

THE REDISCOVERY OF *CERATOPAGURUS* YOKOYA
AND A NEW GENUS FOR *PAGURUS PIERCEI* WASS
(DECAPODA, PAGUROIDEA, PAGURIDAE)

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RÉSUMÉ

Le genre monotypique *Ceratopagurus* Yokoya, 1933 a été décrit d'après six spécimens de *C. pilosimanus* Yokoya, qui ne semblent plus exister. Un spécimen de cette espèce a été récemment découvert parmi les collections de la mer de Chine méridionale conservées à l'Académie des Sciences de Californie. *Pagurus piercei* Wass, 1963, a été décrit d'après un unique spécimen mâle et n'avait pas été signalé depuis lors. Cette espèce a été retrouvée en abondance au large des côtes sud-est de Floride et un examen détaillé des deux sexes a révélé qu'elle appartenait à un genre non décrit. Des diagnoses de *Ceratopagurus* et de *Goreopagurus* n. gen. sont donnés ici, en même temps qu'une redescription de leurs espèces respectives.

REDISCOVERY OF *CERATOPAGURUS*

In a report of the biological survey of the continental shelf of Japan surrounding the islands of Honshu, Shikoku and Kyushu, Yokoya (1933) described several new hermit crab taxa, most of which are still recognized in current Japanese carcinological literature (e.g., Miyake, 1978, 1982). However, with the exception of the listing by Gordan (1956), one genus, *Ceratopagurus*, has not been recorded since its initial description.

In my revision of pagurid genera characterized by 11 pairs of gills, paired first pleopods (gonopods) in females and no sexual modifications in males (McLaughlin, 1981), I noted that *Ceratopagurus* Yokoya was monotypic and that the generic and specific descriptions based on only six, apparently no longer extant, specimens were too brief to permit evaluation. Yokoya's (1933) generic description consisted of three statements: "Near *Nematopagurus*. A paired appendage on female only. Vas deference [sic] not produced in male." His specific description of *C. pilosimanus*, although not as cryptic, was brief and inadequate by present standards. Recently, a female specimen clearly agreeing in most respects with this description and illustration was found among the extensive decapod collections donated to the California Academy of Sciences (CAS) by the late F. B. Steiner. From this specimen, and Yokoya's generalized description, it is now possible to present more detailed diagnoses of both the genus and the species.

Ceratopagurus Yokoya

Ceratopagurus Yokoya, 1933: 93. — Gordan, 1956: 307. — McLaughlin, 1981: 1. Type species, by monotypy: *Ceratopagurus pilosimanus* Yokoya, 1933. Gender masculine.

Diagnosis. — Eleven pairs of phyllobranch gills. Ocular acicles narrowly triangular, with strong submarginal spine; separated basally by slightly more than basal width of 1 acicle. Antennal peduncle with supernumerary segmentation. Crista dentata well developed, accessory tooth present. Sternite of 3rd maxillipeds unarmed.

Chelipeds subequal; right chela moderately long and slender; articulation of chela and carpus perpendicular. Left cheliped with dorsal surface of chela slightly rounded; articulation of chela and carpus perpendicular. Sternite of 3rd pereopods with anterior lobe subquadrate. Fourth pereopods with propodal rasp consisting of single row of corneous scales; dactyl short; preungual process small. Sternite of 5th pereopods forming 2 distinct lobes, each with tufts of long stiff setae.

Abdomen flexed. Uropods asymmetrical. Telson with transverse suture; posterior lobes subtriangular; terminal margins oblique, each with few large calcareous spines interspersed with smaller spines and secondary row of small spines better developed on left; lateral margins each with numerous small calcareous spines and larger spines terminally. Males without sexual modifications, unpaired pleopod number unknown. Females with paired 1st pleopods modified as gonopods, with 4 unpaired, biramous pleopods, 2nd to 4th with both rami very well developed, 5th with endopod reduced.

Remarks. — It is quite understandable that Yokoya related *Ceratopagurus* to *Nematopagurus* as the two genera have many morphological characters in common, e.g., subequal and generally flattened chelipeds, the fingers of which open in a horizontal plane; paired first female pleopods modified as gonopods; the generally similar shapes and armature of the telsons and shapes of the sternites of the 5th pereopods and anterior lobes of the sternites of the 3rd (cf. McLaughlin & Brock, 1974); and elongate ambulatory legs (cf. Alcock, 1905; Lewinsohn, 1969). However, the well developed, very long right and short left sexual tubes of males of species of *Nematopagurus* immediately distinguish this genus from *Ceratopagurus*.

***Ceratopagurus pilosimanus* Yokoya, 1933 (fig. 1)**

Ceratopagurus pilosimanus Yokoya, 1933: 93, text-fig. 36; type localities: Kii Channel and east and west of Tanegasima Island, Japan. — Gordan, 1956: 307. — McLaughlin, 1981: 1.

Syntypes. — Apparently no longer extant (T. Sakai, personal communication).

Material examined: 1 non-ovigerous ♀ [shield length (SL) = 7.3 mm]; East China Sea, southeast of Cheju-do, Korea and west of Kyushu, Japan; 80 m; December 1971; coll. F. B. Steiner; CSA 046939.

Diagnosis. — Shield longer than broad. Rostrum rounded, unarmed; lateral projections produced, truncate, each with laterodistal acute spine. Ocular peduncles moderately short or short, stout, cornea dilated and with tuft of setae at basal margin dorsally. Ocular acicles long, slender, dorsal surface deeply concave, with strong submarginal spine.

Right cheliped with ventromesial and ventrolateral margins of merus each with 2 or 3 tuberculate spines; all surfaces with transverse ridges and long, stiff setae. Carpus with dorsomesial marginal row of spines, dorsolateral margin not delimited, dorsodistal margin with small spine, surface generally flattened; all surfaces with squamiform ridges and rows of long, stiff setae. Chela with dorsal surface of palm and fixed finger with moderately closely-spaced, short, squamiform ridges, each with several stiff setae; dorsomesial margin of palm with row of moderately strong spines, dorsolateral margin with row of tuberculate spines decreasing in size on fixed finger; dactyl with tufts of long setae. Left cheliped with ventrolateral and ventromesial margins of merus each with small to moderately strong spines; all surface with transverse ridges and rows of long setae. Carpus with few acute spines and spinulose, squamiform ridges with long stiff setae on dorsomesial margin; dorsal surface with moderately closely-spaced, squamiform ridges and long, stiff setae, distal margin with 1 spine; lateral surface with transverse ridges and stiff setae, distal margin with few spinules. Palm with dorsomesial and dorsolateral marginal rows of moderately strong spines, dorsal surface slightly elevated in midline and armed with short, longitudinal row of small spines, not extending onto fixed finger; dorsal, lateral and mesial surfaces with moderately closely-spaced, short, squamiform ridges, each with row of short to long, stiff setae.

Second and 3rd pereopods elongate, overreaching right cheliped by two-thirds length of dactyl, similar from left to right. Dactyls long, approximately one and one-half times length of propodi (shorter on right 3rd); in lateral view curved ventrally, in dorsal view twisted; dorsal margins each with row of long, stiff setae; mesial faces each with row of corneous spines dorsally and few corneous spines ventrally; ventral margins each with row of strong, corneous spines; terminating in moderately small, corneous claws. Propodi with transverse rows of long, stiff setae on dorsal surfaces, scattered setae on mesial, lateral and ventral surfaces. Carpi of 2nd each with 1 spine at dorsodistal margin and 2 or 3 spines proximally, carpi of 3rd with dorsodistal spine only; dorsal and lateral surfaces also with transverse rows of long, stiff setae, mesial and ventral surfaces with scattered tufts of setae. Meri with transverse rows of long setae.

Distribution. — Southern Japanese Islands and East China Sea; 80 to 219 meters.

Remarks. — The present specimen differs most noticeably from the figure given by Yokoya (1933) in the propodal rasp of the 4th pereopod. Yokoya's figure shows the rasp as consisting of several rows of scales; whereas, only a

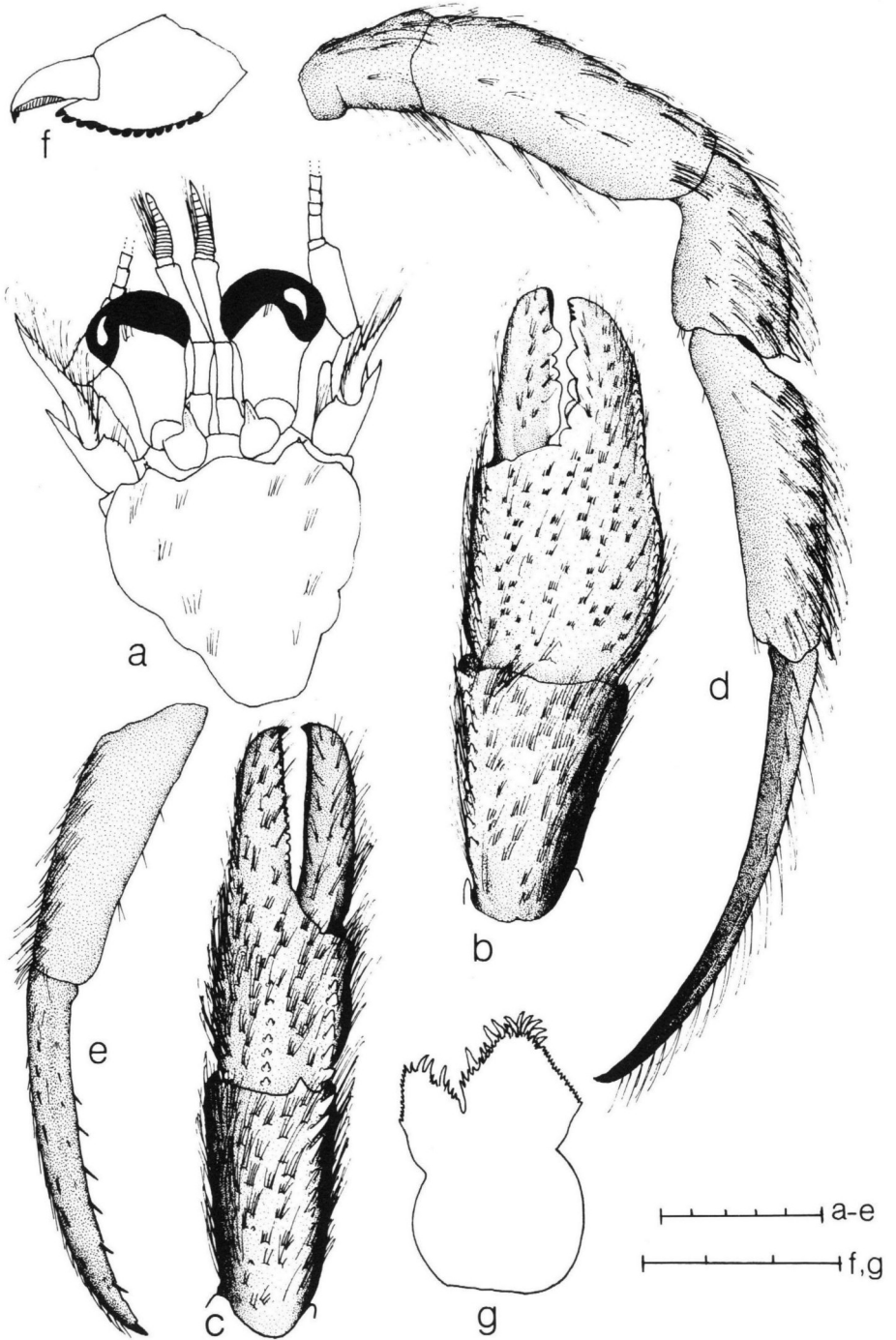


Fig. 1. *Ceratopagurus pilosimanus* Yokoya. a, shield and cephalic appendages; b, right chela and carpus; c, left chela and carpus; d, right P₂ (lateral view); e, right P₃ dactyl and propodus (mesial view); f, left P₄ dactyl and propodus (lateral view); g, telson. Scales equal 5 mm (a-c) and 3 mm (f, g).

single row is present on the East China Sea specimen. Although this difference is significant, the figured rasp is atypical of pagurid rasps in general. Thus I assume that the difference is the result of artistic error, as other aspects of the illustration, such as the shape of the ocular acicles and the setation, do not agree well with Yokoya's description.

A NEW GENUS FOR "*PAGURUS PIERCEI*"

More than two decades ago, Wass (1963) described a number of new hermit crab taxa from the western Atlantic, among them *Pagurus piercei* Wass, known from a single male specimen collected off Port Aransas, Texas. In distributional studies of decapod crustaceans from the continental shelf and slope in the Middle Atlantic Bight a large number of specimens of *P. piercei* were collected but simply identified and counted (Wenner & Boesch, 1979). More recently a second large sample of this species was collected from the *Oculina varicosa* Lesueur coral reefs off the east Florida continental shelf (Reed et al., 1982). Examination of this latter sample of *P. piercei* has shown that adult females are provided with paired first pleopods modified as gonopods and mature males carry a short sexual tube on the coxa of the right 5th pereopod. Occasionally the vas deferens of the left is slightly protruded to form a small papilla or very short sexual tube. These characters exclude this species from the genus *Pagurus*.

Among pagurid genera with 11 pairs of branchia, the only ones having sexual specializations in both sexes are *Nematopagurus* A. Milne Edwards & Bouvier, 1892, and *Pagurodes* sensu Bouvier (1922). *Pagurodes* was first described by Henderson (1888) for three Indo-Pacific species from abyssal depths. Henderson's generic diagnosis included characters such as trichobranchiate gill structure, moderately well developed rostrum, males with a short, curved sexual tube (formed by the protruded vas deferens) on the coxa of the 5th right pereopod, linear abdominal terga, 3 unpaired uniramous pleopods in the male and 4 unpaired, biramous (pl₂-pl₃) pleopods in the female. No mention was made of paired 1st pleopods in the female; however one of the species, *Pagurodes limatulus* Henderson, was described from a single male. Subsequently, Alcock (1905) redescribed *P. limatulus* and reported that the female possessed a pair of "curved, rod-like appendages on the first abdominal segment". Bouvier (1922) described two new Atlantic abyssal species and assigned them to *Pagurodes*. Bouvier reported the gill structure for the genus as narrow and leaf-like or trichobranchiate, the females ordinarily with paired first abdominal appendages, and the males with a short sexual tube on the right and sometimes also on the left. When De Saint Laurent (1969), established the genus *Acanthopagurus* for species with phyllobranch gills, the males of which were provided with asymmetrical coxae of the 5th pereopods and a short, but massive, right sexual tube, and females that lacked sexually

modified appendages, she discussed the affinities of *Acanthopagurus*, with other genera characterized by male sexual tubes. In this discussion, De Saint Laurent commented that all three of Henderson's (1888) species of *Pagurodes* represented distinct genera. As *Pagurodes inarmatus* Henderson was the first described, and generally best fit Henderson's generic diagnosis, she designated this species as the type of the genus. She did not, at that time, reassign *P. piliferus* Henderson or *P. limatulus* to other genera. Although she noted certain similarities by which *P. limatulus*, Bouvier's (1922) *Pagurodes atlanticus* and *P. richardi*, and *Acanthopagurus dubius* (A. Milne Edwards & Bouvier) might be related, she separated *P. limatulus* from these other, presumably closely related, taxa on several important characters, i.e., symmetrical coxae of the male 5th pereopods, two unequal sexual tubes, paired first pleopods in the female and trichobranchiate gills. Ingle (1985), taking De Saint Laurent's (1969: 740) remarks "... nous envisageons leur inclusion dans le même genre..." literally, provisionally placed both of Bouvier's (1922) species in *Acanthopagurus*. However, as Bouvier described the female of *P. richardi* with paired 1st pleopods, and *P. atlanticus* with trichobranchiate gills, neither species agrees with the definition of *Acanthopagurus*.

Pagurodes Henderson, as restricted by type-species designation, is not available for species in which the females possess paired first pleopods modified as gonopods. Thus, *Nematopagurus* is the only genus characterized by males with a right sexual tube and females with a pair of gonopods. Species of *Nematopagurus* differ significantly from both "*Pagurodes*" *limatulus* and "*Pagurus*" *piercei* in the development of the male sexual tube. In *Nematopagurus* species the sexual tube is elongate and filiform, where as in the latter two species it is short and stubby.

"*Pagurus*" *piercei* agrees with *Pagurodes limulatus* in having generally symmetrical coxa, short and unequal sexual tubes and paired female first pleopods; however, Wass' (1963) species has phyllobranchiate rather than trichobranchiate gills, grossly unequal chelipeds and relatively short ambulatory dactyls. Thus it is unlikely that the two species are congeneric. De Saint Laurent (1969) indicated that generic placement of Henderson's (1888) species would be included in subsequent revisionary work. As "*Pagurus*" *piercei* was not considered in such anticipated work, a new genus is herein established for this taxon.

Goreopagurus new genus

Type species. — *Pagurus piercei* Wass, 1963.

Diagnosis. — Eleven pairs of phyllobranch gills. Ocular acicles triangular with strong submarginal spine; separated basally by basal width or more than basal width of 1 acicle. Antennal peduncle with supernumerary segmentation. Maxillule with internal lobe moderately well developed, with 1 stiff bristle;

external lobe somewhat produced, not recurved. Third maxilliped with well developed crista dentata and prominent accessory tooth; merus and carpus unarmed. Sternite of 3rd maxillipeds unarmed.

Right cheliped with chela very elongate, narrow; articulation with carpus generally perpendicular; carpus exhibiting marked sexual dimorphism. Left cheliped moderately short; chela narrow, weakly triangular in cross-section, articulation with carpus perpendicular. Ambulatory legs with dactyls and propodi subequal in length. Sternite of 3rd pereopods with anterior lobe subquadrate to subrectangular. Sternite of 5th pereopods with two narrowly separated ovate lobes. Fourth pereopods with propodal rasp consisting of 1 row of corneous scales; dactyl moderately long; preungual process present.

Mature males with coxae of 5th pereopods generally symmetrical; vas deferens of right produced as short sexual tube, not appreciably swollen basally, often directed laterally or anteriorly and sometimes partially obscured by posterior tuft of setae; coxa of left often with vas deferens slightly produced; with 3 unpaired uniramous or weakly biramous pleopods. Females with paired gonopores; well developed, paired 1st pleopods modified as gonopods; 4 unpaired pleopods, pl₂-pl₄ with both rami well developed, pl₅ uniramous.

Abdomen flexed. Uropods asymmetrical. Telson with transverse suture; posterior lobes somewhat asymmetrical, separated by moderately narrow median cleft; terminal margins straight or oblique, each armed with several small spines.

Distribution. — Northern Gulf of Mexico; eastern U.S. from Mid Atlantic Bight to southeastern Florida; 41-260 meters.

Etymology. — This genus is named for Dr. Robert H. Gore, a major contributor to our knowledge of decapod crustaceans in general and those of southeastern Florida in particular, and who, as curator of the Indian River Coastal Zone Reference Museum (IRCZM), made these specimens available. Gender masculine.

Goreopagurus piercei (Wass)

Pagurus piercei Wass, 1963: 147, fig. 7 (type locality: 37 miles southeast of Port Aransas, Texas). — Wenner & Boesch, 1979: 110 (list). — Reed et al., 1982: 768 (list). — Williams, 1984: 218, fig. 155.

Holotype. — USNM 106599.

Material examined. — 1 ♂ (SL = 1.3 mm), 37 mi. SE Port Aransas, Texas, July 8, 1960, 120 m, coll. J. Stonklin, USNM 106599. Johnson SeaLink II *Oculina* study: 1 ♂ (SL = 1.1 mm), 2 non-ovigerous ♀ (SL = 0.9, 1.0 mm), 1 ovigerous ♀ (SL 1.0 mm), 27°10.7'N 80°01.0'W, October 27, 1976, 43.4 m, coll. F. Stanton, IRCZM. 7 ♂ (SL = 0.6-1.8 mm), 11 ovigerous ♀ (SL = 1.1-1.8 mm), 27°10.8'N 80°00.8'W, April-August, 1977 43.4-43.6 m, coll. L. Edmiston and J. Reed, IRCZM, USNM 229715, 3 ♂ (SL = 0.7-1.8 mm), 2 non-ovigerous ♀ (0.8 mm), 2 ovigerous ♀ (SL = 1.1, 1.2 mm), 27°11.2'N 80°01.0'W, 41.8 mm, October 26, 1976, coll. F. Stanton, IRCZM. 6 juveniles (0.3-0.5 mm), 58 ♂ (SL = 0.5-1.6 mm), 16 non-ovigerous ♀ (SL = 0.7-1.5 mm), 61 ovigerous ♀ (SL = 0.8-1.6 mm), 27°32.8'N 79°58.8'W, September 1976-August 1977, 77.7-81.4 m, coll. L. Edmiston, J. Reed and F. Stanton, IRCZM.

Diagnosis. — Shield varying from slightly longer than broad (small individuals) to broader than long. Rostrum acutely or bluntly triangular. Ocular peduncles inflated basally, with corneae slightly dilated; ocular acicles narrowly triangular, with strong submarginal spine; separated basally by usually more than basal width of 1 acicle.

Right cheliped with ventrolateral margin of merus armed with row of acute spines, dorsodistal margin with 1-3 small spines. Carpus only slightly broader than palm (females and small males) or, because of marked lateral slope, appearing to be two to three times broader (large males); ventral surface distinctly concave, ventrolateral margin with row of strong, acute spines, ventromesial margin with row of smaller, acute or blunt spines; dorsomesial margin with row of strong, acute spines, dorsolateral margin not delimited; dorsal surface (in females and small males) with row of widely-spaced spines in midline and second row of moderately strong spines laterally, lateral face with row of acute spines dorsally and scattered smaller spines ventrally; large males with dorsomesial margin prominently flared, dorsal surface strongly sloping laterally and with armature becoming increasingly obsolete with increased size, lateral surface markedly produced ventrally. Chela elongate, dorsoventrally compressed; dorsal surface slightly convex, with 2 or 3 irregular rows of small spinules and few scattered spines or tubercles (females and small males) or unarmed (large males), and with scattered low ridges and tufts of short setae, dorsomesial and dorsolateral margins each with row of closely-spaced, small spines; dactyl with row of small spines on dorsomesial margin, dorsal midline with row of small spinules. Left cheliped with row of strong spines on ventrolateral margin of merus, ventromesial margin scalloped or with few blunt, sometimes multidenticulate, spinules. Carpus with row of strong, acute spines on dorsolateral margin, row of much smaller spines on dorsomesial margin; ventrolateral margin with row of acute spines, ventromesial margin spinulose. Chela with dactyl and fixed finger spoon-shaped, dactyl very elongate, unarmed; palm slightly elevated in midline and armed with row of small spinules or tubercles extending onto fixed finger proximally; dorsolateral margin with distinct ridge, often armed with row of small spinules or tubercles.

Second and 3rd pereopods similar from right to left. Dactyls moderately short to moderately long, not curved or twisted; ventral margins each with row of numerous, strong corneous spines. Propodi each with row of corneous spines on ventral surface, often with low protuberances on dorsal surface. Carpi each with distal spine and dorsal row of tufts of setae. Meri often with acute spine at ventrolateral distal angle (P_2) or unarmed (P_3).

Remarks. — *Goreopagurus pierci* is a quite small species, in which the length of the right cheliped frequently exceeds the total body length of the animal. However, shield length, the standard indicator of size given for hermit crabs, is somewhat misleading in this species because the shield becomes noticeably

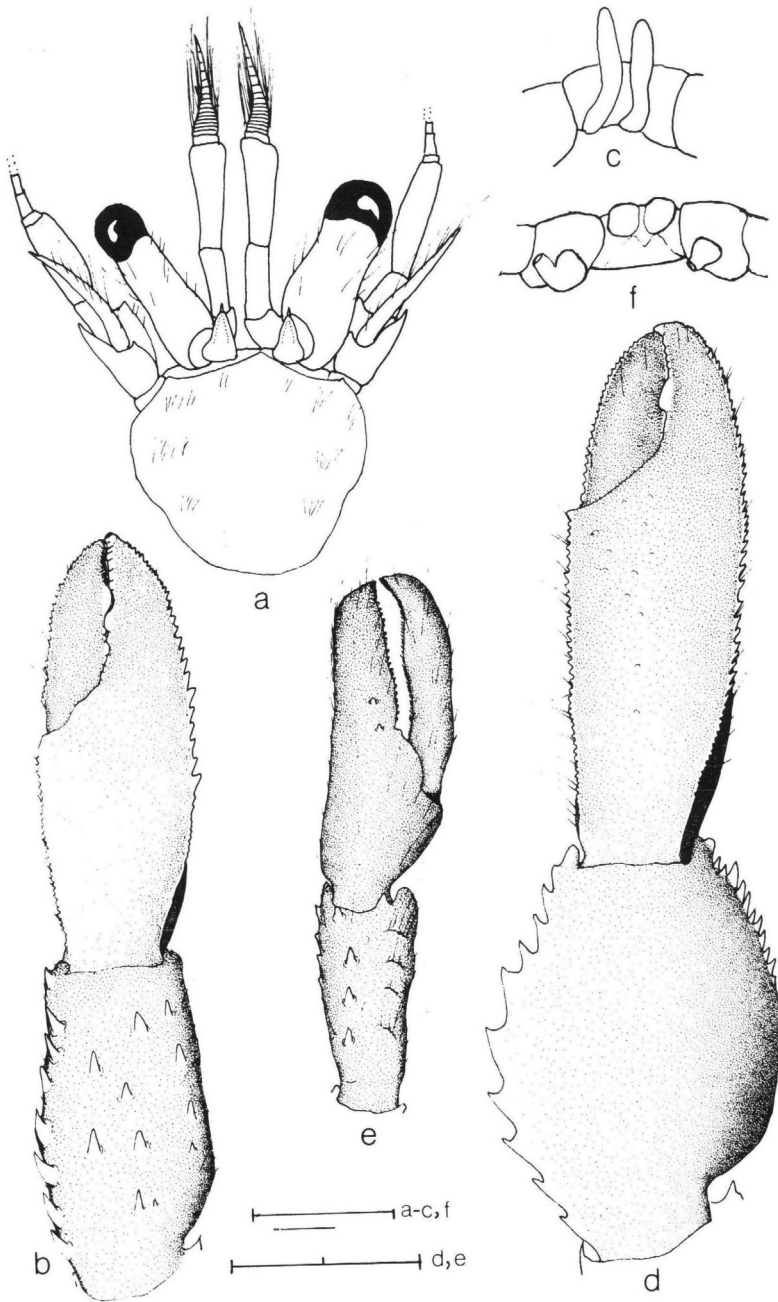


Fig. 2. *Goreopagurus piercei* (Wass). a-c, mature female: a, shield and cephalic appendages; b, right chela and carpus; c, sternite of 5th pereopods and paired gonopods. e-f, mature male: d, right chela and carpus; e, left chela and carpus; f, sternite and coxae of 5th pereopods with left and right sexual tubes developed. Scales equal 2 mm (d, e), 1 mm (a, b, f) and 0.5 mm (c).

shorter and broader with increased body size. Females are mature (have well developed gonopods) and are egg-bearing at very small overall size; whereas, males of comparable body size frequently do not exhibit development of the sexual tube, thus presumably mature at an older age.

Because the holotype is a relatively small male (SL = 1.3 mm), the right sexual tube, although produced, is not as well developed as in large individuals; a very short tube is also apparent on the left coxa. Wass (1963) referred to the gonopores of this specimen as being "raised". He related this species to *Pagurus longimanus* Wass because of the general similarity of the elongate right chelipeds of the two species. At the time of their initial descriptions, both species were known only from their male holotypes. I have been able to examine both males and females of *Pagurus longimanus* from collections made by the staff of the Rosenstiel School of Marine and Atmospheric Science and have confirmed that the Wass' generic placement of *P. longimanus* was correct; neither sex has any specialized sexual modifications.

In the only other description of this species, Williams (1984) remarked that his juvenile male from Georgia did not exhibit the enlarged carpus and merus of the right cheliped seen in the holotype.

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