Walton, B.
1954

To Dr. Fenner A. Chace, with the best regards of the author.

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(PLATES 39-43)

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THE GENUS *PYLOPAGURUS* (CRUSTACEA: ANOMURA) IN THE PACIFIC WITH DESCRIPTIONS OF TWO NEW SPECIES

By
BRYCE C. WALTON[1]

Among the crustaceans popularly known as the "hermit crabs" is the small genus *Pylopagurus*. Relatively little known from the Pacific, these animals are unique in choosing as a carcinoecium or "dwelling" those structures having an aperture of circular outline and rather uniform size, such as tooth-shells (*Dentalium spp.*) or the tubes of annelids and mollusks. Adaptation to this means of protecting their soft and unarmored abdomens has been accomplished by the development of a broad, flattened, large pincer which forms a perfectly fitted trap-door, sealing off the entrance when the hermit retreats into his refuge. As a further refinement, at least two species of pylopagurids have developed a unique symbiosis with a colonial hydrocoral, which completely overgrows the gastropod shell except for the aperture, where it is neatly trimmed back by the crab's large pincer. The pylopagurid is thus provided with a "custom-made" aperture which exactly fits the chelate operculum with which it is closed.

Nine species of *Pylopagurus* have been described from Pacific waters to date. However, only a small number of specimens have been collected and references to the group have been limited to descriptions of new species and a very few records of collections made. Descriptions available at present are not satisfactory, since they were written at different times by different authors and are not parallel in the diagnostic features used. Furthermore, most of the species have not been illustrated. Consequently, identification is difficult, if not impossible, without access to type material.

The collections of the Allan Hancock Foundation at the University of Southern California include probably the greatest aggregation of Pacific forms of *Pylopagurus* available in any one place. These collections from the Eastern Pacific between Oregon and Ecuador, made in the period from 1931 to 1950, are the basis for the present study. Over 500 specimens of this genus were examined. The purpose of this paper is to report the knowledge of the geographic and bathymetric distribution of *Pylopagurus* afforded by these collections, and to facilitate the easy and accurate identification of these hermits.

[1] Captain, MSC, Army Medical Service Graduate School, Washington, D.C.

The writer did not have an opportunity to examine the types of Faxon's species, but fortunately they were well figured and specimens were available from the type locality which agreed in every particular with the original descriptions.

The writer wishes to express his appreciation to Captain Allan Hancock for the great privilege of using the collections and facilities of the Foundation; to Dr. John S. Garth for his help and guidance; and to Dr. Waldo L. Schmitt and Dr. Fenner A. Chace for their assistance and for permission to examine the type specimens in the United States National Museum.

PYLOPAGURUS Milne-Edwards & Bouvier 1893

Chelipeds dissimilar and unequal, the right much larger, highly developed as a more or less discoidal operculum. Fourth pair of thoracic legs subchelate. External maxillipeds widely separated at base, exopodite of all three pairs flagellate. Abdomen not spirally coiled, straight or merely flexed; paired abdominal appendages present on first somite of female only; vasa deferentia of male not extruded.

Genotype: Not designated. The genus was erected by Milne-Edwards and Bouvier to accommodate only forms found in the Caribbean. Since the writer has not had an opportunity to examine these genosyntypes, the designation of a genotype is not possible in this paper.

Key to the Eastern Pacific Species of *Pylopagurus*

I. Carpus of major cheliped with three or less teeth on inner margin of dorsal surface.
   - A. Telson with "V" shaped notch in terminal margin, strong curved teeth at each edge of notch; margins of opercular face of hand a low subserrate ridge.
     1. Major cheliped discoidal, widest portion at level of base of dactyl; carpus length less than twice its width . . . . . *holmesi*
     2. Major cheliped spatulate, widest at point distal to base of dactyl; carpus length more than twice its width . . . . . *longicarpus*
   - B. Telson a simple semioval plate with entire margins; margins of opercular face of large hand with distinct denticulations.

1. Carpus of major cheliped with three teeth on inner margin of dorsal surface.
   a. Outer margin of major hand a low granulate ridge . . . . . *spinicarpus*
   b. Outer margin of major hand with large evenly spaced teeth tipped with inwardly directed corneous spinules . . . . . *hancocki*
2. Carpus of major cheliped with two teeth on inner margin of dorsal surface.
   a. Lateral points of front rounded, inner margin of minor hand unarmed . . . . *guatemoci*
   b. Lateral points of front acute, inner margin of minor hand with row of sharp spines . . . . . *coronatus*

II. Carpus of major cheliped with more than three teeth on inner margin of dorsal surface.
   A. Telson grossly asymmetrical, palm of hands ornamented with large conical tubercles with radiating peripheral processes . . . . . *hirtimanus*
   B. Telson essentially symmetrical, palm set with microscopic granules.
      1. Denticulations on terminal margin of telson restricted to sides of notch . . . . . *cervicornis*
      2. Denticulations of telson not restricted to notch, but extending across terminal margin of entire telson.
         a. Major cheliped longer than rest of body, granules of palm tipped with vertical corneous spinules . . . . . *longimanus*
         b. Major cheliped shorter than rest of body, granules of palm tipped by anteriorly directed corneous spinules . . . . . *varians*

Pylopagurus holmesi Schmitt

1921 *Pylopagurus holmesi* Schmitt. U. Cal. Publ. Zool. 23, pp. 144-145, figs. 94 a, b.

Type: Male holotype, U. S. N. M. catalogue number 53330, from Santa Catalina Island, California.

Description: Chelipeds dissimilar and unequal, the right much larger; discoidal upper surface of manus completely margined by finely incised denticulate ridge, separating discoidal surface posteriorly from

short, transversely and longitudinally convex proximal portion; widest portion at base of broad, flattened fingers; carpus trigonal with stout acute spine at anteromedial corner, surface covered with distinct, pointed, forward curved granules; merus trigonal, only slightly overreaching eyes, lower anterolateral corner with stout spine.

Minor cheliped very small, less than one-half width of right; lateral margin of palm a slight, finely denticulate ridge; fingers gaping at base, with fascicles of setae on outer edges; carpus crested with many sharp spines.

Precervical portion of carapace smooth, polished, slightly longer than wide, median point narrow, acute, twice as long as width of base; lateral projections rounded, reaching only slightly beyond base of median point; postcervical portion not calcified, posterior border with slight rounded indentation.

Eyestalks short, stout, compressed; corneas dilated; eye scales triangular, longitudinally convex, apices slightly rounded, furnished with stout, acute, subterminal spines which extend beyond apices.

Antennal acicle slender, smooth-margined, acute, curving outward, slightly shorter than eyes; antennal peduncles when extended approximating length of eyes, flagella slightly setose and not overreaching major cheliped; antennular peduncles exceeding length of eyes by one half length of terminal article, ventral flagellum three fourths as long as dorsal flagellum.

Pereiopods of left side as long as right, reaching base of fingers of major hand; carpus and propodus crested with forward-hooked, pointed spines; dactyl spinulose, slightly longer than propodus, and tipped with sharp corneous claw.

Fourth pair of thoracic legs subchelate, rasp restricted to distal margin, not developed on outer face of hand; fifth pair minutely chelate, rasp developed on outer surface of propodus and fingers.

Abdomen straight, membranous, slightly longer than thorax, terga not present except in poorly calcified caudal shield.

Telson symmetrical, rather poorly calcified, smooth, outline almost a half-circle except for prominent notch in terminal margin, a strong, downward curving, flattened tooth at each end of notch, setae and smaller denticles along sides toward apex; uropodal peduncles short, heavy, anterior pair of blades over twice length of posterior pair, both sparsely setose along anterior and posterior margins.

Distribution: From Santa Catalina Island and San Pedro to San Diego, California, 10 to 30 fathoms. (Schmitt 1921).

Specimens in the Hancock collection are from San Miguel Island, Santa Cruz Island, Santa Barbara Island, Santa Catalina Island, San Clemente Island, California, and Baja California, Mexico; and from Inner Gorda Bank, Coronados Island, Natividad Island, Angeles Bay, San Pedro Nolasco Island, and Lobos Point, Gulf of California, Mexico.

This species was taken at the following Hancock stations. The number of specimens is indicated after each station number:

523-36	1	1012-39	11	1251-41	1	1341-41	1
539-36	2	1023-39	2	1253-41	1	1348-41	3
546-36	2	1024-39	1	1258-41	1	1418-41	1
725-37	2	1035-40	1	1278-41	5	1419-41	1
735-37	7	1054-40	1	1298-41	3	1422-41	36
882-38	9	1080-40	30	1330-41	1	1919-49	2
975-39	3	1084-40	6	1332-41	4	1920-49	40
979-38	3	1119-40	2	1336-41	2	1922-49	1
1009-39	2	1147-40	3	1338-41	1	1927-49	10
1010-39	17						

The San Miguel Island record at 34°05′20″ N. Latitude and 120° 20′40″ W. Longitude represents a slight northward extension of the known range of the species. The southward records to the tip of Baja California and thence northward into the Gulf of California constitute a very considerable extension of the known range and indicate a unique geographic distribution. The bathymetric range is quite wide, from one fathom to 250 fathoms.

Discussion: A considerable degree of sexual dimorphism is exhibited in this species. The females tend to be more slender and have the major hand longer in proportion to its width; this results in the opercular face of the manus approaching an ovoid rather than a discoidal outline, with the terminal end slightly flattened. The difference is further heightened in old males, apparently as a result of isogonic growth. After maximum size is attained, further laying down of calcium carbonate builds up the margins of the hand, the resultant high ridge imparting a very concave surface to the hand, although otherwise the relative proportions remain unchanged.

Remarks: The favored carcinoecium seemed to be shells of *Dentalium sp.* although some were found in a tubular bryozoan colony, *Antropora tincta* (Hastings).

Pylopagurus longicarpus n. sp.

Type: Male holotype, AHF no. 407, five male and five female paratypes, from station number 1057-40 off Puerto Refugio, Angel de la Guardia Island, Gulf of California, dredged on 29 January 1940 by the *Velero III* in 51 to 56 fathoms.

Diagnosis: Major part of upper surface of large hand spatulate, over twice as long as wide, widest portion distal to base of fingers; carpus greatly elongate, over twice as long as wide.

Description: Chelipeds dissimilar, unequal, the right much larger; spatulate upper surface of manus margined by ridge of minute pointed granules, widest portion distal to base of fingers, anterior one-third so strongly longitudinally convex that it appears to be bent downward when viewed from lateral aspect, proximal portion longitudinally and transversely convex, covered with minute pointed granules; carpus elongate, over twice as long as wide, surface covered with pointed, forward-curved granules, broad-based acute spine on anteromedial corner; merus also elongate, extending beyond tips of eyes for over two thirds of its length, lower anterolateral corner with acute spine.

Minor cheliped quite small, manus approximately one half the greatest width of the major; carpus crested with sharp forward curved spines, several forward directed spines on dorsal surface of anterior margin.

Percervical portion of carapace smooth, longer than wide, median point narrow, extremely acute, over twice as long as width of base; lateral projections rounded, barely reaching beyond base of median point; postcervical portion not calcified, glabrous, posterior border with slight rounded indentation.

Eyestalks short, stout, somewhat dorso-ventrally compressed; corneas dilated; eye-scales triangular, longitudinally convex, furnished with stout acute, subterminal spines which project beyond apices.

Antennal acicle slender, smooth-margined, acute, curving outward, slightly shorter than eyes; antennal peduncles when extended approximating length of eyes, flagella slightly setose, reaching to middle of major carpus; antennular peduncles longer than eyes by one half the length of terminal article.

Pereiopods on left side as long as on right, not reaching base of fingers of major hand; carpus and propodus crested with forward curved pointed granules; dactyls spinulose, slightly longer than propodus and tipped with a corneous claw.

Fourth pair of thoracic legs subchelate, rasp restricted to distal margin, not developed on outer face of hand; fifth pair minutely chelate, rasp developed on outer surface of propodus and fingers.

Abdomen straight, membranous, over twice as long as thorax, terga not present except in poorly calcified caudal chield.

Telson symmetrical, rather poorly calcified, smooth, outline almost a half-circle except for prominent notch in terminal margin, a strong, downward curving, flattened tooth at each end of notch, with setae and smaller denticles along sides toward apex; uropodal peduncles short, heavy, anterior pair of blades over twice length of posterior pair, both sparsely setose along anterior and posterior margins.

Measurements: Total length (rostral point to tip of abdomen) 33 mm; length of carapace 4.3 mm; length of precervical portion 2 mm; length of major manus 5.9 mm; width of major manus 2.3 mm; length of carpus 4.2 mm; width of carpus 1.7 mm; length of minor manus 2.4 mm; width of minor manus 1 mm; length of dactyl second thoracic leg 3.6 mm; length of propodus second thoracic leg 2.9 mm.

Distribution: Known only from the Gulf of California at Angel de la Guardia Island and Consag Rock at the following stations.

541-36	5
1057-40	66
1068-40	1

The bathymetric range was from 24 to 60 fathoms.

Discussion: This species is very closely related to *P. holmesi,* and, as in that species, there is a considerable variation in the ratio of length to width, especially of the major cheliped. The extremely long narrow form of the cheliped is typical of adult males, apparently the result of heterogonic growth. Each growth stage results in the addition of a considerable increment at the terminal margin with only a slight addition to the width. This is apparent to a lesser degree in other appendages and in the body itself. The younger forms tend toward an ovoid rather than a spatulate hand and in the females the over-all proportions and appearance are often practically identical with the females of *P. holmesi;* in fact, they are often distinguishable only with considerable difficulty.

Remarks: With the exception of a few juveniles, this species was taken only in the chitinous tubes of the polychaete *Hyalinoecia juvenalis* Moore.

Pylopagurus guatemoci Glassell

1937 *Pylopagurus guatemoci* Glassell, Zoologica 22, (3) p. 254.

Type: Male holotype, New York Zoological Society, Department of Tropical Research, catalogue number 36801, from five miles west of San Jose Point, Pacific side of Baja California, in 45 fathoms.

Description: Chelipeds dissimilar and unequal, the right much larger; merus smooth, trigonal, as deep as wide, inferomedial margin with deep narrow indentation to receive ischium; carpus greatly widened distally, superomedial border armed with two prominent, forward-curving spines, one overhanging anterior margin, the other medial; upper surface smooth, lightly setose, rounding gradually to the inferolateral margin; manus discoidal, face four-fifths as wide as long, almost completely surrounded by upturned denticulate margin, proximal margin prominent, teeth irregular in size, tipped with corneous spines, some teeth double, some turned inward; teeth on fingers a continuation of those on palm but diminishing in size, and inclined outward instead of vertical, face of hand set with microscopic low, rounded granules bearing long, slender, corneous spines.

Minor cheliped extending to base of fingers of major hand; carpus bicristate, medial row of spines smaller, hand depressed, outer margin of row of spines extending onto pollex, palm with medial row of small spines, medial margin unarmed and slightly setose.

Precervical portion of carapace as broad as long, strongly transversely convex, smooth-polished; medial projection a broad based triangle, three times as wide at base as high, tipped with minute spinule; lateral projections rounded but tipped with minute subterminal spinule; postcervical portion naked, membranous.

Eyestalks cylindrical, slightly constricted in middle, equal in length to width of front; cornea very slightly dilated; ophthalmic scales longitudinally convex, bluntly rounded with very prominent, wide based, acute, subterminal spine.

Antennal acicle slender, curving, acute, reaching just beyond corneal base, margins entire, medial margin setose; peduncle when extended exceeds eyes by one-third length of terminal article; flagellum with scattered setae.

Antennular peduncle when extended exceeds corneal base by full length of terminal article; dorsal flagellum densely setose beneath; ventral flagellum small, of five articles with single terminal seta.

Pereiopods equally developed on both sides; merus smooth, compressed, superior and inferior margins with line of tufted setae; carpus has single, small, hooked spine medially on superior surface; propodus almost one-fourth longer than dactyl; dactyl spinulose on superior and inferior margins, setose, tipped with sharp curved, horny claw.

Fourth pair of thoracic legs subchelate, rasp restricted to small area on face of propodus; fifth pair longer than fourth, rasp covering one-half of propodus and the minute dactyl and pollex.

Abdomen short, obese, terga not present except in caudal shield; anterior tergum in shield separate, larger, smooth, anterolateral corners rounded; posterior tergum with posterolateral corners produced into bluntly triangular lobes equipped with long setae.

Telson symmetrical, semioval, smooth, margins entire; uropodal blades equally developed on both sides, rasp covering narrow crescentic area on upper distal face, posterior blade reduced, barely exceeding base of anterior blade, rasp covering almost all upper surface.

Distribution: Previously known only from the type locality near San Jose Point, Baja California, in 45 fathoms (Glassell 1937).

Specimens in the Hancock collections are from Point Hueneme, Santa Cruz Island, Santa Rosa Island, Seal Beach, Santa Barbara Island, Santa Catalina Island, San Clemente Island, and San Diego, California; Cortes Bank, Guadalupe Island, and Cedros Island, Baja California, and east of Angel de la Guardia Island, Gulf of California, Mexico.

534-36	1	1240-41	1	1354-41	1	1920-49	3
984-39	1	1253-41	6	1374-41	1	1922-49	1
1012-39	5	1264-41	2	1391-41	1	1927-49	1
1018-39	2	1274-41	1	1392-41	1		
1023-39	1	1298-41	1	1418-41	3		
1158-40	3	1342-41	1	1624-48	1		

The bathymetric range was from 11 to 150 fathoms.

The Hueneme locality at 34°05′30″ N. Latitude, 119°02′40″ W. Longitude now represents the northernmost report of the occurrence of the species and the Cedros Island station at 28°05′50″ N. Latitude, 115°31′00″ W. Longitude the southernmost report. The Angel de la Guardia Island locality is the only report of the species from the Gulf of California.

Remarks: Two female specimens were without the paired abdominal appendages characteristic of the genus. Both were infected with (what the writer believes to be) rhizocephalan parasites and the lack of these appendages is therefore presumed to be the result of parasitic castration with suppression of secondary sexual characteristics.

Pylopagurus hancocki n. sp.

Type: Male holotype AHF no. 362, dredged by the *Velero III* 2 March 1936 at the station 534-36 off San Francisquito Bay, Gulf of California, in 125 fathoms.

Diagnosis: Merus of major cheliped trigonal, inner margin of carpus with three spines, two medial and one distal; opercular surface of hand entirely margined by regularly spaced, inward-curving spines with sharp corneous tips; median projection angular, apex sharply truncate, lateral points rounded, almost obsolete.

Description: Chelipeds dissimilar and unequal, the right much larger; merus trigonal, upper surface setose; carpus narrow proximally, widening evenly to manus, medial margin bearing three distinct, forward-curving spines, two medially and one distally, superior surface lightly setose; opercular surface three fifths as wide as long, widest point just distal to base of fingers, completely margined by evenly spaced spines with sharp corneous tips directed inward, separated by rounded sinuses; fingers broad, having line of tufted setae bordering cutting edges.

Minor cheliped reaching base of fingers of major hand; carpus rugose, with coarse setae, inner margin armed with two minute spines medially and large distal spine which is partially cleft, leaving two points on single base; outer margin of hand marked by row of small spines reaching to base of pollex, large spine supported by a ridge on medioproximal margin; dactyl longer than palm, setose.

Anterior portion of carapace not quite as broad as long, transversely convex, slightly rugose, and bearing a few tufts of setae, median point angular, apex sharply truncate, lateral points rounded, almost obsolete; posterior portion membranous, slightly setose on branchial regions.

Eyestalks stout, terete, constricted in middle, slightly setose on superior surface; cornea dilated; ophthalmic scales longitudinally convex, triangular, margins entire, with prominent subterminal spine.

Antennal acicle slender, outward-curving, pointed, reaching middle of cornea; peduncle when extended exceeding eyes by two thirds the length of the cylindrical terminal article; flagellum setose.

Antennular peduncle when extended exceeding length of eyes by full length of terminal articles; superior flagellum of about eighteen annulations, densely setose beneath, inferior flagellum almost equal in length to superior.

Pereiopods slightly longer on right side, slightly compressed, setose, with margins unarmed except for spinules on lower margins of dactyli; propodus equal in length to the related dactyl.

Fourth pair of thoracic legs subchelate, rasp on propodus only; fifth pair minutely chelate.

Abdomen short, membranous, terga not present except in well calcified caudal shield; anterior tergum transversely and longitudinally convex, slightly setose, rough, anterolateral corners rounded off, sulcus deep and flexible; posterior tergum smaller, with tufted setae on posterolateral corners and two tufts on terminal margin.

Telson symmetrical, simple, calcareous plate, semioval in outline with margins entire; uropods slightly larger on left side.

Measurements: Total length (rostral point to tip of abdomen) 7 mm; length of carapace 2.75 mm; length of precervical region 1.75 mm; width of precervical portion 1.50 mm; length of major manus 3 mm; width of major manus 1.75 mm; length of dactyl 1 mm; length of carpus 2 mm; length of minor manus 1.25 mm; width of minor manus 0.75 mm; length of propodus first ambulatory leg 8.5 mm; length of dactyl first ambulatory leg 8.5 mm; length of caudal shield 1 mm; width of caudal shield 0.75 mm.

Distribution: Known only from the type locality, off San Francisquito Bay, Gulf of California.

Discussion: This species is closely related to *P. guatemoci,* but may be distinguished from it by the three large spines on the superior surface of the major carpus (*P. guatemoci* having but two), the truncate rostral point, and the partially cleft spine on the distal end of the carpus of the minor cheliped.

Remarks: The carcinoecium was a gastropod shell completely overgrown with cheilostomatous Bryozoa.

The species is named for Captain Allan Hancock in recognition of his contributions to the zoological knowledge of the Pacific regions.

Pylopagurus coronatus (Benedict)

1892 *Eupagurus coronatus* Benedict, Proc. USNM 15 (887) p. 24.
1937 *Pylopagurus coronatus,* Glassell, Zoologica 22 (3) p. 254.

Type: Holotype, U.S.N.M. Catalogue number 16699. From *Albatross* station number 2829, off Cape San Lucas, Gulf of California, in 31 fathoms.

Description: Chelipeds dissimilar and unequal, the right much larger; merus short, compressed, with narrow longitudinal ridge on superior surface; carpus short, also crested with narrow ridge ending in sharp projection just short of distal margin, inner margin bearing forward hooked spine medially and similar larger spine at anterior end, overhanging distal margin; hand suboval, twice as long as carpus, opercular face completely bordered by sharp teeth separated by rounded sinuses and with unevenly spaced angular elevations.

Minor cheliped very small, less than one third the width of major hand; carpus with forward hooked spine medially on inner margin and two prominent spines side by side at anteromedial corner; hand with inner margin marked by minute sharp, forward inclined spines; fingers about as long as palm, setose, not gaping at base.

Precervical portion of carapace about as broad as long, rugose, slightly setose; median point triangular, acute, much in advance of very acute lateral points; postcervical portion membranous, slightly setose on cardiac and intestinal areas.

Eyestalks cylindrical, long, slender, much constricted in middle, cornea elongate, only slightly dilated; ophthalmic scales short, with rounded margins and prominent, acute, subterminal spine.

Antennal acicle slender, outward-curving, acute, falling short of corneal base; peduncle when extended slightly longer than eye; flagellum with long scattered setae.

Ambulatory legs about equally developed on both sides, superior and inferior margins hairy, unarmed except for claw-tipped dactyli which are spinulose on inferior margins.

Fourth pair of thoracic legs extremely short, subchelate, rasp restricted to terminal margin of propodus; fifth pair minutely chelate, rasp covering both fingers and laterally swollen propodus.

Abdomen longer than thorax, membranous, caudal shield well calcified; anterior tergum transversely convex, bearing tufts of setae, anterolateral corners rounded off, posterolateral corners produced slightly into small triangular points, suture deep and flexible; posterior tergum smaller, bearing tufts of long setae on posterolateral corners and two smaller tufts on terminal margin.

Telson symmetrical, a simple calcareous plate, with smoothly rounded corners and entire margins; uropods symmetrical, heavily calcified.

Distribution: Previously recorded from Cape San Lucas in the Gulf of California (Benedict), and a single specimen from Arena Bank, Gulf of California, in 50 fathoms (Glassell).

Specimens were taken by Hancock Expeditions at Isla Partida at station 559-36 and at San Francisquito Bay at station 634-36, both in the Gulf of California. The depths were 45 and 125 fathoms, respectively.

Remarks: One specimen was taken in a coiled gastropod shell.

Pylopagurus spinicarpus Glassell

1938 *Pylopagurus spinicarpus* Glassell, Allan Hancock Pac. Exped. 5 (1) p. 1.

Type: Male holotype, U.S.N.M. catalogue number 75432, and female paratype, from Puerto Refugio, Angel de la Guardia Island, Gulf of California, collected 4 March 1936 in 65 fathoms.

Description: Chelipeds dissimilar and unequal, the right much larger; merus trigonal, upper distal portion rounded, slightly setose, medial and inferior margins entire; carpus widening distally, medial margin with two forward-curving medial teeth separated from larger, distal tooth by deep rounded sinus, superior surface smooth with few large scattered setae, medial surface greatly contorted; manus longitudinally and transversely convex, medial margin of palm a serrate ridge, lateral margin a low granulate ridge; both margins continued on to fingers; fingers and palm equal in length.

Minor cheliped reaching nearly to middle of palm of major cheliped, merus compressed, smooth, lightly setose; carpus slightly shorter, widening distally with scattered coarse setae, outer margin with one medial spine, anterior margin with two spines; hand long, outer margin a low-toothed ridge, inner margin obsolete, surface smooth except for median ridge on palm extending some distance onto pollex.

Precervical portion of carapace as long as wide, transversely convex, naked, polished; median point obtuse, armed with sharp, depressed spinule, lateral points as long as median, armed with spinules; postcervical portion naked, membranous.

Eyestalks long, equal to width of carapace, cylindrical, constricted in middle, with several tufts of coarse setae on dorsal and medial surfaces, cornea dilated; ophthalmic scales bluntly pointed, margins entire with fringe of radiating setae, subterminal spines prominent and sharp.

Antennal acicle slender, outward-curving, acute, reaching base of cornea; peduncle when extended exceeds length of eyes by one third the length of cylindrical terminal article; flagellum setose.

Antennular peduncle exceeding eyes by length of terminal article; superior flagellum of about 17 annulations, densely setose beneath; inferior flagellum about one half the length of superior flagellum.

Ambulatory legs equally developed on both sides, slightly setose, upper margins unarmed, propodus with spinule on distal end of medial surface, dactyl spinulose beneath.

Fourth pair of thoracic legs subchelate, short, rasp restricted to terminal margin of propodus; fifth pair minutely chelate, rasp on both fingers and on swollen outer surface of propodus.

Abdomen slightly longer than carapace, uncoiled, membranous; no terga present except those of caudal shield, of which anterior is convex, with tufted setae, rounded anteriorly, posterior corners produced slightly, suture flexible, posterior smaller, posterior corners acute triangular lobes.

Telson a smooth, symmetrical, semioval plate with entire margins; uropodal blades larger on left side, posterior blades much reduced on both sides.

Distribution: Santa Inez Bay and Gorda Bank, Gulf of California, at depths from 40 to 80 fathoms (Glassell 1938).

Specimens in the Hancock collections are from Angel de la Guardia Island, Gulf of California, Ladrones Island, Panama, and Gorgona Island, Colombia.

The station numbers are:

541-36	2	943-39	1
546-36	1	1057-40	2
851-38	1	1058-40	1

The depth range was 10 to 70 fathoms.

Pylopagurus varians (Benedict)

1892 *Eupagurus varians* Benedict, Proc. USNM 15 (887) p. 24.
1898 *Eupagurus varians,* Bouvier, Bull. Mus. Hist. Nat. 4 (8) p. 382.
1937 *Pylopagurus varians,* Glassell, Zoologica 22 (3) p. 253.

Type: Syntypes, U.S.N.M. catalogue number 16734, from near Espiritu Santo Island, Gulf of California, in 39 fathoms.

Description: Chelipeds dissimilar and unequal, the right much larger; merus compressed, slightly crested, produced down to angle or tubercle on inferior surface; carpus long, narrow proximally, widening toward manus, sides and lower surface rounded, upper surface covered with spines; hand roughly discoidal, face covered with granules constricted at base and bearing an anteriorly directed spine.

Minor cheliped with carpus compressed, bicristate, inner row reduced, hand reaching past base of fingers of major hand, depressed, wide, covered with pointed granules, fingers longer than palm, widely gaping at base.

Precervical portion of carapace about as broad as long, transversely convex, glabrous; median projection broadly triangular, apex produced slightly into a more acute point; lateral projections of cardiac region distinctly marked off as a pentagonal plate.

Eyestalks stout, terete, constricted in middle, cornea dilated; ophthalmic scales bluntly triangular, longitudinally convex, with prominent, acute, subterminal spine.

Antennal acicle slender, outward-curving, pointed, slightly setose, and approximating length of eyes; peduncles when extended exceeding eyes by over one half length of slightly compressed terminal article; flagella slender, slightly setose.

Antennular peduncles when extended exceeding eyes by full length of long slender terminal article; inferior flagellum slender, evenly tapering, about two thirds length of superior flagellum.

Ambulatory legs wide, compressed, slightly longer on right side; merus much compressed, smooth except for slight scales and setae on superior and inferior margins; carpus rounded laterally, crested with small sharp spines; propodus of second pair sometimes similar but often with spines reduced to mere scales; dactyls spinulose, with only sparse setae.

Fourth pair of thoracic legs subchelate, minute dactyl not bearing rasp as does pollex and small distal portion of propodus; fifth pair minutely chelate, with tuft of very long setae on distal end of laterally swollen propodus.

Membranous abdomen as long as carapace, membranous terga not in contact, caudal shield calcified, suture flexible; anterior tergum transversely and longitudinally convex, smooth, posterolateral corners produced slightly; posterior tergum similar in shape, slightly smaller with few tufted setae on lateral and terminal borders.

Telson symmetrical, fringed laterally by setae, posterolateral corners with prominent, flat, downward curving tooth, entire terminal margin between teeth occupied by denticulations of varying size; uropods larger on left side, anterior blade with rasp over most of outer surface, posterior blade much reduced, completely covered by rasp on outer surface.

Distribution: Arena Bank and Santa Inez Bay in the Gulf of California (Glassell); near Espiritu Santo Island, Gulf of California (Benedict).

Specimens in the Hancock collections are from Ensenada de San Francisco, Sonora, San Pedro Nolasco Island, Tiburon Island, Isla

Partida, Angel de la Guardia Island, Angeles Bay, Los Coronados Islands, all in the Gulf of California, and from Secas Island, Panama. The complete list of station numbers is:

449-35	6	556-36	1	701-37	3	738-37	1
524-36	1	559-36	6	711-37	1	1051-40	1
538-36	2	566-36	1	712-37	3	1056-40	11
546-36	2	575-36	2	734-37	8	1725-49	2
549-36	5	699-36	1	737-37	1	1726-49	2

The bathymetric range was from 10 to 100 fathoms.

The report from Secas Island, Panama, at 7°57′35″ N. Latitude 82°01′35″ W. Longitude constitutes the first record of the species outside the Gulf of California.

Discussion: This species is very closely allied with *P. cervicornis.* Glassel (1937) stated, "These two species, *P. varians,* and *P. cervicornis,* may prove to be one and the same species, one a variety of the other, when it is possible to get a large series of adult forms from both ends of the Gulf of California together for comparison. There seems to be an intergradation which is difficult otherwise to explain."

There exists, indeed, a high degree of intergradation, largely due to the great amount of individual variation in the appropriately named *P. varians.* Of the characters used in Benedict's description (Glassell did not redescribe the species), only one, the type of granules on the major cheliped, was found to be constant for the differentiation of the two forms.

These unique granules, along with the distinctive shapes of the telson, which also proved to be unvarying, provide characters clearly indicating that these are distinct species and afford a quick method of identifying each.

Remarks: The common carcinoecium of this form is a gastropod shell completely overgrown with a hydrocoral which forms several medial and long upswept lateral spines described by Benedict as "branches not unlike the horns of a deer." This is probably the "Bryozoan"-encrusted shell mentioned by Bouvier (1898) and Glassell (1937) as the habitat of this species.

Pylopagurus cervicornis (Benedict)

1892 *Eupagurus cervicornis* Benedict, Proc. USNM 15 (887) p. 25.
1937 *Pylopagurus cervicornis,* Glassell, Zoologica 22 (3) p. 253.

Type: Syntypes, U.S.N.M. catalogue number 16700, off Cape San Lucas, Gulf of California.

Description: Chelipeds dissimilar and unequal, the right much larger; merus compressed, almost as deep as long; carpus long, widening proximally to manus, inner margin marked by row of pointed, forward-hooked spines, upper surface covered with similar smaller spines, outer margin marked by row of more closely spaced spines, granular inferior surface produced to a prominence which often, but not invariably, bears a spine surrounded by a circle of seven or eight smaller spines; hand roughly discoidal, opercular face completely margined by corneous-tipped spines, and covered by widely spaced pointed granules tipped with vertically directed slender spines.

Minor cheliped reaching beyond base of fingers of major hand, carpus bicristate, outer row of spines much the larger; palm depressed, oval, covered with sharp-pointed granules; fingers longer than palm, gaping at base.

Precervical portion of carapace as broad as long, transversely convex, glabrous; median point broadly triangular, slightly in advance of angular laterals; postcervical portion membranous, cardiac region distinctly marked off.

Eyestalks stout, terete, constricted in middle; cornea dilated; ophthalmic scales generally acutely triangular, with prominent, acute, subterminal spine.

Antennal acicle slender, outward-curving, acute, slightly setose, slightly exceeding length of eyes; peduncle when extended exceeding eyes one half length of compressed terminal article; flagellum setose.

Antennular peduncle when extended exceeding eyes by length of long terminal article; superior flagellum of about twenty annulations, setose beneath; inferior flagellum slender, evenly tapering, about two thirds as long as superior.

Ambulatory legs wide, compressed, slightly longer on right side; merus much compressed, smooth but for slight scales and setae on superior and inferior margins; carpus rounded laterally, crested with sharp spines; propodus of first pair similarly crested, second pair with spines often reduced to mere scales; dactyls spinulose with only sparse setae.

Fourth pair of thoracic appendages chelate, minute dactyl not bearing rasp as does pollex and anterior portion of propodus; fifth pair minutely chelate, with tuft of very long setae on distal end of laterally swollen propodus.

Abdomen as long as carapace, membranous, terga membranous, not in contact with one another; caudal shield calcified, suture flexible, anterior tergum longitudinally and transversely convex, smooth, polished, posterolateral corners produced slightly, posterior tergum slightly smaller.

Telson symmetrical, posterior margin with wide, shallow "V"-shaped notch, with flattened, acute, downward-curving teeth of varying size, restricted to notch area; uropods larger on left side, anterior blade with rasp over most of outer surface, posterior blade much reduced, completely covered by rasp.

Distribution: Off Cape San Lucas, Gulf of California (Benedict), Arena Bank, Gulf of California, 30 to 50 fathoms (Glassell).

Specimens in the Hancock collections are from San Pedro Nolasco Island, Angel de la Guardia Island, and San Ignacio Bay, Sinaloa, Gulf of California, Mexico. The list of stations is as follows:

544-36	4	708-37	1	1054-40	1	1084-40	1
546-36	2	735-37	1	1055-40	3	1725-49	1
549-36	1	742-37	14	1080-40	5	1726-49	16

The bathymetric range was from 30 to 110 fathoms.

Remarks: The carcinoecium is usually a gastropod shell completely overgrown with hydrocoral as in *P. varians*.

Pylopagurus longimanus Faxon

1893 *Pylopagurus longimanus* Faxon, Bull. Mus. Comp. Zool. 24 p. 168.

1895 *Pylopagurus longimanus* Faxon, Mem. Mus. Comp. Zool. 18 p. 61, Pl. 12, figs. 1-1e.

Type: Five male syntypes in the Museum of Comparative Zoology, Harvard University, from Cocos Island, Costa Rica, *Albatross* station number 3368, in 66 fathoms (Faxon 1895).

Description: Chelipeds dissimilar and unequal, the right much larger, longer than entire body in older specimens; merus compressed, lateral surface smooth, polished, lower and medial surfaces granulate, dorsal surface with slightly larger granules; carpus equaling combined length of all three preceding segments, longitudinally convex dorsal surface with pointed granules between well defined lateral margins of larger teeth; hand slightly longer than carpus, irregularly oval, small denticles along entire margin of opercular surface, posterior margin falling just short of carpus, basal angle quite small; entire surface of

hand covered quite uniformly with upright, pointed granules, those on opercular surface slightly larger; fingers elongate, crossed at tips, dactyl five eighths total length of hand, longitudinally contorted, pollex one half total length of hand, with prominent tubercle on cutting edge.

Minor cheliped much reduced, reaching to about the middle of carpus of major cheliped; merus and carpus slightly setose and hardly more expanded than corresponding articles of ambulatory legs; carpus armed on superolateral margin with row of strong forward-curving spines; propodus quite narrow, flaring abruptly to widest portion at base of fingers; dactyl almost twice the length of propodus, strongly convex in outline; both fingers armed with regular chitinous denticles on cutting edge, gaping at base, and furnished with many tufted setae on under surface.

Precervical portion of carapace broader than long, very convex, smooth, polished, median projection quite long and acute, extending beyond bases of eye scales, lateral points angular, shorter than median; postcervical portion naked, membranous.

Eyestalks short, cylindrical, constricted in middle and then widening, diameter at base of cornea greater than at basal portion, cornea large, dilated; ophthalmic scales convex, acute, with prominent, sharp, subterminal spine.

Antennal acicles slender, pointed, outward-curving, slightly setose, equaling or slightly exceeding length of eyes; peduncles when extended with proximal portion of terminal article even with base of cornea; flagellum setose.

Antennular peduncles very long, exceeding eyestalks by more than one half length of terminal segment, dorsal flagellum of about twenty-four annulations, densely setose beneath, inferior flagellum evenly tapering, about two thirds length of superior.

Ambulatory legs longer on right side, very slightly setose, merus unarmed on dorsal surface; carpus slightly shorter, with row of sharp spines on dorsal surface; propodus of first pair armed with similar spines, but propodus of second pair unarmed; dactyli of both pairs flattened, spinulose, and longer than related propodus.

Fourth pair of thoracic legs subchelate, minute dactyl not bearing rasp as does pollex and distal portion of palm; fifth pair minutely chelate, rasp covering both fingers and propodus.

Abdomen as long as carapace, membranous; terga membranous, not in contact; caudal shield calcified, suture flexible, anterior tergum smooth, posterior corners produced slightly, posterior tergum similar in shape, slightly smaller, with a few tufts of setae on lateral and terminal borders.

Telson symmetrical, incompletely divided by transverse suture, terminal margin armed with denticulations, the most lateral pair of teeth on each side largest, then two or three minute teeth, one larger, and then a series of rather uniform minute teeth in the center; uropods larger on left side, anterior blade with rasp over most of outer surface, posterior blade much reduced, completely covered by rasp on outer surface.

Distribution: Cocos Island, Costa Rica, in 66 fathoms (Faxon 1893).

Specimens in the Hancock collections are from off Nuez Island and Chatham Bay, Cocos Island. The station numbers are as follows:

772-38	1	779-38	1
773-38	1	780-38	3

The depth range was from 30 to 60 fathoms.

Pylopagurus hirtimanus Faxon

1893*Pylopagurus hirtimanus* Faxon, Bull. Mus. Comp. Zool. 24 p. 170.
1895 *Pylopagurus hirtimanus* Faxon, Mem. Mus. Comp. Zool. 18 p. 65, Pl. 13, figs. 1-1e.

Type: Syntypes, Museum of Comparative Zoology, Harvard University, from off Cocos Island, Costa Rica, dredged by the *Albatross* in 66 fathoms 28 February 1891 (Faxon 1895).

Description: Chelipeds dissimilar and unequal, the right much larger; merus short, naked, almost as deep as long, lower lateral margin with series of sharp spines; carpus with dorsal surface very hirsute and with scattered small, pointed granules, medial margin marked by row of sharp, anteriorly curved spines; hand margined by row of even, sharp teeth except for ill-defined posterior margin, proximal one third of dorsal surface setose, hairy area ending abruptly to expose low dome-shaped granules with flat, circular bases cut into radiating peripheral processes covering entire opercular surface.

Minor cheliped reaching beyond base of dactyl, over one half as wide as major hand, merus similar to that of major hand but smaller; carpus very hairy on dorsal surface, bearing median row of sharp curved spines; hand covered with tubercles similar to those of larger hand, lateral border likewise margined as the larger hand, but medial margin lacking teeth, inferior surface hairy and tuberculose.

Precervical portion of carapace wider than long, posterior border extending into rounded lobe, median projection in advance of laterals, obtuse, slightly depressed and obscured by tuft of setae near apex; lateral

points obtuse but tipped with sharp spinule; postcervical portion membranous, becoming hairy on branchial regions, cardiac region defined as a quadrangular plate.

Eyestalks terete, constricted in middle with median line of tufted setae on dorsal surface, cornea dilated; ophthalmic scales convex, pointed, margins entire with subterminal spine slightly protruding.

Antennal acicles slender, outward-curving, very hairy on medial margin, reaching corneal base; peduncles when extended slightly exceeding reach of eyes; flagellum very slender, greatly exceeding reach of major hand, with short, very fine setae.

Antennular peduncles when extended exceed eyes by one half the length of the distally flaring third article.

Ambulatory legs of equal length on both sides, only slightly compressed, very hairy on dorsal surface, unarmed but for single tooth medially placed on distal end of dorsal surface of carpus and spinules above and below on the dactyli.

Fourth pair of thoracic legs very short, subchelate, rasp restricted to terminal margins; fifth pair minutely chelate, outer surface of swollen propodus covered by rasp, lower margin with line of long, silky setae.

Abdomen obese, terga not distinct except in caudal shield; anterior tergum larger, tufted, convex, front corners rounded, posterior corners produced, suture only slightly flexible; posterior tergum with setal tufts on terminal margin.

Telson divided into two lobes, both asymmetrical, the posterior greatly so, left side much larger; posterior margin medially notched and bearing several strong, downward-curving teeth; uropods larger on left side, posterior blade much reduced on both sides.

Distribution: Off Cocos Island, Costa Rica, in 66-100 fathoms (Faxon 1895).

Specimens in the Hancock collections are from Nuez Island and Chatham Bay, Cocos Island, and north of Hood Island, Galapagos Islands. The station numbers are as follows:

773-38	2
780-38	6
814-38	2

The depths ranged from 20 to 50 fathoms.

Pylopagurus (?) affinis Faxon

1893 *Pylopagurus affinis* Faxon, Bull. Mus. Comp. Zool. 24 p. 169.
1895 *Pylopagurus affinis* Faxon, Mem. Mus. Comp. Zool. 18 p. 64, Pl. 12, figs. 2-2d.

Type: Male holotype, dredged in 85 fathoms by the *Albatross* in the Gulf of Panama, *Albatross* station number 3397, in the Museum of Comparative Zoology, Harvard University.

Description: Chelipeds dissimilar, unequal, the right much larger; upper margin of carpus armed with two or three spines, the anterior spine largest, outer face of carpus smooth except for a light tubercular ridge along the middle; external (opercular) face flat, covered with minute, spinulous granules, and surrounded by border of sharp spines, the proximal border not sharply defined by spines from basal portion; lower surface of chela smooth.

Minor cheliped very hirsute; inferior border of chela conspicuously toothed.

Ambulatory legs hairy; the vasa deferentia are extruded from the base of the fifth leg on each side, appearing as slender threads, the right much longer and twisted.

Telson symmetrical, subcircular in outline, its posterior border convex and entire.

Discussion: The preceeding description was adapted from the original description by Faxon (1895). From this, and the very clear figure (pl. XII, fig. 2 C), it is apparent that the extruded vas deferens precludes the assignment of this species to *Pylopagurus,* or indeed, to any existing genus. The formation of any opinion regarding the placement of this form is probably best reserved until more specimens are examined, since the single male obtained in 1891 is the only report of this form.

Discussion

The results of this study indicate that *Pylopagurus* is predominately a tropical form in the Eastern Pacific as it is in other waters. *P. longimanus* and *hirtimanus* are obviously Panamic species and the information now at hand clearly confirms this assignment for *varians* and *cervicornis.* It is also the writer's belief that *coronatus, spinicarpus, hancocki,* and *longicarpus* should definitely be considered as belonging to the Panamic fauna, in spite of the small number of existing records many of which

are near the northern limits of this region, since additional evidence for their southern affinities is afforded by their absence in the extensive collections to the North. It seems quite improbable that they would not have been discovered by the widespread collecting of the *Velero III* and *Velero IV* off the coast of Northern Mexico or Southern California if they did occur in the North Temperate Zone.

P. guatemoci alone appears clearly to fit the distributional pattern of the North Temperate Fauna, with no records of its occurrence south of the 28th parallel. Previously, *holmesi* was considered to be North Temperate also, but the records here given show its distribution to be something of a puzzle. The northern segment of its range corresponds rather closely to that of *guatemoci,* with a sharp break around the Punta Eugenia area. However, its occurrence in the Gulf of California, and in the presumably tropical southern portion, does not coincide with any expected pattern. Moreover, these southern records are the more anomalous in that they also represent some of the shallowest records for the species. This is the direct opposite to normal expectation, in that northern forms usually occur in progressively deeper (colder) water as they range southward. For the present, this anomaly must remain without an explanation. Possibly it may serve as a useful reminder of the need for more information and spur on the search that will bring a fuller understanding of this interesting group of crustaceans.

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EXPLANATION OF PLATES

PLATE 39

Pylopagurus holmesi Schmitt ♂

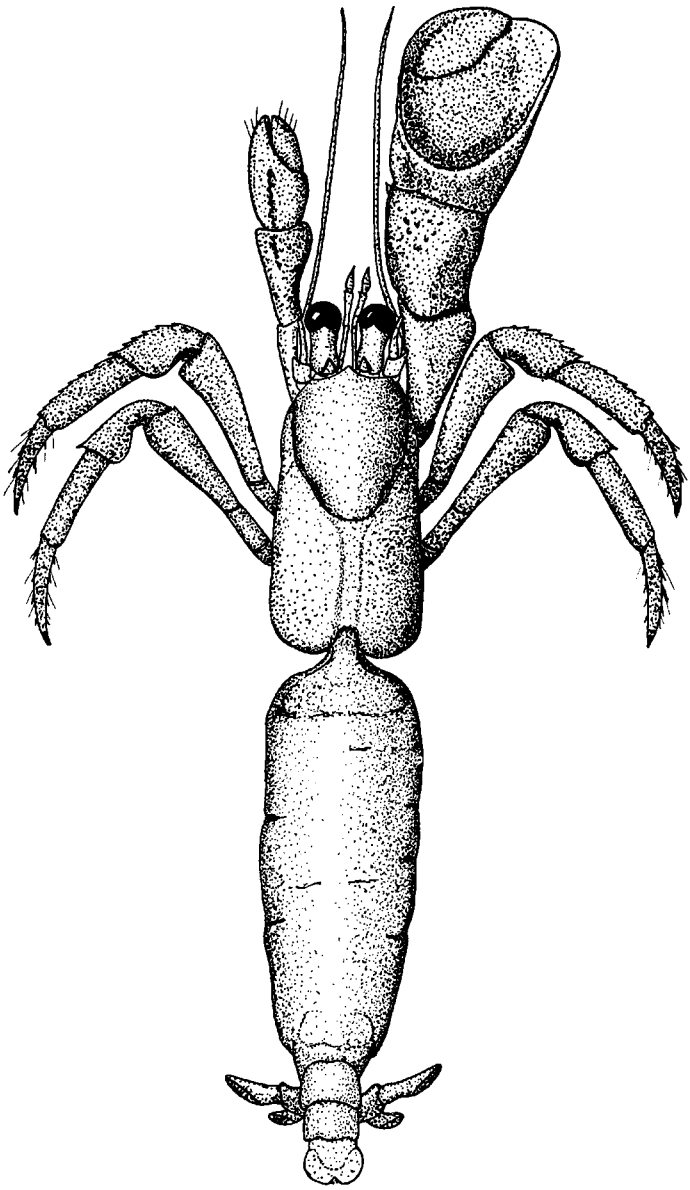


PLATE 40

Pylopagurus longicarpus n. sp.

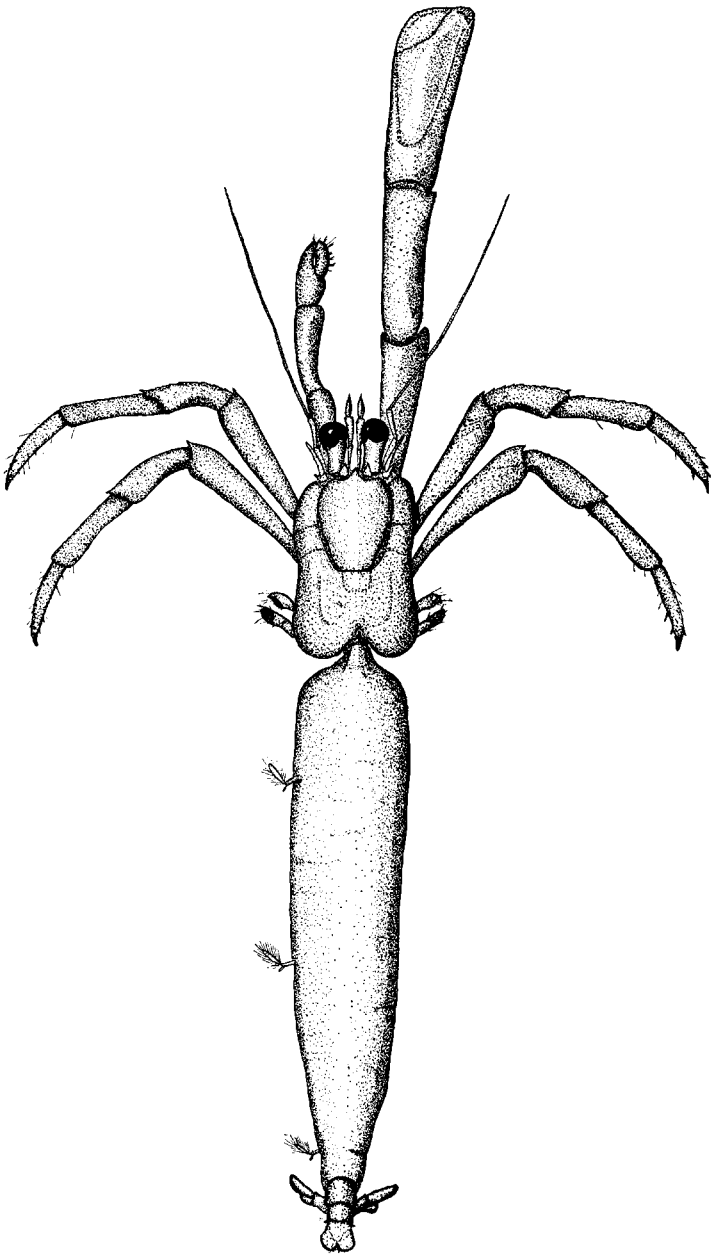


PLATE 41

Pylopagurus hancocki n. sp.

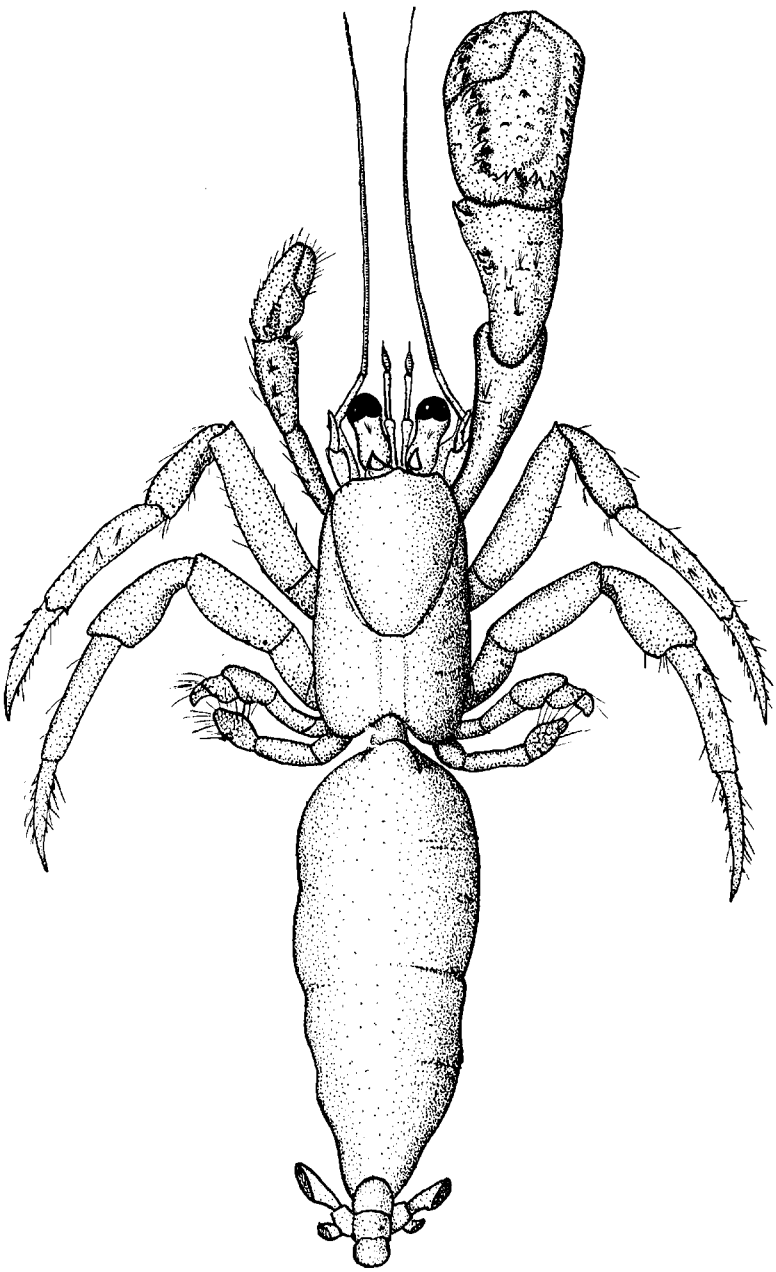


PLATE 42

A-D *Pylopagurus cervicornis*
A. Telson
B. Microscopic granules of palm
C. Major manus
D. Carapace

E-H *Pylopagurus varians*
E. Telson
F. Microscopic granules of palm
G. Major manus
H. Carapace

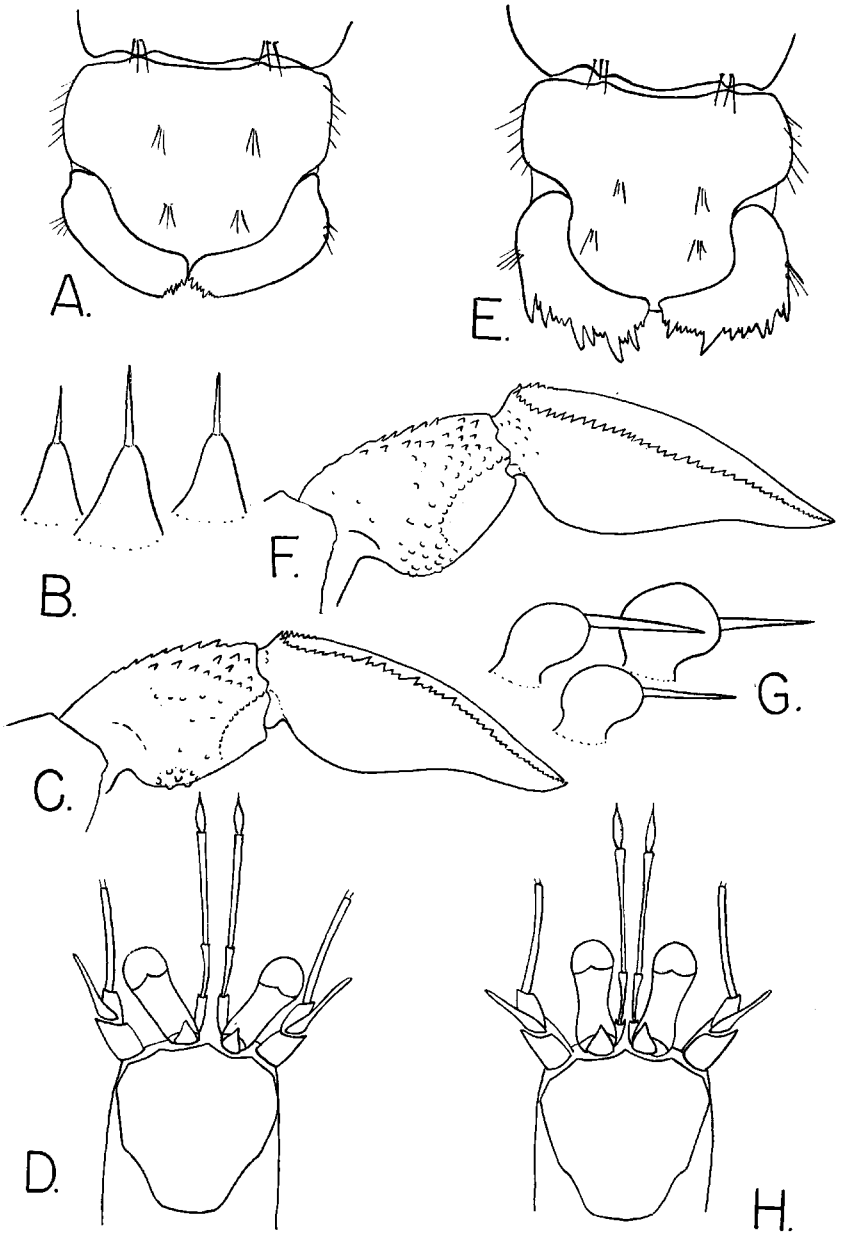
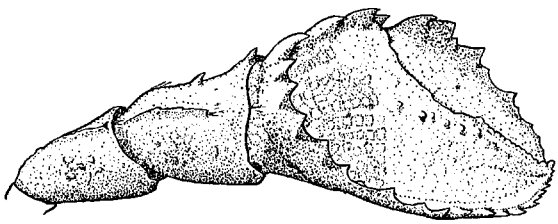

A.
E.
B.
F.
G.
C.
D.
H.

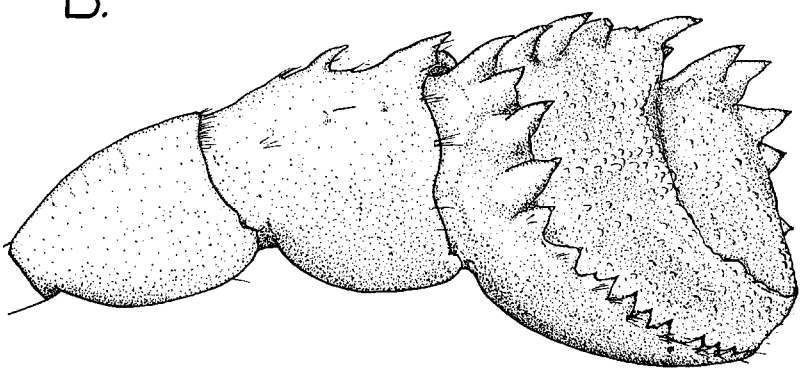
PLATE 43

A. *Pylopagurus coronatus* - Major manus
B. *Pylopagurus guatemoci* - Major manus
C. *Pylopagurus spinicarpus* - Major manus

A.



B.



C.