García-Gómez, Julio 1988

BULLETIN OF MARINE SCIENCE, 42(1): 44–64, 1988

A NEW GENUS AND THREE NEW SPECIES OF HERMIT CRABS (CRUSTACEA: DECAPODA: PAGURIDAE) FROM THE WESTERN ATLANTIC OCEAN

Julio García-Gómez

ABSTRACT

Enneobranchus, a new genus of hermit crabs of the family Paguridae, and its three new species from the western Atlantic Ocean are described and illustrated. A key to the species is presented. The nine pairs of branchiae, characteristic of *Enneobranchus* represents the minimum number of gills recorded in the superfamily Paguroidea.

Within the family Paguridae sexual modifications are most advanced in those genera characterized by the development of male sexual tubes (extruded vas deferens). Among the genera with well developed left sexual tubes, four were defined, in part, by the presence of an accessory tooth on the crista dentata of the 3rd maxilliped, i.e., *Spiropagurus* Stimpson, 1858, *Anapagurus* Henderson, 1886, *Micropagurus* McLaughlin, 1986, and *Pygmaeopagurus* McLaughlin, 1986. The remaining genera all lack the accessory tooth, i.e., *Iridopagurus* De Saint Laurent-Dechancé, 1966 [a], *Anapagrides* De Saint Laurent-Dechancé, 1966 [b], and a new genus proposed herein.

From the extensive collections of the western Atlantic that I used in the revision of *Iridopagurus* (García-Gómez, 1983) I noted, in certain presumably new species of this genus, several discrepancies from the generic characteristics listed by De Saint Laurent-Dechancé (1966a), for example, the branchial formula, the distal setation of the ultimate antennular segment, and the lack of the iridescence of the integument. Also, other important differences, such as the terminal armature of the telson and the length of the right uropod in relation to the left, were found in the large number of specimens examined which set them apart from *Iridopagurus*.

MATERIALS AND METHODS

Most specimens used in this study have been from the collections of the University of Miami's Rosenstiel School of Marine and Atmospheric Science (RSMAS) (formerly University of Miami Marine Laboratory, UMML); the University of Alabama's Dauphin Island Sea Lab (DISL), and the Bermuda Biological Station for Research, St. George's West, Bermuda (BBSR).

Holotypes have been deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM); some paratypes have been returned to the institution of origin; other paratypic material has been accessioned into the Harvard University Museum of Comparative Zoology, Cambridge, Massachusetts (MCZ), the Allan Hancock Foundation, University of Southern California (AHF), and the Rijksmuseum Van Natuurlijke Historie, Leiden, The Netherlands (RMNH).

The methods used and the general morphological terminology follow those of García-Gómez (1983).

Enneobranchus new genus

Spiropagurus: A. Milne-Edwards and Bouvier, 1893: 118 (in part).-Alcock, 1905, 188 (in part).
Iridopagurus: De Saint Laurent-Dechancé, 1966a: 171 (in part).

Description.—Nine pairs of intermediate branchiae (cf., Lemaitre, 1986). Shield with anterolateral angle produced, unarmed; anterior margin between rostrum and lateral projections concave and with scattered tufts of short setae. Rostrum rounded not exceeding lateral projections; unarmed, with terminal tufts of moderately long setae. Lateral projections acutely triangular, each terminating in mod-

erately strong marginal spine. Ocular peduncles moderately short, cylindrical; slightly inflated basally and in corneal region. Ocular acicles equilaterally triangular, lateral and mesial margins slightly depressed, terminating in acute marginal spine and with additional strong submarginal spine; reaching base of ocular peduncles; separated basally by slightly less than basal width of one acicle. Antennular peduncles moderately long. Ultimate segment moderately long, slightly dilated distally; with dorsolateral distal row of plumose setae composed of 1 long setae and few short setae; basal segment moderately slender with strong acute spine on laterodistal margin. Antennal peduncles with supernumerary segmentation; ventrodistal margin of first segment slightly produced and with 2 or 3 spines laterally. Antennal flagella long, overreaching extended pereopods.

Maxillule with 1 or 2 stiff bristles on slightly produced internal lobe, external lobe slightly produced. Crista dentata of 3rd maxilliped with variable number of corneous teeth; no accessory tooth; merus with 1 spine on dorsodistal margin. Sternite of 3rd maxillipeds unarmed, but with setae on each side of shallow median cleft.

Chelipeds subequal, right stronger and slightly longer than left. Unarmed dactyl and fixed finger opening in horizontal plane. Carpus trapezoidal in cross section; ventrolateral distal angle with strong acute spine. Left cheliped slender. Dactyl shorter than or equalling length of palm. Palm slightly inflated dorsoventrally; dorsomesial margin with short spines and tufts of moderately long setae. Carpus trapezoidal in cross section; dorsal surface somewhat convex and with 2 irregular rows of strong acute spines in distal half. Ambulatory legs, overreaching chelipeds by approximately ¼ to entire length of dactyls of 2nd pereopods; generally similar in armament and ornamentation. Dactyls moderately long and slender; in lateral view curved ventrally; in dorsal view strongly twisted; terminating in moderately long corneous claws. Propodi almost twice length of carpi; dorsal margins each with row of paired setae. Carpi each with 1–7 short acute spines on dorsal margin. Meri of 2nd pereopods each unarmed or with 2–4 spinules on distal half on ventrolateral margin; ventrolateral distal angle each with moderately strong acute spine, ventrolateral margins of 3rd pereopods unarmed. Right lobe of sternite of the 2nd pereopods unarmed or with 1 short spine distally, left lobe with 1 or 2 short spines. Anterior lobe of sternite of 3rd pereopods subrectangular, anterior margin with several acute or blunt spines partially obscured by long setae at each side of deep median depression. Fourth pereopods simple; dactyls with 4–8 short corneous, acuminate scales; ventromesial margin with preungual process at base of claw; propodal rasp with one row of corneous scales extending approximately ¾ length of ventral margin.

Males with left sexual tube well developed, coiled; right sexual tube sometimes slightly produced and obscured by moderately long setae. Females with paired gonopores; no gonopods. Abdomen with typical flection. Males with 3 unpaired, biramous pleopods. Females with 4 unpaired, biramous pleopods. All exopods well developed, endopods reduced. Right uropod only slightly shorter than left. Telson with well developed, asymmetrical posterior lobes; separated by a broad median cleft; left lobe considerably larger than right; terminal margin of each with few strong spines; anterior lobes usually small, lateral margins unarmed but with short setae. Integument not iridescent.

Type Species.—*Enneobranchus flavioculatus* new species.

Remarks.—The three genera *Anapagrides, Iridopagurus* and *Enneobranchus* share certain primary characteristics: (1) long left sexual tube, (2) absence of an accessory tooth on the crista dentata, and (3) intermediate type branchiae (cf., Lemaitre,

1986); however *Anapagrides* is immediately distinguished from *Iridopagurus* and *Enneobranchus* by the slenderness of the left sexual tube, which terminates in a tuft of setae, and by the absence of a short right sexual tube.

Although *Enneobranchus* and *Iridopagurus* share several other characters (i.e., subequal chelipeds, bifid equilaterally triangular ocular acicles and males with well-developed coiled left sexual tube, the former genus can be distinguished by: (1) the presence of 9 rather than 11 pairs of branchiae; (2) the ultimate antennular segment with a distolateral row of setae instead of a dorsodistal fringe of setae implanted in "V"; (3) a few strong distal spines on the telson as opposed to strong spines interspersed with spinules; (4) the right uropod more than half the length of the left, in contrast to less than half in *Iridopagurus;* and (5) the characteristic iridescence of *Iridopagurus,* as its name implies, that is not apparent in the three known species of *Enneobranchus.*

Etymology.—From the Greek *ennea,* meaning nine and *branchos,* meaning gill. Gender masculine.

Key to the Species of *Enneobranchus*

1a. Ambulatory propodi scarcely setose on ventromesial margin. Antennal flagella with short setae (less than 1 flagellar article in length) interspersed with long setae (3–6 flagellar articles in length) ..... *E. bermudensis* new species

1b. Ambulatory propodi densely setose on ventromesial margin. Antennal flagella with only short setae (1 or 2 flagellar articles in length) 2

2a. Dorsal surface of right cheliped with 1 middorsal row of spines. Propodi of ambulatory legs each with ventromesial marginal row of numerous closely-spaced long setae. Crista dentata and meral spine of 3rd maxillipeds weakly developed ..... *E. markhami* new species

2b. Dorsal surface of right cheliped with 2 middorsal rows of spines. Propodi of ambulatory legs each with ventromesial marginal row of widely-spaced stiff setae on distal half. Crista dentata and meral spine of 3rd maxillipeds well developed ..... *E. flavioculatus* new species

Enneobranchus flavioculatus new species
Figures 1, 2

Spiropagurus dispar? A. Milne-Edwards and Bouvier, 1893: 118, pl. IX, figs. 1–6. Not *Spiropagurus dispar,* 1858.

Spiropagurus dispar: Alcock, 1905: 188 (in part).—Gordan, 1956: 341 (in part).

Iridopagurus sp.: De Saint Laurent-Dechancé, 1966a: 171.

Holotype.—♂ (SL = 2.5 mm) USNM 000 000, type locality: N.W. Cay Sal Bank, Bahama Islands; GERDA station 984: 24°05.0'N, 80°20.0'W.

Paratypes.—See material examined, Table 1.

Description.—Shield usually as long as broad, occasionally slightly longer; anterolateral margins sloping or slightly terraced. Ocular peduncles approximately ⅔ to ¾ length of shield. Antennular peduncles exceeding ocular peduncles by ⅔ to ¾ length of ultimate segment. Antennal peduncles exceeding ocular peduncles by ⅔ length of ultimate segment. Fifth segment with row of tufts of moderately long setae dorsally and ventrally. Fourth segment with long setae distally. Third segment with strong acute spine and moderately long setae at ventrolateral distal angle. Second segment with dorsolateral distal angle produced, terminating in bifid spine, dorsomesial and dorsolateral margins each with row of setae; dorsomesial distal angle with strong acute spine. Antennal acicles usually reaching distal third of ultimate peduncular segment, strongly arcuate, terminating in short spine encircled by moderately long setae, dorsal margin and distal half of ventral margin each with row of short stiff setae interspersed with few moderately long

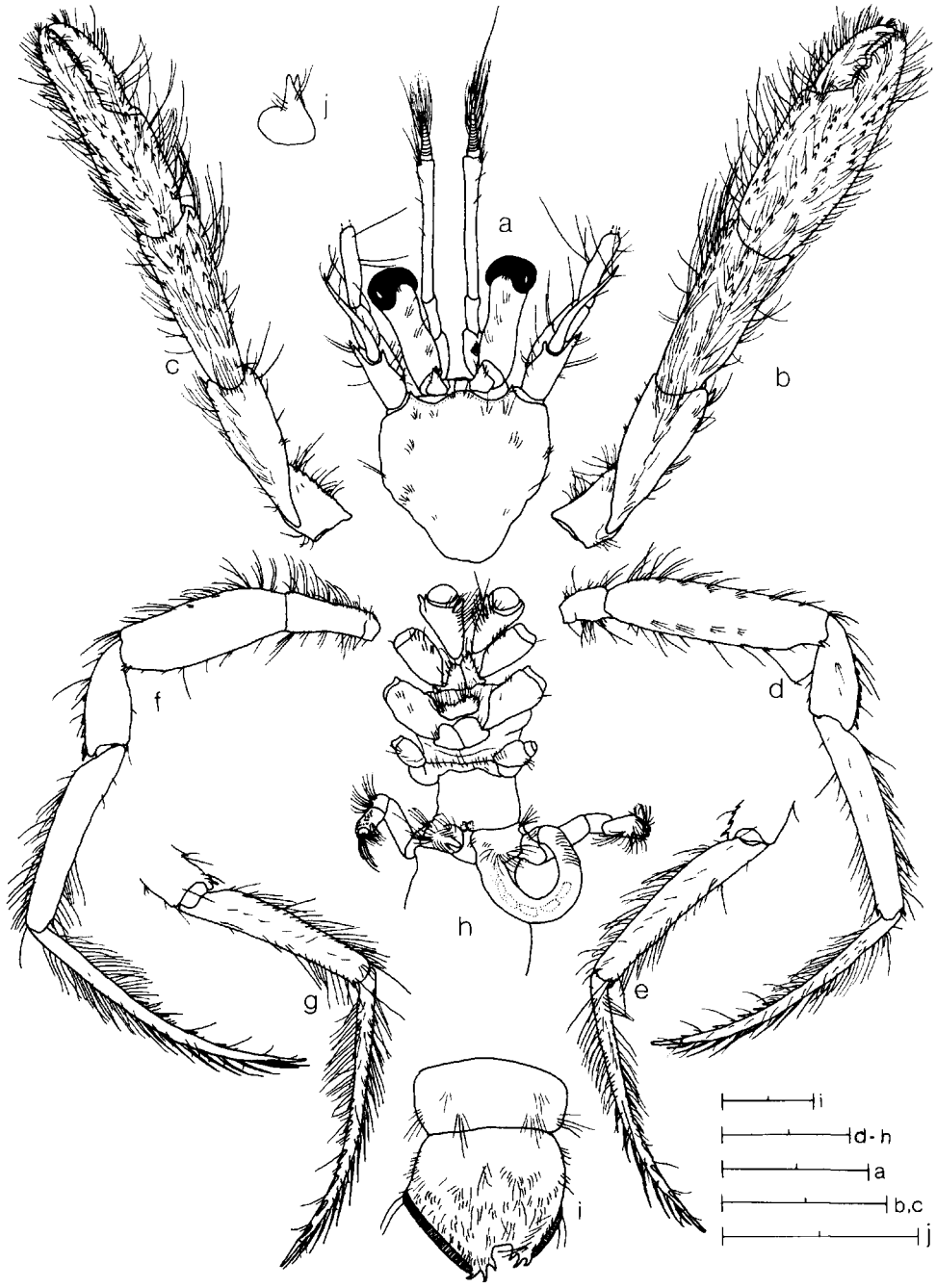
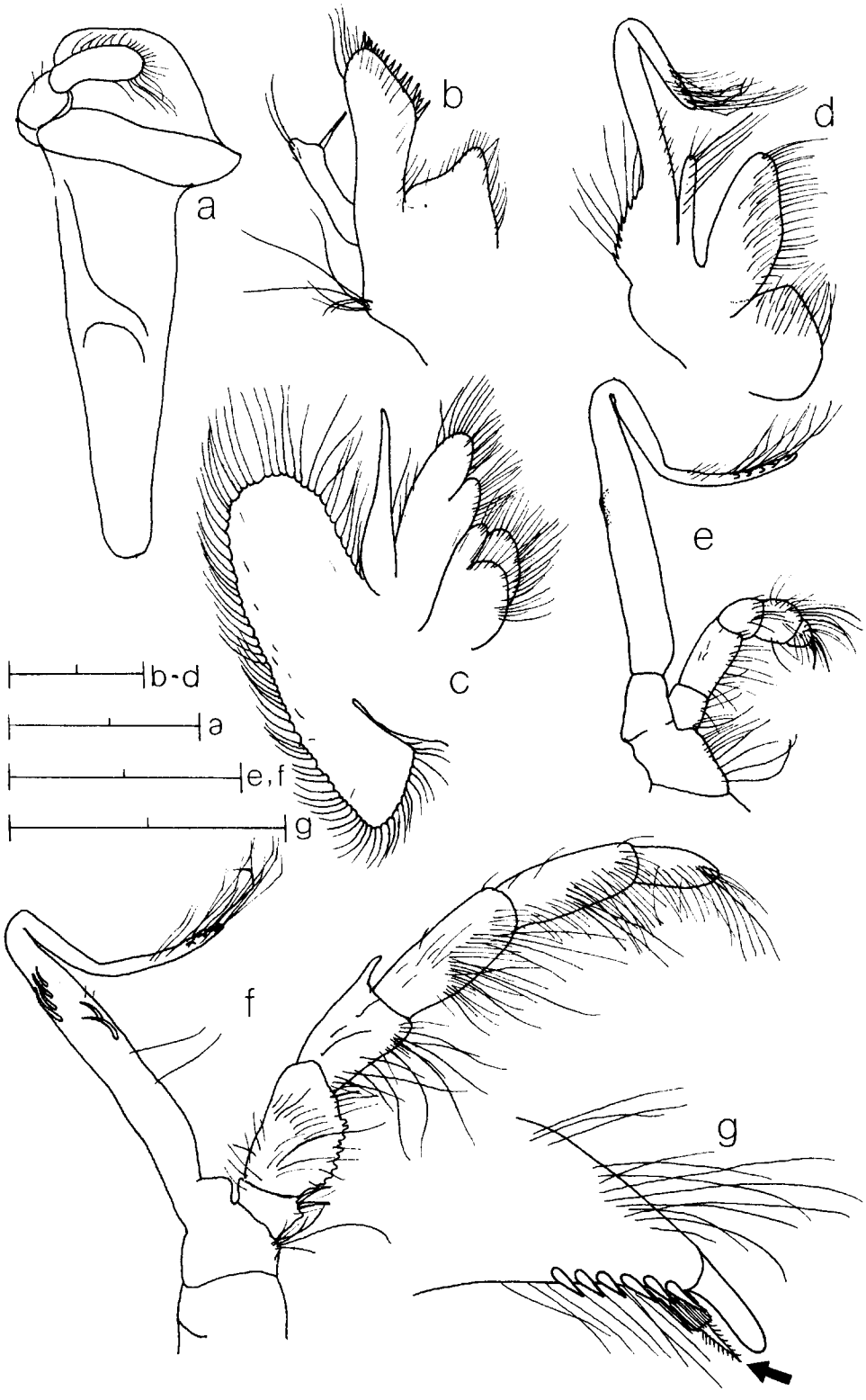


Figure 1. *Enneobranchus flavioculatus*, new species. a, shield and cephalic appendages; b, right cheliped (dorsal view); c, left cheliped (dorsal view); d, right 2nd pereopod (lateral view); e, right 2nd pereopod, dactyl and propodus (mesial view); f, left 3rd pereopod (lateral view); g, left 3rd pereopod, dactyl and propodus (mesial view); h, thorax, appendages removed with the exception of both 5th pereopods (ventral view); i, telson and last abdominal segment; j, left ocular acicle. Scales equal 0.5 mm (i), 2 mm (a–h) and 1 mm (j).


a
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setae. Antennal flagellar articles each with 2 to 6 short bristles (less that 1 to 2 flagellar articles in length).

Maxillule with 1 stiff moderately long bristle on internal endopodal lobe. Maxilla with endopod inflated basally, reflexed, exceeding scaphognathite in distal extension. First maxilliped with endopod approximately ⅓ length of exopod; epipod somewhat produced, basal segment of exopod slightly inflated. Second maxilliped without distinctive characters. Third maxilliped with strong coxal spine encircled by moderately long plumose setae; basis with strong spine obscured by short, serrate setae; crista dentata with 4 to 10 corneous teeth; merus with moderately long spine on dorsodistal margin.

Right cheliped with dactyl short, ½ to ⅔ length of palm, unarmed; cutting edge with 2 prominent calcareous teeth proximally separated by smaller calcareous teeth, short corneous teeth distally; terminating in small corneous claw, slightly overlapped by fixed finger; dorsal surface slightly elevated in midline; all surfaces with tufts of moderately long, occasionally plumose setae. Palm subrectangular, equalling or slightly exceeding length of carpus, somewhat inflated dorsoventrally; dorsomesial margin with row of short spines; dorsal surface slightly convex, with 2 rows of short spines in midline; dorsolateral margin with 1 row of short spines in distal half, extending onto fixed finger proximally; cutting edge of fixed finger with prominent calcareous tooth proximally and corneous teeth interpsersed with few short calcareous teeth distally; terminating in small corneous claw, encircled by tufts of short setae; mesial face slightly flattened, lateral face somewhat convex; ventrolateral margin with 2 short, corneous subterminal spines near claw; all surfaces with short to moderately long, frequently plumose setae. Carpus equalling or slightly exceeding length of merus, slightly inflated ventrally, equalling palm in depth; dorsal surface slightly convex, and with 2 irregular rows of strong acute spines in distal half; dorsolateral margin with few short acute spines distally; ventrolateral distal angle with strong acute spine; all surfaces with scattered moderately long setae. Merus with 1 strong acute spine and 1 short spine distally on ventrolateral margin, partially obscured by moderately long setae; ventromesial margin with strong acute spine distally, partially obscured by moderately long setae; all surfaces with short to moderately long setae. Ischium with row of spinules and moderately long setae on ventromesial margin. Coxa with 1 or 2 short spines at ventrolateral distal angle and few short setae; ventromesial margin with tufts of moderately long setae and 1 short acute spine at distal angle; ventrolateral and ventromesial margins each with row of granules proximally. Left cheliped with dactyl shorter than or equalling length of palm; cutting edge with row of spatulate corneous teeth; terminating in small corneous claw; slightly overlapped by fixed finger; dorsal surface slightly elevated in midline; unarmed or occasionally with row of short acute spines proximally; all surfaces with tufts of setae. Palm subrectangular, ⅔ to ¾ length of carpus, slightly inflated dorsoventrally; dorsomesial margin with row of short acute spines, dorsal surface slightly convex, with median row of short acute spines proximally, usually becoming double row distally and extending onto fixed finger as scattered short acute spines; dorsolateral margin with single or double row of short acute spines in distal half, extending onto fixed

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Figure 2. *Enneobranchus flavioculatus*, new species. a–f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, 1st maxilliped; e, 2nd maxilliped; f, 3rd maxilliped; g, right 4th pereopod. Distal part of dactyl (lateral view). (Type II preungual process indicated by the arrow.) Scales equal 0.25 mm (g), 0.5 mm (a–d) and 1.25 mm (e, f).

Table 1. Material examined of *Enneobranchus flavioculatus* new species

Locality	Depth (m)	Station deposition	Date	Sex ♂	♀	♀ ov	J	SL (mm)	Collector
Florida West Coast									
26°18'N 83°49'W	91	D+M-2:2105 DISL-210540-1871025	25-02-77	1				1.8	DISL
26°18'N 83°49'W	91	D+M:2105 DISL-210519-1870822	22-08-77			1		1.8	DISL
26°18'N 83°49'W	97	D+M-4:2105 DISL-210519-1880202	02-02-78	2				1.2, 1.7	DISL
27°19'N 84°20'W	—	BLM-46:2747 371901-3 DISL-274719-1860717	17-07-76			2		1.2, 1.7	DISL
27°19'N 84°20'W	68	D+M-1:2747 DISL-274718-1870823	23-08-77	1				1.1	DISL
27°19'N 84°20'W	68	D+M-1:2747 DISL-274719-1870823	23-08-77			1		1.5	DISL
27°49'N 84°32'W	102	D+M-1:0001 DISL-000119-1870824	24-08-77	1				1.7	DISL
28°56'N 84°56'W	91	BLM-58 22-58111-Ba-3 DISL-2-0148	1975–1976	1				1.6	DISL
29°45'N 87°15'W	117	D+M-1:2645 DISL-264540-1870908	09-08-77	1				1.4	DISL
—	92	D+M-2; DISL-	29-10-77	1				1.4	DISL
Bahama Islands									
24°05.0'N 80°20.0'W	155–230	G-984 USNM- (Holotype)	05-03-68	1				2.5	RSMAS
24°05.0'N 80°20.0'W	155–230	G-984 USNM-	05-03-68	5	3			1.7–2.3	RSMAS
24°05.0'N 80°19.0'W	137–241	G-986 UMML-	05-03-68		1			1.5	RSMAS
20°54.5'N 73°28.2'W	110–220	P-1143 UMML-	13-01-70	1				1.9	RSMAS
Venezuela									
11°21.0'N 62°21.0'W	79	P-707 UMML-	19-07-68	1	1			1.9	RSMAS
11°08.0'N 62°46.5'W	46	P-709 UMML-	19-07-68		1			1.7	RSMAS
10°20.0'N 65°41.0'W	57–60	P-734 UMML-	22-07-68	1				1.9	RSMAS
Colombia									
12°05.0'N 72°38.5'W	79–82	P-775 UMML-	29-07-68	1				2.0	RSMAS

Table 1. Continued

Locality	Depth (m)	Station deposition	Date	Sex ♂	♀	♀ ov	J	SL (mm)	Collector
9°45.1′N 76°09.1′W	75–79	P-392 UMML-	16-07-66	1				2.0	RSMAS
Panama									
9°32.1′N 78°33.5′W	53–59	P-421 UMML-32:4845	19-07-66	1				1.6	RSMAS
Barbados									
—	183	HASSLER-MCZ-4006	29-30-12-1871	1				2.7	L. F. Pourtales
—	—	NR:1-2 MCZ-	1969?	1				1.9	—
—	—	NR:2-1 MCZ-	1969?	3				1.7–1.8	—
—	—	NR:4-2 AHF-	1969?	5	1	3		1.5–2.0	—
—	—	NR:21-1 RMNH-	1969?	2		1		1.4–1.7	—
—	—	— RMNH-	1969?	1				1.5	—
Guyana									
07°19.0′N 56°51.0′W	55–59	P-684 UMML-	14-07-68	2				1.7–2.1	RSMAS
French Guiana									
67°07.0′N 52°19.0′W	84–91	P-650 UMML-	08-07-68	1				2.5	RSMAS
Belize									
—	29	18 UMML	16-06-79		1		3	0.6–1.1	J. D. Thomas

finger proximally; cutting edge of fixed finger with spinulose corneous teeth interspersed with few calcareous teeth, terminating in small corneous claw, encircled by tufts of short setae; ventrolateral margin with 2 subterminal short corneous spines near claw; all surfaces with short to long, occasionally plumose setae. Carpus, slightly longer than merus, inflated ventrally, somewhat deeper than palm; dorsal surface somewhat convex and with 2 irregular rows of strong acute spines in distal half; ventrolateral distal angle with 1 strong acute spine; all surfaces with long or moderately long setae. Merus with 1–3 strong acute spines at ventrolateral distal angle; ventromesial distal angle with strong acute spine; all surfaces and margins with tufts of moderately long setae. Ischium with row of spinules and moderately long setae on ventromesial margin. Coxa with short spine at ventrolateral distal angle; ventromesial margin with 1 or 2 short acute spines at distal angle. Ambulatory legs with dactyls moderately long and slender, exceeding length of propodi by ¼ to ⅓ own length; terminating in relatively long corneous claw; dorsal margins each with moderately long plumose setae on proximal half, and longer stiff setae on distal half; mesial faces each with row of short setae near dorsal margin, several short stiff setae on proximal fourth, and with few widely

spaced stiff setae near ventral margin; row of 4–7 corneous spines and row of moderately long plumose setae on mesial face ventrally; ventral margins each with sparse row of moderately long setae; lateral faces each with sparse row of short setae near dorsal margin. Propodi 1⅓ to 1½ length of carpi; dorsal margins each with row of sets of paired setae composed of 1 long plumose seta and 1 short stiff seta; dorsodistal margins each with row of moderately long plumose setae interspersed with short stiff setae; mesial faces each with sparse row of short setae on midline; ventromesial margins each with row of numerous closely-spaced setae on proximal half, row of widely-spaced stiff setae on distal half, and with 1 short acute distal spine; lateral faces each with row of widely-spaced, moderately short stiff setae near dorsal and ventral margins. Carpi, ½ to ⅔ length of meri; dorsal surfaces each with 2–7 short acute spines increasing in size distally, and with row of tufts of moderately long plumose setae, interspersed with few short stiff setae; mesial faces with few short stiff setae on distal margins; ventral surfaces each with few scattered short setae; lateral faces each with row of median tufts of short setae. Meri moderately long; dorsodistal, dorsomesial and dorsolateral margins each with row of moderately long setae; ventral margin of 2nd pereopods each with 2–4 spinules on distal half partially obscured by moderately long setae, and with moderately strong acute spine at ventrolateral distal angle; ventrolateral margins of 3rd pereopods unarmed but each with sparse row of short setae. Dorsal margins of ischia with moderately long setae; mesial faces each with tufts of short setae near ventral margins distally. Coxae each with tufts of moderately long setae on ventromesial and ventrodistal margins. Anterior lobe of sternite of 3rd pereopods subrectangular; anterior margin with a deep median depression, usually with 1–6 spines on each side, partially obscured by long setae, occasionally unarmed. Dactyls of fourth pereopods each with 4–8 small corneous acuminate scales; ventromesial margins each with type II preungual process consisting of 1 to 3 long stiff plumose setae encircled by bundle of numerous fine short setae; propodal rasp with single row of 7–11 corneous scales, occasionally with moderately long spine at ventromesial distal angle.

Color.—Shields of living specimens of *Enneobranchus flavioculatus* have scattered red orange spots; ocular peduncles with several pale turquoise chromatophores dorsally, corneae brownish yellow; ultimate antennular segment with a red orange mesial stripe. Chelipeds white with a narrow red orange band on the dorsodistal surface of palm outlining the margins of palm with dactyl; dorsolateral surface of dactyl and dorsomesial surface of fixed finger, each with a red orange spot; ventrolateral and ventromesial angles of proximal margin of palm, each with a red orange spot; merus of right cheliped with a dorsodistal white chromatophore and a middorsal pale turquoise spot. Fourth pereopods each with scattered red orange chromatophores on lateral face of merus proximally (Provenzano, field notes). All colors fade out in formalin or ethanol.

Related Organisms.—Carcinoecia: One of the shells of *Nassarius albus* (Say) occupied by *E. flavioculatus* had actinians fastened to its inner lip, and several serpulid polychaete tubes were observed on another shell of the same gastropod.

Four males of *E. flavioculatus* were parasitized by rhizocephalans on the left side of the host's abdomen anteriorly, next to 3rd pleopod; two of these hermits had only 1 rhizocephalan while in the other two hosts, 2 and 3 parasites were observed; one infected specimen lacked the right sexual tube. No other external effects of the parasites were observed.

Behavior.—Living individuals were not observed.

Distribution.—*E. flavioculatus* has been collected off the west coast of Florida as

far north as Pensacola; it has been found in localities such as Cay Sal Bank and Great Inagua Island, Bahamas; from Barbados along the north coast of Panama; some specimens were also collected off the coast of Guyana, French Guiana and Belize; 46–241 m.

Remarks.—In 1893, A. Milne-Edwards and Bouvier described and illustrated a specimen that they questionably assigned to *Spiropagurus dispar.* As Stimpson's type material presumably was destroyed by fire in 1871 (R. Rathbun, 1884), A. Milne-Edwards and Bouvier could refer only to Stimpson's (1859) brief description. They listed several similarities which are generic rather than specific, such as the relative size of both chelipeds, similarity in length of the chelipeds and the ambulatory legs, and the non-subchelate 4th pereopods. Among differences they cited "the narrow ocular acicles" of Stimpson's species versus "the acicles with a wide base and a bifurcated tip" of *S. dispar?.* Their specimen had spinose chelipeds and walking legs, while these appendages of Stimpson's species were described as unarmed. De Saint Laurent-Dechancé (1966a) examined the specimen questionably assigned to *S. dispar* and found that it was not conspecific with Stimpson's taxon and referred to it simply as *Iridopagurus* sp.

While describing *Enneobranchus flavioculatus* I had the opportunity to examine, not only the specimen assigned to *S. dispar*? by A. Milne-Edwards and Bouvier (1893), but also several specimens, including 17 from Barbados, the same area where the questionable *S. dispar* was collected. The antennal acicles and chelipeds of the latter specimen are missing; however, the subrectangular anterior lobe of the sternite of third pereopods with deep median depression, and A. Milne-Edwards and Bouvier's description and illustration of a double row or short spines on the middorsal surface of the palms, led me to believe that A. Milne-Edwards and Bouvier's specimens are *E. flavioculatus.*

Enneobranchus flavioculatus is distinguished from *E. markhami* by the presence, in the former, of a double row of short spines on middorsal surfaces of the palms, by the less heavily setose appearance of the walking pereopods, and by the better developed crista dentata and meral spine of the 3rd maxillipeds. It may be separated from *E. bermudensis* by the difference in setal arrangement of the antennal flagella, density of the setation on the ventromesial margins of the propodi of the 2nd pereopods, and degree of development of the meral spine of 3rd maxilliped.

The specimen examined by A. Milne-Edwards and Bouvier would most appropriately be designed as the holotype. However, as the chelipeds and antennal acicles of this specimen are missing, a specimen from the present collection has been designated as the holotype.

Etymology.—The specific name *flavioculatus* is derived from the Latin *flavidus,* yellowish, and *oculus,* eye, and refers to the color of the cornea, noted in living specimens by A. J. Provenzano, Jr.

Enneobranchus markhami new species
Figures 3, 4

Holotype.—♀ (SL = 1.7 mm) USNM 000 000; type locality: off South Bight, Andros Island, Bahamas, 24°14.4'N, 77°36.6'W.

Paratypes.—See material examined, Table 2.

Description.—Shield usually slightly broader than long; anterolateral margins slightly terraced. Ocular peduncles approximately ¾ length of shield. Antennular peduncles exceeding ocular peduncles by ⅔ to ¾ length of ultimate segment.

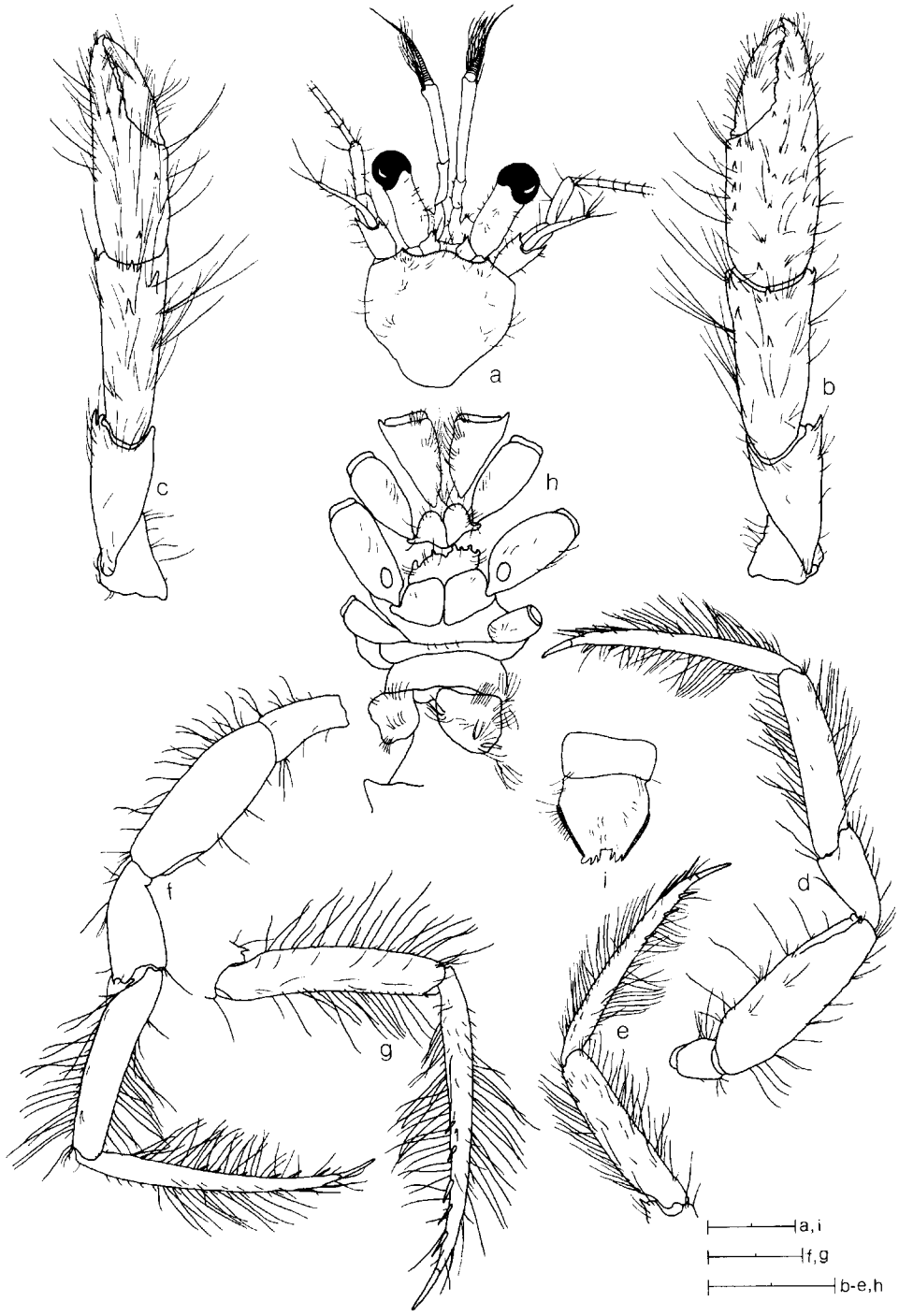

Figure 3. *Enneobranchus markhami*, new species. a, shield and cephalic appendages; b, right cheliped (dorsal view); c, left cheliped (dorsal view); d, right 2nd pereopod (lateral view); e, right 2nd pereopod, dactyl and propodus (mesial view); f, left 3rd pereopod (lateral view); g, left 3rd pereopod dactyl and propodus (mesial view); h, thorax, appendages removed (ventral view); i, telson. Scales equal 1 mm.

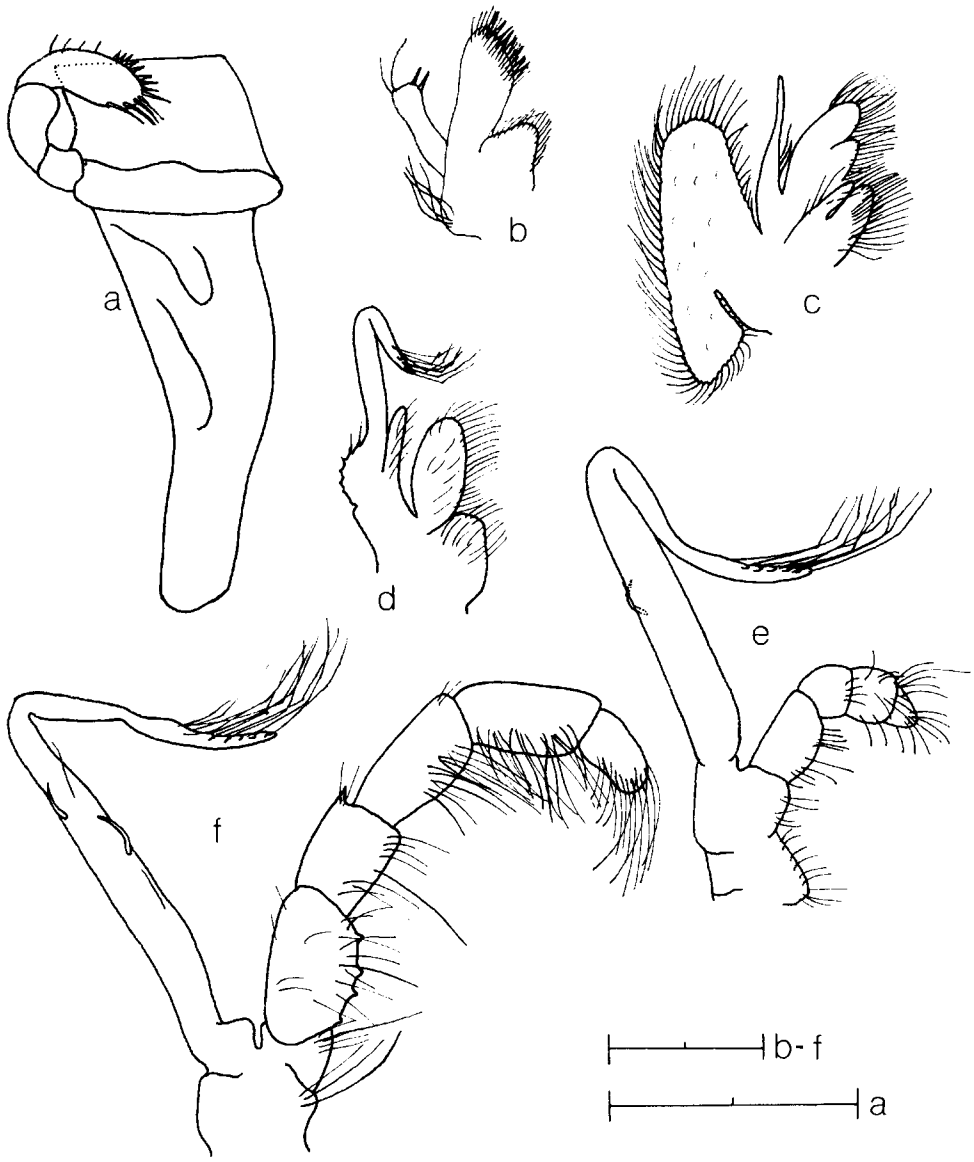

Figure 4. *Enneobranchus markhami,* new species. Mouthparts (left, internal face); a, mandible; b, maxillule; c, maxilla; d, 1st maxilliped; e, 2nd maxilliped; f, 3rd maxilliped. Scales equal 0.5 mm (b–f) and 2 mm (a).

Antennal peduncles exceeding ocular peduncles by ⅔ length of ultimate segment. Fifth segment with row of tufts of moderately long setae dorsally and ventrally. Fourth segment with long setae distally. Third segment with strong acute spine and moderately long setae at ventrolateral distal angle. Second segment with dorsolateral distal angle produced, terminating in bifid spine, dorsomesial and dorsolateral margins each with row of setae; dorsomesial distal angle with strong acute spine. Antennal acicles usually reaching distal third of ultimate peduncular

Table 2. Material examined of *Enneobranchus markhami*, new species

Locality	Depth (m)	Station deposition	Date	Sex ♂	Sex ♀	Sex ov ♀	SL (mm)	Collector
Bahama Islands								
24°15.5′N 77°37.3′W	17.5–16	D-90 UMML-	08-09-73			1	1.6	J. C. Markham
24°14.4′N 77°36.6′W	15	D-81 USNM- (Holotype)	06-09-73		1		1.7	J. C. Markham
21°50.5′N 72°20.8′W	20	D-69 USNM-	31-08-73		1	2	1.3–1.6	J. C. Markham

segment, strongly arcuate, terminating in short spine encircled by moderately long setae; dorsal margin and distal half of ventral margin, each with row of short stiff setae interspersed with few moderately long setae. Antennal flagellar articles each with 2 to 5 short bristles (less than 1 to 2 flagellar articles in length).

Maxillule with 1–2 stiff, moderately long bristles on internal endopodal lobe. Maxilla with endopod inflated basally, reflexed, exceeding scaphognathite in distal extension. First maxilliped with endopod approximately ⅓ length of exopod; exite somewhat produced, basal segment on exopod slightly inflated. Second maxilliped without distinguishing characters. Third maxilliped with short coxal spine encircled by moderately long plumose setae; basis with strong spine obscured by short serrate setae; crista dentata with 4 to 7 corneous teeth; merus with short spine on dorsodistal margin.

Right cheliped with dactyl moderately long, ⅔ to ⅘ length of palm, unarmed; cutting edge with 2 prominent calcareous teeth proximally separated by smaller calcareous teeth, short corneous teeth distally; terminating in small corneous claw, slightly overlapped by fixed finger; dorsal surface slightly elevated in midline; all surfaces with tufts of moderately long, occasionally plumose setae. Palm subrectangular, slightly shorter than length of carpus, somewhat inflated dorsoventrally; dorsomesial margin with row of short spines; dorsal surface slightly convex and with median row of short spines; dorsolateral margin with few short spines in distal half, extending onto fixed finger proximally; cutting edge of fixed finger with prominent calcareous tooth proximally and corneous teeth, interspersed with short calcareous teeth, distally; terminating in small corneous claw, encircled by tufts of short setae; mesial face slightly flattened, lateral face somewhat convex; ventrolateral margin with 2 short corneous subterminal spines near claw; all surfaces with short to moderately long, frequently plumose setae. Carpus equalling or slightly exceeding length of merus, slightly inflated ventrally, equalling palm in depth, dorsal surface slightly convex, and with row of strong acute spines in distal half; dorsolateral margin with few short acute spines distally; ventrolateral distal angle with strong acute spine; all surfaces with scattered, moderately long setae. Merus with 2 strong acute spines distally on ventrolateral margin, partially obscured by moderately long setae; ventromesial margin with strong acute spine distally, partially obscured by moderately long setae; all surfaces with short to moderately long setae. Ischium with row of spinules and moderately long setae on ventromesial margin. Coxa with short spine on ventrolateral distal angle and few short acute spines at distal angle, ventrolateral and ventromesial margins each with row of granules proximally. Left cheliped with dactyl shorter than length of palm, unarmed; cutting edge with corneous teeth; terminating in small corneous

claw, slightly overlapping fixed finger; dorsal surface slightly elevated in midline; all surfaces with tufts of setae. Palm ovate, shorter than or equalling length of carpus; slightly inflated dorsoventrally; dorsomesial margins with few short acute spines; dorsal surface slightly convex, and with median row of short, acute, widely-spaced spines, occasionally with 2 spines distally, dorsolateral margin with few short acute spines distally extending onto fixed finger proximally; cutting edge of fixed finger with spinulose, corneous teeth interspersed with few calcareous teeth; terminating in small corneous claw encircled by tufts of short setae; ventrolateral margin with 1 subterminal, short corneous spine near claw; all surfaces with short to moderately long setae. Carpus slightly longer than merus, inflated ventrally, somewhat deeper than palm; dorsal surface somewhat convex and with 2 irregular rows of strong acute spines in distal half; ventrolateral distal angle with 1 strong acute spine; all surfaces with moderately long setae. Merus with 2 strong acute spines at ventrolateral distal angle; ventromesial distal angle with strong acute spine; all surfaces and margins with tufts of moderately long setae. Ischium with 1 spinule and moderately long setae on ventromesial margin. Coxa with short acute spine at ventromesial distal angle. Ambulatory legs with dactyls moderately long and slender, exceeding length of propodi by ½ to ⅔ own length; terminating in relatively long corneous claw; dorsal margins each with moderately long plumose setae on proximal half and longer stiff setae on distal half; mesial faces each with row of short setae near dorsal margin, several short stiff setae on proximal ¼ and row of few widely-spaced, stiff setae near ventral margin; row of 2–7 corneous spines and two of moderately long plumose setae on mesial face ventrally, ventral margins each with sparse row of moderately long setae; lateral faces each with sparse row of short setae near dorsal margin. Propodi 1½ to 1⅔ length of carpi; dorsal margins each with row of paired setae, each composed of 1 long plumose seta and 1 short stiff seta; dorsodistal margins each with row of moderately long plumose setae interspersed with short stiff setae; mesial faces each with sparse row of short setae on midline; ventromesial margin each with row of widely spaced stiff setae on proximal half, row of moderately long plumose setae on distal half, and with 1 short acute distal spine; lateral faces each with row of widely spaced moderately short stiff setae near dorsal and ventral margins. Carpi ⅓ to ½ length of meri; dorsal surfaces each with 1 to 7 short acute spines, increasing in size distally and with row of tufts of moderately long plumose setae, interspersed with few short stiff setae; mesial faces with sparse short stiff setae on distal margins; ventral surfaces each with few scattered short setae; lateral faces each with median row of tufts of short setae. Meri moderately long; dorsodistal, dorsomesial and dorsolateral margins each with row of moderately long setae; ventrolateral distal angle with moderately strong acute spine. Dorsal margins of ischia with moderately long plumose setae; ventral margins with moderately long setae; mesial faces each with tufts of short setae near ventral margin distally. Coxae each with row of tufts of moderately long setae on ventromesial and ventrodistal margins. Anterior lobe of sternite of 3rd pereopods broadly subrectangular; anterior margin usually with 2–4 blunt spines partially obscured by long setae at each side of deep median depression. Dactyl of fourth pereopods each with 4–6 very small corneous scales; ventromesial margins each with type II preungual process; propodal rasp with single row of 6–7 corneous scales. Male sexual tubes and pleopods not known.

Color.—Living or recently preserved specimens have not been observed; in formalin or ethanol preserved animals, all colors fade to white or straw color.

Related Organisms.—Carcinoecia: Two specimens of *E. markhami* were found inhabiting the gastropod shells of *Polinices lacteus* (Guilding) and *Olivella* sp.

There is no external evidence of commensals or parasites in any of the specimens examined.

Behavior.—Specimens of *E. markhami* were observed jumping while they were being collected at night. (J. C. Markham, personal communication).

Distribution.—Specimens of *E. markhami* were collected off Andros Island, Bahama at two different localities: off Settlement Point and South Bight, and also 0–2 miles off Wend, Providenciales, Turks and Caicos islands; 15–20 m.

Remarks.—*Enneobranchus markhami* is best distinguished from *E. flavioculatus* and *E. bermudensis* by the less spinose chelipeds, the more heavily setose walking legs, and the less developed crista dentata and meral spine of 3rd maxillipeds. *E. markhami* also can be separated from *E. bermudensis* by the different arrangement of the antennal setation and the dissimilar type of preungual process of 4th pereopods.

Although males of this species have yet to be collected, in all characters examined, this species agrees with *Enneobranchus.*

Etymology.—This species is named for Dr. John C. Markham who provided the specimens.

Enneobranchus bermudensis new species
Figures 5, 6

Holotype.—♂ (SL = 1.9 mm) USNM 000 000; type locality: off the West Coast of Castle Roads, Bermuda.

Paratypes.—See material examined, Table 3.

Description.—Shield usually as long as broad; anterolateral margins sloping or slightly terraced. Ocular peduncles approximately ⅔ to ¾ length of shield. Antennular peduncles exceeding ocular peduncles by ⅔ to ¾ length of ultimate segment. Antennal peduncles exceeding ocular peduncles by approximately ⅔ to ¾ length of ultimate segment. Fifth segment with row of tufts of moderately long setae dorsally and ventrally. Fourth segment with long setae distally. Third segment with strong acute spine and moderately long setae at ventrolateral distal angle. Second segment with dorsolateral distal angle produced, terminating in bifid spine, dorsomesial and dorsolateral margins each with row of setae; dorsomesial distal angle with strong acute spine. Antennal acicles usually reaching distal third of ultimate peduncular segment, strongly arcuate, terminating in short spine encircled by moderately long setae, dorsal margin and distal half of ventral margin, each with row of short stiff setae, interspersed with few moderately long setae. Antennal flagellar articles with short setae (less than 1 flagellar article in length), interspersed with long setae (3–6 flagellar articles in length).

Maxillule with 1 stiff moderately long bristle on internal endopodal lobe. Maxilla with endopod inflated basally, reflexed, exceeding scaphognathite in distal exten-

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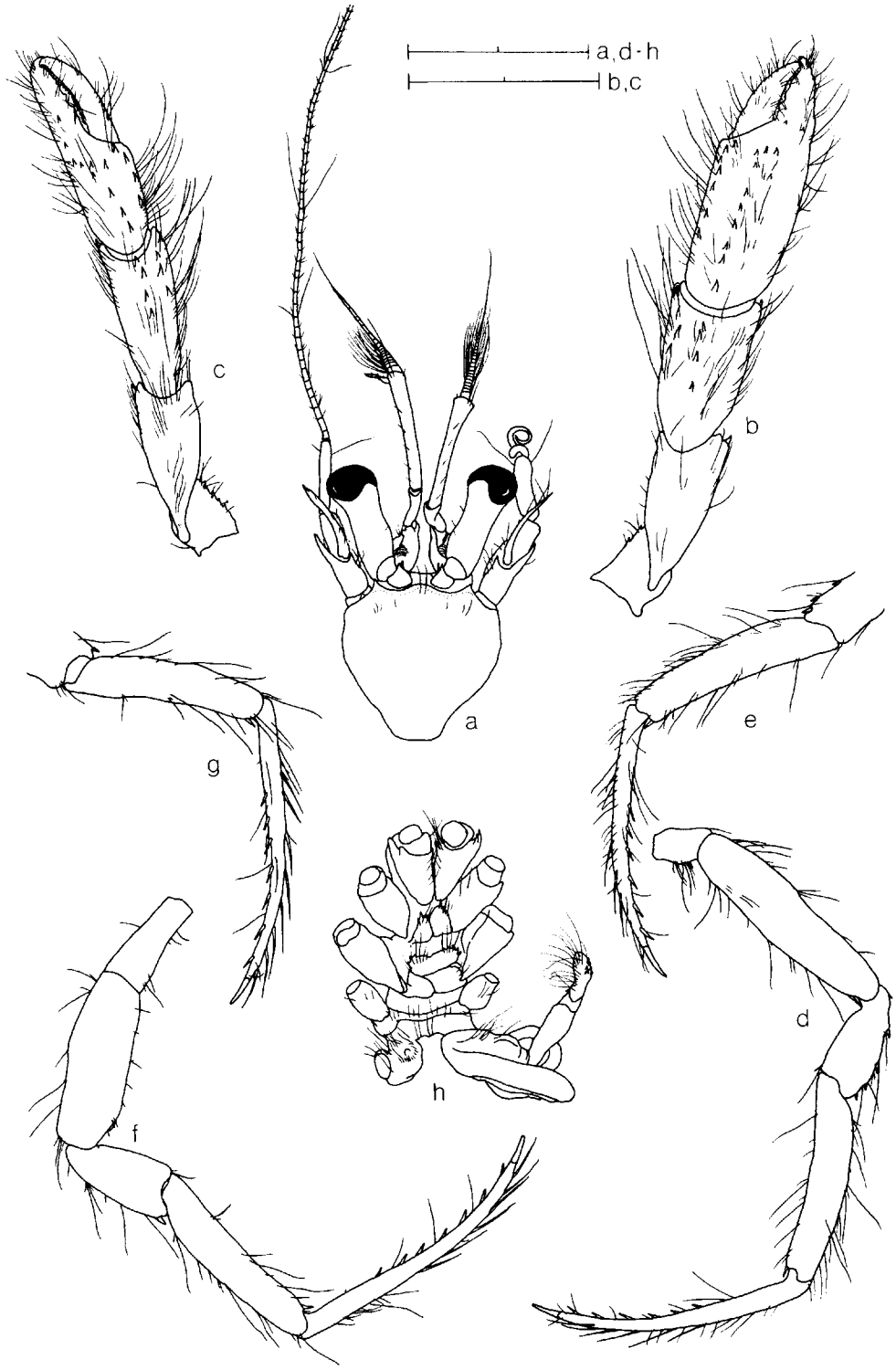
Figure 5. *Enneobranchus bermudensis,* new species. a, shield and cephalic appendages; b, right cheliped (dorsal view); c, left cheliped (dorsal view); d, right 2nd pereopod (lateral view); e, right 2nd pereopod, dactyl and propodus (mesial view); f, left 3rd pereopod (lateral view); g, left 3rd pereopod, dactyl and propodus (mesial view); h, thorax, appendages removed with the exception of left 5th pereopod (ventral view). Scales equal 2 mm.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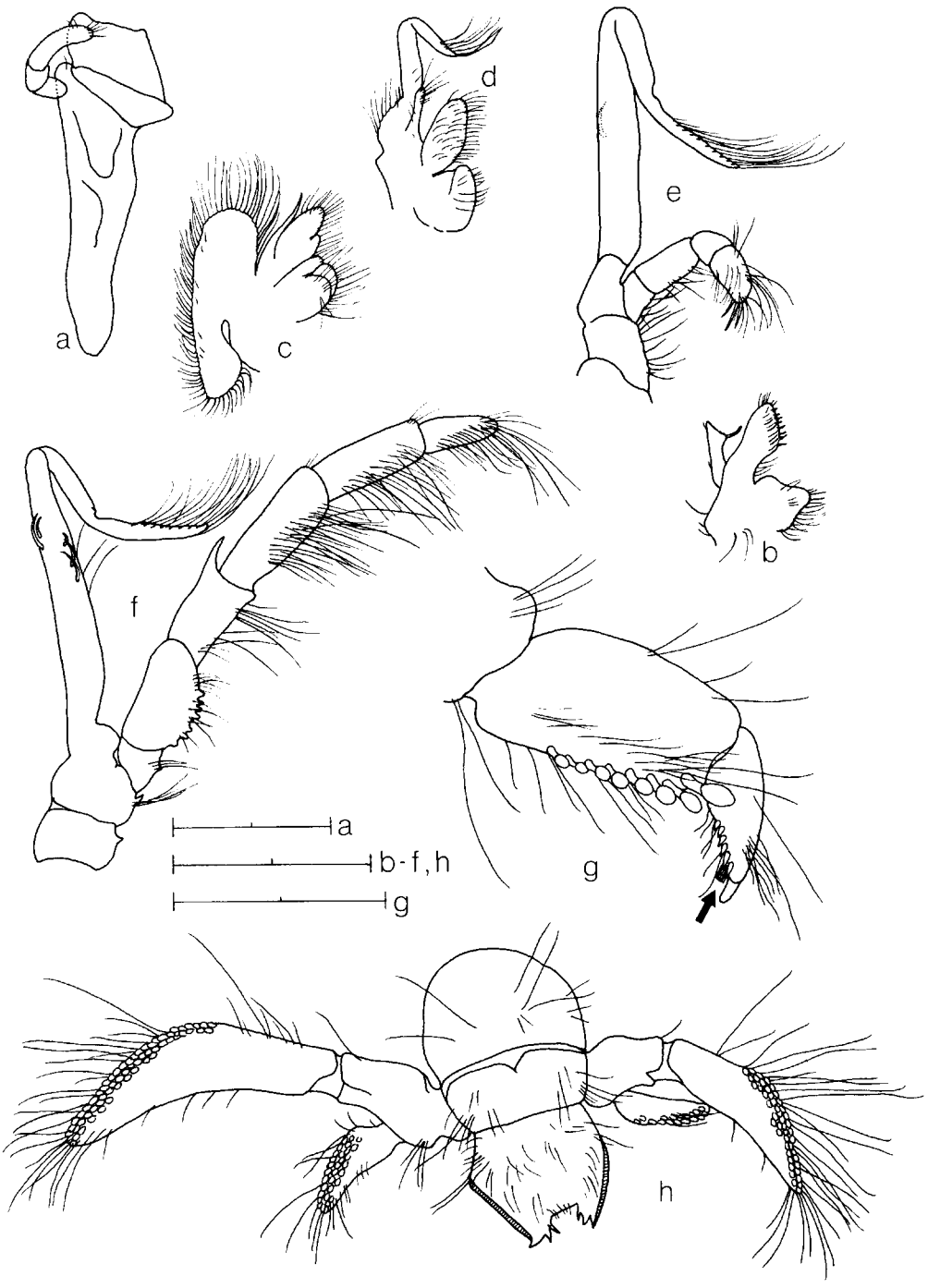

Figure 6. *Enneobranchus bermudensis,* new species. a–f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, 1st maxilliped; e, 2nd maxilliped; f, 3rd maxilliped; g, right 4th pereopod, dactyl and propodus (lateral view) (type I preungual process indicated by the arrow); h, extremity of abdomen, uropods and telson. Scales equal 0.5 mm (a, g) and 1 mm (b–f, h).

Table 3. Material examined of *Enneobranchus bermudensis* new species

Locality	Depth (m)	Station deposition	Date	Sex ♂	♀	ov ♀	J	SL (mm)	Collector
Bermuda									
West off Castle Roads	73–110	— USNM-(Holotype)	13-11-77	1				1.9	J. H. R. Lightbourn and J. C. Markham
Off Castle Roads	64–91	North Star Expedition BBSR-51-019-01	25-09-76	1	1	2		1.4–1.5	J. C. Markham
3.2 km off south of Castle Roads	90	North Star Expedition BBSR-	30-10-76	1				1.4	J. H. R. Lightbourn, A. I. Guest and J. C. Markham
Off Castle Roads	50	North Star Expedition BBSR-51-016-02	13-08-77	1				1.6	J. C. Markham
2 km off south of Castle Roads	80	1411 UMML-	03-09-77		2	1		1.6–2.1	J. C. Markham
Off Castle Roads	80	North Star Expedition BBSR-51-016-01	03-09-77	2				1.3, 2.0	J. C. Markham
2 km off south of Tucker's Town	82–91	North Star Expedition BBSR-51-016-03	18-08-79			1		1.6	J. C. Markham
Bahama Islands									
24°15.5'N 77°37.25'W	16–18	D-90 UMML-	08-09-73				2	0.7, 0.9	J. C. Markham

sion. First maxilliped with endopod approximately ⅓ length of exopod; epipod somewhat produced, basal segment of exopod slightly inflated. Second maxilliped without distinctive characters. Third maxilliped with strong coxal spine encircled by moderately long plumose setae; basis with strong spine obscured by short serrate setae; crista dentata with 4 to 8 corneous teeth; merus with long spine on dorsodistal margin.

Right cheliped with dactyl, ⅗ to ⅔ length of palm, unarmed; cutting edge with 2 prominent calcareous teeth proximally separated by smaller calcareous teeth; short corneous teeth distally; terminating in small corneous claw, slightly overlapped by fixed finger; dorsal surface slightly elevated in midline; all surfaces with tufts of moderately long, occasionally plumose setae. Palm subrectangular, slightly exceeding length of carpus, without noticeable dorsoventral inflation; dorsomesial margin with row of short spines; dorsal surface slightly convex, with median row of short spines and additional row of short spines on distal half; dorsolateral margin with 1 row of short spines in distal half, extending onto fixed finger proximally; cutting edge of fixed finger with prominent calcareous tooth proximally and corneous teeth, interspersed with few short calcareous teeth distally; terminating in small corneous claw, encircled by tufts of short setae; mesial face

slightly flattened, lateral face somewhat convex, ventrolateral margin with 2 short, corneous, subterminal spines near claw; all surfaces with short to moderately long, frequently plumose setae. Carpus equalling or slightly exceeding length of merus; slightly inflated ventrally, equalling palm in depth; dorsal surface slightly convex and with row of strong acute spines in distal half of dorsal surface; dorsolateral margin with few short acute spines distally; ventrolateral distal angle with strong acute spine; all surfaces with scattered moderately long setae. Merus with 2 strong acute spines distally on ventrolateral margin, partially obscured by moderately long setae; ventromesial margin with strong acute spine distally, partially obscured by moderately long setae; all surfaces with short to moderately long setae. Ischium with row of spinules and moderately long setae on ventromesial margin. Coxa with 1 or 2 short spines at ventrolateral distal angle and few short setae; ventromesial margin with tufts of moderately long setae and 1 or 2 short acute spines at distal angle. Left cheliped dactyl unarmed; shorter than or equalling length of palm; cutting edge with row of spatulate corneous teeth; terminating in small corneous claw, slightly overlapped by fixed finger; dorsal surface slightly elevated in midline; all surfaces with moderately long, occasionally plumose setae. Palm subrectangular, ⅔ to ¾ length of carpus, slightly inflated dorsoventrally; dorsomesial margin with row of short acute spines; dorsal surface slightly convex, and with median row of short acute spines; dorsolateral margin with few short acute spines distally extending onto fixed finger proximally; cutting edge of fixed finger with spinulose, corneous teeth, interspersed with few calcareous teeth; terminating in small corneous claw, encircled by tufts of short setae; ventrolateral margin with 2 subterminal short corneous spines near claw; all surfaces with short to long, occasionally plumose setae. Carpus slightly longer than merus; inflated ventrally, somewhat deeper than palm; dorsal surface somewhat convex and with 2 irregular rows of strong acute spines in distal half; ventrolateral distal angle with 1 strong acute spine; all surfaces with long or moderately long setae. Merus with 1 or 2 strong acute spines at ventrolateral distal angle; ventromesial distal angle with strong acute spine; all surfaces and margins with tufts of long setae. Ischium with row of spinules and moderately long setae on ventromesial margin. Coxa with 1 or 2 short spines at ventrolateral distal angle; ventromesial margin with 1 or 2 short acute spines at distal angle. Ambulatory legs with dactyls moderately long and slender, exceeding length of propodi by ¼ to ⅓ own length; terminating in relatively long corneous claw; dorsal margins each with moderately long setae on proximal half and longer, stiff setae on distal half; mesial faces each with row of short setae near dorsal margin and several short, stiff setae on proximal ¼, few widely spaced stiff setae near ventral margin; row of 3–8 corneous spines and row of moderately long setae on mesial face ventrally; ventral margins each with sparse row of moderately long setae; lateral faces each with sparse row of short setae near dorsal margin. Propodi almost twice length of carpi; dorsal margins each with row of sets of paired setae composed of 1 long seta and 1 short stiff seta; dorsodistal margins each with row of moderately long setae interspersed with short stiff setae; mesial faces each with sparse row of short setae on midline; ventromesial margins each with row of few moderately long setae interspersed with short setae and with 1 short acute distal spine; lateral faces each with row of widely-spaced, moderately short stiff setae near dorsal and ventral margins. Carpi ½ to ⅔ length of meri; dorsal surfaces each with 1 or 2 short acute spines near dorsodistal margin and with row of tufts of moderately long setae, interspersed with few short stiff setae; mesial faces with few short stiff setae on distal margins; ventral surfaces each with few scattered short setae; lateral faces each with row of median tufts of short setae. Meri moderately long; dorsodistal, dor-

somesial and dorsolateral margins each with row of moderately long, occasionally plumose setae; ventrolateral distal angle of 2nd pereopods with moderately strong acute spine; ventrolateral margins of 3rd pereopods unarmed but each with sparse row of short setae. Ischia with dorsal and ventral margins each with moderately long plumose setae; mesial faces each with tufts of short setae near ventral margins distally. Coxae each with row of tufts of moderately long setae on ventromesial and ventrodistal margins. Right lobe of sternite of 2nd pereopods with 1 short distal spine; left lobe with 1 or 2 short distal spines. Anterior lobe of sternite of 3rd pereopods subrectangular; anterior margin with a deep median depression, usually with 1–6 spines on each side partially obscured by long setae, occasionally unarmed. Dactyls of fourth pereopods each with 5–7 small corneous acuminate scales; ventromesial margin each with type I preungual process consisting of simple bundle of fine setae occasionally reaching to tip of claw; propodal rasp with single row of 7–9 corneous scales.

Color.—Living or recently preserved specimens have not been examined; in formalin or ethanol all colors fade to white or straw color.

Related Organisms.—Carcinoecia: only one specimen of *Enneobranchus bermudensis* was examined inhabiting the gastropod shell of *Olivella* sp. There is no external evidence of commensals or parasites in any of the specimens examined.

Behavior.—Living individuals were not observed.

Distribution.—Bermuda: off the coasts of Castle Roads and South of Tucker's Town; Bahama Islands: off the southwestern coast of Andros Island (Tongue of the Ocean); 16–110 m.

Etymology.—This species has been named for its type locality, off the West Coast of Castle Roads, Bermuda.

Acknowledgments

I am specially thankful to Dr. P. A. McLaughlin who supplied criticism during this research and reviewed the manuscript. I am indebted to the researchers and curators of the institutions and museums cited in the material section who provided specimens from their collections, to Dr. A. J. Provenzano for the use of his field notes and to Ms. Liset Barrera for typing services.

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DATE ACCEPTED: April 1, 1987.

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