Lepidophthalmus sinuensis: A New Species of Ghost Shrimp (Decapoda: Thalassinidea: Callianassidae) of Importance to the Commercial Culture of Penaeid Shrimps on the Caribbean Coast of Colombia, with Observations on its Ecology

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Abstract.– A new species of ghost shrimp *Lepidophthalmus sinuensis* is described from the Caribbean coast of Colombia, and general ecological observations are made on the conditions under which it was found. The new species can be distinguished from others in the genus by the presence of large subrectangular lateral projections on the frontal region of the carapace. The new species was discovered in ponds of a commercial penaeid shrimp farm where its burrow densities range up to 2093 burrow openings/m^2 in pond bottoms consisting of fine sand. It appears that, on at least a temporary basis, activities of *L. sinuensis* may negatively impact penaeid shrimp culture.

Manuscript accepted 1 July 1991.
Fishery Bulletin, U.S. 89:623–630 (1991).

During the first few months of 1990, penaeid shrimp production in several of the older ponds of a penaeid shrimp farm owned by the company Agrosoledad S.A. (located south of Cartagena, on the Caribbean coast of Colombia) began unexpectedly to decrease. Symptoms in the affected ponds during the grow-out cycles were: sustained low dissolved oxygen concentrations, an unusually high number of thalassinid burrows on the bottom, and small (unmarketable) shrimp in the harvest. About 50% of the ponds of the farm appeared to be affected. Other shrimp farms along this coast, however, were not affected. In July of 1990, biologists from the company, suspecting that the thalassinid might be the cause of the problem, sent specimens to one of us (RL) for identification. Our examination of the material revealed that the specimens represented a new species of the family Callianassidae. Subsequently, we traveled to the shrimp farm to obtain additional samples and make observations. Included herein is the description of this new species as well as some general ecological observations on the conditions under which it was found.

The discovery of this new callianassid is of significance to the rapidly growing industry of penaeid shrimp culture in Colombia. In 1990, the 1504 ha of ponds that were in production on the Caribbean coast alone produced a total harvest of 4314 metric tons of whole shrimp, valued at US$22.4 million. The shrimp produced is a mixture of *Penaeus vannamei* Boone, and *P. stylirostris* Stimpson. Although in Asian countries and western North America, thalassinids are known to cause damage to aquaculture operations, paddy fields, and engineering projects (e.g., Scharff and Tweedie 1942, Sankolli 1963, MacGinitie and MacGinitie 1968, ASEAN 1978), this is the first known case in the New World where a thalassinid has been proposed as potentially affecting penaeid shrimp mariculture.

The material of the new species has been deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC (USNM), Museu de Zoologia da Universidade de São Paulo, Brazil

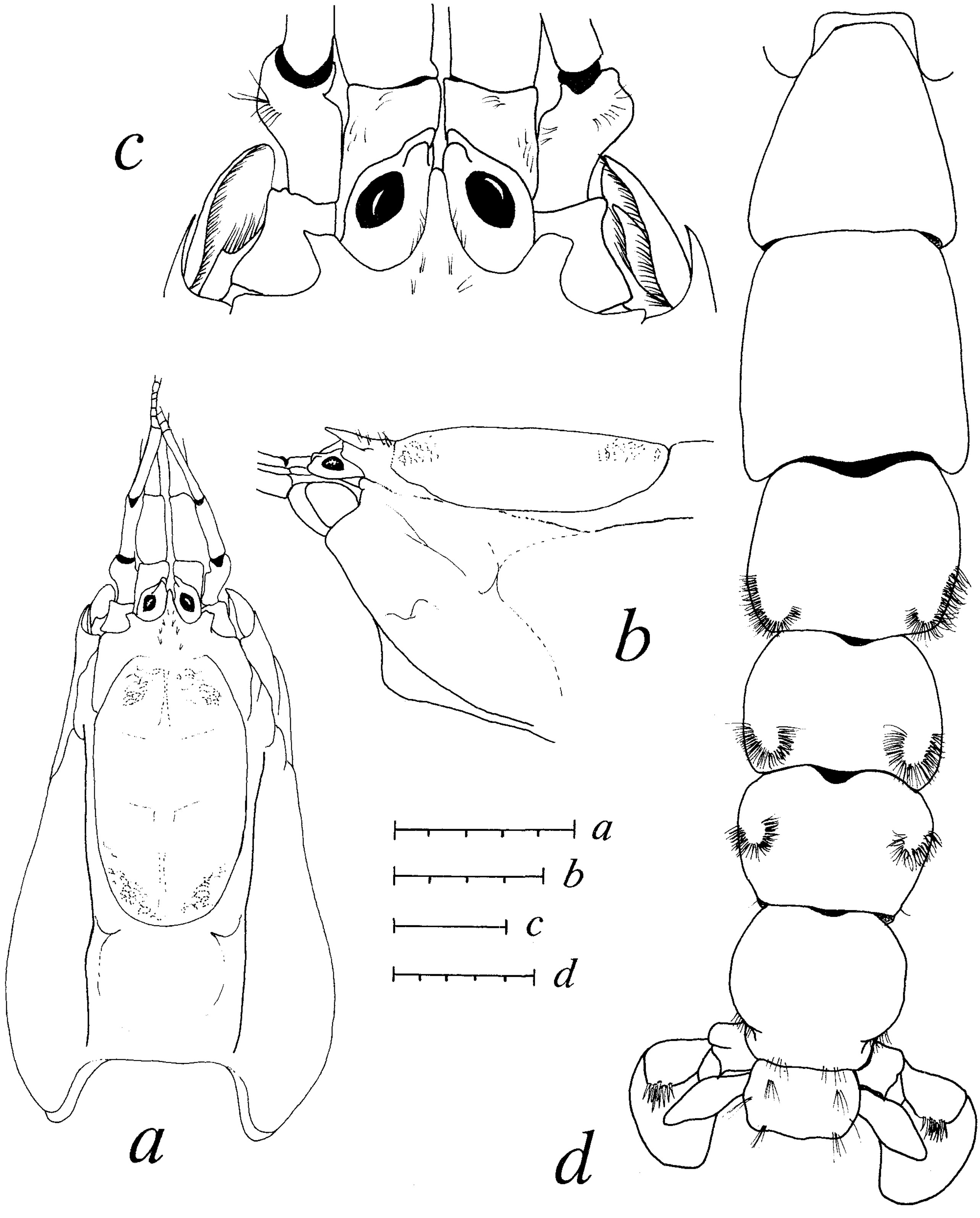

Figure 1
Lepidophthalmus sinuensis new species. (a) Carapace and cephalic appendages (dorsal view); (b) anterior portion of carapace and cephalic appendages (lateral view); (c) frontal region and cephalic appendages (dorsal view); (d) abdomen and tail fan (dorsal view). (a–c) Male CL 11.5 mm; (d) female CL 9.8 mm. Scales equal 5 mm (a, d), 4 mm (b), 1 mm (c).

(MZUSP), and in the zoological collections of the University of Southwestern Louisiana, Lafayette (USLZ). The abbreviation "CL" refers to carapace length measured along the dorsal midline from the level of the posterior orbital margin to the posterior end of the carapace. Two *in situ* burrow casts were made using epoxy resin (Araldit with hardener), following the method described by Dworschak (1983).

Lepidophthalmus sinuensis new species Figures 1–4

Material examined

Agrosoledad S.A. shrimp farm, 3 mi inland from mouth of Rio Sinú, Departamento de Cordoba, Colombia (9°17′N, 75°50′W): 1 ♂, holotype (CL 11.8 mm), pond 5, 20 Aug. 1990, USNM 252399; 25 ♂ (CL 5.2–13.4 mm), 24 ♀ (CL 3.5–9.1 mm), pond 5, 20 Aug. 1990, USNM 252400, 252401, MZUSP 10751, USLZ 3027; 5 ♂ (CL 4.9–11.6 mm), 5 ♀ (1 ovig.) (CL 7.2–10.3 mm), pond 7, 20 Aug. 1990, USNM 252402. Bungalow beach near San Bernardo del Viento, Departamento de Córdoba, Colombia (9°17′N, 76°00′W): 1 ♂ (CL 11.0 mm), 5 ♀ (1 ovig.) (CL 8.3–11.8 mm), July 1990, coll. J. Araújo, USNM 252404, 252405; 3 ♂ (CL 10.5–13.8 mm), 7 ♀ (1 ovig.) (CL 8.6–13.2 mm), drainage canal, 20 Aug. 1990, USNM 252403.

Description

Frontal margin of carapace with blunt rostral spine and two fixed subrectangular lateral projections (Fig. 1c); rostral spine and lateral projections directed slightly upward; rostral spine reaching to about 2/3 length of eyestalks, lateral projections reaching to about midlength of rostrum. Anterior margin of carapace level between subrectangular lateral projections and margin of antennal peduncle, then curving forward to anterolateral angle of branchiostegite. Dorsal oval about 0.6 times length of carapace, smooth, weakly delimited anteriorly.

Eyestalks reaching to about 2/3 length of basal antennular segment, terminating distally in two subtriangular blunt protuberances (shorter dorsal, larger ventral). Cornea small, pigmented, centrally situated on the eyestalk. Antennular peduncle stouter than antennal peduncle, first (basal) segment shorter than second; third segment about 2.5 times as long as second; second and third segments with dense setation on ventral margin; flagellum with subequal rami. Antennal peduncle reaching to about midlength of ultimate antennular segment; flagellum about twice as long as antennular flagellum.

Mandible with several teeth on molar process, and long two-segmented palp. Maxillule with endopod curved distally. Maxilla, first and second maxillipeds as figured (Fig. 2c–e). Third maxilliped with slender, curved dactyl shorter and narrower than propodus; propodus about as long as wide, outer surface naked, inner surface with tuft of setae on posterior half; carpus with tuft of setae on inner surface near distal margin; with rudimentary exopod.

Branchial formula:

	maxillipeds			pereopods				
	1	2	3	1	2	3	4	5
Pleurobranchs	–	–	–	–	–	–	–	–
Arthrobranchs	–	1*	2	2	2	2	2	–
Podobranchs	–	–	–	–	–	–	–	–
Epipods	1	1	–	–	–	–	–	–
Exopods	1	1	1*	–	–	–	–	–

* rudimentary

Chelipeds strongly dissimilar, major cheliped on right or left side. Sexual dimorphism evident on major and minor chelipeds. Major cheliped of male (Fig. 3a) massive, reaching to about tip of antennal flagellum. Fingers leaving large gap proximally when closed. Dactyl longer than palm, smooth except for tufts of setae on dorsal margin and on basal outer surface of teeth; prehensile edge with 4–6 large, unequal, rounded teeth; inner face of dactyl with deep longitudinal groove. Fixed finger with strong tooth (pointing slightly outward and forward) near middle of prehensile edge and under second tooth of dactyl. Palm with scattered tufts of setae on outer face, row of tufts of setae on dorsal margin, and tufts of very long setae (reaching to about 2/3 length of dactyl) near dorsomesial distal angle; dorsal and ventral margin defined by keel-like ridge; outer face with several small tubercles bearing tufts of setae on sloping depression near base of fixed finger; inner face of palm (Fig. 3b) with tubercles bearing tufts of setae on ventromesial margin and on sloping depression near base of fixed finger. Carpus longer than palm, broader than long, dorsal and ventral margin defined by keel-like ridge, with small blunt tooth on dorsodistal and ventrodistal angle. Merus about as long as carpus, with row of three blunt spines on ventromesial distal margin. Ischium slender, slightly shorter than merus, armed with row of 14 small spines on ventrolateral margin.

Major cheliped of female strong but shorter, less high than in male. Fingers with tips strongly curved inward, crossing when closed; prehensile edge of dactyl and fixed finger straight or irregular (Fig. 3d, e), with small rounded teeth; fixed finger usually with strong, sharp tooth basally on outer face. Merus with ventromesial distal row of blunt to sharp spines, and usually with

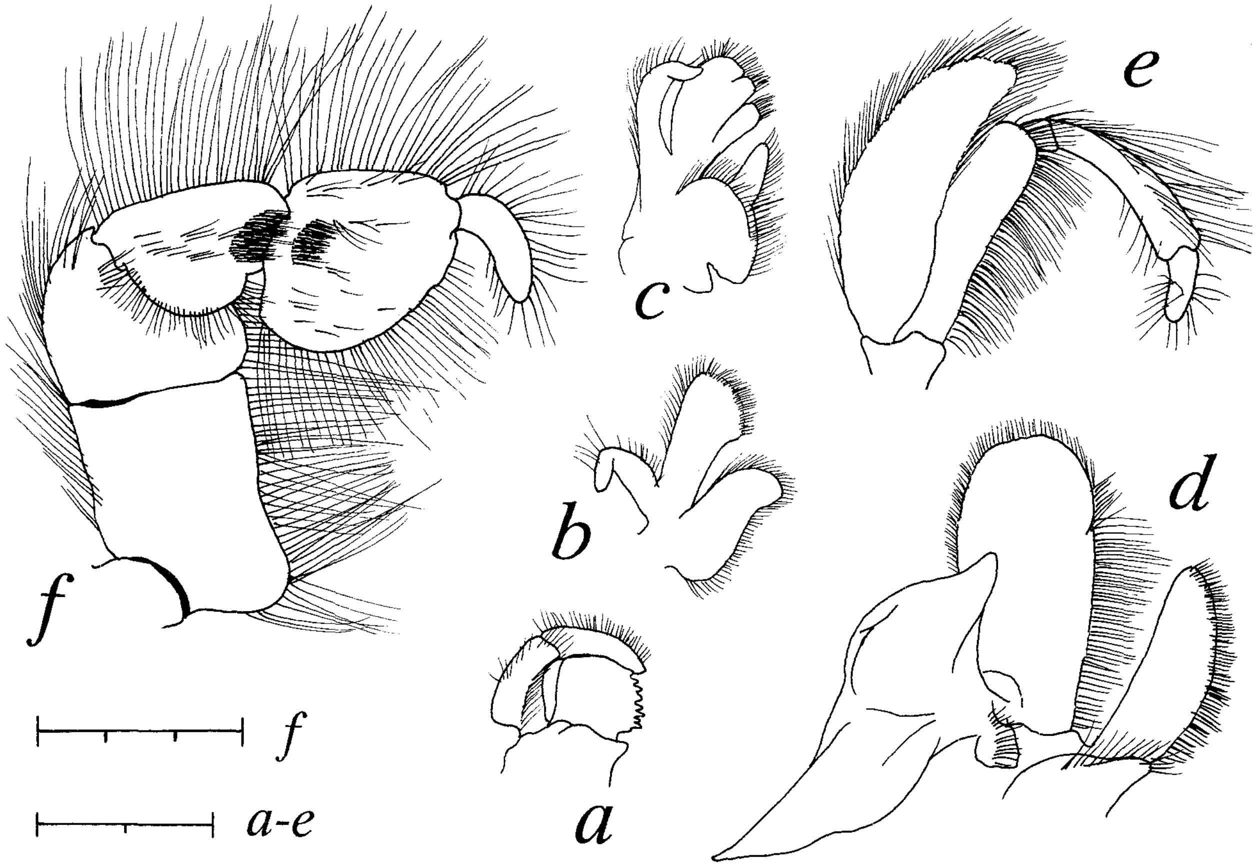

Figure 2
Lepidophthalmus sinuensis new species. Mouthparts (internal view): (a) mandible; (b) maxillule; (c) maxilla; (d) first maxilliped; (e) second maxilliped; (f) third maxilliped (exopod not shown). Male CL 11.5 mm. Scales equal 2 mm (a–e) and 3 mm (f).

slender, curved spine on lateroproximal angle. Ischium with row of 16–17 small spines on ventrolateral margin.

Minor cheliped of male reaching to about level of bases of fingers of major cheliped. Fingers gaping when closed; prehensile edges of fingers formed by ridge of small rounded teeth. Dactyl with row of tufts of setae on dorsal and ventrolateral margin. Fixed finger with dense, brush-like setae basally on prehensile edge (Fig. 3c). Merus with slender curved spine on lateroproximal angle. Ischium with row of 18 small spines on ventrolateral margin.

Minor cheliped of female similar to that of male but somewhat slenderer, lacking brush-like setae on fixed finger.

Second pair of pereopods chelate, subequal; margins of chela and carpus setose; ventral margin of merus with row of evenly spaced long setae. Third pereopod with dactyl slightly longer than broad, subtriangular. Margins of dactyl and propodus with long setae. Propodus with ventral margin divided into three unequal lobes (medial one smallest); outer face covered with numerous tufts of short setae. Fourth pereopod subchelate; propodus and dactyl with setae, densely setose grooming apparatus on ventral margin of propodus. Fifth pereopod subchelate; propodus and dactyl with setae, densely setose grooming apparatus on suboval area covering most of inner face of propodus.

Abdominal somites smooth; dorsal surface naked except for line of dense setae forming sub-semioval near posterolateral angles of each somites 3 and 4 and on midline of somite 5, and line of short setae on posterolateral angle of somite 6 (Fig. 1d). Male first pleopod uniramous, two-segmented (Fig. 4c); distal segment with long setae, terminating in subtriangular tip with small lobe at base on anterior margin; basal segment two times (or more) as long as distal segment. Male second pleopod biramous, with appendix interna on endopod (Fig. 4d). Female first pleopod uniramous,

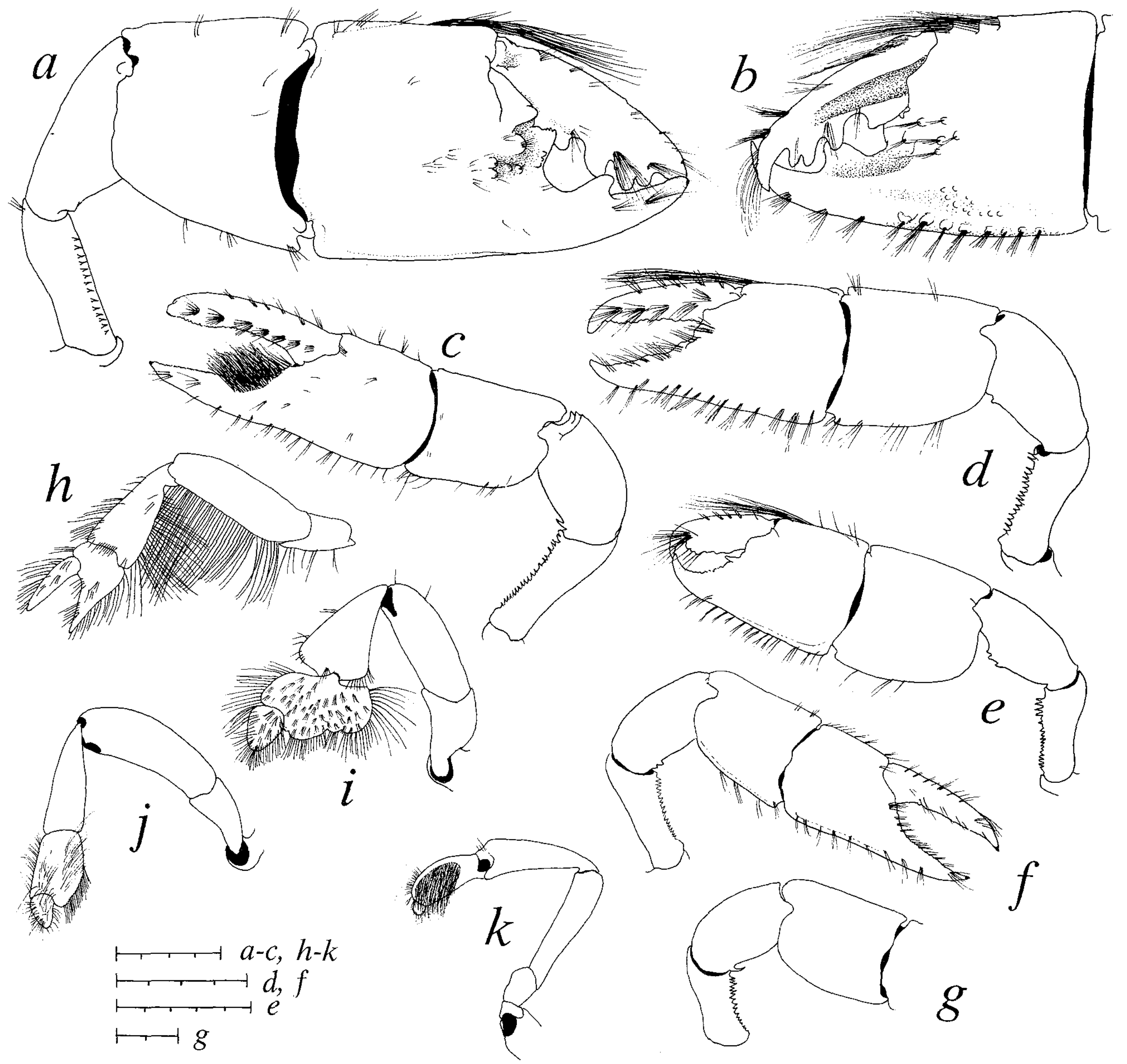

Figure 3

Lepidophthalmus sinuensis new species. (a) Male major cheliped (lateral view); (b) male chela (internal view); (c) male minor cheliped (lateral view); (d, e) female major cheliped (lateral view); (f) female minor cheliped (lateral view); (g) ischium, merus, and carpus of female minor cheliped (lateral view); (h–k) left pereopods: (h) second, (i) third, (j) fourth, (k) fifth. (a–c, h–j) Male CL 11.5 mm; (d, f) female 9.8 mm; (e, g) female CL 9.0 mm; (k) male 10.0 mm. Scales equal 4 mm (a–d, f, h–k), 5 mm (e), and 2 mm (g).

two-segmented (Fig. 4e); distal segment setose, with sinuous anterior margin; basal segment bent in midline at about right angle. Female second pleopod biramous (Fig. 4f), with appendix interna on endopod. Third to fifth pleopods large, strong (Fig. 4g); each pair forming a subcircular fan when linked together by appendix interna; exopod leaf-like, endopod subtriangular.

Telson subrectangular, about 1.4 times as wide as long (Fig. 4b); dorsal surface smooth, with two pairs of tufts of setae (one on anterior half, one near posterolateral angle); lateral margins convex; posterior margin weakly divided into large, medial, broadly rounded lobe, and two rounded lateral lobes. Uropod with protopodite-bearing spine on posterolateral angle;

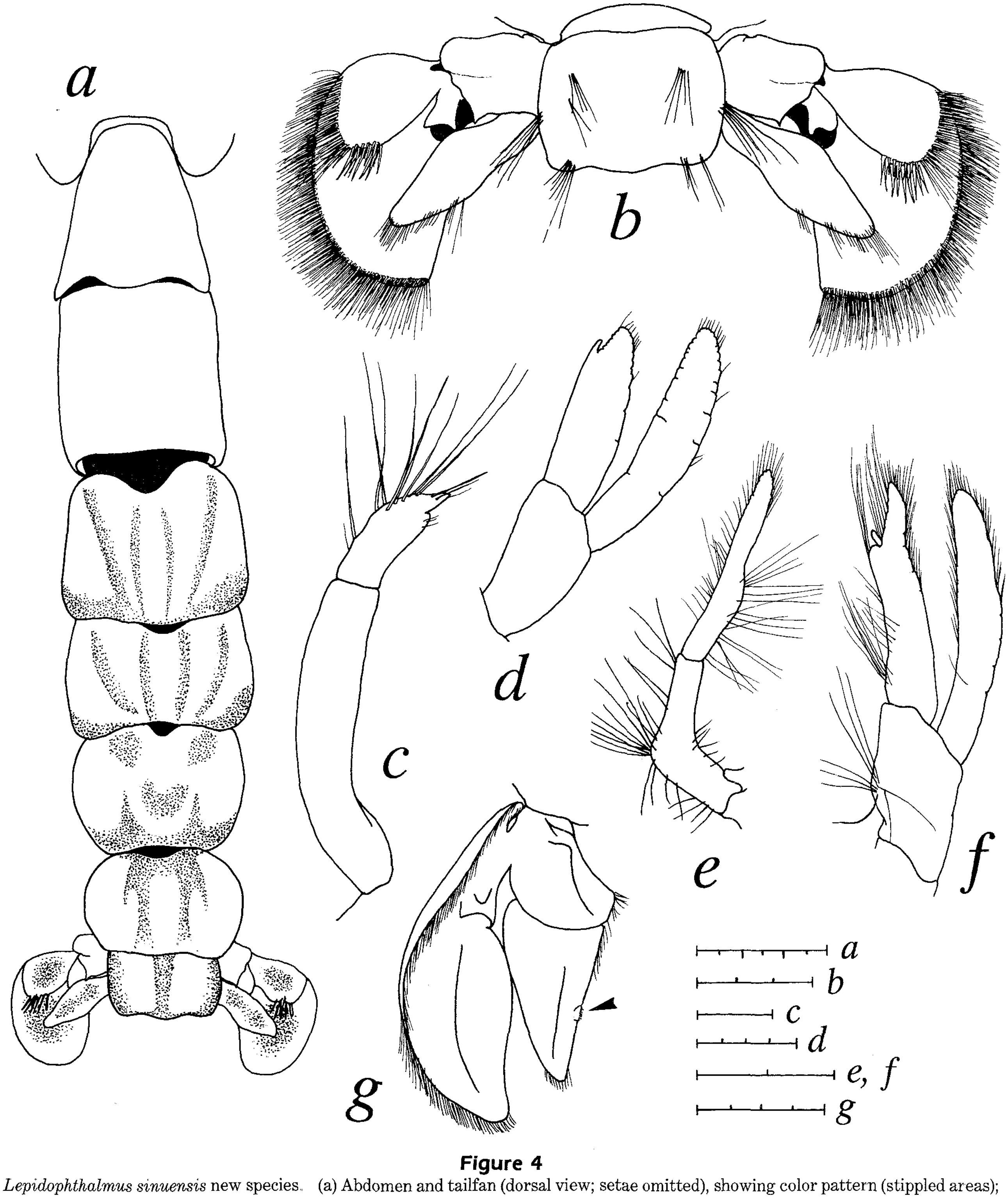

Figure 4

Lepidophthalmus sinuensis new species. (a) Abdomen and tailfan (dorsal view; setae omitted), showing color pattern (stippled areas); (b) telson and uropods (dorsal view); (c) male left first pleopod (lateral view); (d) male left second pleopod (posterior view); (e) female left first pleopod (lateral view); (f) female left second pleopod (lateral view); (g) third left pleopod (posterior view; arrow indicates appendix interna). (a) Female CL 11.3 mm; (b–d, g) male CL 11.5 mm; (e, f) female 9.8 mm. Scales equal 6 mm (a), 3 mm (b), 0.5 mm (c), 4 mm (d, g), and 2 mm (e, f).

endopod narrow, more than 2.5 times as long as broad, distal half slightly bent ventrally; upper exopodal plate shorter and smaller than lower exopodal plate, with rows of long, slender corneous spines on posterolateral margin; lateral margin of exopodal plates with dense setation.

Coloration (Fig. 4a)

In life, carapace transparent except for white frontal region. Chelipeds and pereopods 2–5 white, with densely setose areas brownish or dark orange. Abdomen with somites 1, 2 transparent; dorsal surface of somites 3–6 with olive patterns as follows: somite 3, 4 with stripes on each side of midline, and one stripe on each side forming a "V"; somite 5 with 3 patches on anterior 2/3 (each patch located on ends of inverted triangle), and band on posterior margin forming a triangle on each side of midline; somite 6 with two stripes on each side of midline. Telson with three olive stripes (one medial, one on each side adjacent to lateral margin). Uropod olive, with darker areas on central part of exopodal plates and endopod.

Distribution

Caribbean coast of Colombia: so far known only from Agrosoledad S.A. shrimp farm, near the mouth of the Sinú River, on the southern coast of the Golfo de Morrosquillo, and south of the farm at a beach near the town of San Bernardo del Viento. Intertidal, and in shrimp ponds at about 1.5 m depth.

Etymology

The specific name is given in honor of the Sinú indians, original inhabitants of the area where the new species was found.

Remarks

The traditional division of the family Callianassidae (Borradaile 1903, de Man 1928a, b) has been under constant criticism by recent authors (de Saint Laurent 1973 and 1979, Manning and Felder 1986, Manning 1987, Sakai 1987). For example, some of the American species that in the past were in the genus *Callianassa* Leach, 1814, are now being reassigned to other genera previously considered junior synonyms of *Callianassa*. This new species is placed in *Lepidophthalmus* Holmes, 1904, a genus recently resurrected by Manning and Felder (In press).

Lepidophthalmus sinuensis can be easily distinguished from the other species in the genus—*L. bocourti* (Milne Edwards 1870) from the eastern Pacific, and *L. louisianensis* (Schmitt 1935) and *L. jamaicense* (Schmitt 1935) from the western Atlantic—by the presence in the new species of large subrectangular projections of the frontal region of the carapace. Other differentiating characters observed in *L. sinuensis* are: the sexual dimorphism shown in the minor cheliped with brush-like setae on the fixed finger of males (lacking in females); the distal segment of the male first pleopod that is weakly divided distally; and the endopod of the uropod that is very slender and bent distally.

Ecological observations

Specimens of *Lepidophthalmus sinuensis* were obtained in penaeid shrimp ponds of about 10 ha each, and in a natural habitat on a beach site west of the shrimp farm. Individuals were easily collected by digging with a shovel or using a yabby pump, a suction device of the type described by Reaka and Manning (1989). Salinities in the ponds ranged from 15 to 25‰. The type of sediment where the new species was found is a very fine grey sand. In one pond with both fine sand and clayish bottom sections, *L. sinuensis* was absent in the clayish section whereas it was abundant in the fine-sand section. Therefore, *L. sinuensis* does not appear to survive in clayish sediment.

The number of burrow openings in the ponds most heavily populated with this callianassid ranged from 1894 to 2093 burrow openings/m^2. Resin casts of the burrows indicate that many have double openings and are Y-shaped. A conservative estimate of the population density in these ponds probably is about half the burrow density (947–1046 individuals/m^2). These densities are among the highest recorded for adult thalassinids. Dworschak (1987) has reported a density of 2420 burrow openings/m^2 of juvenile *Upogebia pusilla* (Petagna), quoting this number as the highest ever reported, and Griffis (1990) found a maximum density of slightly less than 1400/m^2 of juveniles of *Callianassa gigas* Dana.

The great proliferation of *Lepidophthalmus sinuensis* in penaeid shrimp ponds can be attributed, possibly, to one or a combination of the following factors: (1) abundant supply of food due to the high productivity that is artificially produced during the penaeid grow-out cycle (e.g., by addition of fertilizers such as chicken manure, urea, and pelleted food); (2) availability of a large area of undisturbed, stable sand, ideal for the construction of burrows; (3) concentration and increased survival of callianassid larvae in an enclosed area at the time of transition from the planktonic to the benthic stage; and (4) the ability to survive the drying stages of the ponds between grow-out cycles (one pond left dry for 45 days still had a population of live *L. sinuensis*). Callianassids are known to influence sediment characteristics, benthic communities, and the release of nutrients into the water column (Ott et al. 1976, Posey 1986a,b). The nature of their effect on the penaeid culture is unknown. Based on our observations it appears that, at least during some growing cycles, the activity of *L. sinuensis* can prevent pond-grown penaeid shrimp from reaching a marketable size and weight. However, the exact short-term and long-term effects caused by this new species on the culture will have to be investigated.

Acknowledgments

We thank J.V. Mogollón, J. Araújo, A.P. Serna, and other staff of Agrosoledad S.A. for providing us with the opportunity to study the material, and their help and hospitality during our stay in Cartagena. Our trip to Colombia was possible thanks to the funds provided by Agrosoledad S.A., at the request of J.V. Mogollón, who has been instrumental in the successful development of shrimp mariculture in Colombia. The critical reading of the manuscript by D.L. Felder and R.B. Griffis, and their comments, are gratefully acknowledged.

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