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On the Systematics of *Ancinus* (Isopoda, Sphaeromatidae), with the Description of a New Species from the Tropical Eastern Pacific[1]

PETER W. GLYNN[2] AND CARMEN S. GLYNN[2]

ABSTRACT: Recent quantitative sampling of sandy beaches in Central America revealed that species in the sphaeromatid genus *Ancinus* are abundant and widespread at low latitudes. *Ancinus panamensis* n. sp. is described from the Pacific coasts of Panama and Colombia and compared with *A. brasiliensis* Lemos de Castro from the Caribbean coasts of Panama and Costa Rica. The morphology and color polymorphism of the Panamanian species are illustrated in detail. Study of all known species in the genus indicated the existence of at least four and probably five distinct species in the New World. A key to these species is presented.

A RECENT COMPARATIVE STUDY of the sand beach faunas of Panama has shown that sphaeromatid isopods in the genus *Ancinus* are often present in great numbers on both Pacific and Caribbean shores (Dexter 1972). The Pacific species of *Ancinus* (referred to by Dexter [1972] as *Ancinus* sp. A) was found to rank second in abundance of all the macroscopic animals sampled, with a mean density of 102.6 individuals/m^2; the Caribbean species (*Ancinus* sp. B) was the most abundant animal present, with a mean density of 80.3 individuals/m^2. Subsequent sampling by Dexter (personal communication) and ourselves elsewhere in Central America and Colombia indicated that these species are numerically important at several localities and have probably gone unrecognized for so long because of the lack of fine quantitative sampling on the sand beaches in this region.

Ancinus is presently known only from the New World. *Bathycopea*, a closely related genus, contains deep-living species in both European (North Atlantic) (Tattersall 1906) and western North American (Menzies and Barnard 1959, Loyola e Silva 1971, Schultz 1973) waters. Five species of *Ancinus* have been described as follows: the Atlantic species are *Ancinus depressus* (Say 1818) from the eastern and Gulf coasts of the United States and *A. brasiliensis* Lemos de Castro 1959, from Brazil; the Pacific species include *A. granulatus* Holmes & Gay 1909, *A. daltonae* Menzies & Barnard 1959 (recently placed in *Bathycopea*, see below), and *A. seticornvus* Trask 1970, from the California coast. Loyola e Silva (1971) synonymized *A. granulatus* and *A. brasiliensis* with *A. depressus* and transferred *A. daltonae* to the genus *Bathycopea*. The synonymy of *Ancinus* was based mainly on the appearance of the pleotelsonal apex, which Loyola e Silva (1971) concluded is due to the viewing position and is, therefore, nothing more than a form of intraspecific variation. Schultz (1973) did not agree with this conclusion and asserted that better criteria would probably be found to show the distinctness of the three species. Schultz (1973) did conclude, however, that *Ancinus seticornvus* is a junior synonym of *A. granulatus*. These conflicting views indicate some of the current difficulties encountered in this group.

In our study a detailed comparison was made of the morphology and color polymorphism in the allopatric populations of *Ancinus* in Panama in order to provide new data for the evaluation of species in this group. Large samples of live and preserved material were examined from several different populations (Fig. 1). Many individuals of different size and sex were dissected and measured quantitatively. The results of this analysis are comparad critically with collections of all known species of *Ancinus*. We offer evidence here that the tropical Pacific

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[2] Smithsonian Tropical Research Institute, P.O. Box 2072, Balboa, Canal Zone.

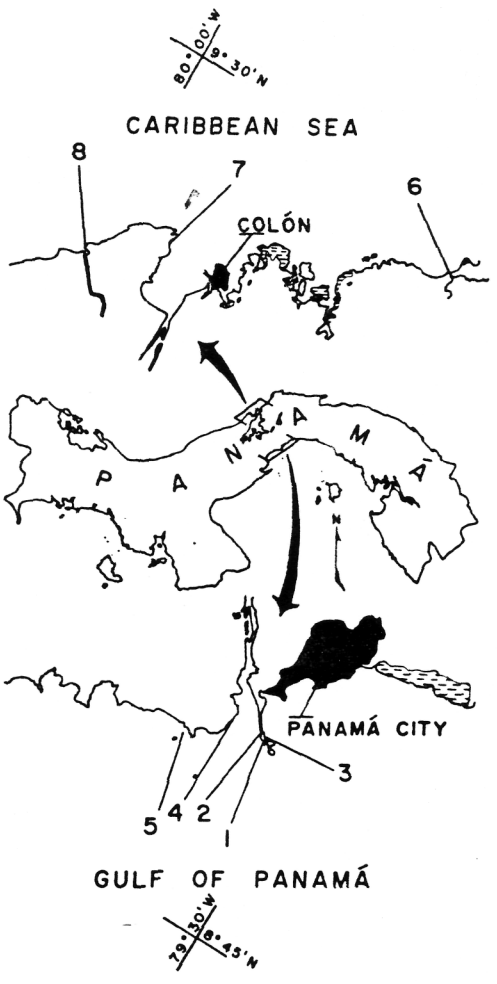

FIG. 1. Principal collecting localities on the Pacific and Caribbean coasts of Panama. *1*, type locality for *Ancinus panamensis* n. sp., sand beach between Naos and Culebra islands; *2*, *3*, beaches on Naos Island; *4*, Palo Seco leprosary; *5*, Venado Beach; *6*, María Chiquita; *7*, Shimmey Beach; *8*, San Lorenzo. Note the difference in orientation of the large-scale maps.

Ancinus is a new species and that the Caribbean species belongs to *A. brasiliensis*. Further, our results corroborate Schultz (1973) in his opinion that *A. granulatus*, *A. depressus*, and *A. brasiliensis* are separate species. However, we cannot accept Schultz's conclusion that *A. seticornvus* is a junior synonym of *A. granulatus*. The status of *A. seticornvus* is problematical and will require further study.

It is a pleasure to acknowledge the numerous donations of material made by D. M. Dexter and her constant help and interest in this ... Material was also kindly provided by ... Bowman, C. E. Dawson, and M. L. ... We thank G. A. Schultz for making avail... manuscript on *Ancinus* and both G. A. ... and T. E. Bowman for their critical ... of the manuscript. Assistance in the fie... laboratory was provided by A. Velarde. ... we express our gratitude for the enc... ment and assistance offered by I. Rubin...

Ancinus belongs to the section Anci... the group Platybranchiatae (erected by ... 1905). Some of the more important ... teristics of the platybranchiate sphaero... include: (*a*) absence of transverse br... folds on Plp^4 and Plp^5, (*b*) exopods of Pl... Plp^5 are unjointed, (*c*) exopod of Plp... squamiferous protuberances in slight ... and (*d*) pleotelson usually without a te... slit or foramen. Among some of the disti... ing features of the Ancinini may be not... Md without molar process, (*b*) pereopod ... chelate in both sexes, and (*c*) pereopod ... hensile in male, ambulatory in female.

Genus *Ancinus* Milne Edwards 184...

Type Species

Naesa depressa Say 1818. *Ancinus d...* (Say, 1818) Milne Edwards 1840.

Diagnosis

Cephalon fused with pereonite 1; Mx^1 ... degenerate; Mx^2 composed of two lobe... mera directed downward; pleonite 1 ... very small suture on each side; Plp^1 uniram... Plp^3 exopod uniarticulate; uropod wit... exopod, basipod not widened laterall... breviated from Loyola e Silva 1971).

Remarks

Bathycopea can be distinguished on the ... of the following characters: Mx^2 compose... three lobes; epimera expanded laterally; ... nite 1 with two sutures on each side, the ... terior pair well developed; Plp^1 biramous; ... exopod biarticulate; uropodal basipod wid... laterally (Loyola e Silva 1971).

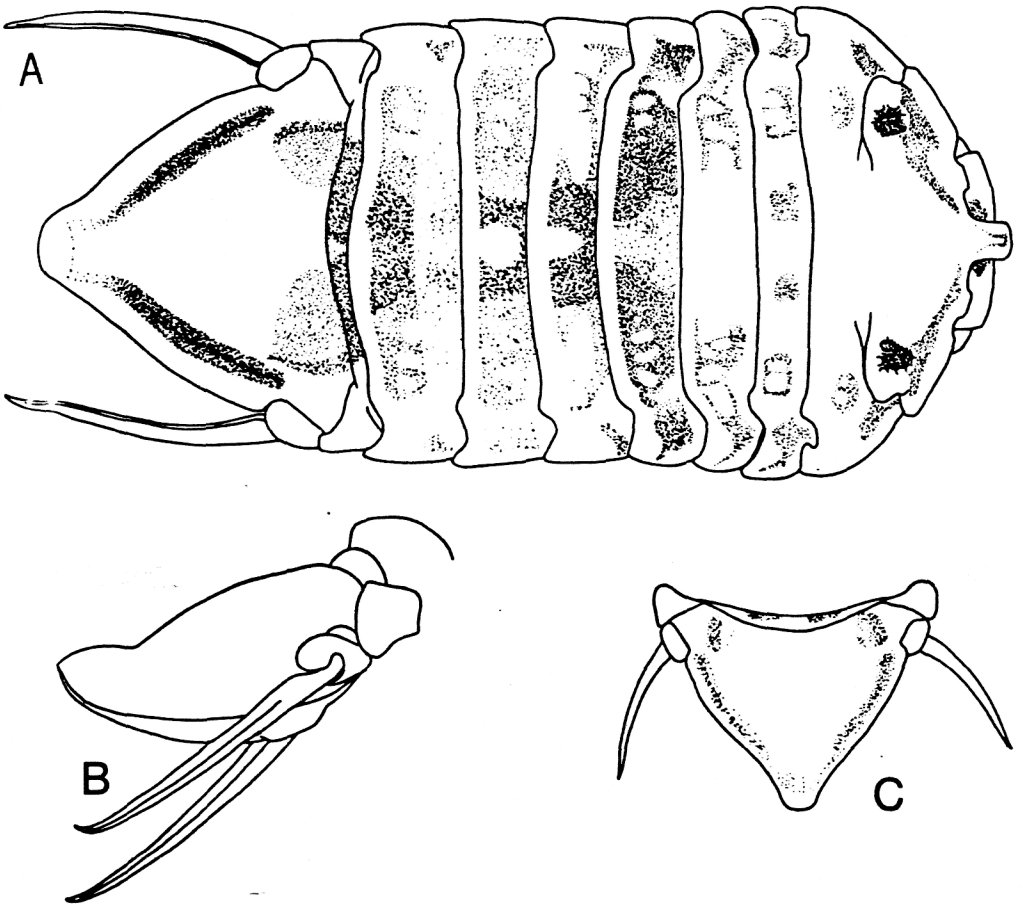

FIG. 2. *Ancinus panamensis* n. sp. *A*, dorsal view, male holotype, length 4.29 mm, width 2.05 mm; *B*, pleotelson, later[illegible]view of holotype; *C*, pleotelson, dorsal view of female allotype, length 2.89 mm, width 1.41 mm.

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Ancinus panamensis n. sp.

Figs. 2, 3, 4, 5, 6

Diagnosis

Cephalon narrower than pereonites; frontal margin of cephalon and pereonite 1 broadly rounded. Sutures separating cephalon and pereonite 1 reach medially only to about halfway between eye and rostrum. Rostrum anterior margin smooth. Pereonites 1–3 broadest, pereonites 4–7 narrower and subequal in width. Lateral margins of pereonites and epimera smooth, without ridges. Lateral margins and apex of pleotelson broadly rounded. Pleotelson dorsum strongly arched (best viewed laterally). Anterolateral margins of pleonite smooth, following body outline. Uropodal endopod styliform, strongly arched, recurved, and extending slightly beyond tip of pleotelson. Md palp articles 2 and 3 with 9 and 10 plumose setae respectively; incisor with three strongly sclerotized cusps. Lacinia mobilis well developed, present on both mandibles, bilobed, each lobe a stout sclerotized tooth. Setal row consists of two acute serrate spines adjacent to lacinia mobilis, a few simple fine setae and a large bladelike spine serrated apically. Mx^1 exite with 11 spines, one stout and three serrate. Mx^2 endite with five weakly plumose setae; exite with a total of six plumose setae. Mxp palp articles 2, 3, and 4 with produced

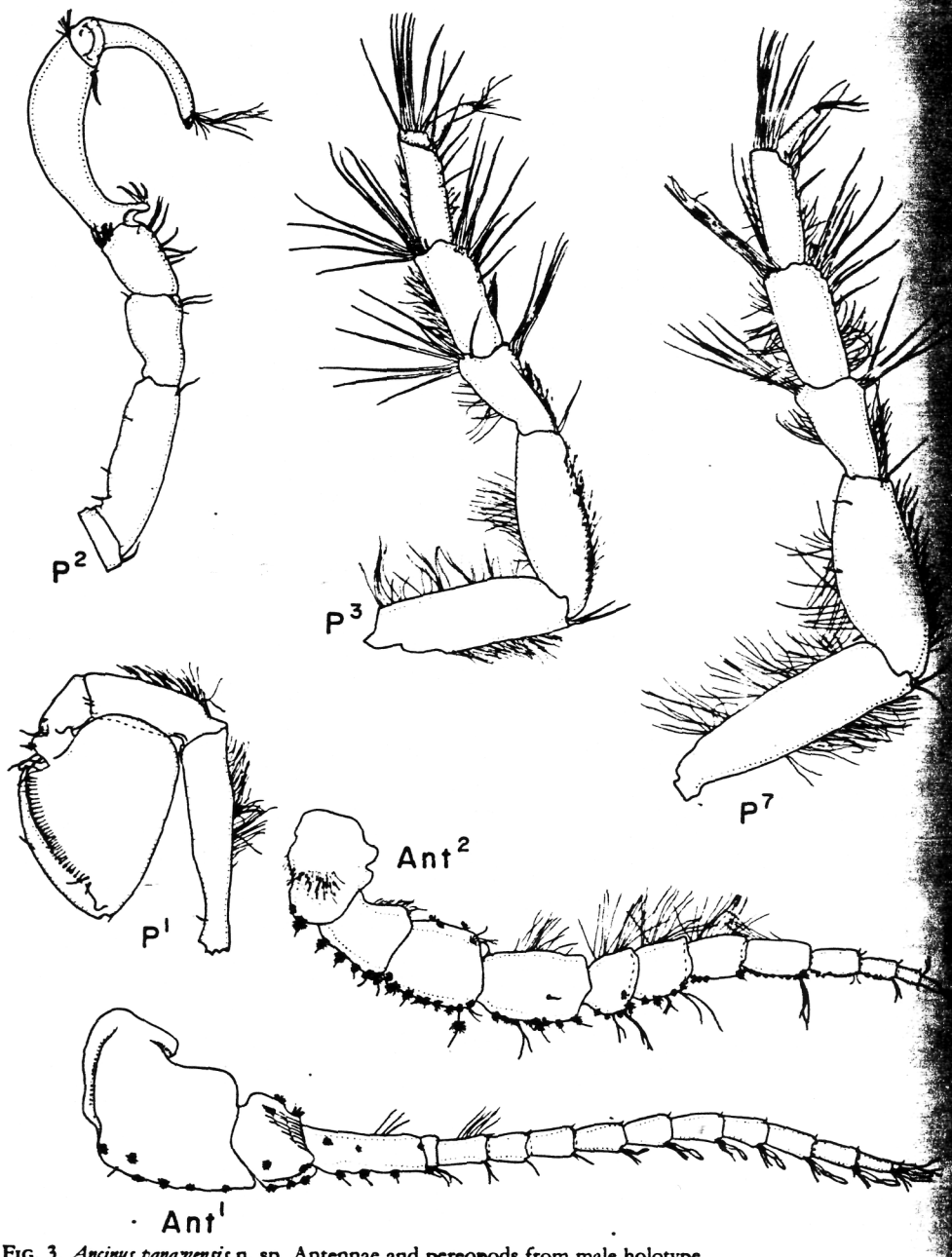

FIG. 3. *Ancinus panamensis* n. sp. Antennae and pereopods from male holotype.

lobes bearing 8, 7, and 13 spines respectively; article 5 with 10 spines; lateral basal border of article 4 with simple fringe setae. Setae sparse on sensory border of endite; simple fringe setae abundant laterally near articulation of palp. Ant[1] peduncular articles with few penicillate setae; flagellum of 13 articles; uniramou thetascs present on flagellar articles 5–12. peduncular articles with relatively few pe late setae; flagellum of nine articles; pedu lar article 5 and flagellar articles 1–4 fri with long simple setae. P[1] dentiform proce

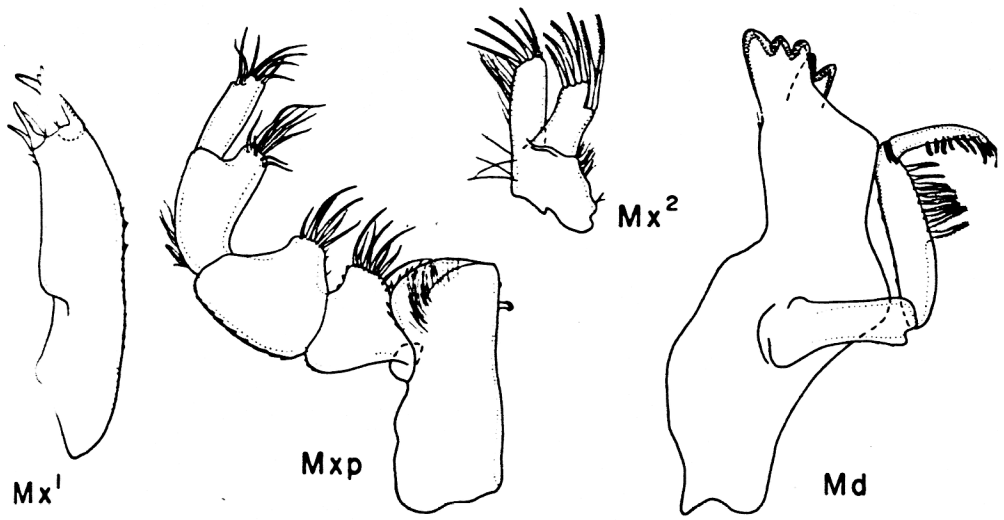

FIG. 4. *Ancinus panamensis* n. sp. Mouthparts from male holotype.

inner base of propodus slightly shorter than carpus; basis and ischium fringed with fine elor te simple setae. P^2 dactylus (male) relatively short, closing at midlength of propodus; three long tapering setae on process inside proximal part of propodus. P^3–p^7 highly setose; merus, carpus, and propodus with numerous closely set elongate setae distally and with fewer long stout setae along medial border. Ischium with numerous fine setae on all pereopods. Plp^1 uniramous with 33 plumose marginal setae (PMS). Ppl^2 exopod less than half length of endopod; stylet tenuiform, slightly shorter than endopod; endopod medial and lateral borders with few penicillate and numerous plumose setae respectively. Plp^3–Plp^5 with well-developed blood sinuses (broken lines in Fig. 5 delimit these areas). Plp^3 exopod ovate, 3/4 length of endopod, lateral margin fringed with short simple setae. Plp^4 endopod with apical spine. Plp^5 exopod with three squamiferous protuberances, endopod distomedial border with incipient protuberance.

Coloration

The dorsum in the male holotype displayed a variegated pigment pattern of reddish brown, brownish red, and white. (All colors in this paper are from Kornerup and Wanscher 1967.) This particular color morph is designated "pattern" and is discussed in more detail below under color polymorphism.

Measurements

Male holotype, length 4.29 mm, width 2.05 mm. Female allotype (gravid), length 2.89 mm, width 1.41 mm. The mean length and width (and size range) of 101 paratypes sampled at random were 1.98 mm (1.02–3.40 mm) and 0.95 mm (0.48–1.70 mm), with a mean width: length ratio (percent) of 48.0. Since the distributions of samples were not approximately normal, the median and 0.95 confidence limits of the median ($K = 50/100\ [N+1] - \sqrt{N}$) are also given to indicate the degree of dispersion in the paratypes. The median length and width (and 0.95 confidence limits) of the 101 paratypes were 1.63 mm (1.34–1.95 mm) and 0.77 mm (0.64–0.94 mm). The mean length and width (and size range) of 17 adult male paratypes were 3.76 mm (2.96–4.28 mm) and 1.91 mm (1.64–2.14 mm); for 23 adult female paratypes the mean length and width (and size range) were 3.44 mm (2.40–4.04 mm) and 1.69 mm (1.20–2.00 mm). The mean length of 10 released young was 0.83 mm with the range 0.81–0.84 mm. The mean and median number of embryos per female (range in length 2.05–

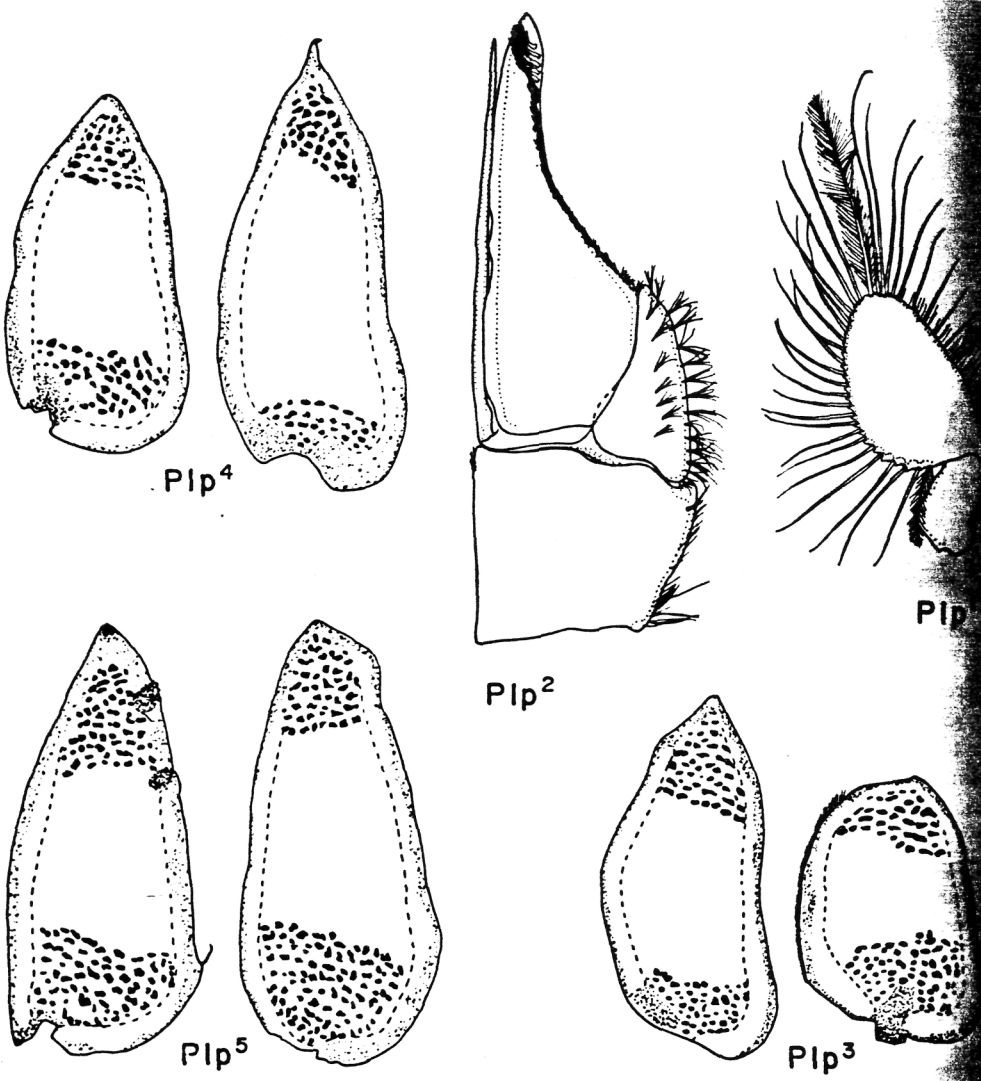

FIG. 5. *Ancinus panamensis* n. sp. Pleopods from male holotype.

2.81 mm) respectively in a sample of 20 from Naos Island (11 August 1972) were 9.7 and 10. The Kendall rank correlation test showed a highly significant positive correlation between body size and number of embryos ($P \ll 0.001$).

Type Locality

Sand beach between Naos Island and Culebra Island (no. 1 in Fig. 1) near Pacific entrance of the Panama Canal (79°31′57″ W; 8°54′51″ N). In sand near neap low water level. Male type catalog number USNM 143954, female type USNM 143955, 363 paratypes USNM 14 (20 July 1969).

Material Examined

(Collections were made by authors u noted otherwise.) Monthly collections num ing at least 100 individuals were examined the sand beach between Naos Island and C bra Island over the period 5 February 1

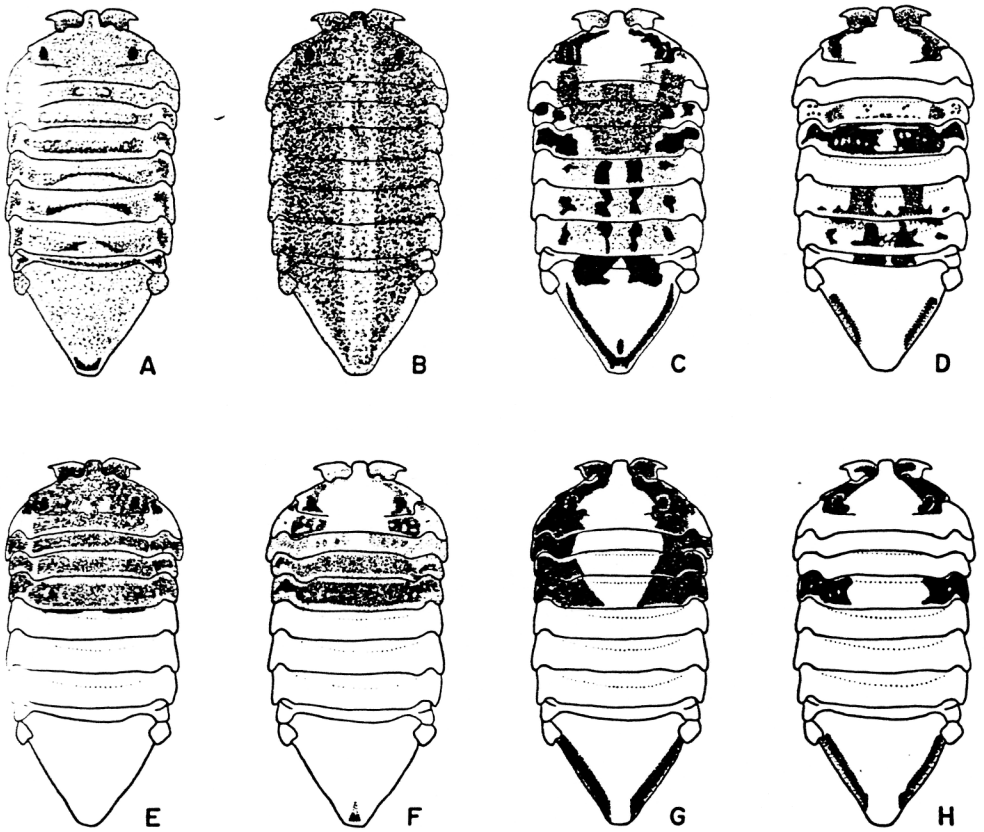

FIG. 6. Color polymorphism in *Ancinus panamensis* n. sp. *A*, uniform; *B*, stripe; *C*, pattern; *D*, half pattern; *E*, bicolor; *F*, bi-O; *G*, bi-1/2 O; *H*, half belt. Various morph patterns are illustrated on a single standardized individual.

13 May 1971. Large collections were also examined from the following localities in Panama: Naos Island beaches (nos. 2 and 3, Fig. 1), 30 July 1969 and 28 August 1969 (collector D. Dexter), several samples in 1970 and 1971; Palo Seco Leprosary (no. 4, Fig. 1), 11 December 1969, 11 and 12 March 1970, 22 October 1971; Venado Beach (no. 5, Fig. 1), 8 January 1970; San Carlos Beach, Panama Province (79°57.5′ W; 8°28.0′ N), 4 August 1969, collector D. Dexter. One collection of 71 specimens was examined from Colombia, Juanchaco, Bahía de Málaga (77°22.0′ W, 3° 54.4′ N), 20 January 1971.

Distribution

Abundant at type locality and on other partly protected sand beaches near the Pacific terminus of the Panama Canal (Fig. 1). Also found at San Carlos Beach, Panama, and at Juanchaco, near the mouth of Bahía de Málaga, Colombia.

Supplementary Descriptive Notes

The following information is based on the examination of adult male and female paratypes. Pereonite 1 in males tends to be the broadest of all pereonites; in females about half have pereonites 1 or 2 the broadest and half pereonite 6 the broadest. Ant^1 reaches to pereonite 4, flagellar articles 10–11. Penicillate setae present on both antennae (about 10–15 visible along anterior margin of Ant^1 and 50–60 along anterior margin of Ant^2). Pleotelson inflated in females, with a rounded apex (Fig. 2*C*) as in males. Uropods do not reach apex of pleotelson in all specimens. Mouthparts virtually identical

in both sexes. Md palp articles 2 and 3 with 7–9 and 6–10 plumose setae respectively. Mx^1 exite with eight–nine spines, one always stout, two–three serrate. P^1 dentiform process may be subequal in length to carpus. The process inside the proximal part of the propodus of p^2 with three tapering setae in the six males examined. P^2 ambulatory in female and similar to p^3. Elongate setae on merus, carpus, and propodus abundant on p^3–p^5, decreasing in number on p^6–p^7. Pleopods similar in both sexes. Plp^1 with 22–28 PMS. Specimens collected in Colombia varied slightly from the Panamanian material in the following characters: (*a*) dorsum of pleotelson less inflated, and (*b*) pleotelsonal shelf relatively narrow.

Affinities

Ancinus panamensis shares a number of features in common with *A. depressus* (Say) and *A. granulatus* Holmes & Gay. The pleotelson in these three species is inflated and tends to be truncate posteriorly. The third peduncular article of Ant^1 is also without esthetascs. Ant^2 in *A. panamensis* and *A. granulatus* has few setae present on peduncular article 5 and flagellar articles 1–3. In *A. depressus* these setae are much more numerous and present on a greater number of articles (up to nine articles). The location and number (3) of the squamiferous protuberances on the exopod of Plp^5 is also similar in *A. panamensis* and *A. granulatus*. However, it will become apparent later that *A. panamensis*, like *A. granulatus*, stands apart from the closely allied species complex *A. depressus*, *A. brasiliensis*, and *A. seticomvus*.

Etymology

The specific epithet *panamensis* is derived from the Republic of Panama, where the species was first collected.

Ancinus brasiliensis Castro 1959

Figs. 7, 8, 9, 10, 11*A–C*, and 12

References

Ancinus brasiliensis Castro 1959: 215–218, figs. 1–8; Loyola e Silva 1963: 1–19, figs. 1–5. *Ancinus depressus* (Say 1818).—Loyola e Silva 1971: 212–215, fig. 1. *Ancinus brasiliensis* (1959. Schultz 1973.

Diagnosis

Body elongate, breadth 0.44–0.48 of le surface smooth except for ridges pr laterally on pereonites; pleotelson elo breadth 0.40–0.45 of length; pleotelsona narrow, not noticeably truncate; pleotels inflated, vault shelf narrow; Ant^1 basal art and flagellar article 1 with numerous ste esthetascs; pereopod 2 (male) propodus cess with four setae; Plp^5 exopod with squamiferous protuberances.

Coloration

Illustrated adult male "uniform." Cpl eggs green, newly released young white out pigmentation). See section on color morphism for further variations in this sp

Measurements

Mean length and width (and size range spectively of individuals in random sa ($N = 111$) from María Chiquita Beach (6 tember 1973) 3.25 mm (1.57–6.11 mm) 1.50 mm (0.76–2.65 mm). Mean length width (and size range) respectively of viduals in random sample ($N = 141$) Shimmey Beach (6 September 1973) 2.71 (1.64–5.42 mm) and 1.27 mm (0.82–2.39 The mean width:length (100) ratio (and r of 20 individuals (range in length 2.83–4.03 was 46.4 (44.4–48.2). Comparable measure in 20 *Ancinus panamensis* (range in length 4.28 mm) gave a mean width:length ratio of 50.1 (48.3–51.8) with no overl values, a quantitative indication of the elongate body proportions in *A. brasiliensis* largest individuals were males, as observe this species by Loyola e Silva (1963), and i *panamensis*. Mean length (and size range) released young 1.14 mm (1.12–1.19 mm), mean and median number of embryo female respectively in 20 individuals (le 2.71–3.46 mm) sampled from Shimmey B (16 October 1970 and 6 September 1973) 14.6 and 14. This indicates a larger brood than that observed in *A. panamensis* (media

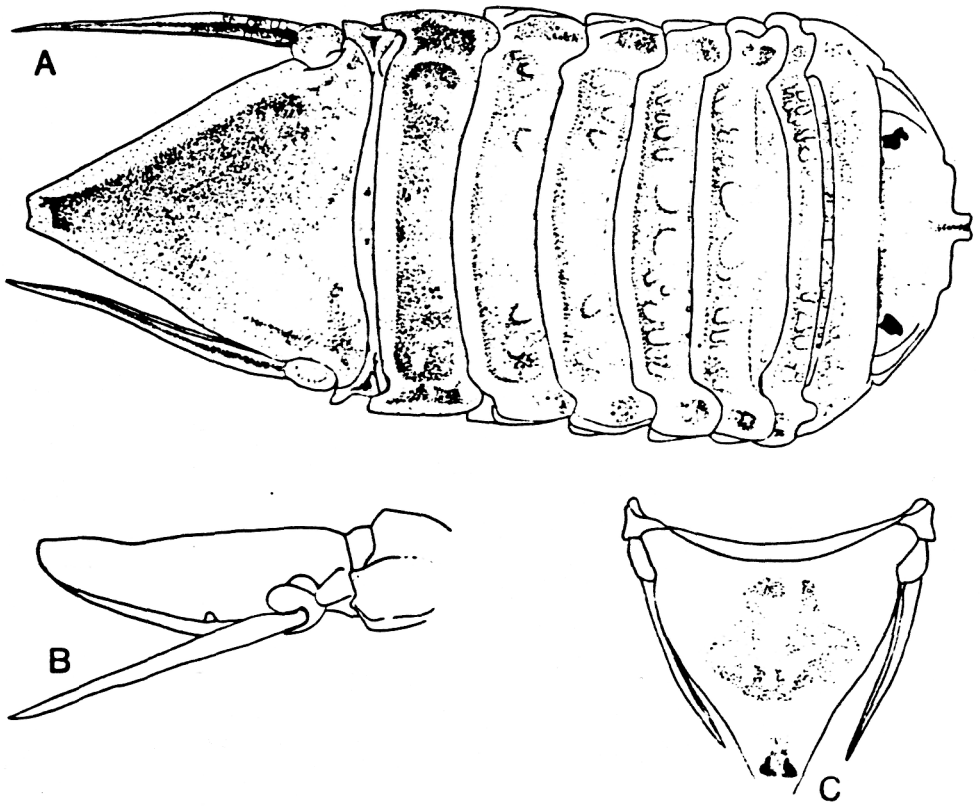

FIG. 7. *Ancinus brasiliensis* Lemos de Castro. *A*, dorsal view, male, length 5.64 mm, width 2.50 mm; *B*, pleotelson, lateral view; *C*, pleotelson, female, length 4.74 mm, width 2.24 mm.

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10). However, since the number of embryos and body size are positively correlated in both species ($P < 0.001$, Kendall rank correlation test) and females of *A. brasiliensis* attain a larger size, this difference is best interpreted as a size effect only. Mean length and width (and size range) of seven specimens from Brazil (courtesy of M. L. Koening, Castro 1959, Loyola e Silva 1963) 6.45 mm (5.38–8.50 mm) and 3.05 mm (2.53–3.80 mm).

Type Locality

Ribeira Beach, Mangaratiba Bay, Rio de Janeiro State. Collected from a sand bottom at 1.5 m depth.

Material Examined

PANAMA: María Chiquita, from beach near mouth of Brazuelo River (no. 6, Fig. 1), 13 August 1969, 29 specimens, collector D. Dexter; 15 March 1970, 22 specimens; 6 October 1970, 35 specimens; 6 September 1973, 95 specimens. Shimmey Beach, near Ft. Sherman (no. 7, Fig. 1), 5 July 1969, three specimens, collector D. Dexter; catalog no. USNM 143957, 20 July 1969, 69 specimens, collector D. Dexter; 28 July 1969, 94 specimens, collector D. Dexter; 16 October 1970, 156 specimens; 11 August 1972, 398 specimens; 6 September 1973, 105 specimens. Ft. San Lorenzo, from beach at base of ruins east of the Chagres River mouth (no. 8, Fig. 1), 26 June 1969, one specimen, collector D. Dexter; 27 June 1969, seven specimens.

COSTA RICA: Puerto Viejo (9°40′ N, 82°44′ W), 2 April 1971, two specimens, collector D. Dexter. Cahuita south (9°44′ N, 82°50′ W), 1 April 1971, 10 specimens, collector D. Dexter. Cahuita north (9°45′ N, 82°52′ W), 3 April 1971, four specimens, collector D. Dexter. Airport

FIG. 8. *Ancinus brasiliensis* Lemos de Castro. Antennae and pereopods from male in Fig. 7.

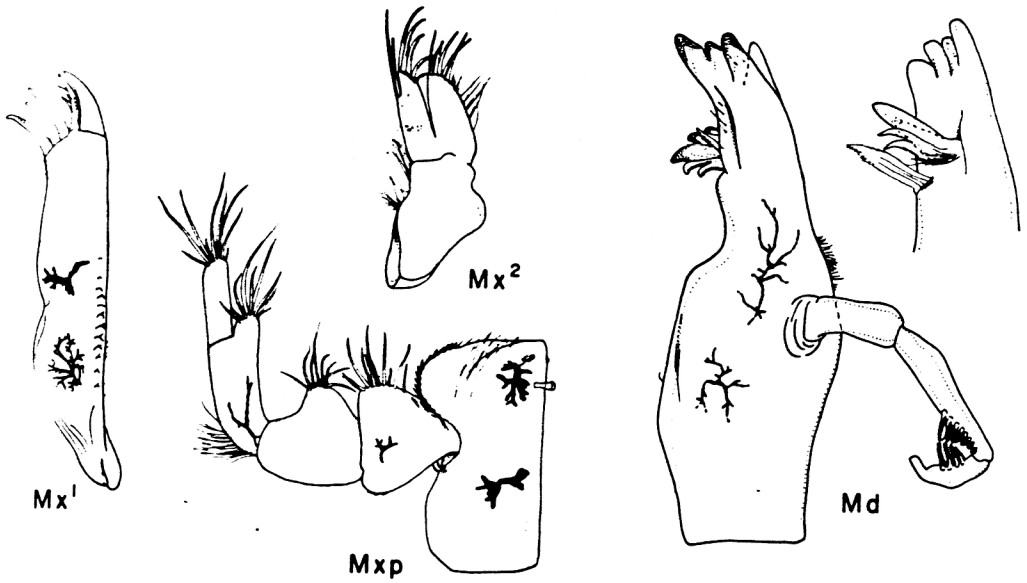

FIG. 9. *Ancinus brasiliensis* Lemos de Castro. Mouthparts from male in Fig. 7. Inset of distal portion of mandible (Md) from male, length 5.88 mm, width 2.72 mm.

Be: , Limón (9°58′ N, 83°01′ W), 19 March 1971, two specimens, collector D. Dexter.

BRAZIL: Isle of Itamaracá, Pernambuco, two specimens, collection no. ITA 19, *Halimeda* sand bottom, 5.6 m depth; one specimen, collection no. ITA 91, calcareous algal bottom, 1.5 m depth. Tambaú, Paraíba, one specimen, from algae, collector M. L. Koening.

Di ibution

A wide-ranging western Atlantic species. Widespread along Brazilian coast from Ubatuba (Enseado de Flamengo), São Paulo (Loyola e Silva 1963), ca. 24° S to Tambaú, Paraíba State (M. L. Koening, personal communication), ca. 7° S. Abundant on beaches in Panama at María Chiquita, Shimmey, and near Ft. San Lorenzo (Fig. 1). Present along Costa Rican coast between latitudes 9°40′ N to 9°58′ N.

Supplementary Descriptive Notes

The following is based on the examination of collections from Panama and Brazil. In each case where significant differences were observed these are noted, otherwise the material was in essential agreement. *Ancinus brasiliensis* is contrasted with other species of *Ancinus* in a separate section below. Ant¹ reach to pereonite 5, peduncular articles with numerous penicillate setae (18 present along anterior margin in illustrated specimen); flagellum usually of 14–16 articles; uniramous stemless esthetascs present on peduncular article 3 and flagellar article 1 (unlike the usual esthetascs, these structures are stemless but presumably chemoreceptive in function, T. Bowman, personal communication), uniramous esthetascs with stems present on distal articles of flagellum; the Brazilian specimens have esthetascs on the distal flagellar articles only. Ant² peduncular articles with numerous penicillate setae (75 present along anterior margin of illustrated specimen); flagellum usually of 8–10 articles; peduncular articles 4 and 5 and flagellar articles 1–4 with numerous long simple setae. Rostrum anterior margin slightly indented lengthwise. Sutures between cephalon and pereonite 1 reach far medially, approaching midline. Anterolateral margin of pleonite usually concave. Ridges well developed laterally on epimera and pereonites 2–7. Pleotelson not inflated, lateral profile of apex acute (Brazilian material, Fig. 11*A*, *B*) or truncate (Panamanian material, Fig. 11*C*). Pleotelson narrow, more so in specimens from Brazil (Table 1). Pleotelsonal shelf relatively narrow and equal in all collections (Table 2). Pleotel-

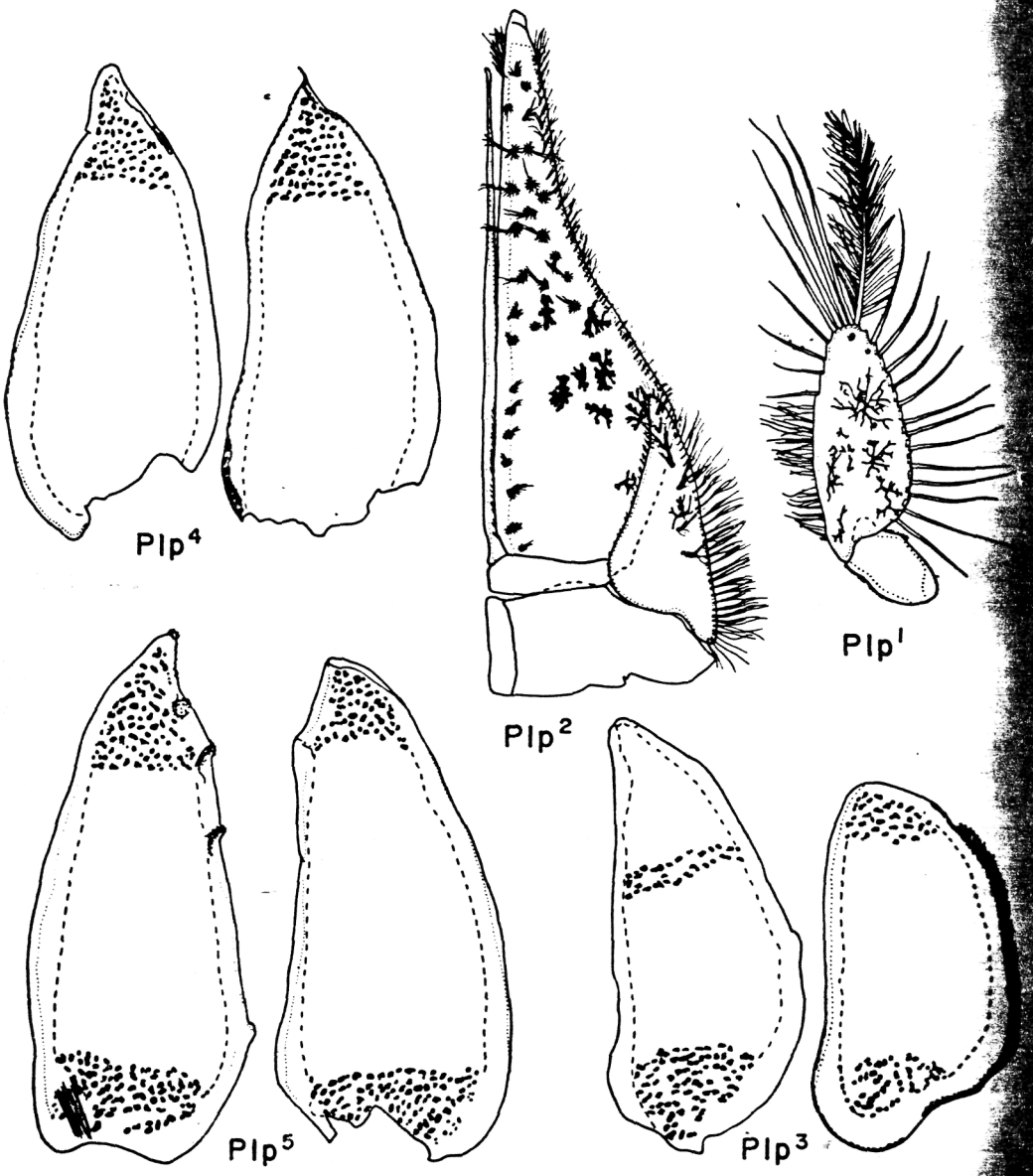

FIG. 10. *Ancinus brasiliensis* Lemos de Castro. Pleopods from male in Fig. 7.

sonal apex (in dorsal view) slightly truncate, especially in younger individuals. Mxp as described in Loyola e Silva (1963), including simple fringe setae at base of palp article 4. Plumose setae on Md palp articles variable in number, ranging from 8–11 on article 2 and 4–11 on article 3; incisor with three strongly sclerotized cusps and a stout nonsclerotized process. P^1 basis and ischium without fine setae. P^2 dactylus long, closing onto carpus; process inside proximal part of propodus with four relatively short, stout, and blunt setae. P^3–p^7 highly setose; merus, carpus, and prop dus with numerous closely set elongate se distally and along medial border (although of fewer in number than those present distall setae progressively diminish in number on and p^7; fine setae on ischium increase in numb from p^3–p^6, but absent from p^7. Plp^1 in sp mens from Brazil and Pamana without an complete suture as illustrated in Loyola e Si (1963), Fig. 4; PMS number variable, from 2 27. Plp^2 rami without clefts. Plp^3 exopod ova smaller than endopod, lateral margin fringed

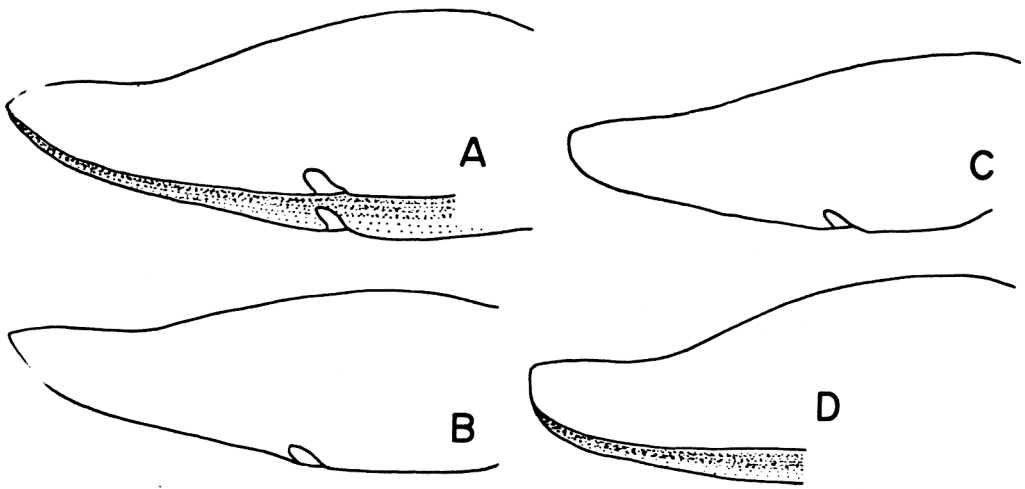

FIG. 11. Lateral views of pleotelson in males. *Ancinus brasiliensis* Lemos de Castro from Brazil—*A*, length 6.30 mm; *B*, length 6.20 mm. *A. brasiliensis* from the Caribbean Sea, Panama—*C*, length 5.80 mm. *Ancinus depressus* (Say) from the Gulf of Mexico—*D*, length 11.92 mm.

with simple setae. Plp[4] endopod acute apically. Plp[5] exopod with four squamiferous protuberances (a fifth incipient squamiferous protuberance also present proximally) and margin slightly squamous between two distal protuberances; endopod distal medial border with slight bulge.

Ancinus brasiliensis *Compared with* A. depressus *and* A. granulatus

Since Loyola e Silva (1971) and Schultz (1973) are not in agreement on the status of *Ancinus brasiliensis*, *A. depressus*, and *A. granulatus*, the three species are here compared in detail. We hope to demonstrate that Schultz was correct in believing that the three species are distinct and not conspecific with *A. depressus* as interpreted by Loyola e Silva. *Ancinus granulatus* is treated first because this species is relatively easy to distinguish from the others.

Ancinus granulatus Holmes & Gay 1909

Fig. 13*A–C*

References

Ancinus granulatus Holmes & Gay 1909: 375–376, figs. 1 and 2; Loyola e Silva 1963: 18–19. *Ancinus depressus* (Say 1818).—Loyola e Silva 1971: 214. *Ancinus seticornvus* Trask 1970: 145–149, figs. 1, 2. *Ancinus granulatus* Holmes & Gay 1909.—Schultz 1973: 268–269, fig. 1*B*, *C*, *F*.

Diagnosis

Body very broad and densely granulated; eyes slightly elevated on swellings; pleotelson very short with truncate apex; pleotelsonal shelf broad (revised).

Material Examined

Pete's Campo, ca. 16 km north of San Felipe, Baja California, Gulf of California, Mexico, 1 April 1969, three males, seven females, collector D. Dexter. Radar Beach, Punta Diggs, ca. 25 km south of San Felipe, Baja California, Gulf of California, Mexico, 18 March 1972, one male, collector D. Dexter.

Discussion

The specimens of *A. granulatus* examined from the Gulf of California agree well with Holmes' and Gay's (1909) description of the species, including the dense granulations whose presence was denied by Loyola e Silva (1971). Other notable features include: (*a*) the elevation of the eyes on swellings, (*b*) a short pleotelson, (*c*) the truncate apex of the pleotelson, (*d*) a broad pleotelsonal shelf, (*e*) strongly recurved

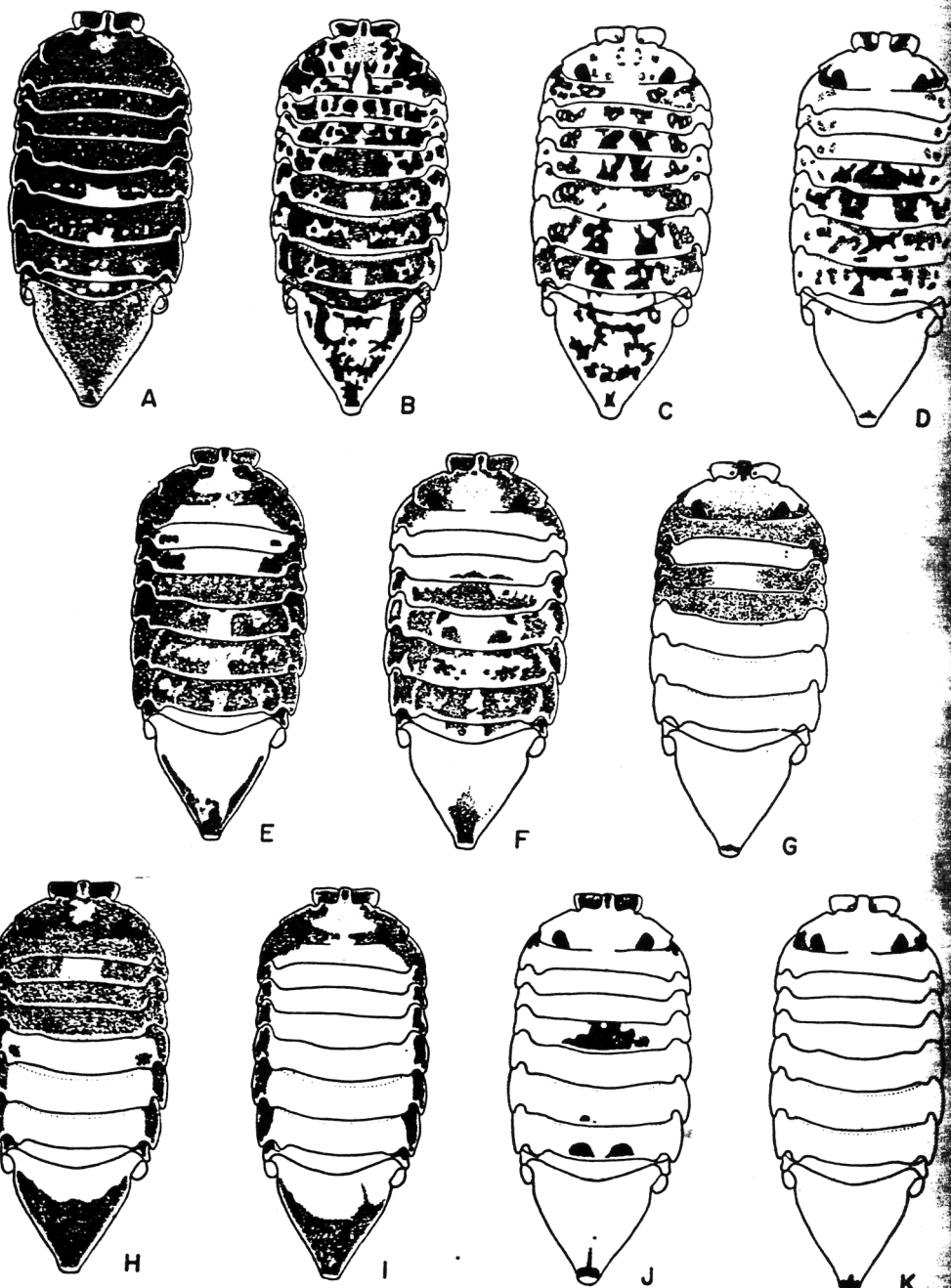

FIG. 12. Color polymorphism in *Ancinus brasiliensis* Lemos de Castro. *A*, uniform-S; *B*, *C*, speckled; *D*, speckled; *E*, girdle; *F*, girdle-B; *G*, belt; *H*, half quadrate; *I*, quadrate; *J*, fleck; *K*, uniform. Various morph patte are illustrated on a single standardized individual.

TABLE 1

RATIO OF WIDTH TO LENGTH OF PLEOTELSON IN *Ancinus brasiliensis* AND *Ancinus depressus*

SPECIES	LOCALITY	BODY LENGTH (mm) NUMBER	$\bar{X}$ (range)	MEDIAN	RATIO (%) $\bar{X}$ ($s_{\bar{X}}$)	MEDIAN	SIGNIFICANCE LEVEL, P*
Ancinus brasiliensis	Brazil Itamaracá Lambari Mangaratiba Bay and Ubatuba†	6	6.43 (5.38–8.50)	6.25	40.5 (1.11)	40.4	$P < 0.01$
Ancinus brasiliensis	Panama Shimmey Beach	10	5.54 (4.74–6.27)	5.72	45.0 (0.82)	44.0	
Ancinus depressus	Gulf of Mexico Texas Mississippi	10	9.42 (5.51–11.92)	9.46	55.3 (1.00)	56.0	$P \ll 0.001$

NOTE: Pleotelsonal width measured at a point two-thirds the length of the pleotelson (toward apex). Measurements include both sexes and large adults selected to maximize overlap in size.

* Nonparametric Mann-Whitney U test (after Siegel 1956).

† One measurement each from illustrations in Castro (1959) and Loyola e Silva (1963).

TABLE 2

RATIO OF WIDTH OF PLEOTELSONAL SHELF TO LENGTH OF PLEOTELSONAL VAULT IN *Ancinus brasiliensis* AND *Ancinus depressus*

SPECIES	LOCALITY	BODY LENGTH (mm) NUMBER	$\bar{X}$ (range)	MEDIAN	RATIO (%) $\bar{X}$ ($s_{\bar{X}}$)	MEDIAN	SIGNIFICANCE LEVEL, P*
Ancinus brasiliensis	Brazil Itamaracá Lambari	4	5.91 (5.38–6.30)	5.98	11.8	12.0	NS $P > 0.05$
Ancinus brasiliensis	Panama Shimmey Beach	10	5.54 (4.74–6.27)	5.72	11.6 (0.40)	11.4	
Ancinus depressus	Gulf of Mexico Texas Mississippi	10	9.42 (5.51–11.92)	9.46	15.1 (0.56)	14.4	$P \ll 0.001$

NOTE: Shelf width is the average of two sides measured at a point one-half the length of the vault. NS, not significant.

* Nonparametric Mann-Whitney U test (after Siegel 1956).

uropods, and (*f*) Plp[5] with three squamiferous protuberances. The collection from Pete's Campo contained, in addition to the 10 specimens of *A. granulatus*, six adult male and female (some gravid) *Ancinus* that correspond to Trask's description of *A. seticornus*. Schultz (19[illegible]) examined the type specimens of *A. granulatus* and paratypes of *A. seticornus* and concluded that they are conspecific. He emphasized that the key character used by Trask to erect the species *A. seticornus*, namely the setal number on the process of the propodus of pereopod 2, is not a good character for specific distinction. Schultz found the setal number to vary between six–eight in both forms and noted that "...it was difficult to count the exact number on some of the male propodi." The setal number in the Pete's Campo material was four–five in *A. granulatus* and five–six in *A. ?seticornus*. Our study of the Pete's Campo material indicates the existence of two distinct species, with no overlap whatever in the morphological features enumerated for *A. granulatus* above. The form agreeing with *A. seticornus* has a smooth body surface with no granulations and can be further contrasted with *A. granulatus* as follows: (*a*) eyes not elevated, (*b*) pleotelson long, (*c*) pleotelson nearly acute

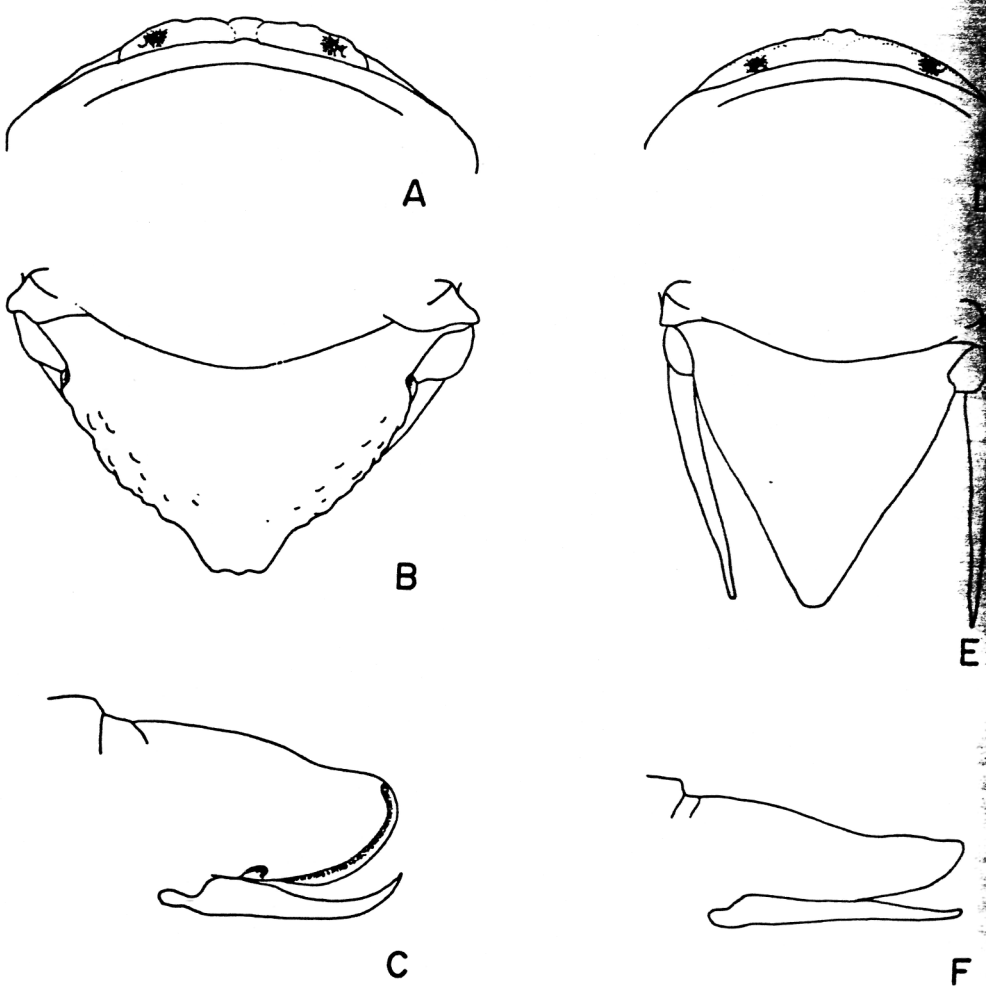

FIG. 13. Cephalon and pleotelson (dorsal and lateral views) from *Ancinus granulatus* Holmes & Gay, *A*, *B*, an male, length 7.12 mm, width 3.65 mm; and *Ancinus ?seticomvus* Trask, *D*, *E*, and *F*, male, length 6.43 mm, w 3.02 mm. Cephalon tilted down anteriorly and pleotelson tilted down posteriorly in both specimens.

or narrowly rounded, (*d*) pleotelsonal shelf narrow, (*e*) uropods only slightly recurved, and (*f*) Plp^5 with five squamiferous protuberances, one positioned far basally (Fig. 13*D–F*). Additional specimens agreeing with *A. seticomvus* were collected by D. Dexter at Punta Diggs and Topolobampo (Sinaloa), Gulf of California, and at Mazatlán (Sinaloa), near the entrance to the Gulf. In order to resolve this problem, it will be necessary to study the holotypes, type collections, and—preferably—new collections. It is possible that the sympatric occurrence of the two species has led to mixed collections and the resulting confusion noted.

Ancinus depressus (Say 1818)

Fig. 11D

References

Naesa depressa Say 1818: 482–485. *Anci depressus* (Say 1818).—Milne Edwards 1840: 2 pl. 32, figs. 17–20; Richardson 1905: 271–2 fig. 282; Richardson 1909: 173–177, figs. 1 Menzies and Frankenberg 1966: 43, fig. Loyola e Silva 1971: 212–215, fig. 1; Schu 1973: 269–270, fig. 1*A*.

Diagnosis

Cephalon and pereonite 1 fused medially for short portion of length; pleotelson usually about three-fourths as long as wide; uropods either slightly shorter or slightly longer than pleotelson; swellings (ridges) present on lateral margins of dorsum of pereonites 3–7; pereopod 2 (male) with six–eight setae on process on inner proximal margin of propodus (slightly modified from Schultz 1973). Additionally, pleotelsonal apex truncate and vault shelf wide.

Material Examined

Padre Island, Cameron County, Texas, 5 December 1954, two specimens, collector L. Hubricht, accession no. USNM 209567. Horn Island, Mississippi, 27 March 1958, four specimens, collector J. Y. Christmas, GCRL (Gulf Coast Research Laboratory) no. 160: 50; Horn Island, 5 February 1959, one specimen, collector J. Y. Christmas, GCRL 160: 51; Horn Island, 23 March 1959, 11 specimens, collector J. Y. Christmas, GCRL 160: 52; Horn Island, 9 December 1958, four specimens, collector J. Y. Christmas, GCRL, 160: 53; Horn Island, 26 February 1973, four specimens, collector R. Heard and N. Whatley, GCRL 1067.

Discussion with Supplementary Descriptive Notes

Contrary to Schultz's (1973) assertion that the differences between *Ancinus depressus* and *A. granulatus* are very slight, we found the two species readily distinguishable. A more difficult distinction, requiring detailed study with quantitative measurements, was that between *A. depressus* and *A. brasiliensis*. Comparison of the width to length ratios demonstrates that *A. depressus* (mean percent and range, 48.1, 45.4–50.8, and median percent 48.4 for $N = 14$) has a wider body than *A. brasiliensis* (mean percent and range 46.4, 44.4–48.2, median percent 46.6 for $N = 20$). This is largely due to the broad pereonites 1–2 in *A. depressus*. The difference is significant at $P < 0.01$ (Mann-Whitney U test). Other statistical differences in the pleotelson (width to length) and the pleotelsonal vault shelf (width) are given in Tables 1 and 2. The pleotelson in *A. depressus* is also strongly arched, has a broad apex, and is notably truncate (Fig. 11*D*). The only differences observed in dissected appendages were in the antennae. Ant^1 in *A. depressus* has long fine setae on the third peduncular article and flagellar articles 2–7; penicillate setae are relatively sparse (about 16 present along anterior margin versus 18–20 in *A. brasiliensis*); esthetascs are present on the terminal flagellar articles only. Ant^2 has long simple setae extending to flagellar article 6; in *A. brasiliensis* these setae extend to flagellar articles 3–4 only.

KEY TO SPECIES OF *Ancinus*

1. Body broad, breadth 0.48–0.54 ($\bar{X} = 0.50$) of length; pleotelson truncate or broadly rounded 2
1. Body elongate, breadth 0.44–0.48 ($\bar{X} = 0.46$) of length; pleotelson nearly acute, not broadly truncate 4
2. Pleotelsonal apex broadly rounded; ridges absent from lateral margins of pereonites and epimera; p^2 (male) dactylus short, closing on propodus; propodus process with three setae. (Small species, up to 4.3 mm in length.) ..... *A. panamensis*, new species
2. Pleotelsonal apex truncate; ridges present on lateral margins of pereonites and epimera; p^2 (male) dactylus long, closing on carpus; propodus process with four–eight setae. (Large species, maximum length exceeding 9 mm.) 3
3. Body surface granulose, eyes elevated on swellings; upper pleotelsonal apex surface cylindriform; Plp^5 exopod with three squamiferous protuberances; up to 9.5 mm in length ..... *A. granulatus* Holmes & Gay 1909

3. Body surface smooth, eyes not elevated; upper pleotelsonal apex not cylindriform; exopod with five squamiferous protuberances; up to 13.5 mm in length ..... *A. depressus* (Say

4. Pleotelsonal apex narrowly truncate; pereopod 2 (male) propodus process with four se Ant[1] peduncular article 3 and flagellar article 1 with stemless esthetascs, proximal flage articles without numerous fine setae; Plp[5] exopod with four squamiferous protubera ..... *A. brasiliensis* Castro

4. Pleotelsonal apex acutely rounded; pereopod 2 (male) propodus process with five–seven s Ant[1] with normal esthetascs on distal flagellar articles only, proximal flagellar articles w numerous fine setae; Plp[5] exopod with five squamiferous protuberances..... ..... *A. ?seticornus* Trask

COLOR POLYMORPHISM

This separate treatment of the color forms in Panamanian *Ancinus* is presented to illustrate specific differences of a nonmeasurable kind and to serve as a reference for studies on the balanced polymorphism in these populations. Color identification (after Kornerup and Wanscher 1967) was carried out with reflected light under low magnification (×25). In this discussion, pattern refers to the distribution of pigment on the dorsum; descriptive color terms denote the coloration of the patterns; ground color is the dominant color of individuals. Laboratory-reared animals showed that the pigmented patterns developed gradually in 1–2 weeks and remained unchanged to maturity and against different colored sand substrata.

Ancinus panamensis n. sp.

All populations of *A. panamensis* examined in Panama (alive or freshly preserved in formalin) exhibited a similar set of pigment patterns (Fig. 6 *A–H*). In addition, the colors were similar within populations. Colors between populations differed, however; each tended to match the dominant sand color, creating a cryptic effect. The morphs described here are from live adult specimens collected at the type locality near Naos Island, 1 September 1973. Eight types are described, each showing a variety of hues. These are arranged below in approximate order of diminishing pigmentation. Synoptic morph frequencies are noted for samples collected over the period 1970–1973.

UNIFORM (A): pigmentation on dorsum nea uniformly distributed. Some individuals w dense pigmentation on anterior margin cephalon, pereonite 4, and lateral margins pleotelson. Dominant ground colors are oran (ranging from light and grayish to browni and gray (greenish to yellowish gray). Yello red, and brown pigmentation is less comm This morph comprised from 10 to 20 perce of the population.

STRIPE (B): Pigmentation nearly uniform distributed except along midline where it is le dense, extending from the cephalon to the ap of the pleotelson. Width of stripe varies som what among different individuals. The dom nant ground color is red, ranging from grayi and pastel to dull red. Commonly from 3 to percent of the population.

PATTERN (C): Characteristically with pigmen free areas centrally on cephalon and pereonite along posterolateral margins, and often ce trally on the pleotelson. Minor variations a common, including (*a*) complete pigmentatio of pereonites 2–4, (*b*) complete pigmentation pleotelson, (*c*) marginal pigmentation of ple telson reduced or absent, (*d*) entire bo sparsely pigmented over the basic morp pattern. The coloration tends to be intense wi orange (grayish and brownish) and red (orang and brownish) hues predominant. Browni red and orange areas are commonly prese centrally on pereonites 2–4. This morph co prised about 60 percent of the population.

HALF PATTERN (D): Pigmented areas general less common than in the "pattern" morp

Variations include: (*a*) sparse pigmentation on pereonites 6–7, (*b*) dense pigmentation on pereonites 3 and 7, (*c*) entire anterior half of body pigmented (from pereonite 4 to cephalon), (*d*) all of pleotelson pigmented. The ground color is highly variable, ranging from grayish green to reddish brown, violet-white, and dark brown. Reddish orange areas are commonly present centrally on pereonites 3 and 7. This morph comprised about 10 percent of the population.

BICOLOR (E): Anterior half of body from pereonite 4 forward uniformly pigmented. Some pigmentation occasionally present on pereonites 5 and 7 and pleotelson. Lateral margins of pleotelson also often pigmented. Ground color highly variable with shades of brown (grayish and mustard brown), orange (brownish and reddish orange) and red (orange and pastel red) predominating. Uncommon, from 1 to 4 percent of the population.

[illegible] (F): Similar to "bicolor" except for pigment-free area located centrally on cephalon and pereonite 1. All of pereonite 1 may be pigment-free and often the lateral margins of the pleotelson are pigmented. Red and orange areas are sometimes present centrally on pereonites 2–4. The dominant coloration is brownish gray, gray, or brownish orange. From 3 to 8 percent of the population.

[illegible] 1/2 O (G): Central pigment-free area not entirely enclosed and usually extending posteriorly to pereonite 4. The ground color in one specimen was brownish gray. Uncommon, less than 2 percent of the population.

HALF BELT (H): Pigmentation sparse, usually present along margin of cephalon, on pereonite 4, and laterally on margins of pleotelson. Some pigmentation is often present laterally on pereonites 1–3. Brownish gray is most common ground color. From 3 to 10 percent of the population.

Ancinus brasiliensis

The 10 morphs of *A. brasiliensis* illustrated and described below (Fig. 12*A–K*) represent the most common forms observed in populations collected 6 September 1973 from Shimmey and María Chiquita beaches. Although only the first peduncular article of Ant^1 is shown, usually all of the peduncular articles of both Ant^1 and Ant^2 are pigmented.

UNIFORM-S (A): "S" refers to the conspicuous spots or pigment-free areas astride midline on pereonites 5–7 and pleonite 1; these areas contain faint traces of grayish green or reddish orange pigment. Remainder of body segments with dark gray pigmentation. Reddish orange patch at center of cephalon. Uncommon, about 17 percent of populations sampled.

SPECKLED (B AND C): B—Rounded pigment patches light to dark gray in color present on all body segments. Small nonpigmented to slightly pigmented areas astride midline on pereonites 5–7 and pleonite 1; if pigmented, these areas often contain traces of pastel green or orange-red pigment. Orange-red patch present at center of cephalon. Uropods with dark gray pigment. This dark speckled morph was the most common present at María Chiquita Beach, comprising 72 percent of 136 individuals sampled. C—Similar to the "speckled" morph described in (B) except with fewer pigmented areas. Peduncular articles of antennae pigmented, but mostly light in color with an iridescent sheen. Light orange patch often present on cephalon and orange pigment interspersed on midbody pereonites. This light speckled morph was the most common present at Shimmey Beach; it comprised 66 percent of 196 individuals sampled.

HALFSPECKLED (D): Similar to "speckled" except that gray pigment sparse on pereonites 1–3 and pleotelson. Ground color usually white, but a few individuals golden yellow in color. Pale orange patch sometimes present centrally on cephalon. Uncommon, about 2 percent of the populations sampled.

GIRDLE (E): Dark gray pigment present on cephalon and sometimes pereonite 1, on pereonites 4–7, and posteriorly on pleotelson. Orange patch usually present centrally on cephalon. Traces of pale green pigment often present on pereonites 5–7. Nonpigmented areas usually

white, but light yellow in some individuals. Present only at María Chiquita Beach, about 6 percent of populations sampled.

GIRDLE-B (F): "Girdle-B" refers to the broken pattern of dark gray pigmentation on pereonites 4–7, otherwise similar to the "girdle" morph. Most common ground color is orange; however, some individuals with white on either side of girdle. Present only at María Chiquita Beach, about 8 percent of populations sampled.

BELT (G): Light to dark gray pigment concentrated on pereonites 1 and 4 with an intervening white area. Pigmentation sometimes reduced or absent from pereonites 1–3, but always present on pereonite 4. Superficially similar to "Bi-O" in *Ancinus panamensis* n. sp. except for location of clear area. Present only at Shimmey Beach, about 2 percent of population.

HALF QUADRATE (H): Body dark gray except for nonpigmented (white) areas on pereonites 2 (central patch), 5–7, and pleotelson. Light orange patch present centrally on cephalon. Relatively rare, less than 1 percent of populations sampled.

QUADRATE (I): Violet brown marginally (covering all of epimera), nearly completely enclosing a white or pale orange interior. Cephalon with a central orange patch. Relatively rare, less than 1 percent of populations sampled.

FLECK (J): Small and varying amounts of grayish brown or dark gray (in one case pastel red) pigment spotting pereonites 4–7 near midline. Ground color usually white, but sometimes orange. Nearly 5 percent of population at Shimmey Beach.

UNIFORM (K): Essentially identical with "uniform" morph of *A. panamensis*. Illustrated specimen nearly completely white, but dark gray and orange ground color also common. Orange to pale orange patch on cephalon occasionally present. Of 42 "uniform" morphs sampled from the light-colored sand at Shimmey Beach (about 21 percent of population), 60 percent were white and all of the "uniform" morphs from the dark sand at María Chiquita Beach (11 percent of the population) were in color (13 grayish brown to gray, two g orange).

The differences in color polymorphism sufficiently pronounced that specific deter tions could be made on this basis alon example, the pigment patterns of the dom morphs "pattern," "half-pattern" (*A. mensis*) and "speckled," "half-speckled" *brasiliensis*) are markedly distinct. Unique s morphs include, for example, "stripe," " rate," and "half-quadrate." Moreover, *brasiliensis* an orange patch was comm present centrally on the cephalon, and peduncular articles of the antennae were us pigmented. Finally, it is our impressio the color polymorphism is more variab *A. brasiliensis* than in *A. panamensis*. T morphs illustrated for *A. brasiliensis*, plus additional rare morphs, give a total o morphs found in a sample of 539 individ Over 2,000 individuals of *A. panamensis* classified and these contained only eight defined morphs and three additional morphs.

COUPLING BEHAVIOR

From preliminary observations on coupling frequency between males and fem of conspecifics, we felt that this precopul step in the mating behavior of the two P manian species might differ. In coupling male grasps a female with the second pereo and places her below, oriented in the direction. In this position the female, al smaller than the male partner, is carried underneath. The coupling frequency tested with 30 pairs of each species under parable conditions on both sides of the Isth The median number of interactions (and confidence limits) observed were 4/pair/ (2–19/pair/hour) in *A. brasiliensis* and 2/ hour (2–9/pair/hour) in *A. panamensis*. T results are not significantly different ($P \geq$ Mann-Whitney U test). The initial impre of a difference in the coupling frequency c not be demonstrated; indeed, the interact were highly variable and apparently gr influenced by the conditions of transport a the Isthmus (approximate time of trip 1½ ho

Heterospecific pairs (involving both combinations) were also observed and found to undergo coupling rather commonly. Females of *A. brasiliensis* were always matched with larger males of *A. panamensis*. The results were variable, ranging from median coupling frequencies ($N = 10$) of 0 to 2 and 4.5/pair/hour. The short dactylus on pereopod 2 in males of *A. panamensis* did not appear to handicap their coupling with females of *A. brasiliensis*. However, the frequency of precopulatory encounters among heterospecifics would be expected to be less than that between conspecifics because of the specific size differences in the sexes. It was not determined whether or not copulation had taken place.

CONCLUSIONS

On the basis of morphological criteria, reinforced by differences in color polymorphism, we conclude that the tropical amphi-American members of *Ancinus* are separate species. Minor differences, believed intraspecific in kind, were found to exist between populations of *A. brasiliensis* from Brazil and those present in Panama and Costa Rica in the Caribbean. *Ancinus depressus* from the Gulf of Mexico and east coast of the United States is closely related to *A. brasiliensis*, but does demonstrate significant differences that we interpret to be specific in nature. Morphologically, the closest relative of the Atlantic species group is the problematical species *A. seticomvus*. The latter species overlaps in distribution with *A. granulatus* in southern California and the Gulf of California, but continues at least as far south as Mazatlán, Mexico.

With the scant information at hand it is not possible at present to establish any coherent zoogeographic relationships within the genus. Considering the geographic proximity of the new Panamic species to *A. brasiliensis* and the former continuity of this region in Pliocene time (Whitmore and Stewart 1965), it is interesting that the transisthmian species appear to be less closely allied than the more distantly disjunct pair *A. seticomvus–A. brasiliensis*. One of several possible factors that may have a bearing on this is the great contrast in the marine environments of the eastern Pacific and Caribbean (Rubinoff 1968, Glynn 1972) and the extent that this has affected the evolution of the littoral ancinids.

LITERATURE CITED

CASTRO, A. L. 1959. Descrição de uma nova espécie do gênero "Ancinus" Milne Edwards (Isopoda, Sphaeromidae). Revta. bras. Biol. 19(2): 215–218, 8 figs.

DEXTER, D. M. 1972. Comparison of the community structures in a Pacific and an Atlantic Panamanian sandy beach. Bull. Mar. Sci. 22(2): 449–462, 4 figs., 2 tables.

GLYNN, P. W. 1972. Observations on the ecology of the Caribbean and Pacific coasts of Panamá. Bull. biol. Soc. Wash. (2): 13–30, 3 figs.

HANSEN, H. J. 1905. On the propagation, structure, and classification of the family Sphaeromidae. Quart. J. micr. Sci., new ser., 49(1): 69–135, 1 pl.

HOLMES, S. J., and M. E. GAY. 1909. Four new species of isopods from the coast of California. Proc. U.S. nat. Mus. 36(1670): 375–379, 6 figs.

KORNERUP, A., and J. H. WANSCHER. 1967. Methuen handbook of colour. 2nd ed. rev. Methuen & Co., London. 243 pp.

LOYOLA E SILVA, J. 1963. Redescrição de *Ancinus brasiliensis* Castro, 1959 (Isopoda-Crustacea). Bol. Univ. Paraná, Zool. 2(1): 1–19, 5 figs.

———. 1971. Sôbre os gêneros *Ancinus* Milne Edwards, 1840 e *Bathycopea* Tattersall, 1909, da coleção U.S. Nat. Mus. (Isopoda-Crustacea). Archos. Mus. nac., Rio de J. 54: 209–223, 7 figs.

MENZIES, R. J., and J. L. BARNARD. 1959. Marine Isopoda on coastal shelf bottoms of southern California: systematics and ecology. Pacif. Nat. 1(11): 1–35, 28 figs., 2 tables.

MENZIES, R. J., and D. FRANKENBERG. 1966. Handbook on the common marine isopod Crustacea of Georgia. University of Georgia Press, Athens. viii + 93 pp.

MILNE EDWARDS, H. 1840. Pages 115–284 *in* Histoire naturelle des Crustacés comprenant l'anatomie, la physiologie et la classification de ces animaux. Vol. 3, pp. 115–284, 3 pls. Roret, Paris.

RICHARDSON, H. 1905. A monograph on the isopods of North America. Bull. U.S. nat. Mus. 54. liv+727 pp., 740 figs.

———. 1909. The isopod crustacean, *Ancinus depressus* (Say). Proc. U.S. nat. Mus. 36(1663): 173–177, 9 figs.

RUBINOFF, I. 1968. Central American sea-level canal: possible biological effects. Science 161: 857–861, 3 figs.

SAY, T. 1818. Description of three new species of the genus *Naesa*. (An account of the Crustacea of the United States.) J. Acad. nat. Sci. Philad. 1(2): 482–485.

SCHULTZ, G. A. 1973. *Ancinus* H. Milne Edwards in the New World (Isopoda, Flabellifera). Crustaceana 25(3): 267–275, 1 fig., 2 tables.

SIEGEL, S. 1956. Nonparametric statistics for the behavioral sciences. McGraw-Hill Book Co., New York. xviii+312 pp.

TATTERSALL, W. M. 1905. The marine fauna of the coast of Ireland. Part V, Isopoda. Scientific Investigations, 1904, no. 2, pp. 53–[illegible], 11 plates. Department of Agriculture and Technical Instruction for Ireland, Fisheries Branch, Dublin.

TRASK, T. 1970. *Ancinus seticornus*, n. sp. (Isopoda), from Santa Barbara, California. Bull. S. Calif. Acad. Sci. 69(3–4): 145–149, 2 figs.

WHITMORE, F. C., JR., and R. H. STEWART. 19[illegible] Miocene mammals and Central American seaways. Science 148: 180–185, 2 figs.