

Redescription of *Pinnixa arenicola* Rathbun, 1922 (Decapoda: Brachyura: Pinnotheridae), with new observations on its range and host

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Abstract.—*Pinnixa arenicola* is redescribed and illustrated on the basis of new collections and reexamined type material. Its occurrence in the burrows of *Upogebia vasquezi* Ngoc-Ho is reported, along with range extensions that include Florida, Puerto Rico, Aruba, and the Cayman Islands. New collections represent the first reports of *P. arenicola* since original discoveries in Curaçao and suggest a potentially wide distribution of the species in the tropical western Atlantic. Following publication of the unillustrated original description for the holotype male, females were also noted to occur in Curaçao, but illustrations with limited detail were provided by Rathbun for only the male holotype specimen. Prior to our work, no illustrations have depicted female morphology, unique male gonopods, or some pereopod features of potential value in defining phylogenetic relationships.

During a 1995 preliminary survey of the malacostracan fauna of Little Cayman Island, an unusual pinnotherid crab of the genus *Pinnixa* White, 1846, was discovered in burrows of the mud shrimp, *Upogebia vasquezi* Ngoc-Ho, 1989, on the northwest side of Owens Island. Specimens were originally thought to represent an undescribed species, but closer examination revealed them to be members of the little-known species *Pinnixa arenicola* Rathbun, 1922. Additional specimens were subsequently discovered near the Smithsonian Marine Station on the Atlantic coast of Florida and among collections made by a colleague in Aruba, Dutch Antilles. More recently, a single sub-adult male of the species was found in samples from Puerto Rico.

Pinnixa arenicola has not been reported since its brief original text-only description (Rathbun 1922) and later limited illustration (Rathbun 1924). While the earliest of these papers refers only to the male holotype from Curaçao, the second refers to both that holotype as well as two ovigerous females, all of which were collected there in 1920.

New materials reported in the present study are deposited in the National Museum of Natural History, Smithsonian Institution (USNM), Washington, D.C., Gulf Coast Research Laboratory Museum (GCRL), Ocean Springs, Mississippi, and University of Louisiana at Lafayette (ULLZ), Lafayette, Louisiana. Materials examined include the male holotype from the Zoological Museum Amsterdam (ZMA), Netherlands. Carapace length (cl) and carapace width (cw), along with all other measurements, are in millimeters (mm).

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Family Pinnotheridae De Haan, 1833

Pinnixa arenicola Rathbun, 1922

Figs. 1–4

Pinnixa arenicola Rathbun, 1922:104.—
Rathbun, 1924:17.

Material examined.—Type material: Holotype male, 3.0 mm cl, 5.9 mm cw (ZMA De242240); Spanish Harbor, Curaçao, C. J. van der Horst coll., 16 Apr 1920. Additional materials: 1 male, 3.4 mm cl, 6.4 mm cw (ULLZ 9248); Fort Pierce Inlet, Florida, U.S.A., sandbar along U.S. Highway A1A South Causeway, intertidal burrows, host unknown thalassinidean or worm, yabby pump, D. L. Felder coll., 2 Aug 2000. 1 male, 2.9 mm cl, 5.7 mm cw (USNM 1119182); 1 female, 2.9 mm cl, 6.5 mm cw (USNM 1118178); 1 ovigerous female, 2.6 mm cl, 6.1 mm cw (USNM 1119166); 1 ovigerous female 3.1 mm cl, 7.5 mm cw (USNM 1117107); 1 male, 2.6 mm cl, 5.2 mm cw, 1 ovigerous female, 2.6 mm cl, 5.1 mm cw (USNM 1117108); 2 males, 2.8 mm cl, 5.3 mm cw; 2.7 mm cl, 5.5 mm cw; 1 ovigerous female, 3.3 mm cl, 7.6 mm cw (GCRL 2898); Cayman Islands, Owen Island, NW beach, 0–0.5 m depth, yabby pump, in burrows of *Upogebia vasquezi*, Station 4A, R. W. Heard coll., 19 May 1995. 1 female, 3.1 mm cl, 6.7 mm cw (ULLZ 6070); Dutch Antilles, Aruba, near village of Pos Chiquito, 0.5–1.0 m, sand in grass bed near sea, yabby pump, burrow of unidentified thalassinidean, A. Anker coll., 6–7 Dec 2003. 1 male, 1.5 mm cl, 2.6 mm cw (ULLZ 8989); infaunal sample from sea grass, Puerto Rico, gift from J. Coulter, date and coll. unknown.

Description.—Carapace (Fig. 2a) firm, suboblong, width 2–2.25 times length, regions not defined; surface smooth, glossy; cervical groove of female shallow, that of male slightly deeper and broader than in female; posterior margin straight to slightly convex; front truncate and sparsely pubescent, slight median sulcus

present; anterolateral margin setose; orbits inclined slightly anterolaterally in dorsal view. Sternum of male with obvious points or acute processes (Fig. 2c) on third thoracic somite.

Antennule (Fig. 3a, c) with 4-segmented peduncle, lacking setae; inner ramus (endopod) of 2 articles, distal article with 3 terminal and 2 lateral setae; outer ramus (exopod) with 4 articles, fourth article greatly reduced, third and fourth articles each terminating with 4 long aesthetascs.

Antennal peduncle (Fig. 3a, b) with 4 articles; second and third articles each with 2 distinct distomedial setae. Antennal flagellum with 4 articles; first article shortest; articles two through four approximately equal in length, nearly twice as long as first article; second article with 2 distinct distal setae, third article with single distal seta, ultimate article terminating in 2 setae.

Third maxilliped (Figs. 1b, 3f, h) with ischium and merus indistinguishably fused, ischium-merus subpyriform; palp of 3 articles, carpus longer than propodus, approximately as long as dactylus, nearly as wide as ischium-merus; propodus inserted subdistally on ventral margin of carpus, subquadrate, with distal margin forming rounded triangle; dactylus blade-shaped, inserted mid-length on flexor margin of propodus, subparallel to flexor margin of ischium-merus at distal end; exopod with inner margin straight to slightly convex, outer margin convex with small lobe at mid-length, flagellum of 1 article.

Chelipeds (first pereopods) (Figs. 1c, 4a–c) similar between sexes, weakly pubescent, those of two sides subequal in development; upper margin of palm denticulate, with dense long setae, lower margin smooth with fewer, slightly shorter setae; fixed finger slightly deflexed, tip heavily setose (sparse in type), proximal half of cutting edge with several rounded teeth, distal portion smooth, large rounded tooth at base; gape with few sparse

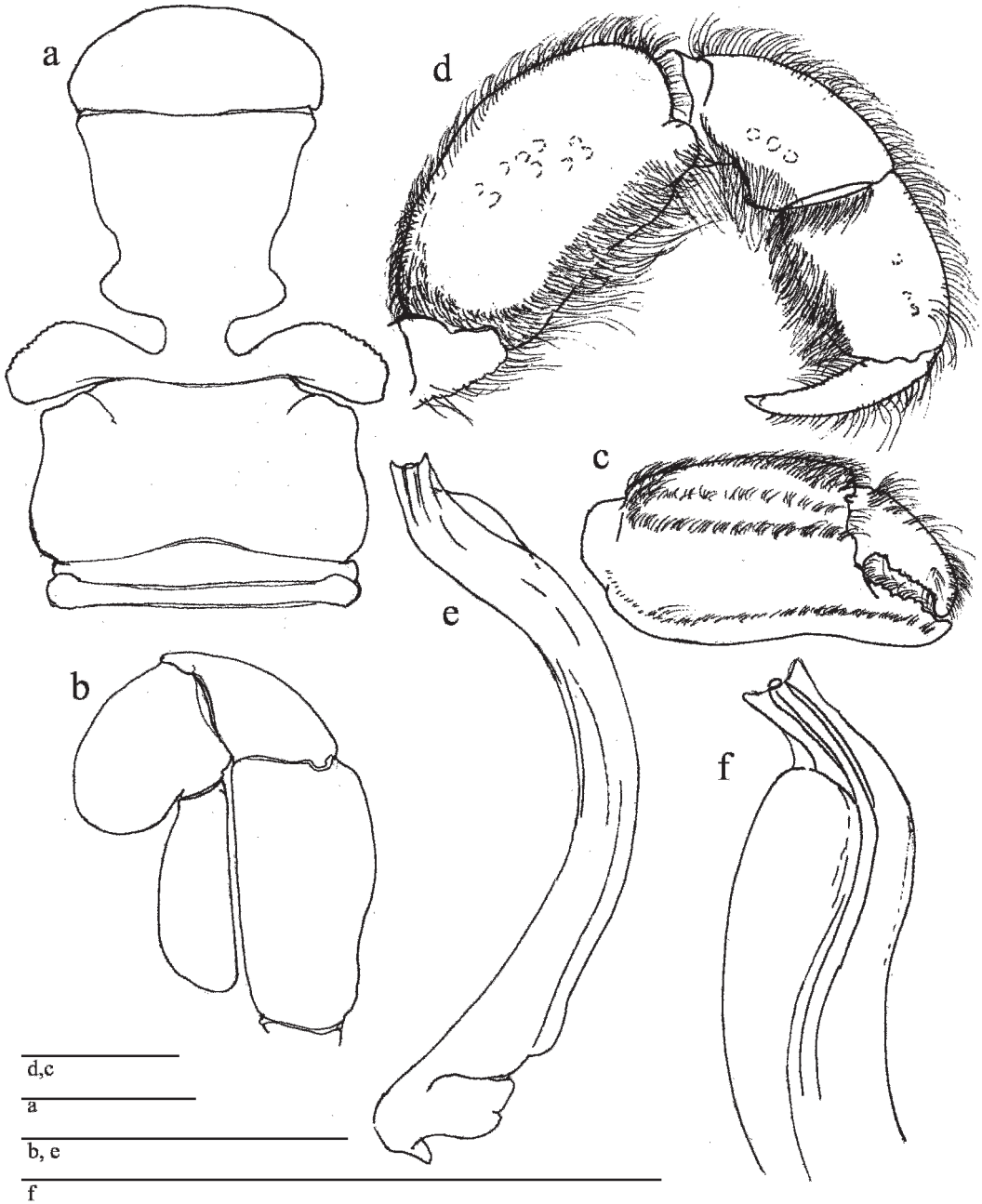


Fig. 1. *Pinnixa arenicola*, male holotype, Spanish Harbor, Curaçao, 3.0 mm cl, 5.9 mm cw (ZMA De242240): a, abdomen; b, left third maxilliped, external surface, setae not shown; c, right cheliped, external surface; d, right fourth pereopod, superior surface; e, right gonopod, ventrolateral surface, setae not shown; f, right gonopod apex, mesiodorsal surface, setae not shown. Scales = 1 mm.

setae; dactyl nearly straight, upper margin with few sharp denticles, lined with long sparse setae, proximal half of cutting edge with several pointed teeth, distal half

crenulate, tip decurved, forming large tooth. Outer surface of chela (Figs. 1c, 4c) with row of short setae extending from distal end of fixed finger to proximal

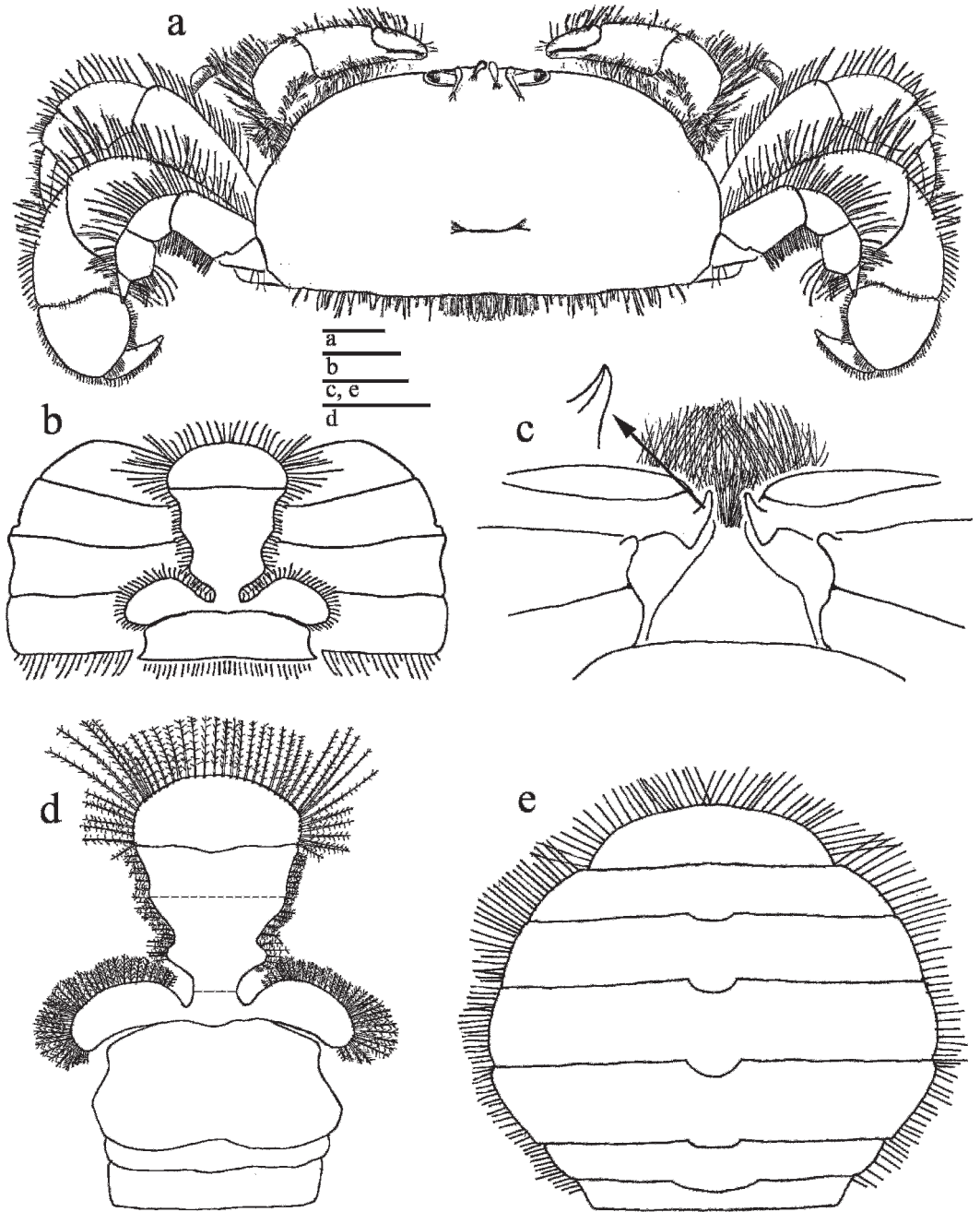


Fig. 2. *Pinnixa arenicola*, female, Cayman Islands, 3.3 mm cl, 7.6 mm cw (GCRL 2898): a, dorsal habitus. *Pinnixa arenicola*, male, Cayman Islands, 2.9 mm cl, 5.7 mm cw (USNM 1119182): b, abdomen and sternum; c, sternal points and enlarged point, posteroventral view; d, abdomen, dashed lines indicating lines of incomplete fusion. *Pinnixa arenicola*, female, Cayman Islands, 2.6 mm cl, 6.1 mm cw (USNM 1119166): e, abdomen of female. Scales = 1 mm.

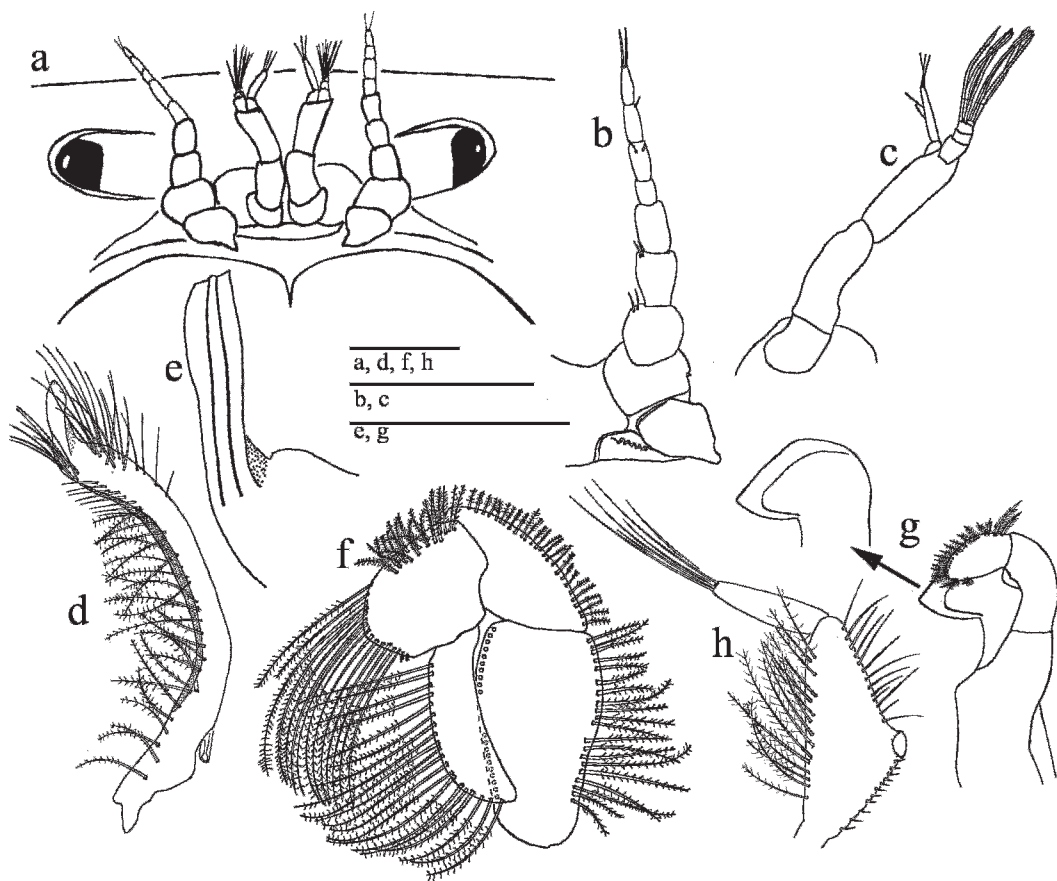


Fig. 3. *Pinnixa arenicola*, female, Cayman Islands, 3.1 mm cl, 7.5 mm cw (USNM 1117107): a, frontal view; f, right third maxilliped, internal surface; g, mandible and palp articulated and enlarged cutting edge of mandible without palp. *Pinnixa arenicola*, female, Cayman Islands, 2.6 mm cl, 6.1 mm cw (USNM 1119166): b, antenna; c, antennule. *Pinnixa arenicola*, male, Cayman Islands, 2.9 mm cl, 5.7 mm cw (USNM 1119182): d, right gonopod, ventrolateral view; e, enlarged apex of right gonopod, ventrolateral view; h, exopod of right third maxilliped, internal surface. Scales = 0.5 mm.

edge of palm along lower margin; upper half of outer surface of palm pubescent, with setae longest near upper margin. Inner surface of chela (Fig. 4a) with dense row of long plumose setae extending from tip of fixed finger to proximal edge of palm along lower margin; row of short setae from gape to proximal edge of palm becoming sparse near carpus.

First walking leg (Fig. 4d) weakest, merus 2–2.5 times longer than wide, dorsal margin slightly concave, smooth, with row of sparse setae, ventral margin slightly convex, with slightly more setae than dorsal margin; propodus 1.3–1.5

times as long as wide, distal half of ventral margin densely pubescent, with 10–12 stout teeth; dactyl dorsal margin bearing approximately 8–10 teeth, lined with mixed row of simple and plumose setae.

Second walking leg (Fig. 4e) merus approximately twice as long as wide, dorsal margin with row of long plumose setae, denticulate in distal fourth, lower half of posterior surface densely setose, setae plumose, ventral margin with single ridge of long plumose setae, denticulate in proximal one third; carpus relatively smooth, with posterior half of ventral

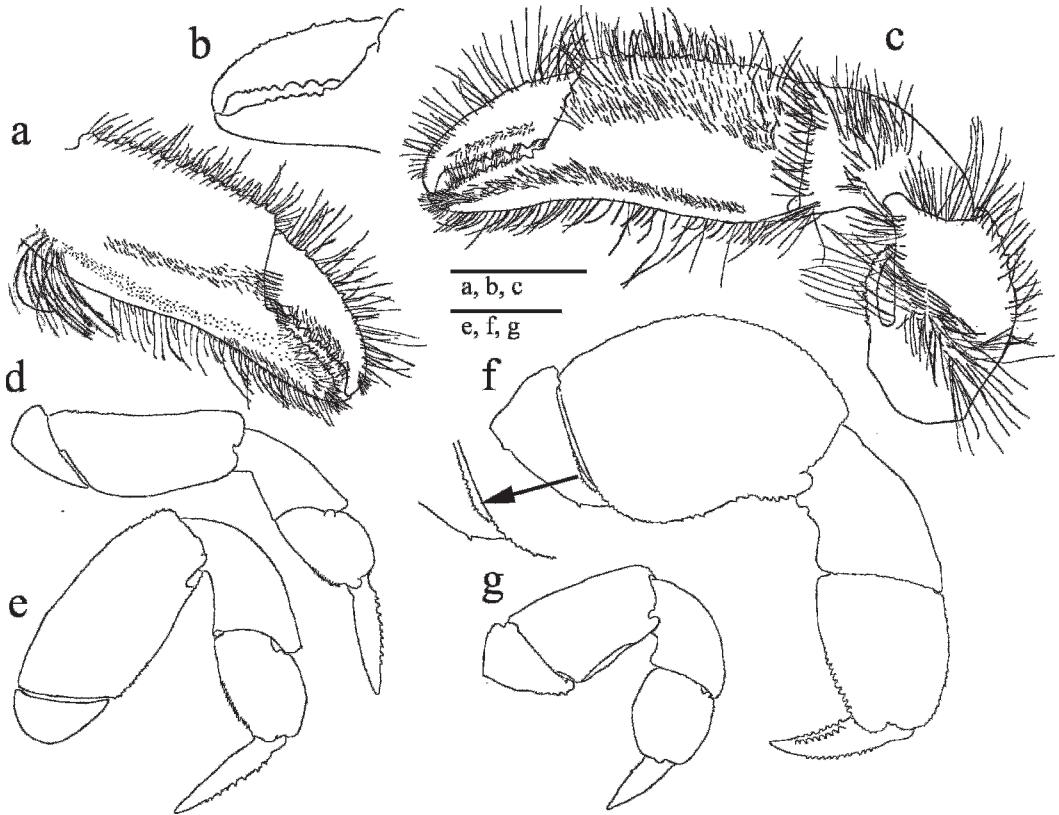


Fig. 4. *Pinnixa arenicola*, female, Cayman Islands, 2.6 mm cl, 6.1 mm cw (USNM 1119166): a, left chela, inner surface; b, left chela, outer surface; c, left cheliped, outer surface; d, left first walking leg (second pereopod), anterior surface; e, left second walking leg (third pereopod), anterior surface; f, left third walking leg (fourth pereopod), anterior surface and enlarged ventro-distal margin of ischium; g, left fourth walking leg (fifth pereopod), anterior surface; setae not shown in b, d-g. Scales = 0.5 mm.

margin setose; propodus 1.3–1.5 times as long as wide, dorsal margin densely pubescent, with intermittent long setae, distal half of ventral margin with 10–14 teeth, ventral surface slightly pubescent; dactyl, dorsal surface with approximately 8–10 teeth, with mixed simple and plumose setae of various lengths.

Third walking leg (Figs. 1d, 4f) strongest, heavily setose; ischium with ventral half of distal margin crenulate; merus about 1.5 times as long as wide at the point of greatest width, dorsal margin denticulate, with long plumose setae along ridge, ventral margin crenulate, teeth increasing in size distally, ventral half of posterior surface with long dense

plumose setae, distal margin finely denticulate, lined with dense setae; carpus relatively smooth, row of short setae with intermittent longer plumose setae along dorsal ridge, ventral margin with short dense plumose setae; propodus nearly as wide as long, dorsal margin denticulate, with row of short setae and intermittent long plumose setae along ridge, distal half of ventral margin with rounded teeth; dactyl with two longitudinal rows of rounded teeth on ventral surface, dorsal surface with single row of sharper teeth, lined with short plumose setae.

Fourth walking leg (Fig. 4g) stout, similar to third but much smaller; merus 1.5–2.0 times as long as wide, dorsal

margin smooth, with sparse line of long plumose setae, posterior surface of ventral margin with dense row of long plumose setae; carpus large, dorsal surface heavily setose with long plumose setae, ventral margin with slightly less dense, shorter setae, distal third of dorsal margin denticulate; propodus nearly as wide as long, proximal third of dorsal margin finely denticulate, pubescent with intermittent long plumose setae, ventral margin with dense row of plumose setae; dactyl stout, simple.

Abdomen of male (Figs. 1a, 2b, d) with 6 somites and unfused telson, fourth, fifth, and sixth somites incompletely fused; first somite short, expanding very slightly distally; second somite shortest, slightly broader than first somite; third somite long, slightly wider than second somite, lateral margins deeply concave; fourth somite incompletely fused to fifth, broadest of the seven somites, narrowing distally to form narrowest point of abdomen, at widest point bilobate, with broad lateral lobes curving proximally around distal portion of somite three, lobes heavily setose; fifth somite incompletely fused to fourth and sixth somites, approximately as long as third somite, base narrow, expanding distally to form low, rounded marginal lobes, then contracting and expanding again to meet the sixth somite (Figs. 1a, 2d), lateral margins lined with short dense, plumose setae; sixth somite incompletely fused with fifth, lateral margins concave, with fewer short plumose setae, expanding distally; telson broadly rounded, slightly wider than sixth somite at widest point, lateral margins with long thin plumose setae, setae longest at distolateral margins. Abdomen of female (Fig. 2e) of six somites and unfused telson, covering most of sternum, but not reaching base of legs, broadly rounded; third somite widest, slightly wider than fourth at widest point, lateral margins with dense plumose setae, setae shortest at distal margin of first somite,

longest at midpoint of fifth somite; telson broadly rounded, slightly narrower than sixth somite.

Male gonopod (Figs. 1e, f, 3d, e) strongly curved over length, conforming to abdomen; rounded subterminal boss centered on dorsomesial surface, bearing long setae obscuring corneous terminal apex; apex deflected laterally, compressed, thin enclosing sheath flared terminally in holotype; distinct terminal pore at end of conspicuous thick-walled duct.

Remarks.—Comparisons of the herein reported specimens from the Cayman Islands and Aruba with the male holotype from Curaçao revealed no major differences in general morphology of the carapace, third maxillipeds, and pereopods (Fig. 1a–f). Direct comparison to type materials was deemed essential as the original description (Rathbun 1922) was not accompanied by illustrations and subsequent illustrations (Rathbun 1924: pl. 3, figs. 9, 10; text-figs. 3, 4) were limited to poor resolution photographs and line sketches of the third maxilliped and abdomen. Even so, for males, the unique configuration of the abdomen does appear to be highly diagnostic for this species (Figs. 1a, 2b, d). Slight differences were evident in the gonopod between the male holotype and newly collected males from Little Cayman Island. While general flexure and shape of this often-diagnostic structure was very similar, the distal terminus in the male holotype appeared to be bracketed by a thin-walled sheath that flared to produce a flanged appearance when viewed from ventro-lateral perspective (Fig. 1e, f). However, close inspection of males from Little Cayman Island revealed that a similar, though thinner and less-developed, sheath at least in part extended terminally in those specimens (Fig. 3c). While not as flared as that in the holotype, the relative development of this sheath is for the present regarded as a

variation most likely dependent upon stage of sexual maturation or molt cycle.

Without question, morphological and molecular variations within the genus *Pinnixa* sensu lato warrant further careful reconsideration of generic assignments (Cuesta et al. 2001, Palacios-Theil 2009). Unique characters of the third maxilliped and male abdomen appear to set *P. arenicola* and a number of its present congeners well apart from *Pinnixa cylindrica* (Say, 1818), the type species of the genus. Present treatment of *P. arenicola* in this genus should thus be considered provisional, pending the outcomes of major phylogenetic studies that are presently underway.

Type locality.—Spanish Harbor, Curaçao (Rathbun 1922).

Distribution.—Atlantic coast of Florida, U.S.A.; Curaçao (type locality); Aruba, Dutch Antilles; Little Cayman Islands, British West Indies; Puerto Rico.

Biology.—In the Cayman Islands, this species was collected as an associate of the mud shrimp *Upogebia vasquezii*, occurring in its burrows from shoreline to 0.5 m depths, usually on firm, intertidal sand with sparse seagrass. All specimens from this area were taken on the northwest side of Owens Island, Little Cayman Island, British West Indies, Caribbean Sea. The specimen from Aruba was found in what appeared to be the burrow of a thalassinidean shrimp, though the host was not captured (A. Anker, pers. comm.).

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