

Two new species of Parapaguridae (Crustacea, Decapoda, Anomura, Paguroidea) with subconical corneas, and new data on biology of some rare species

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ABSTRACT

Two new parapagurid species with subconical corneas, *Oncopagurus conicus* n. sp. and *Paragiopagurus schnauzer* n. sp., are described based on collections by French expeditions to New Caledonia, the Philippines and Solomon Islands, in the western Pacific. These represent the 16th and 18th documented species of *Oncopagurus* Lemaitre, 1996 and *Paragiopagurus* Lemaitre, 1996, respectively. Two other parapagurids are known to have subconical corneas, *Sympagurus acinops* Lemaitre, 1989, and *Oncopagurus minutus* (Henderson, 1896). Also reported are specimens of two rare and morphologically unique parapagurids, *Typhlopagurus foresti* de Saint Laurent, 1972 and *Bivalvopagurus sinensis* (de Saint Laurent, 1972), and represent geographical and bathymetric range extensions for both species. The diagnoses of the monotypic genera *Typhlopagurus* and *Bivalvopagurus* are to be modified due to new data on morphology and biology. The former genus was given to include *T. foresti*, wrongly assumed to lack cornea, thus presumed blind; and the latter for *B. sinensis*, prematurely assumed to exclusively use bivalve shells as housing.

KEY WORDS

Crustacea,
Decapoda,
Anomura,
Parapaguridae,
Paragiopagurus,
Oncopagurus,
Typhlopagurus,
Bivalvopagurus,
hermit crabs,
deep-water,
mishnomers,
new species.

RÉSUMÉ

Deux nouvelles espèces de Parapaguridae (Crustacea, Decapoda, Anomura, Paguroidea) avec des cornées subconiques, et données nouvelles sur la biologie de quelques espèces rares.

Deux nouvelles espèces de Parapaguridae ayant des cornées subconiques, *Oncopagurus conicus* n. sp. et *Paragiopagurus schnauzer* n. sp., sont décrites en se basant sur des récoltes françaises faites dans le Pacifique ouest, en Nouvelle-Calédonie, aux Philippines et aux îles Salomon. Ces espèces sont, respectivement, les 16^e et 18^e décrites dans les genres *Oncopagurus* Lemaître, 1996 et *Paragiopagurus* Lemaître, 1996. Deux autres espèces de Parapaguridae ayant des cornées subconiques sont connues : *Sympagurus acinops* Lemaître, 1989 et *Oncopagurus minutus* (Henderson, 1896). Dans ce travail, sont également mentionnés des spécimens de deux espèces rares et présentant des caractères morphologiques uniques *Typhlopagurus foresti* de Saint Laurent, 1972 et *Bivalvopagurus sinensis* (de Saint Laurent, 1972), qui voient toutes deux leurs répartitions géographique et bathymétrique étendues. Les diagnoses des genres monotypiques *Typhlopagurus* et *Bivalvopagurus* doivent être modifiées du fait de données nouvelles sur la morphologie et la biologie. Le premier a été créé pour accueillir *T. foresti*, supposé à tort ne pas avoir de cornée et ainsi présumé aveugle, le second pour *B. sinensis*, prématurément supposé utiliser exclusivement des coquilles de bivalves pour s'abriter.

MOTS CLÉS

Crustacea,
Decapoda,
Anomura,
Parapaguridae,
Paragiopagurus,
Oncopagurus,
Typhlopagurus,
Bivalvopagurus,
bernard-l'ermite,
eau profonde,
noms mal fondés,
espèces nouvelles.

INTRODUCTION

The Parapaguridae or deep-water hermit crabs are classified in 10 genera (Lemaître 1996; McLaughlin 2003a). The majority of species are typically found at depths ranging from 200 to 3000 m, although one species, *Paragiopagurus diogenes* (Whitelegge, 1900), occurs as shallow as 40 m, and another, *Parapagurus saintlaurentae* Lemaître, 1999, is found as deep as 5020 m. This depth range for parapagurids includes the twilight zone (200-1000 m), where light penetrates minimally, and the zone below 1000 m where light does not penetrate at all (e.g., Marshall 1979; Castro & Huber 2003). Thus, it is not surprising that a good number of parapagurids have reduced ocular peduncles and corneas as an adaptation to limited light conditions.

The study of parapagurid samples obtained by French expeditions in the New Caledonian region continues to yield striking examples of morphological diversity in this hermit crab family. Although species with reduced corneas are common among several parapagurid genera, only two species in

the family were known to date to have subconical corneas: *Sympagurus acinops* Lemaître, 1989, and *Oncopagurus minutus* (Henderson, 1896). During this study, two new parapagurid species with subconical cornea have been discovered, and are fully described. When specimens of these new species were first encountered, they superficially appeared to represent a single species based on the shape of the ocular peduncles and corneas. However, a close study revealed not only that two new species were actually represented, but that they belong to different genera, *Oncopagurus* Lemaître, 1996, and *Paragiopagurus* Lemaître, 1996.

Also discovered during the study of the parapagurid samples were specimens of two intriguing taxa, *Typhlopagurus foresti* de Saint Laurent, 1972, and *Bivalvopagurus sinensis* (de Saint Laurent, 1972), the former previously known only from Borneo, and the latter from the South China Sea. Twenty-three specimens were found of *T. foresti*, a morphologically unique species previously known from only three type specimens. This taxon is the sole representative of *Typhlopagurus* de Saint Laurent, 1972, originally

described as lacking corneas, and as the generic name suggests, presumed blind. However, examination of these new specimens revealed the presence of corneas, thus the generic misnomer. The name of the monotypic genus *Bivalvopagurus* Lemaitre, 1993 was given “in reference to the common usage of a bivalve shell to shield its abdomen” (Lemaitre 1993: 12) by *B. sinensis*. During this study, three specimens of this unique species from the Philippines and the Solomon Islands were each found living in association with a *Stylobates*-like actinian with a small gastropod shell near the apex. Thus, the habitat of this parapagurid is not restricted to bivalve shells as previously assumed. The new material of *T. foresti* and *B. sinensis* is herein documented, and represents considerable horizontal and vertical range extensions for both taxa.

The specimens used remain deposited in the collections of the Muséum national d'Histoire naturelle, Paris (MNHN), with some duplicates in the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM). The general morphological terminology follows Lemaitre (1999, 2004). Information on the French expeditions, along with detailed station data can be found at <http://www.tropicaldeapseabenthos.org>. The measurements in millimeters included in the material examined are of shield length, measured from the midpoint of the rostrum to the midpoint of the posterior margin of the shield. Other abbreviations used in the manuscript are: BT, benthic trawl; C, CP, from the French “chalut” or “chalut à perches”, meaning beam-trawl or fishing trawl; DW, Warén dredge; ovig., ovigerous; stn, station.

SYSTEMATICS

Family PARAPAGURIDAE Smith, 1882
 Genre *Oncopagurus* Lemaitre, 1996

Oncopagurus conicus n. sp.
 (Figs 1-4)

TYPE MATERIAL. — Holotype: New Caledonia. HALI-PRO 1, stn C 858, 21°42'S, 166°41'E, 1000-1120 m, 20.III.1994, ♂ 2.0 mm (MNHN-Pg 7612).
 Paratypes: same stn as holotype, 2 ♀♀ 2.0, 2.4 mm

(MNHN-Pg 7613). — BIOGEOCAL, stn CP 214, 22°43'09'S, 166°27'19'E, 1590-1665 m, 9.IV.1987, 1 ♂ 2.1 mm, 1 ♀ 1.8 mm, 1 ovig. ♀ 2.1 mm (MNHN-Pg 7614).

ETYMOLOGY. — The specific epithet is from the Greek *konikos*, meaning cone-like, and refers to the shape of the corneas in this species.

DISTRIBUTION. — So far known only from the New Caledonian region; 1000 to 1665 m.

DESCRIPTION

Gills biserial (Fig. 1A). Shield (Fig. 1B, E) longer than broad; dorsal surface weakly calcified medially and sometimes also anteriorly, with scattered short setae; rostrum broadly rounded, weakly produced, with short mid-dorsal ridge; anterior margins weakly concave; lateral projections subtriangular, terminating in small spine; anterolateral margins sloping; posterior margin broadly rounded; ventrolateral margins of shield without spine. Anterodistal margin of branchiostegite rounded, unarmed, setose.

Ocular peduncles (Fig. 1C) more than half length of shield, diminishing in width distally, somewhat inflated ventroproximally; with longitudinal row of long setae dorsally; ventroproximal surface weakly calcified. Cornea reduced, subconical, usually ending sharply. Ocular acicles subtriangular, terminating in strong spine; separated basally by about basal width of one acicle.

Antennular peduncle long, slender, exceeding distal margin of cornea by at least 0.25 length of penultimate segment. Ultimate segment nearly twice as long as penultimate segment, with scattered setae. Basal segment with strong ventromesial spine; lateral face with distal subrectangular unarmed except for setae, and strong spine proximally. Ventral flagellum with four or five articles.

Antennal peduncle (Fig. 1F) exceeding distal margin of cornea by about 0.2 length of fifth segment. Fifth segment unarmed, but with scattered setae. Fourth segment unarmed. Third segment with strong ventromesial distal spine. Second segment with dorsolateral distal angle produced, terminating in strong, simple spine; mesial margin with spine on dorsodistal angle. First segment with lateral face unarmed or with small spine; ventromesial angle produced, with two or three small blunt spines

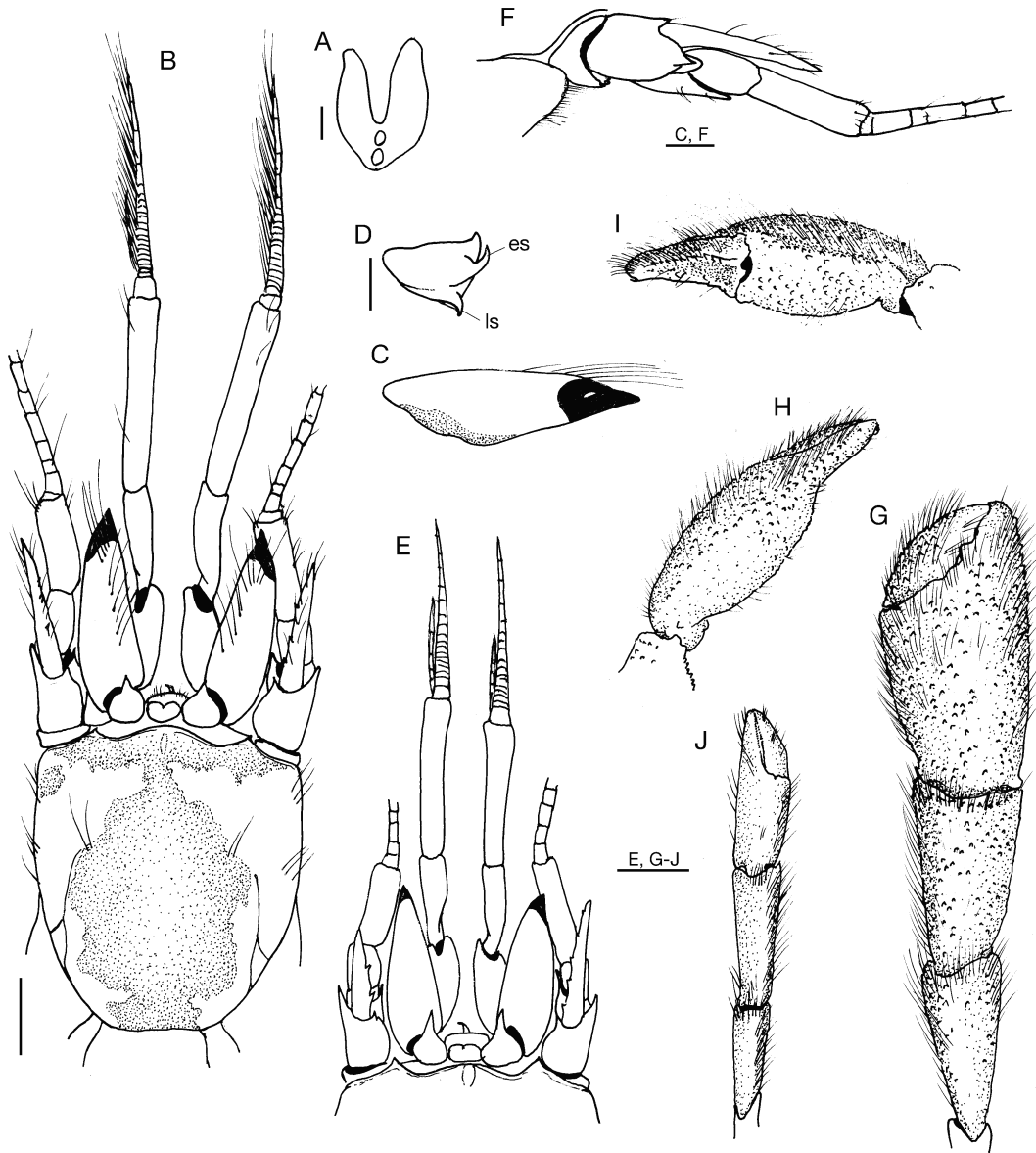


FIG. 1. — *Oncopagurus conicus* n. sp., New Caledonia: **A**, ♀ paratype 2.0 mm, HALIPRO 1, stn C 858 (MNHN-Pg 7613); **B-D, F-J**, ♂ holotype 2.0 mm, HALIPRO 1, stn C 858 (MNHN-Pg 7612); **E**, ovig. ♀ paratype 2.1 mm, BIOGEOCAL, stn CP 214 (MNHN-Pg 7614); **A**, gill lamella; **B**, shield and cephalic appendages, dorsal (stippling indicates weakly calcified portion); **C**, right ocular peduncle and cornea, lateral; **D**, epistome, dorsolateral (**es**, epistomial spine; **ls**, labral spine); **E**, anterior portion of shield and cephalic appendages, dorsal; **F**, right antennal peduncle, lateral; **G**, right cheliped, dorsal; **H**, chela of same, lateral; **I**, same, mesial; **J**, left cheliped, dorsal. Scale bars: A, 0.10 mm; B, 0.50 mm; C-F, 0.25 mm; G-J, 1 mm.

laterally. Antennal acicle nearly straight (in dorsal view), not reaching distal margin of cornea, terminating in strong spine; mesial margin armed with

two to five small spines, setose. Flagellum long, slightly exceeding extended right cheliped, articles with setae < 1-3 flagellar articles in length.

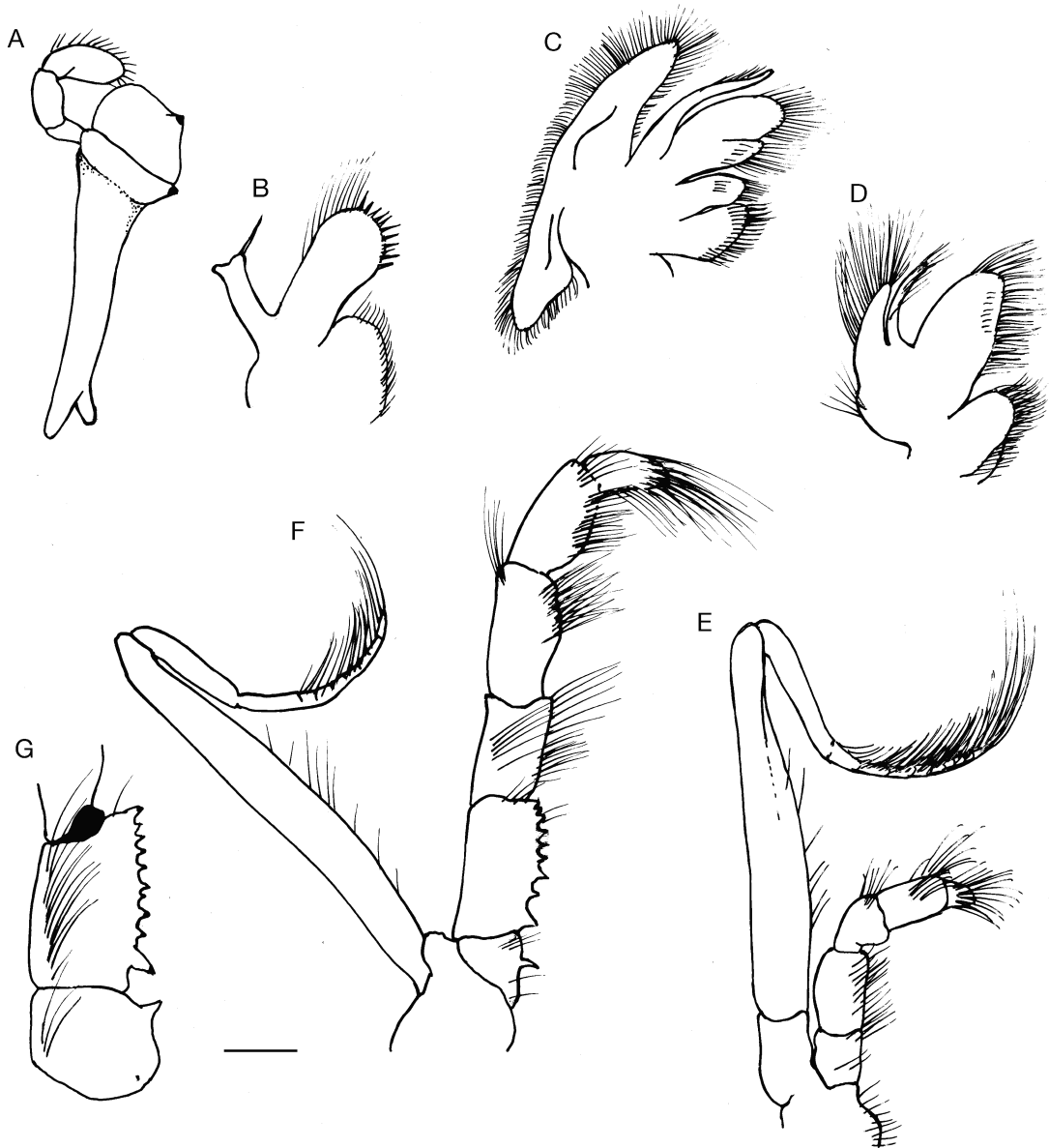


FIG. 2. — *Oncopagurus conicus* n. sp., ♀ paratype 2.0 mm, HALIPRO 1, stn C 858, New Caledonia (MNHN-Pg 7613), left mouthparts, internal: **A**, mandible; **B**, maxillule; **C**, maxilla; **D**, first maxilliped; **E**, second maxilliped; **F**, third maxilliped; **G**, ischium and crista dentata of same, external. Scale bar: 0.25 mm.

Mandible (Fig. 2A) with three-segmented palp; cutting edge calcified, with small corneous tooth medially; molar process with small corneous tooth medially. Maxillule (Fig. 2B) with external lobe

of endopod slender, moderately developed, not recurved, internal lobe with long, terminal seta. Maxilla (Fig. 2C) with endopod exceeding distal margin of scaphognathite. First maxilliped (Fig. 2D)

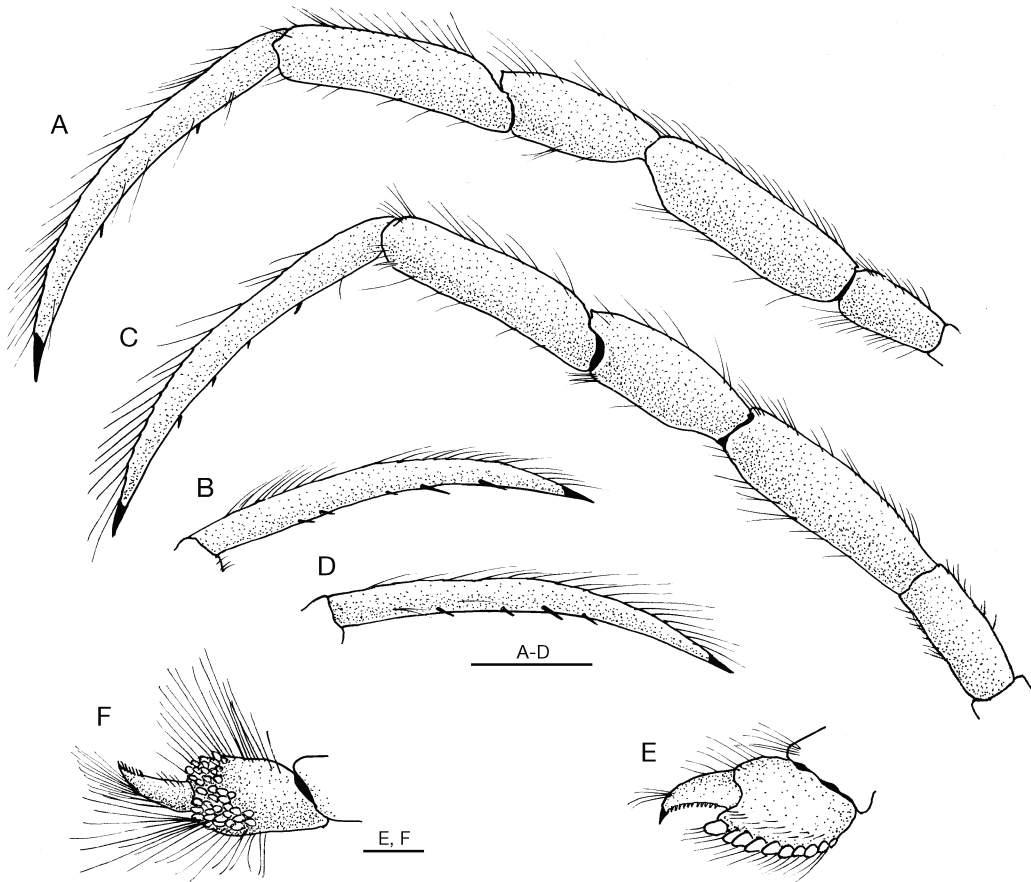


FIG. 3. — *Oncopagurus conicus* n. sp., ♂ holotype 2.0 mm, HALIPRO 1, stn C 858, New Caledonia (MNHN-Pg 7612): **A**, left second pereopod, lateral; **B**, dactyl of same, mesial; **C**, left third pereopod, lateral; **D**, dactyl of same, mesial; **E**, propodus and dactyl of left fourth pereopod, lateral; **F**, propodus and dactyl of left fifth pereopod, lateral. Scale bars: A-D, 1 mm; E, F, 0.20 mm.

with endopod exceeding exopod in distal extension. Second maxilliped (Fig. 2E) without distinguishing characters. Third maxilliped (Fig. 2F, G) with merus to dactyl each distinctly longer than broad, ischium about twice as long as broad; crista dentata with about nine corneous-tipped teeth; basis with mesial spine; coxa lacking spine. Sternite of third maxillipeds with small spine on each side of midline. Epistomial spine slender, strongly curved upward (Fig. 1D).

Chelipeds markedly dissimilar. Right cheliped (Fig. 1G-I) relatively slender, with moderately dense setae on dorsal surfaces of carpus and chela. Fingers nearly straight, terminating in small, usually blunt

corneous claw; cutting edges with two (dactyl) or three (fixed finger) large calcareous teeth. Dactyl about as long as mesial margin of palm, set at weak oblique angle to longitudinal axis of palm; mesial margin broadly curved, well defined by row of blunt or sharp spines diminishing in size distally; dorsal face with scattered small tubercles, ventral face smooth, ventromesial face concave. Fixed finger broad at base, dorsal and ventral faces with scattered small spines or tubercles. Palm longer than broad, lateral surface rounded, sometimes with dorsolateral margins weakly delimited by row of small spines; mesial face rounded, with scattered small tubercles; dorsomesial margin delimited by

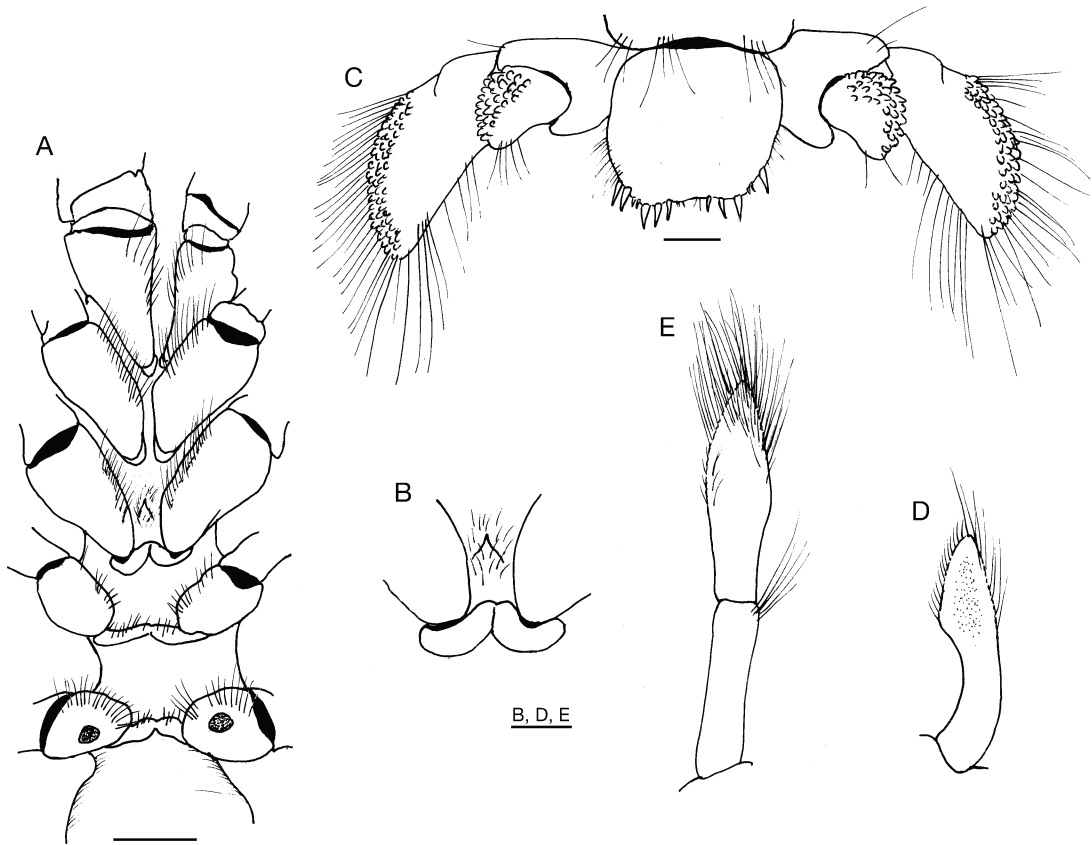


FIG. 4. — *Oncopagurus conicus* n. sp., ♂ holotype 2.0 mm, HALIPRO 1, stn C 858, New Caledonia (MNHN-Pg 7612); **A**, thoracic region, ventral; **B**, anterior and posterior lobes of thoracic sternite XII (third pereopods), ventral; **C**, uropods and telson, dorsal; **D**, left first pleopod, mesial; **E**, left second pleopod, anterior. Scale bars: A, 0.50 mm; B, D, E, 0.20 mm; C, 0.25 mm.

row of small blunt or sharp spines; dorsal surface with well spaced small spines or tubercles; ventral surface with scattered small tubercles. Carpus with dorsolateral margin rounded; dorsal surface with well spaced small spines or tubercles; ventromesial margin with row of spines; ventral face with scattered small tubercles. Merus with setae mostly dorsally and on mesial and ventral surfaces; ventromesial margin with row of spines. Ischium and coxa unarmed, but with ventromesial row of setae.

Left cheliped (Fig. 1J) sometimes weakly calcified medially on merus and carpus. Fingers terminating in small corneous claw; dorsal and ventral surfaces unarmed except for scattered tufts of setae; cutting edge of dactyl with row of minute, fused corneous

teeth; cutting edge of fixed finger with row of well spaced small corneous teeth. Dactyl slightly shorter than mesial margin of palm in length. Palm unarmed except for dorsomesial and dorsolateral setae; ventral face smooth. Carpus with dorsodistal spine; dorsal margin with long setae; ventral face smooth. Merus with long setae on dorsal margin; ventral face smooth. Ischium and coxa unarmed, but with ventromesial row of setae.

Ambulatory legs (Fig. 3A-D) or second and third pereopods similar right from left except for longer meri on right; exceeding extended right cheliped by about 0.20 or less length of dactyls. Dactyl broadly curved, about twice as long as propodus, and terminating in sharp corneous claw; with dorsal

and dorsomesial distal rows of long setae, and ventromesial row of about four to seven slender, corneous spines. Propodus with row of setae on dorsal margin, and scattered setae on ventral margin. Carpus with small dorsodistal spine, and long setae dorsally. Merus and ischium unarmed except for setae on dorsal and ventral margins. Coxa with ventromesial row of setae. Anterior lobe of sternite XII (third pereopods, Fig. 4A, B) subsemicircular, setose, with distinct spine.

Fourth pereopod (Fig. 3E) semichelate. Dactyl terminating in sharp corneous claw; with ventrolateral row of small corneous spinules. Propodus longer than broad, rasp with one row of rounded scales at least distally. Carpus with long setae on dorsal margin. Merus with rows of long setae on dorsal and ventral margins.

Fifth pereopod (Fig. 3F) semichelate. Propodal rasp extending to mid-length of segment.

Uropods and telson symmetrical or nearly so (Fig. 4C). Telson lacking transverse suture; dorsal surface with scattered short setae; lateral margins with long setae distally; posterior margin separated into shallow or obsolete U-shaped cleft into rounded projections, each armed with about four to seven corneous spines, some often ventrally curved.

Male first gonopod (Fig. 4D) with weakly concave distal lobe; second gonopod (Fig. 4E) lacking rudimentary exopod, distal segment with row of short bristles on lateral margin medially, and long setae on distomesial face. Female with short, uniramous, unsegmented second right pleopod.

Coloration

Live coloration unknown.

HABITAT

Scaphopod shells.

REMARKS

An important character to consider in separating this new *Oncopagurus* species as well as other congeners from those of other parapagurid genera, is the presence of an upwardly curved epistomial spine (Fig. 1D). This new species is the second found in the genus *Oncopagurus* to have reduced, subconical corneas, the other is *O. minutus*. The two can

be separated using subtle characters. In the new species the corneas terminate sharply (Fig. 1C) whereas in *O. minutus* they terminate bluntly; the antennal acicles are armed mesially with weak spines (Fig. 1B, E), whereas in *O. minutus* the spines are strong; the dactyls of the ambulatory legs are armed on the ventral margins with long spinules (Fig. 3B, D), whereas in *O. minutus* the spinules are short; the uropods and telson are symmetrical or nearly so (Fig. 4C), whereas in *O. minutus* they are markedly asymmetrical.

Paragiopagurus schnauzer n. sp. (Figs 5-8)

TYPE MATERIAL. — Holotype: New Caledonia. BIOGEOCAL, stn CP 214, 22°43.09'S, 166°27.19'E, 1590-1665 m, 9.IV.1987, ♂ 3.3 mm (MNHN-Pg 7615). Paratype: Loyalty Islands. HALIPRO 2, stn BT 105, 25°45'S, 162°50'E, 1200-1218 m, 27.XI.1996, 1 ♂ 3.2 mm (MNHN-Pg 6705).

ETYMOLOGY. — The honoree of this *Zoosystema* issue will be pleased to see her favorite Schnauzer dog breeds, the Standard and Giant, recognized in the naming of this new species. Many generations of these noble and loyal dogs have provided her with loving company and protection.

DISTRIBUTION. — So far known only from the New Caledonian region; 1200 to 1665 m.

DESCRIPTION

Gills quadriserial (Fig. 5A), deeply divided. Shield (Fig. 5B) distinctly longer than broad, weakly calcified medially; dorsal surface with few short rows of setae. Rostrum broadly subtriangular, reaching well in advance of lateral projections; with short mid-dorsal ridge. Anterior margins of shield straight; lateral projections broadly rounded; anterolateral margins sloping; anteroventral margins unarmed. Anterodistal margin of branchiostegite rounded, unarmed, setose.

Ocular peduncles (Fig. 5C) stout, diminishing in width distally, somewhat inflated ventroproximally; with longitudinal row of long setae dorsally; ventroproximal surface weakly calcified. Corneas reduced, subconical, terminating bluntly or sharply. Ocular acicles subtriangular, each terminating in

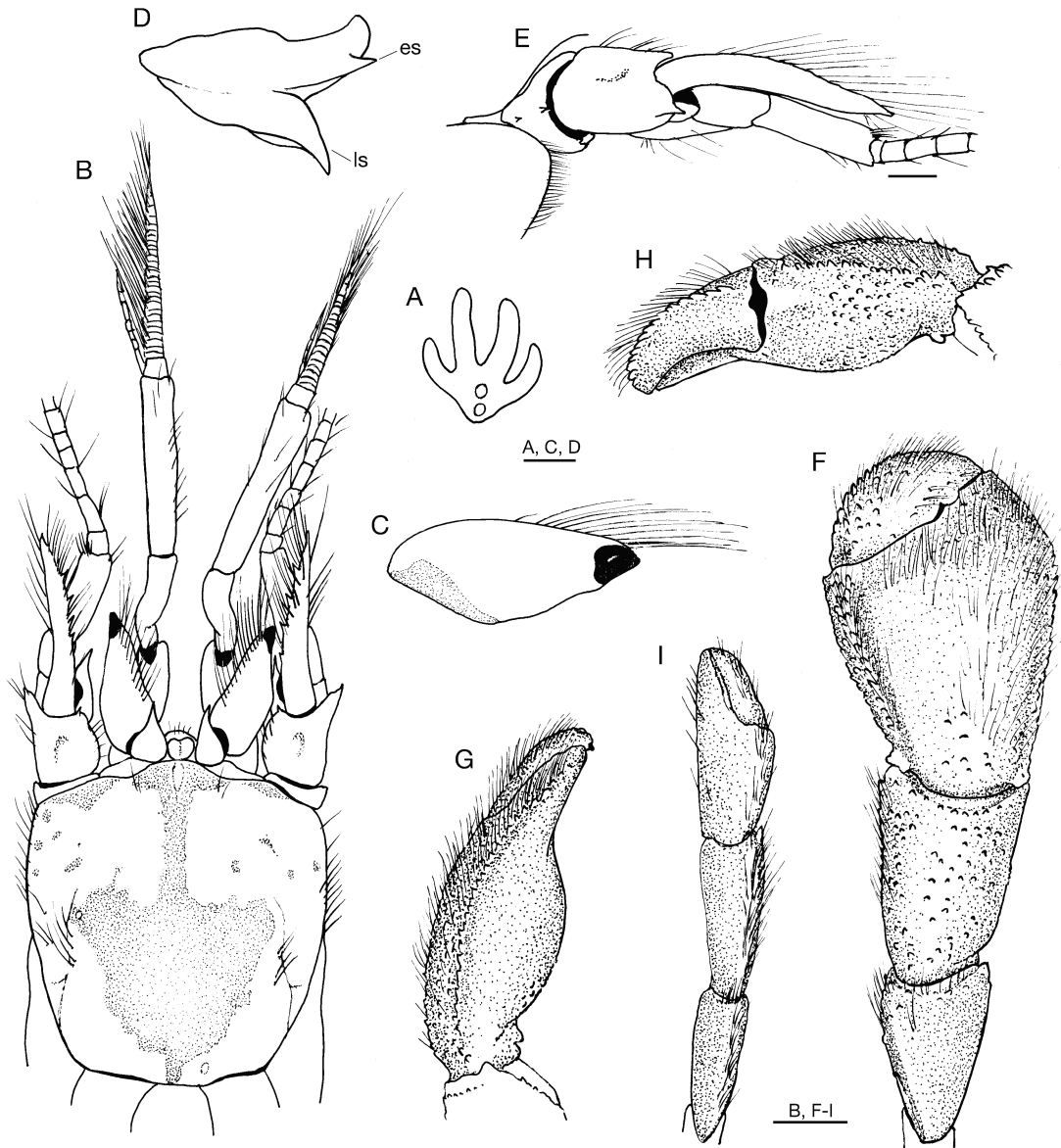


FIG. 5. — *Paragiopagurus schnauzer* n. sp., ♂ holotype 3.3 mm, BIOGEOCAL, stn CP 214, New Caledonia (MNHN-Pg 7615): **A**, gill lamella; **B**, shield and cephalic appendages, dorsal (stippling indicates weakly calcified portion); **C**, right ocular peduncle and cornea, lateral; **D**, epistome, dorsolateral (**es**, epistomial spine; **ls**, labral spine); **E**, right antennal peduncle, lateral; **F**, right cheliped, dorsal; **G**, chela of same, lateral; **H**, same, mesial; **I**, left cheliped, dorsal. Scale bars: A, C, D, 0.25 mm; B, F-I, 1 mm; E, 0.50 mm.

strong spine; separated basally by about basal width of one acicle.

Antennular peduncles exceeding distal margin of corneas by 0.66 to nearly full length of penultimate

segment; segments with scattered setae. Ultimate segment about 1.5 times as long as penultimate. Basal segment with strong ventromesial spine; lateral face with distal subrectangular armed with

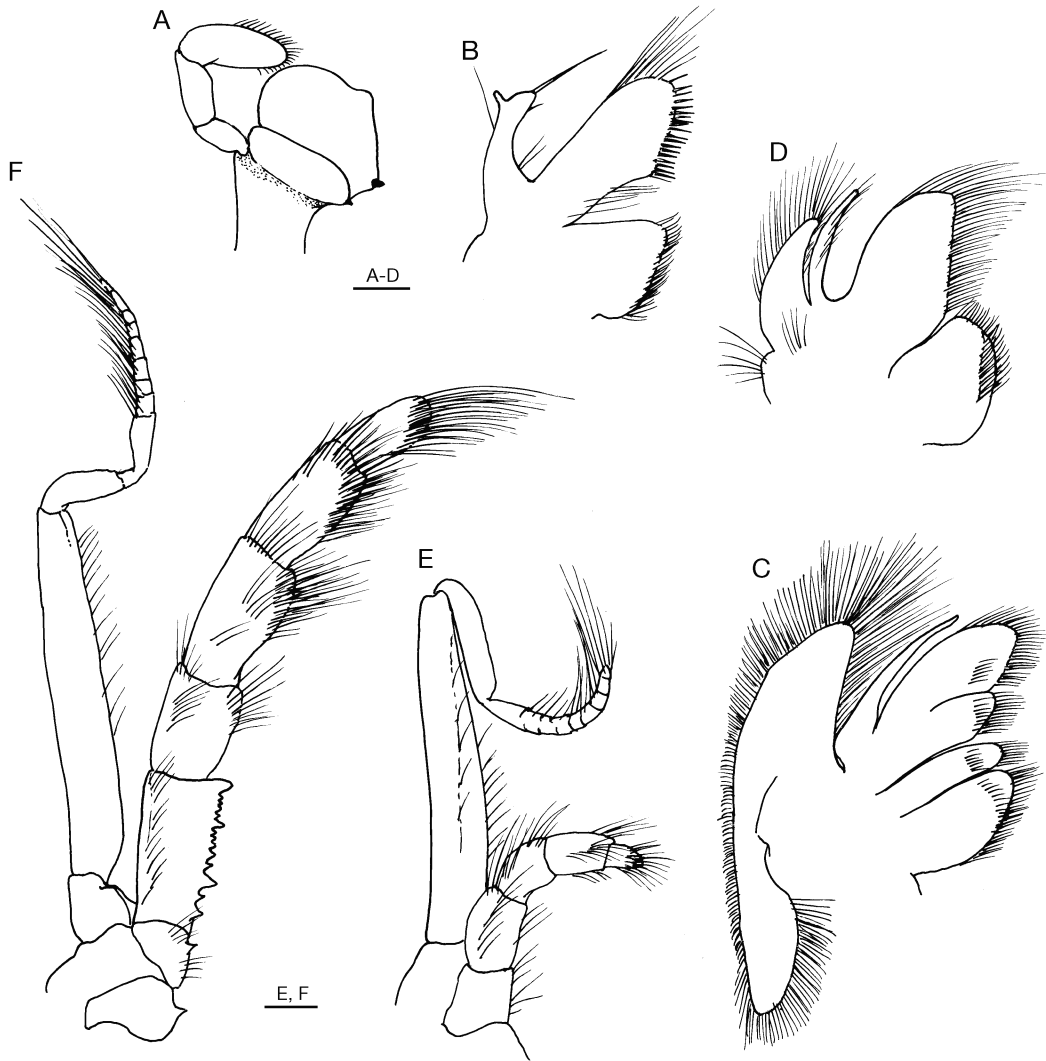


FIG. 6. — *Paragiopagurus schnauzer* n. sp., ♂ paratype 3.2 mm, HALIPRO 2, stn BT 105, Loyalty Islands (MNHN-Pg 6705), left mouthparts, internal: **A**, mandible; **B**, maxillule; **C**, maxilla; **D**, first maxilliped; **E**, second maxilliped; **F**, third maxilliped. Scale bars: 0.25 mm.

one spine, and strong spine proximally. Ventral flagellum with six articles.

Antennal peduncles (Fig. 5E) exceeding distal margin of corneas by 0.30 length of fifth segment. Fifth segment with row of mesial setae. Fourth segment lacking spine on dorsodistal margin. Third segment with strong ventromesial distal spine. Second segment with dorsodistal angle produced, terminating in strong spine. First segment with

small spine on lateral face; ventromesial angle produced, with row of one to three small spines laterally. Antennal acicle exceeding distal margin of cornea by about half length of acicle, terminating in strong spine; mesial margin with long setae, and armed with four to eight spines. Flagellum slightly exceeding distal margin of palm of right cheliped; with numerous short and long setae < 1-4 flagellar articles in length.

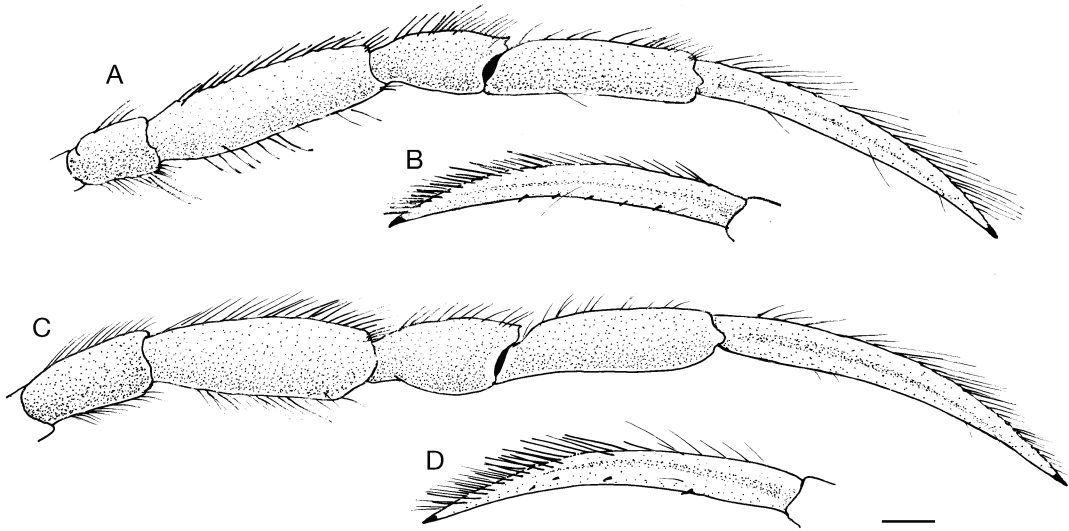


FIG. 7. — *Paragiopagurus schnauzer* n. sp., ♂ holotype 3.3 mm, BIOGEOCAL, stn CP 214, New Caledonia (MNHN-Pg 7615): **A**, right second pereopod, lateral; **B**, dactyl of same, mesial; **C**, right third pereopod, lateral; **D**, dactyl of same, mesial. Scale bar: 1 mm.

Mandible (Fig. 6A) with three-segmented palp; cutting edge calcified, with small corneous tooth medially; molar process with small corneous tooth medially. Maxillule (Fig. 6B) with external lobe of endopod slender, moderately developed, not recurved, internal lobe with long, terminal seta. Maxilla (Fig. 6C) with endopod slightly exceeding distal margin of scaphognathite. First maxilliped (Fig. 6D) with endopod exceeding exopod in distal extension. Second maxilliped (Fig. 6E) without distinguishing characters. Third maxilliped (Fig. 6F) slender, merus to dactyl each distinctly longer than broad, ischium about twice as long as broad; crista dentata with about 14 corneous-tipped teeth; coxa and basis each with mesial spine. Sternite of third maxillipeds with small spine on each side of midline. Epistomial spine straight, simple.

Chelipeds markedly dissimilar. Right cheliped (Fig. 5F-H) with at most moderately dense, mostly plumose setae on dorsal surfaces of carpus and chela. Fingers slightly curved ventromesially, terminating in small, blunt corneous claws; cutting edges each with row of small blunt, or broadly rounded, unequal calcareous teeth, and with distal row of small corneous teeth (often worn out on fixed finger). Dactyl set at strongly oblique angle to longitudinal

axis of palm; mesial margin well defined by row of spines or tubercles; dorsomesial surface with small spines; ventromesial face not concave or weakly so. Fixed finger broad basally, with scattered small tubercles on dorsal surface, unarmed on ventral surface except for a few tufts of setae. Palm broadening distally, slightly broader than long; dorso-lateral margin well defined by small spines at least on distal half; dorsomesial margin with irregular row of small spines, mesial face rounded. Carpus longer than broad; dorsal surface with few, widely separated small tubercles or spines; dorsodistal margin with row of small spines; mesial surface rounded, with few small tubercles, ventrolateral and ventromesial distal margins each with row of small blunt spines. Merus usually with row of small spines on dorsodistal margin; with ventromesial distal row of small spines. Ischium and coxa with ventrodistal row of setae.

Left cheliped (Fig. 5I) well calcified, reaching when fully extended to about distal 0.50-0.75 of mesial margin of palm of right cheliped; dorsal margins carpus and dorsomesial margin of palm with long setae, otherwise with scattered short setae. Fingers terminating in sharp corneous claws; dorsal and ventral surfaces unarmed except for

tufts of setae; cutting edge of dactyl with row of closely-set small corneous teeth, cutting edge of fixed finger with small, rounded calcareous teeth. Dactyl about as long as mesial margin of palm. Palm dorsal surface usually with small median spine or tubercle proximally; dorsomesial margin with row of few low, setose tubercles. Carpus with strong dorsodistal spine. Ischium and merus with setae on dorsal and ventral margins. Coxa with ventromesial row of setae.

Ambulatory legs or second and third pereopods (Fig. 7A-D) similar from right to left except for slightly longer meri on right; when fully extended reaching to, or slightly exceeding distal margin of right cheliped by about 0.2 or less length of dactyls. Dactyl 1.8 to 2.1 times as long as propodus, broadly curved, terminating in sharp corneous claw; with dorsal and distomesial rows of long setae; ventromesial surface with row of four to six small, corneous spinules. Propodus and carpus each with dorsal row of setae. Carpus with small dorsodistal spine. Merus with dorsal and ventral rows of setae. Ischium and coxa with ventromesial row of setae. Anterior lobe of sternite XII (third pereopods, Fig. 8C, D) subsemicircular, sparsely setose, lacking spine.

Fourth pereopod (Fig. 8A) subchelate; merus, carpus, and propodus with setae on dorsal and ventral margins. Dactyl subtriangular, terminating in sharp corneous claw; with ventrolateral row of small corneous spinules. Propodus longer than wide, rasp consisting of one row (at least distally) of ovate scales.

Fifth pereopod (Fig. 8B) semichelate. Propodal rasp extending slightly beyond mid-length of segment. Dactyl with row of small rounded scales on ventral surface (in lateral view), lacking subterminal corneous tooth on prehensile margin.

Uropods and telson symmetrical or nearly so (Fig. 8E). Telson with weak or obsolete transverse suture; dorsal surface with scattered short setae and often low, blister-like tubercles; lateral margins with long setae mostly on distal half; posterior margin separated by shallow, narrow U-shaped cleft, into rounded projections each armed with about eight to 10 corneous spines, some often ventrally curved.

Male first gonopod (Fig. 8F) with concave distal lobe; second gonopod (Fig. 8G) with or without rudimentary exopod, distal segment with row of short bristles on lateral margin medially, and long setae on distomesial face. Female unknown.

Coloration

Live coloration unknown.

HABITAT

Scaphopod shells.

REMARKS

This new species is unique among *Paragiopagurus* species in having reduced, subconical corneas. As previously mentioned, it is only superficially similar to *Oncopagurus conicus* n. sp., and in addition to differences in generic characters, the two differ markedly in gill shape, quadriserial (Fig. 5A) in *P. schmauzer* n. sp., biserial (Fig. 1A) in *O. conicus* n. sp.; length of ocular peduncles relative to the shield, less than 0.50 shield length in *P. schmauzer* n. sp., more than 0.50 shield length in *O. conicus* n. sp.; and distal extension of the antennal acicles relative to the ocular peduncles, exceeding distal margins of corneas by about 0.50 length of the acicle in *P. schmauzer* n. sp., not exceeding distal margins of the corneas in *O. conicus* n. sp.

INTERESTING NEW MATERIAL AND MISNOMERS IN THE FAMILY

Typhlopagurus foresti de Saint Laurent, 1972 (Fig. 9A-C)

Typhlopagurus foresti de Saint Laurent, 1972: 118, figs 26-29 (type locality: Borneo, 4°19'54"N, 118°58'38"E, 1630 m).

TYPE MATERIAL. — Holotype: **Borneo**. *Albatross*, stn 5582, 4°19'54"N, 118°58'38"E, 1630 m, 26.IX.1909, ♂ 3.6 m (USNM 168313).

Paratypes: same stn data as holotype, 2 ♀♀ 2.0, 2.3 mm (USNM 168314).

OTHER MATERIAL EXAMINED. — **Solomon Islands**. SALOMON 1, stn CP 1781, 8°31.2'S, 160°37.7'E, 1036-1138 m, 29.IX.2001, 1 ♂ 3.7 mm, 2 ♀♀ 1.7, 1.8 mm, 3 ovig. ♀♀ 2.9-3.1 mm (USNM 1084207; ex

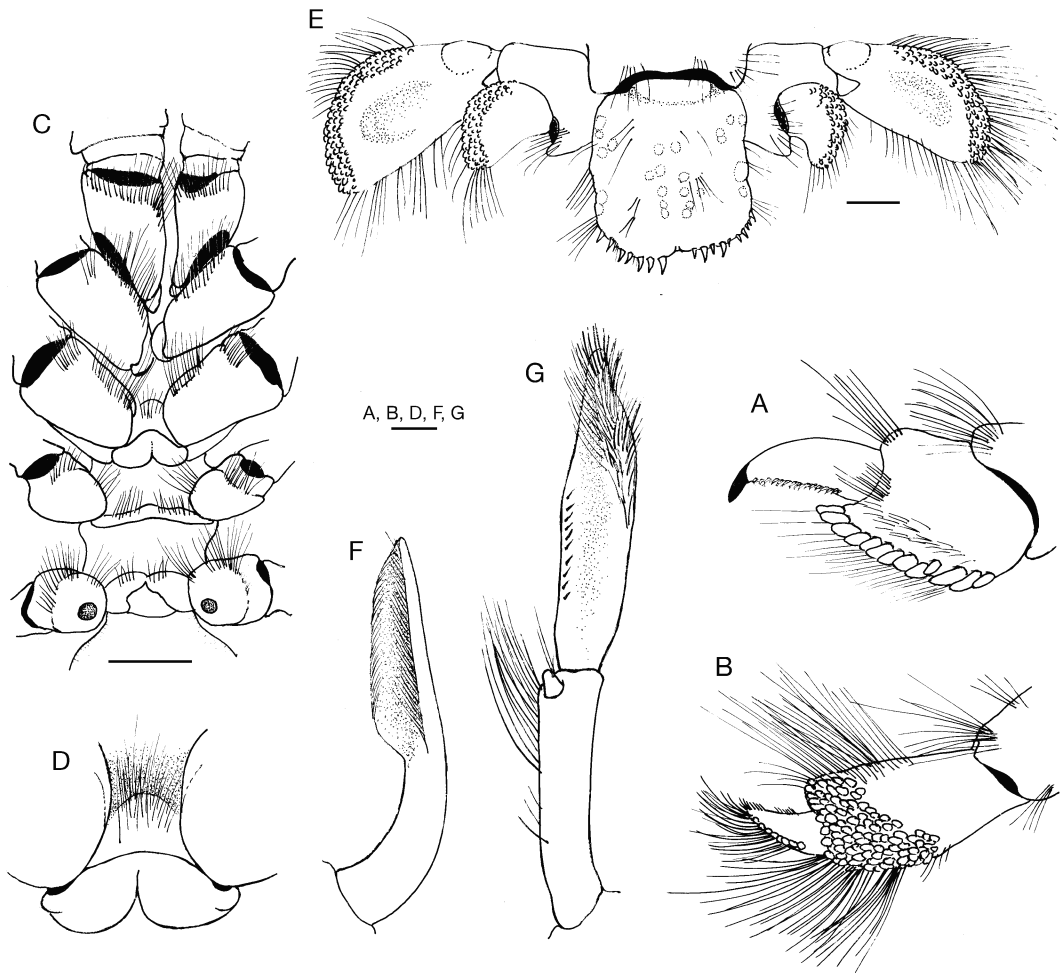


FIG. 8. — *Paragiopagurus schnauzer* n. sp., ♂ holotype 3.3 mm, BIOGEOCAL, stn CP 214, New Caledonia (MNHN-Pg 7615): **A**, propodus and dactyl of left fourth pereopod, lateral; **B**, propodus and dactyl of left fifth pereopod, lateral; **C**, thoracic region, ventral; **D**, anterior and posterior lobes of thoracic sternite XII (third pereopods), ventral; **E**, uropods and telson, dorsal; **F**, left first pleopod, mesial; **G**, left second pleopod, anterior. Scale bars: A-D, F, G, 1 mm; E, 0.5 mm.

MNHN-Pg 6706); 12 ♂♂ 3.4-4.4 mm, 2 ovig. ♀♀ 2.4, 2.5 mm (MNHN-Pg 6707); stn DW 1853, 9°46.5'S, 160°52.9'E, 222-240 m, 7.X.2001, 3 ♂♂ 2.5-4.5 mm (MNHN-Pg 6708).

DISTRIBUTION. — Off northeastern Borneo, and now Solomon Islands; 222-1620 m.

REMARKS

De Saint Laurent (1972) erroneously cited the Philippines as the locality for *Albatross* stn 5582,

the type locality. Actually, this station is off northeastern Borneo, south of Darvel Bay, Sabah. Previously known from only the type locality at 1630 m depth, *T. foresti* has now been found in the Solomon Islands at 222 m.

This is a rare and morphologically unusual species, and thus it is of interest to document that compared to most other parapagurids, females of *T. foresti* carry large and relatively few eggs. One of the ovigerous females herein reported with a shield

length 2.7 mm (MNHN-Pg 6706), was found with a full load of eggs, only 11 in total, and each about 1.3 mm in diameter.

All the new specimens of *T. foresti* clearly have pigmented corneas, although small and located ventrodistally on the peduncle, at the base of a large terminal spine (Fig. 9A-C). The corneas are not easily observed in dorsal view. It appears that the corneal pigmentation disappears in preservation over time, or perhaps pigmentation is often absent, and this might explain why de Saint Laurent (1972) considered this species to lack corneas. A reexamination of the type material has shown that indeed the types lack pigment in the corneas. However, in the types as well the additional material here reported, the corneas can be discerned by the presence of corneal cuticular facets.

The new material of *T. foresti* extends the horizontal range of this species considerably to the west on the western Pacific. The vertical range is extended upward to a depth of 222 m, or 1408 m shallower than previously known.

Bivalvopagurus sinensis (de Saint Laurent, 1972)

Parapagurus sinensis de Saint Laurent, 1972: 116, figs 12, 24 (type locality: South China Sea, 16°19.3'N, 114°29'E, 220 m).

Sympagurus sinensis – Lemaitre 1989: 37.

Bivalvopagurus sinensis – Lemaitre 1993: 12, figs 1-4.

TYPE MATERIAL. — Holotype: **South China Sea**. Fisheries Research Station Hong Kong, Cruise 7, stn 55, transect 172, 16°19.3'N, 114°29'E, 220 m, [no date], ♂ 9.0 mm (MNHN-Pg 1238).

Paratype: same stn data as holotype, ♂ 7.3 mm (MNHN-Pg 2239).

OTHER MATERIAL EXAMINED. — **Philippines**. MUSORSTOM 2, stn CP 79, 13°45'S, 120°32'E, 682-770 m, 1.XII.1980, 1 ♂ 7.9 mm (MNHN-Pg 6415).

MUSORSTOM 3, stn CP 133, 11°58'S, 121°52'E, 334-390 m, 5.VI.1985, 1 ♀ 11.7 mm (MNHN-Pg 6700). **Solomon Islands**. SALOMON 1, stn CP 1833, 10°11.8'S, 161°18.7'E, 367-533 m, 5.X.2000, 1 ovig. ♀ 8.4 mm (MNHN-Pg 6701).

DISTRIBUTION. — South China Sea, and now the Philippines, and Solomon Islands; 200-770 m.

REMARKS

As previously mentioned, Lemaitre (1993) gave the name *Bivalvopagurus* to this monotypic genus presuming that its only species, *B. sinensis*, used exclusively mollusks bivalve shells as housing. The considerable number of specimens (122) of this species available to Lemaitre (1993), many of which were found living in bivalve shells with an actinian (although some hermit specimens were also found preserved without any housing), led to the derivation of the generic name. The new specimens reported here were each found living with a *Stylobates*-like actinian completely covering a very small gastropod shell near the apex of the carinoecia. Thus, the habitat used by *B. sinensis* is variable, and the generic name was evidently prematurely chosen. The new material of *B. sinensis* extends the range of this species considerably to the south and west of the western Pacific.

DISCUSSION

Among parapagurids there are five genera, *Oncopagurus*, *Parapagurus* Smith, 1879, *Sympagurus* Smith, 1883, *Tylaspis* Henderson, 1885, and *Probeebei* Boone, 1926, with species having reduced corneas, i.e. no larger in diameter than the distal width of the ocular peduncle. The corneas in most of these species are subcircular, such as in *Parapagurus saintlaurentae* (Fig. 9E). Among these, subconical corneas are now known in four species: *S. acinops* (Fig. 9D), ranging from 1000 to 2500 m; *O. minutus*, ranging from 800-2308 m; *O. conicus* n. sp., ranging from 1000 to 2500 m; and *P. schnauzer* n. sp., ranging from 1200-1665 m (see Lemaitre 1989, 1996, 1998, 2004). Subconical corneas have been documented in species of other hermit crab families as well, such as in the Paguridae *Bathypaguropsis microps* (Balss, 1911), a species ranging in depth from 455 to 1079 m (McLaughlin 2003b); and in species of the Pylochelidae genus *Cheiroplatea* Bate, 1888, found in depths from 200 to 567 m (Forest 1987). Thus, this morphological feature clearly has evolved independently in various paguroid genera, and is not indicative of any phylogenetic relationship. Reduced ocular peduncles or corneas have been

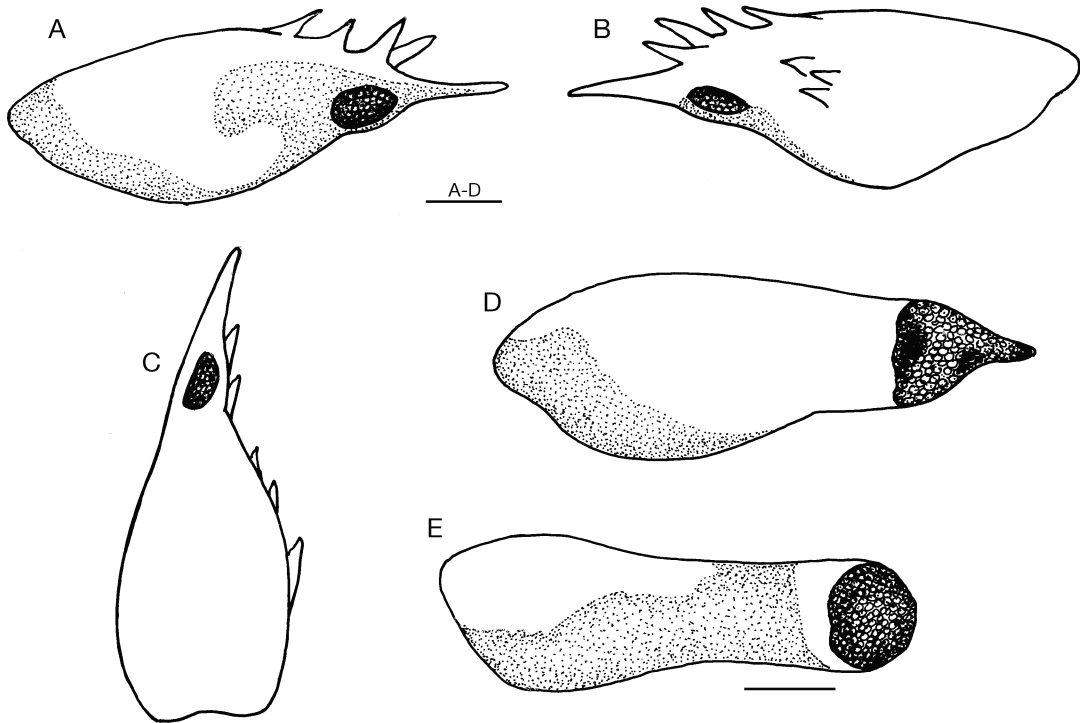


FIG. 9. — Right ocular peduncle and cornea (stippling indicates weakly calcified portion): **A-C**, *Typhlopagurus foresti* de Saint Laurent, 1972, ♂ 3.7 mm, SALOMON 1, stn CP 1781 (USNM 1084207, ex MNHN-Pg 6706); **D**, *Sympagurus acinops* Lemaitre, 1989, ♂ paratype 3.2 mm, Tongue of the Ocean, Bahamas, 1438 m (USNM 231834); **E**, *Parapagurus saintlaurentae* Lemaitre, 1999, ♂ paratype 12.8 mm, N of Madagascar, 4810 m (USNM 276123); **A, D, E**, lateral; **B**, mesial; **C**, ventral. Scale bars: A-D, 0.25 mm; E, 1 mm.

documented for other deep-sea crustaceans as well (e.g., Barnard *et al.* 1962; Menzies *et al.* 1973).

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