal structural features, and photographs of a Dominican animal filter feeding and of sections through the mouth parts.

DIAGNOSIS.—Cephalic region comparatively weakly sculptured except nodose in larger individuals; much of carapace studded with pile of short stiff setae (conspicuous in early postmolt stages); antennal and pterygostomial spines prominent. Rostrum with margins bearing paired preapical angles, latter almost always slightly produced anteriorly; dorsal surface with rather sharp median carina. Ventral margin of second through fifth abdominal pleura with row of sclerotized denticles (occasionally absent on second and fifth pleura throughout the range of the species and almost characteristically wanting on the second in members of African populations); caudoventral angle of fourth and fifth pleura acute but rarely produced. Sternum of sixth abdominal segment little more than half as long as wide; compressed median prominence on sternum of fifth abdominal segment conspicuous but never forming hornlike element overlapping sixth abdominal sternite. Preanal carina acute to rounded apically and directed caudoventrally, apex rarely reaching caudal margin of basal part of carina. Telson about 1.5 to 1.7 times as long as broad with paired dorsal rows of 5 to 7 spines. Antennular peduncle with dorsal surface of proximal article bearing 1 to 3 sclerotized spinules proximal to transverse distal row; penultimate article 1.3 to 1.6 times as long as wide and bearing scattered spinules on dorsal surface. Coxae of third and fourth pereopods lacking prominent anterolateral spine. Third pereopod with merus rounded ventrally, about 3 times as long as high, ventromesial surfaces of paired articles not touching when appendages brought together, and lateral surface bearing irregular rows of prominent

corneous-tipped tubercles; propodus 1.7 to 2.1 times as long as broad and studded with rows of sclerotized tubercles on both extensor and flexor surfaces, tubercles in row on flexor surface mesial to median line of article quite or almost contiguous; dactyl freely movable and bearing single row of usually 6 or 7 tubercles on flexor surface.

REMARKS.—Much of the misunderstanding of the range and variations in *Atya scabra* no doubt resulted from the fact that Leach described the species from specimens obtained from an unknown locality. Despite the existing confusion, most previous authors have agreed that the American atyids with a heavily pubescent body and the third pereopods studded with large corneous tubercles are members of Leach's species. Clouding this general concept of *A. scabra*, however, is a dry specimen in the British Museum identified as *A. scabra* and bearing a label on which is written "Type." The specimen is clearly identifiable with *Atya gabonensis* Giebel and exhibits characteristics that would hardly have been ignored by the delineators of the illustrations presented by Leach (1815, 1816) and H. Milne Edwards (1816). The label is therefore strongly suspect.

As Holthuis (1966:234) has pointed out, Newport (1847:158) noted that there were four specimens of this species "in the cabinets of the British Museum, but nothing whatever is known of their habits, or from whence they were obtained." Continuing his remarks on the types of this shrimp, Holthuis stated:

In White's (1847:74) list of the Crustacea in the British Museum, however, is indicated under *Atya scabra* "a-d. Mexico. From the collection of Dr. Leach." It is impossible [inasmuch as Leach's specimens lacked data] therefore that the locality of Leach's type material has been discovered later and that the material listed by White indeed is the type material.

Although Holthuis did not designate a neotype for the species, he stated (p. 234): "It seems safe to restrict the type locality to the Atlantic drainage of Mexico and more accurately to the area of Veracruz." In order that stability in the action of Holthuis be more assured, we are designating a male specimen in the British Museum from Misantla (the location of which is in the area desig-

nated by Holthuis) as the neotype of Leach's *Atya scabra*.

NEOTYPIC MALE.—Rostrum (Figure 45a,d) with concave lateral margins slightly produced at base of acumen in angles little less than 90 degrees; acumen just overreaching proximal podomere of antennule; dorsal median carina high, rather sharp, excavate dorsally (dipping to or below level of lateral carina posterior to acumen), and reaching apex of acumen; ventral carina with single anteriorly directed corneous-tipped tooth. Ocellar beak, largely obscured by eyes, tuberculiform with anterior margin almost vertical and apex directed dorsally, latter fitting into shallow subrostral groove. Antennal spine acute; pterygostomial spine slender and acute, no spines present between them. Carapace (length 29.8 mm) devoid of other spines, but surface somewhat nodose dorsally; most conspicuous nodules arranged in 1 to 3 subparallel rows extending anteroventrally, and almost entire surface bearing punctations studded with clusters of 2 to 5 short, erect setae. Conspicuous subcircular obliquely impressed area present at cephalic end of branchiocardiac groove, and 2 smaller flat ones situated posterodorsal to it, these areas smooth and lacking punctations and setae.

Pleuron of second abdominal segment (Figure 45e) with rounded posteroventral extremity, that of third, fourth, and fifth weakly produced in very short subspiniform corneous prominences. Ventral margins of second through fifth pleura with linear clusters of 14, 17, 11, and 8 corneous denticles on right side of body, respectively, and 6, 18, 11, and 7 on left; margin of fifth lacking prominent setal fringe. Fourth, fifth, and sixth abdominal terga approximately subequal in length and 0.9 as long as telson. Sternum of fifth abdominal segment (Figure 45f) with rather large, median, laterally compressed projection having irregular oblique ventral extremity bearing row of 3 very small corneous tubercles; sternum of sixth about 0.67 as long as broad. Preanal carina with caudally directed apex almost reaching level of posterior margin of basal (dorsal) part of carina. Telson injured, but that of male in same lot of specimens (Figure 45h) about 1.6

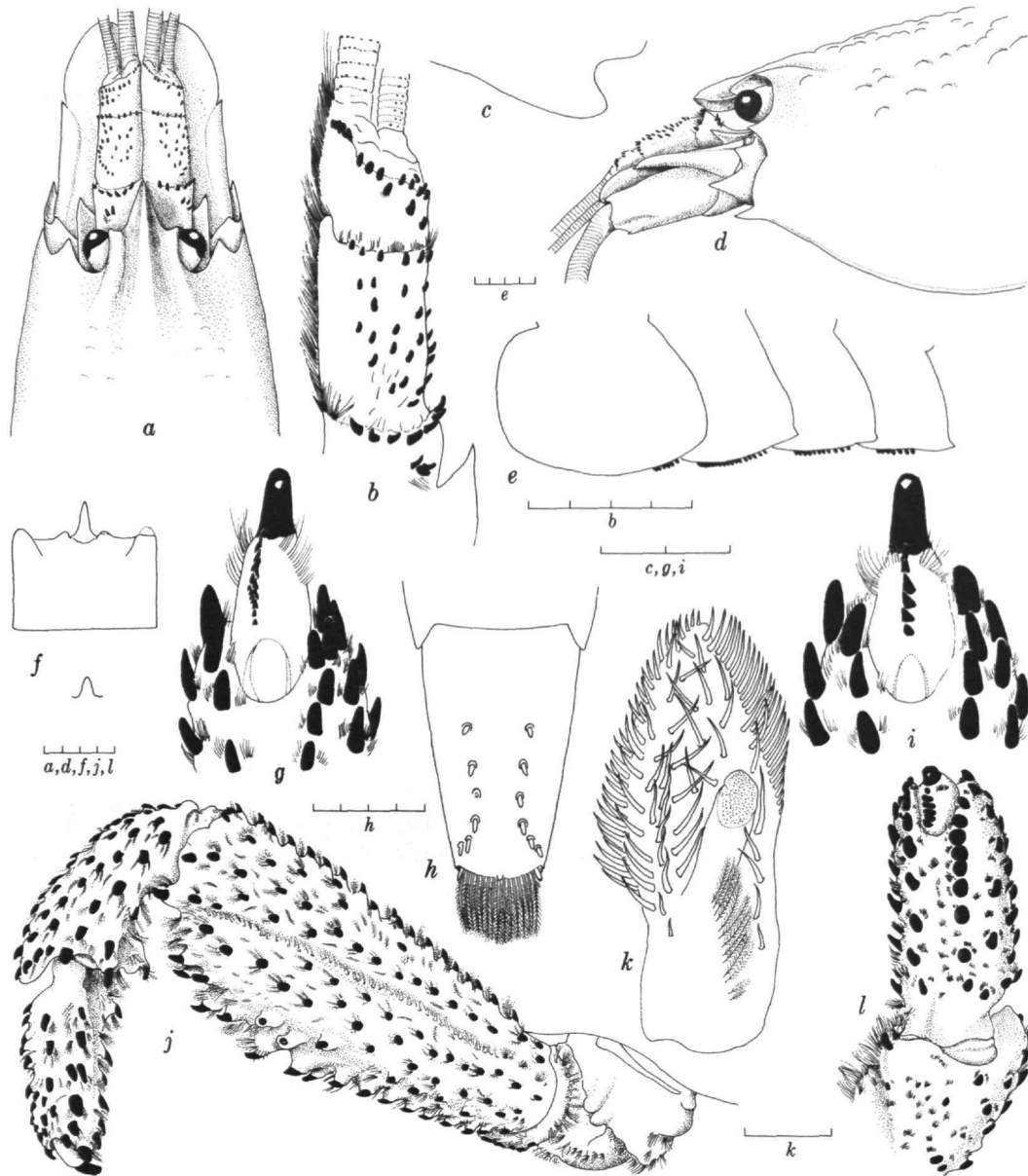


FIGURE 45.—*Atya scabra* (all from neotype except *h* from topotype): *a*, dorsal view of cephalic region; *b*, dorsal view of antennular peduncle; *c*, lateral view of preanal carina; *d*, lateral view of cephalic region; *e*, lateral view of second through fifth abdominal pleura; *f*, preanal carina, sternum of sixth abdominal segment, and median tubercle on that of fifth; *g*, flexor surface of distal part of fifth pereiopod; *h*, dorsal view of telson; *i*, flexor surface of distal part of fourth pereiopod; *j*, lateral view of third pereiopod; *k*, mesial view of appendices masculina and interna; *l*, flexor surface of distal part of third pereiopod. (Scales marked in 1 mm increments.)

times as long as wide, its dorsal surface bearing paired, mesially concave rows of 6 corneous denticles each and posteromedian tubercle, latter very slightly overreaching caudal margin of telson.

Proximal podomere of antennule (Figure 45*b*) with stylocerite bearing acute, corneous tip al-

most reaching distal end of segment, dorsal surface with linear cluster of setae and 3 corneous denticles; distal margin studded with row of 7 (right) or 6 (left) cornified spinules; penultimate segment of peduncle 1.6 times as long as wide, its dorsal surface bearing 22 small, irregularly arranged, corneous spinules, dorsodistal margin

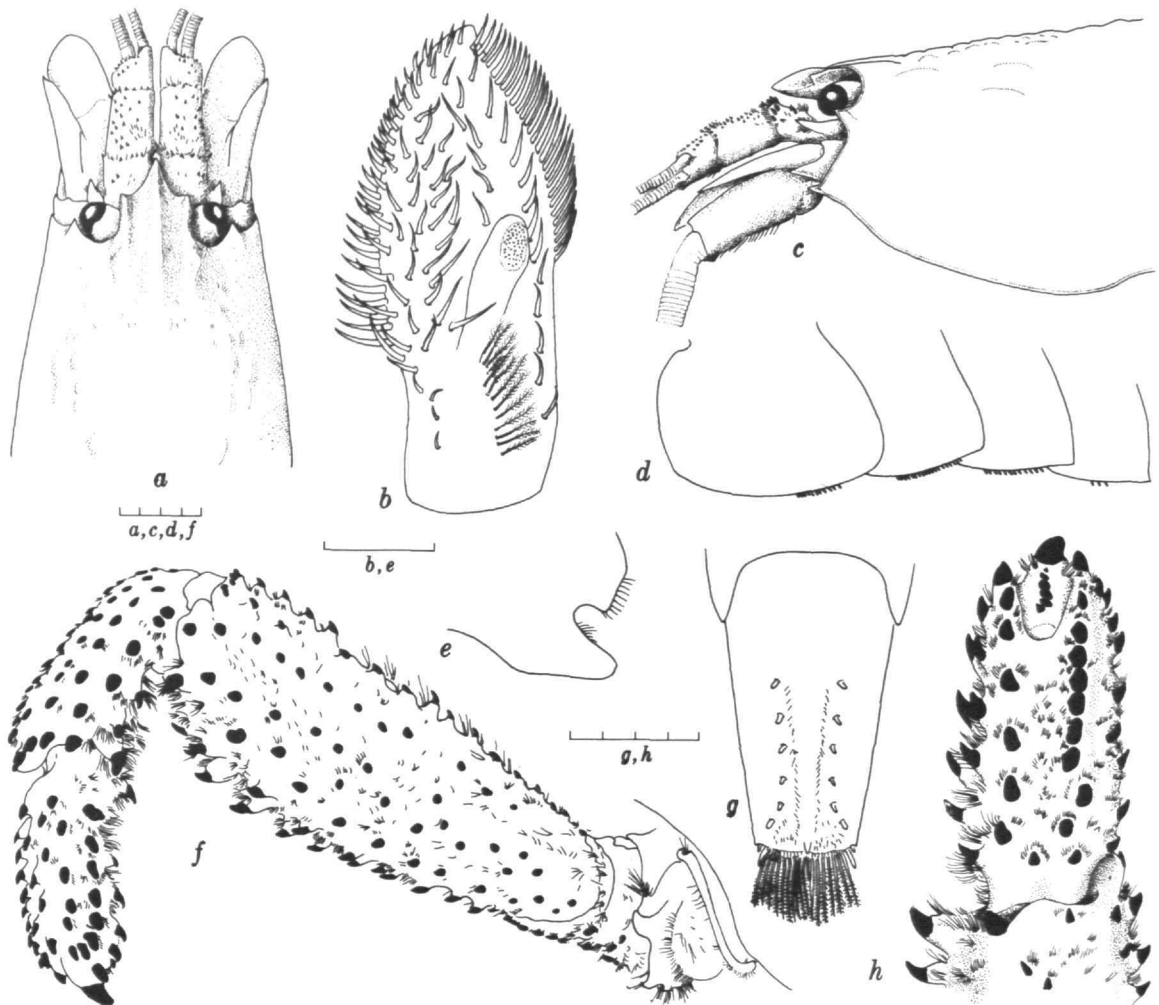


FIGURE 46.—*Atya scabra* (all from male from Río Sabinas, Estado de Tamaulipas, Mexico): *a*, dorsal view of cephalic region; *b*, mesial view of appendices masculina and interna; *c*, lateral view of cephalic region; *d*, lateral view of second through fifth abdominal pleura; *e*, lateral view of preanal carina; *f*, lateral view of third pereiopod; *g*, dorsal view of telson; *h*, flexor surface of distal part of third pereiopod. (Scales marked in 1 mm increments.)

with row of 8; dorsum of ultimate segment of peduncle about 0.5 as long as penultimate podomere, 3 or 4 spinules on dorsal surface, oblique row of 8 and 2 eccentric distolateral spinules flanking dorsal base of lateral flagellum; similar rows of 4 (right) and 5 (left) at dorsomesial base of mesial flagellum, and 3 or 4 on dorsal surface proximal to latter rows. Antenna with lateral spine on basis clearly overreaching stylocerite; lateral spine on scaphocerite extending to slightly beyond midlength of ultimate podomere of antennule and falling considerably short of distal extremity of antennal peduncle; lamella far surpassing latter; flagellum broken but reaching at least to midlength of second abdominal tergum.

Third maxilliped extending anteriorly to about same level as antennular peduncle; penultimate segment about 1.5 times as long as ultimate; tip of exopod reaching base of distal fifth of penultimate podomere of endopod.

First pereopod reaching only slightly farther anteriorly than second and attaining level (neglecting terminal setae) of about midlength of penultimate segment of antennular peduncle; bristles composing terminal brush of both pereopods lacking scraping denticles. Third pereopod (Figure 45j,l) lacking spines, and, when extended anteriorly, overreaching antennular peduncle by distal 3 podomeres; merus with ventromesial margin bowed, 2.3 times as long as high, 1.8 times as long as carpus, and 1.6 times as long as propodus; latter almost twice as long as wide and about 0.9 as long as carpus; distoventral margin of coxa entire and with conspicuous mesial caudoventral prominence bearing corneous tip and studded with tufts of plumose setae. Lateral, dorsal, and ventral surfaces of merus studded with conspicuous corneous tubercles of which many, if not most, somewhat flattened distally and bearing sharp free edge; plumose setae, either singly or in groups, present at distal base of tubercles, some setal groups partly encircling tubercles; median longitudinal row of setae on lateral surface of podomere well defined; distomesial extremity of podomere produced in broad rounded lobe bearing row of 5 (right) or 7 (left) corneous denticles. Carpus strongly tuberculate except ventrally and

ventromesially, there mostly studded with conspicuous tufts of plumose setae borne in punctations. Propodus entirely tuberculate, those on flexor surface arranged in 2 longitudinal series, 5 of those in mesial row contiguous. Dactyl not fused with propodus, flexor surface with single row of 6 tubercles flanked distally by setal clusters.

Fourth pereopod with dactyl almost reaching distal end of merus of third; length of merus about twice that of carpus, and latter only slightly shorter than propodus. Fifth pereopod almost reaching midlength of merus of third; merus about 1.5 times as long as carpus, and latter 0.65 as long as propodus. Ornamentation of fourth pereopod similar to that of third, except merus with articulated distal ventrolateral spine and ventral one proximally, and carpus with similar large distolateral spine. Ornamentation of fifth pereopod like that of fourth, except merus with 2 articulated ventral spines, and flexor surface of dactyl with row of many more spinules.

Diagnosis of lateral ramus of uropod with 19 (right) or 20 (left) articulated corneous denticles and fixed lateral spine, latter about same size as spinules.

COLOR NOTES.—The most complete notes on the color of this shrimp are those of Chace and Hobbs (1969:63–66) based upon specimens collected on the island of Dominica (Figure 47).

Green Phase: Ground color of cephalothorax and abdomen dark green (chromatophores forming reticulate pattern), darker dorsally, gradually fading ventrolaterally to olive interspersed with dark cream. Dorsum with broken, narrow, median, longitudinal, greenish-cream stripe extending from anterior part of rostrum to posterior margin of fifth abdominal tergum. (In some larger individuals, dorsal light stripe obliterated.) Three dorsally situated transverse bands of dark forest green as follows: (1) immediately posterior to base of rostrum and extending ventrally almost to level of antennal spine; (2) on posterior margin of carapace, continuing onto anterior portion of first abdominal tergum, and extending ventrally on both to level of base of abdominal pleura; and (3) on anterior half of sixth abdominal tergum extending ventrally to margin. Carapace with dark green spot immediately below second band and cream one immediately anterior to spot, studded with pile of short golden setae, one to three setae in each punctation.

Antennular and antennal peduncles forest green; flagella

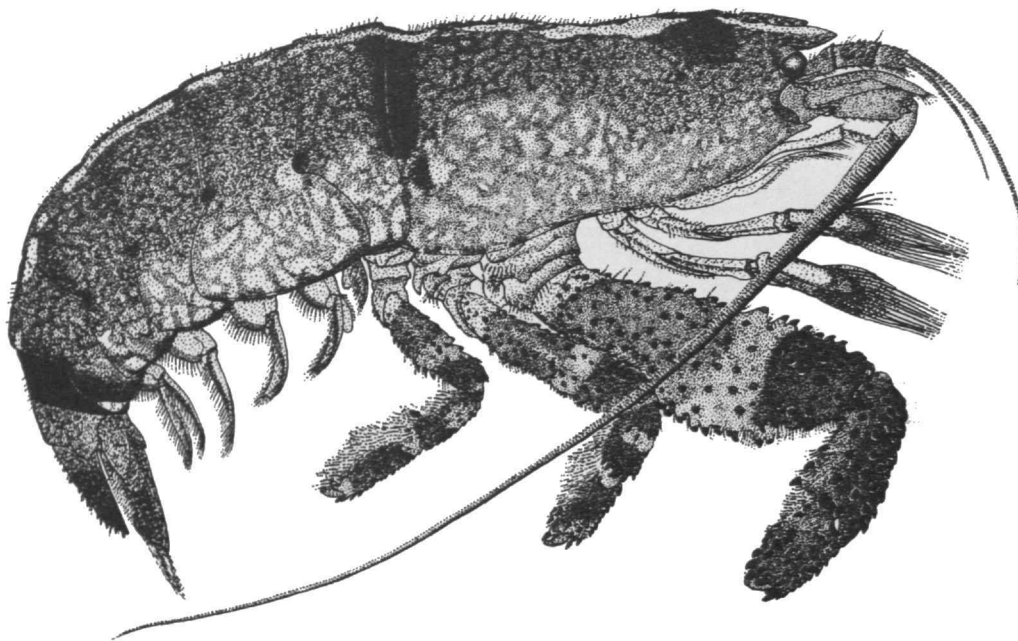


FIGURE 47.—Lateral view of *Atya scabra* (from Chace and Hobbs, 1969).

tan to brown. Third maxillipeds and first two pairs of pereiopods lavender cream with bright green longitudinal lines on ischium and merus; proximal portions of chelae of first two pereiopods lavender, distal portions vermilion; distal setal tufts dark gray proximally fading to beige distally. Proximal three podomeres of third, fourth, and fifth pereiopods cream with irregular green markings; merus with cream-colored base followed distally by broad green band, narrower cream one, and distal green one; carpus and propodus of third pereiopods forest green; those of fourth and fifth cream proximally and dark green distally; dactyls of three orange brown (corneous); tubercles on all three legs progressively darker from proximal to distal podomeres. Basal portions of pleopods cream with greenish-tan lateral margin; rami tan with brown borders. Uropod light green proximally, dark green distally with patches of brownish pigment alternating with aqua spots in distal portions of both rami; marginal setae golden. Telson light green anteriorly, dark green posteriorly with brownish spots and brown tip.

Brown Phase: Pattern essentially identical; colors, however, range from cream through pale buff to dark brown.

SIZE.—The largest specimen that we have examined is a male from Brazil exhibiting a carapace length of 46.3 mm, and the largest in African waters is also a male with a corresponding length of 34.4 mm. The largest female, which is oviger-

ous and is also from Brazil, has a carapace length of 29.5 mm; the corresponding length of the smallest ovigerous female is 7.1 mm.

DISTRIBUTION AND SPECIMENS EXAMINED.—*Atya scabra* ranges from Liberia to northern Angola, in the islands off the west coast of Africa from the Cape Verde group southward to Annobón, in the West Indies from Cuba and Hispaniola to Curaçao and Trinidad, and from Tamaulipas, Mexico, to Santa Catarina, Brazil. In Panama it has apparently crossed the continental divide, occurring in the Río Frijoles Basin (Figures 49–52). Its presence elsewhere on the Pacific slope perhaps resulted from introductions.

Records for the known localities are listed below. Collections that we have examined are marked with an asterisk if they have been previously reported and with a dagger if they are reported herein for the first time. Numbers following the specimens listed are measurements, in mm, of the carapace length or, if followed by "t.l.," total length. Some listings lack dates and/or collectors; these could not be determined.

LIBERIA: (1) *USNM, St. Paul River, Mt. Cof-