

**THE HERMIT CRABS
(CRUSTACEA DECAPODA, PAGURIDEA)
OF NORTHWESTERN NORTH AMERICA**

by

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With 101 text figures, 1 map, and 1 plate

Abstract. — A systematic study has been made of the Paguridea (exclusive of the Lithodidae) from northwestern North America. In addition to the redescription of all known species, two subgenera are herein raised to generic rank and a new genus is described. Several systematic problems have been resolved, and have resulted in the suppression of several specific names familiar to North American carcinologists.

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INTRODUCTION

In northwestern North America the Paguridea (exclusive of the Lithodidae) constitute a major component of the reptant decapod fauna. Although three families, the Diogenidae, Parapaguridae, and Paguridae, are indigenous to the region, only the Paguridae are represented by more than one or two species of a single genus. With the exception of three new species recently described by Hart (1971), our knowledge of the pagurids of the area has been derived primarily from the works of Brandt (1851), Dana (1851, 1852a-d, 1855), Stimpson (1857, 1858, 1859a, b, 1863, 1864), Benedict (1892), and Stevens (1925). The intuitive abilities of these early carcinologists to recognize and distinguish between closely related species was exceptional. However, their difficulty in translating this "sixth sense" into descriptive phrases which could be interpreted by subsequent workers has resulted in virtual taxonomic chaos. Only a brief review of the existing literature is needed to point out the sources of many problems.

One major problem is caused by the ambiguities which appear in the literature regarding the publication dates of many of Dana's and Stimpson's reports. These ambiguities can be traced, for the most part, to the customs of the times. Scientific findings, including descriptions of new species, often were presented at meetings of scientific societies, and appeared later in the published records of the societies. However, frequently, parts of particular papers were also published separately, usually in advance of the society's publication. Such was the case of Dana's reports of the U. S. Exploring Expedition which appeared, in part, in 1852 and, in part, in 1855. These reports first appeared in four separate parts during late 1851 and early 1852. Similarly, several of Stimpson's papers appear both as preprints and later as part of the publication of a particular society. Where known, these separate publications are noted in the literature cited.

With the exception of the report by Murdoch (1885) on the results of an expedition to Point Barrow, Alaska, little information was added to our knowledge of the northwestern North American pagurids until Benedict (1892) published the descriptions of the pagurids in the collections of the United States National Museum. Of 37 new species described, Benedict reported 16 from Alaska and the Bering Sea and one from British Columbia. His descriptions formed the bases of subsequent descriptions and faunal reports (e.g., Rathbun, 1899, 1904, 1910; Holmes, 1900; Schmitt, 1921; Stevens, 1925). Although Terao (1913), Balss (1913), Yokoya (1933, 1939), Kobjakova (1936, 1937) and others noted species occurring on both sides of the Pacific Ocean and Bering Sea, little additional descriptive information was contributed. The monographic review by Makarov (1938b, 1962) of the anomuran fauna of the Soviet Seas also included a large percentage of northwestern North American species, and provided the first major revision of the pagurid fauna of the region. The only additional regional information on the pagurids has been added through larval studies (e.g., Coffin, 1958, 1960), faunal surveys (e.g., Hart, 1940, 1971; Belyayev, 1960; Neyman, 1960, 1961a, b; McLaughlin, 1963; Kuznetsov, 1964; Filatova & Barsanova, 1964), physiological or parasitic studies (e.g., Reinhard, 1944; Reischman, 1959) and behavioral studies (e.g., Bollay, 1964; Orians & King, 1964).

All systematic studies of the Paguridae have been aided considerably through the publication of a bibliographic work by Gordan (1956) which lists the majority of papers published since Alcock's (1905) monographic review of the group.

A historical review of the pagurids of northwestern North America cannot be complete without the inclusion of both generic and specific considerations on more than a regional level. For this reason, the contributions of numerous

authors are discussed as they relate to particular species complexes and individual problems.

This report presents the results of an extensive study of the pagurids of northwestern North America, with a partial revision of the genus *Pagurus*. The principal area of study (map 1, on p. 379) ranges from the Pacific Ocean at an approximate latitude of 42°N to the Arctic Ocean at an approximate latitude of 72°N and from the Washington-Oregon coast and inland waters to an approximate longitude of 173°W in the vicinity of the Aleutian and Pribilof Islands. Comparative materials from California, the northwestern Pacific Ocean, Okhotsk and Japan Seas and the north and south Atlantic Oceans have been utilized when available and pertinent.

The completion of this study has been made possible through the efforts of a great many individuals to whom I wish to express my gratitude both collectively and, as much as possible, individually. I am particularly indebted to Drs. Fenner A. Chace, Jr., National Museum of Natural History, Smithsonian Institution, J. F. L. Hart, Victoria, British Columbia, Dora P. Henry and Paul L. Illg, University of Washington, L. B. Holthuis, Rijksmuseum van Natuurlijke Historie, and A. J. Provenzano, Jr., University of Miami for their many helpful suggestions and reviews of portions of this manuscript. Thanks are also due Janet Haig, Allan Hancock Foundation, and M. de Saint Laurent, Muséum National d'Histoire Naturelle, for their cooperative exchange of information and material.

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MATERIALS AND METHODS

The primary source of specimens used in this study has been the collections made by the National Marine Fisheries Service, National Oceanic and Atmospheric Administration (formerly known as the Bureau of Commercial Fisheries, U.S. Fish and Wildlife Service) during the years 1959-1963 and 1966. Additional collections were provided by a number of other agencies and institutions and these are listed, with abbreviations as they appear in the text, in table 1. With the completion of this study, these collections have been returned to the collectors or deposited in museum collections. The ultimate deposition of each lot appears as an abbreviation with its entry in the tables of "Material Examined".

All specimens were examined using a Wild M-5 binocular microscope and the illustrations were made using a camera lucida attachment. For each species described, the shield and cephalic appendages, mouthparts and telson have been illustrated. In addition, characters which have been found to be diagnostic or which contribute to better interpretation of the species (e.g., chelae, carpi of the chelipeds, dactyl and propodus of the left third pereopod) have also been figured. A few species previously have never been illustrated or illustrations have been reproduced so poorly as to be of little interpretative value. In such instances, these species have been illustrated in considerably greater detail. For a few species I have obtained, through the courtesy of the National Museum of Natural History, the original drawings, which presumably were to have accompanied Benedict's (1892) species descriptions. It

has not been possible to determine the individual specimens from which these illustrations were made; however, their publication herein is considered pertinent, as Benedict's brief species descriptions have often been a source of debatable interpretation.

Only one measurement has been made on each specimen, i.e., the shield length (SL). The shield length is defined as the distance on the dorsal surface from the tip of the rostrum to the midpoint of the posterior margin of the shield. Measurements were made with a pair of "Mitutoyo" calipers calibrated in 0.05 mm intervals and read to the nearest 0.1 mm.

The symbols used in the tables of material examined, i.e. ♂, ♀, ♀♀, ♂⁺, refer to male, female, ovigerous female and "intersex" respectively.

TABLE I

List of agencies and institutions with abbreviations used in the text

Allan Hancock Foundation, University of Southern California	AHF
Auke Bay Biological Laboratory, National Oceanic and Atmospheric Administration (formerly U.S. Fish and Wildlife Service)	ABL
British Museum (Natural History), London, England	BM
College of Fisheries — M/V "Commando", University of Washington	CC
Department of Oceanography — R/S "Brown Bear", University of Washington	BB
Fisheries Research Board of Canada, Nanaimo Biological Station	FRBC
Gear Research and Exploratory Fishing — M/V "John N. Cobb", National Oceanic and Atmospheric Administration (formerly U.S. Fish and Wildlife Service)	JNC
Geological Survey of Canada	GSC
International North Pacific Halibut Commission	INPHC
National Museum of Canada, Ottawa, Canada	NMC
National Museum of Natural History, Smithsonian Institution, Washington, D.C. (formerly United States National Museum)	USNM
Naturhistoriska Museet, Göteborg, Sweden	NHMG
Northwest Fisheries Center, National Oceanic and Atmospheric Administration (formerly Seattle Biological Laboratory, U.S. Fish and Wildlife Service)	SBL
Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands	RMNH
Rosenstiel School of Marine and Atmospheric Science, University of Miami (formerly University of Miami Marine Laboratory)	UMML
Universitetets Zoologiske Museum, Copenhagen, Denmark	UZM
U.S. Department of Commerce, National Oceanic and Atmospheric Administration (formerly U.S. Fish and Wildlife Service)	USFWS
Zoological Laboratory, Kyushu University, Japan	KU

MORPHOLOGIC AND TAXONOMIC CONSIDERATIONS

The general morphology of pagurids has been treated in detail by Jackson (1913) and Makarov (1938b, 1962) for *Pagurus*, and is not repeated in the present work, except with reference to differences in interpretation or to

structures not considered by these authors. With few exceptions, the terminology of morphological structures, as depicted in figures 1 to 5 follows that of the above cited authors. The terminology applied to the sexual appendages of *Paguristes* follows that of McLaughlin & Provenzano (in press) (fig. 6). Certain ambiguous terms are defined below.

a. Spine: a sharp, pointed process, of variable magnitude, usually with sloping sides; calcareous or corneous.

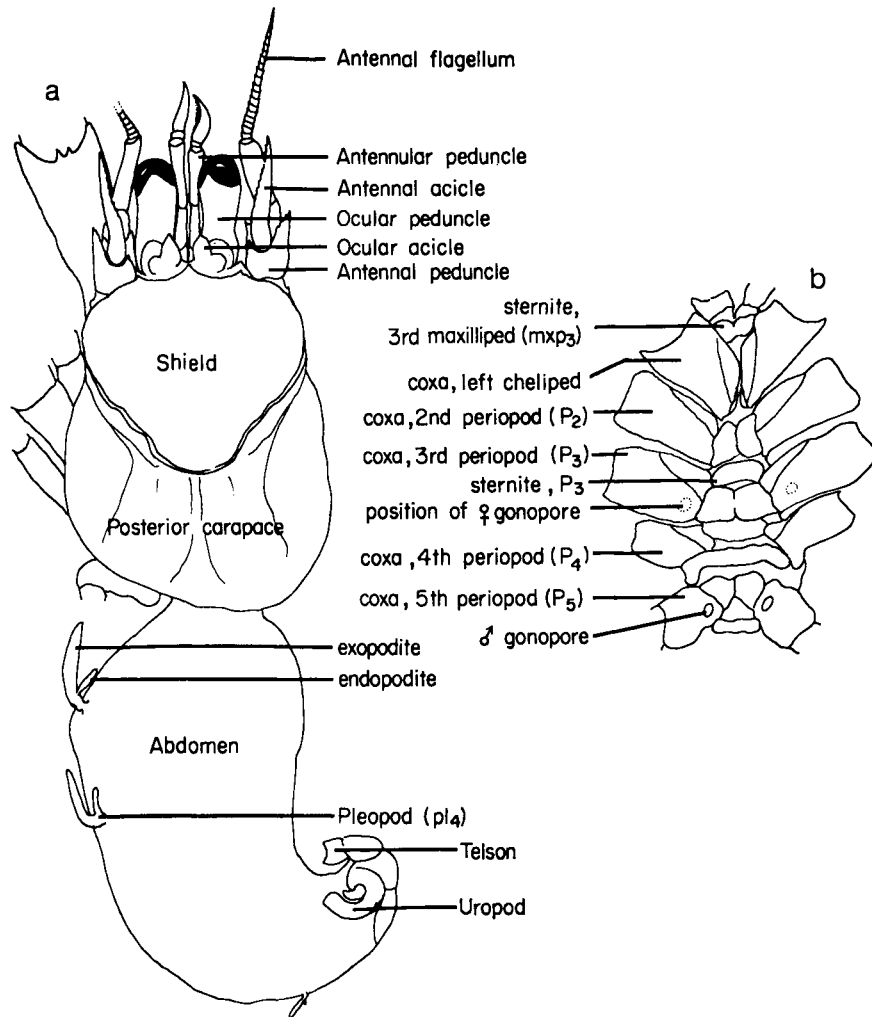


Fig. 1. Diagrammatic *Pagurus*, showing terms used in descriptions: a, cephalothorax and abdomen in dorsal view (thoracic appendages removed); b, thorax in ventral view (appendages removed).

b. Spinule: a small process with the general character of a spine, but of much smaller size.

c. Tubercle: a rounded knob or nodule, of varying size, usually with straight sides.

d. Tooth: a large, broad, blunt, often cusped, structure, suggestive of grinding capability, with one exception: by convention, the large process(es) adjoining the crista dentata on the ischium of the third maxilliped is referred to as a tooth (teeth), even though it is a very strong, usually acute, spiniform process.

e. Denticle: a small, tooth-like structure, usually flattened or compressed, lacking the symmetry of a small tubercle.

f. Granule: a low, protuberant structure, usually of definitive, circular shape.

g. Protuberance: an amorphic swelling.

Slight differences from the presentations of Jackson (1913: 7) and Makarov (1938b: 125; 1962: 119) will be noted in the lineae and sulci of the cephalothorax. As considered here, the lineae and sulci (fig. 2a) are basically defined according to the scheme proposed by Boas (1926), with the addition of sulcus "a" [bc (branchiocardiac groove) of Pilgrim, 1973], shown, but not designated by Boas. Very little variation has been observed in these demarcations at the specific level; however, they do appear to have some generic significance (see *Labidochirus*, p. 341).

Perhaps one of the most notable and significant differences will be found in the segmentation of the antennal peduncle as given here (fig. 3b) and that of Makarov (1938b: 127, fig. 48; 1962: 121, fig. 48). Makarov describes the peduncle as four-jointed; his figure suggests a fusion between the second and third segments such as is cited by Calman (1909) as characteristic of higher reptant decapods. Jackson (1913: 11, fig. 2) illustrates a similar condition, but does not discuss the segmentation in detail. As indicated by Bouvier (1940), however, no fusion of the second and third segments has occurred in the Paguridae and five segments are clearly distinguishable. In addition, a structure, here referred to as a supernumerary segment, is also present between the third and fourth segments. That this structure represents the remnant of a segment is suggested by its calcification and its articulation with both adjoining segments. At least two possible explanations can be advanced: 1) that the peduncle is derived from a six-segmented condition such as is seen in certain of the Isopoda; or 2) that the structure represents the morphological third segment of a five-segmented peduncle, implying that the segment presently referred to as the fifth segment is actually the very greatly elongated basal segment of the

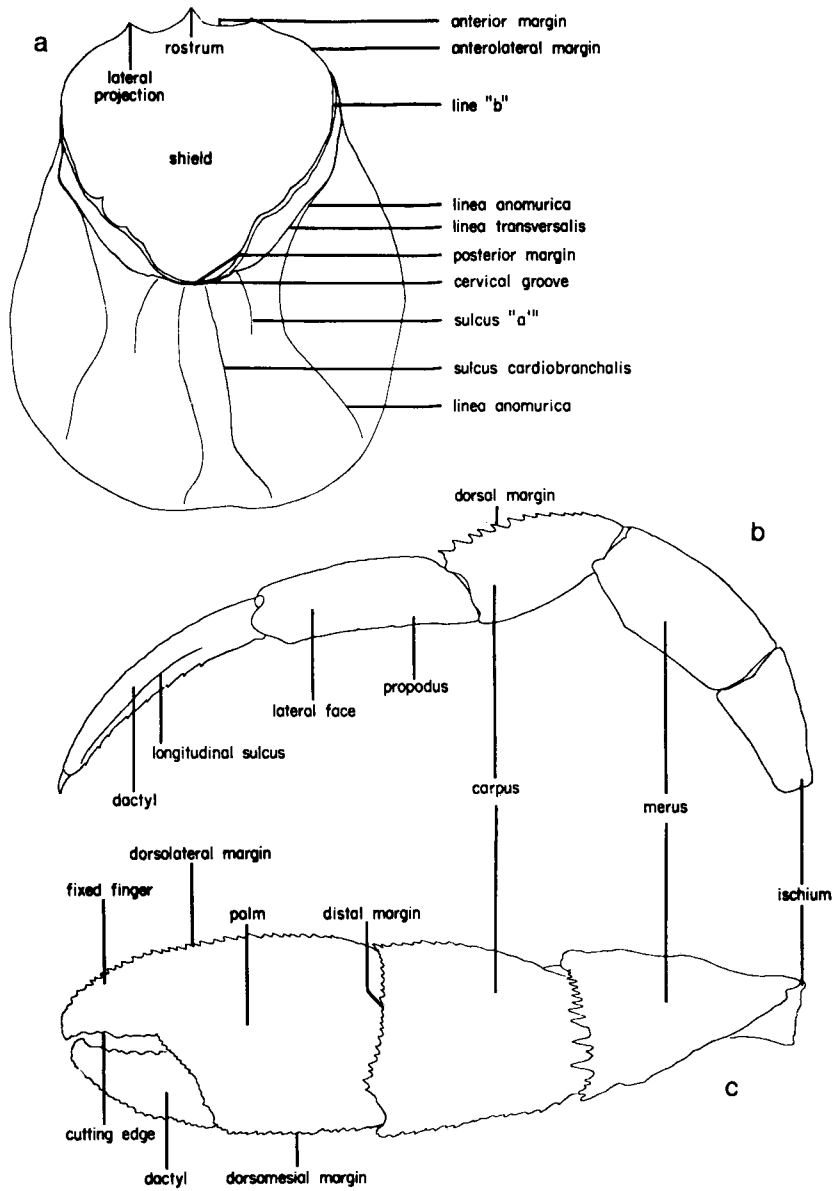


Fig. 2. Diagrammatic *Pagurus*, showing terms used in descriptions: a, cephalothorax (dorsal view); b, third left pereiopod (lateral view); c, right cheliped (dorsal view).

antennal flagellum. Much further study will be necessary before this question of segmentation of the antennal peduncle can be resolved.

In the mouthparts, the structure of the first maxilliped is erroneously represented by both Jackson and Makarov. According to these authors, the endopodite bears a flagellum, whereas the exopodite is small and lacks a

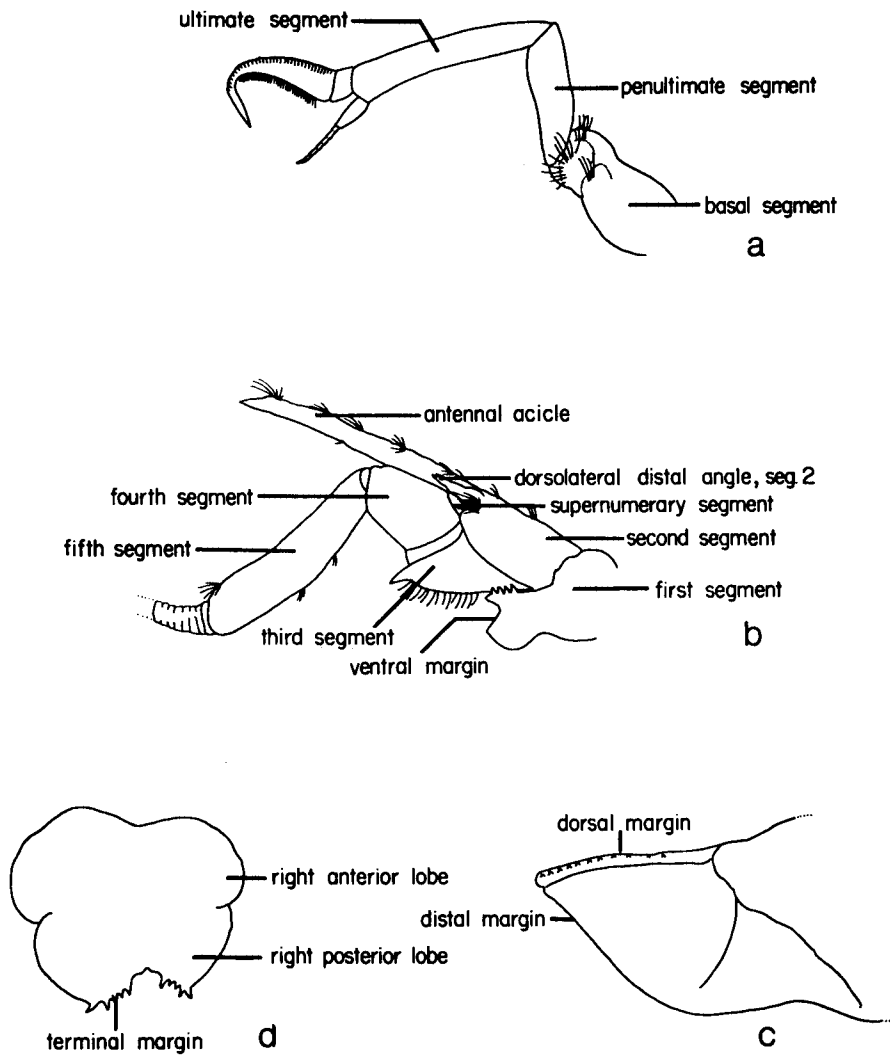


Fig. 3. Diagrammatic *Pagurus*, showing terms used in descriptions: a, antennule (lateral view); b, antenna (lateral view); c, branchiostegite (anterior third); d, telson.

flagellum (Jackson, 1913: 12, fig. 6; Makarov, 1938b: 128, fig. 49D; Makarov, 1962: 122, fig. 49D). However, as pointed out by Bouvier (1940) and illustrated by De Saint Laurent (1968a, b; 1969, 1970a, b), it is the endopodite which is small and slender and lacks a flagellum; the exopodite bears a flagellum.

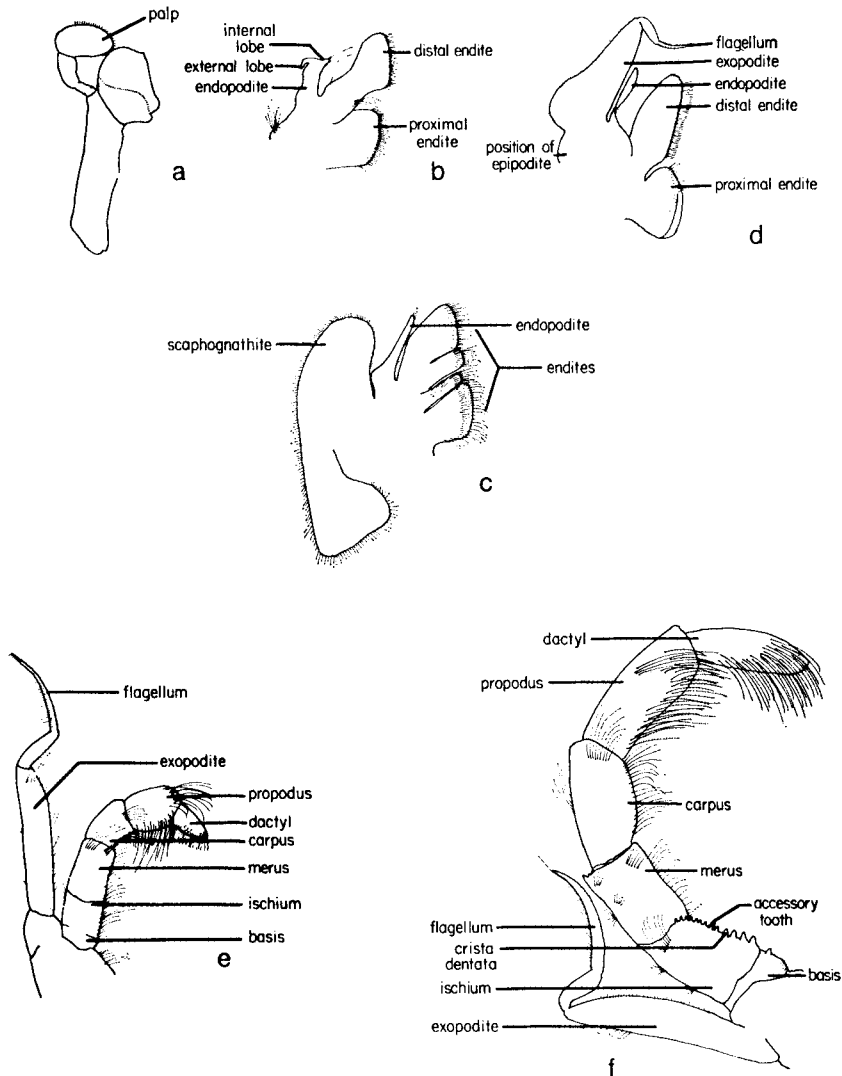


Fig. 4. Diagrammatic *Pagurus* mouthparts (left, internal face), showing terms used in descriptions: a, mandible; b, maxillule; c, maxilla; d, first maxilliped (mxp₁); e, second maxilliped (mxp₂); f, third maxilliped (mxp₃).

The endopodite of the second maxilliped is described by Jackson (1913: 12, fig. 7) as being seven-jointed, and by Makarov (1938b: 129, fig. 49E; 1962: 123, fig. 49E) and Bouvier (1940: 19) as five-jointed. In the species here described, the endopodite is most frequently five-segmented with fusion of the basis-ischium complete. However, in certain species complete fusion of these segments does not appear to have occurred. The diagnostic significance of this phenomenon has not been investigated as yet.

Makarov's (1938b, figs. 39A-E; 1962, figs. 49A-E) figures of the mouthparts of *Pagurus pubescens* are diagrammatic and do not accurately represent the structures as they occur in either *Pagurus pubescens* Kröyer or *Pagurus trigonocheirus* (Stimpson) (cf. figures 60 and 63).

Two characters recently suggested by Squires (1964) as having diagnostic significance, i.e., the configuration of the sternite of the third pereopods and the configuration and armature of the telson, have been found useful throughout this study. Intraspecific variation in the sternite is relatively small and this character has proved to be of considerable significance in the separation of certain, closely allied species. The telson, particularly in the armature of the terminal margins, has been found to be much more variable. Similarities in configuration among closely related species restricts its usefulness; however, it does appear to be significant in the evaluation of species groups.

At the generic level, a lengthy list of characters has been recommended by De Saint Laurent (1970b: 218) for consideration in diagnostic evaluations. Of these, the structure of certain mouthparts (e.g., external lobe of the endopodite of the maxillule, shape of the basal segment of the exopodite of the first maxilliped) have also been found to have significance in species groups. They do not appear to be significant in species determinations among closely related species, however, as intraspecific variation often equals or exceeds interspecific variation.

During the course of the study, two structures have been encountered which appear to have both diagnostic and physiological significance. They have been treated herein as two types of a similar structure; however, future investigations may show them to be entirely distinct entities. The first, occurring at the base of the claw on the lateral face of the fourth pereopod, was first reported by De Saint Laurent (1969b) in *Solenopagurus*, and termed a preungual process ["processus préungéal"]. It is now known to occur in several species of *Pagurus* as well, although the very fine hairs reported on this process in *Solenopagurus diomedea* (Faxon, 1893) (cf. De Saint Laurent, 1969: 1453, fig. 14) are not discernable in the *Pagurus* species. It is possible that the structure in *Pagurus*, although

similar, may not be homologous; however, for the present it too will be referred to as a preungual process. The second structure, also occurring on the lateral face of the fourth pereiopod is simply referred to as a "type A, P₄ structure" and occurs in the newly established genus, *Elassochirus*. The meager information which has been obtained on these structures, to date, pertains primarily to the "type A, P₄ structure" (fig. 5c). That this pro-

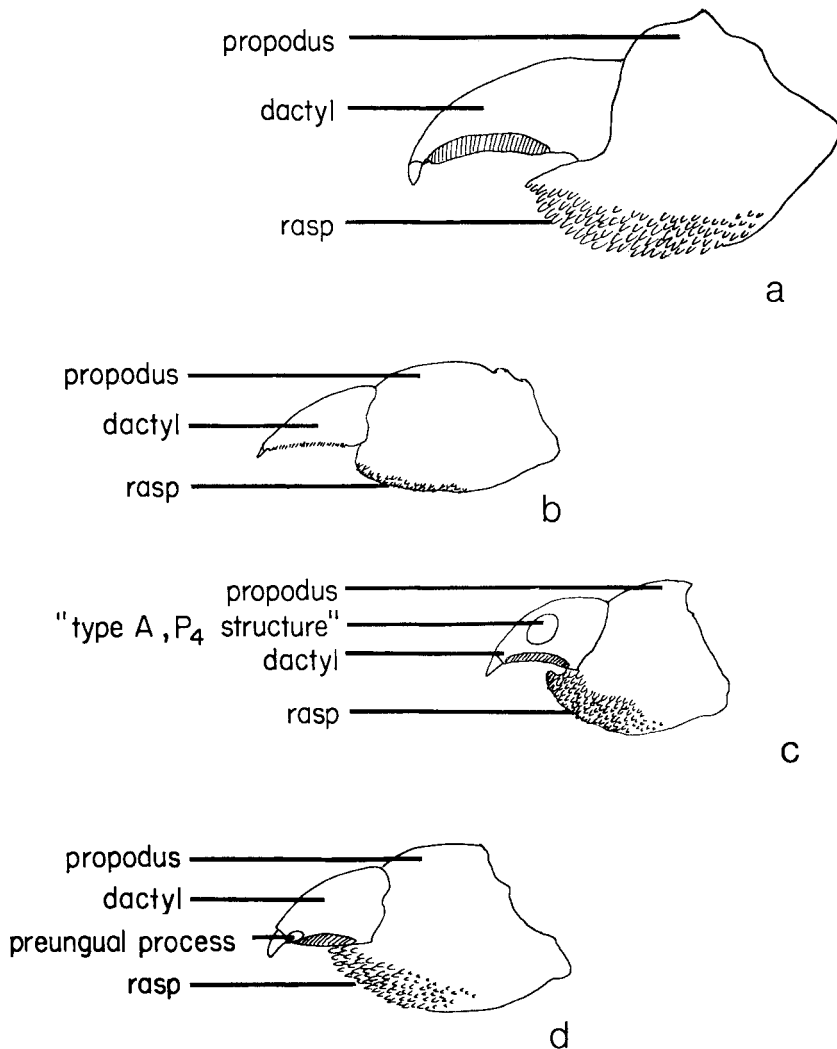


Fig. 5. Diagrammatic pagurid fourth pereiopod, dactyls and propodi (left, lateral view), showing terms used in descriptions: a, *Pagurus* "bernhardus group"; b, *Labidochirus*; c, *Elassochirus*; d, *Pagurus* "confragosus group".

minent, circular structure, having the appearance of an uncalcified blister, is recognizable in the integuments of molts, as well as in preserved specimens, indicates that the structure is not an artifact of preservation. Preliminary studies, which have included both gross dissections and examination of $8\ \mu$ serial cross-sections, have provided the following information about the "type A, P_4 structure":

The structure is clearly separated from the surrounding integument; however, it appears to have direct connection to the haemocoel of the appendage through minute (approximately $2\ \mu$ diameter) pores. Internally, the structure appears to consist of a spongy, acellular material, latticed with very small capillary spaces containing an eosinophilic fluid. As yet, neural fibers and muscle strands have not been identified. Externally, the structure appears chitinous. (Interpretation of the serial cross-sections was provided by Dr. C. E. Lane, Rosenstiel School of Marine and Atmospheric Science, University of Miami.)

The preungual process (fig. 5d) is much smaller and often less definitive. It occurs as an oval or circular blister or nodule on the ventrolateral face of the dactyl between the ventroproximal angle of the claw and the most distal tooth of the row of corneous teeth on the ventrolateral margin. In gross dissection this structure appears similar to the "type A, P_4 structure" in being distinctly separate from the surrounding integument, but material has not been available for histological examination. Much more detailed investigation of these structures is needed to determine their structure and function.

During the course of this study, several of the problems encountered by early carcinologists have become increasingly more apparent, and explain much of the existing confusion and misinterpretations of species identities. As with pagurids elsewhere, the northwestern North American species exhibit a high degree of intraspecific variation; rarely can a species be distinguished on the basis of a single character. Coupled with this variability is a similarly high degree of interspecific overlap in morphological characters. It is the exceptional species that can be described adequately on two or three specimens.

A major source of misinterpretation has arisen as the result of the placement of diagnostic emphasis on characters subject to alteration with growth. The length of the ocular peduncles, for example, has often been used as a diagnostic character without qualification. As shown by Provenzano & Rice (1966), for *Paguristes*, relative size and shape of the ocular peduncles change with growth. While affording some information, the length and width of the ocular peduncles must be considered relative characters.

The chelipeds are particularly affected by allometric growth. Very fre-

quently small specimens are characterized by short, moderately broad right chelae and carpi; however, with growth, the chelae, primarily, lengthen disproportionately to the width, giving the impression of a species characterized by a moderately long, slender right chela. A similar growth pattern occurs in the left chelae, and is particularly pronounced in *P. trigonocheirus*. In this species, the dorsolateral margin of the palm is characteristically expanded laterally in relation to the length of the palm in small specimens. With increased size, the lateral expansion is less pronounced, until very little lateral expansion is noticeable in very large specimens.

Other characters which show considerable variability are the strength and number of spines or tubercles, pilosity, and to a lesser extent, rostral development and the configuration of the telson in closely allied species.

KEY TO THE NORTHWESTERN NORTH AMERICAN GENERA OF
 PAGURIDAE, PARAPAGURIDAE, AND DIOGENIDAE

- 1. Third maxillipeds approximated basally; 13 pairs of branchiae; paired pleopods in both sexes (♂ with 2 pairs, ♀ with 1 pair); chelipeds similar, approximately equal *Paguristes*
- Third maxillipeds widely separated basally; 11 pairs of branchiae; no paired pleopods in either sex, or paired pleopods in males only; chelipeds dissimilar, unequal 2
- 2. Crista dentata without accessory tooth; males with first and second pleopods paired; females with gonopore on left only *Parapagurus*
- Crista dentata with 1 or more accessory teeth; no paired pleopods; gonopores in females paired 3
- 3. Carapace well calcified throughout; shield produced anteriorly, obscuring ocular acicles basally; fourth pereopods simple, not subchelate *Labidochirus*
- Carapace with only shield well calcified, not produced anteriorly; fourth pereopods subchelate 4
- 4. Uropods generally symmetrical; abdomen not spirally coiled; usually inhabiting polychaete tubes 5
- Uropods asymmetrical; abdomen spirally coiled 6
- 5. Telson with median transverse constriction; terminal margin with shallow to prominent median cleft *Orthopagurus*
- Telson without median transverse constriction; terminal margin entire *Discorsopagurus* n. gen.
- 6. Left cheliped with very pronounced counterclockwise torsion; fourth pereopods with prominent "type A, P₄ structure" on median lateral face of dactyl *Elassochirus*
- Left cheliped without noticeable torsion; fourth pereopods without "type A, P₄ structure" on median lateral face of dactyl *Pagurus*

DIOGENIDAE

Paguristes Dana

Paguristes Dana, 1851: 269. Type species by subsequent selection by Stimpson (1858: 235): *Paguristes hirtus* Dana, 1851: 272. Gender: masculine.
Paguristes Lörenthey & Beurlen, 1929: 71 (misspelling of *Paguristes* Dana).

Diagnosis. — Thirteen pairs of branchiae, most frequently phyllobranchiate, occasionally trichobranchiate or intermediate.

Maxillipeds approximated basally. Basis-ischium of m_{xp}_3 usually incompletely fused; ischium with well developed crista dentata, without accessory tooth.

Ocular acicles usually subtriangular, often multispinous.

Chelipeds usually subequal, orientated in horizontal plane; claws corneous.

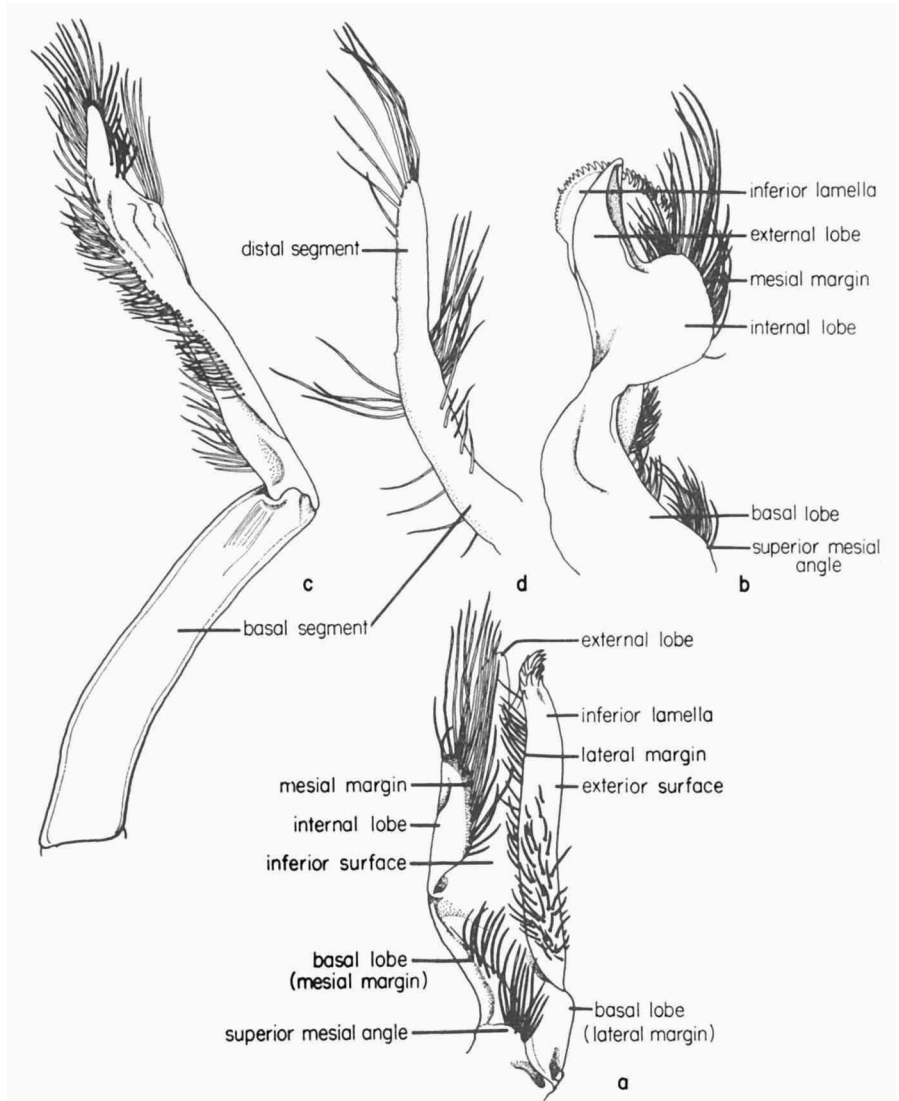


Fig. 6. Diagrammatic *Paguristes* gonopods illustrating terms used in descriptions: a, ♂ pl_1 (internolateral view); b, ♂ pl_1 (external view); c, ♂ pl_2 ; d, ♀, pl_1 . (From McLaughlin & Provenzano, in press).

Fourth pereopods simple, not subchelate.

Males with paired gonopores; paired first and second pleopods, modified as copulatory appendages.

Females usually with paired gonopores, occasionally with single gonopore; paired first pleopods (except in *Paguristes hummi* Wass, 1955); usually with brood pouch developed at base of pl₄.

Uropods and telson asymmetrical.

Distribution. — Worldwide.

Discussion. — Two nominal species, *Paguristes longirostris* Dana and *Paguristes hirtus* Dana were included by Dana (1851) in his genus *Paguristes*; however, he did not designate either as the type species of the genus. Subsequently, Stimpson (1858) designated *Paguristes hirtus* as the type species. In the interim, Dana (1852b: 122) did vaguely indicate a type for *Paguristes* in the statement "The 3d, *Paguristes*, having for its type *Paguristes gonagrus* or *P. pilosus*." Neither of these species of H. Milne-Edwards (1836) are nominal species included in the original description of *Paguristes*, therefore, Dana's subsequent type designation is not valid (cf. Int. Code Zool. Nomen., art. 69a).

Key to the species of *Paguristes* in northwestern North America

1. Antennal flagella with row of very long setae on ventral margin; brood pouch of ♀ subrectangular *P. ulreyi* Schmitt (p. 19)
- Antennal flagella with intermittent short to moderately long setae on all surfaces of articles; brood pouch of ♀ subtriangular, elongate *P. turgidus* (Stimpson) (p. 28)

Paguristes ulreyi Schmitt (figs. 7-9)

Paguristes ulreyi Schmitt, 1921: 125, pl. 18 figs. 3-5, 7 (type locality: off Point Loma, San Diego, California, "Albatross" station 4304). — Hilton, 1918: 54. — Glassell, 1937: 245. — Gordan, 1956: 324. — Haig, Hopkins & Scanland, 1970: 18. — Hart, 1971: 1542.
Paguristes occator Glassell, 1937: 245 (type locality: Off Gorda Point, Lower California, Mexico). — Gordan, 1956: 323.

Holotype. ♂ (SL = 12.0 mm), USNM 50427.

Material examined. — See table 2.

Table 2. *Paguristes ulreyi* Schmitt Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex				SL (mm)	Collector
				♂	♀	♂♀	♀♂		
<i>British Columbia</i>									
Frederick I.	---	----	3/6/69	1				4.1	Hart
Hecate Strait	---	FRBC 65-49 Hart	6/8/65	1				7.4	Hart
<i>California</i>									
Off San Nicolas I.	56	Albatross 4422 USNM 51146	13/4/04	1				5.4	---
Santa Monica Bay	---	----- USNM 50019	8/8/13	2				4.3-12.6	Dohrn
Off Point Loma, San Diego	---	Albatross 4304 USNM 50427	1/3/04	1	1			9.4-12.0	---

Diagnosis. — Ocular peduncles elongate, slender, cylindrical, with bases somewhat inflated. Antennal flagellum with row of very long setae on ventral margin. Rostrum well developed, usually considerably exceeding lateral projections. Brood pouch of female large, subrectangular.

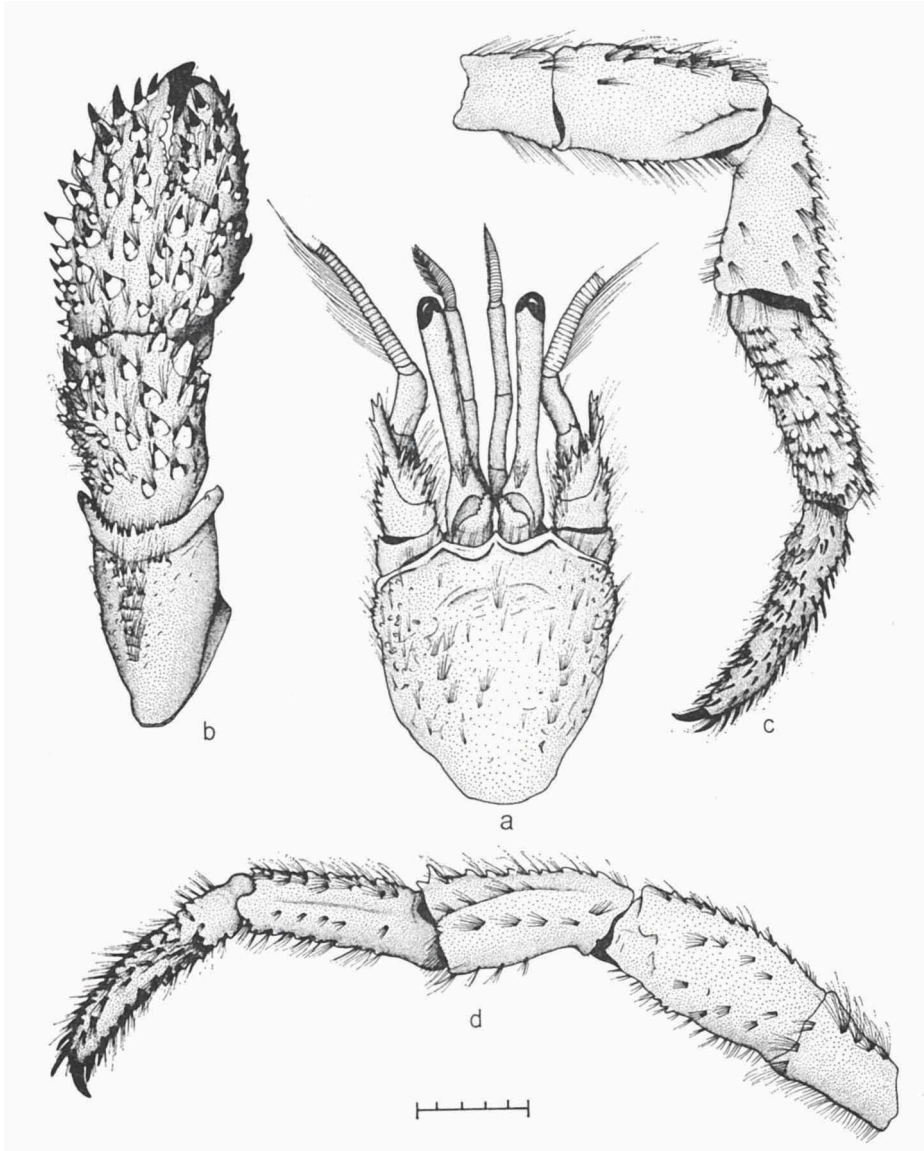


Fig. 7. *Paguristes ulreyi* Schmitt. a, shield; b, left cheliped (dorsal view); c, left P₂ (mesial view); d, left P₃ (lateral view). Scale equals 5 mm.

Description. --- Shield longer than broad; anterolateral margins sloping, anterior margin between rostrum and lateral projections concave; posterior margin truncate or roundly truncate; dorsal surface rugose anteriorly, with numerous small spines and spinules laterally and with scattered tufts of moderately stiff setae; anterolateral angles usually with strong, corneous-tipped spine obscured by dense setae. Rostrum long, considerably exceeding lateral projections, or less frequently moderately short, moderately or broadly triangular, usually with small terminal spine and tufts of short setae. Lateral projections obtusely triangular, prominent, with small or moderately strong, marginal or submarginal spine. Branchiostegites each with row of small spines or spinules partially obscured by tufts of long setae on distal and anterodorsal margins.

Ocular peduncles long, three-fourths to four-fifths length of shield, or occasionally equalling length of shield, slender, cylindrical, with bases strongly inflated; dorsal surface with tuft of plumose setae basally, dorsomesial margin usually with row of tufts of short setae. Ocular acicles moderately long, subovate or subtriangular, mesial margins depressed usually unarmed, lateral margins with 3-7 small or moderately strong spines; terminating in bifid or trifid spine; separated basally by one-fourth to one-half basal width of one acicle.

Antennular peduncles long, equalling or exceeding length of ocular peduncles by one-fourth to one-third length of ultimate segment. Ultimate and penultimate segments unarmed; basal segment with strong, acute spine at ventrodistal margin, laterodistal margin with strong spine dorsally.

Antennal peduncles moderately short, usually reaching distal half of ocular peduncles; with supernumerary segmentation. Fifth segment with few tufts of short setae. Fourth segment with strong spine at dorsodistal margin and scattered tufts of setae. Third segment with ventral margin strongly produced, terminating in 2 strong spines, or occasionally in single strong spine, occasionally also with small accessory spine on ventromesial margin distally, and with tufts of long setae. Second segment with dorsolateral distal angle strongly produced, terminating in strong bifid spine, lateral margin with 2-5 moderately strong, occasionally corneous-tipped spines and tufts of long setae, mesial margin unarmed; dorsomesial distal angle with prominent spine, partially obscured by long setae, mesial margin setose. First segment with 1 or 2 spines on dorsolateral margin or lateral face distally, ventral margin produced, unarmed or with 1-4 small spinules laterally. Antennal acicles moderately long, usually reaching proximal half of ultimate peduncular segment; terminating in strong bifid spine; mesial margin with row of strong, acute spines, predominately on proximal half and partially obscured by long

setae, lateral margin unarmed or with 1 or 2 moderately small spines. Antennal flagella moderately short, usually not exceeding tips of chelipeds; each article with very long setae depending from ventral margin.

Mandible without distinct characters. Maxillule with proximal endite subquadrate; endopodite with 4 or 5 bristles on weakly produced internal lobe,

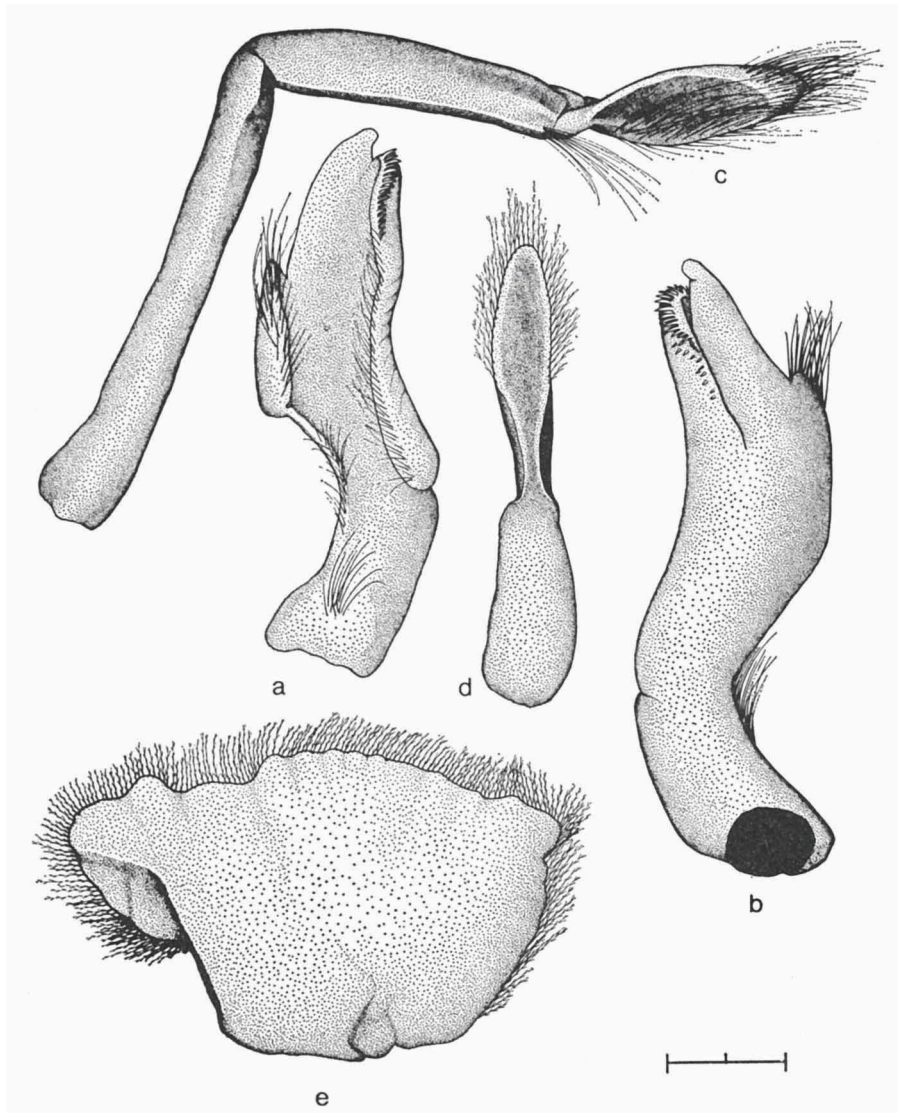


Fig. 8. *Paguristes ulreyi* Schmitt. a-c, ♂ : a, pl₁ (left, internolateral view); b, pl₁ (left, extrolateral view); c, pl₂. — d, e, ♀ : d, pl₁; e, brood pouch. Scale equals 1 mm.

external lobe extremely well developed, recurved, one-third to one-half length of endopodite. Maxilla with endopodite moderately short, not exceeding scaphognathite in distal extension, somewhat inflated basally. First maxilliped with endopodite enlongate, approximately equalling basal segment of

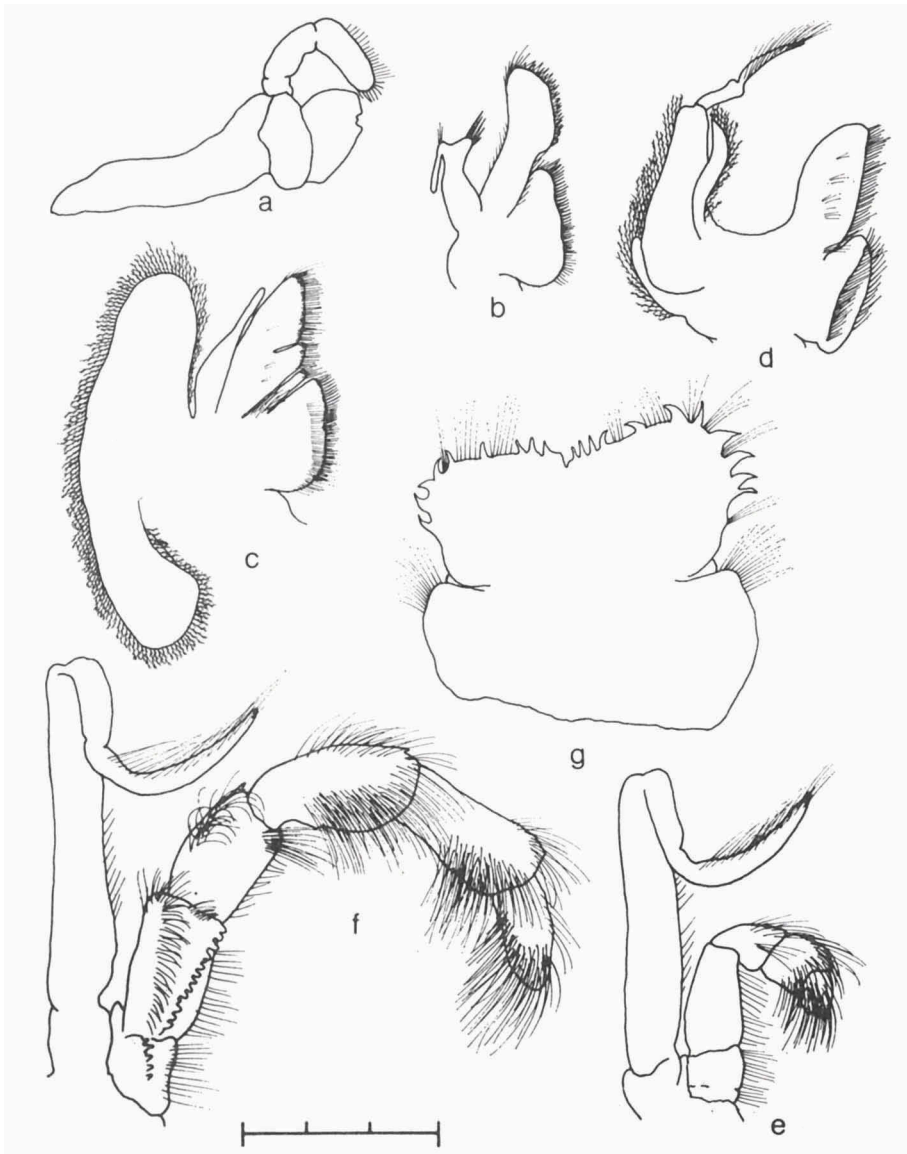


Fig. 9. *Paguristes ulreyi* Schmitt. a-f, mouthparts (left internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, telson. Scale equals 3 mm.

exopodite, strongly reflexed; epipodite well developed. Second maxilliped with basis-ischium fusion incomplete. Third maxilliped with basis-ischium fusion incomplete; basis usually with 3 or 4 small spines; ischium with crista dentata well developed, no accessory tooth, usually with 1 or 2 small spines at ventrodistal margin; merus unarmed or with 1-3 small spines on ventral margin, dorsodistal margin with moderately strong spine; carpus with spine at dorsodistal margin.

Chelipeds equal or subequal, short. Dactyls moderately long, one-fourth to one-third longer than palm; mesial margins somewhat arcuate; cutting edges each with row of calcareous teeth proximally, corneous teeth distally; terminating in moderately strong or strong corneous claws; slightly overlapped by fixed fingers; dorsomesial margins each with row of strong, corneous-tipped spines and tufts of stiff setae, dorsal surfaces each with 2 somewhat irregular rows of strong, corneous-tipped spines and tufts of stiff setae; mesial faces each with prominent row of corneous-tipped spines dorsally, irregular, transverse rows of corneous-tipped spines ventrally and tufts of stiff setae; ventral surfaces often with few corneous-tipped spines and tufts of stiff setae. Palms moderately long, one-half to two-thirds length of carpi; dorsomesial margins each with rows of 3 or 4 strong, corneous-tipped spines, dorsal surfaces each with 4 or 5 irregular rows of prominent, usually corneous-tipped spines and tufts of stiff, sometimes plumose setae, dorsolateral margins each with row strong, corneous-tipped spines increasing in size on fixed finger; mesial, lateral and ventral surfaces each with few small to moderately strong, corneous-tipped spines and scattered tufts of stiff setae. Carpi moderately short, one-half to three-fourths length of meri; dorsomesial margins each with row of strong, tubular, corneous-tipped spines accompanied by tufts of very long, stiff setae, dorsal surfaces each with numerous strong or moderately strong spines, distal margins often with corneous-tipped spines; dorsolateral margins not noticeably delimited, lateral faces with scattered, moderately small spines, usually corneous-tipped, distal margins usually with few small corneous spines; mesial faces and distal margins each with few small spines; ventral surfaces unarmed; all surfaces with numerous tufts of long or moderately long, stiff setae. Meri subtriangular; dorsal surfaces each with row of small spines increasing in size distally and becoming transverse rows of moderately strong, often corneous-tipped spines distally and accompanied by tufts of long setae, distal margins each with row of moderately strong spines extending onto lateral and mesial margins; lateral faces spinulose or denticulate, ventrolateral margins each with irregular row of corneous-tipped spines and tufts of setae; mesial faces with few scattered tufts of setae, ventromesial margins each with row of corneous-tipped spines

increasing in size distally and tufts of setae. Ischia each with row of small spines on ventromesial margin, ventrolateral distal angle with 1 or 2 spines, distal margin with long setae. Coxae with few spines on distal margins, ventromesial distal angles each with tuft of long, stiff setae.

Second pereiopods moderately long, overreaching chelipeds by one-third to two-thirds length of dactyls. Dactyl moderately long, one-fourth to one-third longer than propodus; in lateral view, slightly curved ventrally; in dorsal view, slightly twisted or straight; terminating in strong, curved, corneous claw; dorsal surface with row of prominent corneous-tipped spines proximally, becoming row of strong corneous spines distally, often partially obscured by tufts of dense setae; mesial face with 1 or 2 irregular rows of strong, corneous spines and tufts of dense setae; ventral margin with row of strong corneous spines, increasing in size distally and accompanied by tufts of long setae; lateral face with faint longitudinal sulcus proximally, and 1 or 2 rows of short stiff setae. Propodus moderately short, slightly less than, equalling, or slightly longer than carpus; dorsal surface with row of strong, often conical or tubular, corneous-tipped spines, partially obscured by tufts of stiff setae; mesial face with 3 or 4 irregular rows of corneous-tipped spines, frequently obscured by tufts of long stiff setae; ventral surface with transverse rows of small spines and tufts of short setae, distal margin with row of corneous spines or spinules; lateral face with longitudinal row of short, stiff setae. Carpus moderately long, two-thirds to three-fourths length of merus; dorsal surface with double row of strong, corneous-tipped spines and tufts of long stiff setae; lateral face with longitudinal sulcus lined with tufts of stiff setae, flanked by scattered, corneous-tipped, small spines partially obscured by tufts of setae; mesial and ventral surfaces with tufts of setae, mesiodistal margin often with few corneous spines or spinules. Merus laterally compressed; dorsal surface with row of corneous-tipped spines becoming transverse rows of spines distally, partially obscured by tufts of stiff setae; lateral and mesial faces with tufts of setae; ventral surface with double row of small corneous-tipped spines and tufts of long setae. Ischium with row of small spines on ventromesial margin, obscured by tufts of stiff setae. Coxa usually with 1 or 2 small spines or spinules on ventromesial and ventrolateral distal angles.

Third pereiopods equalling second in length. Dactyl moderately long, equalling or slightly exceeding length of propodus; in lateral view, slightly curved ventrally; in dorsal view, straight or slightly twisted; dorsal surface with row of moderately prominent corneous or corneous-tipped spines proximally, becoming strong corneous spines increasing in size distally; mesial face often with faint longitudinal sulcus proximally, flanked by single or

double rows of strong corneous spines, distally with irregular, frequently transverse, rows of strong corneous spines and tufts of stiff setae; ventral margin with row of strong corneous spines, increasing in size distally, accompanied by tufts of long stiff setae; lateral face with faint longitudinal sulcus lined with tufts of stiff setae and row of corneous spines ventrally (right), or with irregular, transverse, often spinulose rows of protuberances and tufts of stiff setae, lateroventral margin with row of small spines and tufts of stiff setae (left). Propodus moderately short, slightly shorter than or equalling length of carpus; dorsal surface with double irregular row of strong, often corneous-tipped spines, partially obscured by tufts of long setae; mesial face with irregular transverse rows of simple, bifid, or multifid, corneous-tipped spines; lateral face with faint longitudinal sulcus and tufts of stiff setae, occasionally also with few small spines or spinules, ventrolateral margin with row of small spines, usually stronger on left; ventral margin with single or double row of corneous-tipped spines and tufts of long setae, distal margin usually with several corneous spines. Carpus approximately equalling merus in length; dorsal margin with row of strong corneous-tipped spines partially obscured by tufts of long stiff setae; lateral face with longitudinal sulcus lined with tufts of stiff setae, often flanked with few corneous or corneous-tipped spines distally, also with longitudinal row of tufts of stiff setae ventrally; ventral and mesial surfaces with few tufts of setae, frequently with few corneous or corneous-tipped spines on mesial face distally. Merus laterally compressed, short; dorsal surface with row of small, often corneous-tipped spines, more prominent on left, usually partially obscured by tufts of stiff setae; mesial and lateral faces with scattered tufts of stiff setae; ventral surface usually with double row of small spines and tufts of long, stiff setae. Ischium with scattered tufts of setae on all surfaces. Coxa with tufts of stiff setae on ventromesial distal angle and ventromesial and ventrolateral margins.

Fourth pereopods with propodal rasp well developed.

Fifth pereopods chelate.

Sternite of third pereopods subrectangular.

Pleopods of male with first and second paired, modified. Pl_1 with row of moderately short setae on mesial margin of basal lobe, superior mesial angle with tuft of long bristles; inferior lamella with row of moderately long setae on lateral margin, distal margin and external face distally with 1-3 rows of curved spines; external lobe subtriangular, slightly exceeding inferior lamella in distal extension, naked; internal lobe squadrated, mesial and distal margins with irregular rows of long setae. Pl_2 with basal segment usually naked; endopodite with tuft of long setae; appendix masculina strongly

twisted, lateral and distal margins and inferior face laterally with long setae. Pl₃-pl₅ unpaired, with exopodite very well developed, endopodite reduced or vestigial.

Pleopods of females with first paired, modified. Pl₁ with basal segment usually naked, bulbous; distal segment with inferior face concave, margins with long, plumose setae. Pl₂-pl₄ with both rami well developed, pl₅ with exopodite well developed, endopodite reduced or vestigial. Brood pouch sub-rectangular, usually very well developed, margins with short to long plumose setae.

Telson with posterior lobes somewhat asymmetrical, left usually larger than right; subquadrate; separated by small, shallow median cleft; right terminal margin with 4-7 strong spines and row of long setae, lateral margin with 1-4 moderately strong spines; left terminal margin with 5-8 strong spines and row of long setae, lateral margin with 3-6 strong spines; anterior lobes unarmed, lateral margins with row of long setae.

Coloration. — In life: unknown. In preservative: Ocular peduncles each with broad red longitudinal stripe on mesial and lateral faces. Antennular peduncles each with dorsal and ventral longitudinal red stripe; flagella red. Antennal flagella each with ventral red stripe. Chelipeds and ambulatory legs mottled red or reddish-orange.

Distribution. — British Columbia, Frederick Island (Hart) to west coast of Baja California and Gulf of California, Mexico (Haig et al); intertidal to 56 m (Schmitt).

Affinities. — *Paguristes ulreyi* and *P. turgidus*, the only other member of the genus known in northwestern North America are very similar in both morphology and coloration. These similarities suggest that the recent recognition of *P. ulreyi* in British Columbia (Hart, 1971) does not necessarily indicate the recent introduction of this species into the colder northwestern waters; it may have simply been overlooked by earlier investigators. The very long setae on the ventral surface of the antennal flagella and the sub-rectangular brood pouch of the females of *P. ulreyi* immediately distinguish this species from *P. turgidus*. The characters used by Schmitt (1921), i.e., the longer ocular peduncles and more prominent rostrum, to distinguish *P. ulreyi* are subject to variation, and therefore less reliable.

Discussion.— Haig et al. (1970) placed *P. occator* Glassell in synonymy with *P. ulreyi* without discussion. I have not examined Glassell's (1937) species; however, when morphological variation in *Paguristes* species is considered, his description of *P. occator* applies equally well to *P. ulreyi*. I would, therefore, concur with Haig's proposed synonymy.

Paguristes turgidus (Stimpson) (figs. 10-12)

- Clibanarius turgidus* Stimpson, 1857: 484, pl. 21 fig. 1 (type locality: Puget Sound, Washington). — Bate, 1866: 278. — Whiteaves, 1878: 471.
- Paguristes turgidus*: Stimpson, 1858: 236. — Stimpson 1859a: 40. — Smith, 1880: 211B. — Walker, 1898: 275. — Holmes, 1900: 151. — Rathbun, 1904: 161. — Alcock, 1905: 156. — Stimpson, 1907: 212. — Rathbun, 1910: 161. — Taylor, 1912: 205. — Schmitt, 1921: 123, pl. 18 figs. 1, 8. — Stevens, 1925: 300, figs. 23, 24. — Wismer & Swanson, 1935: 342. — Glassell, 1937: 245. — Hart, 1937: 184, figs. 7-9, pl. 1 figs. 1, 2. — MacGinitie, 1937: 1032. — Gurney, 1939: 98. — Hart, 1940: 95. — Dechancé & Forest, 1958: 275. — Bourdillon-Casanova, 1960: 124. — Pike & Williamson, 1960: 512. — Dechancé, 1961: 529. — Provenzano, 1962: 200. — Provenzano, 1963: 11. — Rice & Provenzano, 1965: 251. — Provenzano, 1967: 472. — Kurata, 1968: 182. — Provenzano, 1968a: 170. — Hart, 1971: 1542.
- Eupagurus turgidus*: Stimpson, 1859b: 90. — Stimpson, 1862: 86. — Harrington, 1898: 215.
- Pagurus turgidus*: Williamson, 1915: 481.
- Paguristes turgides*: Gordan, 1956: 324.

Holotype. — Not seen (presumably no longer extant).

Material examined. — See table 3.

Diagnosis. — Ocular peduncles moderately short, moderately stout, cylindrical. Antennal flagella moderately short, acticles with intermittent short to moderately long setae on all surfaces. Rostrum moderately short, usually equalling or only slightly exceeding lateral projections. Brood pouch of female elongate, subtriangular, folded.

Description. — Shield usually considerably longer than broad, occasionally only slightly longer than broad; anterolateral margins slightly sloping; anterior margin between rostrum and lateral projections concave; posterior margin truncate; dorsal surface rugose anteriorly and with small spines or spinules laterally and scattered tufts of moderately long stiff setae; anterolateral angle with small corneous-tipped spine. Rostrum moderately short, equalling or slightly exceeding lateral projections; triangular; terminating in acute spine or occasionally in minute bifid or trifid spine, often obscured by dense tuft of long setae. Lateral projections obtusely triangular with strong marginal spine. Branchiostegites with row of small spines on the anterodorsal and distal margins partially obscured by tufts of long setae.

Ocular peduncles usually moderately long, one-half to two-thirds length of shield, moderately slender, cylindrical, with bases somewhat inflated; dorsal or dorsomesial surface with longitudinal row of stiff setae. Ocular acicles subtriangular or subquadrate; mesial margins strongly depressed, unarmed or with 1 or 2 small spines, lateral margins usually with 2 or 3 small spines; terminating usually in bifid or multifid spine partially obscured by tufts of setae; separated basally by one-fourth to one-half basal width of one acicle.

Antennular peduncles moderately long, usually exceeding ocular peduncles by one-fourth to one-half length of ultimate segment. Ultimate and penulti-

Table 3. *Paguristes turgidus* (Stimpson) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	♂♀		
<i>Chukchi Sea</i>								
68°13.5'N, 166°35.8'W	---	236-131 USNM	24/8/59	1			11.4	BB
<i>British Columbia</i>								
54°05'N, 131°06'W	91	3D USNM	2/7/61	1			13.1	INPHC
50°59'N, 129°59'W	65	----- USNM	1/8/36		2		6.3-6.5	Stevens
N end Kaisen Halibut Bank	200	----- USNM	28/7/36	1			7.9	Stevens
<i>Washington</i>								
Waldron Bay	---	----- USNM	29/7/61	1			4.3	Ray
San Jaun Is.	---	----- USNM, AHP	5/61	4	2	1	7.3-16.4	Henry
San Juan Is.	---	----- USNM, CNM	8/61	2	1		12.4-17.3	McLaughlin
Lopez Sound	---	----- USNM	25/6/61	1			8.5	---
Off Mats-Mats	60	----- USNM	14/3/39	1			17.7	Stevens
Point Defiance	---	----- USNM	6/62	2	4		8.5-12.6	Young
48°56'N, 126°22'W	141-143	RMNH, BM 18 USNM	18/10/62	1	1		6.7-14.6	JNC
<i>Oregon</i>								
46°07'50"N, 124°13'00"W	84-91	1A RMNH	26/6/61	2	1		7.9-8.8	CC
46°07'N, 124°12.7'W	91	----- USNM	5/4/63	1			14.1	CC
46°01.5'N, 124°43.2'W	270	5A USNM	5/8/63	3			9.3-9.6	CC
46°00'50"N, 124°43'15"W	270	SS-5A USNM, RMNH	6/27/61	8	1		6.4-10.9	CC
45°58'15"N, 124°44'30"W	410-420	8A USNM	29/6/61	1			8.0	CC
45°58'15"N, 124°44'30"W	412	8A USNM	17/9/61	1			11.4	CC
Off Columbia River	244	----- USNM	4/7/61	1			8.0	CC
Off Columbia River	135	----- USNM	21/8/63	1			11.2	CC
Off Columbia River	183	----- USNM	11/1/64	1			8.3	CC

mate segments unarmed, each usually with few tufts of short setae; basal segment with small spine at ventrodorsal margin, lateral face with strong spine on middorsal margin, distal margin with small spine often obscured by long setae.

Antennal peduncles moderately short, usually not exceeding length of ocular peduncles; with supernumerary segmentation. Fifth segment unarmed, often with scattered tufts of short setae. Fourth segment with small spine at dorsodistal margin. Third segment with ventral margin produced, terminating in strong acute spine, mesial face usually with small spine distally. Second segment with dorsolateral distal angle produced, terminating in simple, bifid or trifid spine, mesial margin unarmed or occasionally with small spine distally, lateral margin with 1-3 small or moderately strong spines

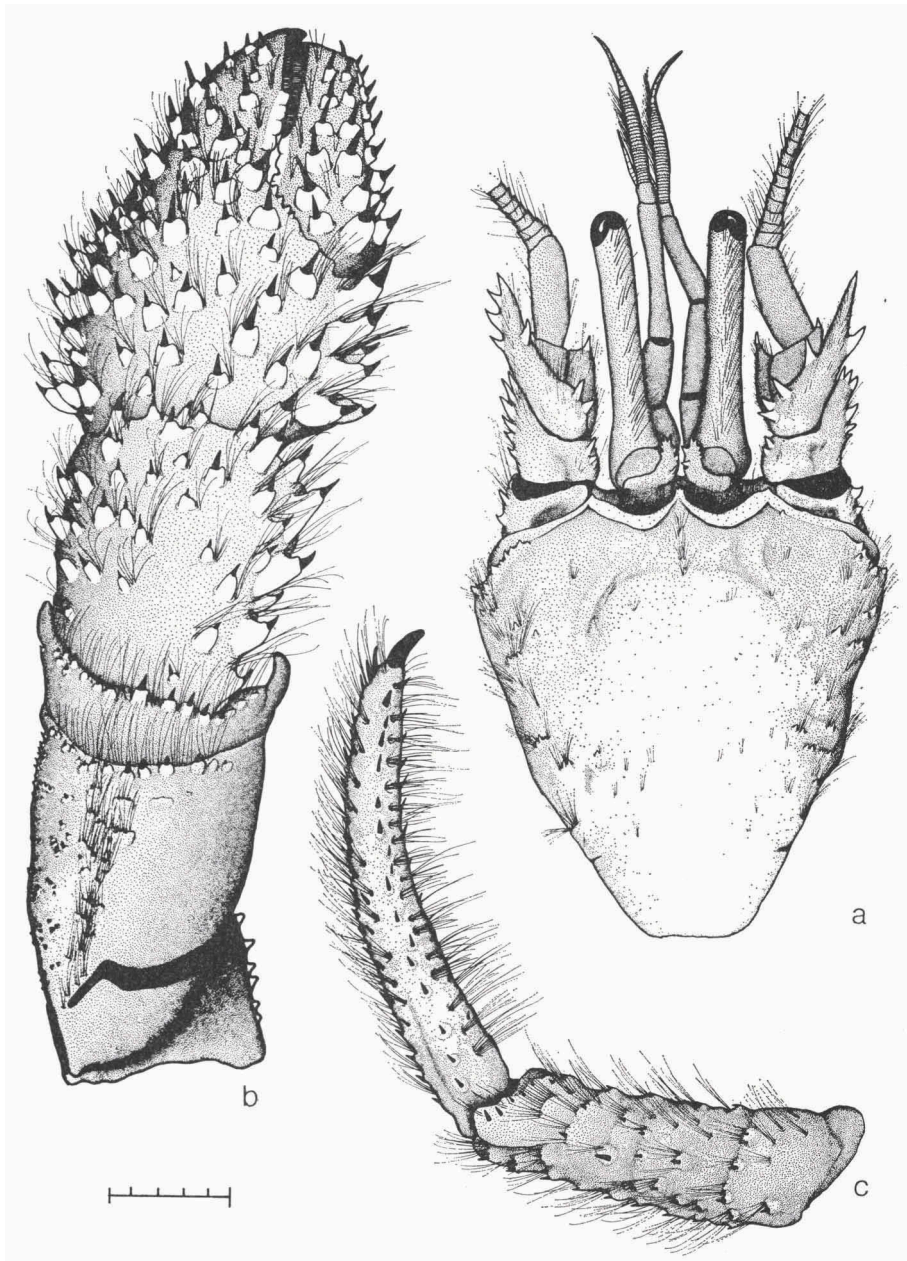


Fig. 10. *Paguristes turgidus* (Stimpson). a, shield; b, left cheliped (dorsal view); c, left P₃ dactyl and propodus (mesial view). Scale equals 5 mm.

and tufts of long setae; dorsomesial distal angle with strong spine, mesial face unarmed or with small spine and tufts of long setae. First segment with lateral face unarmed or with 1-3 small spines, ventral margin produced, usually with 1 or 2 strong spines laterally. Antennal acicles moderately long, usually reaching proximal half of ultimate peduncular segment; terminating in strong simple or bifid spine; mesial margin with 1-4 moderately strong spines proximally widely separated from 1 or 2 strong spines distally, or occasionally distal spines absent, and with dense tufts of long setae, lateral margin usually with 1-4 strong spines and tufts of long stiff setae. Antennal flagella short, not reaching to tips of chelipeds; each article with several short to moderately long setae or bristles on all surfaces.

Mandible with tuft of plumose setae on basal segment of palp. Maxillule with proximal endite subquadrate, dorsodistal angle slightly produced; endopodite with tuft of plumose setae basally, 6 or 7 bristles on weakly developed internal lobe, external lobe very well developed, recurved, two-thirds to three-fourths length of endopodite, exterobasal angle with several setae. Maxilla with endopodite somewhat inflated basally, moderately short, not exceeding scaphognathite in distal extension. First maxilliped with endopodite elongate, approximately equalling basal segment of exopodite; epipodite well developed. Second maxilliped with basis-ischium fusion apparently incomplete. Third maxilliped with basis-ischium fusion incomplete; basis usually with 2 or 3 spines, partially obscured by tufts of long setae; ischium with crista dentata well developed, no accessory tooth; merus usually with 2 or 3 small spines on ventral margin, dorsodistal margin with small spine; carpus with small spine at dorsodistal margin.

Chelipeds equal or slightly subequal, moderately short; chelae, in dorsal view, subtriangular, surfaces moderately to densely setose. Dactyls moderately short, one and one-half to twice length of palms; cutting edges each with few strong calcareous teeth proximally, row of corneous teeth distally; terminating in broad corneous claw; overlapped by fixed finger; dorsal surfaces each with 2 somewhat irregular rows of strong, conical, prominently corneous-tipped spines, dorsomesial margins each with row of strong, conical, corneous-tipped spines decreasing in size distally; mesial faces each with irregular row of small corneous-tipped spines dorsally and 2 or 3 rows of corneous-tipped tubercles or corneous scales ventrally; ventral surfaces unarmed or with few corneous spines distally. Palms moderately long, two-thirds to three-fourths length of carpi; dorsomesial margins each with 4, or rarely only 3, strong corneous-tipped spines, dorsal surfaces each with several irregular rows of strong, conical, prominently corneous-tipped spines, decreasing in size slightly on fixed fingers; dorsolateral margins not noticeably

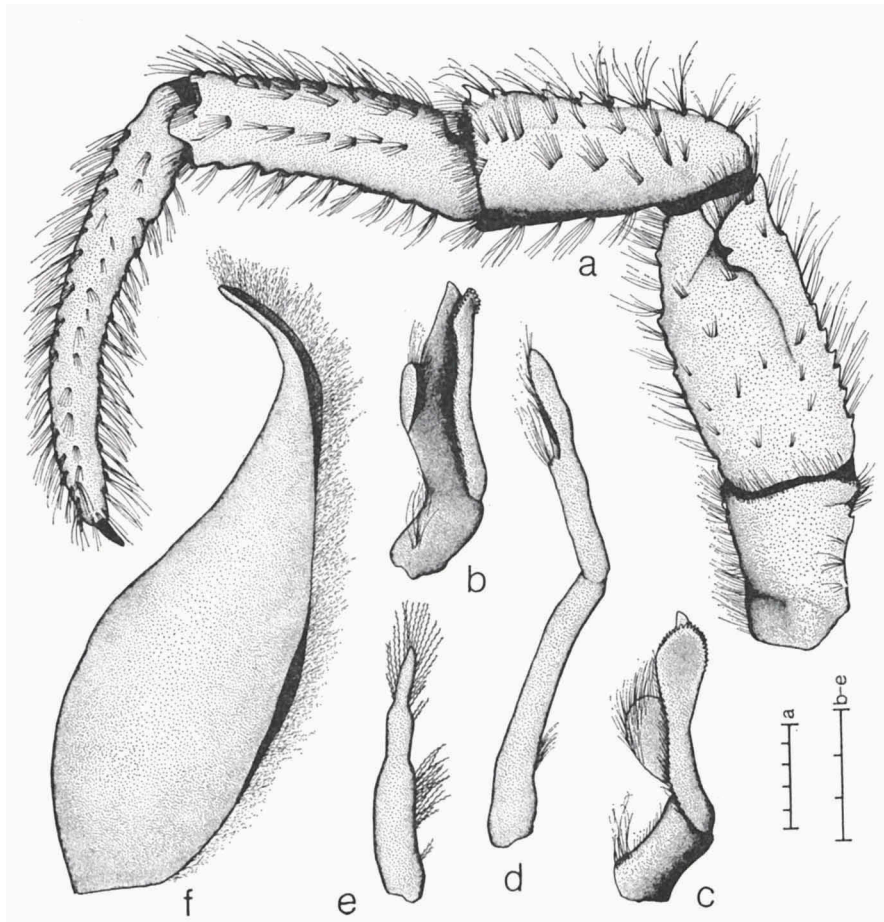


Fig. 11. *Paguristes turgidus* (Stimpson). a, left P₃ (lateral view). — b-d, ♂ : b, pl₁ (left internolateral view); c, pl₁ (right internal view); d, pl₂. — e, f, ♀ : e, pl₁; f, brood pouch. Scales equal 5 mm (a) and 3 mm (b-f).

delimited, lateral faces with numerous moderately strong, conical, corneous-tipped spines; ventral surfaces with scattered corneous-tipped tubercles, often in irregular rows laterally; mesial faces with few moderately small corneous-tipped spines. Carpi moderately short, one-half to two-thirds length of meri, dorsal and mesial surfaces and distal margins predominantly, with numerous tufts of long setae; dorsomesial margins each with row of 4 or 5 strong, conical or tubular, corneous-tipped spines, dorsal surfaces with irregular widely spaced rows of moderately strong corneous-tipped spines, distal margins each with few moderately small corneous-tipped spines; lateral faces and distal margins with few corneous-tipped spines, ventrolateral mar-

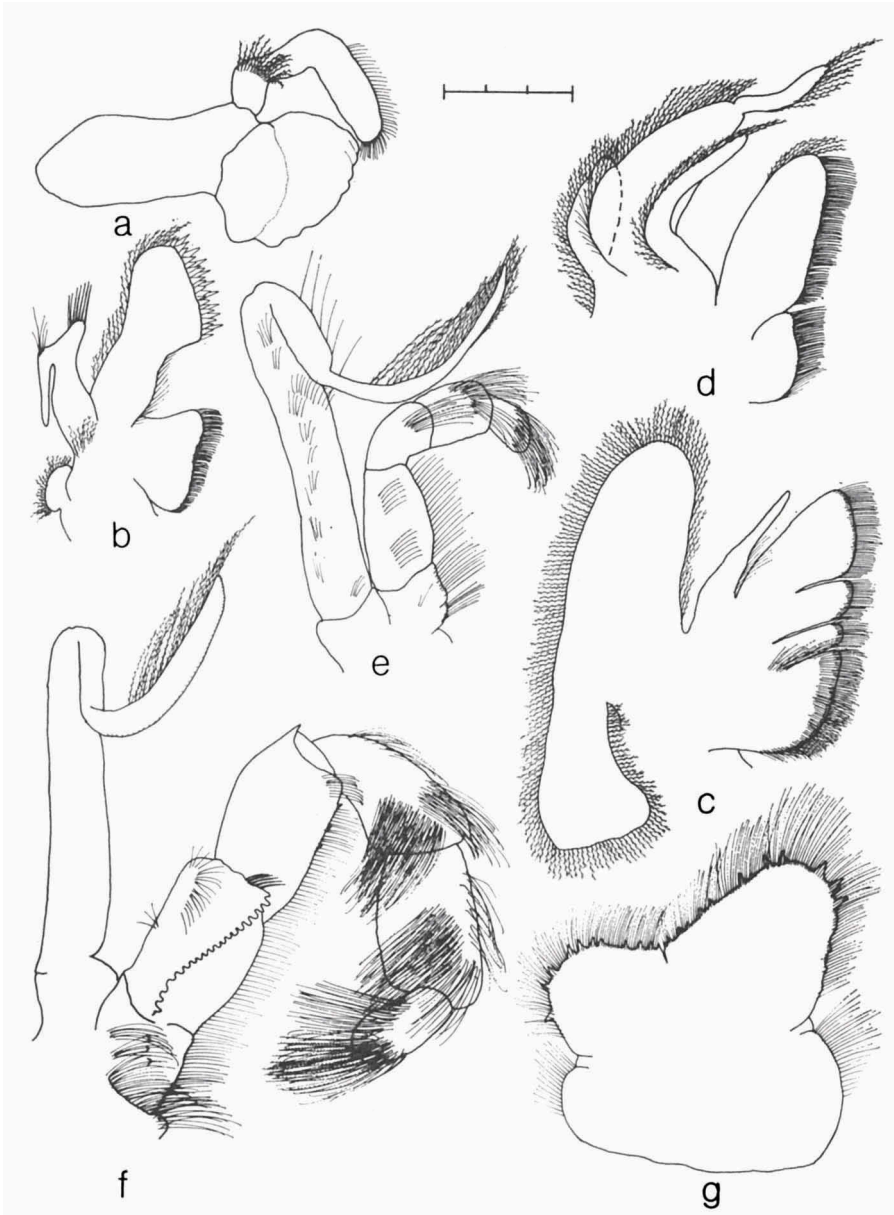


Fig. 12. *Paguristes turgidus* (Stimpson). a-f, mouthparts (left internal face) : a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, telson. Scale equals 3 mm.

gins each frequently with row of corneous-tipped spines, occasionally only with strong spine at ventrolateral distal angle; mesial faces each with row of low protuberances, becoming corneous-tipped tubercles or spines distally, distal margins each with row of moderately small corneous-tipped spines. Meri subtriangular; dorsal margins each with row of spinulose protuberances proximally, becoming transverse rows of corneous-tipped, often multifid, tubercles or spines distally, distal margins each with row of moderately strong, prominently corneous-tipped spines extending laterally and mesially; lateral faces with numerous scattered corneous-tipped spinules, tubercles or small spines, ventrolateral margins each with single or double row of corneous-tipped, simple or multifid spines; mesial faces each with vertical row of corneous-tipped spines or spinulose tubercles distally, occasionally with few spinulose ridges ventrally, ventromesial margins each with row of corneous-tipped spines increasing in size distally. Ischia each with row of moderately small corneous-tipped spines on ventromesial margin; ventrolateral distal angles each with cluster of small spines. Coxae with ventrodistal margins each with row of corneous tipped spines laterally and mesially, separated by prominent longitudinal line of decalcification, and partially obscured by tufts of long setae.

Second pereopods moderately short, slightly overreaching chelipeds. Dactyl moderately short, one-fourth to one-third longer than propodus; in lateral view slightly curved ventrally; in dorsal view, slightly curved mesially; terminating in small corneous claw; dorsal surface with row of small corneous spines partially obscured by row of tufts of long stiff setae; lateral face with faint longitudinal sulcus proximally and with single or double row of corneous spines ventrally and row of stiff setae; ventral margin with row of small corneous spines increasing in size distally and flanked by row of tufts of long stiff setae; mesial face frequently with very faint longitudinal sulcus and with median row of small corneous spines usually flanked by row of stiff setae. Propodus moderately short, slightly less than or equalling length of carpus; dorsal surface with irregular row of strong, conical corneous-tipped spines and second row of very small corneous-tipped spines laterally, partially obscured by tufts of dense long setae; lateral face with row of small, simple or bifid, spines or tubercles ventrally and with 1 or 2 longitudinal rows of stiff setae; mesial face usually with 2 rows of small corneous-tipped spines, strongest dorsally and tufts of stiff setae, distal margin often with few small corneous-tipped spines dorsally; ventral margin with 2 or 3 rows of small corneous-tipped spines partially obscured by tufts of long stiff setae. Carpus moderately long, three-fourths to four-fifths length of merus; dorsal surface with double row of strong corneous-tipped

spines and tufts of long setae; lateral face with faint longitudinal sulcus lined with tufts of stiff setae, distal margin with few corneous spinules; mesial face usually with small spine near dorsodistal margin, distal margin with few corneous spinules. Merus laterally compressed; dorsal margin with double row of low, often spinulose protuberances and tufts of stiff setae, distal margin with few corneous spinules; lateral and mesial faces with few tufts of stiff setae; ventral margin with 1 or 2 rows of small corneous-tipped spines obscured by tufts of long stiff setae. Ischium usually with few small corneous-tipped spines and stiff setae on ventral margin; dorsal margin with row of long stiff setae. Coxa with small spine at ventromesial distal angle, ventromesial and ventrodistal margins with long stiff setae.

Third pereopods approximately equalling second in length, slightly overreaching chelipeds. Dactyl moderately short, one-fourth to one-third longer than propodus; in lateral view, somewhat curved ventrally; in dorsal view, slightly curved mesially; terminating in moderately small corneous claw; dorsal surface with single or double row of small corneous-tipped spines increasing in size distally; lateral face with faint longitudinal sulcus proximally, and with 1 or 2 rows of stiff setae; mesial face with weak longitudinal sulcus and with 1 or 2 rows of corneous spines, strongest ventrally and increasing in size distally and 2 rows of tufts of stiff setae; ventral margin with row of corneous spines increasing in size distally and 2 rows of long stiff setae. Propodus moderately short, equalling or slightly exceeding length of carpus; dorsal surface with 1 to 3 rows of small corneous-tipped spines or tubercles and row of tufts of stiff setae; lateral face with 1 or 2 rows of tufts of stiff setae, distal margin with few corneous spinules ventrally; mesial face with irregular rows of small corneous-tipped spines or tubercles, often forming transverse ridges distally and tufts of stiff setae; ventral margin with row of low corneous-tipped spines or tubercles and tufts of long stiff setae. Carpus moderately long, slightly shorter than or equalling length of merus; dorsal surface with single or double row of moderately strong corneous-tipped spines and tufts of long stiff setae; lateral face with faint longitudinal sulcus, often lined with tufts of stiff setae, irregular row of stiff setae ventrally; mesial and ventral surfaces with scattered tufts of long setae. Merus laterally compressed; dorsal surface with strong spine at distal margin, often with row of small spines proximally (left) or low protuberances (right) and tufts of long setae; mesial and lateral faces with scattered tufts of stiff setae; ventral margin unarmed or with row of small spines or spinulose protuberances and tufts of long setae. Ischium unarmed or with few small spines or tubercles on ventral margin and occasionally small spine on dorsal

margin, both margins with long stiff setae. Coxa with rows of stiff setae on ventromesial and ventrodistal margins.

Fourth pereopods with propodal rasp well developed.

Fifth pereopods chelate.

Sternite of third pereopods subrectangular.

Pleopods of male with first and second paired, modified. Pl_1 with row of moderately short setae on mesial margin of basal lobe, superior mesial angle with tuft of long bristles; inferior lamella with row of setae on lateral margin, distal margin with row of small curved spines extending down mesial face; external lobe subtriangular, slightly exceeding inferior lamella in distal extension, naked; internal lobe subsemicircular, mesial and distal margins and inferior face distally with long setae. Pl_2 with short row of moderately long setae proximally; endopodite with tuft of long setae; appendix masculina strongly twisted, lateral and distal margins and inferior face with long setae. Pl_3 - pl_5 upaired, exopodite very well developed, endopodite vestigial or absent.

Pleopods of female with first paired, modified. Pl_1 with row of plumose setae on basal segment; distal segment with distal half tapered, margins with plumose setae. Pl_2 - pl_4 with both rami well developed, pl_5 with exopodite well developed, endopodite vestigial or absent. Brood pouch elongate, usually folded, subtriangular, with distal extremity strongly tapered, margins with long plumose setae.

Telson with posterior lobes very asymmetrical, left considerably larger than right; subtriangular or subquadrate; separated by moderately deep, very narrow median cleft; right terminal margin with 5-11 moderately strong, corneous-tipped spines extending onto lateral margin and partially obscured by long stiff setae; left terminal margin with 9-12 moderately strong corneous-tipped spines extending onto lateral margin and partially obscured by long stiff setae; anterior lobes unarmed, margins with long stiff setae.

Coloration. — In life: not known. In preservative: "Pinkish buff to vinaceous-rufous (brown), obscured by hirsute covering; eye stalks, antennules and inner surface of flagella with a longitudinal streak of vinaceous-rufous; spines dark tipped." (Stevens, 1925: 301).

Distribution. — Chukchi Sea (68°N); British Columbia, Queen Charlotte Is. (Hart) to San Diego, California (Schmitt); subtidal to 420 meters. This record from the Chukchi Sea is a major extension of the northern range of *P. turgidus*.

Affinities. — As previously noted, *Paguristes turgidus* is closely allied to *P. ulreyi*. It may be distinguished from the latter species by the presence of scattered long and short setae on all surfaces of the articles of the

antennal flagella, and by the elongate subtriangular brood pouch of the females.

Discussion. — In a paper presented before the Boston Society of Natural History in 1856, Stimpson first described this species as *Eupagurus turgidus*; however, the proceedings of this meeting were not published until 1859. In the interim Stimpson (1857) transferred the species to the genus *Clibanarius*, and then to *Paguristes* (Stimpson, 1858). The delayed publication of the proceedings, which were also reprinted in 1862, accounts for Stimpson's apparent generic inconsistencies as seen in the synonymy of *Paguristes turgidus*.

PAGURIDAE

Pagurus Fabricius

Cancer Linnaeus, 1758: 625 (in part).

Pagurus Fabricius, 1775: 410 (in part). Type species, by subsequent selection by Latreille (1810: 422): *Cancer bernhardus* Linnaeus, 1758: 631 (as defined by lectotype selection by Forest & Holthuis, 1955: 312: specimen figured by Swammerdam, 1737, pl. 11 fig. 1). Gender: masculine.

Eupagurus Brandt, 1851: 105 (in part). Type species by subsequent selection by Stimpson (1858: 236): *Cancer bernhardus* Linnaeus, 1758: 631. Gender: masculine. Founded as a subgenus of *Pagurus* Fabricius, 1775.

Bernhardus Dana, 1851: 267 (in part). Type species by original designation, *Bernhardus typicus* Dana, 1851: 267 (= *Cancer bernhardus* Linnaeus, 1758). Gender: masculine. not *Pagurus* Berthold, 1827: 255 (nomen nudum). not *Pagurus* Fabricius sensu Dana, 1851: 267 (= *Dardanus* Paulson, 1875).

Diagnosis. — Shield well calcified; posterior carapace primarily membranous.

Eleven pairs of phyllobranchiate branchiae.

Maxillipeds widely separated basally. Basis-ischium of mxp₃ incompletely fused; ischium with crista dentata well developed, 1 or more accessory teeth; merus with or without spine at dorsodistal margin.

Ocular acicles usually triangular; dorsal surface level, slightly convex or slightly concave.

Chelipeds grossly unequal; right considerably larger than left. Both chelipeds oriented in horizontal plane.

Fourth pereopods subchelate; propodal rasp usually well developed; dactyl with or without preungual process on lateral face.

Males with paired gonopores, coxae of P₅ equal; no sexual tubes.

Females with paired gonopores.

No paired pleopods in either sex.

Abdomen well developed; uropods asymmetrical.

Distribution. — Worldwide.

Discussion. — As first established by Fabricius (1775), *Pagurus* included a heterogeneous group of non crab-like species of Linnaeus' (1758) genus *Cancer*. The type species of *Pagurus*, *Cancer bernhardus* Linnaeus, was later selected by Latreille (1810). Subsequently, two genera, *Birgus* Leach, 1815, and *Coenobita* Latreille, 1826, were erected for terrestrial species formerly assigned to *Pagurus*. It was not until several years later, however, that a major revision of the genus was undertaken (H. Milne-Edwards, 1836, 1848). In addition to erecting the genus *Cancellus* for pagurids possessing straight abdomens, H. Milne-Edwards (1836) subdivided *Pagurus* into three subgroups: Pagures Ordinaires, Pagures Appendiculés and Pagures Armés; *Pagurus bernhardus* was listed first in his subgroup Pagures Ordinaires. Later he subdivided Pagures Ordinaires into three sections: Dextres, including *P. bernhardus*, Senestres, and Aequimanes (H. Milne-Edwards, 1848). For section 1. Dextres of Milne-Edwards' Pagures Ordinaires, Brandt (1851) assigned the name *Eupagurus* which he gave sub-generic rank. Listed first in this taxon was *Pagurus bernhardus*. In this publication, Brandt did not discuss Milne-Edwards' other sections or subgroups; however, in a footnote (Brandt, 1851: 105) he remarked that a synoptic review of *Pagurus*, which included some modification of the Edwardian classification, was in preparation. Apparently this revision was never published.

Unaware of Brandt's paper, Dana (1851) published a revision of Milne-Edwards' classification. For Pagures Ordinaires section 1. Dextres, Dana assigned the generic name *Bernhardus*, and designated *P. bernhardus*, which he renamed *Bernhardus typicus*, as the type. However, Dana did not subscribe to Milne-Edwards' divisions, Senestres and Aequimanes. Instead he chose to use the terminal structure of the left chela to subdivide the remaining Pagures Ordinaires. For the species with calcareous-tipped left chelae, Dana established the genus *Calcinus*; he believed that the remaining species, with corneous-tipped left chelae, constituted the genus *Pagurus* of Fabricius. In addition, Dana assigned the name, *Paguristes*, to H. Milne-Edwards' Pagures Appendiculés and *Diogenes* to Pagures Armés. The following year, Dana (1852b) designated *Pagurus punctulatus* Olivier, 1811 as the type of *Pagurus* (sensu Dana).

In a paper read before the Boston Society of Natural History in 1856, Stimpson (1859b) raised *Eupagurus* Brandt to generic rank. In the following year, Stimpson (1857) pointed out that *Eupagurus* and *Bernhardus* were synonymous and that Brandt's name had priority over Dana's by a few weeks. Subsequently, he (Stimpson, 1858) designated *Cancer bernhardus* Linnaeus as the type species of *Eupagurus* Brandt. Although *Eupagurus* replaced *Bern-*

hardus as the generic name for species characterized by an enlarged right cheliped, species with corneous-tipped, enlarged left chelipeds continued to be referred to *Pagurus* (sensu Dana).

Paulson (1875, 1961) erected the genus, *Dardanus*, for *Pagurus depressus* Heller, 1861, which he renamed *Dardanus helleri* Paulson. He differentiated *Dardanus* from *Pagurus* (sensu Dana) on the structure of the orbital region; however, this character was shown to be invalid (Kossmann, 1880) and *Dardanus* was treated as a junior synonym of *Pagurus* (sensu Dana).

Benedict (1892), in a study of the genus *Eupagurus* in the collections of the United States National Museum, established four subgenera, i.e., *Eupagurus*, with type species *E. bernhardus* (Linnaeus), *Trigonocheirus*, with type species *E. trigonocheirus* Stimpson, *Elassochirus*, with type species *E. tenuimanus* (Dana), and *Labidocheirus*, with type species *E. splendescens* (Owen). Benedict (1896), noting that *Pagurus* (sensu Dana) contained none of the species originally placed in the genus by Fabricius, pointed out that Latreille's (1810) selection of *Cancer bernhardus* Linnaeus had priority over the designations of this species as the type of *Bernhardus* by Dana and *Eupagurus* by Stimpson. Benedict, therefore, strongly recommended that *Pagurus* (sensu Fabricius) be returned to the taxon typified by *bernhardus*. Rathbun (1899) and Holmes (1900) accepted Benedict's recommendation and, by implication, placed *Eupagurus* in synonymy. However, a replacement name for *Pagurus* (sensu Dana) was not proposed until Benedict (1901a) assigned the name *Pagurias* Benedict to this taxon. Subsequently, Rathbun (1903: 33), who pointed out that *Dardanus* Paulson was an available name for *Pagurus* (sensu Dana), placed *Pagurias* Benedict in synonymy. Although American and Russian carcinologists accepted *Pagurus* (sensu Fabricius) and *Dardanus* Paulson, most Asian and European carcinologists continued to refer species to *Eupagurus* Brandt and *Pagurus* (sensu Dana). This nomenclatural problem was not resolved until a request was submitted to the International Commission on Zoological Nomenclature for a ruling (Forest & Holthuis, 1955). Subsequently, the Commission validated the names *Pagurus* and *Dardanus* (Opinion 472, cf. Hemming, 1957) and placed the names, *Eupagurus* Brandt and *Bernhardus* Dana, on the Official Index of Rejected and Invalid Generic Names in Zoology (Hemming, 1958).

The ruling of the Commission clarified the nomenclatural confusion of *Pagurus*; however, definition of the genus still remains ambiguous. Although early carcinologists recognized the heterogeneity of *Pagurus*, the only major revisions of the genus were based on secondary sexual characters, e.g., sexual tubes in the males or paired pleopods in one or both sexes, etc., and the following genera were erected: *Catapagurus* A. Milne-Edwards, 1880;

Anapagurus Henderson, 1886; *Catapaguroides* A. Milne-Edwards & Bouvier, 1892; and *Pylopagurus* A. Milne-Edwards & Bouvier, 1893.

Melin (1939) attempted a revision of *Eupagurus* based on collections of the Bonin-Inseln 1914 Expedition. However, as pointed out by De Saint Laurent (1968a), his work was hampered by lack of material, which perhaps accounts for his disregard for the significance of sexual tubes. His revision resulted in the recombination of several previously defined genera as groups or subgenera within *Eupagurus*. Melin's proposed subgenera have rarely been adopted and his recombinations, based primarily on pleopod number, have been shown to have been unjustified (De Saint Laurent, 1968a: 934). In several recent studies, carcinologists have avoided formal subdivision of the genus, but have grouped species on the basis of morphological similarities (Bouvier, 1940; Forest & De Saint Laurent, 1967), larval development (MacDonald, Pike & Williamson, 1957; Pike & Williamson, 1960), and behavior (Hazlett, 1966).

An extensive revision of *Pagurus* has not been undertaken as yet; however, four northwestern North American species differed sufficiently from the general interpretation of the genus that it has been necessary to remove them from *Pagurus*. Two of these species represent the type species of two previously described subgenera, *Elassochirus* Benedict and *Labidochirus* Benedict. As originally described, each of these subgenera included a heterogeneous group of species; both are herein restricted and raised to generic rank.

Species-group diagnoses

Forest & De Saint Laurent (1967: 116) established four groups within the genus *Pagurus* for species from the "Calypso" collections; they included among these groups numerous species having superficially similar characters. For groups I to IV, the diagnoses are taken from Forest & De Saint Laurent (1967); where possible I have added pertinent characters of the mouthparts or other structures, based on specimens of available species included in the groups by the authors. In one instance (Group II "*exilis*") it has been necessary to emend the group diagnosis. Four additional groups are also proposed, based on species-relationships found in northwestern North America. Some species do not appear to adequately fit into the existing species-groups nor into those proposed; however, none are sufficiently unique to warrant establishment of monospecific groups.

Group I ("*miamensis*" group). — Frontal margin with median projection generally slightly produced and obtuse. Ocular peduncles subcylindrical,

slender. Ocular scales broad, uni- or multifid or denticulate terminally, according to species.

Chelipeds very unequal, hands covered with spiny tubercles; interspersed with numerous bristles. Ambulatory legs slender, dactyls terminating in sharp, corneous claw; ventral margin with spiniform bristles. Fourth pereopod subchelate, propodus provided with multiseriated rasp of squamiform bristles.

Three unpaired, biramous pleopods in males; four in females.

In several species, internal margin of exopod of left uropod bordered by long, ribbon-like bristles.

All species of small size, length of carapace rarely exceeding 7 or 8 mm. (After Forest & de Saint Laurent, 1967, translated from the French).

Maxillule with proximal endite generally tapering; external lobe of endopodite elongate, not recurved. Maxilla with endopodite inflated basally; scaphognathite very slender proximally. First maxilliped with basal segment of exopodite very narrow. Third maxilliped with 1 accessory tooth on crista dentata; merus with dorsodistal margin unarmed. [Description based on mouthparts of *Pagurus miamensis miamensis* Provenzano, 1959 (UMML) and *Pagurus provenzanoi* Forest & De Saint Laurent, 1967 (UMML).]

In this group, Forest & De Saint Laurent (1967) list the following species: *Pagurus provenzanoi*; *P. miamensis uncifer* Forest & De Saint Laurent, 1967; *P. criniticornis* (Dana, 1852d); *P. leptonyx* Forest & De Saint Laurent, 1967; *P. trichocerus* Forest & De Saint Laurent, 1967; *P. brevidactylus* (Stimpson, 1859a); *P. miamensis miamensis*; *P. pygmaeus* (Bouvier, 1918); *P. marschi* [misspelling of *P. marshi* (Benedict, 1901a)]; *P. annulipes* (Stimpson, 1862); *P. bonairensis* Schmitt, 1936; *P. stimpsoni* (A. Milne-Edwards & Bouvier, 1893); *P. hendersoni* Wass, 1963; *P. lepidus* (Bouvier, 1898); and *P. benedicti* (Bouvier, 1898). To this list Hart (1971) added *P. quaylei* Hart and *P. caurinus* Hart. The structure of the mouthparts of this group, based on those of *P. miamensis miamensis* and *P. provenzanoi*, are sufficiently different from those of *P. quaylei* and *P. caurinus* to suggest that these latter two species should not be included in the "miamensis" group. However, as the mouthparts have not been described for most of the species in this group, a final decision on the affinities of these species must await further investigations.

Group II ("exilis" group). — Frontal margin with triangular, obtuse rostrum; lateral projections with spinule directed to exterior. Ocular peduncles strong, with corneae dilated. Ocular scales triangular, summits rounded, with subdistal spinule inserted ventrally, dorsal face concave.

Chelipeds very unequal, right much longer, with hand lengthened, narrow,

weakly pilose, more or less strongly granulated. Left cheliped compressed laterally, with hand very narrow. Ambulatory legs long, dorsal margin of carpus denticulate or granulate; dactyls long, arched, more or less twisted at tip, ventral margins with very short, spiniform bristles. Fourth pereopods with extremity subcheliform, propodus furnished with rasp of squamiform, multiserial bristles (except in *P. gladius*) [with or without preungual process].

Males with 3 unpaired pleopods with external rami well developed, internal rami rudimentary (absent in *P. gladius*).

Posterior region of telson divided into 2 lobes, asymmetrical, strongly spinous, without bristles or lateral corneous plates [or posterolateral margins each with row of short stiff bristles or spinules]. (After Forest & De Saint Laurent, 1967: 117, translated from the French; [] refers to emendation by the present author).

Maxillule with proximal endite generally tapering; endopodite with external lobe moderately well developed, straight or slightly recurved. First maxilliped with basal segment of exopodite strongly inflated proximally. Third maxilliped with relatively few teeth on crista dentata, 1 accessory tooth; merus with small spine at dorsodistal margin. [Description of mouthparts based on specimens of *Pagurus longicarpus* Say, 1817 (UMML) and *Pagurus longimanus* Wass, 1963 (UMML)].

The six species assigned to this group by Forest & De Saint Laurent (1967: 117) are the following: *Pagurus exilis* (Benedict, 1892); *P. longicarpus*; *P. longimanus*; *P. perlatus* H. Milne-Edwards, 1848; *P. gladius* (Benedict, 1892); and *P. albus* (Benedict, 1892). One species from northwestern North America, *Pagurus mertensii* Brandt (sensu stricto), is added herein to this group.

The diagnosis of Group II ("*exilis*" group) has been emended from that given by Forest & De Saint Laurent. As originally defined, the posterior lobes of the telson were described as "Région postérieure du telson divisée en deux lobes asymétriques fortement épineux, sans soies ni lames cornées latérales." (Forest & De Saint Laurent, 1967: 117). In *P. longicarpus* and *P. longimanus*, as well as in *P. mertensii*, the lateral margins of the posterior lobes each carry a row of short, stiff, somewhat spiniform, bristles or spinules. A preungual process also appears to be present in both *P. longicarpus* and *P. longimanus*; however, the small size of the available specimens makes confirmation of the presence of this structure difficult.

The remaining species assigned to this group are not known to this author. Future study may show that as presently defined, the "*exilis*" group contains two distinct, but superficially similar, groups and that the telson as redefined,

as well as the mouthparts are representative only of species akin to *P. longicarpus*, *P. longimanus* and *P. mertensii*.

Group III (“*comptus*” group). — Frontal margin of carapace characterized by strong rostral projection, sharp, exceeding acuteness of weak lateral projections and marked by small spinule. Ocular peduncles rather narrow, subcylindrical. Ocular scales triangular, with subterminal spine inserted ventrally.

Chelipeds very unequal, right with carpus enlarged distally, with ventral surface slightly excavated anteriorly; hand broad, granulose, weakly pilose or smooth. Ambulatory legs thick-set, with short dactyls ornamented by strong, spiniform bristles on ventral margin. Fourth pereopod with extremity subcheliform, propodus bordered by single row of spiniform bristles.

Three unpaired, unequally biramous pleopods in male; four in female.

Posterior lobes of telson separated by fine, median incision, external margins formed of thin chitinous layer, internal margins denticulate. (After Forest & De Saint Laurent, 1967: 117, translated from the French).

Forest & De Saint Laurent (1967) assigned nine species to the “*comptus*” group, i.e., *Pagurus comptus* (White, 1847); *P. forceps* H. Milne-Edwards, 1836; and *P. edwardsi* (Dana, 1852d) from Atlantic and Pacific South America, and *P. beringanus* (Benedict, 1892); *P. granosimanus* (Stimpson, 1858); *P. hemphilli* (Benedict, 1892); *P. samuelis* (Stimpson, 1857); *P. middendorffii* Brandt, 1851 (cited as *P. middendorfi* (Brandt)); and *P. hirsutiussculus* (Dana, 1851) from northwestern North America. The three species listed from outside the study area are unknown to this author; however, all of the northwestern North American species deviate from the diagnosis of the group in one or more characters. In none of these species does the propodal rasp of the fourth pereopod consist of a single row of spiniform bristles. Similarly, none of these species have chitinous layers on the lateral margins of the posterior lobes of the telson.

It is apparent that the “*comptus*” group is in need of considerable revision; however, as the mouthparts and other diagnostic characters of the South American species are not known, it would seem inadvisable to emend the group at this time, based on the northwestern North American species. To remove the latter species without additional comparisons also seems unwarranted. For the present these species are questionably referred to the “*comptus*” group with the notation that further study is needed to clarify existing discrepancies.

Group IV (“*gaudichaudi*” group). — The unique species of this group, *Pagurus gaudichaudi* H. Milne-Edwards, 1836, is distinguished from almost

all other species described under the name *Pagurus* by the presence of rudimentary pleurobranchs on P₂ and P₃ and by the divided branchial lamellae. (After Forest & De Saint Laurent, 1967: 117, translated from the French).

No representatives of this group are known from northwestern North America.

The following additional groupings of *Pagurus* species are here proposed.

Group V ("*bernhardus*" group). — Anterior margin with rostrum produced, rounded or acutely triangular. Ocular peduncles short, moderately stout; corneae ovately dilated. Ocular acicles subovate; dorsal surface concave.

Chelipeds grossly unequal; left chela with dorsal surface flattened, margins slightly raised. Second and third pereopods elongate; dactyls long, broad, strongly twisted, ventral margins with strong, corneous spines. Fourth pereopods without preungual process; propodal rasp well developed.

Males with 3 unpaired pleopods; females with 4 unpaired pleopods.

Telson with posterior lobes subtriangular; terminal margins oblique, with moderately strong, corneous spines, strongest at terminolateral angle, often with secondary row(s) of very small spinules set slightly off margins.

Maxillule with proximal endite subquadrate; endopodite with external lobe produced, recurved. First maxilliped with basal segment of exopodite inflated. Second maxilliped with basis-ischium fusion incomplete. Third maxilliped with 1 tooth on moderately well developed crista dentata; merus with spine at dorsodistal margin.

This group includes *Pagurus bernhardus* (Linnaeus, 1758); *P. armatus* (Dana, 1851); *P. ochotensis* Brandt, 1851; and *P. aleuticus* (Benedict, 1892). It is probable that this group would also include the other species listed by Benedict (1901b) as of the *Pagurus bernhardus* type; however, only *P. bernhardus* (RMNH, UMML) from outside side the study area has been examined.

Group VI ("*capillatus*" group). — Anterior margin with rostrum produced, triangular or rounded; lateral projections prominent, with terminal spine. Ocular peduncles usually cylindrical; corneae slightly dilated. Ocular acicles acutely or ovately triangular.

Chelipeds grossly unequal; left chelae with dorsolateral surface oblique, not produced into prominent crest or ridge. Second and third pereopods moderately short; dactyls straight or twisted; usually setose. Fourth pereopods without preungual process.

Male with 3 unpaired pleopods; female with 4 unpaired pleopods.

Telson with posterior lobes subtriangular; terminal margins oblique, denticulate or with moderately small spines or spinules.

Maxillule with proximal endite generally tapering; endopodite with external lobe moderately well developed, not recurved. First maxilliped with basal exopodal segment slender. Third maxilliped with crista dentata well developed, with 1 or 2 accessory teeth; merus with spine at dorsodistal margin.

This group includes *Pagurus capillatus* (Benedict, 1892); *P. setosus* (Benedict, 1892); and *P. kennerlyi* (Stimpson, 1864) from northwestern North America and *P. arcuatus* Squires, 1964, from northeastern North America.

Group VII ("*confragosus*" group). — Anterior margin with rostrum strong, triangular, usually acute; lateral projections prominent, with terminal spine. Ocular peduncles moderately short, stout; corneae usually strongly dilated. Ocular acicles ovately triangular.

Right cheliped with prominent, raised, triangular plateau on dorsal surface of chela. Left chela with dorsolateral surface strongly oblique, concave, elevated into prominent crest or ridge. Second and third pereopods with dactyls moderately long, slender, usually twisted. Fourth pereopod with preungual process on lateral face of dactyl at base of claw; propodal rasp well developed.

Male with 3 unpaired pleopods; female with 4 unpaired pleopods.

Telson with posterior lobes slightly asymmetrical, left somewhat larger than right; terminal margins slightly oblique, each with 2-8 strong spines.

Maxillule with proximal endite usually tapering; endopodite with external lobe well developed, recurved. First maxilliped with basal segment of exopodite moderately inflated; epipodite slightly produced. Second maxilliped with basis-ischium fusion incomplete. Third maxilliped usually with small spine or spinule on dorsal margin of ischium, crista dentata well developed, 1 accessory tooth; merus and carpus each with spine at dorsodistal margin.

This group, at present, includes only three species, all from northwestern North America, i.e. *Pagurus confragosus* (Benedict, 1892); *P. tanneri* (Benedict, 1892); and *P. cornutus* (Benedict, 1892).

Group VIII ("*trigonocheirus*" group). — Anterior margin with rostrum usually produced, obtusely or acutely triangular; lateral projections obtuse or broadly rounded. Ocular peduncles subcylindrical; corneae often slightly dilated. Ocular acicles subtriangular, usually with terminal spine, occasionally with 1 or 2 accessory spinules.

Chelipeds grossly unequal; left chelae with dorsolateral surface oblique, concave or convex; midline elevated, often into moderately strong ridge; dorsolateral margin usually expanded slightly. Second and third pereopods with dactyls straight, or more frequently, twisted. Fourth pereopods with or without preungual process.

Male with 3 unpaired pleopods; female with 4 unpaired pleopods.

Telson with posterior lobes asymmetrical, left larger than right; terminal margins straight or oblique, with strong, corneous spines, often extending onto lateral margins.

Maxillule with proximal endite subquadrate or slightly tapering; endopodite with external lobe usually well developed, not recurved. First maxilliped with basal segment of exopodite moderately slender; epipodite occasionally slightly produced. Third maxilliped with crista dentata very well developed, 1 or 2 accessory teeth; merus usually with spine at dorsodistal margin.

This group includes *Pagurus trigonocheirus* (Stimpson, 1858); *P. undosus* (Benedict, 1892); *P. brandti* (Benedict, 1892) s.s.; *P. stevensae* Hart, 1971; and *P. dalli* (Benedict, 1892) from northwestern North America, and *P. pubescens* Kröyer, 1838a from the North Atlantic.

Data from studies currently in progress (De Saint Laurent, personal communication; McLaughlin, unpublished) suggest that *Pagurus* [sensu stricto] will eventually be restricted to a few species typified by *P. bernhardus*; whereas the majority of species now assigned to the genus, including those of the other seven previously mentioned groups, will be transferred to one or more genera yet to be established.

Key to the species of *Pagurus* in northwestern North America

1. Left chela with dorsal surface flattened; palm with dorsolateral and dorsomesial margin slightly raised 2
- Left chela with dorsal surface elevated; palm with dorsolateral surface oblique, convex or concave 4
2. Dactyls of P₂ and P₃ with prominent, single, longitudinal sulcus on dorsal surface *P. aleuticus* (Benedict)
- Dactyls of P₂ and P₃ with 3 longitudinal rows of small spines or spinulous tubercles on dorsal surface, separated proximally by 2 shallow longitudinal sulci 3
3. Chelae with moderately short, conical, simple or multifid spines or tubercles on dorsal surface; palm and dactyl of left chela with mesial surfaces strongly armed with low spines or spinulous tubercles *P. ochotensis* Brandt
- Chelae with long, slender spines on dorsal surface; palm and dactyl of left chela with mesial surfaces usually unarmed or with irregular row of small spines or tubercles approximating dorsomesial margin *P. armatus* (Dana)
4. Left chela with dorsolateral surface generally concave; midline elevated into prominent ridge or crest 5
- Left chela with dorsal surface convex; midline often elevated, but not into prominent ridge or crest 10
5. Right palm with dorsal surface raised into prominent, triangular plateau 6
- Right palm with dorsal surface level, convex, or with prominent, median ridge 8
6. Right palm with triangular plateau extending onto fixed finger as slender, spinose crest; right chela elongate, slender *P. tanneri* (Benedict)
- Right palm with triangular plateau extending onto fixed finger as broadened,

- rounded, spinose or tuberculate ridge; right chela moderately short, broad . . . 7
7. Right palm with apex of triangular plateau elevated into prominent horn
 *P. cornutus* (Benedict)
- Right palm with apex of triangular plateau not elevated into prominent horn
 *P. confragosus* (Benedict)
8. Right palm with prominent, moderately broad, median dorsal ridge; surface concave mesially and laterally *P. undosus* (Benedict)
- Right palm without prominent dorsal ridge; surface convex, not strongly sculptured 9
9. Rostrum strongly produced, triangular; left chela with fingers very elongate, slender, strongly depressed distally (not known from depths less than 500 m)
 *P. iowensendi* (Benedict)
- Rostrum moderately short, obtusely triangular or slightly rounded; left chela with fingers short, not strongly depressed distally, dorsolateral margin expanded proximally, prominently so in small specimens *P. trigonocheirus* (Stimpson)
10. Merus of right cheliped with 1 or 2 prominent tubercles on ventral surface 11
- Merus of right cheliped without prominent tubercle(s) on ventral surface 16
11. Merus of right cheliped with 2 prominent tubercles on ventral surface 12
- Merus of right cheliped with 1 prominent tubercle on ventral surface 14
12. Dactyl and propodus of left P₃ with lateral surfaces unarmed, or propodus with 1 or 2 spines distally or few small tubercles ventrally *P. granosimanus* (Stimpson)
- Dactyl and propodus of left P₃ with irregular row(s) of small spines or tubercles on lateral surfaces ventrally 13
13. Chelae with small spines or spinules; carpus of left cheliped with 1 row of strong spines on dorsal surface; 2 tubercles, set at distal angles, on ventral surface of merus of right cheliped *P. beringanus* (Benedict)
- Chelae with tubercles or granules; carpus of left cheliped with 2 rows of moderately strong spines on dorsal surface; 2 tubercles, set at proximal angles, on ventral surface of merus of right cheliped *P. samuelis* (Stimpson)
14. Chelae with irregular rows of moderately strong spines, partially obscured by tufts of long setae *P. caurinus* Hart
- Chelae with closely-spaced tubercles or granules, frequently inconspicuous; with or without scattered tufts of setae 15
15. Carpus of right cheliped very strongly inflated ventrally; shield noticeably longer than broad *P. hemphilli* (Benedict)
- Carpus of right cheliped not strongly inflated ventrally; shield noticeably broader than long *P. hirsutiusculus hirsutiusculus* (Dana)
16. Chelae granular, often inconspicuously so; setae few or lacking 17
- Chelae spinose, spinulose, or tuberculate; with or without tufts of setae 18
17. Carpus of right cheliped with longitudinal row of small tubercles in midline; terminal margins of telson with prominent spines, lateral margins each with row of short, stiff bristles *P. mertensii* Brandt
- Carpus of right cheliped evenly granular; terminal margins of telson spinulose, lateral margins each with few setae *P. middendorffii* Brandt
18. Left chela very elongate, slender; fingers strongly depressed distally; carpus of right cheliped with shallow depression at dorsomesial distal angle, with tuft of long setae (♂), or naked (♀) *P. rathbuni* (Benedict)
- Left chela not markedly elongate; fingers not strongly depressed distally; carpus of right cheliped without shallow depression at dorsomesial distal angle 19
19. Left chela short; dactyl bowed, producing prominent hiatus with fixed finger; ocular acicles usually terminating with bifid or multifid spine *P. quaylei* Hart
- Left chela variable in length, lacking prominent hiatus; ocular acicles terminating acutely or subacutely, unarmed or with simple spine 20
20. Terminal margins of telson with strong spines 21

- Terminal margins of telson with numerous small spines, usually most prominent at terminolateral angle, or spinulose 23
21. Carpus of right cheliped very elongate and slender; left chela with double row of strong, divergent spines on dorsal midline. Telson with terminolateral margins oblique *P. stevensae* Hart
- Carpus of right cheliped moderately short and broad; left chela with single row of strong spines on dorsal midline. Telson with terminolateral margins rounded 22
22. Right cheliped with prominent spinose or spinulose protuberance on ventromesial surface of merus *P. brandti* (Benedict)
- Right cheliped without prominent spinose or spinulose protuberance on ventromesial surface of merus *P. dalli* (Benedict)
23. Dactyls of P₂ and P₃ with row of small, corneous spinules on ventral margins *P. capillatus* (Benedict)
- Dactyls of P₂ and P₃ with row strong, corneous spines on ventral margins 24
24. Right third pereopod with row of spines on dorsal margin of carpus *P. kennerlyi* (Stimpson)
- Right third pereopod without row of spines on dorsal margin of carpus *P. setosus* (Benedict)

Pagurus armatus (Dana) (figs. 13, 14)

- Bernhardus armatus* Dana, 1851: 270 (type locality: "in freto 'Puget' Oregonensi" [Puget Sound, Washington]). — Dana, 1852c: 270. — Dana, 1852d: 442. — Dana, 1855: 9, pl. 27 figs. 2a, b. — Stimpson, 1907: 218.
- Eupagurus armatus*: Stimpson, 1857: 484. — Bate, 1866: 278. — Whiteaves, 1878: 471. — Henderson, 1888: 69. — Harrington, 1898: 214 (footnote). — Calman, 1898: 263. — Balss, 1924: 786, fig. 35. — Balss, 1927: 970.
- Eupagurus ochotensis*: Stimpson, 1858: 248 (in part). — Calman, 1898: 274. — Bonnier, 1900: 222. — Alcock, 1905: 178 (in part). — Balss, 1957: 1717 (in part). — Not *Eupagurus ochotensis* (Brandt, 1851). See discussion.
- Eupagurus alaskensis*: Harrington & Griffin, 1897: 159. — Harrington, 1898: 214 (footnote), pl. 16 fig. 1. — Calman, 1898: 263. Not *Eupagurus alaskensis* Benedict, 1892.
- Pagurus (Eupagurus) ochotensis*: Holmes, 1900: 137 (by implication). Not *Pagurus ochotensis* Brandt, 1851.
- Pagurus ochotensis*: Benedict, 1901b: 463, text fig. (unnumbered). — Rathbun, 1904: 157. — Rathbun, 1910: 157. — Taylor, 1912: 204. — Schmitt, 1921: 130, fig. 84. — Stevens, 1925: 279, fig. 3. — Johnson & Snook, 1927: 333. — Fraser, 1932: 64. — Wismer & Swanson, 1935: 342. — MacGinitie, 1937: 1034. — Wiersma & van Harreveld, 1939: 44. — Hart, 1940: 92. — Hatch, 1947: 224. — MacGinitie & MacGinitie, 1949: 294. — Gordan, 1956: 332 (in part). — George & Strömberg, 1968: 253. — Roberts, 1968: 9. Not *Pagurus ochotensis* Brandt, 1851. See discussion.
- ? *Eupagurus ochotensis*: Lenz, 1901: 444. Probably not *Eupagurus ochotensis* (Brandt, 1851).
- Pagurus armatus*: Williamson, 1915: 470. — Makarov, 1938b: 201. — Gordan, 1956, p. 326. — Makarov, 1962: 191.

Neotype, herein selected. — ♂ (SL = 19.6 mm), USNM 143637.

Material examined. — See table 4.

Diagnosis. — Left chela with dorsolateral and dorsomesial margins slightly raised, dorsal surface flattened, with closely-spaced, long or moderately long, slender spines; dactyl and palm with mesial faces usually unarmed,

Table 4. *Pagurus armatus* (Dana) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex				SL (mm)	Collector
				♂	♀	♀♀	♀+		
<i>British Columbia</i>									
1.5 mi NW Klashun Pt.	---	----	3/9/34	2				5.3-7.2	Stevens
Departure Bay	---	USNM	8/8/34	1				9.2	Hart
		USNM							
<i>Washington</i>									
Straits of Juan de Fuca	---	----	9/8/61	1				5.8	Davis
Foulweather Bluff	---	USNM	3/3/39	1				16.6	Stevens
Friday Harbor, San Juan I.	---	----	1922	2	1			14.1-14.8	Stevens
		USNM							
Friday Harbor, San Juan I.	---	----	summer 57	1				16.3	Ray
San Juan Channel	---	----	2/8/61	4	4			4.4-8.1	McLaughlin
Lopez Sound	36	USNM, AHF	10/8/61	2	4			3.8-8.3	McLaughlin
Larson Bay, Kungtight I.	27-54	USNM, BM	7/7/34	1				6.6	Stevens
Puget Sound	36	----	9/8/62	1				7.5	---
		USNM							
Off Fauntleroy Fry Dock	9	----	25/8/62	2	1			9.3-19.6	Barton
Off Golden Gardens	---	USNM, RMNH	spring 60	2	1			6.2-9.9	Sukuda
Off Golden Gardens	---	RMNH	3/11/60	1	1			2.3-3.5	CC
		USNM							
Golden Gardens	---	----	3/63	1				3.1	---
Point Defiance	---	USNM	3/62	5				14.5-16.2	Young
Tacoma	---	----	3/62	9				13.4-17.2	Young
		USNM							
<i>California</i>									
Off. San Francisco	60-84	Albatross 5789 USNM 52666	21/10/04	8	17	2		2.6-12.9	---

or with row of small spines approximating dorsomesial margin. Dactyls of P_2 and P_3 with 3 longitudinal rows of small spines separated proximally by 2 shallow, longitudinal sulci.

Description. — Shield broader than long, or occasionally with width equalling length; anterolateral margins terraced; anterior margin between rostrum and lateral projections concave; posterior margin truncate or roundly truncate; dorsal surface generally smooth, with scattered tufts of short setae; anterolateral angle produced, blunt. Rostrum moderately long, equalling or exceeding lateral projections, obtusely triangular, acute, subacute, or broadly rounded, frequently with small, terminal spine and tuft of short setae. Lateral projections moderately well developed, broadly rounded or obtusely triangular, with moderately strong, terminal spine, and frequently with 1 or 2 small, accessory spines laterally.

Ocular peduncles moderately short, one-half to two-thirds length of shield; stout, somewhat inflated basally, corneal region ovate, dilated; dorsomesial face with longitudinal row of short setae. Ocular acicles large, subtriangular,

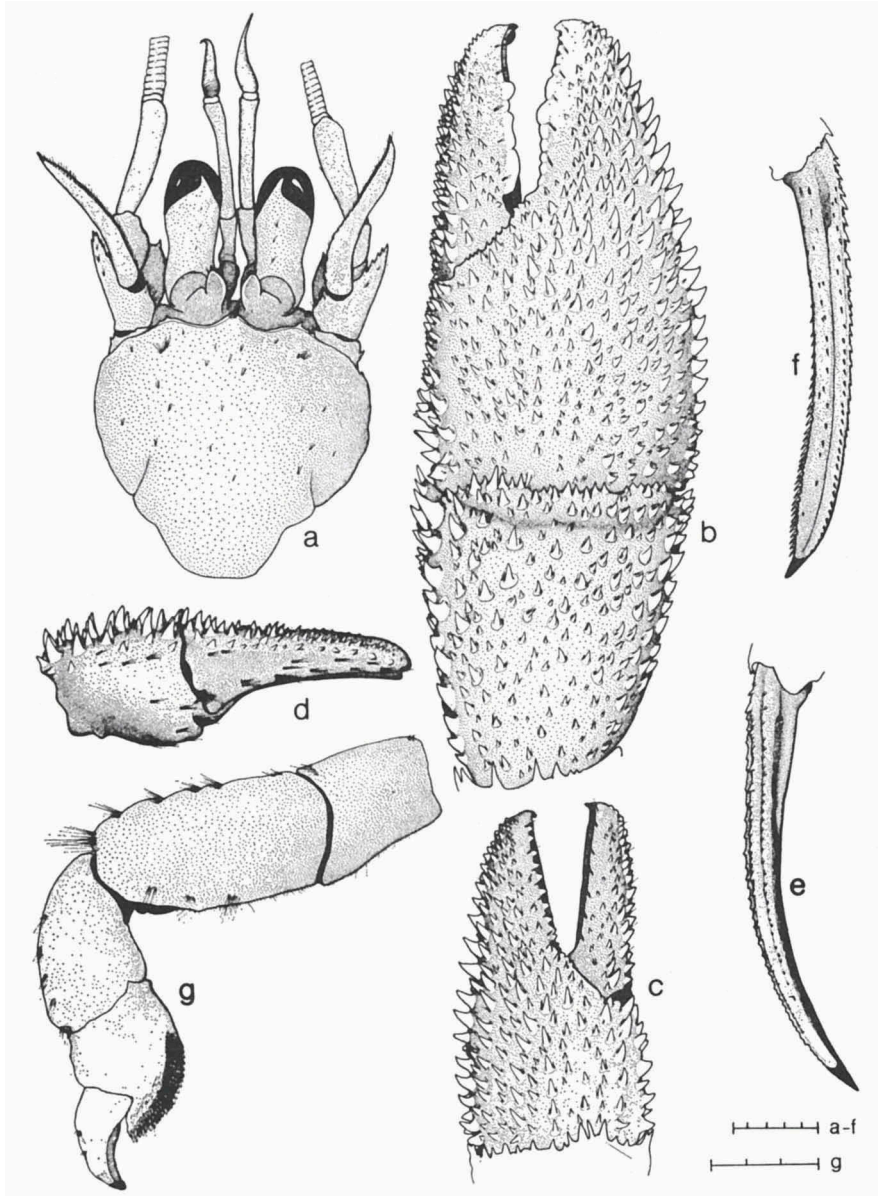


Fig. 13. *Pagurus armatus* (Dana). a, shield; b, right chela and carpus (dorsal view); c, left chela (dorsal view); d, left chela (mesial view); e, left P₃ dactyl (dorsolateral view); f, left P₃ dactyl (mesial view); g, left P₄ (lateral view). Scales equal 5 mm (a-f), 3 mm (g).

mesial margins strongly expanded, lateral margins straight or slightly expanded, dorsal surface concave; terminating acutely or subacutely, usually with moderately strong submarginal spine and few setae; separated basally by approximately basal width of one acicle.

Antennular peduncles long, exceeding ocular peduncles by three-fourths to entire length of ultimate segment; ultimate and penultimate segments with few short setae; basal segment occasionally with small spine or spinule on distolateral margin and tufts of moderately stiff setae.

Antennal peduncles long, exceeding ocular peduncles by one-half to four-fifths length of ultimate segment; with supernumerary segmentation. Fifth segment usually unarmed, with few tufts of short setae, occasionally with 1 or 2 minute spinules on ventral margin. Fourth segment with tufts of short setae. Third segment with ventromesial distal angle produced, terminating in moderately strong spine, partially obscured by tuft of long setae. Second segment with dorsolateral distal angle produced, terminating in simple or bifid spine, mesial margin with 2-6 small spines, lateral margin unarmed; dorsomesial distal angle with strong spine, mesial margin with tufts of short setae. First segment with small spine at laterodistal margin; ventral margin produced, with few small spines or spinules laterally. Antennal acicle moderately long, considerably exceeding length of ocular peduncles; arcuate, subtriangular, with dorsal surface flattened; terminating in strong spine; mesial margin often with row of very small spinules and tufts of short setae, lateral margin unarmed. Antennal flagella long, overreaching right cheliped, articles usually naked.

Mandible without distinctive characters. Maxillule with proximal endite subquadrate, endopodite with 1 or 2 bristles on moderately well developed internal lobe, external lobe produced, recurved toward interior. Maxilla with endopodite moderately slender, exceeding scaphognathite in distal extension. First maxilliped with endopodite one-half to two-thirds length of exopodite. Second maxilliped with basis-ischium fusion incomplete. Third maxilliped with basis-ischium fusion incomplete; basis with strong spine; ischium with crista dentata moderately well developed, with 1 accessory tooth; merus usually with moderately strong spine on ventral margin, dorso-distal margin with prominent spine; carpus with spine at dorsodistal margin. Sternite of mxp_3 unarmed, anterior margin with long, dense setae.

Right cheliped moderately long, considerably larger than left. Dactyl approximately equalling length of palm, mesial margin slightly curved; cutting edge with few, strong, calcareous teeth proximally, small corneous teeth distally; terminating in strong calcareous tooth, usually overlapped and overreached by fixed finger; dorsomesial margin with single or double row of

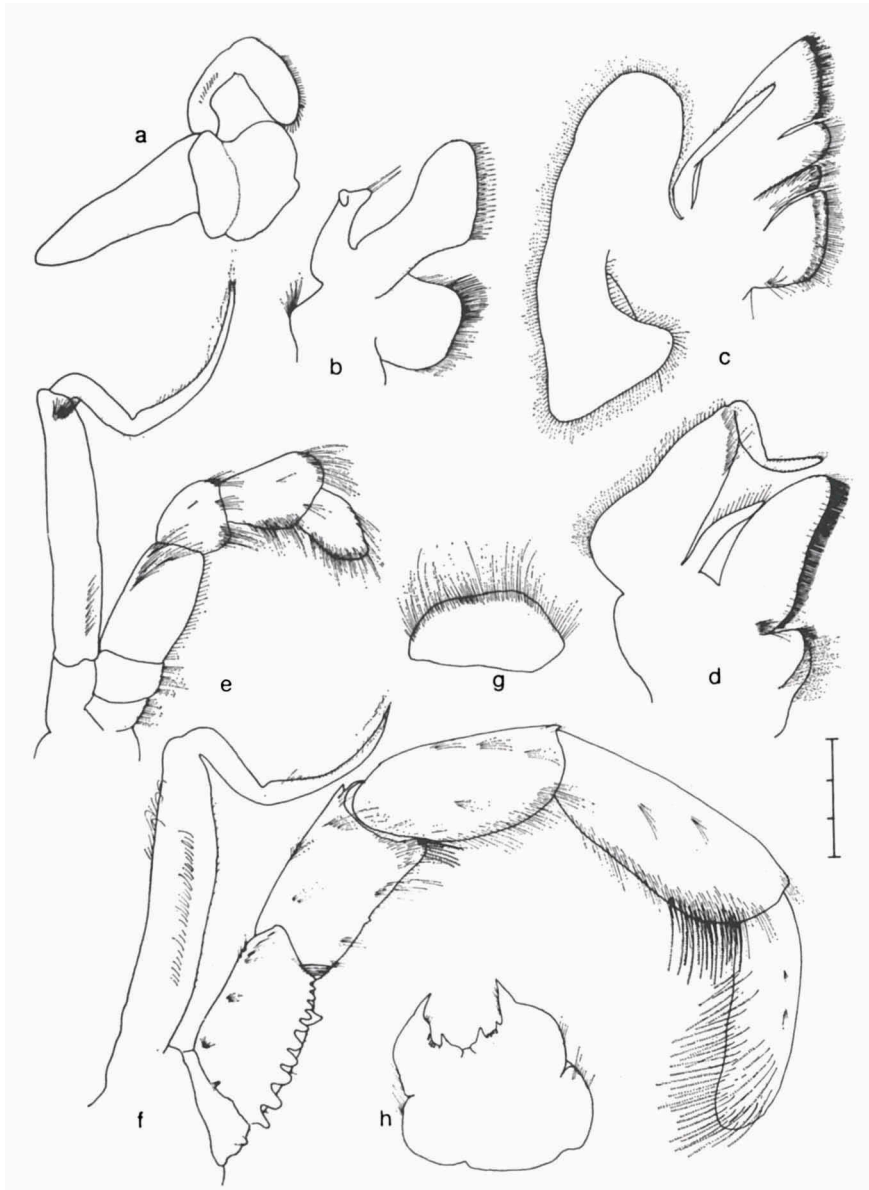


Fig. 14. *Pagurus armatus* (Dana). a-f mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite P₃; h, telson. Scale equals 3 mm.

strong spines, dorsal surface with few irregular rows of moderately short spines and few scattered tufts of setae; mesial face with closely-spaced, conical, subacute or acute spines; ventral surface with few, scattered, low tubercles and tufts of short bristles. Palm moderately long, two-thirds to three-fourths length of carpus; dorsal surface convex, with closely-spaced, long, cylindrical spines and frequently tufts of moderately long setae, dorso-mesial margin with row of prominent cylindrical spines, dorsolateral margin with row of moderately long spines, increasing in size on fixed finger; lateral and ventral surfaces with scattered, low, blunt or spinulose tubercles and tufts of short setae; mesial face with tuberculate spines and tufts of short setae. Carpus approximately equalling length of merus; dorsal surface convex, with moderately closely-spaced acute or subacute spines and frequently with tufts of short setae, distal margin with 1 or 2 rows of moderately small spines, dorsomesial margin with row of strong, cylindrical, acute or subacute spines, increasing in size distally; mesial and lateral faces with small spines or tubercles and often with tufts of short setae, distal margins each with row of moderately strong spines; ventral surface with small tubercles or spines. Merus subtriangular; dorsal surface with transverse multidenticulate ridges and rows of short stiff setae, distal margin with several strong spines, extending laterally and mesially; lateral face minutely spinulose or tuberculate, ventrolateral margin with 1 or 2 rows of small tubercles or spines, increasing in size distally; mesial face unarmed or minutely spinulose, ventromesial margin with 1 or 2 irregular rows of small tubercles or spines, increasing in size distally; ventral surface tuberculate or spinulose. Ischium with row of small spines or denticles and tufts of moderately long setae on ventromesial margin, ventrolateral margin with few small tubercles. Coxa with few small spinules or tubercles at ventrolateral distal angle; ventromesial margin with tufts of long setae.

Left cheliped moderately short, often not reaching to base of dactyl of right. Dactyl long, slightly less than twice length of palm; cutting edge with row of small corneous teeth; terminating in small, corneous claw; overlapped and overreached by fixed finger; dorsomesial margin with single or double row of conical, acute or subacute spines, dorsal surface with 3 or 4 irregular rows of small conical spines, and often with tufts of setae; mesial and ventral faces unarmed, with scattered tufts of stiff bristles. Palm one-half to two-thirds length of carpus; dorsal surface slightly convex, with irregular rows of long cylindrical spines, interspersed with small spines and tufts of moderately long setae, dorsolateral margin with row of moderately strong spines, decreasing in size on fixed finger; mesial face usually unarmed, with scattered tufts of stiff setae, occasionally with few, small, spinulose or blunt

tubercles dorsally; ventral and lateral surfaces with irregular rows of small spines or tubercles and tufts of setae. Carpus slightly shorter than or equalling merus in length; dorsal surface oblique, with irregular rows of moderately small conical spines and tufts of short setae, distal margin with 2 or 3 irregular rows of corneous-tipped spines, dorsomesial margin with row of strong spines, increasing in size distally; mesial and lateral faces with scattered low tubercles or spines and tufts of setae, distal margins each with row of spines or tubercles, strongest distally; ventral surface tuberculate or spinulose. Merus subtriangular; dorsal surface with irregular rows of transverse multidenticulate ridges and tufts of short setae, distal margin with 1-3 strong spines; lateral face minutely spinulose, with scattered tufts of short setae, ventrolateral margin with single or double row of spines, increasing in size distally; mesial face with tufts of short setae, and frequently with scattered tubercles ventrally, ventromesial margin with irregular single or double row of small tubercles or spines; ventral surface with small spines or tubercles and tufts of short setae. Ischium with row of strong denticles and tufts of long setae on ventromesial margin; ventrolateral margin and distal angle with small spinulose tubercles. Coxa with clump of setae at ventromesial distal angle; ventrolateral margin with short row of small spines or denticles distally.

Second pereopods long, often slightly overreaching right cheliped. Dactyl long, one and one-half to twice length of propodus; moderately broad; in lateral view curved ventrally; in dorsal view, twisted; terminating in strong, corneous claw; dorsal surface with 3 rows of small calcareous or corneous spines, separated proximally by 2 shallow longitudinal sulci; mesial face with prominent longitudinal sulcus and ventrally, irregular, double row of corneous spinules; lateral face with longitudinal sulcus proximally and few, small spinules or tubercles ventrally; ventral margin with row of corneous spines, increasing in size distally. Propodus equalling or slightly exceeding length of carpus; dorsal surface slightly oblique, with 4 or 5 irregular rows of moderately strong spines and few tufts of short setae; mesial and lateral faces with scattered low tubercles; ventral surface with double row of small spines or tubercles. Carpus two-thirds to three-fourths length of merus; dorsal surface with single or double row of strong spines, increasing in size distally; lateral face with irregular rows of small spines or spinulose tubercles and tufts of short setae, frequently with longitudinal row of transverse spinulose ridges and tufts of short setae ventrally; ventral and mesial surfaces unarmed, or occasionally with few small spinules or tubercles and tufts of short setae, ventrodistal margin often with short row of small spines or tubercles. Merus laterally compressed; dorsal margin with 1 or 2 rows of multidenticulate

tubercles and tufts of short setae, distal margin unarmed, or with 1 or 2 small spines; lateral and mesial faces unarmed, or with few scattered tubercles or spinules ventrally; ventral margins with single or double rows of simple or multifid small spines or tubercles. Ischium with row of small denticles and tufts of setae on ventral margin, surfaces with scattered tufts of short setae. Coxa with small cluster of spinules at ventroproximal angle, ventrolateral margin usually with row of very small denticles and few tufts of moderately short setae.

Third pereopods long, usually equalling length of right cheliped, slightly shorter than second. Dactyl long, one and one-half to one and three-fourths length of propodus; moderately broad; in lateral view, curved ventrally; in dorsal view, twisted; terminating in strong, corneous claw; dorsal surface with 3 rows of small calcareous or corneous spines, separated proximally by 2 shallow longitudinal sulci; mesial face with prominent, longitudinal sulcus and ventrally, irregular, single or double row of corneous spinules and few tufts of short setae; lateral face with longitudinal sulcus proximally and frequently, with few spinules ventrally; ventral margin with row of corneous spines, increasing in size distally. Propodus approximately equalling carpus in length; dorsal surface slightly oblique, with 4-6 irregular rows of moderately small spines and usually tufts of short setae; mesial and lateral faces with small spinules or tubercles; ventral surface usually tuberculate. Carpus two-thirds to three-fourths length of merus; dorsal surface with single or double row of moderately strong spines, increasing in size distally; lateral face with scattered spinules, or with 1 or 2 irregular rows of small spinules dorsally; ventral and mesial surfaces usually unarmed, or with few minute spinules, ventrodial margin frequently with 1-5 small spines. Merus laterally compressed; dorsal surface with irregular rows of small multidenticulate ridges, often becoming spinulose distally, distal margin with 1 or 2 small spines; lateral and mesial faces usually unarmed, occasionally with few, scattered, small spinules or tubercles; ventral margins unarmed or with few small spinules and tufts of short setae proximally. Ischium with row of small denticles and tufts of setae on ventral margin. Coxa with few small spinules or tubercles at ventroproximal angle, ventrolateral margin with row of minute spinules or denticles and tufts of short setae.

Fourth pereopods apparently without preungual process on lateral face of dactyl; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods roundly rectangular, anterior margin unarmed, with row of long setae.

Pleopods of male unpaired, pl_3-pl_5 with exopodites moderately well

developed; endopodites reduced. Females with pleopods unpaired, pl_2 - pl_4 with both rami well developed; pl_5 with exopodite moderately well developed, endopodite reduced.

Telson with posterior lobes usually slightly asymmetrical, left larger than right; separated by broad, extremely shallow median cleft; terminal margins irregular, lateral terminal angles strongly produced; right terminal margin with 2-4 moderately strong spines, strongest at lateral angle, with few small corneous spinules approximating margin; left terminal margin with 3-6 moderately strong spines, strongest at lateral angle, several small corneous spinules approximating margin; lateral margins anteriorly with tufts of moderately long setae; anterior lobes unarmed, with tufts of setae.

Coloration. — In life: "Pale olive buff to apricot orange with markings of madder brown similar to those of *P. alaskensis* [= *P. ochotensis*] but with wistaria violet largely replacing the opalescence" (Stevens, 1925: 280). In preservative: Chelipeds fading to straw color with cutting edges of dactyl and fixed finger of right cheliped trimmed in reddish-orange; meri of both chelipeds with band of reddish-orange at distal margin laterally. Second and third pereopods with reddish-orange, longitudinal stripes on lateral faces of propodi and carpi; meri with 2 broad, vertical bands on lateral faces.

Distribution. — From Unalaska, Alaska, to San Diego, California; 11 to 146 m (Rathbun, Schmitt, Stevens).

Affinities. — *Pagurus armatus* is very closely allied to *P. ochotensis* Brandt and *P. aleuticus* (Benedict), the other two species of the "*bernhardus*" group occurring in northwestern North American waters. *P. armatus* is usually distinguished by the closely-spaced, long, cylindrical spines which cover the dorsal surfaces of both chelae. In addition, the mesial faces of the palm and dactyl of the left chela, which are generally unarmed in *P. armatus*, are in striking contrast to the spinose or tuberculate mesial faces of the chelae of the other two species. Some of the characters cited by Makarov (1938b: 201; 1962: 191), although sometimes distinctive, are subject to considerable variation and cannot be used with certainty to separate *P. armatus* from *P. ochotensis*.

Discussion. — Dana (1851) described *Bernhardus armatus* from Puget Sound, Washington, at approximately the same time that Brandt's descriptions of new varieties of *Pagurus bernhardus* (Linnaeus) (*P. bernhardus* Var. A. *granulata* or sp. *borealis*, Var. B. *granulato-denticulata*, and Var. C. *spinimana* or sp. *ochotensis*) were published. Although Stimpson (1857) reported *Eupagurus armatus* (Dana) from Puget Sound, he subsequently (Stimpson, 1858) placed Dana's species in synonymy with Brandt's var. C. (*Eupagurus ochotensis* (Brandt)), after examining two specimens of

Brandt's species from Japan. Of his Japanese specimens, Stimpson (1907: 218) noted that Dana's *armatus* differed from them "... in one point only — the greater hand is more elongated and rounded at its extremity". This difference he attributed to immaturity or intraspecific variation. As Dana's type of *B. armatus* had been destroyed and Brandt's material was not readily accessible, carcinologists accepted Stimpson's conclusion of conspecificity and specimens from northwestern North America corresponding to Dana's description were referred to *P. ochotensis* Brandt. Makarov (1938b, 1962), after comparing his collections from the Far Eastern Seas of the USSR and Brandt's material with American specimens identified as *P. ochotensis* (USNM 52666), concluded that the American species was not conspecific with Brandt's *ochotensis*. He, therefore, reestablished *Pagurus armatus* (Dana), restricting its distribution to the western shores of North America. Having personally compared specimens from Alaska, Puget Sound and British Columbia and the California specimens seen by Makarov (USNM 52666) with specimens from Japan identified as *P. ochotensis* Brandt (USNM 51176; KU 8682), I must concur with Makarov that *Pagurus armatus* is a valid species, distinct from Brandt's *P. ochotensis* (also see discussion of *P. ochotensis*). Because of the confusion which has arisen over the identity of *P. armatus* as a result of the loss of Dana's type material, presumably stored at the Chicago Museum which was destroyed in 1871 (cf. Rathbun, 1883), it has been necessary to select a neotype for this species.

The references of Harrington & Griffin (1897) and Harrington (1898, pl. 16 fig. 1) to *Eupagurus alaskensis* Benedict were the result of an original misidentification, which was corrected by Harrington (1898: 214).

Pagurus ochotensis Brandt (figs. 15, 16)

? *Cancer bernhardus*: Herbst, 1791: 15, pl. 22 fig. 6. Not *Cancer bernhardus* Linnaeus, 1758.

Pagurus (Eupagurus) bernhardus var. *B. granulato-denticulata* Brandt, 1851: 107 (by implication; type locality: Unalaska, Alaska).

Pagurus (Eupagurus) bernhardus var. *C. spinimana* or sp. *ochotensis* Brandt, 1851: 108 (by implication; type locality: "Ochotskischen Meere", Okhotsk Sea).

Eupagurus bernhardus: Stimpson, 1857: 483. — Molander, 1914: 5. Not *Cancer bernhardus* Linnaeus, 1758. See discussion.

Eupagurus ochotensis: Stimpson, 1858: 248 (in part). — Alcock, 1905: 178 (in part). — Stimpson, 1907: 218. — Balss, 1913: 60. — Yokoya, 1933: 82. — Yokoya, 1939: 284. — Urita, 1942: 43, fig. 13. — Kamita, 1954-58a: 60. — Kamita, 1954-58b: 42, fig. 18. — Kamita, 1954-58c: 69. — Oguro, 1955: 100. — Yamaguchi & Yamada, 1955: 132. — Balss, 1957: 1717 (in part).

Pagurus bernhardus L. var. *granulato-denticulata*: Richters, 1884: 403.

Eupagurus (Eupagurus) alaskensis Benedict, 1892: 2 (by implication; type locality:

- Alaska; here restricted by lectotype selection to off Kouloulak Bay, Alaska, "Albatross" station 3301).
- Eupagurus alaskensis*: Harrington, 1898: 214 (footnote) (not pl. 16 fig. 1). — Alcock, 1905: 178. — Appellöf, 1906: 215.
- Pagurus alaskensis*: Rathbun, 1899: 555. — Benedict, 1901b: 465, text fig. (unnumbered). — Rathbun, 1904: 157. — Rathbun, 1910: 157. — Taylor, 1912: 203. — Williamson, 1915: 470. — Stevens, 1925: 277, fig. 1, pl. 34 fig. 25, pl. 35 figs. 26-33, pl. 36 figs. 34-41. — Fraser, 1932: 64. — Wismer & Swanson, 1935: 342. — Hart, 1940: 92. — Reinhard, 1944: 53. — Gordan, 1956: 325. — Reischman, 1959: 410. — McLaughlin, 1963: 21. — George & Strömberg, 1968: 251.
- Pagurus (Eupagurus) alaskensis*: Holmes, 1900: 135 (by implication).
- Pagurus ochotensis*: Przibram, 1905: 199. — Kobjakova, 1936: 191. — Kobjakova, 1937: 143. — Makarov, 1937: 58, fig. 6. — Makarov, 1938a: 418, fig. 5. — Makarov, 1938b: 199, figs. 44, 69B, pl. 2 fig. 2. — Vinogradov, 1947: 106. — Gordan, 1956: 332 (in part). — Kobjakova, 1956: 61. — Miyake, 1957: 88. — Kobjakova, 1958a: 232. — Uchida, 1958: 170, fig. 589. — Lindberg et al., 1959: 232. — Makarov, 1962: 188, figs. 44, 69B, pl. 2 fig. 2. — Miyake, Sakai & Nishikawa, 1962: 125. — Kim, 1963: 302. — Kim, 1964: 8. — Kobjakova, 1967: 239. — Kim, 1970: 7. — Nielsen, 1970: 30.
- Eupagurus ortmanni* Balss, 1911: 7 (type localities: Nagasaki and "Wladiwostok").
- Pagurus alascensis*: Balss, 1911: 7. — Balss, 1913: 60. — Derjugin & Kobjakova, 1935: 142.
- Eupagurus spinimanus*: Terao, 1913: 372. Not *Pagurus spinimanus* H. Milne-Edwards, 1848.
- Pagurus ochatensis*: Williamson, 1915: 479.
- ? *Eupagurus ochotensis*: Parisi, 1918: 113.
- Pagurus ochotensis ochotensis*: Vinogradov, 1950: 229 (key), fig. 121.
- not *Eupagurus alaskensis*: Harrington & Griffin, 1897: 159. — Calman, 1898: 263 (= *Pagurus armatus* (Dana, 1851)).
- not *Eupagurus ochotensis*: Calman, 1898: 274. — Bonnier, 1900: 222 (= *Pagurus armatus* (Dana, 1851)).
- not *Pagurus (Eupagurus) ochotensis*: Holmes, 1900: 137 (by implication; = *Pagurus armatus* (Dana, 1851)).
- not *Pagurus ochotensis*: Benedict, 1901b: 463, text fig. (unnumbered). — Rathbun, 1904: 157. — Rathbun, 1910: 157. — Taylor, 1912: 204. — Schmitt, 1921: 130, fig. 84. — Stevens, 1925: 279, fig. 3. — Fraser, 1932: 64. — Wismer & Swanson, 1935: 342. — MacGinitie, 1937: 1034. — Wiersma & Harreveld, 1939: 44. — Hart, 1940: 92. — Hatch, 1947: 224. — MacGinitie & MacGinitie, 1949: 294. — George & Strömberg, 1968: 253. — Roberts, 1968: 9 (= *Pagurus armatus* (Dana, 1851)).
- ? not *Eupagurus ochotensis*: Lenz, 1901: 444 (? = *Pagurus armatus* (Dana, 1851)).

Lectotype of *Eupagurus alaskensis* Benedict, herein selected. — ♂ (SL = 23.7 mm), USNM 16388.

Material examined. — See table 5.

Diagnosis. — Left chela with dorsolateral and dorsomesial margins slightly raised, dorsal surface flattened, with closely-spaced, moderately short, conical spines or spinulose tubercles; dactyl and palm with mesial faces armed with closely-spaced small spines or tubercles. Dactyls of P₂ and P₃ with 3 longitudinal rows of small spines or spinulose tubercles separated proximally by 2 shallow longitudinal sulci.

Table 5. *Pagurus ochotensis* Brandt Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂+	♀	♀+		
<i>Japan</i>								
Off Abashini, Hokkaido	20-40	----	----	1			16.1	---
Mori, Yezo I.	---	KU 8682 ----- USNM 51176	----	1			23.3	---
<i>Bering Sea</i>								
58°12'N, 160°37'W	31	Albatross 3301	20/7/90	6	1		4.9-23.7	---
58°00'N, 162°03'W	48	USNM 16388,128946 SBL J-10	24/7/60	3	4		11.4-25.1	USFWS
57°57'N, 162°13'W	40	USNM ABL J-10	29/6/66	2	1	1	10.6-19.5	USFWS
58°00'N, 161°30'W	55	USNM ABL J-11	15/6/66	5	2	3	11.8-26.5	USFWS
58°02'N, 160°12'W	51	USNM ABL J-13	18/6/66	14	8	15	10.6-25.0	USFWS
57°58'N, 159°37'W	42	USNM SBL J-14	21/8/60	2			12.9-19.7	USFWS
58°02'N, 159°36'W	40	USNM ABL J-14	18/6/66	1	1		15.9-23.6	USFWS
57°40.5'N, 163°24'W	48	USNM ABL I-8	10/7/66	6	2		14.1-20.6	USFWS
57°40'N, 162°45'W	44	USNM SBL I-9	26/8/60	3	1		13.9-19.4	USFWS
57°42.5'N, 162°51'W	42	USNM ABL I-9	29/6/66	15	2	3	9.0-25.3	USFWS
57°40'N, 162°08'W	48	USNM SBL I-10	24/8/60	8			14.9-21.5	USFWS
57°40'N, 162°06'W	48	USNM ABL I-10	29/6/66	3			12.4-20.2	USFWS
57°40'N, 161°31'W	49	USNM SBL I-11	25/8/60		1		11.1	USFWS
57°43'N, 160°59'W	53	USNM SBL I-12	23/8/60	4	1		12.4-16.8	USFWS
57°39'N, 160°16'W	57	USNM ABL I-13	17/6/66	2			14.8-16.8	USFWS
57°38'N, 159°40'W	48	USNM SBL I-14	21/8/60	6	6		15.9-25.5	USFWS
57°40'N, 159°37'W	49	USNM ABF, RM ABL I-14	18/6/66	1	2	1	13.4-24.0	USFWS
57°20'N, 163°28'W	55	USNM SBL H-8	27/8/60	1			21.1	USFWS
57°20'N, 162°46'W	48	USNM SBL H-9	26/8/60		1		10.9	USFWS
57°22'N, 162°44'W	48	USNM ABL H-9	30/7/66	5	2		11.0-18.4	USFWS
57°20'N, 162°09'W	49	USNM SBL H-10	25/8/60	1			6.6	USFWS
57°17'N, 161°10'W	62	USNM SBL H-12	23/8/60	1			15.5	USFWS
57°25'N, 160°59'W	62	USNM ABL H-12	10/6/66	3			14.3-21.7	USFWS
57°20'N, 160°03'W	55	USNM SBL H-13	20/8/60	5			18.4-24.7	USFWS
57°20'N, 160°18.5'W	62	USNM, RMNH ABL H-13	10/6/66	6	1		10.8-26.7	USFWS
57°20'N, 159°42'W	51	USNM SBL H-14	20/8/60	6	4	2	11.3-21.5	USFWS
57°18'N, 159°38'W	58	USNM ABL H-14	19/6/66	16	4	7	12.9-21.1	USFWS
57°06'N, 163°15'W	64	USNM SBL G-8	16/8/59	2	1		12.3-14.8	USFWS
57°00'N, 160°20'W	62	CNM SBL G-13	20/8/60	12	3	8	8.2-23.5	USFWS
56°40'N, 161°35'W	73	USNM SBL F-11	30/7/61	1			14.1	USFWS
56°40'N, 160°22'W	55	USNM SBL F-13	19/8/60	10	4	2	12.8-22.2	USFWS
56°40'N, 159°46'W	31	USNM SBL F-14	19/8/60	3	2	4	15.8-23.9	USFWS
56°20'N, 164°36'W	82	USNM SBL E-6	14/8/60	4			13.0-19.6	USFWS

Table 5 (Continued). *Pagurus ochotensis* Brandt Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	?		
<i>Bering Sea</i>								
56°20'N, 163°24'W	88	SBL E-8 USNM	12/6/61	1			18.1	USFWS
56°20'N, 161°37'W	70	SBL E-11 USNM	6/8/60	1			4.5	USFWS
56°23'N, 161°02'W	55	SBL E-12 USNM, RMNH	9/8/59	4	2	1	15.9-22.2	USFWS
56°20'N, 161°00'W	51	SBL E-12 USNM	19/8/60	5	5		6.7-23.4	USFWS
56°20'N, 160°26'W	26	SBL E-12 USNM	7/6/66	7	5	3	11.3-18.9	USFWS
56°00'N, 162°48'W	77	SBL D-9 USNM	5/8/60	1			21.8	USFWS
56°00'N, 162°50'W	82-90	ABL D-9 USNM	3/6/66	1			19.7	USFWS
55°58'N, 162°13'W	66	SBL D-10 USNM	5/8/59	1			18.1	USFWS
56°00'N, 162°12'W	70	SBL D-10 USNM	5/8/60	1			15.3	USFWS
56°00.5'N, 162°08.5'W	53-60	ABL D-10 USNM	4/6/66	7	6	1 3	8.1-17.4	USFWS
55°40'N, 164°00'W	95	SBL C-7 USNM	9/7/61	1			11.2	USFWS
55°10'N, 163°55.5'W	38-42	ABL AB-7 USNM	14/7/66	1	1		12.2-16.1	USFWS
Bristol Bay	---	----	summer 57	5	3	6	5.2-20.9	USFWS
Bristol Bay	---	----	summer 61	1	1		13.2-18.9	USFWS
Amak I.	---	Albatross 3270 USNM 16368	----	2	3		4.6-14.1	---
Kagalaska Strait	---	----	25/7/56	1	1		6.9-7.1	USFWS
Akun Bay, Akun I.	18	----	7/8/62	1			14.5	Fiscus
Akutan Harbor, Akutan I.	---	AHF ----	12/9/62	2			7.0-7.9	Fiscus
<i>Gulf of Alaska</i>								
Unga Strait Light	46	----	4/12/65	3	1		4.7-22.8	Fiscus
57°58'N, 151°45'W	---	RMNH 54L USNM	25/8/62	26	6		12.9-27.1	INPHC
56°39'N, 155°15'W	54-73	40M USNM	10/2/62	5	2	3	14.8-23.4	INPHC
56°21'N, 155°15'W	40	400 USNM	11/6/61		1		16.7	INPHC
56°15'N, 155°15'W	27	40P USNM	13/2/62	2			23.3-27.7	INPHC
55°41'N, 155°15'W	37	40T USNM	19/5/61	8			16.0-24.6	INPHC
Homer	---	----	8/60	2	2		8.6-15.8	Hatfield
55°15'N, 133°45'W	110	RMNH 1D USNM	5/7/61	1			13.3	INPHC
54°09'N, 131°44'W	---	4D USNM	3/7/61	2			10.9-22.4	INPHC
Auke Village Reef	---	----	28/5/64	1			7.6	Gonor
Auke Village recreation area	4	----	27/4/63	1	1		21.3-27.5	Gonor
Auke Village recreation area	---	----	9/4/64	1			16.8	Gonor
Auke Village recreation area	18	----	14/4/64		1		20.0	Gonor
Auke Bay recreation area	4	USNM ----	1/5/64		1		20.3	Gonor
<i>British Columbia</i>								
48°53'N, 126°08.6'W	91-93	----	17/10/62	1			7.4	JNC

Table 5 (Continued) *Pagurus oohotensis* Brandt Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	♀♂		
<i>Washington</i>								
Off Foulweather Bluff	---	1-4-1 USNM	1/7/32	4			3.1-4.7	Stevens
Off Foulweather Bluff	---	----- USNM	3/3/39	1			14.3	Stevens
Puget Sound	----	1-25-5 USNM	4/7/32	1			6.0	Stevens
Deer Harbor, San Juan Is.	----	----- USNM	3/8/57	2			9.5-14.4	Hart
Waldron I.	----	----- USNM	27/7/61	1			8.9	Ray
San Juan I.	----	----- USNM	8/61	3	4		3.9-14.1	McLaughlin
Friday Harbor, San Juan I.	----	----- USNM	1922	1			11.9	Stevens
President Channel	----	----- USNM	10/8/61	1			7.1	McLaughlin
Cowry Bay, San Juan Is.	----	----- USNM	26/8/61	2			4.8-4.9	McLaughlin
East Sound, San Juan Is.	----	----- USNM	4/8/61	2	1		4.8-9.8	Grier
Parker Reef, N of Orcas I.	----	----- USNM	24/7/52	1			8.2	Illg
SE Rose Spit, Graham I.	20	----- USNM	30/7/36	1	2		7.3-8.9	Stevens
Off Port Townsend	65	----- USNM	8/8/38			1	16.1	Stevens
Off Golden Gardens	---	----- USNM	3/63	1			6.2	---
<i>Oregon</i>								
Tillamook Head	37-40	----- USNM	19/7/39	1			4.9	Stevens

Description. — Shield usually broader than long, occasionally width equalling length; anterolateral margins sloping or slightly terraced; anterior margin between rostrum and lateral projections straight or slightly concave; posterior margin truncate, roundly truncate, or broadly rounded; dorsal surface smooth or with small spinules or tubercles laterally, and with scattered tufts of short setae; anterolateral angle produced, blunt or spinulose. Rostrum moderately long, usually greatly exceeding lateral projections, broadly triangular, acute or subacute, or rarely, broadly rounded, usually with small, terminal, marginal or submarginal spine. Lateral projections well developed, subtriangular or slightly rounded with moderately strong marginal or submarginal spine.

Ocular peduncles moderately short, one-third to two-thirds length of shield; stout, slightly inflated basally, corneal region ovate, dilated; dorsal or dorsomesial face, and less frequently, dorsolateral face with row of tufts of short setae. Ocular acicles large, mesial margins strongly expanded, lateral margins straight or slightly expanded, dorsal surface concave; terminating acutely or subacutely, with prominent submarginal spine; separated basally by two-thirds to entire basal width of one acicle.

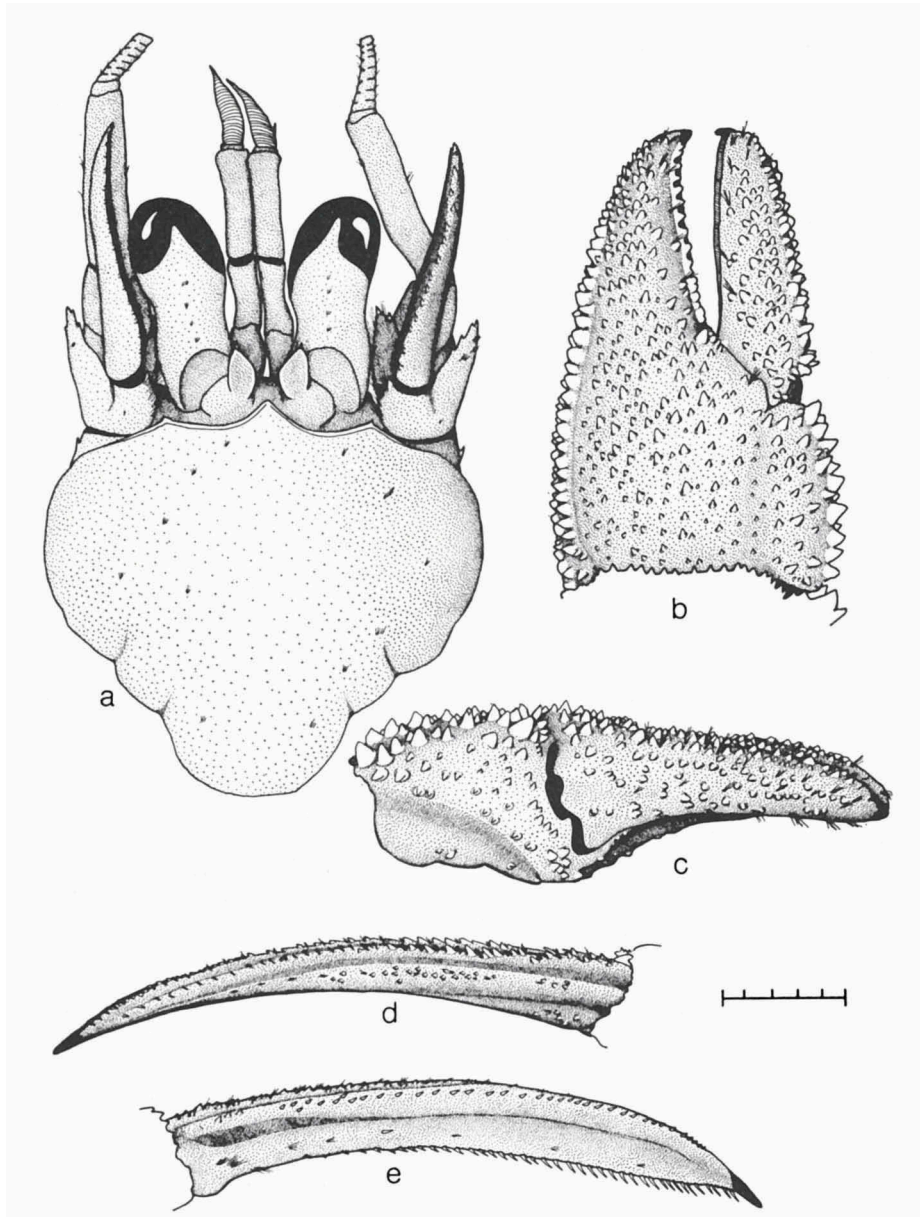


Fig. 15. *Pagurus ochotensis* Brandt. a, shield; b, left chela (dorsal view); c, left chela (mesial view); d, left P₃, dactyl (dorsolateral view); e, left P₃, dactyl (mesial view). Scale equals 5 mm.

Antennular peduncles long, usually exceeding ocular peduncles by approximately entire length of ultimate segment. Ultimate and penultimate segments unarmed, with few tufts of short setae; basal segment with strong, sometimes spinulose, protuberance near distolateral margin, occasionally ventromesial margin acutely produced and with scattered tufts of short setae.

Antennal peduncles long, exceeding ocular peduncles by one-half to five-sixths length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments unarmed, with tufts of short setae. Third segment with ventromesial angle produced, terminating in 1 or 2 acute spines, often with 2 or 3 spinules and tufts of short setae on ventral margin. Second segment with dorsolateral distal angle produced, terminating in simple or bifid spine, mesial margin with 1-4 small spines, lateral margin unarmed or with 1 or 2 small spines, dorsal surface with few tufts of short setae; dorsomesial distal angle usually with strong spine, mesial margin with tufts of moderately short setae. First segment with small spine on lateral face distally; ventral margin produced, usually with few spinules laterally. Antennal articles long, greatly exceeding ocular peduncles; arcuate and strongly twisted; triangular, with dorsal surface flattened; terminating in small spine; mesial margin with row of small spinules and tufts of short setae, lateral margin unarmed or with 1 or 2 small spines distally. Antennal flagella long, often overreaching right cheliped, each article usually with 1 or 2 short bristles.

Mandible without distinctive characters. Maxillule with proximal endite subquadrate; endopodite with 1 or 2 bristles on well developed internal lobe, external lobe produced, recurved. Maxilla with endopodite inflated basally, not reflexed, exceeding scaphognathite in distal extension. First maxilliped with endopodite approximately one-half length of exopodite. Second maxilliped with basis-ischium partly fused. Third maxilliped with basis-ischium fusion incomplete; basis with 1 or 2 spines; ischium with crista dentata moderately well developed, with 1 accessory tooth; merus with ventral margin unarmed or with 1 or 2 spines, dorsodistal margin with moderately prominent spine; carpus usually unarmed. Sternite of m_{xp}_3 unarmed, anterior margin with row of long, dense setae.

Right cheliped considerably larger than left. Dactyl equalling or slightly exceeding length of palm, mesial margin arcuate; cutting edge with row of strong calcareous teeth, terminating in strong, calcareous tooth; usually overreached and overlapped by fixed finger; dorsomesial margin with row of small tubercles or tuberculate spines, dorsal surface with closely-spaced tubercles; mesial face with closely-spaced small tubercles, ventromesial margin shorter or equalling length of carpus, moderately inflated dorsoventrally; dorsomedial margin with row or rows of small, often spinulose, tubercles,

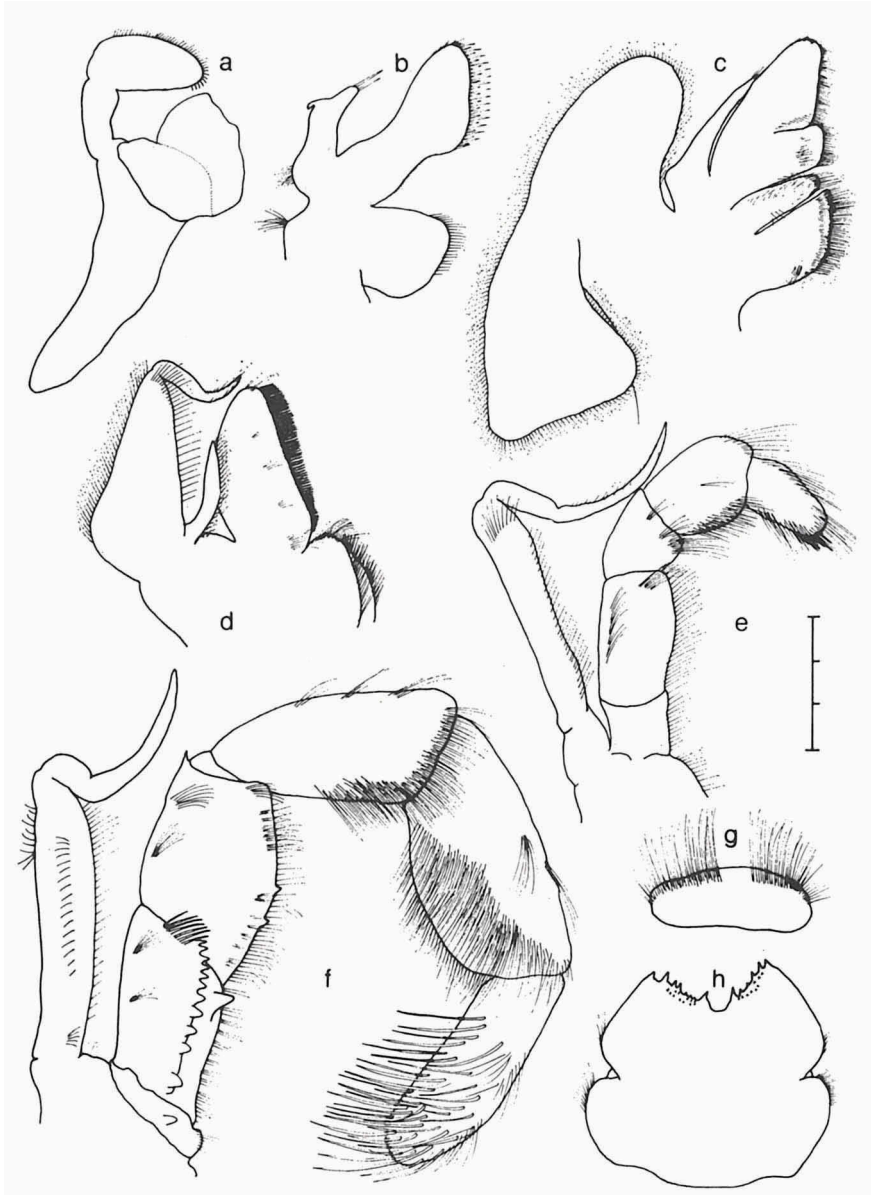


Fig. 16. *Pagurus ochotensis* Brandt. a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite, P₃; h, telson. Scale equals 3 mm.

dorsal surface convex, with closely-spaced, blunt or spinulose tubercles, or less frequently tuberculate spines, most prominent and forming irregular inverted V in midline, dorsolateral margin with row of moderately strong, acute or subacute, conical spines or spinulose tubercles, increasing in size on fixed finger, dorsolateral proximal angle produced, tuberculate or spinulose; lateral face with low, subacute, simple or bifid tubercles; mesial face with closely-spaced tubercles; ventral surface with scattered simple or bidenticulate tubercles and tufts of short setae. Carpus moderately long, slightly shorter than or equalling length of merus; dorsomesial margin with single or double row of strong, acute or subacute spines, dorsal surface convex, with small conical spines or spinulose tubercles, most prominent in 2 irregular rows in midline, distal margin with double row of small spines or denticles, dorsolateral margin with single or double row of small tuberculate spines or tubercles; lateral and mesial faces with simple and bifid tubercles or small spinules; ventral surface with scattered bilobed tubercles or protuberances. Merus subtriangular; dorsal surface with irregular transverse rows of multidenticulate ridges, becoming spinulose and more prominent distally, distal margin with strong spines; mesial face with scattered, bilobed or multidenticulate, spinulose tubercles and distally, short transverse row of spinulose tubercles, ventromesial margin with simple or bilobed acute or blunt tubercles; lateral face spinulose or tuberculate, ventrolateral margin with irregularly spaced, bilobed tubercles becoming spines distally; ventral surface with low tubercles and few tufts of short setae. Ischium with row of blunt or spinulose tubercles on ventromesial margin, ventral surface with scattered, small tubercles; ventrolateral margin with low, bilobed tubercles or small spines, frequently, ventrolateral proximal margin with low denticulate keel. Coxa with few tubercles or small spines at ventrolateral distal angle, irregular row of small tubercles on ventrolateral margin proximally, ventromesial margin with 2 irregular rows of long setae.

Left cheliped moderately short, reaching slightly beyond base of dactyl of right; chela triangular. Dactyl approximately twice length of palm, distally slightly depressed; cutting edge with row of small corneous teeth, terminating in moderately strong corneous claw; dorsomesial margin with row of tubercles, dorsal surface with moderately closely-spaced small tubercles and tufts of short setae; mesial face with scattered small tubercles and tufts of short setae; ventral surface with 2 rows of short bristles. Palm one-third to one-half length of carpus; dorsomesial and dorsolateral margins elevated, with double or triple row of simple or bifid spines, or spinulose or blunt tubercles, dorsal surface convex, with irregular rows of small spines or tubercles; mesial face with moderately closely-spaced spines or

tubercles and few tufts of short setae; lateral face with small spines or tubercles, decreasing in size on fixed finger, and scattered tufts of short setae; ventral surface with scattered, low, simple or bilobed tubercles and tufts of short bristles. Carpus slightly shorter than or equalling merus in length; subtriangular, dorsal surface slightly oblique; dorsomesial margin with single or double row of strong simple or bilobed spines, increasing in size distally, dorsal surface with 1 or 2 irregular rows of moderately strong spines and scattered small spines and spinulose tubercles, distal margin with 1-3 irregular rows of small spines or denticles; lateral face with bilobed tubercles or small spines, increasing in size distally; mesial face with small spines, bifid or multifid tubercles, or bilobed spinulose protuberances, distal margin with moderately strong spines, ventromesial margin with double or triple row of simple or bilobed spinulose tubercles, becoming strong spines distally and tufts of short setae; ventral surface with irregular, transverse rows of bilobed tubercles or small spines and tufts of short setae. Merus moderately short, subtriangular; dorsal surface with transverse rows of low protuberances proximally, becoming strong, multifid, spinulose ridges or broad tubercles distally, distal margin with 1-3 strong spines and frequently several small spines; lateral face spinulose, tuberculate, or with widely scattered, small, simple and bifid spines or tubercles, distal margin frequently denticulate or spinose, ventrolateral margin with single or double row of tubercles becoming simple or bifid, acute or subacute spines distally; mesial face unarmed or with scattered low tubercles or small spinules, ventromesial margin with irregularly spaced, often multidenticulate, tubercles or spines; ventral surface with acute or subacute, simple or bifid spines or tubercles and scattered tufts of setae. Ischium with row of subacute or acute spines or tubercles on ventromesial margin proximally, ventral surface with small tubercles or spinules and tufts of setae; ventrolateral margin with short row of tubercles or small spines proximally, lateral face usually spinulose or tuberculate, with scattered tufts of setae. Coxa with cluster of spinulose tubercles or spinules on ventrolateral margin proximally, ventrodistal margin usually spinulose, with clump of long setae at mesial angle.

Second pereopods long, frequently equalling or overreaching right che-
liped. Dactyl long, approximately twice length of propodus, broad; in lateral view, curved ventrally; in dorsal view, strongly twisted; dorsal surface with 3 rows of small spines, decreasing in size distally, and separated proximally by 2 moderately shallow longitudinal sulci; mesial face with prominent, longitudinal sulcus proximally, continued distally as uncalcified line, flanked above by row of corneous spines and below by few corneous

spines and tufts of short setae; lateral face with prominent longitudinal sulcus proximally, few small spines or spinules ventrally; ventral margin with row of corneous spines, increasing in size distally. Propodus equalling or slightly exceeding length of carpus; dorsomesial margin with single or double row of moderately strong simple or bifid spines, dorsal surface with 4 or 5 irregular rows of small simple or bifid spines or spinulose tubercles, distal margin spinose or denticulate, dorsolateral margin with row of small, spinulose tubercles or spines; lateral face with simple or multifid small tubercles or spines and scattered tufts of short setae, distal margin denticulate or spinose; mesial face unarmed, or with scattered, small, simple or multifid tubercles or spines and tufts of short setae; ventral margin with low spinulose tubercles or protuberances and tufts of setae. Carpus moderately long, two-thirds to three-fourths length of merus; dorsal margin with row of strong spines, increasing in size distally; lateral face with scattered, small, simple or bifid spines or spinulose tubercles and tufts of very short setae dorsally, ventrally with row of transverse, multifid, spinulose ridges and tufts of short setae; mesial face with few very small spinules or tubercles and scattered tufts of short setae; ventral surface with tufts of short setae, distal margin often with one to several small tuberculate spines. Merus laterally compressed; dorsal margin with irregular rows of small multifid protuberances, increasing in size and becoming spinose distally, distal margin with row of prominent small spines; lateral face unarmed or with scattered small spinules and tufts of short setae, distal margin usually denticulate, ventrolateral margin with single or double row of moderately strong spines; mesial face with scattered tufts of short setae, occasionally with few scattered spinules, distal margin with small spinules or denticles, ventromesial margin usually with double row of simple or bifid spines or tubercles. Ischium with 1 or 2 rows of moderately small spines or tubercles on ventral margin and tufts of short setae; dorsal margin usually denticulate. Coxa with row of small tubercles or spinules on ventromesial margin, ventrolateral margin frequently with row of blunt tubercles, ventrolateral distal angle with small spine, proximal angle frequently tuberculate; margins with few tufts of short setae.

Third pereopods usually equalling or slightly shorter than second in length. Dactyl long, slightly less than twice length of propodus, broad; in lateral view, curved ventrally; in dorsal view, strongly twisted; terminating in strong corneous claw; dorsal surface with 3 rows of small spines separated proximally by 2 shallow longitudinal sulci; mesial face with prominent, longitudinal sulcus proximally, continuing distally as uncalcified line, with scattered tufts of short setae and few corneous spines ventrally; lateral

face with prominent longitudinal sulcus and cluster of small spines proximally; ventral margin with row of corneous spines, increasing in size distally. Propodus equalling or slightly shorter than length of carpus; dorsal surface oblique, with 4 or 5 irregular rows of small, simple or bifid, spinulose tubercles or spines and few tufts of short setae, dorsomesial margin with single or double row of simple or bifid spines and few tufts of short setae; lateral and mesial faces with simple or bifid small spines or tubercles, distal margins usually denticulate or spinulose; ventral surface with simple or multidenticulate, low tubercles and tufts of short setae, margins with simple or bifid spines or tubercles. Carpus slightly shorter than merus; dorsal margin with row of moderately strong spines, increasing in size distally; mesial face unarmed, or with few, scattered, small spinules or tubercles; lateral face usually with scattered, small spinules or tubercles dorsally, ventrally with row of transverse, multidenticulate ridges or broad tubercles and tufts of short setae, distal margin frequently with several small spines; ventral surface with tufts of short setae, occasionally with few, scattered, small tubercles. Merus laterally compressed; dorsal margin with irregular row or rows of multifid tubercles, becoming spinose distally, distal margin with small spines, extending laterally and mesially; lateral and mesial faces unarmed or with few, scattered, small spinules or tubercles and tufts of short setae; ventral surface with small spinules or tubercles, margins spinose, with tufts of short setae. Ischium frequently with spine at ventrodistal angle, ventral surface with tufts of short setae. Coxa unarmed or with row of small denticles on ventrolateral margin, ventromesial margin with tufts of short setae.

Fourth pereopods apparently lacking preungual process on lateral face of dactyl; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods subrectangular; anterior margin with row of long setae on each side of naked midline.

Pleopods of male unpaired, pl_3-pl_5 with exopodites moderately well developed, endopodites reduced. Females with pleopods unpaired, pl_2-pl_4 with both rami very well developed, with dense tufts of long, stiff setae; pl_5 with exopodite moderately well developed, endopodite rudimentary.

Telson with posterior lobes usually slightly asymmetrical, left larger than right; obtusely triangular; separated by prominent, moderately deep, U- or V-shaped median cleft; right terminal margin with 4-6 moderately strong spines and frequently 1-3 small spinules, 1 or 2 accessory rows of corneous spinules; left terminal margin with 4-7 moderately strong spines and usually 1-3 small spinules, 1 or 2 accessory rows of corneous spinules; margins with

tuft of moderately short setae laterally; anterior lobes unarmed, with tufts of moderately short setae laterally.

Coloration. — In life: "Iridescent or opalescent with golden sheen, below sea-shell pink to apricot orange. A mahogany red streak runs around the prehensile edge of the thumbs and behind dactyls to the anterior margins of the hands. Merus and basiopodite of chelipeds and ambulatory legs with irregular patches of madder brown, spines on the hands madder brown to apricot orange. Dactyls and propodi of ambulatory legs longitudinally streaked with madder brown. In very large specimens the opalescence is largely replaced by wistaria violet, particularly at the distal end of the joints and along the upper surface of the ambulatory legs. Antennal acicles pearly iridescent" (Stevens, 1925: 277). In preservative: Dorsal surfaces of chelipeds and pereopods purple or violet, fading with time to bluish-orange and then to straw, spines often retaining red-orange tint; inner margin of dactyl and fixed finger and distolateral margin of palm of right cheliped dark red, fading to reddish-orange. Dorsomesial faces of meri of chelipeds and pereopods with patch of red, fading to red-orange. Lateral faces of propodi and carpi of second and third pereopods with 1 or 2 longitudinal red-orange stripes; meri often retaining 2 irregular, vertical stripes distally.

Distribution. — Siberia (Rathbun, Hart); Kamchatka (Brandt, Kobjakova, Vinogradov); Okhotsk Sea (Makarov); Sakhalin, Kuril Is. (Kobjakova, Lindberg); Zaliv Petra Veliko (Balss, Yamaguchi & Yamada, Kobjakova); Sea of Japan (Makarov, Kobjakova, Miyake); Avachenskaya Guba to Inubo (Vinogradov); Pribilof Is., Bering Sea to Oregon (Rathbun, Holmes, Hart); subtidal to 249 m.

Affinities. — The closest allied species of *Pagurus ochotensis* in northwestern North America are *P. armatus* and *P. aleuticus*. The armature of the chelipeds, which in *P. ochotensis* varies from blunt or spinulose tubercles to moderately small, tuberculate, occasionally bifid, spines, appears to be intermediate between the elongate, slender spines of *P. armatus* and the short, conical, usually bifid or multifid, spines of *P. aleuticus*. *P. ochotensis* shares with *P. armatus* a very similar configuration of the dactyls of the second and third pereopods, i.e., the 3 rows of small spines on the dorsal surface, separated by 2 shallow, longitudinal sulci. This character alone is sufficient to distinguish these species from *P. aleuticus*, in which the dactyls have a prominent, broad, longitudinal sulcus, flanked by a row of small spines. Several characters can be used to distinguish *P. armatus* from *P. ochotensis*, but perhaps the least variable is seen in the strongly tuberculate or spinose mesial faces of the dactyl and propodus of the left chela in the latter species. These surfaces are almost totally unarmed in *P. armatus*.

Discussion. — As previously noted, Brandt (1851) described three new varieties of *Pagurus bernhardus* (Linnaeus), i.e., var. A. *granulata*, var. B. *granulato-denticulata*, and var. C. *spinimana*. Although he believed all three to be varieties of *P. bernhardus*, Brandt made provision for specific names for varieties A and C if future studies showed these varieties to be distinct species (Brandt, 1851: 108). For variety A, he proposed the name *borealis*, cited without locality data, and for variety C, from the Okhotsk Sea, the name *ochotensis*. Variety B, *granulato-denticulata*, from Unalaska, Alaska, received no suggested specific name. Stimpson (1857) reported *Eupagurus bernhardus* (sensu Brandt) without variety, but implied Brandt's var. *granulato-denticulata* by his notation "Hab. Unalashka (Wosenessenski)" (Stimpson, 1857: 483) and *Eupagurus armatus* (Dana) from the Pacific shores of North America. Subsequently, Stimpson (1858) placed Dana's *armatus* in synonymy with Brandt's var. C. *spinimana*, raising it to specific rank as *Eupagurus ochotensis* (Brandt) (also see discussion of *P. armatus*, pp. 56, 57).

Benedict (1892) described two new species of the "*bernhardus* type" from Alaska, *Eupagurus alaskensis* and *Eupagurus aleuticus*. In a more detailed account of the species of the "*bernhardus* type", Benedict (1901b) designated Brandt's var. A., *granulata* and var. B., *granulato-denticulata* (misspelled as *granalata-denticulata*) as synonyms of *P. bernhardus* (Linnaeus). He also cited var. B. (misspelled as *granulato-denticulata*) questionably as a synonym of *P. alaskensis* (Benedict), remarking that "... As *alaskensis* has much greater resemblance to the true *bernhardus* than does *aleuticus*, Brandt's descriptive phrase is made synonymous with it, though from the locality *aleuticus* would be much more likely to be obtained." (Benedict, 1901b: 458). For Brandt's var. C., *spinimana*, Benedict concurred with Stimpson that this species, *P. ochotensis*, was synonymous with Dana's *armatus* (Benedict, 1901b: 464, unnumbered text figure).

Terao (1913) used Brandt's variety name "*spinimana*" instead of the specific name "*ochotensis*" in reporting his material from Japan. However, from his synonymy of the species it is apparent that he was referring his material to *P. ochotensis* (sensu Brandt).

Records by Japanese and Russian carcinologists of *P. ochotensis* Brandt (Yokoya, 1933; Kobjakova, 1936, 1937; Makarov, 1937, 1938a) referred to the species known to American carcinologists as *P. alaskensis* rather than to the species represented by Benedict's figure of Dana's *armatus*. Subsequently, Makarov (1938b, 1962) directed attention to the double interpretation of Brandt's *P. ochotensis*. After reexamining Brandt's original material, Makarov was able to more precisely interpret Brandt's original descriptions of

two of his varieties, *granulato-denticulata* and *spinimana* or sp. *ochotensis*. Apparently Makarov found Brandt's single specimen of var. *granulato-denticulata* well within the range of intraspecific variability of *P. ochotensis*, as he placed this variety in synonymy with *P. ochotensis*. After examining specimens from the National Museum of Natural History of *P. alaskensis* (USNM 16368) and *P. ochotensis* (sensu Stimpson (= *B. armatus* Dana)) (USNM 52666), Makarov (1938b: 201; 1962: 191) concluded that *P. alaskensis* (Benedict), not *P. armatus* (Dana), was conspecific with *P. ochotensis* Brandt. Although Makarov's work on these taxa appeared in 1938, his conclusions were not readily accessible until his book was translated in 1962. In the interim, the confusion over the identity of specimens reported under the name *P. ochotensis* Brandt persisted.

In the course of the present study, I have been able to reexamine Benedict's type series of *Eupagurus alaskensis* (USNM 16388, 128946) and the specimens of *P. alaskensis* (USNM 16368) and *P. ochotensis* (= *P. armatus*) (USNM 58666) examined by Makarov, as well as to study a large collection of these taxa from Alaska and Puget Sound. In addition, a specimen of *P. ochotensis* (KU 8682) from Japan lent by Dr. S. Miyake, has been compared with the above material. The results of this comparison clearly indicate that specimens referred to *P. ochotensis* by Asian workers are *P. ochotensis* (sensu Brandt) and are conspecific with *P. alaskensis* (Benedict).

Makarov, as the first reviser, chose to ignore Brandt's variety name, *granulato-denticulata*, which has page priority, and used Brandt's specific name for this taxon. Although his decision has been accepted by Russian and Japanese carcinologists, western workers have continued to use *P. alaskensis* and *P. ochotensis* (sensu Stimpson, = *P. armatus*). Only two possibilities are available to resolve the ambiguity resulting from the usage of *ochotensis* for two different taxa: 1) accept Makarov's action as first reviser and use the name *ochotensis* for the taxon which includes *P. alaskensis* (Benedict); or 2) request suppression of the specific name *ochotensis* by action of the International Commission on Zoological Nomenclature, which would result in the replacement of the name by its junior synonym, *alaskensis*. Both alternatives have merit and both have their proponents. I have chosen to retain the name *Pagurus ochotensis* Brandt for the species known from both the western Pacific (as *P. ochotensis*) and northwestern North America (as *P. alaskensis*) because I believe that the best interests of stability in nomenclature are served by this course. The two names as they appear in the literature cannot be affected by either decision; the interpretation of the identity of the species as reported under the two names rests with the reviewer. The acceptance of *P. ochotensis* (sensu Makarov) will result in far

less confusion as relatively few biologists are engaged in studies of pagurids and associated faunae of northwestern North America at the present time. On the contrary, the suppression of *ochotensis* and the replacement of it with its junior synonym, *alaskensis*, would affect a far greater number of Asian biologists actively engaged, not only in carcinological taxonomy, but in ecological studies and in faunistic surveys.

Pagurus aleuticus (Benedict) (figs. 17-19)

- ? *Pagurus streblonyx* Owen, 1839: 81. Not *Pagurus streblonyx* Leach, 1815.
Eupagurus (Eupagurus) aleuticus Benedict, 1892: 3 (by implication; type locality: Aleutian Islands, here restricted by lectotype selection to between Unga and Nagai Islands, Alaska).
Pagurus aleuticus: Rathbun, 1899: 555. — Benedict, 1901b: 460, text fig. (unnumbered). — Rathbun, 1904: 157. — Rathbun, 1910: 157. — Taylor, 1912: 203 (not synonymy). — Williamson, 1915: 470. — Stevens, 1925: 278, fig. 2. — Hart, 1940: 92. — Reinhard, 1944: 53. — Gordan, 1956: 325. — Reischman, 1959: 410. — McLaughlin, 1963: 21. — George & Strömberg, 1968: 253.
Pagurus (Eupagurus) aleuticus: Holmes, 1900: 136 (by implication).
Eupagurus aleuticus: Alcock, 1905: 178. — Balss, 1911: 7. — Balss, 1913: 60.
Pagurus ochotensis aleuticus: Makarov, 1938b: 202, figs. 43, 69A, pl. 2 fig. 3. — Vinogradov, 1950: 229 (key). — Makarov, 1962: 192, figs. 43, 69A, pl. 2 fig. 3.

Lectotype, herein selected. — ♂ (SL = 22.9 mm), USNM 16415.

Material examined. — See table 6.

Diagnosis. — Left chela with dorsolateral and dorsomesial margins slightly raised, dorsal surface flattened, with closely spaced, moderately short, usually bifid, conical spines or spinulose tubercles; dactyl and palm with mesial faces armed with closely-spaced small spines or tubercles. Dactyls of P₂ and P₃ with prominent, single longitudinal sulcus on dorsal surface, flanked by row of small spines or spinules proximally.

Description. — Shield width usually equalling or slightly exceeding length, occasionally slightly longer than broad; anterolateral margins strongly terraced; anterior margin between rostrum and lateral projections concave, with short marginal setae; posterior margin truncate or roundly truncate; dorsal surface smooth or slightly pitted, with scattered tufts of short setae, dorsolateral and posterior margins often with few, small spinules; anterolateral angle often produced, blunt. Branchiostegites frequently with row of minute spinules on anterodorsal margin. Rostrum moderately long, usually exceeding lateral projections; triangular or broadly rounded; usually terminating subacutely, with or without terminal spine. Lateral projections obtusely triangular or rounded, terminating in small spine, often directed toward exterior.

Table 6. *Pagurus aleuticus* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	?		
<i>Bering Sea</i>								
57°00'N, 160°58'W	73	SBL G-12 USNM	18/8/60	1	2		13.5-16.2	USFWS
56°40'N, 167°00'W	101	SBL F-2 USNM	21/7/61	5	5		10.3-21.4	USFWS
56°40'N, 166°26'W	91	SBL F-3 USNM	21/7/61	5	2		16.4-20.5	USFWS
56°42'N, 165°54'W	79	ABL F-4 USNM	19/7/66	1			11.9	USFWS
56°40'N, 165°16'W	80	SBL F-5 USNM	16/7/61	1			12.9	USFWS
56°40'N, 164°37'W	75	SBL F-6 USNM	28/8/60	7	4	1	13.3-21.1	USFWS
56°40'N, 164°00'W	73	SBL F-7 USNM	15/8/60	4	1		15.7-20.9	USFWS
56°40'N, 164°00'W	79	SBL F-7 USNM	14/7/61	2			12.0-17.5	USFWS
56°40'N, 163°24'W	79	SBL F-8 USNM	14/7/61	1			12.6	USFWS
56°37.5'N, 163°23.5'W	83	ABL F-8 USNM	26/6/66	4	1		8.3-20.2	USFWS
56°30'N, 165°31'W	88	SBL EF-4.5 USNM	16/7/61	7	2		10.0-20.6	USFWS
56°30'N, 164°55'W	84	SBL EF-5.5 USNM	17/7/61	2	2		17.8-21.0	USFWS
56°30'N, 164°18'W	88	SBL EF-6.5 USNM	13/7/61	15	7		11.3-24.5	USFWS
56°30'N, 163°42'W	86	SBL EF-7.5 USNM	12/7/61	9	1	2	13.4-21.7	USFWS
56°20'N, 167°03'W	115	SBL E-2 USNM	2/8/61	5	8		18.2-24.4	USFWS
56°21'N, 166°28'W	106	SBL E-3 USNM	29/8/60	4	2		12.4-20.9	USFWS
56°20'N, 166°27'W	106	SBL E-3 USNM	21/7/61	1	4		15.9-19.4	USFWS
56°23'N, 166°23.5'W	99	ABL E-3 USNM	19/7/66	6	1		11.4-19.4	USFWS
56°12'N, 165°33'W	95	SBL E-4 USNM	20/7/61	5	10		11.9-21.2	USFWS
56°00'N, 165°49'W	91-93	ABL E-4 USNM	21/7/66	1	1		13.9-16.2	USFWS
56°20'N, 165°13'W	88	SBL E-5 USNM	28/8/60	3	3		14.8-19.1	USFWS
56°20'N, 165°13'W	88	SBL E-5 USNM	17/7/61	2	4		16.9-21.4	USFWS
56°20'N, 164°36'W	82	SBL E-6 USNM	14/8/60	2	4		14.6-20.4	USFWS
56°20'N, 164°36'W	91	SBL E-6 USNM	13/7/61	7	10	1	7.9-21.6	USFWS
56°19.5'N, 164°37'W	90	ABL E-6 USNM	9/7/66	22	32	1	8.4-22.5	USFWS
56°20'N, 164°00'W	80	SBL E-7 USNM	15/8/60	4			18.2-20.9	USFWS
56°20'N, 164°00'W	90	SBL E-7 USNM, RMNH	12/7/61	10	7		9.0-21.9	USFWS
56°22'N, 164°00'W	83	ABL E-7 USNM	4/7/66	5	2		16.4-22.9	USFWS
56°20'N, 163°24'W	80	SBL E-8 USNM	8/8/60	1			18.3	USFWS
56°20'N, 163°24'W	88	SBL E-8 USNM	12/7/61	7	6		10.8-21.1	USFWS
56°18.5'N, 163°26'W	88	ABL E-8 USNM	12/7/66	31	19	7	5.5-23.4	USFWS
56°20'N, 162°47'W	73	SBL E-9 USNM	7/8/60	3	1		14.9-22.4	USFWS
56°20'N, 162°11'W	75	SBL E-10 USNM	5/8/60		1		15.9	USFWS
56°22'N, 162°11.5'W	75	ABL E-10 USNM	4/6/66	1			16.1	USFWS
56°23'N, 161°02'W	54	SBL E-12 USNM	9/8/59	2	9	1	13.1-22.2	USFWS
56°10'N, 164°55'W	95	SBL DE-5.5 USNM	17/7/61	4	4		14.6-28.1	USFWS
56°10'N, 163°42'W	90	SBL DE-7.5 USNM	11/7/61	3	3		12.4-23.2	USFWS

Table 6 (Continued) *Pagurus aleuticus* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	♂♀		
<i>Bering Sea</i>								
56°00'N, 166°25'W	120	SBL D-3 USNM	29/8/60	2	3		13.8-24.8	USFWS
56°00'N, 166°25'W	152	SBL D-3 USNM	2/8/61	1	1		13.4-18.6	USFWS
56°01'N, 166°24'W	119	ABL D-3 USNM	19/7/66	4	10		11.9-23.1	USFWS
56°00'N, 165°49'W	106	SBL D-4 USNM	13/8/60	4	2		15.9-22.6	USFWS
56°00'N, 165°49'W	113	SBL D-4 USNM	22/7/61	3			21.8-25.5	USFWS
56°03'N, 165°45.5'W	108-110	ABL D-4 USNM	21/7/66	3	4	1	15.4-23.9	USFWS
56°00'N, 165°31'W	93	SBL D-5 USNM	14/8/60	13	8		12.2-21.1	USFWS
56°00'N, 164°36'W	91	SBL D-6 USNM, CNM	14/8/60	20	15		8.0-24.4	USFWS
56°00'N, 164°36'W	93	SBL D-6 USNM	10/7/61	6	4		13.9-21.9	USFWS
56°00'N, 164°00'W	86	SBL D-7 USNM	8/8/60	3	4		14.4-18.9	USFWS
56°00'N, 164°00'W	91	SBL D-7 USNM	11/7/61	4	9		13.4-20.1	USFWS
56°00'N, 163°24'W	84	SBL D-8 USNM, RMNH	8/8/60	8	10		11.8-24.9	USFWS
56°00'N, 163°24'W	91	SBL D-8 USNM	11/7/61	19	24		9.9-22.6	USFWS
55°59'N, 163°27'W	91	ABL D-8 USNM	26/6/66	43	15	10	8.4-24.1	USFWS
56°00'N, 162°48'W	77	SBL D-9 USNM	5/8/60	1			19.5	USFWS
56°00'N, 162°50'W	82-90	ABL D-9 USNM	3/6/66	5			6.9-22.2	USFWS
56°00'N, 162°08'W	66	SBL D-10 USNM	2/5/58	1		1	20.7-21.5	USFWS
55°40'N, 166°25'W	124	SBL C-3 USNM	29/8/60	2	1		17.8-20.4	USFWS
55°40'N, 166°24'W	126	SBL C-3 USNM, RMNH	2/8/61	6	1		17.7-24.6	USFWS
55°38'N, 166°25'W	124	ABL C-3 USNM	19/7/66	12	11		10.5-23.4	USFWS
55°40'N, 165°49'W	113	SBL C-4 USNM	13/8/60	3	4		14.5-25.6	USFWS
55°39.5'N, 165°43'W	117-119	ABL C-4 USNM	26/7/66	1	1		21.9-22.2	USFWS
55°40'N, 165°12'W	106	SBL C-5 USNM	9/8/60	2	3		15.2-24.1	USFWS
55°40.5'N, 165°15'W	112	ABL C-5 USNM	22/7/66	2	3		20.4-22.4	USFWS
55°42'N, 164°36'W	---	SBL C-6 USNM	20/5/58	1			22.2	USFWS
55°40'N, 164°36'W	93	SBL C-6 USNM	9/8/60	6	2		16.2-22.4	USFWS
55°40'N, 164°40'W	101	SBL C-6 USNM	10/7/61	9	12		8.3-23.5	USFWS
55°41'N, 164°38'W	104	ABL C-6 USNM	8/7/66	1	1		22.1-23.3	USFWS
55°40'N, 164°00'W	90	SBL C-7 USNM	8/8/60	1			19.0	USFWS
55°40'N, 164°00'W	95	SBL C-7 USNM	9/7/61	3	4	2	8.6-21.6	USFWS
55°41'N, 164°02'W	96	ABL C-7 USNM	12/7/66	5	9		8.9-21.3	USFWS
55°40'N, 163°23'W	79	SBL C-8 USNM	4/8/60	1			18.1	USFWS
55°40'N, 163°23'W	80	SBL C-8 USNM	9/7/61	4	5		12.4-20.8	USFWS
55°40'N, 162°49'W	53	SBL C-9 USNM	4/8/60	5	1		15.9-23.3	USFWS
55°40'N, 162°46'W	48	ABL C-9 USNM	3/6/66	1			13.4	USFWS
55°20'N, 166°21'W	126	SBL B-3 USNM	30/8/60	3			17.8-21.9	USFWS

Table 6 (Continued). *Pagurus aleuticus* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂+	♀ ♀♀	♀+		
<i>Bering Sea</i>								
55°20'N, 165°46'W	115	SBL B-4 USNM	13/8/60	1			19.6	USFWS
55°20'N, 165°49'W	120	ABL B-4 USNM	22/7/66	2			12.3-16.1	USFWS
55°20'N, 165°12'W	106	SBL B-5 USNM	23/8/60	6	3		15.9-24.8	USFWS
55°20'N, 165°13'W	113	ABL B-5 USNM	22/7/66	7	6		6.7-23.7	USFWS
55°20'N, 164°36'W	95	SBL B-6 USNM	3/8/60	3			13.7-23.5	USFWS
55°20'N, 164°36'W	102	SBL B-6 USNM	8/7/61	3	3		9.6-21.9	USFWS
55°20'N, 164°36'W	108-110	ABL B-6 USNM	9/7/66	2	4		8.4-23.9	USFWS
55°20'N, 164°00'W	73	SBL B-7 USNM, BM	3/8/60	7	7		12.8-23.9	USFWS
55°20'N, 164°00'W	90	SBL B-7 USNM, AHF	8/7/61	6	9	1	11.4-21.9	USFWS
55°20'N, 163°24'W	51	ABL B-8 USNM	14/7/66	1	2		12.1-18.2	USFWS
55°00'N, 165°44'W	122	SBL A-4 USNM	13/8/60	1	2	1	15.8-18.2	USFWS
55°00'N, 164°38'W	128	ABL A-4 USNM	15/6/66	1			15.6	USFWS
55°00'N, 165°10'W	110	SBL A-5 USNM	4/8/61	1			12.7	USFWS
55°01'N, 165°14'W	117	ABL A-5 USNM	15/7/66	6	10	2	12.3-22.0	USFWS
Cape Cheerful, Unalaska I.	91	----- USNM	18/11/65	1			4.5	Fiscus
<i>Gulf of Alaska</i>								
Between Unimak & Shumagin Is.	---	----- USNM	15/5/61	1			12.0	INPHC
Between Unga & Nagai Is.	201	Albatross 2648 USNM 16415, 128949	1888	3	2		19.9-22.9	----
Greater Kodiak I.	---	----- USNM	summer 61	3	2		12.5-20.1	INPHC
60°12'N, 147°30'W	278	73B USNM	2/8/62	9	6		16.5-24.3	INPHC
58°30'N, 150°00'W	101	61L USNM	29/6/62		1		18.3	INPHC
59°50'N, 148°50'W	172-188	60A USNM	10/10/61	2	1		10.8-14.9	JNC
57°45'N, 148°46'W	188-192	66E USNM	10/10/61	1			19.9	JNC
57°24'N, 155°00'W	---	41F USNM	12/5/61	1	1		12.5-18.6	INPHC
56°30'N, 156°00'W	219	37J USNM	15/7/61	7	5		13.4-22.4	INPHC
56°15'N, 157°50'W	---	30H USNM	14/7/61	10	1		11.2-24.9	INPHC
55°39'N, 157°15'W	84	32K USNM	11/7/61	2	1		13.3-21.5	INPHC
55°45'N, 148°28'W	126-128	68B USNM	6/10/61		1		20.9	JNC
55°18'N, 159°00'W	---	25F USNM	10/4/62	1	2	1	15.0-18.4	INPHC
54°54'N, 160°30'W	82	19E USNM	5/4/62	15	1		9.4-21.9	INPHC
54°39'N, 160°45'W	119	18G USNM	9/4/62	12	5	1	12.6-21.1	INPHC
54°27'N, 159°45'W	78-128	22M USNM	6/4/62	10	6	8	9.8-19.7	INPHC
58°18'N, 135°55'W	57	1A USNM	13/7/61	3	1		15.4-18.9	INPHC
Stevens Passage	---	----- USNM	26/3/51	1			5.5	JNC
Auke Bay	38	----- USNM	16/4/64	1			9.4	Gonor

Table 6 (Continued). *Pagurus alauticus* (Benedict) Material Examined

Locality	Depth (m)	Station		Date	Sex			SL (mm)	Collector
		Deposition			♂	♀	♂♀		
<i>British Columbia</i>									
51°41'N, 129°15'W	101	1D	USNM	23/6/61	3	1		19.2-25.7	INPHC
48°52.9'N, 126°19.5'W	146	-----	USNM	17/10/62	1			8.5	JNC
<i>Washington</i>									
Off coast	207	-----	USNM	17/5/60	2	2		5.0-11.5	BB 236
Strait of Juan de Fuca	---	-----	USNM	9/8/61	1			14.4	Davis
San Juan Archipelago	46	-----	USNM	15/8/57	1			10.2	Hart
San Juan I.	---	-----	USNM	8/61	1	1		6.1-10.9	McLaughlin
Friday Harbor, San Juan I.	---	-----	USNM	1923	1			8.7	Stevens
Friday Harbor, San Juan I.	---	-----	USNM	1963	1			10.2	
San Juan Channel	---	-----	USNM	2/8/61	2	2		5.9-8.9	McLaughlin
Waldron I.	---	-----	USNM	26/7/61	1	1		4.8-5.1	Ray
President Channel	32	-----	ABF	11/8/61	1			5.6	McLaughlin
Lopez Sound	---	-----	USNM	25/5/61	2	1		3.9-7.3	Henry
Lopez Sound	36	-----	USNM	10/8/61	5			4.6-8.9	McLaughlin
<i>Oregon</i>									
Off Columbia River	274	-----	USNM	22/8/63	1			15.9	JNC
Off Columbia River	183	-----	USNM	11/1/64	1			12.6	JNC
Off Columbia River	---	-----	USNM	-----	2	1	1	6.6-7.4	JNC
46°06.8'N, 124°38.6'W	183	-----	USNM	7/5/63	1			15.0	CC
46°05'N, 124°40'W	183	-----	USNM	21/5/62	1			13.4	CC
46°01.5'N, 124°43.2'W	274	-----	USNM	8/5/63	1			13.3	CC

Ocular peduncles short, usually less than one-half shield length, stout; slightly inflated basally, strongly dilated in corneal region; dorsomesial face usually with row of tufts of short setae. Ocular acicles long, ovately triangular, with lateral and mesial margins expanded, dorsal surface slightly concave; terminating subacutely with moderately strong, submarginal spine frequently not visible from above; separated basally by two-thirds to entire basal width of one acicle.

Antennular peduncles moderately long, exceeding ocular peduncles by one-third to two-thirds length of ultimate segment. Ultimate and penultimate segments with few tufts of short setae; basal segment frequently with small spine at ventrodistal margin, lateral surface and dorsolateral margin with tufts of short setae, dorsolateral distal angle occasionally with small spine.

Antennal peduncles moderately long, exceeding ocular peduncles by one-

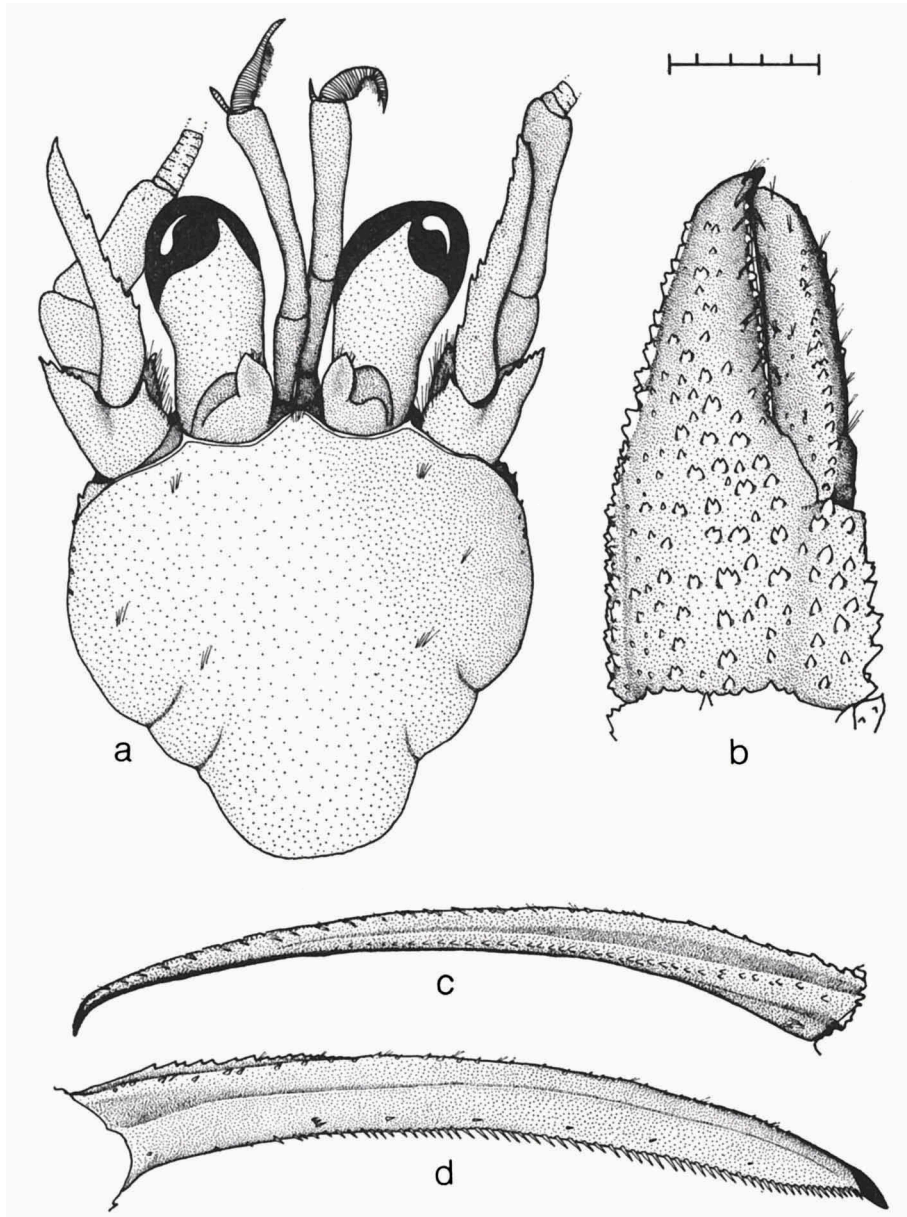


Fig. 17. *Pagurus aleuticus* (Benedict). a, shield; b, left chela (dorsal view); c, left P₃, dactyl (dorsolateral view); d, left P₃, dactyl (mesial view). Scale equals 5 mm.

third to two-thirds length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments unarmed, with few tufts of very short setae. Third segment with ventromesial distal angle produced, terminating in strong acute spine, partially obscured by tufts of long setae. Second segment with dorsolateral distal angle produced, terminating in strong simple or bifid spine, lateral margin straight, mesial margin strongly inflated, with several small spines; dorsomesial distal angle with strong spine, mesial margin with long setae. First segment with strong spine and occasionally second small spinule on lateral face distally; ventromesial distal angle produced, often bilobed, with several small acute spines laterally. Antennal acicles long, usually reaching beyond proximal half of ultimate peduncular segment; arcuate, twisted; terminating in strong simple or bifid spine; mesial margin with row of moderately strong, acute spines; occasionally ventral surface with small spine distally. Antennal flagella moderately long, often reaching tip of right cheliped; naked or with short setae at random intervals.

Mandible without distinctive characters. Maxillule with proximal endite subquadrate; endopodite with 2 or 3 bristles on well developed internal lobe, external lobe strongly produced, recurved. Maxilla with endopodite inflated basally, not reflexed, equalling or slightly exceeding scaphognathite in distal extension. First maxilliped with endopodite approximately one-half length of exopodite. Second maxilliped with basis-ischium partly fused. Third maxilliped with basis-ischium fusion incomplete; 1 small spine on basis; ischium with crista dentata well developed, 1 accessory tooth; merus with ventral margin usually unarmed, strong spine at dorsodistal margin. Sternite of mxp_3 unarmed, anterior margin with long stiff setae.

Right cheliped considerably larger than left; not overreaching right second and third pereopods. Dactyl usually equalling or slightly exceeding length of palm; subtriangular; overreached and overlapped by fixed finger; cutting edge with row of strong calcareous teeth, usually terminating in very small, corneous claw; with slender longitudinal hiatus; dorsal surface with scattered, simple and bifid, conical spines, decreasing in size and number distally, dorsomesial margin with 1-3 rows of moderately small spines proximally, usually decreasing to single row distally; mesial face with closely-spaced simple or bifid spines proximally, frequently becoming obsolete distally, ventromesial margin with single or double row of moderately strong spines or spinulose tubercles; ventral surface with rows of tufts of short setae or bristles. Palm moderately long, two-thirds to four-fifths length of carpus; dorsal surface flattened or slightly convex, with closely-spaced, conical, simple or bifid spines or spinulose tubercles, dorso-lateral margin with double row of simple or bifid subacute spines, increasing

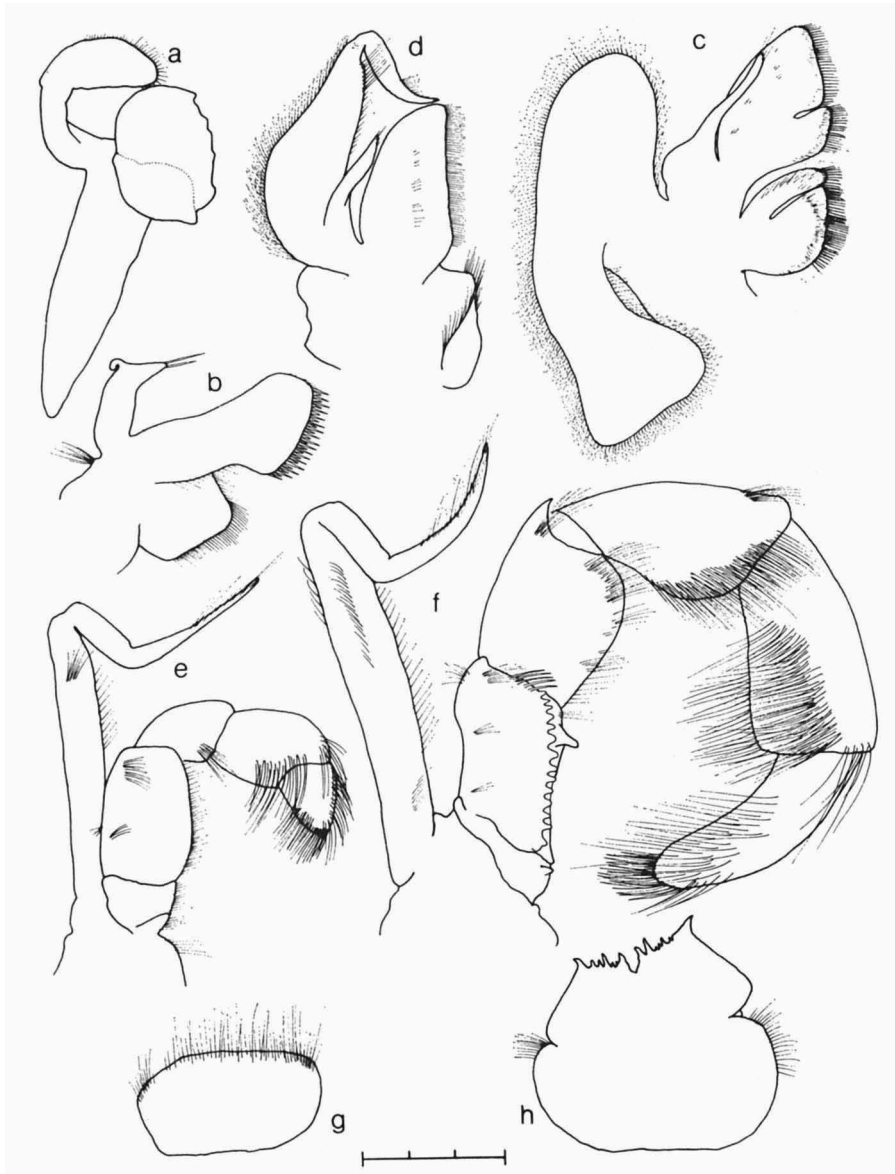


Fig. 18. *Pagurus aleuticus* (Benedict). a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite P₃; h, telson. Scale equals 3 mm.

in size on fixed finger, dorsomesial margin with 2 or 3 rows of moderately small simple or bifid spines, occasionally more prominent and clustered at distal angle; mesial face with closely-spaced simple or bifid spines or spinulose tubercles, ventromesial margin with row of broad, bilobed spines or spinulose tubercles; ventral and lateral surfaces with scattered, simple or bifid spines or spinulose tubercles and tufts of short setae, ventromesial distal angle occasionally with prominent tooth. Carpus two-thirds to three-fourths length of merus, dorsoventrally inflated; dorsomesial margin with single or double row of strong spines, distal angle often produced, with cluster of strong spines, dorsal surface with irregularly spaced, simple, bifid or occasionally multifid spines and small spinules, distal margin with single or double row of small spines; dorsolateral margin with row of simple or bifid spines, lateral face with moderately closely-spaced simple and bifid spines or spinulose tubercles, distal margin spinous or tuberculate; ventral and mesial surfaces with scattered, broad, bilobed, spinulose tubercles, mesio-distal margin spinous. Merus subtriangular; dorsal surface with irregular, transverse, denticulate ridges becoming spinous distally, distal margin dorsally, laterally and mesially with strong spines; lateral face with scattered, low, multidenticulate tubercles, ventrolateral margin with irregular row of simple or multidenticulate, spinulose tubercles, becoming strong, multifid spines distally; ventral surface with scattered, multidenticulate tubercles, ventromesial margin with single or double row of multidenticulate, strong tubercles; mesial face with few, scattered, small, multidenticulate tubercles and tufts of short setae. Ischium with irregular row of short, conical, subacute spines on ventromesial margin, ventrolateral margin with single or double row of multidenticulate spines, ventral surface with scattered, low, multidenticulate tubercles and tufts of short setae or bristles; lateral surface with low denticulate keel proximally, often with scattered small spinules or spinulose tubercles ventrally. Coxa with row of small teeth on distolateral margin ventrally, ventrolateral proximal angle with cluster of small conic spines, extending onto ventrolateral margin as row of small spinules; ventromesial margin and distal angle with tufts of short setae or bristles.

Left cheliped moderately short, usually not reaching base of dactyl of right. Dactyl one and one-half to twice length of palm; cutting edge with row of closely spaced corneous teeth, terminating in small corneous claw; slightly overreached and overlapped by fixed finger; dorsal surface with scattered small spines proximally, dorsomesial margin with row of small spines, decreasing in size distally and scattered tufts of short setae; mesial face approximately perpendicular, with irregular row of small spines and tufts of short setae; ventral surface with tufts of short bristles. Palm

approximately one-half length of carpus; dorsomesial and dorsolateral margins elevated, with double or triple row of simple or bifid spines or spinulose tubercles, dorsal surface convex, with scattered, small, conical, simple or bifid spines and prominent double or triple row of strong bifid spines in midline, extending onto fixed finger; mesial and ventral surfaces

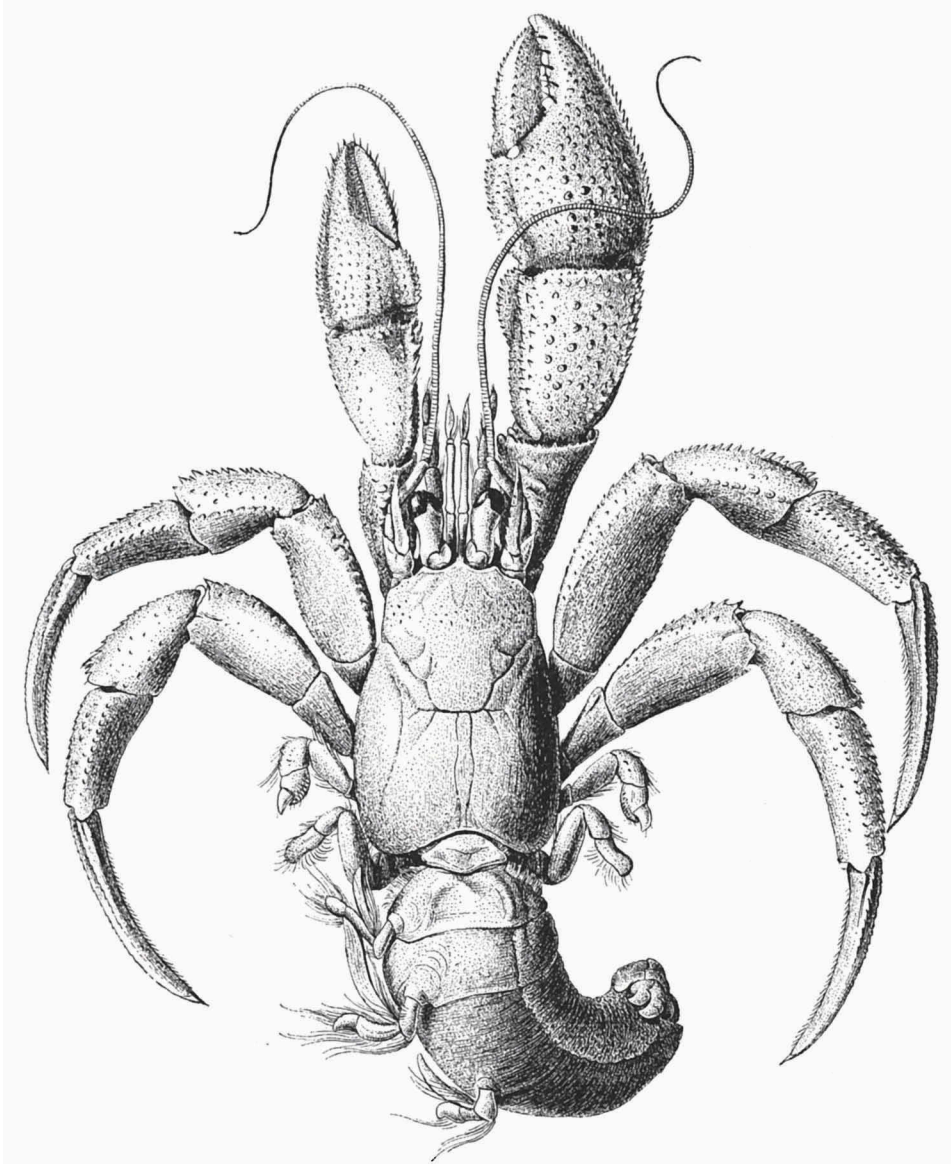


Fig. 19. *Pagurus aleuticus* (Benedict). Original illustration of Benedict (1901b).

with scattered simple or multidenticulate spines or spinulose tubercles and tufts of short setae, ventromesial margin with row of strong, blunt, simple or bifid spines. Carpus moderately long, equalling or slightly shorter than length of merus; subtriangular, dorsal surface oblique; dorsomesial margin with double or triple row of strong spines, dorsolateral surface with irregular rows of simple or multifid spines, distal margin strongly spinous; mesial face with small scattered spinulose tubercles, occasionally moderately strong simple or bifid spines dorsally, distal margin with multidenticulate spines; ventral surface with low, bifid or multifid, spinulose tubercles, ventrolateral margin with multidenticulate spines distally. Merus triangular; dorsal margin with double or triple series of transverse, multidenticulate, subacute ridges, becoming spinulose distally, distal margin with 1-3 strong spines; mesial face with scattered multidenticulate tubercles, distal margin denticulate or spinous; lateral face with low multidenticulate tubercles, distal margin denticulate or spinous, ventrolateral margin with row of multifid spinulose tubercles or small spines; ventral surface with 1-3 irregular rows of bifid or multifid spinulose tubercles, ventromesial margin with low multidenticulate tubercles and few tufts of short setae. Ischium with row of simple or bifid spines on ventromesial margin, ventral surface with few scattered spines proximally; ventrolateral margin with row of small spines, lateral face proximally, with low denticulate keel. Coxa with row of small subacute spines on ventrolateral distal angle, ventrolateral surface with small spinules; ventromesial margin with tufts of setae.

Second pereopods long, usually equalling or exceeding length of right cheliped, right often exceeding left in length. Dactyl long, frequently twice length of propodus, broad; terminating in strong corneous claw; in lateral view, strongly curved ventrally; in dorsal view, strongly twisted; dorsal surface with very prominent longitudinal sulcus proximally, flanked by double or single row of small spines and few tufts of short setae; mesial and lateral faces each with strong longitudinal sulcus proximally, continued distally as uncalcified line and with few small spines or corneous spinules; ventral margin with row of corneous spines, increasing in size distally. Propodus approximately equalling length of carpus; subrectangular; dorsal surface with irregular rows of simple or multidenticulate spines, distal margin with few, small, conical spines; dorsolateral margin with single or double row of multidenticulate spines, lateral face with low, scattered, bidenticulate tubercles, distal margin with small spinulose tubercles; dorsomesial margin with row of strong conical spines, mesial face with scattered, low, multidenticulate tubercles; ventral surface with small spinulose tubercles and tufts of short setae. Carpus equalling or slightly shorter than merus; dorsal sur-

face with single or double row of strong simple or multifid spines, increasing in size distally; mesial face with few, scattered, multidenticulate tubercles; lateral face with longitudinal row of multidenticulate spinulose protuberances or tubercles and tufts of short setae, and scattered small spinules and tubercles; ventral surface with tufts of short setae. Merus laterally compressed; dorsal surface with irregular, transverse, multidenticulate ridges increasing in size distally; lateral and mesial faces with scattered multidenticulate tubercles and few tufts of short setae, prominent suture on mesial face ventrally; ventral margins with irregular rows of simple or multidenticulate spines, scattered spines on ventral surface. Ischium with irregular row of small, conical spines on ventromesial margin; ventrolateral surface with multidenticulate tubercles, dorsal and ventral surfaces with few tufts of short setae. Coxa with small bifid tooth at ventrolateral proximal angle, ventrolateral distal angle with row of small, subacute spines; ventromesial margin with row of tufts of short setae.

Third pereopods long, usually equalling or exceeding length of right cheliped, right usually slightly longer than left. Dactyl long, slightly less than twice length of propodus, broad; terminating in strong corneous claw; in lateral view, strongly curved ventrally; in dorsal view, strongly twisted; dorsal surface with very prominent longitudinal sulcus proximally, flanked by single or double row of moderately small spines proximally and corneous spinules distally; lateral and mesial faces each with moderately deep sulcus proximally, continued distally as uncalcified line, and strong protuberance ventral to sulcus, usually with several small spinules and tufts of short setae; ventral margin with row of corneous spines, increasing in size distally. Propodus equalling or slightly exceeding length of carpus; subrectangular; dorsal surface with scattered simple or bifid spines or tubercles, dorsolateral margin with row of multidenticulate spines or tubercles, distal margin with few, small spines, dorsomesial margin with single or double row of simple or bifid spines; lateral and mesial faces with small multidenticulate or simple tubercles and usually with scattered tufts of short setae; ventral surface with scattered spinulose protuberances or tubercles, distal margin with few corneous spines or spinules. Carpus approximately three-fourths to five-sixths length of merus; dorsal surface with irregular row of simple or bifid spines, increasing in size distally, distal margin often with cluster of spines; lateral face occasionally with faint, irregular, longitudinal sulcus and usually with scattered, multidenticulate, spinulose tubercles, distal margin with row of small spinules ventrally; mesial face with irregular rows of simple or multidenticulate tubercles or very small protuberances, occasionally unarmed; ventral surface usually unarmed, with scattered tufts of short setae, distal

margin often with few, minute spinules. Merus laterally compressed; dorsal surface with 2 or 3 rows of low simple or multifid tubercles, becoming spinous distally, distal margin with spines often moderately prominent; lateral and mesial faces with scattered, simple or multifid, spinulose tubercles or protuberances and tufts of short setae, mesial face also with prominent suture ventrally; ventral surface often with marginal rows of multifid, spinulose protuberances or tubercles, becoming moderately strong spines distally, and tufts of short setae. Ischium with spine near ventrodistal margin, occasionally unarmed; dorsal surface usually with few small spines or spinules and tufts of setae. Coxa unarmed or with 1 or 2 small spinules at ventrolateral distal angle, surface with tufts of setae.

Fourth pereopods with well developed propodal rasp; no preungual process apparent on lateral face of dactyl.

Fifth pereopods typical.

Sternite of third pereopods roundly rectangular, unarmed, anterior margin with moderately long setae.

Pleopods of males, pl_3-pl_5 , unpaired, with exopodites well developed, margins with long setae; endopodites rudimentary. Females with pleopods, pl_2-pl_4 , unpaired, both rami well developed, endopodites with dense tufts of long setae; pl_5 , unpaired, with exopodite well developed, endopodite rudimentary.

Telson with posterior lobes usually asymmetrical, left larger than right, lateral margins oblique; separated by prominent, moderately wide U-shaped cleft; right terminal margin with 5-7 moderate to strong spines; left terminal margin with 5-8 moderate to strong spines. Anterior lobes unarmed, with tufts of setae.

Coloration. — In life: "Chelipeds and ambulatory legs light ochraceous-buff with mineral red above, shading to buff on the hands and dactyls" (Stevens, 1925: 279). In preservative: Generally straw-colored, with no distinctive patterns.

Distribution. — Avachinskaya Guba to Nagasaki and Inubo (north of Tokyo) (Vinogradov); Bering Sea (latitude of Pribilof Is.) southward to Oregon (Rathbun, Vinogradov, Makarov); 15 to 435 m.

Affinities. — As previously mentioned, the three species of the "*bernhardus*" group represented in northwestern North America are all very closely related. In life the coloration and lack of iridescence aids in distinguishing *P. aleuticus* from *P. armatus* and *P. ochotensis*. The most reliable and distinguishing character of this species, however, is found in the configuration of the dactyls of the second and third pereopods. The single, deep and broad sulcus, flanked by a row of small spines or corneous spinules,

on the dorsal surface of the dactyls of *P. aleuticus*, immediately separates this species from *P. armatus* and *P. ochotensis* in which the dorsal surfaces are armed with 3 rows of small spines or spinules, separated proximally by 2 short, shallow sulci.

Discussion. — Owen (1839) reported *Pagurus streblonyx* from Kamchatka and Benedict (1901b) referred Owen's species to *P. aleuticus*. Although Owen's description was short and lacking in many significant details, I would concur with Benedict on the probable synonymy of *P. streblonyx* sensu Owen (not Leach) on the basis of Owen's (1839: 81) remarks on the "dirty brown color" of his specimens. Furthermore, *P. aleuticus* has a wide distribution in Asian waters as reported by Vinogradov (1950).

On the basis of morphological similarities, Makarov ranked *P. aleuticus* as a subspecies of *P. ochotensis*. However, he considered *P. armatus* as a full species and the differences between the latter species and *P. ochotensis* are less significant than those differentiating *P. aleuticus* and *P. ochotensis*. As these two taxa are sympatric through a large portion of their geographic ranges in northwestern North America and apparently also in northeast Asia, the definition of a subspecies as proposed by Mayr (1963) and Blackwelder (1967) is not met. I believe, therefore, that it is necessary to restore *Pagurus aleuticus* (Benedict) to full specific rank.

Pagurus quaylei Hart (figs. 20, 21)

Pagurus quaylei Hart, 1971: 1532, figs. 8-16 (type locality: off Frederick Island, British Columbia, 53°56'N 133°08.5'W (Hart, personal communication)).

Holotype. — ♂ (not seen).

Material examined. — See table 7.

Table 7. *Pagurus quaylei* Hart Material Examined

Locality	Depth (m)	Station		Date	Sex			SL (mm)	Collector
		Deposition			♂	♀	♀ ⁺		
<i>British Columbia</i>									
Port Louis, Queen Charlotte Is.	---	----		4/6/69	1	1		1.6-1.9	Hart
Sunset Point, Vancouver I.	---	----		21/7/62		1		3.0	Landrum

Diagnosis. — Left chela with dorsal surface convex, spinose or tuberculate; dactyl strongly bowed, producing prominent hiatus with fixed finger. Ocular acicles usually terminating with bifid or multifid spine.

Description. — Shield longer than broad; anterolateral margins sloping or slightly terraced; anterior margin between rostrum and lateral projections slightly concave; posterior margin truncate or roundly truncate; dorsal sur-

face smooth or slightly pitted anteriorly, with scattered tufts of setae; antero-lateral angle slightly produced, blunt or spinulose. Rostrum short, equalling or slightly exceeding lateral projections, obtuse or broadly rounded, unarmed, with terminal tuft of setae. Lateral projections obsolete, or very slightly

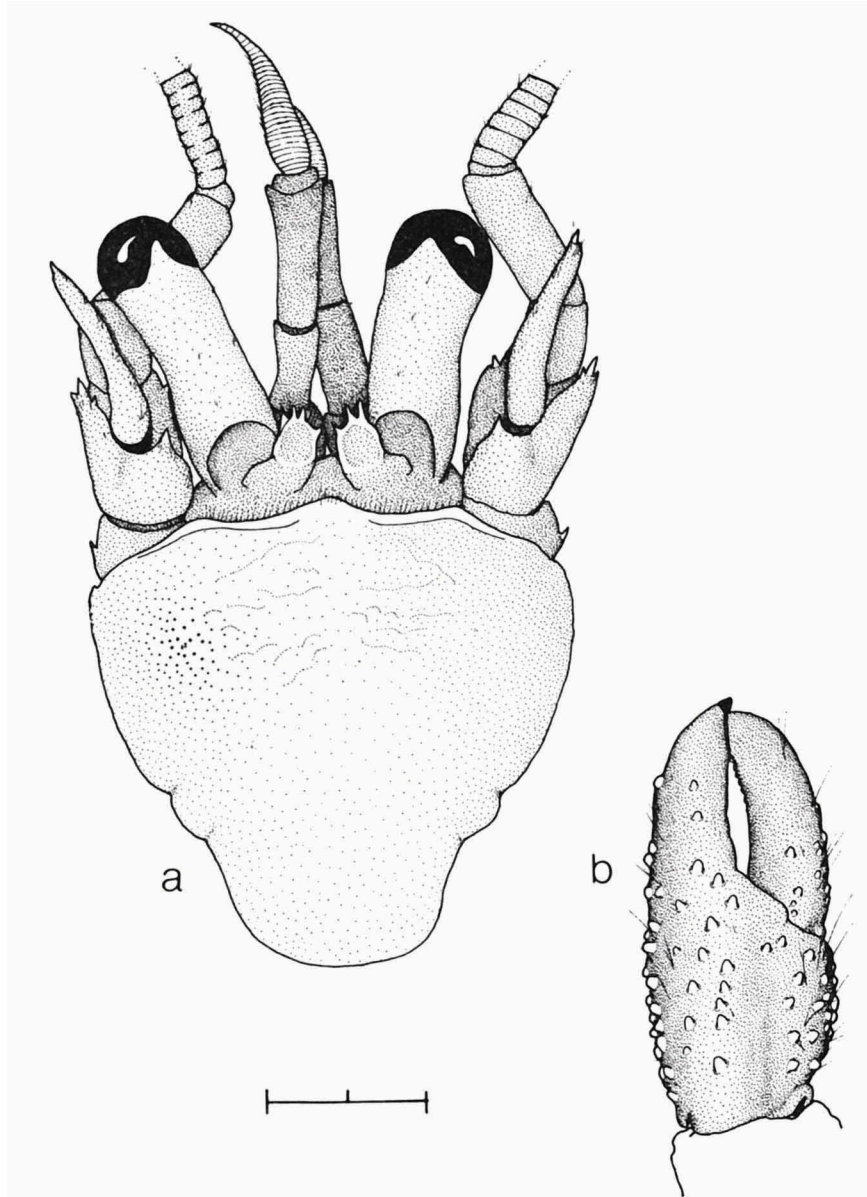


Fig. 20. *Pagurus quaylei* Hart. a, shield; b, left chela (dorsal view). Scale equals 1 mm.

produced, rounded, usually unarmed, rarely with very small submarginal spine.

Ocular peduncles moderately long, one-half to two-thirds length of shield; moderately stout, slightly inflated basally, cornea dilated; dorsomesial face with longitudinal row of tufts of moderately long setae. Ocular acicles large, subovate, mesial and lateral margins straight or slightly expanded, dorsal surface slightly concave; terminating in 1-5 strong spines; separated basally by two-thirds to entire basal width of one acicle.

Antennular peduncles moderately short, exceeding ocular peduncles by one-third to one-half length of ultimate segment; ultimate and penultimate segments unarmed, usually with tufts of short setae; basal segment with small spine on ventral margin distally.

Antennal peduncles moderately short, exceeding ocular peduncles by one-third to one-half length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments unarmed, with scattered tufts of short setae. Third segment with ventromesial distal angle produced, terminating in strong acute spine, ventral margin with moderately long setae. Second segment with dorsolateral distal angle produced, terminating in strong spine, mesial margin with 1-4 small spines, lateral margin unarmed or with small spine distally and few tufts of setae; dorsomesial distal angle with prominent acute spine, mesial margin with row of moderately long setae. First segment with spine on lateral face distally; ventromesial margin produced, with small spine on lateral margin distally. Antennal acicle moderately short; arcuate; terminating in strong spine; mesial margin with row of low protuberances and tufts of moderately long setae. Antennal flagella long, overreaching right cheliped; each article with several short setae.

Mandible without distinguishing characters. Maxillule with proximal endite subquadrate; endopodite with 1 bristle on moderately well developed internal lobe, external lobe weakly produced. Maxilla with endopodite inflated basally, not reflexed, slightly exceeding scaphognathite in distal extension. First maxilliped with endopodite less than one-half exopodite; basal segment of exopodite slightly inflated. Second maxilliped without distinctive characters. Third maxilliped with basis-ischium fusion incomplete; basis with 2 or 3 small spines; ischium with crista dentata well developed, 1 accessory tooth; merus unarmed. Sternite of mxp_3 with strong spine on each side of midline and marginal row of long setae.

Right cheliped moderately short and stout. Dactyl moderately short, slightly less than or equalling length of palm; cutting edge with row of small calcareous teeth proximally, corneous teeth distally, terminating in small corneous claw; dorsal surface slightly elevated in midline with row of small

spines or spinulose tubercles, dorsomesial margin with single or double row of small spines or spinulose tubercles, and long stiff setae; mesial face with 1-3 rows of very small spinules or spinulose tubercles and tufts of

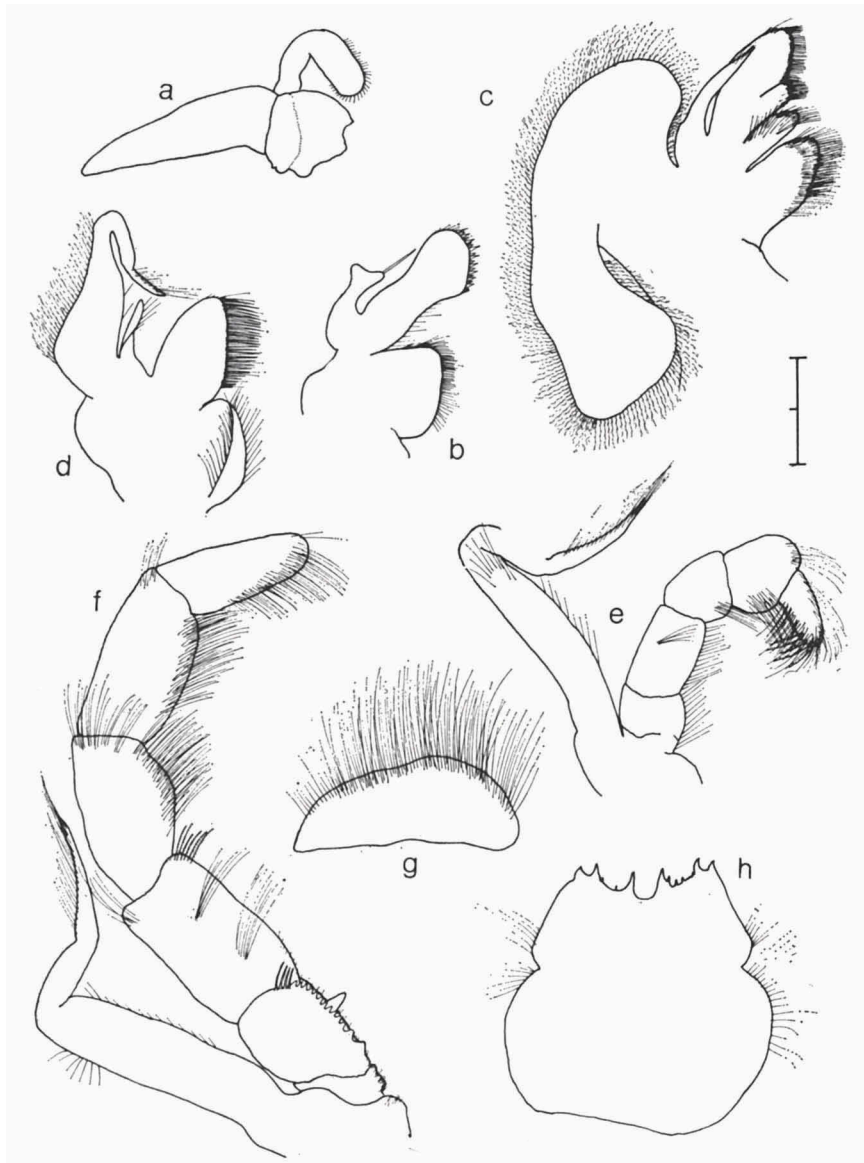


Fig. 21. *Pagurus quaylei* Hart. a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite P₃; h, telson. Scale equals 0.5 mm.

long setae; ventral surface unarmed, with tufts of long setae. Palm moderately short, approximately two-thirds to three-fourths length of carpus; slightly inflated; dorsomesial margin with single or double row of spines, dorsal surface convex, with irregular rows of prominent small spines and very long stiff or coarse setae, dorsolateral margin with row of prominent acute spines, decreasing in size on fixed finger; cutting edge with row of small calcareous teeth, terminating in corneous claw; with broad, longitudinal hiatus; lateral face minutely spinulose with tufts of long setae; mesial face with irregular rows of simple or bifid spinulose tubercles and long setae. Carpus moderately short, slightly less than length of merus; broadened distally; dorsomesial margin with single or double row of prominent acute spines and tufts of very long setae, dorsal surface with irregular rows of small slender spines or spinulose tubercles and tufts of very long stiff setae, distal margin denticulate or tuberculate; lateral face with small simple or bifid tubercles or spinules, distal margin with row of small spines; mesial face with low spinulose tubercles, distal margin with few small spines or tubercles; ventral margin with row of small spinules or tubercles distally. Merus subtriangular; dorsal margin with low transverse ridges and long setae, distal margin with row of long stiff setae or bristles; lateral and mesial faces with short transverse ridges and long setae; ventral surface with 1 or 2 prominent tubercles, frequently with few additional, small tubercles and tufts of long setae. Ischium with row of very small denticles or small spinules on ventromesial margin and few tufts of long setae. Coxa with long fine setae on ventral margins.

Left cheliped elongate, usually extending beyond base of dactyl of right. Dactyl long, one and one-half to twice length of palm; cutting edge with row of small corneous teeth; terminating in small corneous claw; overlapped and frequently overreached by fixed finger; with prominent, longitudinal hiatus; dorsomesial margin with single or double row of small spines or tubercles, becoming obsolete distally, or occasionally unarmed, with few long setae, dorsal surface frequently with few small spines or tubercles proximally; mesial and ventral surfaces with tufts of long setae. Palm approximately one-half length of carpus; dorsal surface strongly convex, with 2 or 3 irregular rows of small spines, dorsomesial margin with single or double row of small spines or spinulose tubercles and few long setae, dorsomesial margin with irregular row of small spines or tubercles; mesial face unarmed or often with scattered small spines or tubercles and numerous tufts of long setae; lateral face with few small spines or spinulose tubercles and long setae. Carpus approximately equalling length of merus; dorso-mesial and dorsolateral margins each with row of prominent acute spines

or spinulose tubercles and tufts of long setae; mesial face unarmed, or occasionally slightly tuberculate and with tufts of long setae; lateral face often slightly spinulose with tufts of long setae, distal margin denticulate or spinulose; ventral surface unarmed, with tufts of long setae. Merus subtriangular, slightly compressed laterally; dorsal surface occasionally protuberant, most frequently smooth with tufts of long setae; lateral and mesial faces unarmed or slightly spinulose; ventral margins each with row of small spines or tubercles and tufts of long setae. Ischium with row of small denticles on ventromesial margin and tufts of long setae. Coxa with long, marginal setae.

Second pereopods long, overreaching right cheliped. Dactyl moderately short, slightly exceeding length of propodus; in lateral view, straight or slightly curved ventrally; in dorsal view, slightly twisted; terminating in very long, curved, corneous claw; dorsal surface with 2 or 3 irregular rows of low protuberances and tufts of long setae; mesial and lateral faces often with weak longitudinal sulcus, flanked by row of tufts of long setae more prominent mesially; ventral margin with row of corneous spinules, increasing in size distally. Propodus slightly longer than carpus; dorsal surface with 2 or 3 rows of moderately small spines and tufts of long setae; lateral surface with few tufts of moderately short setae, occasionally slightly spinulose or tuberculate; mesial and ventral surfaces with tufts of long setae. Carpus one-half to two-thirds length of merus; dorsal surface with single or double row of strong spines, increasing in size distally; lateral face with irregular rows of long setae; mesial and ventral surfaces with tufts of moderately long setae, ventromesial margin frequently with strong spine. Merus laterally compressed; dorsal surface with short, transverse, occasionally spinulose, ridges and tufts of long setae; mesial and lateral faces with few tufts of long setae; ventral margins each with row of small spinules or tubercles and tufts of setae. Ischium with dorsal and ventral margins often slightly denticulate and with tufts of long setae. Coxa with long marginal setae.

Third pereopods long, overreaching right cheliped; dissimilar from left to right. Dactyl moderately short, slightly exceeding length of propodus; in lateral view, slightly curved ventrally; in dorsal view, slightly twisted; terminating in strong, long, curved, corneous claw; dorsal surface with 1 or 2 rows of tufts of long setae; mesial face with faint longitudinal sulcus, flanked by single or double row of small corneous spinules (right pereopod) or by row of tufts of moderately short setae (left pereopod); lateral face with 1 or 2 rows of tufts of setae (right pereopod), or with few tufts of short setae and row of prominent tubercles or blunt spines ventrally (left pereopod); ventral margin with row of small corneous spines, in-

creasing in size distally. Propodus approximately one-third longer than carpus; dorsal surface with 2 or 3 irregular rows of small spines or spinulose tubercles and tufts of long setae; lateral face with 1 or 2 rows of long setae (right pereopod) or usually with small tubercles or spinules distally (left pereopod); mesial and ventral surfaces with tufts of setae. Carpus approximately two-thirds length of merus; dorsal margin with row of small spines and tufts of long setae; lateral face occasionally with faint longitudinal sulcus and tufts of long setae; ventral and mesial surfaces with tufts of long setae. Merus laterally compressed; dorsal margin with tufts of long setae; lateral face occasionally spinulose and with tufts of long setae; mesial and ventral surfaces setose. Ischium with long setae on dorsal and ventral margins. Coxa with long marginal setae.

Fourth pereopods apparently without preungual process at base of claw on lateral face of dactyl; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods subrectangular, slightly skewed, margin with long setae.

Pleopods of male unpaired, pl_3-pl_5 with exopodites moderately well developed; endopodites reduced. Pleopods of female unpaired, pl_2-pl_4 with both rami well developed; pl_5 with exopodite moderately well developed, endopodite reduced.

Telson with posterior lobes very slightly asymmetrical; separated by broad, shallow, median cleft; lateral margins straight, terminal margins each with 2 or 3 very strong spines and 2 to several small spinules; anterior lobes unarmed, margins with long setae.

Coloration. — In life: "Shield dark red with a few brown spots and covered with a fine reticulation of pink with some yellow and orange medially. Light spots on dark brown of lateral part of carapace. ... Antennule pale brown with scarlet chromatophores distally on second and third segments of peduncle; flagella translucent with orange at base of aesthetes. Antennal peduncle with first to third segments light brown, with red patches and some opaque white spots; fourth segment translucent mottled with dark brown. Flagellum translucent and banded with dark brown on certain segments; the pattern is irregular and made up of some all dark segments, others with two patches of dark brown on either side and the remainder without colour. ... Eyestalk pale brown with red-brown and white chromatophores in interrupted stripes. Cornea black with brilliant silver chromatophores covering the surface except for 2 circular bands that curve over the distal part. Third maxilliped greenish-brown with opaque white patches on distal part of each segment".

“Right cheliped: ischium with patches of brown, merus dark brown or mahogany with spots of lighter colour and a white or pale brown band distally, carpus mottled grey or greenish-brown with pale grey spots and tubercles, hand with grey and white tubercles surrounded by reticulated greenish-brown to base of fingers which are white except for a small brown streak medially on base of fixed finger. Left cheliped similar except that distal part of carpus is white and a tinge of grey-blue on distal part of palm. Walking legs: ischium with a few patches of brown, merus with band of red-brown, distal part of opaque grey-white, with a narrow band of mahogany and a wider band of pale yellow. Carpus grey-white and cream with 3 distinct dark red-brown stripes on outer surface, but none on inner surface. Propodus with 3 rows of grey spots separating four stripes of dark brown on the outer surface and 1 medial stripe on inner surface, none of which reach past the middle or last quarter of the segment, which is white with a yellow tinge distally. Dactylus with a dark grey patch proximally on a cream base, with 1 red-brown stripe dorsally on proximal half, and 1 red stripe on each lateral face medially, which reach almost to the brown claw. Fourth and fifth pereopods red-brown with yellow rasps.” (Hart, 1971: 1536). In preservative: Brown colors fading or turning light red or pink and fading completely in time to uniform straw-color.

Distribution. — Qlawdzeet, Stephens Island, B. C. to Bahia de San Quintín, Baja California; 2 to 97 m (Hart).

Affinities. — *Pagurus quaylei* does not appear to have a great deal of similarity to any of the northwestern North American species of *Pagurus*. The small size of this species, its multispinose ocular acicles, and in life, its distinctive color patterns immediately distinguish it.

Discussion. — Hart (1971: 1527) assigned *P. quaylei* to the “*miamensis*” group because of the similarity in characters of this species and the group as generally defined by Forest & De Saint Laurent (1967). The structure of the mouthparts of the group as typified by *P. miamensis* and *P. provenzanoi* (see p. 41) is notably different from that of *P. quaylei* and suggests that the resemblance of this species to the “*miamensis*” group is superficial.

Several discrepancies can be noted between the preceding description of *P. quaylei* and that given by Hart. These are, for the most part, semantic. References to spines on the chelipeds and carpi of the second and third pereopods in this description are equivalent to Hart's spiny tubercles; the terminal margins of the telson as here described are referred to as lateral and posterior margins. In reference to both the armature and color patterns of the antennae, Hart apparently followed Makarov's (1938b: 127, fig. 48; 1962: 121, fig. 48) definition of segmentation. Hart's segments one through

four are equatable to the fifth, fourth, second and first segments of the antennae in the foregoing description.

Pagurus capillatus (Benedict) (figs. 22, 23)

- Eupagurus pubescens*: Stimpson, 1858: 249 (in part). — Stimpson, 1859a: 43 (in part). — Stimpson, 1862: 89 (in part). — Stimpson, 1863: 139 (in part). — Stimpson, 1907: 222 (in part). Not *Eupagurus pubescens* (Kröyer, 1838); see discussion.
- Eupagurus (Trigonocheirus) capillatus* Benedict, 1892: 8 (by implication; type locality: Alaska, here restricted by lectotype selection to Norton Sound, Alaska, 63°37'N 165°19'W).
- ? *Eupagurus pubescens*: Thallwitz, 1892: 35 (by implication). Not *Bernhardus pubescens* Dana, 1851; see discussion.
- Pagurus (Trigonocheirus) capillatus*: Holmes, 1900: 138 (by implication; misspelling of *Trigonocheirus* Benedict, Holmes, 1900: 134).
- Pagurus capillatus*: Rathbun, 1904: 157, pl. 4 fig. 3. — Rathbun, 1910: 157, pl. 4 fig. 3. — Williamson, 1915: 472. — Rathbun, 1919: 7A. — Schmitt, 1921: 132, fig. 85. — Kobjakova, 1936: 191. — Van Winkle & Schmitt, 1936: 330. — Kobjakova, 1937: 144. — Makarov, 1937: 57, fig. 3. — Makarov, 1938a: 412. — Makarov, 1938b: 219, pl. 3 fig. 2. — Reinhard, 1944: 49, fig. 7B. — Vinogradov, 1947: 106, fig. 5. — Vinogradov, 1950: 230 (key), fig. 122. — Birstein & Vinogradov, 1953: 224. — MacGinitie, 1955: 151. — Gordan, 1956: 327. — Kobjakova, 1956: 63. — Kobjakova, 1958a: 245. — Lindberg et al., 1959: 232. — Makarov, 1962: 208, pl. 3 fig. 2. — Kobjakova, 1967: 239. — Hart, 1971: 1532.
- Eupagurus capillatus*: Alcock, 1905: 178. — Appellöf, 1906: 214. — Hansen, 1908: 28. — Selbie, 1921: 32. — Sivertsen, 1932: 11. — Balss, 1957: 1723.
- ? *Pagurus setosus*: Taylor, 1912: 204. — Fasten, 1917a: 440. — Fasten, 1917b: 289, figs. 12-16. ? Not *Pagurus setosus* (Benedict, 1892); see discussion.
- Eupagurus trigonocheirus*: Balss, 1913: 63. Not *Eupagurus trigonocheirus* Stimpson, 1858; see discussion.
- Pagurus setosus*: Stevens, 1925: 290, fig. 11. — Makarov, 1938b: 217 (in part; not fig. 71). — Hart, 1940 (in part): 94. — Makarov, 1962: 206 (in part; not fig. 71). Not *Pagurus setosus* (Benedict, 1892); see discussion.
- Pagurus* sp. [2]: McLaughlin, 1963: 22.

Lectotype, herein selected. — ♂ (SL = 13.9 mm), USNM 16802.

Material examined. — See table 8.

Diagnosis. — Left chela with dorsal surface convex, midline elevated, not produced into prominent ridge or crest. Chelae with dorsal surfaces spinose and usually densely setose. Dactyl and propodus of left P₃ with numerous small spines or tubercles on ventrolateral faces; ventral margins of dactyls of P₂ and P₃ each with row of small, corneous spinules, obscured by long dense setae.

Description. — Shield usually slightly longer than broad, occasionally length equalling width; anterolateral margins terraced; anterior margin between rostrum and lateral projections straight or slightly concave; posterior margin truncate or rounded; dorsal surface generally smooth, with scattered

Table 8. *Pagurus capillatus* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	♂♀		
<i>Chukchi Sea</i>								
69°16'N, 165°35'W	---	59	24/8/59	4	2		6.8-10.9	JNC
69°04'N, 166°12'W	---	USNM 58	24/8/59	2			10.4-11.2	JNC
69°00'N, 166°00'W	20	USNM -----	20/10/62	54	42	21	4.0-14.4	McCauley
<i>Cape Lisbon</i>								
68°47.5'N, 166°54'W	---	USNM 236-21	5/8/59	1			9.5	BB
68°32.5'N, 167°32'W	---	USNM 27	13/8/59	1	1	1	5.2-11.4	JNC
68°31.5'N, 166°54'W	---	USNM 28	14/8/59	1			7.4	JNC
68°30'N, 167°00'W	35	USNM -----	13/8/59	4			3.5-11.0	JNC
68°25'N, 167°55'W	---	USNM 34	22/10/62	11	14	5	3.9-13.2	McCauley
68°25'N, 167°12'W	---	USNM 33	16/8/59	2			10.4-12.4	JNC
68°18'N, 168°15'W	---	USNM 29	16/8/59	2			3.6-8.9	JNC
68°10.8'N, 166°35'W	---	USNM 37	14/8/59	1			12.2	JNC
68°03.5'N, 167°34'W	---	USNM 24	16/8/59	1			6.2	JNC
67°52'N, 165°34'W	---	USNM 17	13/8/59	2	1		4.3-10.8	JNC
67°31'N, 166°35'W	---	USNM 44	11/8/59	1			8.3	JNC
67°24'N, 164°23'W	---	USNM 9	19/8/59	1			6.5	JNC
67°06'N, 163°48'W	---	USNM, RMNH 3	9/8/59	2	1		8.0-15.3	JNC
67°00'N, 165°35'W	27	USNM, AHF -----	7/8/59	6	3		8.7-14.0	JNC
66°58'N, 165°36'W	---	USNM 7	24/10/62	1			6.9	McCauley
66°55.2'N, 164°20'W	---	USNM 4	8/8/59	1			9.5	JNC
66°44'N, 165°00'W	---	USNM 5	8/8/59	4			8.9-14.5	JNC
66°43'N, 166°22'W	---	USNM 73	8/8/59	1			12.9	JNC
66°16'N, 167°10'W	---	USNM 2	29/8/59	1			13.2	JNC
		USNM	6/8/59	1	5		6.0-11.6	JNC
<i>Bering Strait</i>								
65°20'N, 168°09'W	---	1 USNM	6/8/59	1			2.9	JNC
<i>Bering Sea</i>								
63°37'N, 165°19'W	22	-----	15/6/84	2			13.9-14.2	Stoney
58°00'N, 162°03'W	48	USNM 16802, 108266 SBL J-10	24/8/60	6			10.1-14.0	USFWS
58°00'N, 161°30'W	55	USNM ABL J-11	15/6/66	11	13	32	9.0-15.2	USFWS
57°58'N, 160°53'W	44	USNM SBL J-12	24/8/60	3			11.9-14.6	USFWS
58°00'N, 160°52'W	46	USNM ABL J-12	17/6/66	1	1		12.4-12.9	USFWS
58°02'N, 160°12'W	51	USNM ABL J-13	18/6/66	2	1	1	11.8-13.7	USFWS
57°58'N, 159°37'W	42	USNM SBL J-14	21/8/60	1			12.4	USFWS
57°40'N, 162°45'W	44	USNM SBL I-9	26/8/60	2			9.4-9.5	USFWS
57°42.5'N, 162°51'W	42	USNM ABL I-9	29/6/66	2			9.0-10.2	USFWS
57°40'N, 162°08'W	48	USNM SBL I-10	24/8/60	1			12.9	USFWS

Table 8 (Continued). *Pagurus capillatus* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	♂		
<i>Bering Sea</i>								
57°43'N, 160°59'W	53	SBL I-12 USNM	23/8/60	1			7.8	USFWS
57°40'N, 161°10'W	62	SBL I-13 USNM	23/8/60	1			12.9	USFWS
57°38'N, 159°40'W	48	SBL I-14 USNM	21/8/60	2			10.1-13.1	USFWS
57°20'N, 163°28'W	55	SBL H-8 USNM	27/8/60	2	2	1	8.8-16.1	USFWS
57°20'N, 162°54'W	55	SBL H-8 USNM	1/8/61	3	2	1	12.2-15.5	USFWS
57°20'N, 163°26.5'W	55	ABL H-8 USNM	10/7/66	2	5		9.8-14.7	USFWS
57°20'N, 162°44'W	49	ABL H-9 USNM	20/6/66	2			10.5-11.2	USFWS
57°21'N, 162°11'W	51	ABL H-10 USNM	28/6/66	1	1		10.6-14.4	USFWS
57°23'N, 161°37'W	49	SBL H-11 USNM	15/8/59	1	1		8.1-11.0	USFWS
57°23'N, 160°03'W	58	SBL H-13 USNM, RMNH	20/8/60	4	3		10.5-14.6	USFWS
57°20'N, 159°42'W	51	SBL H-14 USNM	20/8/60	2	1		10.1-14.4	USFWS
57°18'N, 159°38'W	58	ABL H-14 USNM	19/6/66	2	2		10.9-13.2	USFWS
57°00'N, 164°00'W	66	SBL G-7 USNM	28/8/60	2	1		12.2-14.7	USFWS
57°00'N, 164°00'W	71	SBL G-7 USNM	15/7/61	3			13.4-14.6	USFWS
57°06'N, 163°15'W	64	SBL G-8 USNM	16/8/59	4			11.3-14.6	USFWS
57°00'N, 163°24'W	62	SBL G-8 USNM	16/8/60	2	1		5.4-13.0	USFWS
57°00'N, 163°24'W	71	SBL G-8 USNM	14/7/61		3		12.5-13.7	USFWS
57°01'N, 162°10'W	57	ABL G-10 USNM	28/6/66		1		15.4	USFWS
57°00'N, 161°34'W	70	SBL G-11 USNM	18/8/60	1			16.9	USFWS
57°00'N, 160°58'W	73	SBL G-12 USNM	18/8/60	1	6		8.8-16.4	USFWS
57°00'N, 160°20'W	62	SBL G-13 USNM	20/8/60	1			13.5	USFWS
56°40'N, 167°00'W	101	SBL F-2 USNM, BM	21/7/61	9	7		13.4-18.2	USFWS
56°40'N, 166°26'W	91	SBL F-3 USNM	21/7/61	4	1		13.4-19.2	USFWS
56°40'N, 165°16'W	80	SBL F-5 USNM	16/7/61	5			7.3-13.4	USFWS
56°40'N, 165°13'W	77	ABL F-5 USNM	20/7/66	1			13.3	USFWS
56°40'N, 164°37'W	75	SBL F-6 USNM	28/8/60	1	2		13.8-17.1	USFWS
56°40'N, 164°00'W	73	SBL F-7 USNM	15/8/60	1	4		10.8-16.8	USFWS
56°40'N, 164°00'W	79	SBL F-7 USNM	14/7/61	4	1	2	12.2-15.2	USFWS
56°40'N, 163°24'W	70	SBL F-8 USNM	15/8/60	4	2		11.5-16.8	USFWS
56°40'N, 163°24'W	79	SBL F-8 USNM	14/7/61	1	4	2	14.8-16.2	USFWS
56°37.5'N, 163°23.5'W	83	ABL F-8 USNM	26/6/66	6	13	1	8.4-16.2	USFWS
56°40'N, 162°11'W	64	SBL F-10 USNM	30/7/61	2	1		11.4-15.7	USFWS
56°44'N, 161°47'W	82	SBL F-11 USNM	7/8/59	1			8.9	USFWS
56°40'N, 161°35'W	73	SBL F-11 USNM	30/7/61	3			12.1-15.0	USFWS
56°40'N, 160°22'W	55	SBL F-13 USNM	19/8/60	2	1		8.1-14.4	USFWS
56°30'N, 165°31'W	88	SBL EF-4,5 USNM	16/7/61	1			12.7	USFWS
56°30'N, 164°55'W	84	SBL EF-5,5 USNM	17/7/61	3	5		11.9-15.2	USFWS

Table 8 (Continued). *Pagurus capillatus* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂ ⁺	♀	♀♀ ⁺		
<i>Bering Sea</i>								
56°30'N, 164°18'W	88	SBL EF-6.5	13/7/61	12	16		11.3-17.2	USFWS
		USNM, CNM						
56°30'N, 163°42'W	86	SBL EF-7.5	12/7/61	4	5		11.9-16.4	USFWS
		USNM						
56°20'N, 167°03'W	115	SBL E-2	2/8/61	1	1		12.8-13.9	USFWS
		USNM						
56°21'N, 166°28'W	106	SBL E-3	29/8/60	1			15.4	USFWS
		USNM						
56°20'N, 166°27'W	106	SBL E-3	21/7/61	2	2		10.7-15.9	USFWS
		USNM						
56°20'N, 165°51'W	93	SBL E-4	29/8/60	1			14.9	USFWS
		USNM						
56°12'N, 165°33'W	95	SBL E-4	20/7/61	1	1		12.5-17.9	USFWS
		USNM						
56°20'N, 165°13'W	88	SBL E-5	28/8/60	2	2		11.0-14.7	USNM
		USNM						
56°20'N, 165°13'W	88	SBL E-5	17/7/61	3	6		11.0-17.8	USFWS
		USNM						
56°20'N, 164°36'W	82	SBL E-6	14/8/60	2	4		9.4-19.4	USFWS
		USNM						
56°20'N, 164°36'W	91	SBL E-6	13/7/61	9	15	1	10.4-17.2	USEFWS
		USNM, RMNH						
56°19.5'N, 164°37'W	90	ABL E-6	9/7/66	12	11		7.8-16.9	USEFWS
		USNM						
56°20'N, 164°00'W	80	SBL E-7	15/8/60	6	5		13.0-16.8	USEFWS
		USNM						
56°20'N, 164°00'W	90	SBL E-7	12/7/61	5	3	1	12.2-18.1	USEFWS
		USNM, RMNH						
56°20'N, 163°24'W	75	SBL E-8	8/8/60	1	4		6.9-13.1	USEFWS
		USNM						
56°20'N, 163°21'W	88	SBL E-8	12/7/61	2	3		13.3-17.2	USEFWS
		USNM						
56°20'N, 162°11'W	75	SBL E-10	5/8/60		1		12.0	USEFWS
		USNM						
56°20'N, 161°57'W	70	SBL E-11	6/8/60	1			11.2	USEFWS
		USNM						
56°20'N, 161°02'W	51	SBL E-12	9/8/59	3	1		11.6-13.3	USEFWS
		USNM, RMNH						
56°20'N, 161°00'W	51	SBL E-12	19/8/60	3	1		2.9-15.5	USEFWS
		USNM						
56°10'N, 164°55'W	95	SBL DE-5.5	17/7/61	6	4		12.0-17.5	USEFWS
		USNM						
56°10'N, 164°18'W	91	SBL DE-6.5	10/6/61	4	11	1	10.5-15.8	USEFWS
		USNM						
56°10'N, 163°42'W	90	SBL DE-7.5	11/7/61	8	12		10.4-18.1	USEFWS
		USNM						
56°00'N, 165°31'W	93	SBL D-5	14/8/60	8	12		11.3-19.8	USEFWS
		USNM						
56°00'N, 164°36'W	91	SBL D-6	14/8/60	6	3	1	13.8-16.9	USEFWS
		USNM						
56°00'N, 164°36'W	93	SBL D-6	10/7/61	2	6		13.8-16.1	USEFWS
		USNM						
56°00'N, 164°00'W	86	SBL D-7	8/8/60	1			15.6	USEFWS
		USNM						
56°00'N, 164°00'W	91	SBL D-7	11/7/61	2	2		12.2-18.4	USEFWS
		USNM						
56°00'N, 163°24'W	84	SBL D-8	8/8/60	3	6		10.7-17.7	USEFWS
		USNM						
56°00'N, 163°24'W	91	SBL D-8	11/7/61	6	8		10.2-16.9	USEFWS
		USNM						
55°59'N, 163°27'W	91	ABL D-8	25/6/66	31	20	6	7.1-18.3	USEFWS
		USNM						
56°00'N, 162°12'W	70	SBL D-10	5/8/60	1	2		10.6-14.4	USEFWS
		USNM						
56°00'N, 162°12'W	68	SBL D-10	28/7/61	3	2	1	9.6-11.2	USEFWS
		USNM						
55°33'N, 166°25'W	124	ABL C-3	10/7/66	3	6		12.4-15.4	USEFWS
		USNM						
55°40'N, 165°49'W	113	SBL C-4	13/8/60	1			14.2	USEFWS
		USNM						
55°40'N, 165°12'W	106	SBL C-5	9/8/60	1	2		11.9-13.5	USEFWS
		USNM						
55°40'N, 164°36'W	93	SBL C-6	9/8/60	2			13.3-14.7	USEFWS
		USNM						

Table 8 (Continued). *Pagurus capillatus* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂+	♀	♂♀ ♀+		
<i>Bering Sea</i>								
55°40'N, 164°40'W	101	SBL C-6 USNM	10/7/61	3	6		10.5-15.4	USFWS
55°40'N, 164°00'W	90	SBL C-7 USNM	8/8/60		2		11.4-14.4	USFWS
55°40'N, 164°00'W	95	SBL C-7 USNM	9/8/61		2		11.1-13.6	USFWS
55°40'N, 163°23'W	79	SBL C-8 USNM, AHF	4/8/60	5	12		5.5-17.0	USFWS
55°40'N, 163°24'W	80	SBL C-8 USNM, CNM	9/6/61	5	14	1	4.3-14.2	USFWS
55°40'N, 162°49'W	49	SBL C-9 USNM, BM	28/7/61	5	14	2	5.2-12.4	USFWS
55°20'N, 165°12'W	106	SBL B-5 USNM	23/8/60		1		9.8	USFWS
55°20'N, 164°36'W	108-110	ABL B-6 USNM	8/7/66		1		10.0	USFWS
55°20'N, 164°00'W	73	SBL B-7 USNM	3/8/60	1	1		11.4-12.4	USFWS
55°20'N, 164°00'W	90	SBL B-7 USNM	8/7/61	4	8	2	4.0-13.5	USFWS
55°20'N, 163°25'W	48	SBL B-8 USNM	3/8/60		1		6.8	USFWS
55°20'N, 163°25'W	55	SBL B-8 USNM	9/7/61	7	8	10	5.7-12.6	USFWS
55°20'N, 163°24'W	51	ABL B-8 USNM	14/7/66	21	58	17	7.0-15.5	USFWS
54°39'N, 165°12'W	73	SBL Z-5 USNM	4/8/61		1		12.1	USFWS
Bristol Bay	---	----- USNM	summer 57	8	3	2	8.3-16.3	USFWS
Bristol Bay	---	----- USNM	summer 59	2	4	5	9.4-14.0	USFWS
Bristol Bay	---	----- USNM	summer 61	1	2	1	9.5-14.7	USFWS
<i>Gulf of Alaska</i>								
Morzavoi Bay	80-82	----- USNM	summer 58		1		8.9	Davenport
Unga Strait Light	46	----- RMNH	4/12/65	1	2		8.3-13.5	Elacus
55°30'N, 161°30'W	---	15B USNM	24/9/61	3	7		6.9-12.4	INPHC
54°27'N, 159°45'W	78-128	22M USNM	10/7/62	3	1		10.8-13.8	INPHC
Auke Bay	66	----- USNM	26/4/64		1		11.6	Gonor
Auke Village Reef	---	----- USNM	28/5/64		1		6.4	Gonor
Auke Bay recreation area	4	----- USNM	7/4/64		1		15.4	Gonor
58°18'N, 135°55'W	57	1A USNM	13/7/61		2		5.8-16.4	INPHC
Gastineau Channel, Douglas	---	----- USNM	28/4/63			1	11.8	---
58°13'N, 134°16'W	25	----- USNM, RMNH	24/2/64	3	3	1	3.6-15.1	Gonor
Off Gastineau Channel	46	----- USNM	5/3/54		1		13.8	---
<i>Washington</i>								
Strait of Juan de Fuca	---	----- RMNH	9/8/61	2	2		3.9-6.1	Davis
San Juan Is.	---	----- USNM	8/61	7	2	4	3.2-8.8	McLaughlin
Friday Harbor, San Juan I.	---	----- USNM	1922		3		2.9-8.7	Stevens
San Juan Channel	---	----- AHF	28/7/61	1	2		4.4-5.4	---
San Juan Channel	110-195	----- USNM	2/8/61	4	3		4.3-10.4	McLaughlin
Peavine Pass	---	----- USNM	26/6/52		2		6.6-6.9	Illig

Table 8 (Continued). *Pagurus capillatus* (Benedict) Material Examined

Locality	Depth (m)	Station	Date	Sex	SL (mm)	Collector
		Deposition		♂ ⁺		
<i>Washington</i>						
Lopez Pass	37	----	10/8/61	12 27	3.2-12.3	McLaughlin
Lopez Sound	---	USNM, CNM	25/5/61	5 1	4.5-7.9	Henry
		USNM				

tufts of short setae; anterolateral angle produced, blunt or spinulose. Rostrum short, usually equalling or slightly exceeding lateral projections, broadly rounded, unarmed, with terminal tufts of moderately long setae. Lateral projections broadly rounded or obtusely triangular; terminating in moderately strong marginal or submarginal spine, occasionally directed toward exterior; occasionally unarmed.

Ocular peduncles moderately long, usually one-half to two-thirds length of shield; slightly inflated basally, corneal region slightly dilated; dorsomesial or dorsal face with longitudinal row of tufts of short setae. Ocular acicles with mesial margins strongly expanded, lateral margins straight or slightly expanded; terminating subacutely, with moderately strong marginal or submarginal spine, occasionally with 1 or 2 minute accessory spinules; separated basally by three-fourths to entire basal width of one acicle.

Antennular peduncles moderately long, exceeding ocular peduncles by one-third to two-thirds length of ultimate segment; ultimate and penultimate segments unarmed with few tufts of short setae; basal segment unarmed or with small spinulose protuberance and tuft of moderately long setae on dorsolateral margin.

Antennal peduncles moderately short, slightly less than or equalling length of ocular peduncles; with supernumerary segmentation. Fifth and fourth segments unarmed with few tufts of short setae. Third segment with ventromesial distal angle produced, terminating in strong acute spine, ventral margin with long setae. Second segment with dorsolateral distal angle produced, terminating in strong, acute, simple or bifid spine, mesial margin with 1-5 small spines, lateral margin usually unarmed with row of moderately long setae; dorsomesial distal angle with small acute spine, mesial margin with row of tufts of long setae. First segment with moderately strong spine on lateral face distally; ventrodistal margin produced, strongly spinulose laterally and with long setae. Antennal acicle long, usually reaching to distal half of ultimate peduncular segment; strongly arcuate; terminating in strong simple or bifid spine; mesial margin with low occasionally spinulose ridges or protuberances and tufts of long setae. Antennal flagella

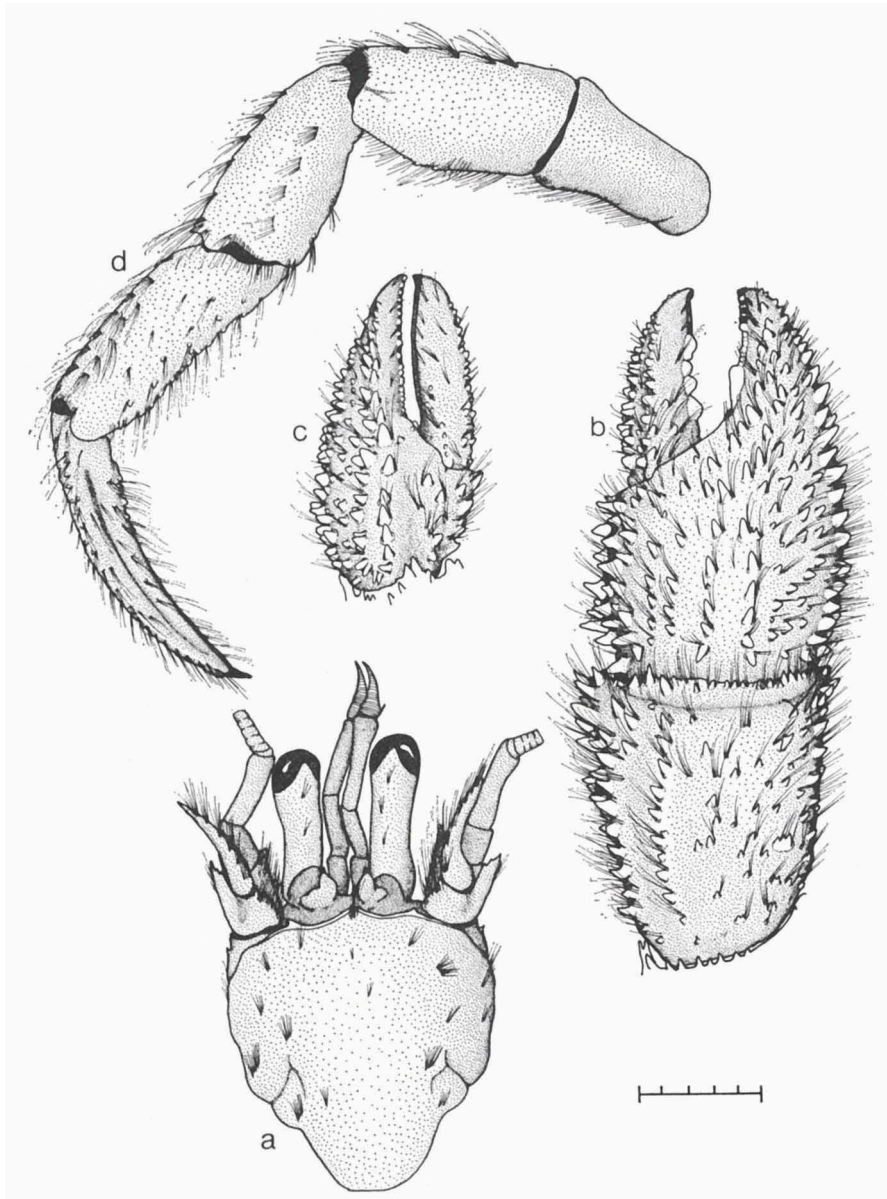


Fig. 22. *Pagurus capillatus* (Benedict). a, shield; b, right chela and carpus (dorsal view); c, left chela (dorsal view); d, left P₃ (lateral view). Scale equals 5 mm.

moderately long, not usually overreaching tip of right cheliped; occasionally with few, moderately short, randomly set bristles.

Mandible without distinguishing characters. Maxillule with proximal endite slightly tapering; endopodite with 1 or 2 bristles on well developed internal lobe, external lobe produced, not recurved. Maxilla with endopodite inflated basally, not reflexed, approximately equalling scaphognathite in distal extension. First maxilliped with endopodite approximately one-half length of exopodite; basal segment of exopodite narrow. Second maxilliped without distinctive characters. Third maxilliped with basis-ischium fusion incomplete; basis with 1 spine and several spinules; ischium with crista dentata well developed, 1 accessory tooth; merus with strong spine at dorso-distal margin, usually 1 or 2 spines on ventral margin. Sternite of m_{xp}_3 unarmed or with 1 small spine on each side of midline, partially obscured by long, dense setae.

Right cheliped generally short and moderately stout in small specimens, elongate and moderately slender in large specimens: Dactyl varying from slightly less than to approximately one-fourth greater than length of palm; cutting edge with strong calcareous teeth proximally, short row of corneous teeth distally; terminating in small corneous claw; frequently overlapped by fixed finger; with prominent longitudinal hiatus; dorsal surface with scattered, small, conical spines or tubercles proximally, elevated in midline with single or double row of moderately strong spines and tufts of long setae, dorsomesial margin with double row of moderately strong, conical, acute or subacute spines and tufts of setae; ventral surface with few spinulose tubercles proximally and tufts of setae and bristles. Palm moderately long, one-half to three-fourths length of carpus; slightly inflated dorso-ventrally; dorsal surface convex, with irregular rows of moderately strong acute or subacute spines and tufts of moderately long setae, dorsolateral margin with tufts of long setae and single or double row of strong spines, decreasing in size on fixed finger distally and usually becoming simple or multifid spinulose tubercles, dorsomesial margin with single or double irregular row of strong spines and tufts of long setae; mesial face with multifid spinulose tubercles or small spines and tufts of setae; lateral face with low, frequently spinulose tubercles and tufts of long setae; ventral surface with rows of spinulose or frequently multidenticulate tubercles and tufts of long setae. Carpus equalling or slightly exceeding length of merus; slightly inflated ventrally; dorsomesial margin with single or double row of strong spines and tufts of long setae, dorsomesial distal angle slightly produced, with cluster of strong spines, dorsal surface with scattered small spines and multidenticulate tubercles and tufts of long setae, usually also with 1 irregular

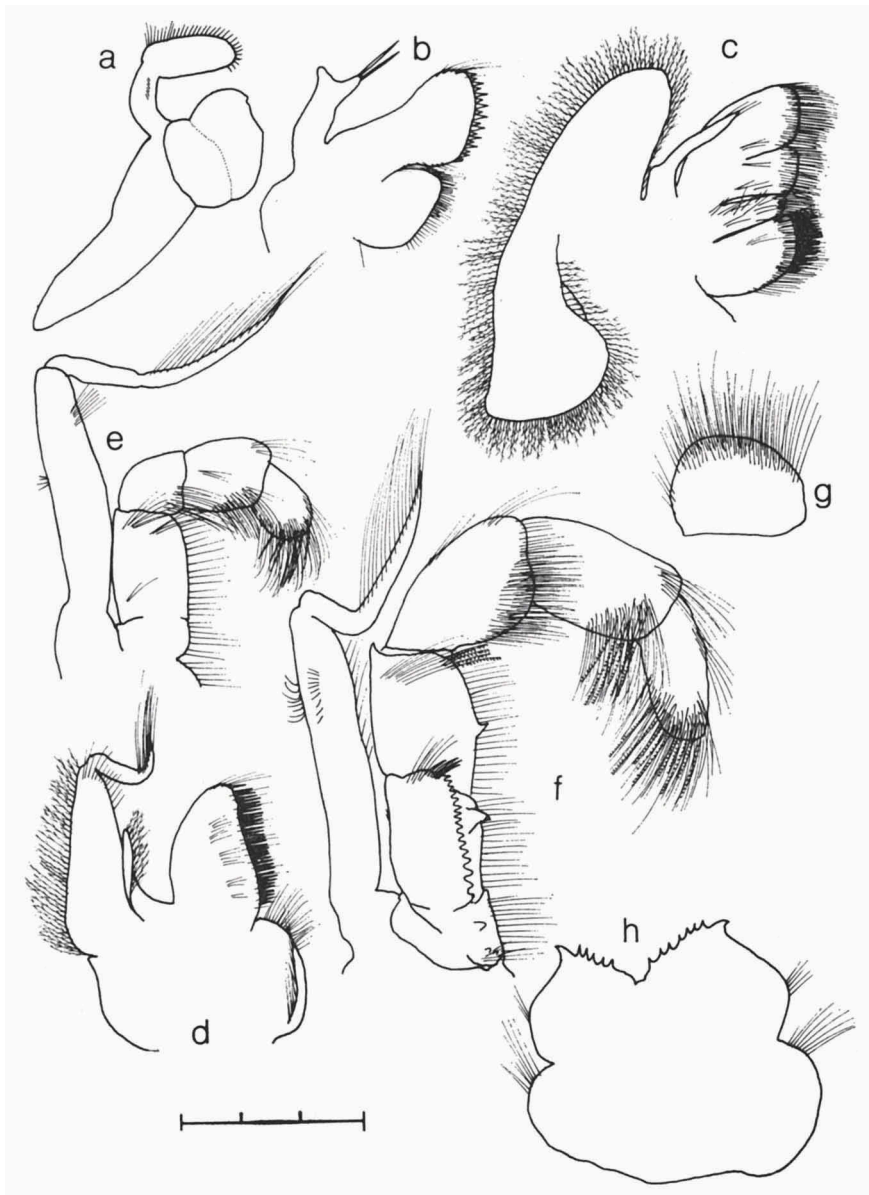


Fig. 23. *Pagurus capillatus* (Benedict). a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite P₃; h, telson. Scale equals 3 mm.

row of moderately strong spines mesially, distal margin with irregular row of prominent spines, dorsolateral margin with row of moderately small spines and tufts of long setae; lateral face with spinulose tubercles or small spines and tufts of long setae, distal margin with row of prominent spines; ventral surface unarmed or with scattered small spines or spinulose tubercles and tufts of long setae; mesial face with spinulose protuberances or tubercles and tufts of very long setae, frequently with row of spines dorsally, distal margin with row of strong spines, decreasing in size ventrally. Merus subtriangular; dorsal surface with low transverse protuberances or ridges and tufts of setae, becoming multidenticulate or spinulose distally, distal margin with row of prominent slender spines and long setae; lateral face with scattered low spinulose or multidenticulate protuberances or tubercles and tufts of long setae, frequently also with vertical row of low multidenticulate tubercles distally, ventrolateral margin with row of small spinulose tubercles or spinules, becoming multifid spines distally and with tufts of long setae; mesial face with low spinulose tubercles and tufts of long setae, occasionally with clusters of small spinules ventrally, ventromesial margin with strong spines and dense long setae. Ischium with row of small spines or spinules and tufts of long setae on ventromesial margin, ventrolateral margin with row of spinulose tubercles, lateral face frequently spinulose distally. Coxa with row of small spinules or denticles on ventrolateral margin, ventrodistal margin with long setae, ventroproximal angle spinulose.

Left cheliped moderately short, usually reaching to base of dactyl of right. Dactyl moderately long, slightly less than twice length of palm; broad and flattened distally; cutting edge with row of corneous teeth, usually terminating in small corneous claw (lectotype with dactyl abnormally short, terminating in calcareous tooth); dorsal surface with 2 irregular, short rows of small spines proximally and scattered tufts of long setae, dorsomesial margin with single or double row of small acute or subacute spines, becoming obsolete distally and tufts of long setae; ventral surface unarmed and with tufts of long setae. Palm moderately short, one-third to two-thirds length of carpus; dorsal surface strongly sloping laterally, with irregular rows of moderately strong spines and tufts of long setae, prominently elevated in midline, with 2 rows of strong acute or subacute spines, extending onto fixed finger as double row of spines, decreasing in size distally, dorsolateral margin with single or double row of moderately strong spines becoming obsolete on fixed finger distally, and with tufts of long setae, dorsomesial surface sloping, often acutely, unarmed or with few moderately small spines or spinulose tubercles and tufts of setae, dorsomesial margin with irregular row of moderately strong spines and tufts of long setae; mesial

face with row of prominent spines and scattered small spines or spinulose tubercles and tufts of long setae; ventral surface with blunt or spinulose tubercles often set in irregular rows, and tufts of very long setae. Carpus slightly shorter or equalling length of merus; surfaces all with long setae; dorsal surface flattened, occasionally with few scattered small spines or spinules, distal margin with 1 or 2 strong spines and usually with several small spines, dorsomesial margin with row of strong spines, dorsolateral margin with row of moderately strong spines, increasing in size distally; mesial face with scattered spinulose protuberances or low tubercles, distal margin with 1 or 2 strong spines and frequently several small spines dorsally, ventromesial distal angle often with several small spines, ventromesial margin with irregular row of small spines; lateral face with multidenticulate or spinulose protuberances or tubercles, distal margin with several strong spines, ventrolateral distal angle produced, spinose, ventrolateral margin with row of small spines, increasing in size distally; ventral surface usually with scattered spinulose tubercles or small spines. Merus laterally compressed; dorsal surface with 2 irregular rows of low often spinulose protuberances, increasing in size and becoming multifid distally, occasionally unarmed, or with few small spinules and spinulose protuberances and tufts of long setae, distal margin unarmed or with 1 or 2 small spines; lateral face spinulose or with small multifid spines or tubercles and scattered tufts of long setae; mesial face with scattered tufts of long setae, frequently with irregular row of multifid protuberances ventrally; ventral surface usually with few small spines or spinulose tubercles and tufts of long setae, ventrolateral margin with row of strong spines, increasing in size distally, ventromesial margin with row of small spines. Ischium with row of small spines or spinules and tufts of long setae on ventromesial margin, ventrolateral proximal margin spinulose, angle protuberant with tuft of long setae. Coxa with cluster of small spinules on ventroproximal angle, ventrolateral margin with row of small spinules, distal margin and ventromesial distal angle with tufts of very long setae.

Second pereopods usually slightly overreaching tip of right cheliped, right usually longer than left. Dactyl equalling or slightly exceeding length of propodus; in lateral view, slightly curved ventrally; in dorsal view, twisted; terminating in moderately strong corneous claw; dorsal surface with 2 rows of long, dense, stiff setae; lateral face with weak longitudinal sulcus flanked by row of tufts of moderately short setae; mesial face with longitudinal sulcus, usually flanked by row of long, dense, stiff setae; ventral surface with row of very small corneous spinules and tufts of long setae. Propodus equalling or slightly exceeding length of carpus; slightly

compressed laterally; dorsal surface with 1 or 2 irregular rows of low occasionally spinulose protuberances and tufts of long, dense setae; lateral face with low protuberances or small spinules and tufts of long setae; mesial face with scattered tufts of long setae, often with longitudinal row of long setae ventrally; ventral margin usually unarmed, with row of tufts of long setae. Carpus moderately long, two-thirds to four-fifths length of merus; dorsal surface with row of moderately strong spines, increasing in size distally and tufts of long setae; lateral and mesial faces unarmed, with scattered tufts of long setae; ventral surface usually with row of low protuberances and tufts of long setae. Merus laterally compressed; dorsal margin with 1 or 2 rows of low occasionally spinulose protuberances and tufts of long setae; mesial and lateral faces frequently with few tufts of setae; ventral margin with 1 or 2 rows of small spines and tufts of long setae. Ischium with row of small spines or spinules and tufts of long dense setae on ventral margin. Coxa with several small spinules on ventromesial margin and tufts of long setae, ventroproximal angle with cluster of small spinules.

Third pereopods usually slightly shorter than second, left shorter than right; dissimilar from right to left; dactyl approximately one-third longer than propodus; in lateral view, slightly curved ventrally; in dorsal view, twisted; dorsal surface with 2 rows of tufts of long, stiff setae; lateral face with longitudinal sulcus flanked by row of long setae (right pereopod), or 1 or 2 rows of tufts of long setae and irregular, single or double row of small spines or spinulose tubercles proximally (left pereopod); mesial face with longitudinal sulcus, flanked with row of tufts of setae, longer and more dense ventrally; ventral margin with row of very small corneous spinules and tufts of long setae. Propodus equalling or slightly exceeding length of carpus; slightly compressed laterally; dorsal surface with 2 or 3 rows of low often spinulose or multidenticulate protuberances and tufts of long dense setae; mesial face with 1 or 2 rows of tufts of setae; lateral face with 1 or 2 rows of tufts of setae (right pereopod) or with 1 or 2 rows of small spines or spinulose tubercles and tufts of short setae, ventrally row of small, usually subacute spines, increasing in size distally and partially obscured by tufts of long setae (left pereopod); ventral surface with tufts of moderately long setae. Carpus three-fourths to four-fifths length of merus or occasionally equalling or slightly exceeding merus in length; dorsal surface with single or double row of small, often subacute spines, increasing in size distally and with tufts of long setae; mesial and ventral surfaces with tufts of setae; lateral face with scattered tufts of setae (right pereopod) or frequently with few small spines or tubercles ventrally

(left pereopod). Merus laterally compressed; dorsal surface with single or double row of low occasionally spinulose protuberances and tufts of long setae; lateral and mesial faces frequently with few tufts of setae; ventral margin unarmed or with few small acute or subacute spines and tufts of long setae. Ischium with row of long setae on ventral margin; dorsal margin frequently with row of long setae. Coxa with row of long setae on ventromesial margin.

Fourth pereopods apparently lacking preungual process on lateral face of dactyl at base of claw; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods subcircular or subovate, frequently slightly skewed, anterior margin with long setae.

Pleopods of male unpaired, pl_3 to pl_5 with exopodites well developed; endopodites reduced. Pleopods of female unpaired, pl_2 - pl_4 with both rami well developed; pl_5 with exopodite well developed, endopodite reduced.

Telson with posterior lobes slightly asymmetrical, left slightly larger than right; subtriangular; separated by broad median cleft; right terminal margin with 5-9 small spines, 1 strong spine at distolateral angle; left terminal margin with 5-11 small spines, 1 strong spine at distolateral angle; lateral margins each with tuft of short setae; anterior lobes unarmed, margins with tufts of long setae.

Coloration. — Living color unknown. In preservative: Chelipeds mottled orange-brown and cream on meri and carpi, fading to straw-colored in time; chelae generally light orange or straw-colored; pereopods with dark, transverse bands of mottled orange-brown on meral, carpal and propodal segments, dactyls usually light orange.

Distribution. — West Kamchatka (Kobjakova); Okhotsk Sea (Kobjakova); Sakhalin, Aniva Zaliv (Kobjakova, Lindberg); Japan Sea (Kobjakova); Zaliv Petra Velikozo (Kobjakova); North Korea, Bukta Goru-G'endoru (Makarov, Vinogradov); Arctic Ocean (Rathbun, Makarov); Chukchi and Bering Seas to California (Rathbun, Schmitt, Vinogradov); British Columbia (Hart); 4 to 432 m.

Affinities. — The species of the "*capillatus*" group, i.e., *Pagurus capillatus*, *P. setosus* and *P. kennerlyi*, in northwestern North America are all very closely allied and have frequently been confused. However, the most striking similarities are found between *P. capillatus* and *P. arcuatus* Squires (figs 24-26) from northeastern North America. From the latter species, *P. capillatus* is distinguished by the presence of small spines or tubercles on the ventrolateral faces of the dactyl and propodus of the third left pereopod (figs. 22d, 25d), by the more elongate, cylindrical ocular pedun-

cles, and by the more obtusely rounded rostral projection (figs. 22a, 25a).

P. capillatus is most easily distinguished from *P. setosus* and *P. kennerlyi* by the absence of a row of strong spines on the ventral margins of the dactyls of the second and third pereiopods and by the presence of small spines or tubercles on the ventrolateral faces of the dactyl and propodus of the left

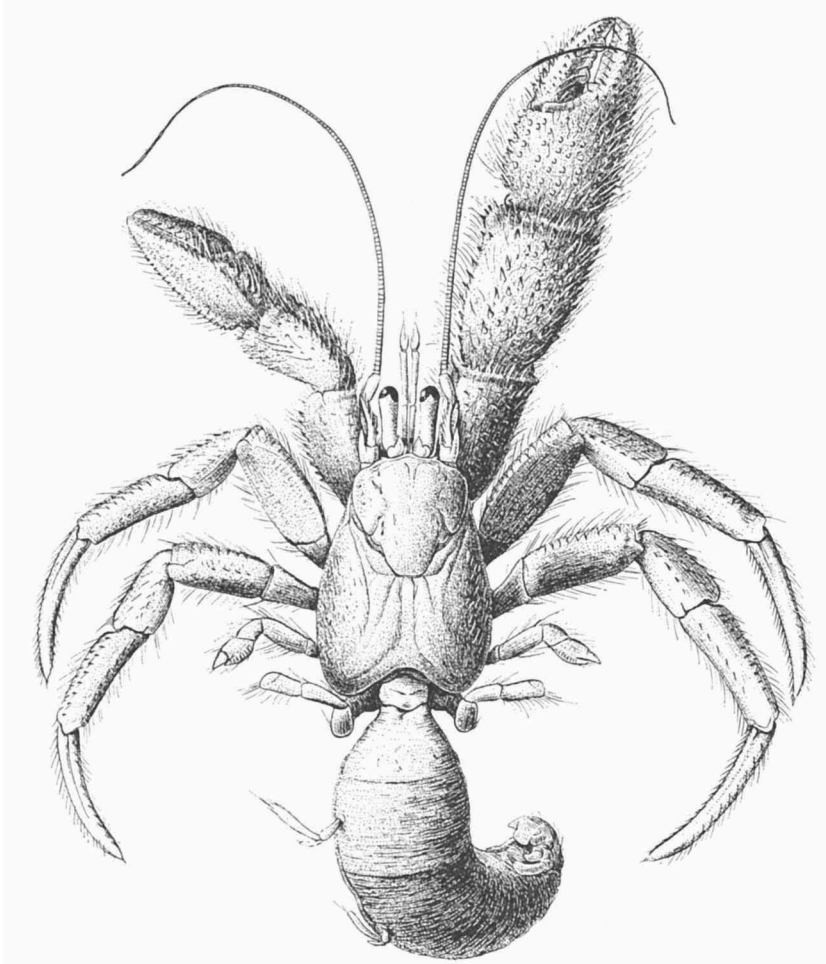


Fig. 24. *Pagurus arcuatus* Squires. Original illustration of J. E. Benedict of *Pagurus pubescens* sensu Stimpson.

third pereiopod. The proportions of the chelipeds reported by Schmitt (1921) to distinguish *P. capillatus* from *P. setosus* have been found to be unreliable; the length-width relations in the segments of the chelipeds are a function of size.

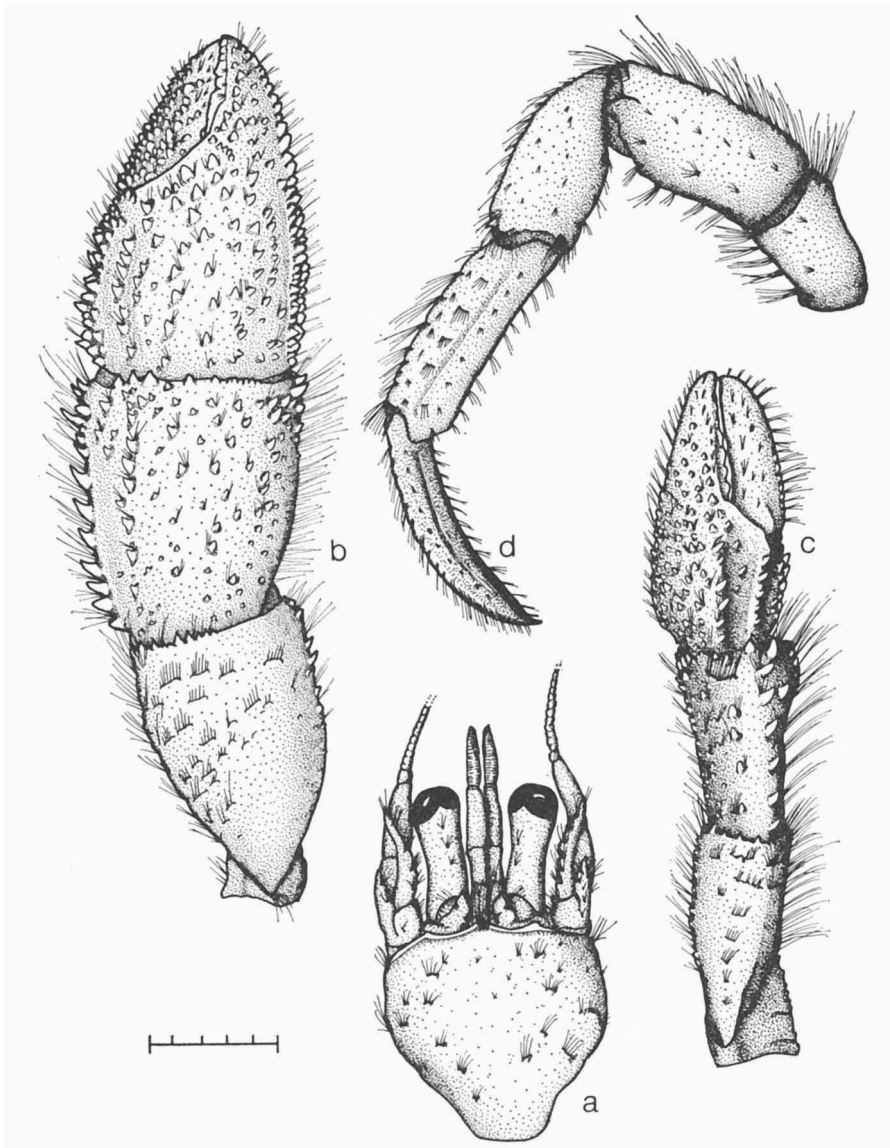


Fig. 25. *Pagurus arcuatus* Squires. a, shield; b, right cheliped (dorsal view); c, left cheliped (dorsal view); d, left P₃ (lateral view). Scale equals 5 mm.

The species of the “*capillatus*” group are also superficially quite similar to *P. caurinus* Hart, and this species was formerly confounded with both *P. capillatus* and *P. setosus* (see discussion). Hart (1971) distinguished *P. caurinus* from *P. capillatus* on the basis of the armature and shape of

the telson; however, in a large series of *P. capillatus*, this character proved to be variable so that its diagnostic value is questionable. The lack of strong spines on the ventral margins of the dactyls of the second and third pereopods and the armature of the lateral faces of the dactyl and propodus of the left third pereopod also distinguish *P. capillatus* from *P. caurinus*.

Discussion. — Stimpson (1858, 1859a) proposed that two species, which he believed to occur in both the Atlantic and Pacific, had been confounded by Kröyer (1838a, 1838b, 1844) under the name *Pagurus pubescens*. Consequently, Stimpson (1859a, 1862) divided Kröyer's species, restricted the name *Eupagurus pubescens* (Kröyer) to the more pilose of the two species and assigned the name *Eupagurus kroyeri* Stimpson to the second species. Finding no differences between *E. kroyeri* and *E. pubescens* (sensu Kröyer), Sars (1886) concluded that Stimpson had been mistaken about the occurrence of two species and placed both *E. kroyeri* and *E. pubescens* (sensu Stimpson) in synonymy with *E. pubescens* (sensu Kröyer).

While most European carcinologists adopted Sars' synonymy, American workers continued to distinguish two species. In describing *Eupagurus capillatus* from northwestern North America, Benedict (1892: 9) remarked that this species was closer to *E. pubescens* (sensu Stimpson) than was any other Pacific species to its Atlantic analog. Benedict (1896) clearly distinguished between *Pagurus kroyeri* (Stimpson) and *P. pubescens* (sensu Stimpson), again implying the restriction of both species to the Atlantic. At that time he strongly urged that the question of the identity of *P. pubescens* be more thoroughly investigated. Unfortunately Benedict's remarks went unheeded and *P. pubescens* continued to be reported from both the Atlantic and Pacific (also see remarks under *P. trigonocheirus*); however, only Hansen (1908) suggested that *E. capillatus* might also be a synonym of *E. pubescens*.

The discrepancies in interpretation of *P. pubescens* were finally resolved when Squires (1964) compared the two presumed species from northeastern North America with Kröyer's type material of *Pagurus pubescens* from Greenland. Squires found that, as Smith (1879: 49) and Benedict (1896: 100) had suggested, *P. kroyeri* (Stimpson) was synonymous with *P. pubescens* (sensu Kröyer) but that *P. pubescens* (sensu Stimpson) was a distinct species. To this latter species Squires gave the name *Pagurus arcuatus* Squires. A similar conclusion was reached by Nesis (1964), who named Stimpson's species, *Pagurus bankensis* Nesis; however, the name *P. arcuatus* has a few weeks' priority over Nesis' specific name *bankensis*. My examination of Atlantic material, including the type series of *P. arcuatus* (CNM 5755, 5756) has confirmed Benedict's contention that *P. capillatus*

and *P. pubescens* (sensu Stimpson (= *P. arcuatus*)) may be considered analog species. Consequently, records of *E. pubescens* (sensu Stimpson) from northwestern North America by Stimpson (1858, 1859a, 1862, 1863, 1907) have been referred to *P. capillatus*.

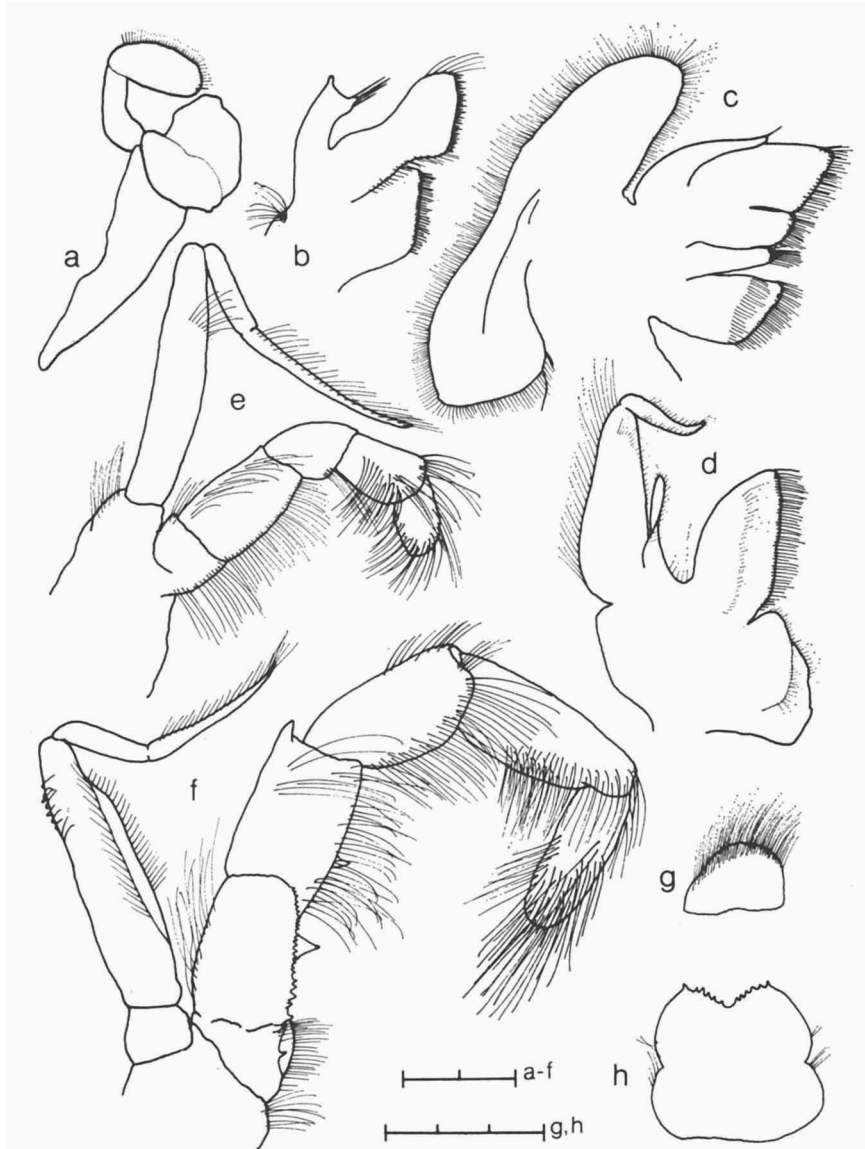


Fig. 26. *Pagurus arcuatus* Squires. a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxps. — g, sternite P₃; h, telson. Scales equal 1.0 mm (a-f) and 3 mm (g, h).

Stimpson (1854) assumed that the species described by Dana (1851) as *Bernhardus pubescens* was synonymous with *P. pubescens* Kröyer. Apparently Stimpson was unaware, at that time, that Dana (1852a: 6) subsequently had explained that he had not known that *pubescens* was preoccupied at the time of his original description; he renamed his species *Bernhardus scabriculus* Dana. Stimpson (1858) later noted his error and recognized Dana's new name. Much later, Thallwitz (1892) described a species, *Eupagurus seriespinosus* Thallwitz, from Japan or China, which he contrasted with *E. pubescens* (Dana) (= *E. pubescens* (sensu Stimpson)) and *E. kennerlyi* Stimpson, in part, on the basis of Stimpson's earlier synonymy.

Balss (1913), who placed *E. capillatus* in synonymy with *Eupagurus trigonocheirus* Stimpson, stated that his conclusion was based on "original" material received from the United States National Museum. Schmitt (1921), Makarov (1938b, 1962) and others reported several diagnostic characters that readily differentiate the two species. In addition to the findings of these carcinologists, I have compared the lectotypes of *P. capillatus* (USNM 16802) and *P. trigonocheirus* (BM 61-44) and have found the two species to be distinct. It is probable, therefore, that the specimens which Balss examined bore an erroneous label and were, in fact, specimens of *P. trigonocheirus*.

Stevens (1925) who referred specimens from Puget Sound, Washington, to *Pagurus setosus*, contrasted them to *P. kennerlyi*. Subsequent reexamination of her material, as well as her figure of *P. setosus* (see Stevens, 1925, fig. 11), indicates that her specimens should have been referred to *P. capillatus*. The references of Taylor (1912) and Fasten (1917a, b) to *P. setosus* could not be verified. However, as the occurrence of *P. setosus* in the area is very rare, these citations should probably be referred to *P. capillatus*. Hart (1940) recorded *P. setosus* from British Columbia. Subsequently, Hart (1971) indicated that her earlier report of *P. setosus* included *P. caurinus* Hart; in addition, she has found that Puget Sound material referred to *P. setosus*, is, in fact, *P. capillatus* (Hart, personal communication). Reexamination of specimens, which I recorded from the Bering Sea as *Pagurus* sp. [2] (McLaughlin, 1963), has shown these to be *P. capillatus*.

***Pagurus setosus* (Benedict) (figs. 27-29)**

Eupagurus (Trigonocheirus) setosus Benedict, 1892: 19 (by implication; type locality: Sitka, Alaska).

Pagurus setosus: Rathbun, 1903: 35. — Rathbun, 1904: 159, pl. 5 fig. 1. — Rathbun, 1910: 159, pl. 5 fig. 1. — Williamson, 1915: 481. — Schmitt, 1921: 136, fig. 58. — Makarov, 1938b: 216, fig. 71 (in part). — Hart, 1940: 94 (in part). — Gordan, 1956: 335 (in part). — Makarov, 1962: 206, fig. 71 (in part). — Moore & McCormick, 1969: 106, fig. 1. — Hart, 1971: 1532. See discussion.

Eupagurus setosus: Alcock, 1905: 179.
 not *Pagurus setosus* H. Milne-Edwards, 1848: 64. — Stimpson, 1858: 236 (= *Paguristes setosus* (H. Milne-Edwards, 1848)).
 ? not *Pagurus setosus*: Taylor, 1912: 204. — Fasten, 1917a: 440. — Fasten, 1917b: 289, figs. 12-16 (? = *Pagurus capillatus* (Benedict, 1892)).
 not *Pagurus setosus*: Stevens, 1925: 290, fig. 11 (= *Pagurus capillatus* (Benedict, 1892)).

Holotype. — ♂ (SL = 13.1 mm), USNM 6633.

Material examined. — See table 9.

Table 9. *Pagurus setosus* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex				SL (mm)	Collector
				♂	♀	♀♀	♀+		
<i>Gulf of Alaska</i>									
Sitka	---	----- USNM 6633	----	1				13.1	Beardslee
<i>British Columbia</i>									
Port Louis, Queen Charlotte Is.	---	----- Hart	4/6/69	1				2.8	Hart
-----	---	----- FBRC 71-56 Hart	20/9/71	1	1			3.0-9.4	Hart
<i>Washington</i>									
48°29'40"N, 124°10'W	253	Albatross 3449 USNM 16917	28/8/91	1	2			7.4-8.0	---
Callam Bay	190	----- RMNH	14/1/39	1				10.2	---
Off Port Townsend	29-55	Albatross 4220 USNM 42494	1/7/03	1				5.0	---
<i>California</i>									
34°43'30"N, 119°09'20"W	128	Velero III 983-39 AHF	29/5/39	2	2			2.5-3.7	---
33°55'30"N, 119°41'30"W	486	Albatross 2948 USNM 16689	7/2/89	1				4.1	---
33°40'55"N, 119°50'10"W	130-139	Velero III 1385-41 AHF	25/8/41		1			4.9	---
33°23'30"N, 118°19'20"W	221-475	Velero III 1029-39 AHF	10/12/39	8	3			2.7-5.9	---
33°20'20"N, 118°16'10"W	179-212	Velero III 1150-40 AHF	4/7/40	4	4			2.7-4.0	---
33°18'25"N, 118°15'30"W	152-229	Velero III 1028-39 AHF	10/12/39	2	1			2.7-3.9	---
33°15'55"N, 118°13'50"W	214-234	Velero III 1151-40 AHF	5/7/40	3	1			3.2-3.3	---
33°15'30"N, 118°12'25"W	265-274	Velero III 1172-40 AHF	20/8/40	1	1			3.4-6.0	---
33°03'10"N, 118°40'30"W	247-274	Velero III 1020-39 AHF	24/11/39	1	2			2.5-3.7	---

Diagnosis. — Left chela with dorsal surface convex, midline elevated, not produced into prominent ridge or crest. Chelae with dorsal surfaces moderately spinose and setose. P₃ with lateral faces of dactyls and propodi unarmed; carpi each with single small spine at dorsodistal margin. Ventral margins of dactyls of P₂ and P₃ each with row of strong, corneous spines.

Description. — Shield slightly longer than broad; anterolateral margins sloping; anterior margin between rostrum and lateral projections straight or slightly concave; posterior margin roundly truncate; dorsal surface smooth

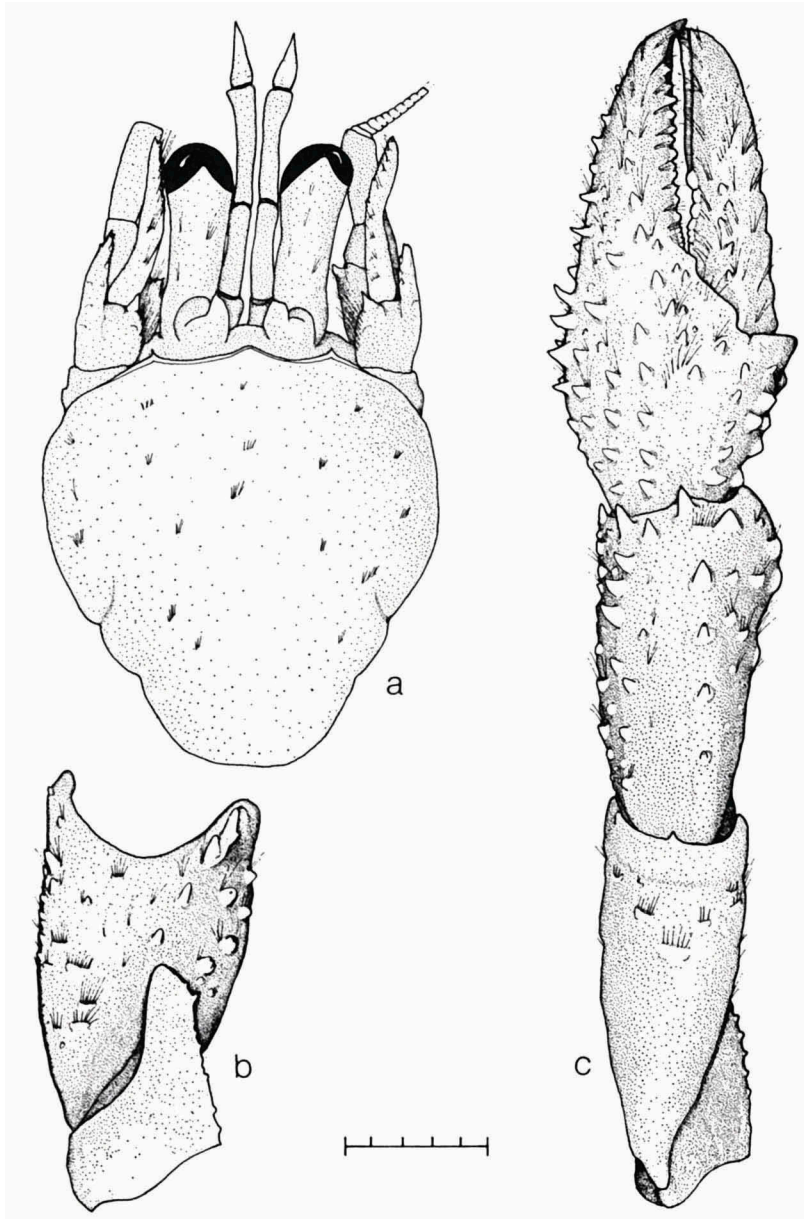


Fig. 27. *Pagurus setosus* (Benedict). a, shield; b, right cheliped, merus (ventral view); c, left cheliped (dorsal view). Scale equals 5 mm.

or slightly rugose with scattered tufts of short setae; anterolateral angle produced, blunt. Rostrum subacute or rounded, equalling or slightly exceeding lateral projections; unarmed. Lateral projections broadly triangular or slightly rounded, with small acute terminal spine.

Ocular peduncles moderately short, slightly less than or approximately one-half length of shield; corneal region dilated; dorsal surface with few, scattered tufts of short setae. Ocular acicles with mesial margins usually strongly expanded, lateral margins straight or slightly expanded; terminating subacutely, with moderately strong marginal or submarginal spine; separated basally by two-thirds to entire basal width of one acicle.

Antennular peduncles long, exceeding ocular peduncles by two-thirds to entire length of ultimate segment; ultimate and penultimate segments unarmed; basal segment with spinulose protuberance on ventrodistal margin.

Antennal peduncles moderately short, exceeding ocular peduncles by one-fourth to one-third length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments unarmed, with few tufts of fine setae. Third segment with ventromesial distal angle produced, terminating in strong spine and tuft of long fine setae, ventral margin with tufts of long setae. Second segment with dorsolateral distal angle produced, terminating in small simple or bifid spine; mesial margin with 2 or 3 small spines, lateral margin with 1 or 2 small spinules, dorsal surface with few spinulose ridges or scattered spinules; dorsomesial distal angle with strong spine, mesial margin with long setae. First segment with small spine at laterodistal angle; ventromesial margin produced, blunt, spinulose laterally. Antennal acicles long, slightly exceeding length of ocular peduncles; arcuate and slightly twisted; mesial margin with row of low frequently minutely spinulose protuberances and tufts of moderately long setae. Antennal flagella long, usually reaching beyond tip of right cheliped; articles naked.

Mandible without distinctive characters. Maxillule with proximal endite tapering; endopodite with 1-3 long bristles on well developed anterior lobe, posterior lobe slightly produced. Maxilla with endopodite inflated basally; not reflexed, approximately equalling scaphognathite in distal extension. First maxilliped with endopodite approximately four-fifths length of exopodite; basal segment of exopodite narrow; epipodite slightly produced. Second maxilliped without distinctive characters. Third maxilliped with basis-ischium fusion incomplete; basis with 1 small spine; ischium with crista dentata well developed, 1 accessory tooth; merus with strong spine at dorsodistal margin, ventral margin usually unarmed. Sternite of mxp_3 usually with 1 small spine on each side of midline, anterior margin with long setae.

Right cheliped moderately short. Dactyl moderately long, approximately

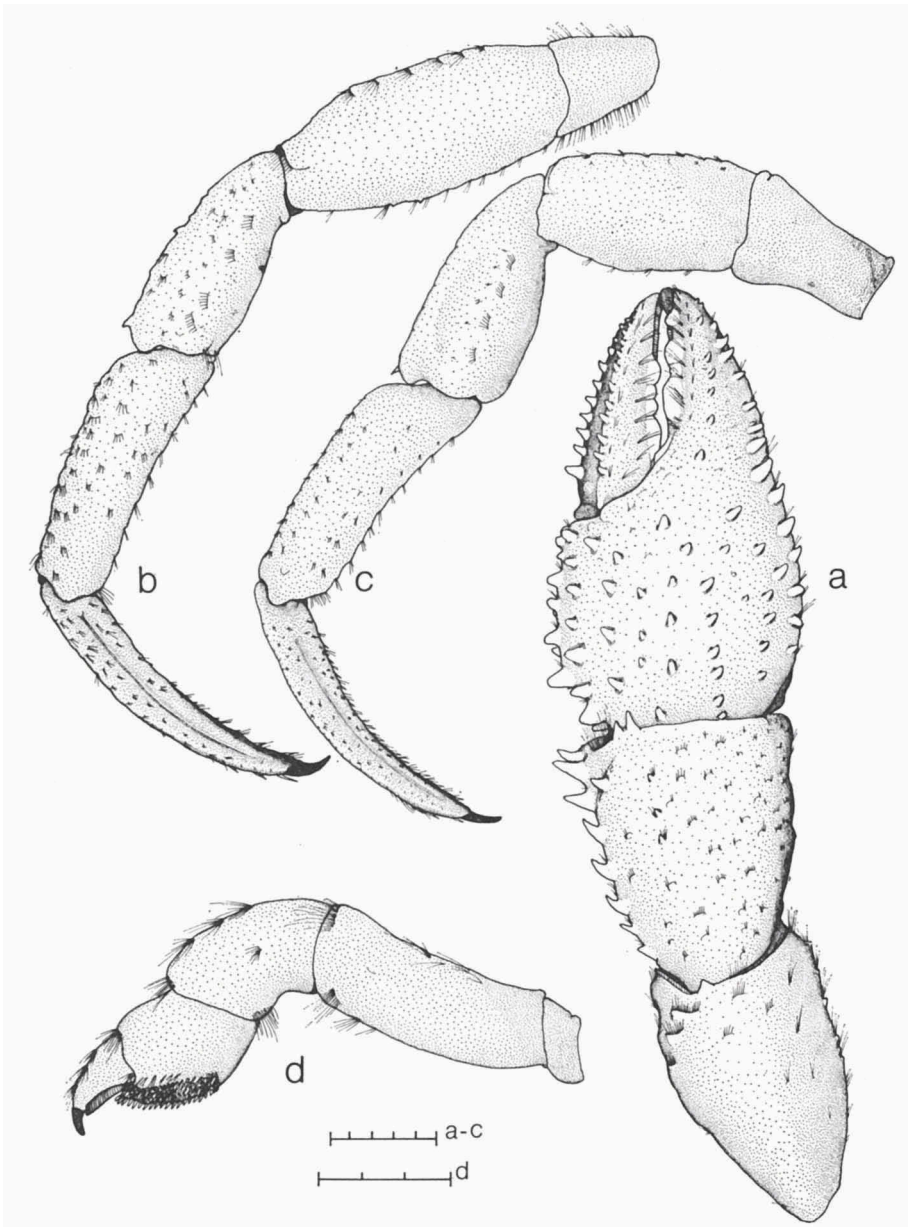


Fig. 28. *Pagurus setosus* (Benedict). a, right cheliped (dorsal view); b, left P₂ (lateral view); c, left P₃ (lateral view); d, left P₄ (lateral view). Scales equal 5 mm (a-c) and 3 mm (d).

equalling palm in length; cutting edge with strong, calcareous teeth proximally, corneous teeth distally; terminating in corneous claw; with prominent longitudinal hiatus; dorsomesial margin with row of very strong slender spines, decreasing in size distally, dorsal surface elevated in midline with row of moderately small spines and tufts of setae; ventral surface with low protuberances and tufts of long setae. Palm slightly less than or equalling length of carpus, slightly inflated dorsoventrally; dorsal surface convex, with irregular rows of moderately strong widely separated spines and tufts of setae, dorsolateral margin with row of strong spines, decreasing in size distally, dorsomesial margin with row of strong acute or subacute spines and tufts of setae; mesial face with scattered small spines and tufts of setae; lateral and ventral surfaces with low, often spinulose protuberances and tufts of setae. Carpus approximately equalling or slightly exceeding length of merus; dorsal surface slightly convex, with irregular rows of small spines or spinulose tubercles usually stronger mesially and tufts of setae, distal margin with 1 or 2 strong spines, dorsomesial margin with row of strong slender spines and tufts of setae; mesial, lateral and ventral surfaces with low sometimes spinulose protuberances or tubercles and tufts of setae. Merus subtriangular; dorsal, dorsolateral and dorsomesial surfaces with transverse spinulose ridges and tufts of setae distally, dorsodistal margin with 1 small spine; ventrolateral margin with row of tuberculate spines, becoming strong acute spines distally; ventromesial margin with row of spines increasing in size distally; ventral surface with few to numerous small or moderately small spines or spinulose tubercles. Ischium with row of small denticles on ventromesial margin, mesial face tuberculate with 1 or 2 broad spinulose tubercles and tufts of setae dorsally. Coxa with 1 or 2 small spinules on ventrolateral margin proximally, row of minute denticles distally, ventromesial margin and distal angle with tufts of long fine setae.

Left cheliped long, reaching approximately to proximal half of dactyl of right, moderately slender. Dactyl long, slightly less than twice length of palm, subtriangular, dorsomesial margin strongly sloping; cutting edge with row of calcareous teeth proximally, small corneous teeth distally; terminating in small corneous claw; overlapped by fixed finger; with slender longitudinal hiatus; dorsal surface with few small spines proximally and tufts of moderately long setae; ventral surface with tufts of setae. Palm one-half to two-thirds length of carpus; dorsal surface strongly arched, with 4 or 5 irregular rows of moderately strong spines, 1 or 2 rows extending onto fixed finger, dorsomesial margin with row of strong slender spines, decreasing in size distally, and with tufts of long setae, dorsomesial surface and margin with strong tubercles or blunt spines, ventral and lateral surfaces with irregular

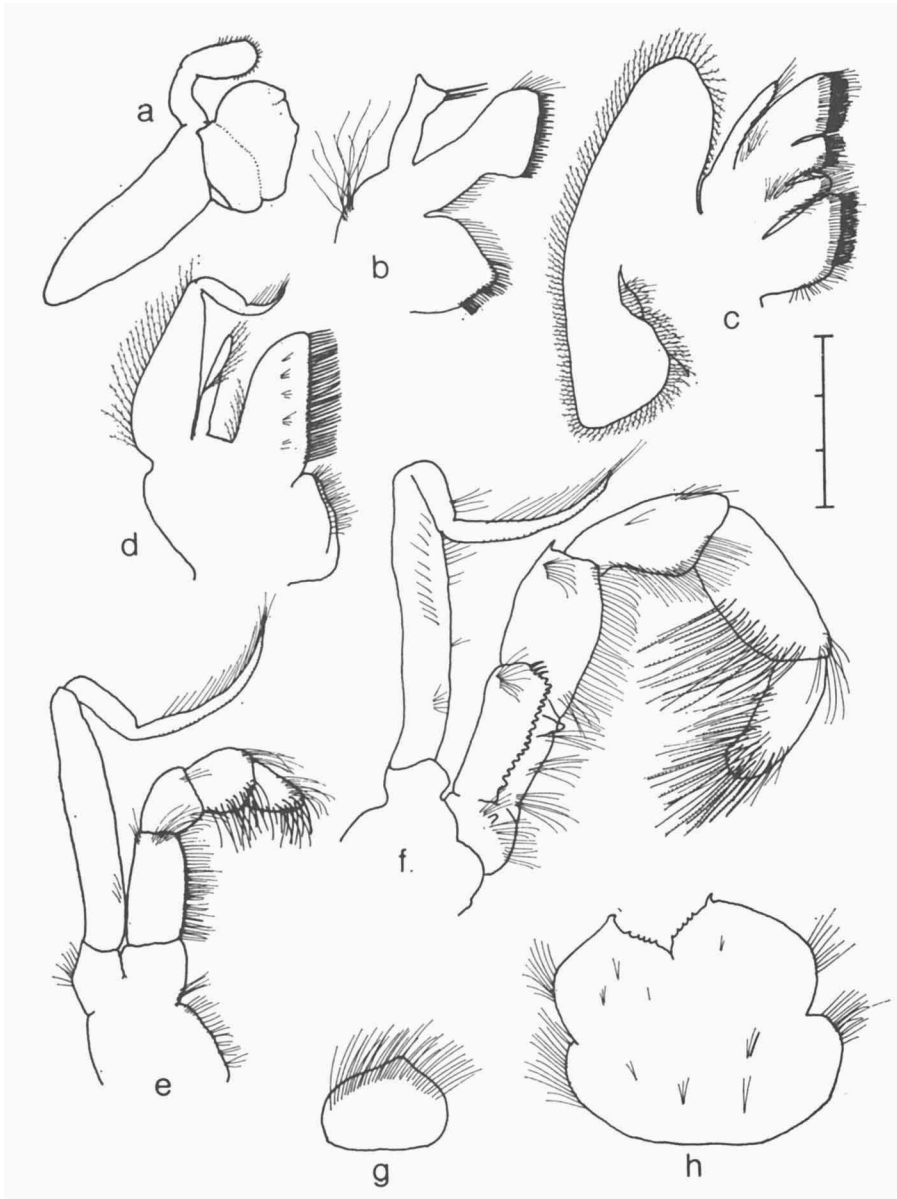


Fig. 29. *Pagurus setosus* (Benedict). a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite P₃; h, telson. Scale equals 3 mm.

rows of spinulose tubercles or tuberculate spines and tufts of setae. Carpus equalling or slightly exceeding length of merus; subtriangular; dorsolateral margin with irregular row of strong spines and tufts of setae, dorsomesial margin with row of moderately strong spines and tufts of setae, surface with few scattered small spines or spinules, distal margin with 1 or 2 strong spines; mesial and lateral faces with strong often spinulose tubercles and tufts of setae; ventrolateral and ventromesial margins each with 1 or 2 rows of tubercles and tufts of setae. Merus subtriangular; dorsal surface and mesial and lateral faces distally with low frequently transverse spinulose ridges and tufts of setae, distal margin with small spine; lateral face minutely spinulose, ventrolateral margin with row of small spines, more tuberculate proximally and tufts of setae; ventromesial margin with row of prominent spines and tufts of setae. Ischium with row of small denticles on ventromesial margin. Coxa with row of minute spinules on ventrolateral margin, ventrolateral distal angle with tuft of long setae.

Second pereopods overreaching right cheliped. Dactyl slightly longer than propodus; slightly compressed laterally; in lateral view, slightly curved ventrally; in dorsal view, straight or slightly twisted; terminating in strong corneous claw; dorsal surface with double row of tufts of stiff setae; lateral face with weak longitudinal sulcus flanked by single or double rows of tufts of short setae; mesial face with longitudinal sulcus flanked by single or double rows of tufts of short setae and row of corneous spines distally; ventral margin with row of corneous spines and double row of tufts of short setae. Propodus equalling or slightly exceeding length of carpus; dorsal, lateral and mesial faces with low protuberances and tufts of setae; ventral margin with tuberculate protuberances and tufts of setae. Carpus three-fourths to four-fifths length of merus; dorsal surface with row of widely-spaced (left) or regularly spaced (right) spines and tufts of setae; lateral, ventral and mesial surfaces with scattered low protuberances and tufts of setae. Merus laterally compressed; dorsal surface with single or double row of short transverse ridges and tufts of setae; mesial and ventral surfaces unarmed, with few scattered tufts of short setae; ventral margin with double row of small spines and tufts of setae. Ischium with small spinules or spinulose protuberances on ventral margin, obscured by tufts of long setae; dorsal margin with tufts of long setae. Coxa with long setae on ventromesial margin.

Third pereopods approximately equalling length of second, overreaching tip of right cheliped. Dactyl slightly longer than propodus; in lateral view, curved ventrally; in dorsal view, straight or slightly twisted; terminating in strong corneous claw; dorsal margin with double row of tufts of stiff

setae; lateral face with faint longitudinal sulcus flanked by irregular rows of corneous spinules and tufts of short setae; mesial face with weak longitudinal sulcus and dorsally with row of strong corneous spines, ventrally with single or double row of tufts of setae; ventral margin with row of strong corneous spines, increasing in size distally and partially obscured by tufts of setae. Propodus equalling or slightly exceeding length of carpus; dorsal margin with double or triple row of low protuberances and tufts of setae; lateral and mesial faces with 2 or 3 rows of low protuberances and tufts of setae; ventral surface with row of strong frequently spinulose protuberances and tufts of setae. Carpus equalling or slightly exceeding length of merus; dorsal surface with low protuberances and tufts of setae, distal margin with moderately small spine; lateral face with 2 rows of tufts of short setae; ventral surface usually with irregular row of tufts of setae. Merus laterally compressed; dorsal margin with single or double row of protuberances and tufts of setae; ventral margin with double row of spinulose protuberances or small spinules and tufts of setae. Ischium with row of setae on ventral margin. Coxa with row of setae on ventromesial margin.

Fourth pereiopods apparently lacking preungual process at base of claw on lateral face of dactyl; propodal rasp well developed.

Fifth pereiopods typical.

Sternite of third pereiopods cordiform, slightly skewed to left; anterior margin with row of long setae.

Pleopods of male unpaired, pl_3-pl_5 , with exopodites well developed; endopodites reduced. Pleopods of female unpaired, pl_2-pl_4 with both rami well developed; pl_5 with exopodite moderately well developed, endopodite reduced.

Telson with posterior lobes slightly asymmetrical, left lobe slightly larger than right; subtriangular; separated by slender V-shaped, median cleft; right terminal margin with 4 to 8 moderately small spines and 1 stronger spine at distolateral angle; left terminal margin with 4 to 9 small spines and 1 stronger spine at laterodistal angle; lateral margins with long setae; anterior lobes unarmed, margins with long setae.

Coloration. — Living color unknown. In preservative: Chelipeds orange or straw-colored; second and third pereiopods with transverse bands of reddish-brown on propodal, carpal and meral segments. Setae often dark red.

Distribution. — Kodiak, Alaska to off Santa Cruz Island, California (Rathbun, Schmitt, Makarov); 9 to 476 m.

Affinities. — Within the "*capillatus*" group, *Pagurus setosus* is very similar to all three other species, but is particularly difficult to distinguish from *P. kennerlyi*. *P. setosus* is also, superficially, quite similar to *P. caurinus*. The characters distinguishing *P. capillatus* from *P. setosus*, i.e., the

absence of a row of strong, corneous spines on the ventral margins of the dactyls of the second and third pereopods and the presence of spines or tubercles on the lateral faces of the dactyl and propodus of the left third pereopods, in the former species, are much less variable and less subjective than are the characters which may be used to separate *P. setosus* from *P. kennerlyi*. The shorter ocular peduncles, broader ocular acicles and more obtuse rostrum characteristic of *P. setosus* are subject to considerable variation. Similarly, the exceptionally strong slender spines of the chelipeds of *P. kennerlyi* are related to size; the shortness of spines in many small specimens can be very misleading. The most reliable characters for distinguishing between the two species are the absence, in *P. setosus*, of a row of small spines or spinules on the dorsal margin of the carpus of the right third pereopod, and the greater length of the dactyls of the second and third pereopods. The telson serves to distinguish *P. caurinus* and *P. setosus*, as do the shorter, broader dactyls of the second and third pereopods (Hart, 1971).

Discussion. — The name, *Pagurus setosus*, was first assigned by H. Milne-Edwards (1848) to a species which was later transferred to the genus *Paguristes*. Although *Pagurus setosus* (Benedict) is a secondary junior homonym, the two species have never been considered congeneric, and no replacement name has ever been proposed for Benedict's species. Therefore according to Article 59 of the International Code of Zoological Nomenclature (1964: 57), *Pagurus setosus* (Benedict) is a valid name.

P. setosus has been contrasted frequently with *P. capillatus* (e.g., Schmitt, 1921; Makarov, 1938b, 1962) and also confused with *P. capillatus* (Stevens, 1925; Hart, 1940 (in part)). Although Schmitt's description and figure (Schmitt, 1921: 136, fig. 58), presumably based on Benedict's type specimen, apply to *P. setosus*, he did not consider the similarities between *P. setosus* and *P. kennerlyi* and his distinctions between *P. capillatus* and *P. setosus* could have applied equally well to the separation of *P. capillatus* from *P. kennerlyi*. However, Schmitt's distributional records of *P. setosus* have been substantiated by the examination of specimens from both northwestern North America and from California.

Hart (1940) similarly had difficulty in differentiating *P. setosus*, as specimens assigned to this taxon were found later to include specimens of *P. caurinus* and *P. capillatus* (Hart, 1971 and personal communication).

***Pagurus kennerlyi* (Stimpson) (figs. 30-32)**

Eupagurus Kennerlyi Stimpson, 1864: 153 (type locality: Puget Sound, Washington).

Eupagurus (Trigonochirus) confragosus Benedict, 1892: 11 (in part; by implication;

- type locality: Alaska, restricted by lectotype selection to Portlock Bank, Alaska, "Albatross" station 2856; see discussion).
- Eupagurus (Trigonocheirus) kennerlyi*: Benedict, 1892: 19 (by implication).
- Eupagurus kennerlyi*: Thallwitz, 1892: 35. — Walker, 1898: 274. — Alcock, 1905: 178.
- Eupagurus kennerlyi* (?): Calman, 1898: 260.
- Pagurus (Trigonocheirus) Kennerlyi*: Holmes, 1900: 143 (by implication; misspelling of *Trigonocheirus* Benedict, Holmes, 1900: 134).
- Pagurus kennerlyi*: Rathbun, 1903: 35. — Rathbun, 1904: 159, pl. 5 fig. 4. — Rathbun, 1910: 159, pl. 5 fig. 4. — Taylor, 1912: 205. — Williamson, 1915: 477. — Stevens, 1925: 289, fig. 10. — Shelford et al., 1935: 282. — Wismer & Swanson, 1935: 342. — Makarov, 1938b: 218, fig. 72. — Hart, 1940: 93. — Gordan, 1956: 331. — Makarov, 1962: 207, fig. 72. — McLaughlin, 1963: 22. — Hart, 1971: 1532.

Neotype, herein selected. — ♀ (SL = 9.8 mm), USNM 77431.

Material examined. — See table 10.

Diagnosis. — Left chela with dorsal surface convex, midline elevated, not produced into prominent ridge or crest. Chelae with dorsal surface usually strongly spinose and with tufts of long, stiff setae. P_3 with lateral faces of dactyls and propodi unarmed; carpi each with row of small spines or spinules on dorsal margins, or occasionally left with only small spine at dorsodistal margin. Ventral margins of dactyls of P_2 and P_3 each with row of strong, corneous spines.

Description. — Shield usually longer than broad; anterolateral margins sloping or slightly terraced; anterior margin between rostrum and lateral projections straight or slightly concave; posterior margin truncate or rounded; dorsal surface often slightly rugose anteriorly and laterally, with scattered tufts of moderately short setae; anterolateral angle produced, often spinulose. Rostrum moderately long, usually exceeding lateral projections; triangular, often acute; with strong marginal terminal spine, partially obscured by tuft of moderately long setae. Lateral projections obsolete, obtusely triangular, or broadly rounded, with strong marginal or submarginal spine, often directed toward exterior.

Ocular peduncles moderately long, two-thirds to four-fifths shield length, slender; slightly inflated basally, often with cornea dilated; dorsomesial, dorsolateral and ventral surfaces usually with irregular longitudinal rows of tufts of short setae, prominent tuft of moderately long setae at base of cornea. Ocular acicles long, moderately slender, subovate with mesial margins expanded, lateral margins straight or slightly expanded; terminating subacutely with strong, submarginal or marginal spine; separated basally by three-fourths to entire basal width of one acicle.

Antennular peduncles long, exceeding ocular peduncles by one-third to three-fourths length of ultimate segment. Ultimate segment unarmed, often

Table 10. *Pagurus kemmerlyi* (Stimpson) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	♂♀		
<i>Japan</i>								
Muroran, Yezo	---	---- USNM 51178	----	1			17.5	Grebnitzki
<i>Bering Sea</i>								
Halfway Point, St. Paul I.	18	---- USNM	21/11/65	1			12.1	Fiscus
Walrus I., Pribilof Is.	---	----	23/11/65	2	4	2	8.0-16.1	Fiscus
56°40'N, 160°59'W	66	USNM, RMNH SBL F-12	18/8/60	1			12.8	USFWS
56°20'N, 164°00'W	80	USNM SBL E-7	15/8/60	1			17.0	USFWS
56°20'N, 161°00'W	51	USNM SBL E-12	19/8/60	1			14.6	USFWS
55°58'N, 162°13'W	66	USNM SBL D-10	5/8/59	1			10.4	USFWS
55°40'N, 162°49'W	53	USNM SBL C-9	4/8/60	2			6.1-14.2	USFWS
54°39'N, 156°12'W	73	USNM SBL Z-5 AHF, RM, CNM	4/8/61	4	3		12.0-16.4	USFWS
Akun Bay, Akun I.	18	---- USNM	11/9/62	1			3.4	Fiscus
Akutan Harbor, Akutan I.	---	---- RMNH	12/9/62	1			12.2	Fiscus
Moorovskay Bay, Unalaska I.	100	Albatross 3321 USNM 16745	18/8/90	2			6.6-10.1	---
Atka I.	---	---- USNM 90665	10/8/27	1			11.5	Scheffer
<i>Gulf of Alaska</i>								
55°30'N, 161°30'W	---	15B USNM	24/9/61	3			11.9-13.3	INPHC
Prince William Sound	---	----	summer 61	1			10.1	INPHC
60°10'N, 146°15'W	66	USNM 74D	25/9/62	1			14.9	INPHC
60°00'N, 146°30'W	274	USNM 73C	7/8/62	1			13.8	INPHC
58°30'N, 150°00'W	101	USNM 61L	29/6/62	1	2		10.1-13.3	INPHC
58°27'N, 151°30'W	110	USNM, RMNH 55I	27/9/62	2			18.5-19.2	INPHC
58°07'N, 151°36'W	124	USNM Albatross 2856	22/8/88	1			7.6	---
56°39'N, 155°15'W	54-73	USNM 40M	10/2/62	1			16.6	INPHC
56°15'N, 155°15'W	27	USNM 40P	13/2/62	1			8.2	INPHC
54°33'N, 159°45'W	78	USNM 22M	6/4/62	2			14.5-15.0	INPHC
Fortlock Bank	124	USNM	22/8/88	1			11.9	---
Swanson Harbor, Icy Strait	---	USNM 16739 ---- AHF	1/7/63	1			8.1	Gonor
<i>British Columbia</i>								
Victoria	---	---- USNM 25862	1/6/99	1			14.5	Coe
<i>Washington</i>								
Strait of Juan de Fuca	---	---- USNM, RMNH	9/8/61	1	3		3.7-9.1	Davis
San Juan Is.	---	---- USNM	8/61	9			5.8-16.9	McLaughlin
Waldron I.	---	---- USNM	19/7/61	2			7.7-9.2	Ray
San Juan I.	---	---- USNM	5/61	1			4.2	Henry
San Juan I.	---	---- USNM	27/7/61	1			6.3	McLaughlin

Table 10 (Continued). *Pagurus kemmerlyi* (Stimpson) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂ ⁺	♀	♀♀ ⁺		
<i>Washington</i>								
Friday Harbor	---	----	1922	1	1		4.2-4.9	Stevens
Friday Harbor	---	USNM	summer 25	1	1		6.0-7.5	Hobbs
San Juan Channel	---	USNM 63094	2/8/61	7	3		4.1-7.9	McLaughlin
San Juan Channel	---	RDNH,AHF	4/8/61	1			6.1	McLaughlin
President Channel	---	USNM	2/8/61	3	1		3.9-4.4	McLaughlin
Peavine Pass	---	USNM, BM	26/6/52	1			7.3	Illg
Lopez Pass	---	USNM	9/8/61	12	4		4.2-14.4	McLaughlin
Lopez Sound	---	USNM, CNM	25/5/61	1	1		4.9-9.9	Henry
Lopez Sound	---	USNM	10/8/61	1			3.2	McLaughlin
Larson Bay	27-55	USNM	7/7/34	1			5.3	Stevens
Puget Sound	---	1-18-15	3/7/32	1			7.7	Stevens
Puget Sound	---	USNM	8/28	1			4.7	Hobbs
Port Townsend	---	USNM 63066	29/6/03	1			9.8	---
Off Port Townsend	65	USNM 77431	8/8/38	1	1		6.7-10.6	Stevens
Admiralty Inlet	60	USNM	17/3/35	2			4.8-5.8	Stevens
Oak Bay, Puget Sound	57-71	Albatross 4221	1/7/03	1			7.0	---
Fidalgo Head off Anacortes	---	USNM 65696	8/11/64	2			11.8-14.0	---
		USNM						

with 2 or 3 longitudinal rows of tufts of short setae; penultimate and basal segments unarmed, with few scattered tufts of short setae.

Antennal peduncles moderately long, exceeding ocular peduncles by one-fifth to one-third length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments unarmed, with scattered tufts of short setae. Third segment with ventromesial distal angle produced, terminating in strong acute spine, partially obscured by tufts of long setae. Second segment with dorsolateral distal angle strongly produced, terminating in moderately strong simple or bifid spine, mesial margin with 1-4 small spines, lateral margin usually unarmed, with tufts of setae; dorsomesial distal angle with strong spine, mesial margin with tufts of long stiff setae. First segment with strong spine on lateral face distally; ventromesial margin with row of small spinules distally. Antennal acicles long, usually reaching distal third of ultimate peduncular segment; strongly arcuate; terminating in moderately strong spine; mesial margin with row of low occasionally spinulose protuberances and tufts of long setae. Antennal flagella long, frequently overreaching tip of right cheliped; each article usually with several minute bristles, occasionally with 1 or 2 additional short setae.

Mandible without distinguishing characters. Maxillule with proximal endite tapering; endopodite with 3 of 4 bristles on slightly produced internal lobe, external lobe very well developed, not recurved. Maxilla with endopodite inflated basally, not reflexed, slightly less than or equalling scaphognathite in

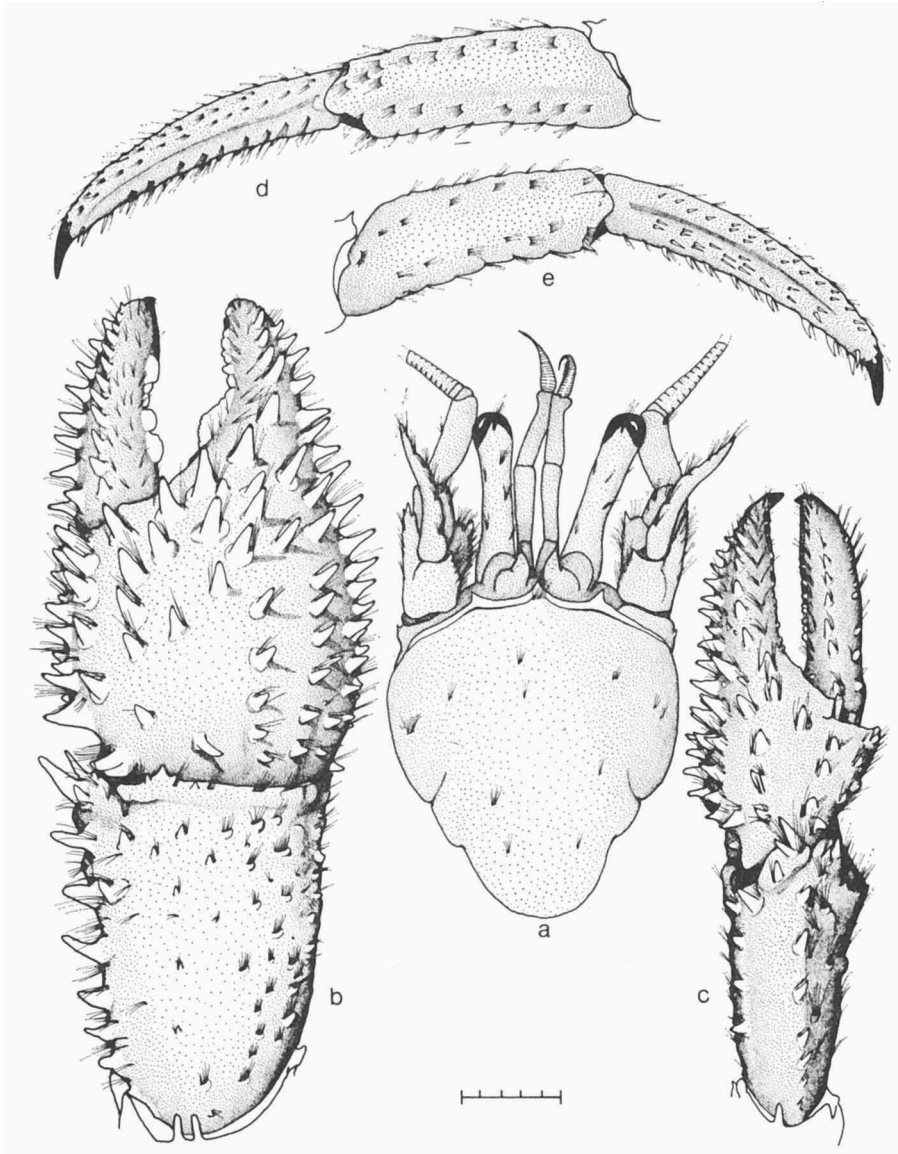


Fig. 30. *Pagurus kennerlyi* (Stimpson). a, shield; b, right chela and carpus (dorsal view); c, left chela and carpus (dorsal view); d, left P₃, dactyl and propodus (lateral view); e, left P₃ dactyl and propodus (mesial view). Scale equals 5 mm.

distal extension. First maxilliped with endopodite approximately four-fifths length of exopodite; basal segment of exopodite slender. Second maxilliped with basis-ischium fusion incomplete. Third maxilliped with basis-ischium fusion incomplete; basis usually with 1 small spine; ischium with crista dentata well developed, 1 or more frequently 2 accessory teeth; merus with spine at dorsodistal margin, ventral margin with 1-3 spines or occasionally, unarmed; carpus with spine at dorsodistal margin. Sternite of mxp_3 with small spine and tuft of long setae on each side of midline.

Right cheliped considerably stronger than left; moderately long and slender. Dactyl moderately short, equalling or slightly exceeding length of palm; cutting edge with row of strong calcareous teeth proximally, short row of corneous teeth distally, terminating in small corneous claw; with prominent, longitudinal hiatus; dorsal surface with very few scattered strong spines, elevated in midline with row of strong, slender corneous-tipped spines and tufts of long, stiff setae, decreasing in size distally, dorsomesial margin with row of very strong, slender, often tubular corneous-tipped spines and tufts of long stiff setae; mesial and ventral surface with longitudinal rows of long setae. Palm moderately long, two-thirds to four-fifths length of carpus; dorsoventrally inflated; dorsal surface convex with several irregular rows of usually very long, tubular or conical, corneous-tipped spines, decreasing very little in size on fixed finger and tufts of long stiff setae, dorsomesial margin with single or occasionally double row of long, slender corneous-tipped spines and tufts of long stiff setae, dorsolateral margin with single or double row of strong, slender corneous-tipped spines, decreasing in size proximally and tufts of long stiff setae; lateral face with scattered small spines or spinulose tubercles and tufts of long setae; mesial face with multidenticulate spines or low tubercles and tufts of stiff setae; ventral surface with irregular rows of long setae. Carpus moderately long, usually equalling or slightly exceeding length of merus; slightly inflated dorsoventrally; dorsomesial margin with row of very long, slender corneous-tipped spines and tufts of long, stiff setae, dorsomesial distal angle slightly produced, with 2-4 very long slender spines, dorsal surface with moderately small or small spines and spinulose tubercles and tufts of long setae, distal margin with few small spines and short rows of moderately long setae, dorso-lateral margin with small spines or spinulose or multidenticulate tubercles and tufts of long setae; lateral face with small spines or tubercles and tufts of setae, distal margin with row of moderately strong spines; mesial face with few low tubercles or protuberances or unarmed, with scattered tufts of long setae, distal margin protuberant or broadly denticulate, with tufts of long setae; ventral surface with tufts of long setae. Merus short, subtriangular; dorsal

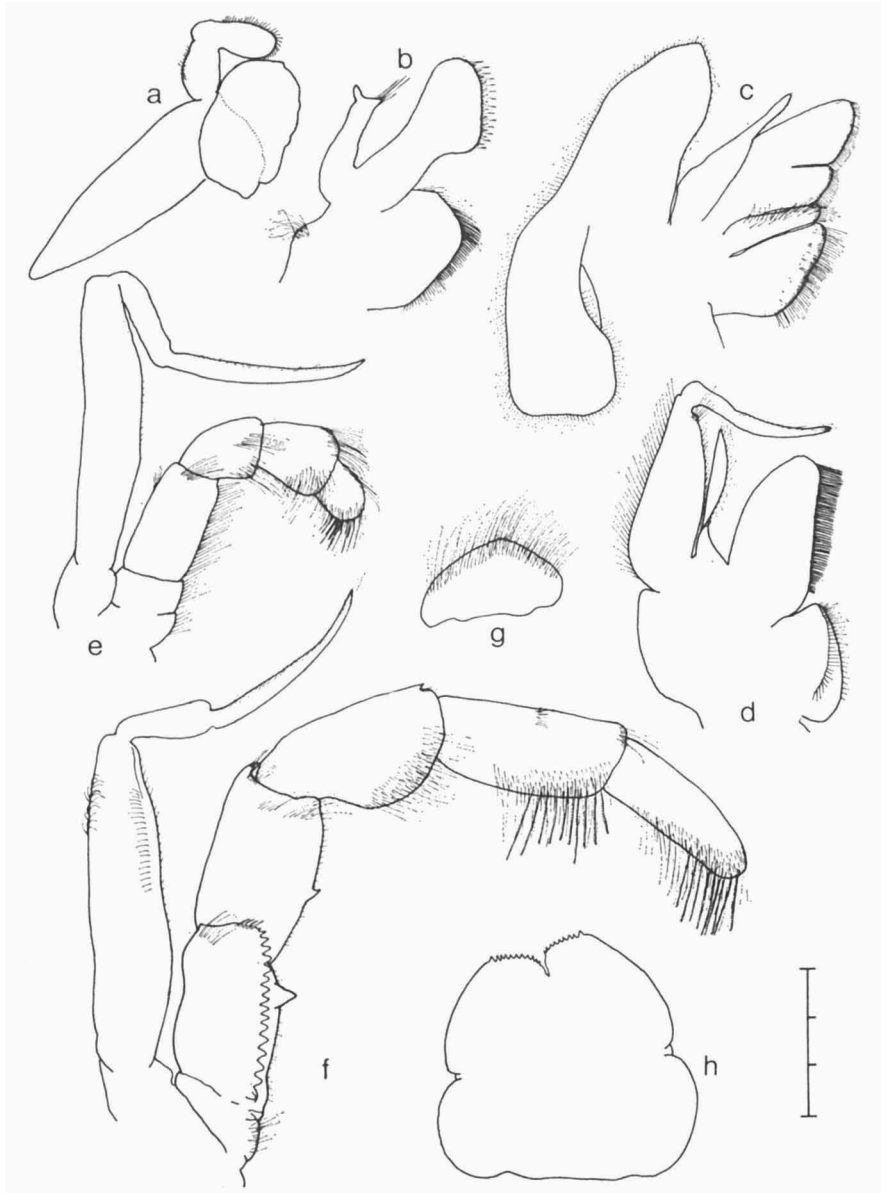


Fig. 31. *Pagurus kennerlyi* (Stimpson). a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite P₃; h, telson. Scale equals 3 mm.

surface with transverse ridges, increasing in size and number distally and becoming multidenticulate and spinulose and with tufts of moderately long setae, distal margin with 1-3 moderately long slender spines; lateral face spinulose or unarmed, ventrolateral margin with irregular row of small spines or spinulose tubercles proximally, becoming strong, corneous-tipped spines distally; ventral surface with multidenticulate protuberances or tubercles and tufts of long setae; mesial face with vertical or transverse rows, often spinulose or multidenticulate, of ridges with tufts of long setae, ventromesial

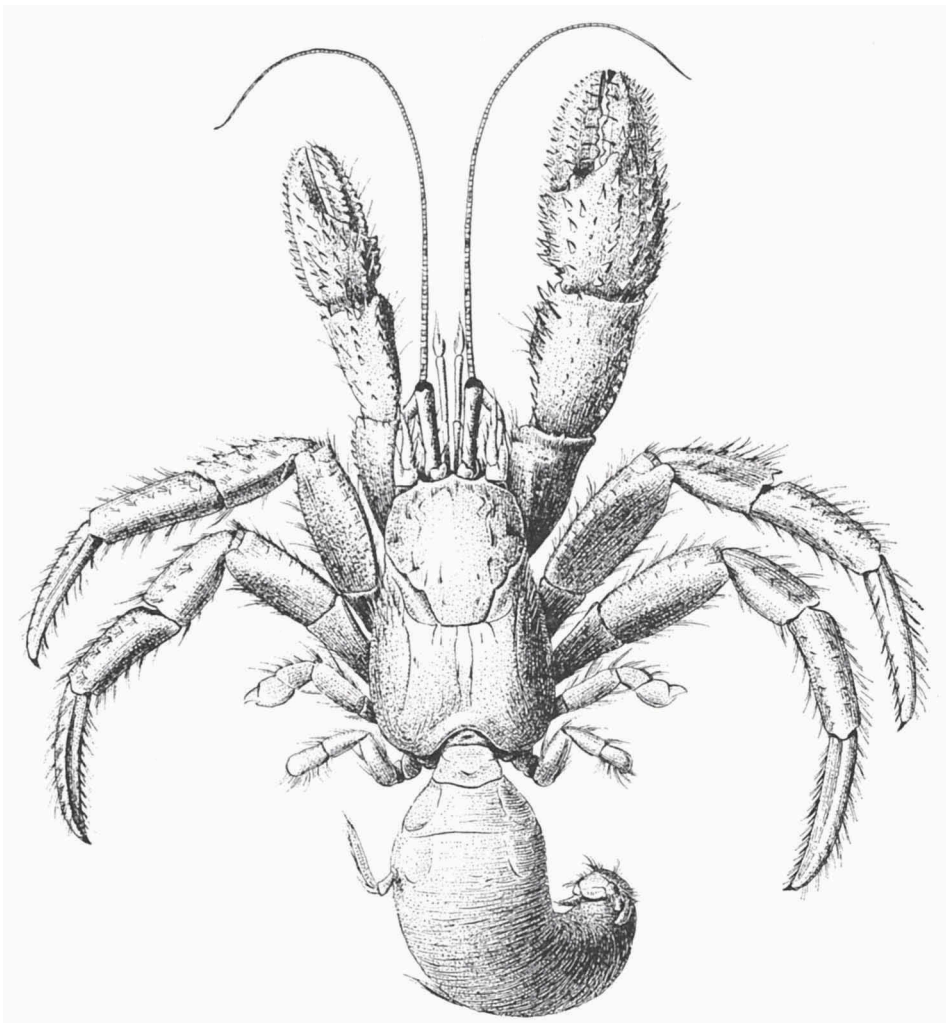


Fig. 32. *Pagurus kennerlyi* (Stimpson). Original illustration of J. E. Benedict.

margin with multidenticulate or spinulose ridges or broad tubercles and tufts of long setae, distal margin with several long slender spines and few spinules ventrally. Ischium with row of small spines on ventromesial margin, ventrolateral distal angle with cluster of small spinules and tufts of long setae. Coxa with short row of small denticles on ventrolateral margin proximally, ventrolateral distal angle with few small spines; mesioventral distal angle with dense tuft of long setae.

Left cheliped moderately long, usually exceeding base of dactyl of right, slender. Dactyl usually quite long, one and one-half to two and one-half times length of palm; cutting edge with row of small calcareous teeth proximally, corneous teeth distally, infrequently interspersed with small calcareous teeth; terminating in small corneous claw; slightly overlapped by fixed finger; with prominent longitudinal hiatus; dorsomesial margin with row of small spines, decreasing in size distally and tufts of long stiff setae, dorsal surface elevated in midline, with row of moderately strong spines, decreasing in size or becoming obsolete distally and tufts of moderately long setae; mesial and ventral surfaces with rows of tufts of long stiff setae. Palm moderately short, one-third to two-thirds length of carpus; dorsolateral margin with single or double row of strong, slender spines, decreasing in size on fixed finger, and tufts of long stiff setae, dorsal surface with few scattered strong spines laterally, elevated in midline and with single or double row of strong moderately slender spines, extending onto fixed finger as single row of moderately strong spines, and with tufts of long setae, dorsal surface mesially with 1 or 2 irregular rows of strong spines and tufts of long setae, dorsomesial margin with irregular row of moderately strong spines or spinulose tubercles and tufts of very long setae; ventral surface with irregular rows of low protuberances and tufts of long setae; lateral face with scattered, small simple or bifid spines or spinulose tubercles. Carpus moderately long, slightly less than or equalling merus in length; dorsal surface slightly oblique, usually unarmed or with few spines distally, dorsolateral margin with row of long, slender, often corneous-tipped spines, dorsomesial margin with row of strong spines and tufts of long setae, distal margin with 1-4 very long, slender spines; mesial face usually with scattered low protuberances or tubercles, often spinulose, or occasionally unarmed and with tufts of very long setae, distal margin with few small spines; ventral surface with scattered, low protuberances or spinulose tubercles and tufts of long setae, distal margin with few small spines; lateral surface with irregular rows of small spines or spinulose tubercles, distal margin unarmed or with few spines, ventrolateral margin with irregular row of small spines or tubercles proximally, increasing to long, tubular spines distally and tufts

of long setae. Merus subtriangular, slightly compressed laterally; dorsal margin with irregular row of low protuberances or ridges, becoming multi-denticulate or spinulose distally and with tufts of long setae, distal margin unarmed or with 1 or 2 moderately strong spines; lateral face usually spinulose with few tufts of long setae, ventrolateral margin with double row of long slender spines and tufts of long setae; mesial face often with low protuberances and tufts of long setae, ventromesial margin with double row of small spines and tufts of long setae; ventral surface with few, small spines. Ischium with row of strong denticles or small spines on ventromesial margin, cluster of long setae proximally. Coxa with row of small denticles on ventrolateral margin, ventrolateral distal angle with few small spines, ventromesial distal angle with clump of long setae.

Second pereopods moderately long, overreaching right cheliped. Dactyl moderately short, one-third to one-fourth longer than propodus; in lateral view, straight or slightly curved ventrally; in dorsal view, usually straight; dorsal surface with rows of tufts of long setae; mesial face with strong longitudinal sulcus flanked by irregular double row of strong corneous spines or spinules, or only by irregular double row of long setae ventrally; lateral face with strong longitudinal sulcus flanked by single or double row of long setae; ventral margin with row of strong corneous spines, increasing in size distally. Propodus usually equalling or slightly exceeding length of carpus; dorsal surface with 2 irregular rows of low occasionally spinulose protuberances and tufts of long setae; mesial and lateral faces with longitudinal rows of tufts of long setae; ventral surface protuberant, with tufts of long setae. Carpus one-half to three-fourths length of merus; dorsal surface with row of long, slender corneous-tipped spines and few tufts of long setae; mesial and ventral surfaces with tufts of long setae; lateral face with longitudinal row of short transverse ridges with tufts of long setae ventrally, few scattered small tubercles or low protuberances and tufts of long setae dorsally. Merus laterally compressed; dorsal margin with single or double row of low frequently spinulose protuberances or tubercles and tufts of long setae; lateral face usually minutely spinulose; mesial face with scattered tufts of long setae; ventral margin with 1 or 2 rows of small tubercles, becoming small spines distally and tufts of long setae. Ischium with row of small denticles on ventral margin obscured by tufts of long setae; dorsal surface minutely spinulose, with tufts of long setae. Coxa with rows of long setae on ventromesial and ventrolateral margins.

Third pereopods moderately long, slightly shorter than or equalling length of second pereopods, overreaching right cheliped. Dactyl moderately short, one-fourth to one-third longer than propodus; in lateral view, straight or

slightly curved ventrally; in dorsal view, usually straight; terminating in very strong, curved corneous claw; dorsal surface with 2 rows of tufts of long setae; mesial face with longitudinal sulcus flanked by single or double row of strong corneous spines; lateral face with longitudinal sulcus flanked by single or double row of tufts of long setae, surface occasionally slightly protuberant, generally on left; ventral margin with row of very strong, corneous spines, increasing in size distally and tufts of long setae. Propodus one-third to two-thirds longer than carpus; dorsal surface with irregular rows of low protuberances and tufts of long setae; lateral and mesial faces occasionally slightly protuberant, with 1 or 2 rows of tufts of long setae; ventral margin with row of low protuberances (more prominent on left) and tufts of long setae. Carpus one-half to two-thirds length of merus; dorsal surface usually with row of small corneous-tipped spines (right), occasionally only with spine at distal margin (left), and row of tufts of long setae; lateral face occasionally with very faint longitudinal sulcus and scattered tufts of long setae; mesial and ventral surfaces with few tufts of long setae. Merus laterally compressed; dorsal surface with 1 or 2 rows of low, occasionally spinulose, protuberances and tufts of long setae; mesial and lateral faces with tufts of moderately long setae; ventral margin protuberant or slightly spinulose or tuberculate and with row of tufts of long setae. Ischium with row of long setae on dorsal and ventral margins. Coxa with row of tufts of long setae on ventromesial margin.

Fourth pereopods with no apparent preungual process at base of claw on lateral face of dactyl; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods cordiform, moderately narrow; anterior margin with dense row of long setae.

Pleopods of male unpaired, pl_3 - pl_5 with exopodites well developed; endopodites reduced. Pleopods of female unpaired, pl_2 with exopodite poorly developed; endopodite well developed; pl_3 - pl_4 with both rami well developed; pl_5 with exopodite well developed, endopodite reduced.

Telson with posterior lobes symmetrical or only slightly asymmetrical; with slender or moderately broad, median cleft; right terminal margin with row of several, very small spinules, very slightly increasing in size laterally; left terminal margin with row of several, very small spinules increasing in size laterally; lateral margins occasionally with tufts of setae; anterior lobes frequently with tufts of long setae on lateral margin.

Coloration. — In life: "Very strong bluish-white spines on hands"; distinct banding of antennal flagella, brick red predominating over clear patches (M. Middaugh, class field notes, Friday Harbor, Wn., 1962). In preservative:

Chelipeds and pereopods light orange, fading to straw-color, spines of chelae light, often with very dark, corneous tips.

Distribution. — Aleutian Islands southward to Washington (Rathbun, Stevens, Makarov). Pribilof Islands and Bristol Bay, Alaska, Gulf of Alaska to Puget Sound, Washington; Muroran, Yezo, Japan; intertidal to 274 m.

The records of *P. kennerlyi* from the Pribilof Islands and Bristol Bay represent a northwestern extension of the range of this species in northwestern North America; however, more significant is the discovery of a specimen of this species from Japan, which represents the first record of *P. kennerlyi* in Asian waters.

Affinities. — The affinities of the species of the “*capillatus*” group have been discussed in some detail in the preceding species and will only be supplemented in this discussion. In life, the bluish-white spines of *P. kennerlyi* immediately distinguish it. In addition, two accessory teeth on the crista dentata frequently occur in this species. None of the examined specimens of the other three species had more than one accessory tooth. Therefore, it would appear that the occurrence of two accessory teeth could be used as supportive evidence in the identification of *P. kennerlyi*. The characters cited by Stevens (1925: 290), which distinguished *P. setosus* from *P. kennerlyi*, actually refer to differences between the latter species and *P. capillatus*.

Discussion. — Stimpson (1864) described *Eupagurus kennerlyi* from Puget Sound, Washington, relating it to *Eupagurus pubescentulus* A. Milne-Edwards & Bouvier, 1892. All subsequent reports of *P. kennerlyi* have been from northwestern North America; it has variously been allied with *Pagurus cuanensis* Bell, 1846 by Walker (1898), *P. setosus* by Benedict (1892), *P. seriespinosus* by Thallwitz (1892), and *P. caurinus*, *P. setosus* and *P. capillatus* by Hart (1971). Among the collections of the National Museum of Natural History, Smithsonian Institution, I recently discovered a specimen from Muroran, Yezo, Japan (USNM 51178), identified by W. L. Schmitt as *Pagurus pectinatus* (Stimpson, 1858), which was clearly conspecific with *P. kennerlyi*. If Schmitt's interpretation of *P. pectinatus* were correct, *P. kennerlyi* would become a junior synonym of the former species. Through the cooperation of Drs. H. Kurata, in Japan, and H. S. Kim, in Korea, I was able to examine a small series of specimens identified by these carcinologists as *P. pectinatus* from Hokkaido, Japan (4 ♂, 1 ♀; SL = 11.1–14.6 mm) and Pohang, Korea (1 ♂, 1 ♀; SL = 9.6, 10.0 mm). This series was supplemented by a specimen from Siache Bay, Japanese Sea, identified by V. V. Makarov as *P. pectinatus* (♂; SL = 10.2 mm; USNM 72370) and an additional specimen of this presumed species (♂; SL = 9.3 mm; USNM 48844; identifier unknown) from the national collections. Of the

nine specimens examined, at least two, and possibly three, distinct species are represented, none of which conspecific with *P. kennerlyi*.

Stimpson (1858) described *P. pectinatus* from Hakodadi, Japan, and contrasted it with a second new Japanese species, *Pagurus constans* (Stimpson, 1858). Stimpson's types of both *P. kennerlyi* and *P. pectinatus* apparently are no longer extant, and his original descriptions are too brief to adequately distinguish the species; in addition, Stimpson's illustration of *P. kennerlyi*, referred to in the preface to his description (Stimpson, 1864: 153), apparently was never published. Through the selection of a neotype of *P. kennerlyi*, from Puget Sound, the identity of this species can be established; however, it is apparent that the true identity of *P. pectinatus* is indeterminable at present. On the basis of current evidence, however, it is reasonable to conclude that the two species are not conspecific.

Rathbun (1903) reported a *Pagurus* sp. from Japan, which she believed was closely allied to *P. setosus*, *P. kennerlyi* and *P. constans*. Makarov (1938b, 1962) placed Thallwitz's (1892) species, *P. seriespinosus*, in synonymy with *P. pectinatus*, and related the latter species to *P. capillatus*; however, the specimen in the national collections, identified as *P. pectinatus* by Makarov, resembles *P. setosus* more than it does *P. capillatus*. Heretofore, *P. kennerlyi* has not been recorded from Asian waters, and *P. setosus* is not known from that region. However, both *P. capillatus* and *P. pectinatus* have been recorded frequently by Russian carcinologists. In contrast, only *P. pectinatus* has been recorded by Japanese and Korean workers. It is beyond the scope of this study to pursue, in depth, the true identity of *P. pectinatus*, its relationship to the species presently assigned to the "*capillatus*" group, or the distribution of this group in Soviet, Japanese and possibly Korean waters. However, attention must be directed to the complexity of the problems of the specific identities of the species appearing under the names, *P. pectinatus* and *P. capillatus*, in these areas. As the species of the "*capillatus*" group are quite similar in gross morphology and, at least in northwestern North America, are all known to exhibit considerable intraspecific and interspecific variation, any adequate review will have to be based on a large series from both continents.

During the recent reexamination of Benedict's type materials in the national collections, a specimen of *P. kennerlyi*, still withdrawn into its shell, was found in the type series of *P. confragosus* (see discussion of *P. confragosus*).

As previously noted, the great majority of Stimpson's type material apparently was destroyed in the Chicago fire of 1871 (cf. Rathbun, 1883). All subsequent efforts to locate the type specimen of *P. kennerlyi* have been

unsuccessful; therefore, because of the considerable confusion that has existed in the identity of this species because of its close similarity to *P. setosus* and *P. capillatus*, it has been necessary to designate a neotype for *P. kennerlyi*.

***Pagurus caurinus* Hart (figs. 33, 34)**

Pagurus setosus: Hart, 1940: 94 (in part).

Pagurus caurinus Hart, 1971: 1528, figs. 1-7 (type locality: Frank Island, Tofino, British Columbia, 49°08'N 125°55'W (J. F. L. Hart, personal communication)).

Holotype. — Not seen.

Material examined. — See table 11.

Table 11. *Pagurus caurinus* Hart Material Examined

Locality	Depth(m)	Station Deposition	Date	Sex			SL (m)	Collector
				♂ ⁺	♀	♀♀ ⁺		
<i>British Columbia</i>								
Fort Louis, Queen Charlotte Is.	---	----	4/6/69		1		2.2	Hart
Frank I., Cox Bay	---	RM -----	15-18/8/66	3	2	1	2.4-4.7	Hart
Cox Bay	---	RMNH,AHF -----	1/7/65		1		4.3	Hart
James I.	---	USNM ----- RMNH	22/8/61		1		2.8	Horner
<i>Washington</i>								
Outer coast	---	---- USNM	1/8/71	4		1	3.6-5.7	Nyblade

Diagnosis. — Left chela with dorsal surface convex, with irregular rows of moderately strong spines. Right cheliped with ventral surface of merus with 1 prominent tubercle; dorsal surface of chela with irregular rows of moderately strong spines, partially obscured by tufts of long, stiff setae. Telson with terminal margins armed with strong spines.

Description. — Shield slightly longer than broad, or less frequently length equalling width; anterolateral margins slightly terraced or sloping; anterior margin between rostrum and lateral projections straight or slightly concave; posterior margin truncate or roundly truncate; dorsal surface generally smooth, occasionally with few tufts of short setae; anterolateral angle slightly produced, blunt or spinulose. Rostrum equalling or slightly exceeding lateral projections, varying from approximately obsolete to obtusely triangular or broadly rounded; unarmed, with terminal tuft of long setae. Lateral projections obsolete or slightly produced, rounded; unarmed or with very small, submarginal spinule.

Ocular peduncles moderately long, approximately two-thirds length of shield; inflated basally, corneal region slightly dilated; dorsal and dorso-mesial faces each usually with longitudinal row of tufts of short setae.

Ocular acicles prominent; mesial margins expanded, lateral margins straight or slightly expanded, dorsal surface slightly concave; terminating acutely or subacutely, with prominent submarginal spine; separated basally by two-thirds to three-fourths basal width of one acicle.

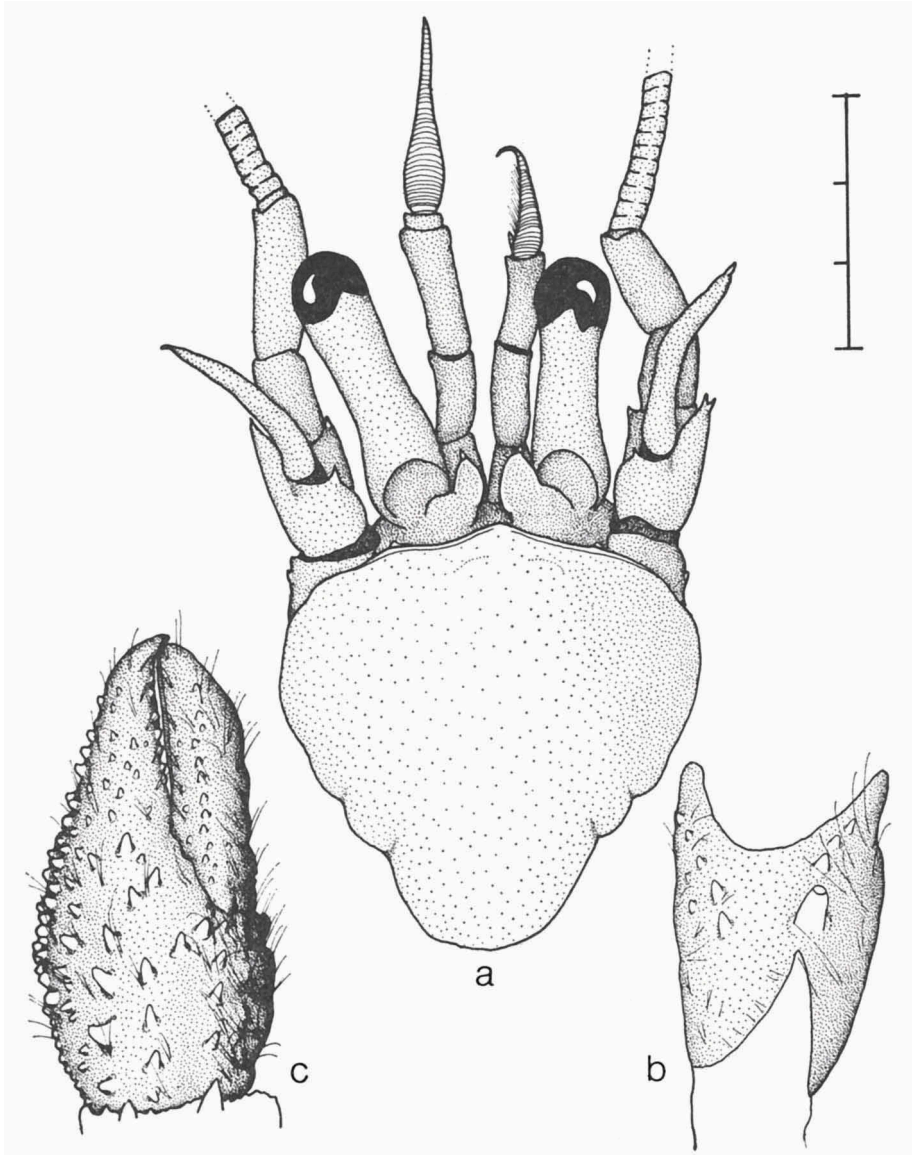


Fig. 33. *Pagurus caurinus* Hart. a, shield; b, right cheliped, merus (ventral view); c, left chela (dorsal view). Scale equals 3 mm.

Antennular peduncles moderately long, equalling or exceeding ocular peduncles by approximately two-thirds length of ultimate segment. Ultimate and penultimate segments unarmed, with few tufts of short setae; basal segment with strong spine at ventromesial distal angle, partially obscured by tuft of long setae.

Antennal peduncles moderately long, exceeding ocular peduncles by one-third to two-thirds length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments unarmed, often with few tufts of short setae. Third segment with small spine at ventromesial distal angle, ventral margin with moderately long setae. Second segment with dorsolateral distal angle produced, terminating in simple, bifid or trifid spine, mesial margin inflated, with 1-4 small spines, lateral margin unarmed, with tufts of long setae; dorsomesial distal angle with small spine, mesial margin with long setae. First segment with small spine on lateral face distally; ventromesial distal margin produced, spinulose laterally. Antennal acicle moderately long, often reaching to distal half of ultimate peduncular segment; strongly arcuate; mesial margin with row of tufts of moderately long setae; terminating in strong spine. Antennal flagella long, overreaching tip of right cheliped; each article with 1-4 very small bristles.

Mandible without distinctive characters. Maxillule with proximal endite tapering or broadly rounded, endopodite with 1 or 2 bristles on slightly produced internal lobe, external lobe moderately well developed, not recurved. Maxilla with endopodite inflated basally, slightly exceeding scaphognathite in distal extension. First maxilliped with endopodite approximately one-half length of exopodite; basal segment of exopodite inflated. Second maxilliped without distinguishing characters. Third maxilliped with basis-ischium fusion incomplete; basis with 3 or 4 small spines; ischium with crista dentata well developed, 1 accessory tooth; merus with dorsodistal margin unarmed, ventral margin with 1-3 small spines. Sternite of mxp_3 unarmed, margin with row of very long setae.

Right cheliped moderately slender and deep, not exceptionally larger than left. Dactyl slightly less than or equalling length of palm; cutting edge with strong calcareous teeth proximally, small corneous teeth distally; terminating in small corneous claw; slightly overlapped and overreached by fixed finger; dorsomesial margin with single or double irregular row of small corneous-tipped or spinulose tubercles or small conical spines and tufts of moderately short setae, dorsal surface slightly elevated in midline, with row of small subacute spines or spinulose tubercles and tufts of short setae; mesial face slightly protuberant, with tufts of long setae; ventral surface with scattered tufts of setae. Palm moderately long, approximately two-thirds to three-

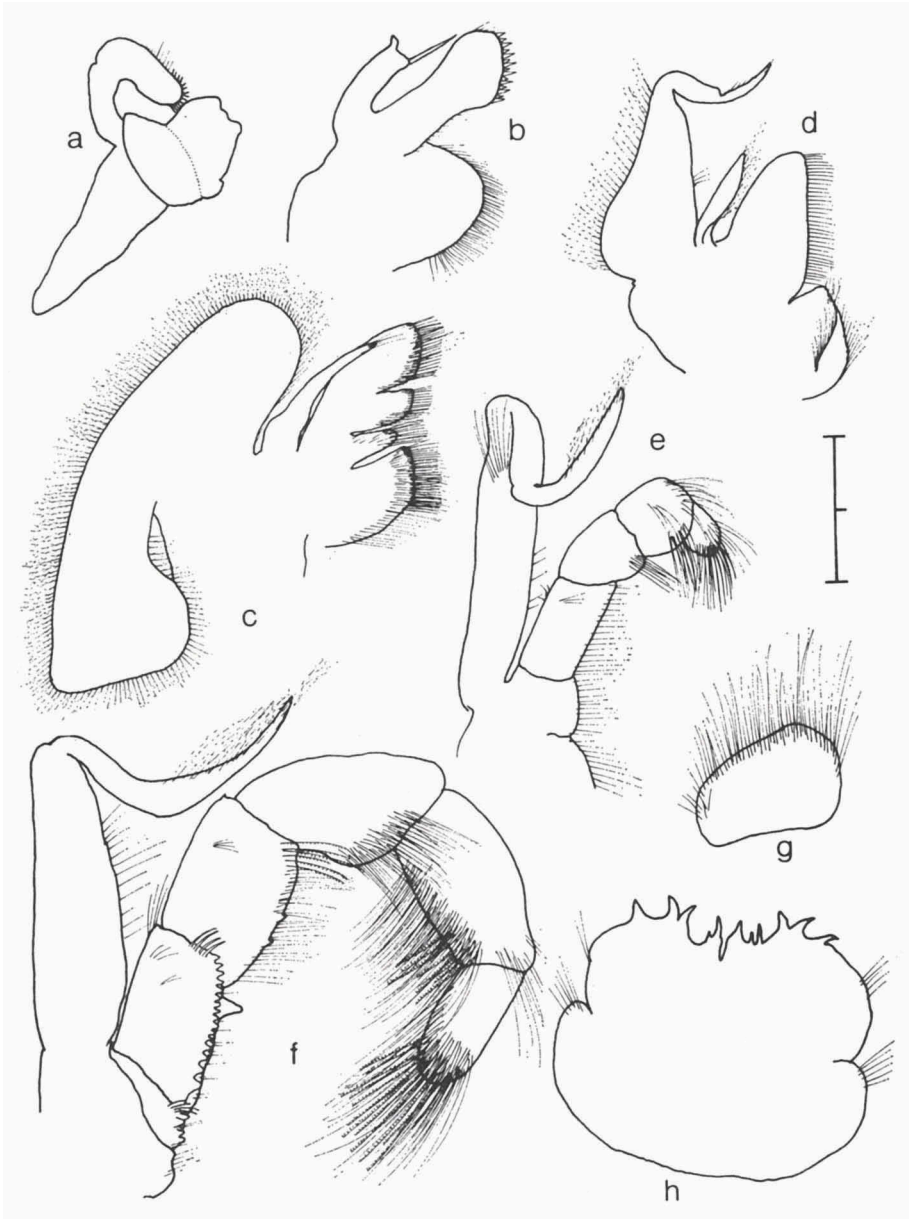


Fig. 34. *Pagurus caurinus* Hart. a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite P₃; h, telson. Scale equals 0.5 mm.

fourths length of carpus; dorsal surface convex, with irregular rows of moderately strong, slender, acute or subacute spines and tufts of long stiff setae, dorsomesial margin with single or double irregular row of moderately small spines, dorsolateral margin with row of subacute or acute spines, increasing in size on fixed finger; lateral face protuberant or tuberculate with tufts of long setae; ventral surface with few, scattered low protuberances and tufts of long, stiff setae; mesial face with simple or bifid small spines or tubercles and scattered tufts of moderately short setae. Carpus equalling or slightly exceeding length of merus; dorsomesial margin with row of strong, slender, acute or subacute spines, usually clustered at distal angle and tufts of very long stiff setae, dorsal surface with 1 row of moderately strong acute or subacute spines mesially, and scattered small spines or spinulose tubercles and tufts of long stiff setae, dorsolateral margin with single or double row of small spines or spinulose tubercles and tufts of short setae, distal margin with row of small spines; lateral face slightly spinulose or tuberculate, distal margin with row of small spines; ventral surface with scattered tufts of setae; mesial face often slightly protuberant with tufts of long setae, distal margin denticulate or spinulose. Merus subtriangular; dorsal surface with transverse irregular rows of low, occasionally spinulose protuberances and rows of stiff setae, distal margin with 2 to several prominent moderately small spines; lateral face spinulose, ventrolateral margin with irregular row of small subacute spines; ventral surface with few small tubercles or subacute spines and 1 or rarely 2 very prominent strong tubercles near ventromesial margin; mesial face with tufts of long setae, distal margin spinulose or denticulate ventrally. Ischium with row of long setae on ventromesial margin, occasionally with few minute spinules on ventral surface. Coxa with row of small denticles on ventrolateral margin, ventromesial margin and distal angle with long setae.

Left cheliped moderately long, frequently reaching beyond base of dactyl of right, slender; surfaces all with tufts of long stiff setae. Dactyl moderately long, one and one-third to one and one-half times length of palm; cutting edge with row of small corneous teeth; terminating in moderately strong corneous claw; usually overlapped by fixed finger; dorsal surface with 1 or 2 rows of small often subacute spines or low tubercles, dorsomesial face oblique, slightly protuberant; ventral surface unarmed. Palm moderately long, approximately one-half length of carpus; dorsal surface strongly convex, with irregular rows of moderately strong acute or subacute spines, decreasing in size on fixed finger, dorsolateral margin with single or double row of moderately slender acute or subacute spines, dorsomesial margin with row of moderately strong, slender acute or subacute spines; mesial

face with spinulose or denticulate low tubercles or protuberances; lateral and ventral surfaces usually tuberculate. Carpus equalling or slightly exceeding length of merus; dorsal surface flattened, dorsomesial and dorso-lateral margins each with row of strong acute or subacute spines, distal margin with few moderately small or occasionally quite prominent spines; mesial face slightly protuberant or tuberculate, distal margin often denticulate; ventromesial margin with row of spinulose tubercles, becoming small spines distally; ventral and lateral surfaces with small tubercles or spines, occasionally only with spinulose protuberances. Merus laterally compressed; dorsal surface with 1 or 2 rows of long setae, distal margin with 1 or 2 small spines; mesial face minutely spinulose or tuberculate, distal margin occasionally spinulose ventrally, ventromesial margin with row of small acute or subacute spines; ventral surface with few scattered small spines or tubercles; lateral face spinulose, ventrolateral margin with row of strong spines. Ischium with row of small spines or spinules on ventromesial margin. Coxa with row of small denticles on ventrolateral margin.

Second pereopods long, equalling or overreaching right cheliped. Dactyl short, approximately four-fifths length of propodus, or occasionally equaling length of propodus; moderately deep; in lateral view, usually straight; in dorsal view, straight or slightly twisted distally; terminating in strong, curved corneous claw; dorsal surface with row of tufts of long setae; mesial face with faint longitudinal sulcus proximally and tufts of long setae, in large specimens also with small corneous spines; lateral face with faint longitudinal sulcus proximally and tufts of long setae; ventral margin with row of strong, corneous spines, increasing in size distally. Propodus slightly exceeding length of carpus; dorsal surface with double row of very long stiff setae; mesial and lateral faces with rows of tufts of long setae; ventral surface with row of corneous spines and tufts of long setae. Carpus three-fourths to four-fifths length of merus; dorsal surface with irregular row of moderately strong often corneous-tipped spines, increasing in size distally; lateral face with faint longitudinal sulcus and usually with 2 or 3 rows of tufts of long stiff setae; mesial and ventral surfaces with few scattered tufts of long setae. Merus laterally compressed; dorsal surface with 2 rows of long setae; lateral and mesial faces with few scattered tufts of setae; ventral margin with single or double row of small spines and tufts of long setae. Ischium with row of long setae on dorsal margin; ventral margin minutely denticulate, with tufts of long setae. Coxa with long setae marginally.

Third pereopods slightly less than or equalling length of second. Dactyl moderately short, slightly less than length of propodus; in lateral view,

straight or slightly curved ventrally; in dorsal view, straight or very slightly twisted; terminating in very strong, curved corneous claw; dorsal surface with row of tufts of long setae, less frequently with double row; mesial face with faint longitudinal sulcus, frequently not noticeable, and 1 or 2 rows of tufts of setae; lateral face occasionally with very faint longitudinal sulcus and tufts of moderately short setae; ventral margin with row of strong corneous spines, increasing in size distally. Propodus approximately one and one-third times longer than carpus; dorsal surface with 2 rows of tufts of long setae; mesial and lateral faces with scattered tufts of setae; ventral surface with row of small corneous spines. Carpus one-half to three-fourths length of merus; dorsal surface with row of tufts of long setae, small spine at dorsolateral margin; mesial, lateral and ventral surfaces with few tufts of short setae. Merus laterally compressed; dorsal surface with 2 rows of long setae; mesial and lateral faces with few tufts of setae; ventral margin with row of long setae. Ischium with rows of tufts of long setae on dorsal and ventral margins. Coxa with long setae marginally.

Fourth pereopods with no apparent preungual process; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods subrectangular, slightly skewed, margin with moderately dense, long setae.

Pleopods of male unpaired, pl_3 - pl_5 with exopodites well developed; endopodites reduced. Pleopods of female unpaired, pl_2 - pl_4 with both rami well developed; pl_5 with exopodite moderately well developed, endopodite reduced.

Telson with posterior lobes very slightly asymmetrical, left larger than right; separated by deep, slender median cleft; right terminal margin with 2 or 3 strong spines laterally, separated by moderately deep concavity from moderately strong spine at inner angle, concavity unarmed, or with 1 or 2 small spines; left terminal margin with 2 or 3 strong spines laterally, separated by broad concavity from 1 moderately strong spine at inner angle, concavity unarmed or with 1 to several small to moderately strong spines; anterior lobes unarmed, margins with moderately long setae.

Coloration. — In life: "Carapace a light grey, with longitudinal stripes of purple and a row of light-coloured spots in each stripe. Laterally, red-brown and cream marbling. Abdomen mottled with grey and purple. Peduncle of both pairs of antennae, eyestalks, and third maxillipeds light coloured with greenish brown bands. Cornea of eye covered with yellow chromatophores, except for narrow bands of black. All flagella orange. Meri of chelipeds a reticulated red-brown and grey, with a dull white or yellowish

band on distal part. Carpi of both chelipeds grey-green and red-brown with tubercles grey based and orange tipped. Chelae light greenish-brown with grey; orange-tipped tubercles and finger tips orange-red. Walking legs with meri red-brown with light spots and a yellowish-white irregular distal band, margined with some orange. Carpus brown with grey spots and median lateral face yellowish. Proximal propodus with a narrow light-coloured band, median part red-brown with grey spots (base of tufts of setae) and distally an opaque white band. Dactylus red-brown with grey spots becoming orange at tip. Claw a translucent brown. The long tan setae mask the colours." (Hart, 1971: 1529). In preservative: Overall red-orange or orange, with bands of cream or white on propodal, carpal and meral segments of second and third pereopods.

Distribution. — Kodiak I., Alaska to McNeil Bay, Victoria, B. C.; littoral to 124 m (Hart); outer Washington coast.

Affinities. — *Pagurus caurinus* appears superficially very close to the species of the "capillatus" group, particularly *P. setosus*. In addition to the characters cited by Hart (1971: 1532), the prominent tubercle on the ventral surface of the merus of the right cheliped will distinguish *P. caurinus* from *P. setosus*, *P. capillatus* and *P. kennerlyi*.

Discussion. — Hart (1971: 1527) tentatively assigned *P. caurinus* to the "miamensis" group of Forest & De Saint Laurent (1967). In their structure the mouthparts of this group differ considerably from those of *P. caurinus*. Similarly, the mouthparts and telson of *P. caurinus* are sufficiently different from those of the "capillatus" group to exclude the species from this group. Therefore, the correct association of *P. caurinus* with other species of *Pagurus* cannot be determined at present.

As previously noted (p. 92), Hart (1971: 1528) followed Makarov (1938b, 1962) in the designation of segments of the antennal peduncle. Hart's references to segments 3 and 4 are equivalent in this description to the fourth and fifth segments, respectively.

***Pagurus beringanus* (Benedict) (figs. 35, 36)**

Eupagurus (Trigonocheirus) beringanus Benedict, 1892: 17 (by implication; type locality: Bristol Bay and north of Aleutian Islands, here restricted by lectotype selection to Bristol Bay, Alaska, "Albatross" station 3231).

Eupagurus (Trigonocheirus) newcombei Benedict, 1892: 17 (by implication; type locality: British Columbia).

Eupagurus newcombei (?): Calman, 1898: 260.

Pagurus (Trigonocheirus) Newcombei: Holmes, 1900: 142 (by implication; misspelling of *Trigonocheirus* Benedict, Holmes, 1900: 134).

Pagurus beringanus: Rathbun, 1904: 159, pl. 5 fig. 5. — Rathbun, 1910: 159, pl. 5 fig. 5. —

Taylor, 1912: 204. — Williamson, 1915: 470. — Schmitt, 1921: 135, fig. 87. — Stevens, 1925: 283, fig. 6. — Hart, 1930: 105. — Shelford et al, 1935: 275. — Wismer & Swanson, 1935: 342. — Hart, 1937: 190, figs. 4A-C, pl. 1 fig. 3. — Makarov, 1938b: 186, pl. 5 fig. 4. — Gurney, 1939: 98. — Hart, 1940: 93. — Vinogradov, 1947: 101 (key). — Vinogradov, 1950: 227 (key). — Gordan, 1956: 326. — MacDonald, Pike & Williamson, 1957: 255. — Coffin, 1958: 1. — Dechancé & Forest, 1958: 275. — Reischman, 1959: 410. — Makarov, 1962: 176, pl. 5 fig. 4. — Bookhout, 1964: 276. — Provenzano & Rice, 1964: 231. — Forest & De Saint Laurent, 1967: 117. — Ricketts, Calvin & Hedgpeth, 1968: 250. — Scelzo & Boschi, 1969: 166. — Roberts, 1970: 201. — Samuelson, 1972: 9.

Eupagurus beringanus: Alcock, 1905: 179. — Gurney, 1939: 98.

Eupagurus newcombei: Alcock, 1905: 179.

Pagurus newcombei: Taylor, 1912: 204. — Williamson, 1915: 479. — Gordan, 1956: 332.

Lectotype of *Eupagurus beringanus* Benedict, herein selected. — ♂ (SL = 11.5 mm), USNM 16679. Lectotype of *Eupagurus newcombei* Benedict, herein selected. — ♂ (SL = 13.7 mm), USNM 15800.

Material examined. — See table 12.

Diagnosis. — Left cheliped with dorsal surface of chela convex, spinose or spinulose; carpus with 1 row of strong spines on dorsal surface. Right cheliped with dorsal face of chela convex, spinose or spinulose; merus with 2 prominent tubercles, set at distal angles, on ventral surface. Dactyl and propodus of left P₃ with ventrolateral faces armed with row(s) of small or moderately strong spines or tubercles.

Description. — Shield with length often considerably exceeding width, rarely length equalling width; anterolateral margins sloping or slightly terraced; anterior margin between rostrum and lateral projections straight or sloping, rarely slightly concave; posterior margin truncate; dorsal surface generally smooth, occasionally slightly rugose or minutely spinulose laterally, with scattered tufts of moderately long setae; anterolateral angle produced, usually spinose. Rostrum moderately short, exceeding lateral projections; triangular or rounded, occasionally obtuse; with or without terminal submarginal spine. Lateral projections obtusely triangular, broadly rounded or obsolete, usually unarmed.

Ocular peduncles moderately long, one-half to three-fourths length of shield; cylindrical, slightly inflated basally, cornea occasionally slightly dilated; dorsal or dorsomesial face with longitudinal row of tufts of short setae. Ocular acicles prominent; subovate or subtriangular, mesial margins usually expanded, lateral margins straight or slightly expanded; terminating acutely or subacutely, with small submarginal spine; dorsal surface level or slightly concave, frequently with tuft of short setae; separated basally by one-third to two-thirds basal width of one acicle.

Table 12. *Pagurus beringanus* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂ +	♀ +	♂ +		
<i>Bering Sea</i>								
58°35'N, 157°28'W	22	Albatross 3231 USNM 16679,108265	2/6/90	3			9.2-11.5	---
Bristol Bay	---	---	---	1			6.9	McKay
Amak I.	---	USNM 5932	9/7/60	1	1		3.9-5.2	Fiscus
Anchor Cove, Unimak I.	---	USNM	26/5/62		2		3.1-3.4	Fiscus
Akutan Harbor, Akutan I.	---	AHF	12/9/62	1			4.9	Fiscus
Unalaska I.	---	RMNH	1897	4			3.6-6.1	---
Eider Pt., Unalaska I.	---	USNM	4/8/63	1			5.2	Fiscus
		EM						
<i>Gulf of Alaska</i>								
King Cove	---	---	14/5/60	1			6.0	Hatfield
		CNM						
Orca, Prince William Sound	---	---	25/6/99	2	1		6.4-10.1	Coe
		USNM 25861						
Yakutat Bay	---	---	6/99	1	1		3.4-3.7	---
		USNM						
<i>British Columbia</i>								
Sunset Pt., Vancouver I.	---	---	21/7/62		1		6.7	Landrum
		AHF						
Victoria	18	---	---	1			13.7	Newcombe
		USNM 15800						
Victoria, McNeil Bay	---	---	9/7/71	12	4	12	4.1-7.5	Hart
		USNM, RMNH, EM						
<i>Washington</i>								
Outer coast	---	---	1/8/71	2			10.7-12.8	Nyblade
		USNM						
Strait of Juan de Fuca	---	---	9/8/61	3			7.3-10.5	Davis
		USNM						
San Juan Is.	---	---	5/61	3	2	5	2.2-6.0	Henry
		USNM						
San Juan I.	---	---	8/61	2	2	1	4.5-10.1	McLaughlin
		EM						
Mitchell Bay, San Juan I.	---	---	28/7/61	3	7	1	2.4-6.6	McLaughlin
		USNM, AHF						
Marvista, San Juan I.	---	---	13/8/61	1	1		2.8-3.4	Landrum
		USNM						
Friday Harbor, San Juan I.	---	---	1922	2			4.6-10.6	Stevens
		USNM						
Friday Harbor, San Juan I.	---	---	8/61	2			8.9-15.5	McLaughlin
		USNM						
San Juan Channel	---	---	2-3/8/61	5	5		2.5-5.2	McLaughlin
		CNM						
Waldron I.	---	---	29/7/61	1			8.5	Ray
		USNM						
Rose Spit Graham I.	36	---	30/7/36	1			4.3	Stevens
		USNM						
Naden Harbor, Graham I.	28	---	10/12/65	2			1.9-2.1	---
		USNM						
Turn I.	---	---	27/7/61	8	11		1.9-6.4	McLaughlin
		RMNH, USNM						
Lopez Sound	36	---	10/8/61	21	18	1	2.4-5.5	McLaughlin
		USNM, RMNH						
Port Orchard Bay	---	---	29/6/61	4	2	4	2.9-6.9	McLaughlin
		USNM						
Golden Gardens	---	---	3/11/60	1			2.3	Sukuda
		USNM						
Point Defiance	---	---	6/62	1			8.9	Young
		USNM						
Off Anchor Point	---	---	spring 60	1			10.5	---
		USNM						

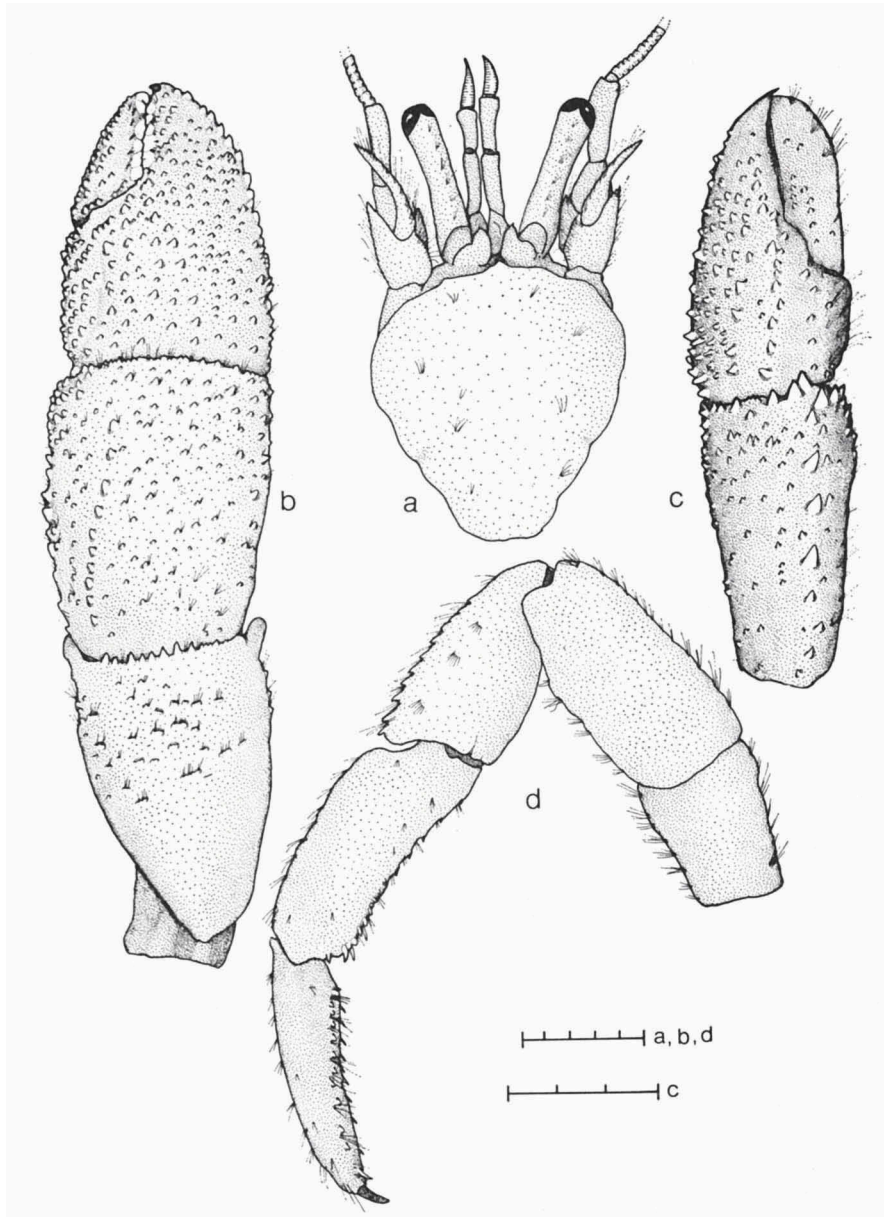


Fig. 35. *Pagurus beringanus* Benedict). a, shield; b, right cheliped (dorsal view); c, left chela and carpus (dorsal view); d, left P₃ (lateral view). Scales equal 5 mm (a, b, d) and 3 mm (c).

Antennular peduncles moderately long, frequently exceeding ocular peduncles by one-third to one-half length of ultimate segment, occasionally not reaching to tip of cornea. Ultimate and penultimate segments unarmed, often with few tufts of short setae; basal segment with dorsolateral distal angle slightly protuberant, spinulose.

Antennal peduncles moderately long, exceeding ocular peduncles by one-fourth to two-thirds length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments unarmed, frequently with few tufts of short setae. Third segment with moderately strong, acute spine at produced ventromesial distal angle, mesial face frequently slightly spinulose. Second segment with dorsolateral distal angle produced, terminating in simple, bifid or multifid spine, mesial margin inflated, with 1-5 small spines or spinules, lateral margin with tufts of long setae; dorsomesial distal angle with strong spine, mesial face with row of long setae. First segment usually with small spine on lateral face; ventrodistal margin produced, unarmed or rarely, slightly spinulose. Antennal acicles moderately long, usually reaching proximal one-third or one-half ultimate peduncular segment; strongly arcuate; mesial margin occasionally slightly spinulose, frequently unarmed, with row of tufts of long setae; terminating in strong, simple or bifid spine. Antennal flagella moderately short, not overreaching tip of right cheliped; with 2-4 minute setae on each of alternating articles.

Mandible without distinctive characters. Maxillule with proximal endite subquadrate; endopodite with small bristle on internal margin proximally, 1 or 2 bristles on weakly produced internal lobe, external lobe well developed, not recurved. Maxilla with endopodite inflated basally, approximately equalling scaphognathite in distal extension. First maxilliped with endopodite approximately two-thirds length of exopodite; basal segment of exopodite subtriangular. Second maxilliped without distinguishing characters. Third maxilliped with basis-ischium fusion incomplete; basis with 1 or 2 small spines or spinules; ischium with crista dentata well developed, 1 or 2 accessory teeth; merus with dorsodistal margin unarmed or with 1 small spine, ventral margin with 1-3 small spines; carpus with dorsodistal margin unarmed. Sternite of mxp_3 unarmed, margin with row of long setae.

Right cheliped moderately short and broad in small specimens, tending to become elongate and moderately slender in large specimens. Dactyl moderately short, usually slightly less than length of palm, moderately broad; cutting edge with row of strong calcareous teeth; terminating in small corneous claw; dorsomesial margin with irregular single or occasionally double row of moderately small tubercles, dorsal surface slightly elevated, with 3 or 4 irregular rows of small blunt or spinulose tubercles and few

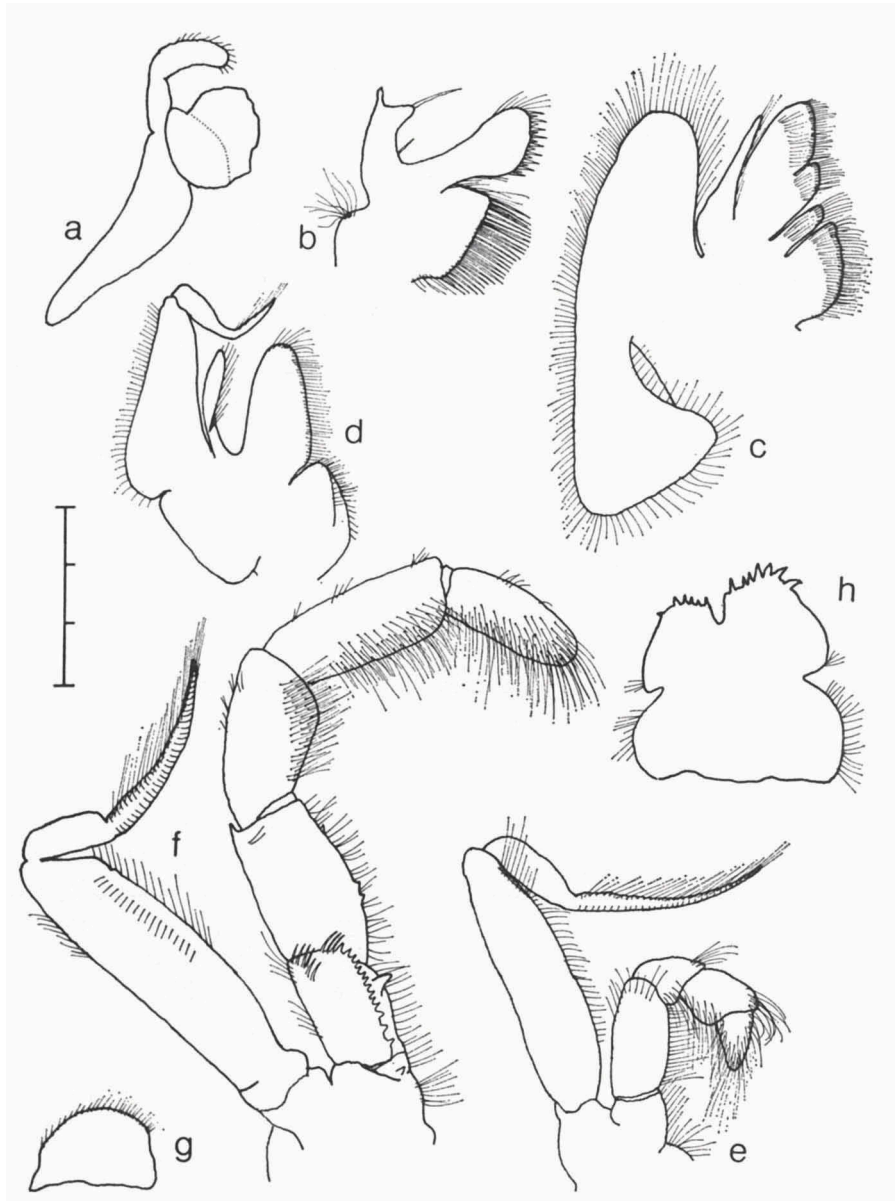


Fig. 36. *Pagurus beringanus* (Benedict). a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite P₃; h, telson. Scale equals 3 mm.

tufts of short setae or bristles; ventral surface unarmed or occasionally slightly tuberculate or protuberant, with tufts of long bristles. Palm moderately long, two-thirds to three-fourths length of carpus; inflated dorso-ventrally, dorsomesial margin with single or double row of small conical spines or spinulose tubercles, frequently separated from convex dorsal surface by shallow longitudinal furrow, surface with irregular rows of small conical often corneous-tipped spines or spinulose or blunt tubercles, usually more prominent in midline and forming indistinct inverted V, dorsolateral margin with single or double row of small spines or tubercles proximally, becoming prominent tubercles on fixed finger and few tufts of short setae; mesial and lateral faces usually tuberculate with tufts of short setae; ventral surface unarmed or with few low tubercles or protuberances and tufts of long setae, ventromesial margin not delimited or occasionally with row of small spinules or spinulose tubercles. Carpus long, usually equalling or slightly exceeding length of merus; dorsomesial margin with single or double row of moderately strong acute or subacute spines or spinulose tubercles frequently clustered at distal angle, dorsal surface slightly convex, with moderately closely-spaced, small spines or spinulose or blunt tubercles, and 1 irregular row of small spines mesially, distal margin denticulate or weakly spinose with tufts of moderately long setae, dorsolateral margin frequently with row of small spines or spinulose tubercles and tufts of short setae; lateral face unarmed or slightly spinulose, distal margin denticulate; mesial margin tuberculate with tufts of long setae, distal margin with row of small tubercles or subacute spines; ventral surface usually slightly tuberculate or spinulose, distal margin tuberculate. Merus triangular; dorsal surface with low, transverse spinulose or multidenticate protuberances and tufts of short setae distally, distal margin with row of moderately strong spines; lateral and mesial faces with tufts of moderately long setae, distal margins each with row of small spines or tubercles; ventral surface with prominent tubercle at each distal angle, ventromesial and ventrolateral margins distally often with few small spines or tubercles. Ischium with row of small denticles on ventromesial margin, ventrolateral proximal angle with cluster of small spinules or denticles, ventromesial and distal margins with long setae. Coxa with row of small denticles on ventrolateral margin, ventrolateral distal angle denticulate, ventromesial distal angle with clump of stiff setae.

Left cheliped moderately short, usually not reaching to proximal margin of right dactyl, moderately slender. Dactyl long, usually approximately twice length of palm, broad, flattened distally; cutting edge with row of small corneous teeth; terminating in small corneous claw; overlapped and overreached by fixed finger; dorsal surface unarmed or with few small spines

or spinulose tubercles and tufts of moderately long setae; mesial and ventral surfaces with tufts of short bristles. Palm moderately short, one-third to one-half length of carpus; dorsolateral margin with single or double row of moderately strong acute or subacute spines, decreasing in size on fixed finger, dorsolateral surface sloping, with several irregular rows of small acute or subacute spines or spinulose tubercles, apex rounded, with row of moderately strong, frequently corneous-tipped spines, decreasing in size on fixed finger, dorsomesial surface strongly sloping, usually unarmed, dorsomesial margin with row of small spines or spinulose tubercles and tufts of long setae; mesial face with 1 or 2 irregular rows of small spines or tubercles and tufts of long setae; ventral surface usually slightly spinulose or tuberculate with tufts of long setae and bristles. Carpus moderately long, slightly less than or equalling length of merus; subtriangular; dorsomesial margin with row of strong acute or subacute spines, distal margin with 2 or 3 strong spines, dorsal surface slightly oblique, often with 1 or 2 rows of small spines; lateral surface strongly spinulose, distal margin with row of small spines or spinulose tubercles, ventrolateral margin with row of small tubercles or spines; mesial face weakly spinulose, with tufts of long setae, distal margin with row of small spines or tubercles, ventromesial distal angle usually produced, spinose, ventromesial margin with irregular row of small spinules or spinulose tubercles and tufts of long setae; ventral surface frequently spinulose or tuberculate with tufts of long setae. Merus subtriangular, slightly compressed laterally; dorsal surface with short, transverse, spinulose or denticulate ridges or small spinulose tubercles, becoming small spines distally and tufts of long setae, distal margin with 2 or 3 small spines; lateral face with scattered small spines or spinules dorsally, usually multidenticate tubercles or protuberances ventrally, distal margin with row of small spines; mesial face with few spinules or spinulose tubercles distally and ventrally, distal margin with few moderately strong spines ventrally; ventral surface unarmed or slightly spinulose or tuberculate and with tufts of very long setae, ventrolateral margin with row of strong spines distally, ventromesial margin with single or double row of small spines or spinules. Ischium with row of denticles or tubercles on ventromesial margin, ventrolateral proximal angle usually protuberant, often spinulose. Coxa with row of small denticles on ventrolateral margin, ventromesial distal angle with clump of long stiff setae.

Second pereopods moderately long, equalling or slightly exceeding length of right cheliped. Dactyl moderately short, equalling or slightly exceeding length of propodus, deep; in lateral view, straight or slightly curved ventrally; in dorsal view, straight or slightly twisted; terminating in strong corneous claw; dorsal surface with single or double row of tufts of moderately long

setae, occasionally also with few corneous spinules distally; mesial face with faint longitudinal sulcus flanked by double or triple rows of corneous spines and tufts of short setae; lateral face with faint longitudinal sulcus and tufts of short setae; ventral margin with row of strong corneous spines, increasing in size distally. Propodus moderately long, usually equalling or slightly exceeding length of carpus; dorsal surface with single or double row of small, frequently corneous-tipped spines and tufts of long setae; mesial and lateral faces with rows of tufts of long setae; ventral surface with row of corneous spines, increasing in size distally and partially obscured by tufts of long setae. Carpus slightly less than or equalling length of merus; dorsal surface with row of moderately strong often corneous-tipped spines and tufts of long setae; mesial and lateral faces with rows of tufts of long setae; ventral surface with row of corneous spines, increasing in size distally and partially obscured by tufts of long setae. Carpus slightly less than or equalling length of merus; dorsal surface with row of moderately strong often corneous-tipped spines and tufts of moderately long setae; lateral face frequently with faint longitudinal sulcus and tufts of long setae; mesial and ventral surfaces with few tufts of setae. Merus laterally compressed; dorsal margin with single or double row of low usually spinulose or denticulate protuberances or ridges and tufts of long setae; lateral face frequently spinulose and with scattered tufts of setae; mesial face with few tufts of setae or bristles; ventral margin with single or double row of small spines, partially obscured by tufts of long setae. Ischium with row of small denticles on ventral margin, partially obscured by tufts of long setae. Coxa with ventroproximal angle denticulate, margins with tufts of long setae.

Third pereopods moderately long, usually equalling length of second; dissimilar from right to left. Dactyl equalling or slightly exceeding length of propodus; in lateral view, straight or slightly curved ventrally; in dorsal view, usually twisted; terminating in strong corneous claw; dorsal surface with double row of tufts of long setae and often with 1 row of small corneous spines; mesial face with longitudinal sulcus flanked by single or double rows of corneous spines and few tufts of setae; lateral face with faint longitudinal sulcus proximally and tufts of setae (right pereopod), or with faint longitudinal sulcus proximally, 1 or 2 irregular rows of small calcareous, often corneous-tipped spines or spinulose tubercles and few tufts of short setae (left pereopod); ventral margin with row of strong corneous spines, increasing in size distally. Propodus slightly exceeding length of carpus; dorsal surface with double row of tufts of moderately long setae, occasionally 1 small spine at distal margin; mesial face with tufts of setae and scattered, small corneous spinules; lateral face with 2 or 3 rows of short setae (right

pereiopod), or 1 or 2 irregular rows of small spines or spinulose tubercles approximating ventral margin, distal margin with 1 or 2 very strong spines and few tufts of short setae (left pereiopod); ventral margin with row of corneous spines, increasing in size distally. Carpus three-fourths to four-fifths length of merus, or occasionally equalling length of merus; dorsal surface with row of moderately small often corneous-tipped spines; lateral, mesial and ventral surfaces with tufts of setae. Merus laterally compressed; dorsal surface with double row of tufts of long setae; mesial and lateral faces occasionally with few tufts of setae; ventral margin unarmed or slightly spinulose, with tufts of long setae. Ischium with tufts of setae on dorsal and ventral margins. Coxa with tufts of setae marginally.

Fourth pereiopods without apparent preungual process; propodal rasp well developed.

Fifth pereiopods typical.

Sternite of third pereiopods subsemicircular, frequently slightly skewed, margin with long setae.

Pleopods of male unpaired, pl_3 - pl_5 with exopodites well developed; endopodites rudimentary. Pleopods of females unpaired, pl_2 - pl_4 with both rami well developed; pl_5 with exopodite moderately well developed, endopodite rudimentary.

Telson with posterior lobes slightly asymmetrical, left slightly larger than right; separated by moderately narrow, median cleft; each terminal margin with 6-10 small spines, increasing in size laterally and frequently extending onto lateral margins distally. Anterior lobes with tufts of setae.

Coloration. — In life: "Brussels brown with brighter markings; chelipeds with flame scarlet spines, fingers pale glaucous green but tipped with scarlet, distal end of merus with a distinct scarlet band terminated by spines of the same color; ambulatory legs of a lighter hue than the chelipeds, often shading to the green on the propodi and dactyls, marked with large irregular spots of claret brown which are replaced by a spot of Brazil red at the articulations, dactyls tipped with claret brown and having spines of the same color. Antennae claret brown to Brussels brown. The young are lighter in color except the basal portion of the coxopodite which is a dark brown to olive and usually separated from the anterior portion of the segment by a darker brown band." (Stevens, 1925: 284). In preservative: Chelipeds reddish-orange with white or cream-colored band on dactyli and fixed fingers, tips dark red; ambulatory legs generally yellow-orange spotted with red, each segment with irregular band of red distally and also proximally on propodi and dactyls; spines red or red-tipped.

Distribution. — Bering Sea, Aleutian Is., southward to Monterey, California; intertidal to 82 m (Rathbun, Schmitt, Stevens, Hart, Makarov).

Affinities. — *Pagurus beringanus* appears to be rather closely allied with several of the other intertidal and shallow water species of the area, i.e., *P. hemphilli*, *P. granosimanus*, *P. samuelis*, and *P. h. hirsutiussculus*. In the structure of the chelipeds, *P. beringanus* is most similar to *P. hemphilli*, but may be distinguished from the latter species by the presence of 2 large tubercles on the ventrodiscal margin of the merus of the right cheliped. The spinose or spinulose armature of the chelipeds distinguishes *P. beringanus* from all four species, as does its distinctive coloration in life.

Discussion. — Rathbun (1904: 159; 1910: 159), noting that the two species varied only in the acuteness of the spines, put *Pagurus newcombei* in synonymy with *P. beringanus*. Having examined the type series of both species, I concur with Rathbun that *P. beringanus* and *P. newcombei* are conspecific. The lectotype of *P. newcombei* has 2 accessory teeth, set perpendicular to the margin of the crista dentata, whereas in the lectotype of *P. beringanus* only 1 tooth is present; however, in a large series of specimens from a single area, the number of accessory teeth on the crista dentata was found to be variable.

As previously mentioned (p. 43), the six northwestern North American species, including *P. beringanus*, which were included in the “*comptus*” group by Forest & De Saint Laurent (1967), are dissimilar among themselves in several significant characters. Specimens of the three South American species assigned to this group have not been available for examination; therefore, no comparisons can be made of the mouthparts. The mouthparts of *P. beringanus* and *P. hemphilli* differ in several characters from the other four North American species. It is also impossible to determine whether the characters used by Forest & De Saint Laurent to define the “*comptus*” group apply to all three South American species. The structure of the propodal rasp of the fourth pereopod does not agree with any of the six assigned North American species. *P. beringanus* also lacks chitinous plates on the lateral margins of the telson and differs in the armature of the terminal margins. Although *P. beringanus* differs from the “*comptus*” group, as originally defined, this species cannot be reassigned until the group has been adequately redefined.

***Pagurus hemphilli* (Benedict) (figs. 37, 38)**

Eupagurus (Trigonochirus) hemphilli Benedict, 1892: 16 (by implication; type locality:

California, here restricted by lectotype selection to Monterey, California).

Pagurus (Trigonocheirus) Hemphilli: Holmes, 1900: 147 (by implication; misspelling of *Trigonochirus* Benedict, Holmes, 1900: 134).

Pagurus hemphilli: Rathbun, 1904: 160, pl. 5 fig. 9. — Rathbun, 1910: 160, pl. 5

fig. 9. — Schmitt, 1921: 142, fig. 92. — Hart, 1940: 94. — Tomlinson, 1953: 374. — Gordan, 1956: 330.

Pagurus hemphilli: Johnson & Snook, 1927: 336. — Reinhard, 1944: 54. — Smith et al, 1957: 183 (key), fig. 90b. — Ricketts, Calvin & Hedgpeth, 1968: 49, fig. 17. — Hart, 1971: 1542.

Pagurus hemphilli: Forest & De Saint Laurent, 1967: 117.

Lectotype, herein selected. — ♂ (SL = 9.8 mm), USNM 3293.

Material examined. — See table 13.

Table 13. *Pagurus hemphilli* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex				SL (mm)	Collector
				♂ ⁺	♀	♀♀	♀ ⁺		
<i>British Columbia</i>									
Stewart Ch., Queen Charlotte Is.	---	----	16/6/35	1			6.2	Hart	
Ucluelet, Vancouver I.	---	RMNH ----- USNM 40061,40263	1909	2			8.2-8.5	---	
<i>Washington</i>									
Outer coast	---	EM, RMNH -----	1/8/71	3			5.4-7.0	Nyblade	
<i>California</i>									
Pacific Grove	---	USNM 53963 -----	1918	1			4.3	Oldroyd	
Monterey	---	USNM 3293 -----	----	1			9.8	Hemphill	

Diagnosis. — Left cheliped with dorsal surface of chela convex, tuberculate; carpus with row of strong spines proximally, usually double row distally. Right cheliped with dorsal surface of chela convex, tuberculate; carpus very prominently inflated ventrally, mesial and lateral faces parallel; merus with prominent tubercles at ventrolateral proximal angle.

Description. — Shield considerably longer than broad; anterolateral margins sloping or terraced; anterior margin between rostrum and lateral projections straight or slightly concave; posterior margin truncate or roundly truncate; dorsal surface smooth or slightly grooved, with tufts of long setae laterally; anterolateral angle produced, blunt. Rostrum moderately long, usually considerably exceeding lateral projections; obtusely or acutely triangular; terminating in small spine or spinule. Lateral projections obtusely triangular or broadly rounded, terminating acutely or with prominent small spine.

Ocular peduncles moderately long, usually one-third to two thirds length of shield, moderately slender; inflated basally, cornea slightly dilated; dorso-mesial and dorsolateral faces often with longitudinal row of tufts of short setae. Ocular acicles moderately long, subtriangular, with mesial margins slightly expanded, lateral margins straight or sloping; terminating acutely

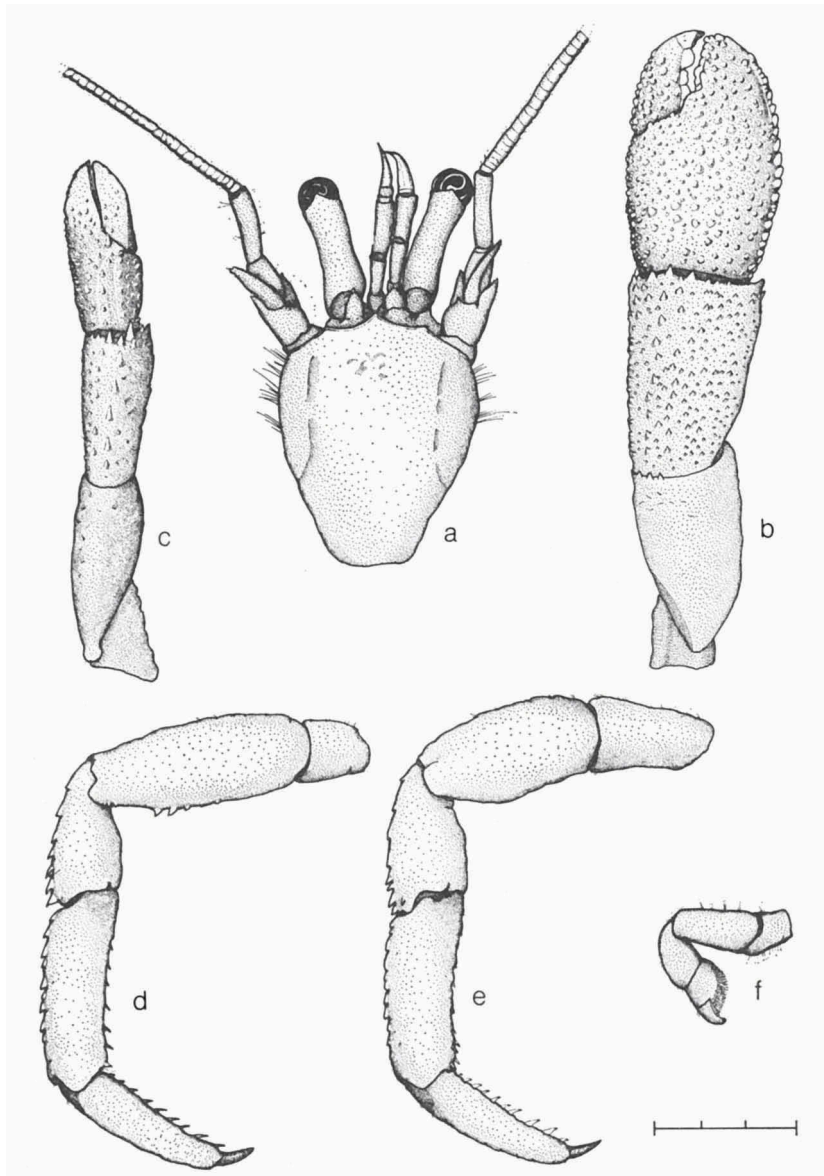


Fig. 37. *Pagurus hemphilli* (Benedict). a, shield; b, right cheliped (dorsal view); c, left cheliped (dorsal view); d, left P₂ (lateral view); e, left P₃ (lateral view); f, left P₄ (lateral view). Scale equals 3 mm.

or subactutely, with small submarginal spine; separated basally by two-thirds to three-fourths basal width of one acicle.

Antennular peduncles moderately short, usually equalling or slightly exceeding length of ocular peduncles, occasionally reaching only to cornea. Ultimate and penultimate segments unarmed, occasionally with few tufts of short setae; basal segment with small spinule at ventromesial distal angle, partially obscured by tuft of short setae.

Antennal peduncles moderately short, equalling or slightly exceeding length of ocular peduncles; with supernumerary segmentation. Fifth segment unarmed, or occasionally with 1 or 2 minute spinules on ventral margin, dorsal and ventral margins with tufts of short setae. Fourth segment with few tufts of short setae. Third segment with ventromesial distal angle produced, terminating in small spine, ventral margin with tufts of moderately long setae. Second segment with dorsolateral distal angle produced, terminating in strong simple or bifid spine, mesial margin with 1-3 small spines, lateral margin with few tufts of short setae; dorsomesial distal angle with strong spine, mesial margin with long setae. First segment often with 1 or 2 small spines or spinules on lateral margin; ventral margin produced, denticulate. Antennal acicles moderately short, usually reaching or slightly exceeding proximal margin of ultimate peduncular segment; arcuate, or rarely almost straight; terminating in simple or bifid spine; mesial margin usually with row of tufts of short setae. Antennal flagella short, rarely reaching to tip of right cheliped; each article with very short setae.

Mandible without distinguishing characters. Maxillule with proximal endite subquadrate; endopodite usually with short bristle on inner margin, 1 or 2 bristles on slightly produced internal lobe, external lobe moderately well developed, not recurved. Maxilla with endopodite slightly inflated basally, equalling or slightly exceeding scaphognathite in distal extension. First maxilliped with endopodite approximately two-thirds length of exopodite; basal segment of exopodite slender. Second maxilliped without distinctive characters. Third maxilliped with basis-ischium fusion incomplete; basis with 1 or 2 small spines; ischium with crista dentata well developed, 2 accessory teeth, parallel to margin; merus with small spine or spinule at dorsodistal margin, ventral margin with 1-5 small spines; carpus usually with small spine or spinule at dorsodistal margin. Sternite of m_{xp_3} unarmed, with long, marginal setae.

Right cheliped considerably larger than left. Dactyl short, one-half to two-thirds length of palm, moderately broad, slightly compressed dorsoventrally; cutting edge with row of strong calcareous teeth proximally, few corneous teeth distally; terminating in strong, calcareous tooth or less frequently in

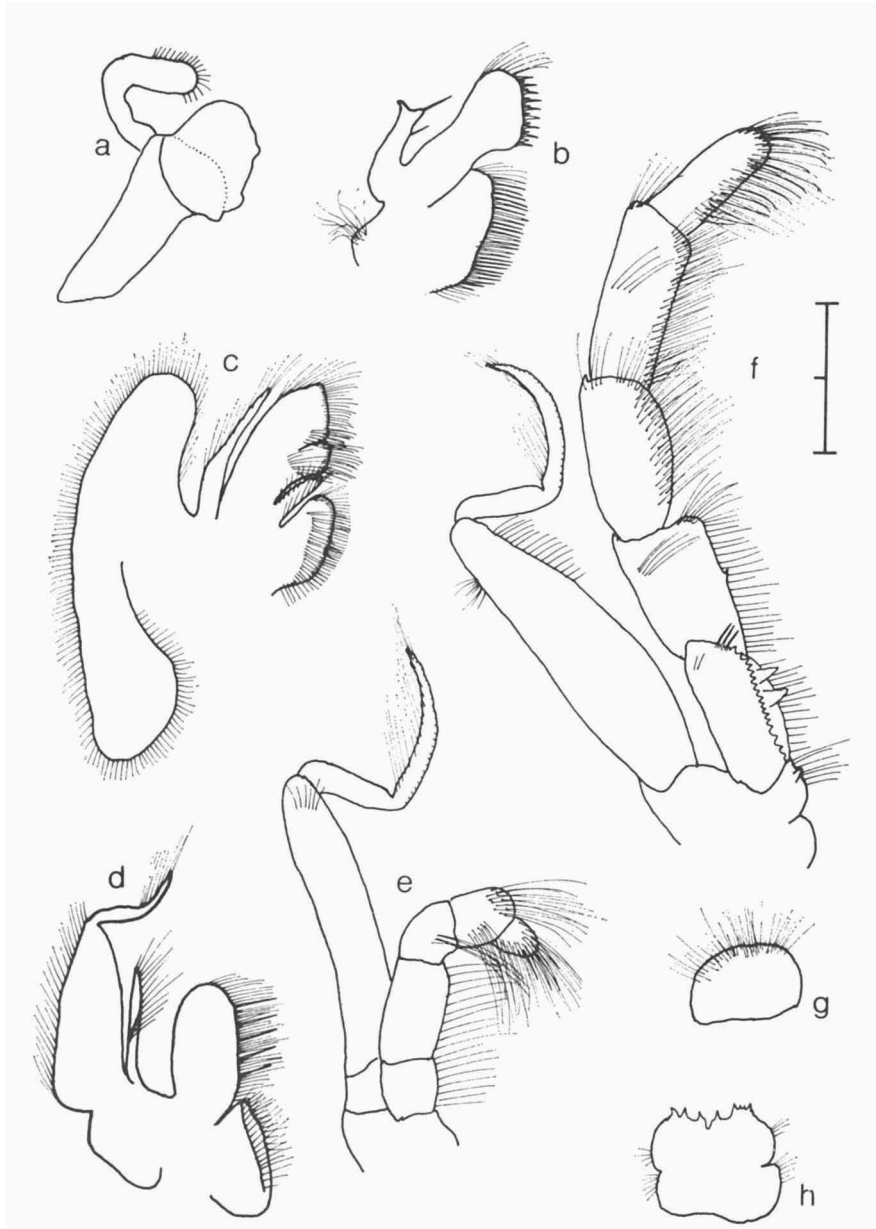


Fig. 38. *Pagurus hemphilli* (Benedict). a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite, P₃; h, telson. Scale equals 1 mm.

corneous claw; dorsomesial margin with row of small tubercles, becoming obsolete distally, dorsal surface slightly convex with scattered low tubercles; ventral surface with small tubercles and tufts of short setae. Palm with fixed finger broad, slightly compressed dorsoventrally; dorsolateral margin with row of prominent usually blunt tubercles, slightly elevated proximally on fixed finger, dorsal surface convex, with moderately closely-spaced tubercles strongest near midline, dorsomesial margin with irregular row of small tubercles, frequently delimited from dorsal surface by shallow, longitudinal furrow; mesial face with closely-spaced small tubercles and few tufts of short setae; ventral and lateral surfaces granular or tuberculate. Carpus moderately long, usually exceeding length of merus, slender, very prominently inflated ventrally, mesial and lateral faces approximately parallel; dorsal surface slightly convex with closely-spaced, small tubercles or spines, distal margin with several moderately strong spines and small spines or spinules, dorsomesial and dorsolateral margins not noticeably delimited; mesial face with closely-spaced small spines, spinulose or blunt tubercles or large granules, distal margin with small usually blunt spines; lateral face spinulose or tuberculate, distal margin with row of small tubercles or denticles; ventral surface minutely spinulose or tuberculate or occasionally granular, ventromesial margin with irregular single or double row of small tubercles. Merus moderately short, subtriangular, ventrally inflated; dorsal surface weakly denticulate or with few spinulose ridges or with numerous spinulose ridges, small tubercles and multifid spines or spinules, distal margin with several moderately strong spines; lateral face smooth or spinulose, distal margin unarmed or with few small spines dorsally, ventrolateral margin with irregular row of small tubercles, becoming small prominent spines distally, or with row of small spinules; mesial face spinulose or weakly tuberculate dorsally, with small usually multidenticate tubercles ventrally, distal margin unarmed or with row of small spines dorsally, ventromesial margin with single or double row of small tubercles or small subacute spines; ventral surface spinulose or tuberculate, 1 slightly more prominent tubercle near ventrolateral margin proximally, not infrequently worn. Ischium with irregular, single or double row of small tubercles on ventromesial margin; ventrolateral margin and proximal angle with small spinules or spinulose tubercles. Coxa with few very small spinules on ventrolateral margin distally, ventromesial distal angle with clump of long setae.

Left cheliped short, reaching slightly beyond proximal margin of right chela, slender. Dactyl moderately long, often considerably exceeding length of palm, slender or moderately stout, approximately equalling width of fixed finger; cutting edge with row of small corneous teeth; terminating in small

corneous claw; slightly overlapped by fixed finger; dorsal surface with small spinulose or blunt tubercles, scattered or in 2 irregular rows and few tufts of short setae or bristles; mesial and ventral surfaces with tufts of bristles. Palm moderately long, one-third to two-thirds length of carpus, slender; dorsolateral and dorsomesial surfaces strongly oblique or approximately perpendicular proximally, with irregular rows of small blunt or spinulose tubercles or small spinules, midline elevated, slightly flattened, with 2 rows of prominent, small acute or subacute spines, extending onto fixed finger proximally as irregular row of small spinulose tubercles; ventral surface unarmed, or with low granules or tubercles and tufts of stiff setae. Carpus moderately long, slightly less than, equalling, or slightly exceeding length of merus; subtriangular, with lateral and mesial surfaces acutely oblique; dorsal surface with row of moderately strong frequently corneous-tipped spines, increasing in size and occasionally becoming double row distally, distal margin with 2 or 3 strong spines; mesial face weakly spinulose or tuberculate, distal margin with few small spines; lateral face with small spines and spinulose and multidenticulate tubercles and tufts of short setae, distal margin with row of small spines; ventral surface with small spines or spinulose tubercles, ventromesial and ventrolateral margins not noticeably delimited. Merus subtriangular, slightly compressed laterally; dorsal surface unarmed or with short, transverse spinulose or denticulate ridges and tufts of short setae, distal margin with 1 or 2 prominent small spines; mesial face unarmed or weakly spinulose, ventromesial margin with single or double row of spinulose tubercles or small spines; lateral face with short spinulose ridges or low spinulose tubercles or protuberances, ventrolateral margin with row of prominent small spines distally; ventral surface usually slightly spinulose or tuberculate. Ischium with row of small denticles or protuberances on ventromesial margin, ventral surface with few small tubercles and tufts of short setae or bristles. Coxa with row of minute spinules on ventrolateral margin proximally, distal angle spinulose, ventromesial distal angle and margin with long, stiff setae.

Second pereopods moderately short, usually not overreaching right cheliped. Dactyl moderately long, slightly less than or equalling length of propodus; in lateral view straight or very slightly curved ventrally; in dorsal view, straight; terminating in strong corneous claw; dorsal surface with 1 or 2 irregular rows of tufts of moderately short setae; lateral face with few tufts of short setae, occasionally with longitudinal sulcus proximally; mesial face usually with longitudinal sulcus flanked by single or double row of small corneous spinules, and few tufts of short setae; ventral margin with row of strong corneous spines, increasing in size distally. Propodus

one and one-fourth to one and one-third times length of carpus; dorsal margin with 1 or 2 rows of small often corneous-tipped spines; mesial and lateral faces with 1-3 rows of tufts of short setae; ventral margin with row of corneous spines, increasing in size distally. Carpus moderately long, two-thirds to three-fourths length of merus; dorsal surface with single or double row of strong spines and few tufts of moderately long setae; mesial, lateral and ventral surfaces with tufts of short setae. Merus laterally compressed, dorsal margin usually with 1 or 2 rows of low protuberances and tufts of moderately short setae; lateral face smooth or spinulose, with tufts of short setae; ventral margin with single or double row of spinulose tubercles, or small spines, or less frequently corneous spinules, increasing in size distally, ventrolateral margin with a few small spinules or denticles distally or frequently unarmed; mesial face unarmed or with few low protuberances dorsally and tufts of short setae. Ischium with row of small spinules on ventral margin and tufts of moderately short setae, dorsal margin frequently denticulate. Coxa usually with 1 or 2 small spinules on ventrolateral distal angle, ventroproximal angle spinulose or denticulate, ventromesial margin with long setae.

Third pereopods slightly shorter or equalling length of second, dissimilar from left to right. Dactyl slightly less than or equalling length of propodus, moderately broad; in lateral view, straight or slightly curved ventrally; in dorsal view, straight or slightly twisted; terminating in strong corneous claw; dorsal surface with 1 or 2 rows of short setae, often also with row of small, corneous spines; mesial face with longitudinal sulcus flanked by single or double row of corneous spinules and tufts of short setae; lateral face occasionally with faint longitudinal sulcus and few tufts of short setae; ventral margin with row of strong, corneous spines, increasing in size distally. Propodus moderately long, usually considerably exceeding length of carpus; dorsal margin with single or double row of small spines or less frequently with double or triple row of spinulose protuberances and tufts of short setae; lateral face with tufts of short setae (right pereopod) or with short row of strong spines at ventral margin distally (left pereopod); mesial face with rows of tufts of very short setae, distal margin frequently with short row of small corneous spines ventrally; ventral margin with row of corneous spines, frequently becoming double row and increasing in size distally. Carpus moderately long, slightly less than or equalling length of merus; dorsal margin with single or double row of small spines, increasing in size distally; lateral face usually unarmed, with few tufts of short setae, occasionally with small spine near distal margin dorsally; mesial and ventral faces with few tufts of short setae. Merus laterally compressed; dorsal surface usually with 1 or

2 irregular rows of low protuberances and tufts of short setae; lateral and mesial faces often with few tufts of short setae; ventral surface with low protuberances and tufts of short setae or with row of small spines or spinules, occasionally with cluster of small spinules distally. Ischium with row of minute spinules and tufts of setae on ventral margin, or unarmed; dorsal margin with row of tufts of moderately long setae. Coxa with marginal tufts of setae.

Fourth pereopods without apparent preungual process; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods broad, subsemicircular, margin with row of moderately long setae.

Pleopods of male unpaired, typically, pl_3 - pl_5 with exopodite well developed; endopodite reduced; rarely pl_2 present, with reduced exopodite, endopodite vestigial or absent. Pleopods of female unpaired, pl_2 - pl_4 with both rami well developed; pl_5 with exopodite well developed, endopodite reduced.

Telson with posterior lobes slightly asymmetrical, left slightly larger than right; separated by V-shaped median cleft; right terminal margin with 2 or 3 moderately strong spines and, frequently few small spines or spinules; left terminal margin with 1-4 moderately strong spines, and usually several small spines or spinules; anterior lobes unarmed, margins with short setae.

Coloration. — In life: Chelipeds deep red with tips white or cream-colored; ambulatory legs deep or dark red, dactyls with broad, white or cream band distally, propodal and carpal segments with numerous white or cream spots. In preservative: Color fading to light red or orange, white band of dactyl and white spots generally straw-colored.

Distribution. — Queen Charlotte Islands, British Columbia to Monterey, California (Hart); intertidal (lower depth limit for this species is not reported).

Affinities. — *Pagurus hemphilli*, although superficially very similar in appearance to *P. granosimanus*, *P. samuelis*, and to a lesser extent, *P. h. hirsutiusculus*, is most closely allied to *P. beringanus*. The striking red color of *P. hemphilli* in life will immediately distinguish it from the other species. In preservative, its color pattern closely resembles that of *P. granosimanus*, which also shares the character of paired teeth on the crista dentata; paired teeth are lacking in *P. samuelis* and *P. h. hirsutiusculus*, and of infrequent occurrence in *P. beringanus*. The exceptionally pronounced, ventral inflation of the carpus of the right cheliped, characteristic of *P. hemphilli*, will distinguish this species from *P. beringanus*, *P. samuelis* and *P. h. hirsutiusculus*. As the carpus of the right cheliped is somewhat inflated in *P. granosimanus*

also, a more reliable character for distinguishing *P. hemphilli* from this latter species is the presence of only one tubercle on the ventral surface of the merus of the right cheliped; two tubercles are present on this surface in *P. granosimanus*.

Discussion. — *Pagurus hemphilli* has been retained in the "comptus" group, although it differs from the group in the same characters noted for *P. beringanus* (p. 149), until such time as the group can be reviewed in its entirety. The similarities in the structure of the maxillule, m_{xp}_1 and m_{xp}_2 , and in the armature of the terminal margins of the telson suggest a much closer relationship between *P. hemphilli* and *P. beringanus* than either species shares with the other four northwestern North American species assigned to the "comptus" group.

Pagurus granosimanus (Stimpson) (figs. 39, 40)

Eupagurus granosimanus Stimpson, 1858: 237 (listed). — Stimpson, 1859a: 44 (type localities: Monterey, California and Puget Sound, Washington, restricted to Monterey, California by Schmitt, 1921: 142). — Stimpson, 1862: 90. — Smith, 1880: 211B. — Calman, 1898: 260. — Alcock, 1905: 179. — Przibram, 1905: 197. — Stimpson, 1907: 226. — Glaessner, 1929: 171.

Eupagurus (Trigonocheirus) granosimanus: Benedict, 1892: 17 (by implication).

Pagurus (Trigonocheirus) granosimanus: Holmes, 1900: 146 (by implication; misspelling of *Trigonocheirus* Benedict, Holmes, 1900: 134).

Pagurus granosimanus: Rathbun, 1904: 160, pl. 5 fig. 8. — Rathbun, 1910: 160, pl. 5 fig. 8. — Taylor, 1912: 206. — Williamson, 1915: 476. — Schmitt, 1921: 141, fig. 91. — Stevens, 1925: 282, fig. 5. — Rathbun, 1926: 410. — Johnson & Snook, 1927: 334, figs. 278, 284. — Hart, 1930: 104. — Fraser, 1932: 64. — Pratt, 1935: 457. — Shelford et al, 1935: 275. — Wismer & Swanson, 1935: 342. — Makarov, 1938b: 205, pl. 2 fig. 5. — Hart, 1940: 94. — Tomlinson, 1953: 374. — Gordan, 1956: 330. — Smith et al, 1957: 183 (key). — Makarov, 1962: 194, pl. 2 fig. 5. — Reese, 1962: 356. — Bollay, 1964: 71. — Orians & King, 1964: 297. — Chapple, 1966: 209, fig. 1. — Chapple, 1967: 65. — Forest & De Saint Laurent, 1967: 117. — Ball, 1968: 302. — Ricketts, Calvin & Hedgpeth, 1968: 237. — Reese, 1969: 348. — MacMillan, 1972: 58.

Holotype. — Not seen (presumably no longer extant).

Material examined. — See table 14.

Diagnosis. — Left chela with dorsal surface convex, tuberculate. Right cheliped with 2 prominent tubercles on ventral surface of merus. Dactyl and propodus of left third pereopod with lateral faces usually unarmed, or propodus with 1 or 2 small spines at ventrodistal angle, or occasionally (females) propodus with few small spines or tubercles. Crista dentata with 2 accessory teeth.

Description. — Shield longer than broad; anterolateral margins terraced; straight or slightly sloping; posterior margin truncate or roundly truncate; dorsal surface with scattered tufts of short setae; anterolateral angle pro-

Table 14. *Pagurus granosimanus* (Stimpson) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex				SL (mm)	Collector
				♂	♀	♂♀	♀♂		
<i>British Columbia</i>									
Sunset Point, Vancouver I.	---	----	21/7/62	2				7.4-7.7	Landrum
		RMNH							
Ucluelet	---	----	9/9/68	2				6.3-7.0	Hart
		USNM							
Chemainus	---	----	2/7/62	2				1.9-2.1	Landrum
		USNM							
<i>Washington</i>									
Outer coast	---	----	1/8/71	1	1			5.6-9.6	Nyblade
		USNM							
Neah Bay	---	----	4/6/64	1				2.3	---
		USNM							
San Juan Is.	---	----	5/61	7	3			3.6-7.6	Henry
		RMNH, USNM							
Waldron I.	---	----	8/61	1				4.6	Ray
		USNM							
San Juan I.	---	----	8/61	3				5.2-7.1	McLaughlin
		USNM							
Mitchell Bay, San Juan I.	---	----	28/7/61	1				4.8	McLaughlin
		USNM							
Culver Point, San Juan I.	---	----	22/7/52		1			6.3	Illg
		USNM							
Mt. Dallas, San Juan I.	---	----	29/7/61	2				4.8-6.0	McLaughlin
		USNM							
Friday Harbor, San Juan I.	---	----	1922	1	2			4.1-4.9	Stevens
		USNM							
Friday Harbor, San Juan I.	---	----	29/7/61	14	19	1		1.6-5.8	McLaughlin
		AHF, RMNH, BM							
Lopez Sound	36	----	2/8/61	1	1			2.3-7.2	McLaughlin
		USNM							
Pearse Canal	---	----	7/9/34	2				4.0-4.6	Stevens
		USNM							
Port Orchard Bay	---	----	29/6/61	4	5	1		2.5-7.2	McLaughlin
		USNM, AHF							
Edmonds	---	----	----	9	3	1		4.3-6.1	Willing
		USNM, CNM							

duced, blunt. Rostrum slightly produced, exceeding lateral projections; broadly rounded or, less frequently obtusely triangular; unarmed, with terminal tuft of setae. Lateral projections obsolete or broadly rounded, unarmed, with short marginal setae.

Ocular peduncles moderately short, one-half to three-fourths length of shield; basally inflated, cornea frequently slightly dilated; dorsomesial, and occasionally dorsolateral, face with longitudinal row of tufts of short setae. Ocular acicles prominent, subtriangular or subovate, with mesial margins expanded, lateral margins straight, sloping, or slightly expanded; terminating acutely or subacutely, with submarginal spine; separated basally by two-thirds to four-fifths basal width of one acicle.

Antennular peduncles moderately short, usually exceeding ocular peduncles by one-third to one-half length of ultimate segment, occasionally reaching only to cornea. Ultimate and penultimate segments unarmed, often with few tufts of short setae; basal segment unarmed or with small spinule at ventromesial distal angle.

Antennal peduncles moderately short, equalling or slightly exceeding

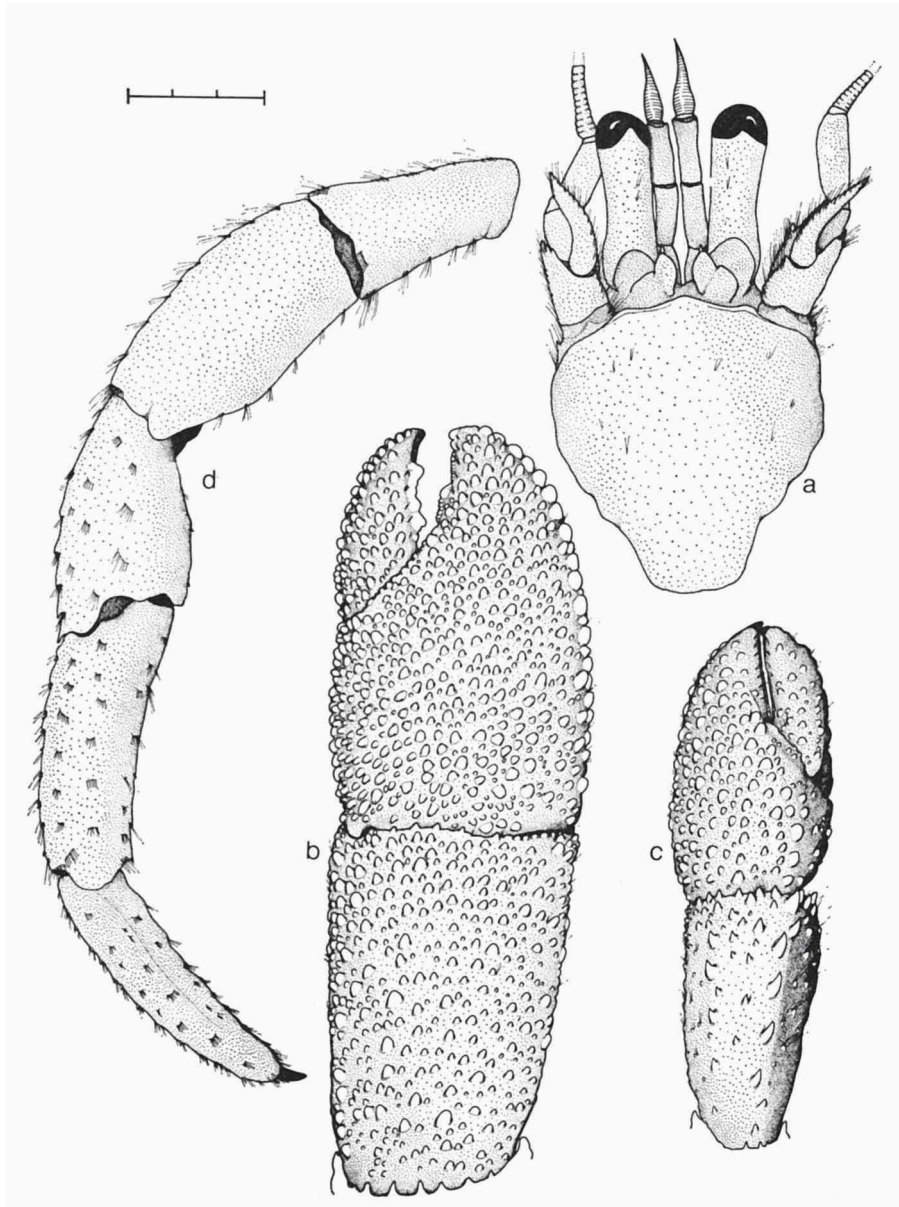


Fig. 39. *Pagurus granosimanus* (Stimpson). a, shield; b, right chela and carpus (dorsal view); c, left chela and carpus (dorsal view); d, left P₃ (lateral view). Scale equals 3 mm.

ocular peduncles; with supernumerary segmentation. Fifth segment unarmed or with small spinule on ventral margin partially obscured by tuft of short setae. Fourth segment unarmed, with few tufts of short setae. Third segment with strong spine at ventromesial distal angle, ventral margin with tufts of long setae. Second segment with dorsolateral distal angle produced, terminating in simple, bifid, or multifid spine, mesial margin inflated, with 1-4 small spines, lateral margin occasionally with small spinules and with tufts of moderately long setae; dorsomesial distal angle with strong spine, mesial face with long setae. First segment with small spine on lateral face; ventromesial margin produced, denticulate or spinulose. Antennal acicle short, usually not reaching distal half of ultimate peduncular segment; arcuate; terminating in small, simple or bifid spine; mesial margin slightly spinulose with tufts of short setae. Antennal flagella moderately short, usually not overreaching right cheliped; each article usually with few very short setae.

Mandible without distinctive characters. Maxillule with proximal endite subquadrate; endopodite with 1 or 2 bristles on weakly produced internal lobe, external lobe well developed, slightly recurved. Maxilla with endopodite inflated basally, usually equalling scaphognathite in distal extension. First maxilliped with endopodite approximately one-half length of exopodite, basal segment of exopodite inflated basally. Second maxilliped without distinguishing characters. Third maxilliped with basis-ischium fusion incomplete; basis usually unarmed; ischium with crista dentata well developed, 2 accessory teeth, parallel to margin; merus with dorsodistal margin unarmed, ventral margin with 1-4 small spines. Sternite of mxp_3 unarmed, margin with long setae.

Right cheliped considerably larger than left, moderately short and stout. Dactyl short, three-fourths to five-sixths length of palm; cutting edge with row of strong, calcareous teeth proximally, small corneous teeth distally, terminating in small corneous claw, or occasionally in small calcareous tooth; dorsal surface convex, with closely-spaced small tubercles or very prominent granules, dorsomesial margin with irregular row of very low, moderately broad tubercles; ventral surface weakly tuberculate or granular, with few tufts of short setae or bristles. Palm moderately long, two-thirds to three-fourths length of carpus; in small specimens broad in relation to length, in larger specimens moderately elongate; dorsal surface convex, with closely-spaced tubercles or prominent granules, dorsomesial margin not delimited, dorsolateral margin with row of prominent low tubercles and few tufts of short setae; mesial, lateral and ventral surfaces tuberculate or granular. Carpus moderately long, equalling or slightly exceeding length of merus; strongly inflated ventrally; dorsal surface convex, with closely-spaced tuber-

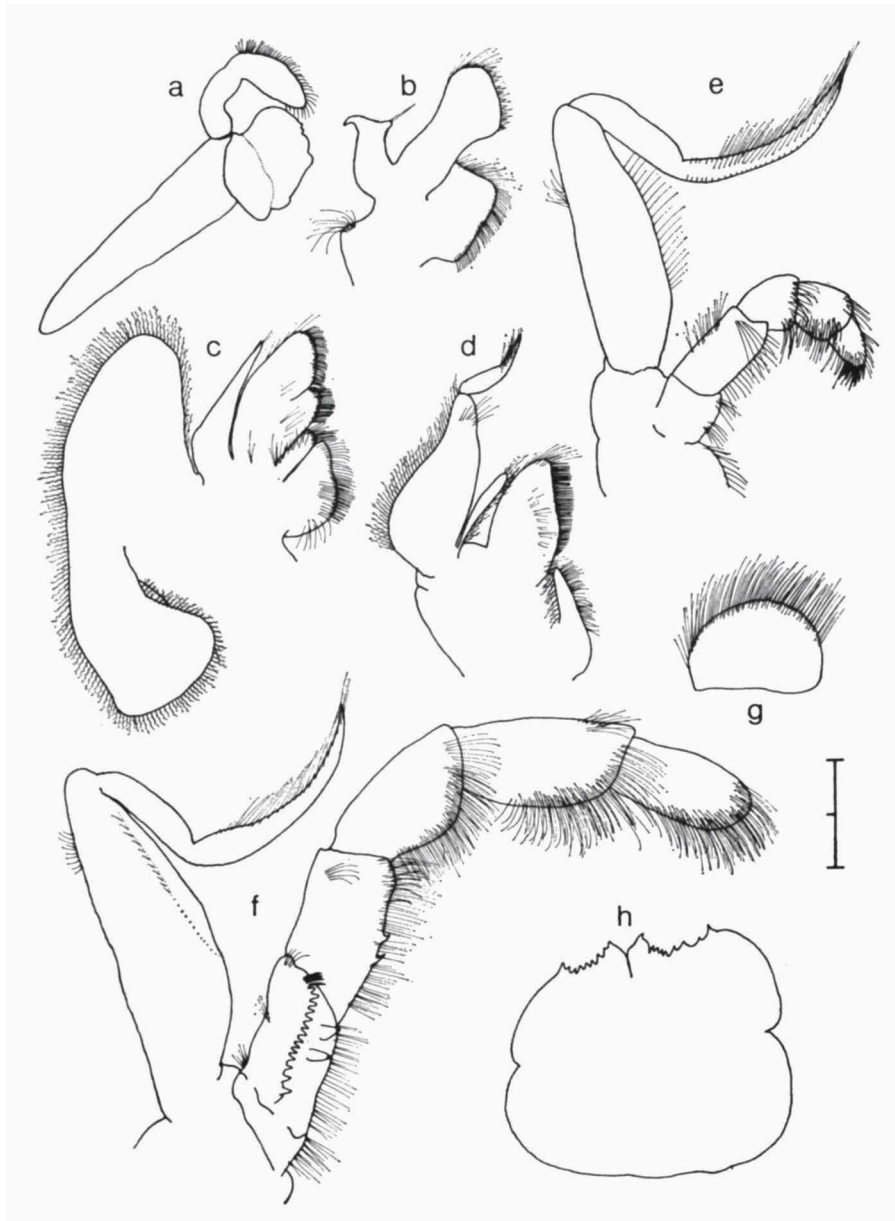


Fig. 40. *Pagurus granosimanus* (Stimpson). a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite, P₃; h, telson. Scale equals 1 mm.

cles and/or granules, distal margin with row of small tubercles, dorsomesial and dorsolateral margins not delimited or with row of slightly more prominent tubercles and few tufts of very short setae; mesial, lateral and ventral surfaces tuberculate or granular. Merus subtriangular; dorsal surface with irregular rows of short, transverse, often spinulose ridges and tufts of short setae, distal margin with few small spines or tubercles and tufts of short setae; lateral and mesial faces weakly tuberculate or granular; ventral surface usually with few small tubercles, ventromesial and ventrolateral proximal angles each with very prominent tubercle, ventromesial and ventrolateral margins each with row of small tubercles becoming small spines distally and extending onto mesial and lateral distal margins ventrally. Ischium with row of small spinules or denticles on ventromesial margin, ventrolateral margin usually tuberculate. Coxa with few spinules on ventrodistal margin laterally, ventromesial and ventrolateral margins with tufts of setae.

Left cheliped short, in larger specimens rarely reaching beyond proximal margin of right chela, in small specimens, usually reaching to distal half of palm; dactyl moderately long, usually exceeding length of palm, broad; cutting edge with row of small corneous teeth; terminating in small corneous claw; slightly overlapped by fixed finger; often with slender hiatus proximally; dorsal surface with irregular rows of low tubercles, dorsomesial margin with irregular row of low tubercles and tufts of short setae; mesial face slightly tuberculate and with tufts of short setae; ventral surface usually unarmed, with tufts of short bristles. Palm moderately long, one-half to two-thirds length of carpus; dorsolateral surface sloping, with moderately closely-spaced tubercles or enlarged granules, midline slightly flattened, with irregular rows of tubercles, dorsomesial margin with row of moderately strong tubercles; mesial face tuberculate; ventral surface with scattered low protuberances or tubercles and tufts of long, stiff setae; lateral margin with double row of tubercles. Carpus moderately short, slightly less than or equalling length of merus; dorsomesial margin with row of strong acute or subacute spines, increasing in size distally, dorsal surface with 1 or 2 irregular rows of small spines or tubercles, distal margin spinose or tuberculate, dorsolateral margin usually with row of moderately strong spines or spinulose tubercles; lateral face with irregular rows of simple, bifid or multifid tubercles and tufts of short setae, distal margin frequently with row of small spines or tubercles, ventrolateral distal angle with cluster of small spines or tubercles; mesial face with scattered low protuberances or tubercles and tufts of long setae, distal margin with small spines or tubercles; ventral surface weakly tuberculate, distal margin with row of small tubercles, ventromesial and ventrolateral margins not delimited. Merus

subtriangular, slightly compressed laterally; dorsal surface with short, transverse, often spinulose or denticulate ridges and tufts of short setae, distal margin with 2-4 small spines or tubercles; lateral face often protuberant or tuberculate, with tufts of short setae; mesial face with few small tubercles ventrally and scattered tufts of short setae; ventral surface with small tubercles and tufts of long setae, ventromesial margin with irregular single or double row of small tubercles becoming spinulose distally, ventrolateral margin proximally with row of broad tubercles or spinules, becoming moderately strong spines distally. Ischium with row of small denticles on ventromesial margin, occasionally unarmed and few tufts of short setae, ventrolateral distal angle with tuft of long setae, often also spinulose. Coxa with clump of long stiff setae at ventromesial distal angle, margins with long setae.

Second pereopods moderately long, usually equalling or occasionally exceeding tip of right cheliped; left usually slightly shorter than right. Dactyl equalling or slightly exceeding length of propodus, moderately deep; in lateral view, straight or slightly curved ventrally, in dorsal view, straight; terminating in strong corneous claw; dorsal surface with 1 or 2 irregular rows of tufts of short setae, usually also with single or double row of small corneous spinules; mesial face with longitudinal sulcus flanked by double row of moderately strong corneous spinules, increasing in size distally and tufts of short setae; lateral face with longitudinal sulcus and rows of tufts of short setae; ventral margin with row of strong corneous spines, increasing in size distally. Propodus moderately short, slightly exceeding length of carpus; dorsal surface with 2 or 3 rows of small spinulose tubercles or conical spines and tufts of short setae; mesial face often slightly tuberculate, with tufts of short setae; lateral face with rows of tufts of short setae; ventral surface with row of small corneous spines, distal margin with 1-3 small, corneous spines. Carpus moderately long, two-thirds to three-fourths length of merus; dorsal surface with single or double irregular row of small, conical spines and few tufts of short setae; lateral face frequently slightly protuberant or weakly tuberculate, with tufts of short setae; mesial face with tufts of short setae. Merus laterally compressed; dorsal surface with 1 or 2 irregular rows of tufts of setae; lateral and mesial faces with tufts of short setae; ventral margin with 1 or 2 rows of small spines or tubercles, ventrolateral margin spinulose or denticulate distally. Ischium with ventral margin unarmed or with row of small spinules, partially obscured by tufts of long setae. Coxa with long setae marginally.

Third pereopods with right often slightly longer than left. Dactyl moderately short, equalling or slightly exceeding length of propodus; in lateral view, slightly curved ventrally; in dorsal view, straight; terminating in strong

corneous claw; dorsal surface with 1 or 2 irregular rows of tufts of setae and usually single or double row of small corneous spines; mesial face with longitudinal sulcus flanked by single or double row of corneous spines and tufts of short setae; lateral face with longitudinal sulcus flanked by low protuberances and tufts of short setae, often more pronounced on left; ventral margin with row of strong corneous spines, increasing in size distally. Propodus moderately short, slightly exceeding length of carpus; dorsal surface with irregular rows of tufts of short setae, occasionally also with small corneous spinules; mesial and lateral faces with tufts of short setae, occasionally mesial face also with small corneous spinules, and particularly in females lateral face often with few small spines or tubercles (left), distal margin with few corneous spines; ventral margin with row of small corneous spines or spinules, increasing in size distally. Carpus two-thirds to three-fourths length of merus; dorsal surface with row of tufts of moderately short setae, occasionally with few small spinules, distal margin with moderately strong spine partially obscured by tufts of short setae; mesial, lateral and ventral surfaces with tufts of short setae. Merus laterally compressed; dorsal surface with single or double irregular row of tufts of setae, occasionally distal margin minutely spinulose, mesial and lateral faces with tufts of short setae; ventral margin usually with row of tufts of long setae, occasionally with few small spines or spinules. Ischium with row of long setae on dorsal and ventral margins. Coxa with tufts of long setae on ventrodistal and ventromesial margins, ventrolateral margin with scattered tufts of long, fine setae.

Fourth pereopods apparently without preungual process; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods subsemicircular, margin with long setae.

Pleopods of male unpaired, pl_3 - pl_5 with exopodites well developed; endopodites reduced. Pleopods of female, unpaired, pl_2 - pl_4 with both rami well developed; pl_5 with exopodite well developed, endopodite reduced.

Telson with posterior lobes slightly asymmetrical, left slightly larger than right; separated by moderately deep, slender or broad median cleft; terminal margins slightly concave, each lobe with 1-3 moderately strong spines medianly, series of small spines or spinules centrally and 1-4 moderately strong spines laterally; anterior lobes unarmed.

Coloration. — In life: "Buffy olive to olive; chelipeds with large porcelain blue granules becoming brighter blue near the extremities of the finger especially on the under side of the hand; ambulatory legs with small blue spots from the front of which arise small tufts of setae; antennae apricot orange shading to olive in the basal segments. The young are lighter in color and

show very little if any blue, the granules and spots being almost white and the ambulatory legs tipped with orange" (Stevens, 1925: 283). In preservative: Generally reddish-orange or orange, with light or cream spots on ambulatory legs.

Distribution. — Unalaska to Ensenada, Lower California (Rathbun, Schmitt, Stevens, Hart); intertidal to 32 m.

Affinities. — *Pagurus granosimanus*, at least superficially, most closely resembles *P. hemphilli*, *P. samuelis* and *P. beringanus*. It may be distinguished from *P. hemphilli*, and *P. h. hirsutiusculus* and *P. middendorffii* as well, by the presence of two prominent tubercles on the ventral surface of the merus of the right cheliped. *P. granosimanus* is distinguished from *P. beringanus* and *P. samuelis* by the lack of row(s) of spines or tubercles on the lateral face of the dactyl of the third left pereiopod.

Discussion. — As is the case with all six northwestern North American species assigned to the "comptus" group by Forest & De Saint Laurent (1967), *P. granosimanus* disagrees with the original definition of the group in respect to the structure and armature of the telson and the structure of the propodal rasp of the fourth pereiopod. It also differs from *P. beringanus* and *P. hemphilli* in the structure of the maxillule and the first maxilliped, as well as in the armature of the telson. Nor does *P. granosimanus* agree in these characters with *P. h. hirsutiusculus* or *P. samuelis*. There is some similarity in the development of the endopodal external lobe of the maxillule in *P. granosimanus* and *P. middendorffii*, however, in all other characters, *P. granosimanus* is distinct. The group placement of this species cannot be determined until the "comptus" group is more adequately redefined.

Pagurus samuelis (Stimpson) [sensu stricto] (figs. 41, 42)

Eupagurus samuelis Stimpson, 1857: 482 (type locality: Tomales Bay, California). —

Stimpson, 1859a: 44, pl. 1 fig. 8. — Stimpson, 1859b: 90. — Stimpson, 1862: 86, pl. 1 fig. 8. — Alcock, 1905: 178 (in part, see discussion). — Stimpson, 1907: 224.

Pagurus (Trigonocheirus) Samuelis: Holmes, 1900: 144 (by implication; misspelling of *Trigonocheirus* Benedict, Holmes, 1900: 134).

Pagurus samuelis: Rathbun, 1904: 160, pl. 5 fig. 7 (in part). — Rathbun, 1910: 160, pl. 5 fig. 7 (in part). — Taylor, 1912: 205. — Williamson, 1915: 481. — Hilton, 1916: 65. — Schmitt, 1921: 139, fig. 90, pl. 16 figs. 2, 3. — Schmitt, 1924: 383. — Johnson & Snook, 1927: 334, figs. 281, 284. — Hanström, 1931: 209. — Pratt, 1935: 457. — Makarov, 1938b: 189 (in part; not pl. 3 fig. 6). — Reinhard, 1944: 412. — Tomlinson, 1953: 374. — Gordan, 1956: 334 (in part). — Smith et al, 1957: 183 (key). — Coffin, 1958: 1. — Coffin, 1960: 1, figs. 1-12. — Hedgpeth, 1962: 85. — Makarov, 1962: 179 (in part; not pl. 3 fig. 6). — Reese, 1962: 347. — Reese, 1963: 81, fig. 8. — Bollay, 1964: 71. — Bookhout, 1964: 276. — Orians & King, 1964: 297. — Provenzano & Rice, 1964: 231. — Codreanu, Codreanu & Pike, 1965: 238. — Greenwood, 1966: 555. — Forest & De Saint Laurent, 1967: 117. — Hazlett, 1968: 31. — Ricketts, Calvin & Hedgpeth, 1968: 33, text plate. — Reese, 1969: 347. — Scelzo & Boschi, 1969: 166. — Haig,

Hopkins & Scanland, 1970: 30. — Hazlett, 1970: 26. — Roberts, 1970: 201. — Hart, 1971: 1542. — MacMillan, 1972: 58.
 not *Eupagurus samuelis*: Stimpson, 1858: 250. — Ortmann, 1892: 301, pl. 12 fig. 12. — Ortmann, 1900: 1268. — Doflein, 1902: 646. — Alcock, 1905: 178 (in part). — Balss, 1913: 61. — Terao, 1913: 371. — Ishii, 1914: 519. — Shiino, 1934: 278. — Shiino, 1936: 186. — Oguro, 1955: 100. — Balss, 1957: 1718. — Shiino, 1958: 68. See discussion.
 not *Pagurus samuelis*: Derjugin & Kobjakova, 1935: 142. — Makarov, 1937: 62, fig. 13. — Makarov, 1938b: 189 (in part, not pl. 3 fig. 6). — Vinogradov, 1947: 101 (key). — Vinogradov, 1950: 227 (key), fig. 118. — Gordan, 1956: 335 (in part). — Kobjakova, 1958a: 245. — Uchida, 1958: 170, fig. 150. — Makarov, 1962: 179 (in part; not pl. 3 fig. 61). — Miyake, Sakai & Nishikawa, 1962: 125. — Kim, 1964: 4. — Kobjakova, 1967: 241. — Kurata, 1968: 265, figs. 1A-H. — Utinomi, 1968: 65, fig. 4. — Kim, 1970: 6. See discussion.

Holotype. — Not seen (presumably no longer extant).

Material examined. — See table 15.

Table 15. *Pagurus samuelis* (Stimpson) Material Examined

Locality	Depth (m)	Station	Date	Sex	SL (mm)	Collector
		Locality		♂ ⁺ ♀ ⁺ ♀♀ ⁺		
<i>British Columbia</i>						
49°45'N, 126°50'W	---	----	28/5/69	1 1 2	4.4-6.4	Hart
Amphitrite Point, Vancouver I.	---	Hart	9/9/68	2 2	6.3-7.9	Hart
		Hart				
<i>Washington</i>						
Outer coast	---	---- USNM, RMNH	1/8/71	3 2	2.9-3.6	Nyblade
<i>California</i>						
Catalina I.	---	---- USNM 16953	----	2	2.7-3.5	Dall

Diagnosis. — Left cheliped with dorsal surface of chela convex, tuberculate or granular; carpus with 2 rows of prominent spines on dorsal surface. Right cheliped with dorsal surface of chela tuberculate or granular; merus with 2 prominent tubercles on ventral surface usually proximally situated. Dactyl and propodus of left third pereiopod with irregular row(s) of small spines or tubercles on lateral faces.

Description. — Shield longer than broad; anterolateral margins sloping; anterior margin between rostrum and lateral projections straight, slightly concave, or sloping; dorsal surface with numerous tufts of moderately long setae; anterolateral angle slightly produced, subacute. Rostrum moderately long, considerably exceeding lateral projections; acutely triangular; terminating with small acute spine. Lateral projections obtusely triangular or broadly rounded, with small, acute marginal or submarginal spine.

Ocular peduncles moderately long, one-half to two-thirds length of shield; strongly inflated basally, slightly dilated in corneal region; dorsomesial and

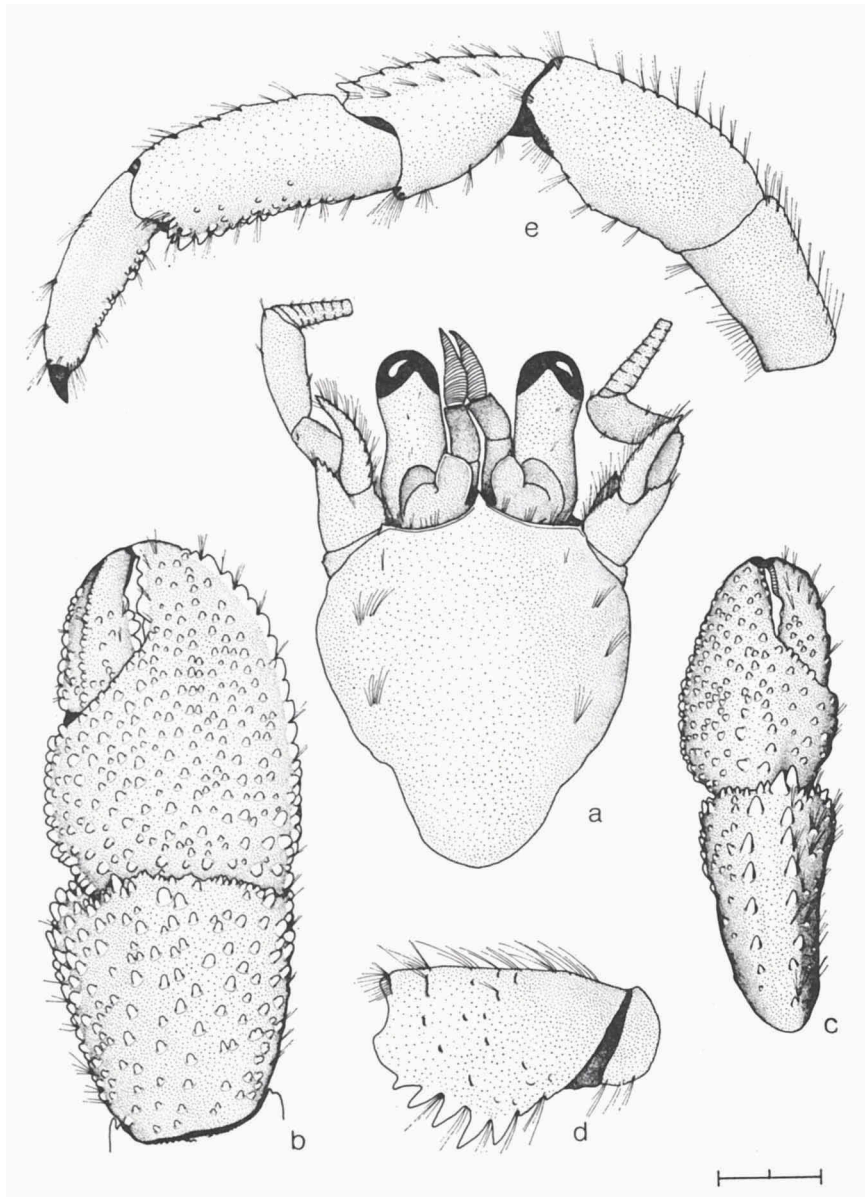


Fig. 41. *Pagurus samuelis* (Stimpson) s.s. a, shield; b, right chela and carpus (dorsal view); c, left chela and carpus (dorsal view); d, left cheliped, merus (lateral view); e, left P₃ (lateral view). Scale equals 1 mm.

dorsolateral faces with longitudinal row of tufts of short setae. Ocular acicles large, subovate, with mesial and lateral margins expanded; terminating acutely or subacutely, with moderately strong, submarginal spine; dorsal surface slightly concave, with 1 or 2 tufts of short setae; separated basally by three-fourths to four-fifths basal width of one acicle.

Antennular peduncles moderately short, exceeding ocular peduncles by one-third to one-half length of ultimate segment. Ultimate and penultimate segments unarmed; basal segment with small spine at ventromesial distal angle.

Antennal peduncles moderately long, exceeding ocular peduncles by one-half to two-thirds length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments unarmed, with few tufts of short setae. Third segment with small spine at ventrodistal margin. Second segment with dorsolateral distal angle produced, terminating in strong, simple or bifid spine, mesial margin with 1-3 small spines, lateral margin occasionally with small spinule distally; dorsomesial distal angle with strong spine, mesial face with tufts of long setae. First segment with small spine at laterodistal margin; ventrodistal margin produced, with 2 or 3 strong, acute spines. Antennal acicles moderately short, slightly exceeding proximal margin of ultimate antennal segment; slightly arcuate; terminating in small spine; mesial with tufts of moderately long setae. Antennal flagella short, usually not over-reaching right cheliped; each article usually with 1 or 2 very short bristles.

Mandible without distinctive characters. Maxillule with proximal endite tapering; endopodite with short bristle on internal face proximally, 1 long bristle on weakly produced internal lobe, external lobe obsolete. Maxilla with endopodite slightly inflated basally, equalling scaphognathite in distal extension. First maxilliped with endopodite approximately one-half length of exopodite; basal segment of exopodite narrow. Second maxilliped without distinguishing characters. Third maxilliped with basis-ischium fusion incomplete; basis with 2 or 3 small spines; ischium with crista dentata well developed, 1 accessory tooth; merus usually unarmed. Sternite of mxp_3 with prominent, small spine on each side of midline, margin with long setae.

Right cheliped moderately short in small specimens, becoming considerably more elongate with increased size. Dactyl equalling or slightly exceeding length of palm, moderately broad; cutting edge with row of calcareous teeth proximally, corneous teeth distally; terminating in small corneous claw; slightly overlapped by fixed finger; with slender longitudinal hiatus; dorsomesial margin with row of small occasionally spinulose tubercles, dorsal surface with irregular rows of low tubercles often spinulose, most prominent medianly; mesial and ventral surfaces with low, occasionally spinulose

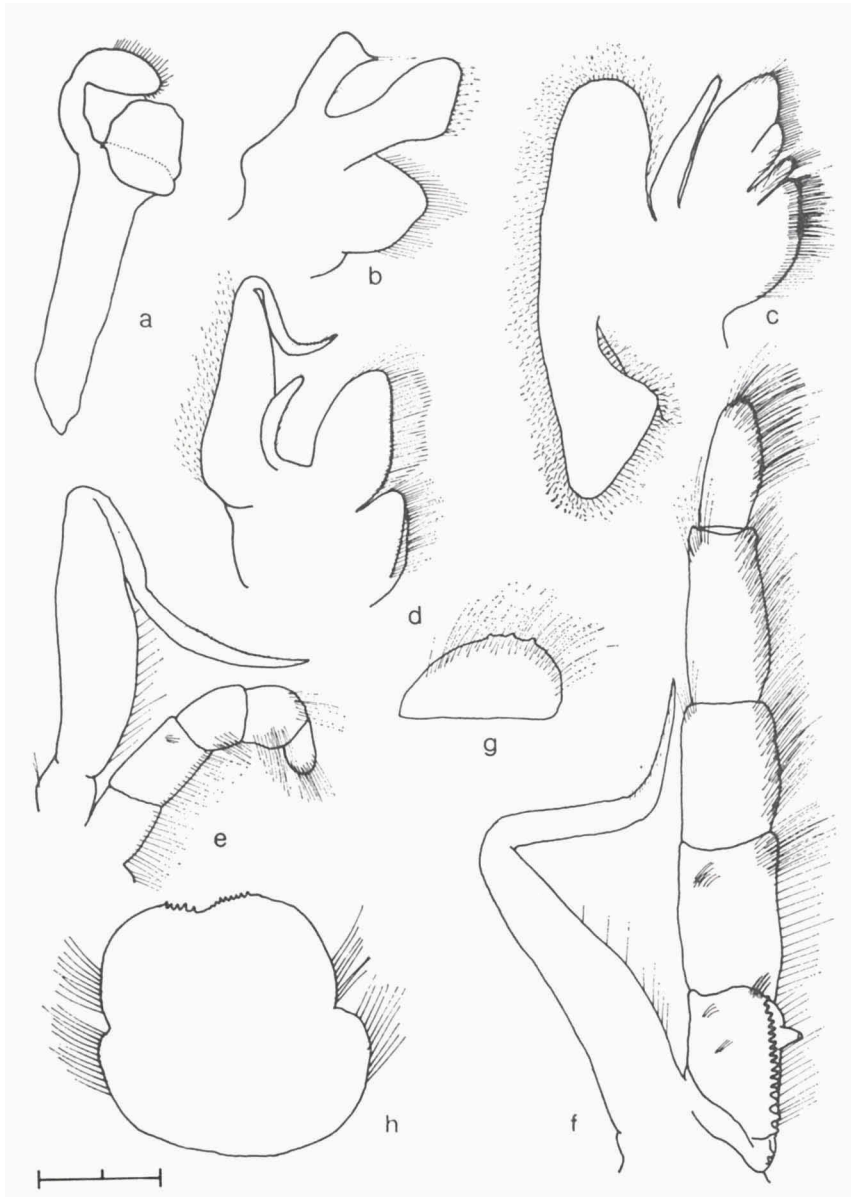


Fig. 42. *Pagurus samuelis* (Stimpson) s.s. a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite, P₃; h, telson. Scale equals 0.5 mm.

tubercles and tufts of short setae or bristles. Palm moderately short, one-half to two-thirds length of carpus, broad; dorsomesial margin with single or double row of small tubercles or prominent granules, dorsal surface slightly convex with irregular rows of prominent granules or small tubercles, dorso-lateral margin with row of moderately prominent subacute spines or spinulose tubercles, increasing in size on fixed finger (becoming obsolete in large males, according to Schmitt, 1921, p. 140); lateral face tuberculate or granular, with few tufts of moderately short setae; ventral surface with irregular rows of low tubercles and tufts of long setae; mesial face with rows of small tubercles and tufts of very long setae. Carpus slightly shorter than merus, increasing in breadth distally; dorsomesial margin with inconspicuous row of small tubercles, distal angle with cluster of small subacute spines or spinulose tubercles, dorsal surface convex, with irregular rows of small tubercles, distal margin slightly tuberculate with tufts of moderately long setae, dorsolateral margin with row of simple or bifid tubercles; lateral face granular or tuberculate, distal margin with row of small spines or spinulose tubercles; ventral surface with scattered low tubercles, distal margin with row of small tubercles or granules; mesial face with few small spinules or tubercles and tufts of setae ventrally, distal margin tuberculate or spinulose. Merus subtriangular; dorsal surface with tufts of short setae, distal margin with few small spinulose tubercles or small spines, dorsal surface occasionally with spinulose ridges and tufts or short setae; lateral face unarmed or spinulose, ventrolateral margin with single or double row of small subacute spines; mesial face spinulose or with scattered, small bifid or multifid protuberances or tubercles and tufts of moderately short setae, ventromesial margin with single or double row of small spinulose tubercles or spines; ventral surface with 1 or 2 prominent tubercles at each proximal angle, few, scattered small tubercles or spinules distally and tufts of long setae. Ischium with row of small denticles on ventromesial margin, ventrolateral distal angle with tufts of long setae, ventrolateral proximal angle slightly protuberant. Coxa with clump of setae at ventromesial distal angle, ventrodiscal distal angle spinulose.

Left cheliped moderately long, usually exceeding base of right dactyl. Dactyl moderately long, one-fourth to one-third longer than propodus; cutting edge with row of small corneous teeth; terminating in small corneous claw; occasionally slightly overlapped by fixed finger; dorsomesial margin with row of small tubercles, occasionally spinulose, and tufts of long setae; dorsal surface with 1 or 2 rows of small tubercles proximally, tufts of long setae distally; mesial and ventral surfaces with tufts of long setae. Palm moderately short, one-third to two-thirds length of carpus, subtriangular; dorso-

lateral surface strongly sloping, medianly rounded, with irregular rows of small tubercles or granules, midline with double or triple row of small tubercles or small conical spines, decreasing in size on fixed finger, dorsolateral margin with row of small conical spines or tubercles, dorsomesial face with irregular rows of small tubercles or granules and tufts of long setae; mesial face slightly tuberculate or granular; ventral surface with irregular rows of low tubercles or protuberances and tufts of long setae. Carpus moderately long, usually equalling length of propodus; dorsomesial and dorsolateral margins each with row of strong, acute or subacute conical spines and tufts of short setae, distal margin with few small spines; lateral face spinulose or tuberculate, distal margin with row of small spines or tubercles or denticulate, ventrolateral margin with row of very strong, acute or subacute spines and few tufts of short setae; mesial face spinulose or tuberculate dorsally and with tufts of long setae, distal margin with row of small spines or tubercles, decreasing in size ventrally, ventromesial margin with row of very small tubercles or spinules; ventral surface with scattered small tubercles or spines, distal margin denticulate. Merus triangular, slightly compressed laterally; dorsal surface with tufts of long setae, distal margin usually unarmed; mesial face with tufts of long setae, ventromesial margin with single or double row of strong spines, decreasing in size distally, proximal angle with very prominent spine; lateral face spinulose or tuberculate, ventrolateral distal margin with row of very strong acute or subacute spines, proximally row of small spines or tubercles and tufts of long setae. Ischium with row of small tubercles or denticles on ventromesial margin, ventrolateral margin with row of small tubercles, partially obscured by tufts of long setae. Coxa with row of small denticles on ventromesial margin, distal angle with clump of long setae.

Second pereopods moderately long, equalling or slightly overreaching right cheliped, right frequently longer than left. Dactyl short, two-thirds to three-fourths length of propodus, moderately deep; in lateral view, straight; in dorsal view, straight; terminating in strong corneous claw; dorsal surface with two rows of tufts of short setae; lateral face with longitudinal sulcus proximally and tufts of short setae; mesial face with faint, longitudinal sulcus and rows of tufts of short setae; ventral margin with row of moderately strong corneous spines, increasing in size distally. Propodus moderately short, slightly exceeding length of carpus; dorsal surface with transverse rows of long setae; lateral and mesial faces with tufts of setae; ventral margin with few corneous spinules distally, and tufts of long setae. Carpus approximately equalling length of merus; dorsal surface with row of small spines, partially obscured by tufts of long setae; lateral face with 2 irregular rows

of transverse ridges and tufts of short setae, distal margin with small spine dorsally; mesial face with few tufts of short setae and few small spinules dorsally, distal margin with small spine dorsally. Merus laterally compressed; dorsal margin with 1 or 2 rows of low often spinulose protuberances and tufts of long setae; mesial and lateral faces with few tufts of setae; ventral margin with double row of small spines and tufts of long setae. Ischium with row of spinules and tufts of long setae on ventral margin. Coxa with long setae marginally.

Third pereopods approximately equalling second in length, right slightly longer than left; dissimilar from right to left. Dactyl short, two-thirds to three-fourths length of propodus; in lateral view, straight or slightly curved ventrally; in dorsal view, straight; terminating in strong corneous claw; dorsal surface with 2 rows of tufts of short bristles; mesial face with longitudinal sulcus flanked by irregular rows of corneous spinules and tufts of short setae; lateral face with faint longitudinal sulcus proximally flanked by tufts of short setae (right pereopod) or, with longitudinal sulcus flanked by row of tufts of short setae dorsally, 1 or 2 rows of small calcareous spines or tubercles ventrally (left pereopod); ventral margin with row of strong corneous spines, increasing in size distally. Propodus slightly longer than carpus; dorsal surface with double row of tufts of long setae; mesial face with irregular rows of low protuberances and tufts of long setae; lateral face with few tufts of short setae, occasionally with few corneous spinules (right pereopod) or with surface protuberant dorsally and with 2 or 3 rows of small tubercles ventrally, increasing in size and converging distally in row of small spines approximating ventral margin, laterodistal margin ventrally with few small spines (left pereopod); ventral surface with row of small corneous spines. Carpus approximately equalling merus in length; dorsal surface with row of small spines, partially obscured by tufts of long setae; lateral face with irregular rows of transverse ridges and tufts of short setae; ventral and mesial surfaces with tufts of setae. Merus laterally compressed; dorsal margin with low often spinulose protuberances and tufts of long setae; lateral and mesial faces with few tufts of short setae; ventral margin with row of small spinules, obscured by tufts of long setae, occasionally with very few spinules or tubercles. Ischium usually with row of small spinules or denticles and tufts of long setae on ventral margin. Coxa with long setae marginally.

Fourth pereopods apparently without preungual process; propodal rasp well developed.

Fifth pereopods typical.

Pleopods of male unpaired, pl_3-pl_5 with exopodites moderately well

developed; endopodites rudimentary. Pleopods of female unpaired, pl_2 - pl_4 with both rami well developed; pl_5 with exopodite frequently poorly developed, endopodite vestigial

Sternite of third pereopods subsemicircular, 2-4 small spines or denticles on anterior margin, partially obscured by long setae.

Telson with posterior lobes approximately symmetrical; separated by very poorly defined median cleft; terminal margins each with short row of very small spinules; anterior lobes unarmed, margins with moderately long setae.

Coloration. — In life: Shield mottled reddish-orange with 3 longitudinal bluish-white stripes dorsally. Ocular peduncles dark olive with bluish-white basally. Antennal peduncle and flagella orange-red.

Chelipeds and pereopods with base color dark olive or olive and red-orange; tips of chelipeds bluish-white, spines of carpi and meri deep or dark red; ambulatory legs with dactyls bluish on proximal three-fourths, tips reddish-white, lateral, mesial and dorsal surface each with longitudinal red stripe; propodi blue or bluish-white on distal three-fourths, spines dark red.

Distribution. — West coast of Vancouver Island, Nootka Sound, to northwest Baja California (Hart, 1971); intertidal, depth range unknown.

Affinities. — *Pagurus samuelis* greatly resembles *P. hirsutiusculus hirsutiusculus* and in the southern part of its range, *P. hirsutiusculus venturensis* Coffin, both in general coloration and in morphological structure. However, several characters of *P. samuelis* will distinguish it from these subspecies, i.e., the presence of 2 prominent tubercles on the ventral margin of the merus of the right cheliped, the very strong row of spines on the ventrolateral distal margin and the strong spine on the ventroproximal angle of the merus of the left cheliped, and the spinulose, subcircular sternite of the third pereopods. Characters such as the shorter dactyli of the second and third pereopods, the length-width relationship of the shield, and the length of the ocular peduncles also distinguish *P. samuelis* from *P. h. hirsutiusculus*; however, these characters are variable and subjective, thus less significant diagnostically. In small specimens, particularly, *P. samuelis* also resembles *P. hemphilli*, *P. granosimanus*, and *P. beringanus*. It may be distinguished from both *P. hemphilli* and *P. granosimanus* by its lack of paired teeth on the crista dentata, and from *P. beringanus* by the armature of the dactyl of the third left pereopod, the more prominent rostrum, and the 2 rows of strong spines on the dorsal surface of the carpus of the left cheliped.

Discussion. — Holmes (1900: 145) expressed doubt that the species in Japan referred to *P. samuelis* was identical with the northwestern North American species; however, subsequent carcinologists continued to report the species from both regions. Hart (1971: 1542) remarked that specimens of

the Japanese species identified as *P. samuelis* differed both in color and in structure. In a recent study of the larval development of the American *P. samuelis*, MacMillan (1972) reported differences in her results of those obtained by Kurata (1968) on the Japanese species. From personal examination of several Japanese specimens in the national collections identified as *P. samuelis* (USMN 51165, 53369) and specimens loaned by Drs. Kurata and Hart, I have been able to determine with certainty that the two forms are not conspecific. The name *Pagurus samuelis* (Stimpson), therefore, must be restricted to the American species; the Japanese species represents an unnamed species (McLaughlin, in press). Similarly, the distribution of *P. samuelis* s.s. is restricted as herein indicated. Rathbun's (1904: 160; 1910: 160) record of this species from Sitka, Alaska, was shown by Schmitt (1921) to refer to a specimen of *P. h. hirsutiusculus*.

Makarov's (1938b, pl. 3 fig. 6; 1962, pl. 3 fig. 6) figure of *P. samuelis* is incorrect. The figure most probably represents *P. middendorffii*; the figure (1938b, pl. 5 fig. 6), indicated as *P. middendorffii*, is also incorrect and does not represent this latter species. Shiino's (1958, pl. 3 fig. 10) figure, cited as *P. samuelis*, is also erroneous and does not represent either *P. samuelis* s.s. or the Japanese species.

The problem of assignment of *P. samuelis* s.s. to the "comptus" group is similar to that discussed in the previous three species. This species also disagrees with the group diagnosis in the structure of the propodal rasp of the fourth pereopod and the absence of chitinous plates on the lateral margins of the telson. However, the armature of the terminal margins of the telson in *P. samuelis* does agree with that described for the "comptus" group.

***Pagurus hirsutiusculus hirsutiusculus* (Dana)**

(figs. 43a-c, 44a-h)

Pagurus (Eupagurus) Mertensii Brandt, 1851: 112 (by implication; in part; see *Pagurus mertensii*).

Bernhardus hirsutiusculus Dana, 1851: 270 (type locality: "in freto 'Puget' Oregonensi", Puget Sound, Washington). — Dana, 1852c: 270. — Dana, 1852d: 447. — Dana, 1855: 9, pl. 27 figs. 3a, b.

? *Eupagurus Mertensii*: Stimpson, 1857: 483. — Stimpson, 1858: 237. ? Not *Pagurus mertensii* Brandt, 1851.

Eupagurus hirsutiusculus: Stimpson, 1857: 484. — Stimpson, 1858: 250. — Stimpson, 1859a: 44. — Chevreux & Bouvier, 1892b: 96. — Alcock, 1905: 178. — Prizibram, 1905: 197. — Stimpson, 1907: 233. — Terao, 1913: 369. — Yokoya, 1933: 83.

Pagurus (Trigonocheirus) hirsutiusculus: Holmes, 1900: 143 (by implication; misspelling of *Trigonocheirus* Benedict, Holmes, 1900: 134).

Eupagurus mertensii: Lenz, 1901: 444. Not *Pagurus mertensii* Brandt, 1851.

Pagurus hirsutiusculus: Rathbun, 1904: 159 (in part). — Rathbun, 1910: 159 (in part. — Taylor, 1912: 205. — Williamson, 1915: 476. — Hilton, 1916: 65. — Schmitt, 1921: 137,

fig. 89. — Stevens, 1925: 281, fig. 4. — Johnson & Snook, 1927: 334, figs. 279, 280. — Hart, 1930: 104. — Fraser, 1932: 64. — Derjugin & Kobjakova, 1935: 142. — Pratt, 1935: 457. — Wismer & Swanson, 1935: 342. — Kobjakova, 1936: 191. — Kobjakova, 1937: 143. — Makarov, 1937: 63, fig. 15. — Makarov, 1938b: 181, pl. 3 fig. 4 (in part). — Hart, 1940: 94. — Reinhard, 1944: 49. — Vinogradov, 1947: 104. — Vinogradov, 1950: 288 (key), fig. 116. — Birstein & Vinogradov, 1953: 224. — Tomlinson, 1953: 374. — Schiller, 1954: 109, fig. 11. — Gordan, 1956: 330. — Coffin, 1957: 1. — Miyake, 1957: 88. — Smith et al, 1957: 183 (key). — Coffin, 1958: 3. — Kobjakova, 1958a: 233. — Kobjakova, 1958b: 253. — Lindberg et al, 1959: 232. — Hedgpeth, 1962: 84. — Makarov, 1962: 171, pl. 3 fig. 4 (in part). — McLaughlin, 1963: 22. — Young, 1963: 131. — Bollay, 1964: 71. — Bookhout, 1964: 276. — Orians & King, 1964: 297. — Forest & De Saint Laurent, 1967: 117. — George & Strömberg, 1968: 251. — Ricketts, Calvin & Hedgpeth, 1968: 241. — Hart, 1971: 1537. — MacMillan, 1972: 58.

Pagurus samuelis: Rathbun, 1904: 160 (in part). — Rathbun, 1910: 160 (in part).

? *Eupagurus mertensii*: Stimpson, 1907: 216. ? Not *Pagurus mertensii* Brandt, 1851.

Eupagurus hirtiusculus: Balss, 1913: 62, pl. 1 fig. 9. — Balss, 1957: 1723.

Pagurus hirsutiussculus hirsutiussculus: Coffin, 1957: 5, fig. 1.

? not *Pagurus hirsutiussculus*: Reese, 1962: 347. — Reese, 1969: 347 (? = *Pagurus hirsutiussculus venturensis* Coffin, 1957).

Holotype. — Not seen (presumably no longer extant).

Material examined. — See table 16.

Diagnosis. — Shield noticeably broader than long. Left chela with dorsal surface convex, tuberculate or granular. Right cheliped with dorsal surface of chela tuberculate or granular; merus with 1 prominent tubercle on ventral surface. Meral segments of chelipeds and ambulatory legs with lateral faces armed with transverse spinulose, denticulate or tuberculate ridges.

Description. — Shield considerably broader than long; anterolateral margins sloping, or occasionally slightly terraced; anterior margin between rostrum and lateral projections sloping, straight, or slightly concave; posterior margin truncate or rounded; dorsal surface frequently with short, transverse spinulose or denticulate ridges laterally, obscured by tufts of setae, usually with numerous dense tufts of moderately long setae; anterolateral angle produced, blunt. Rostrum moderately long, considerably exceeding lateral projections; triangular; terminating acutely or subacutely, often with small spine. Lateral projections obsolete or very broadly rounded, unarmed or with small submarginal spine or spinule, obscured by row of moderately short setae.

Ocular peduncles short, one-third to two-thirds length of shield; stout, strongly inflated basally, corneal region dilated; dorsomesial or dorsal surface with longitudinal row of tufts of short setae. Ocular acicles prominent, subovate, mesial margins expanded, lateral margins usually slightly expanded, occasionally spinulose; terminating acutely or subacutely, with small submarginal spine; dorsal surface slightly concave with few tufts of short setae; separated basally by three-fourths of to entire basal width of one acicle.

Table 16. *Pagurus hirsutiusculus hirsutiusculus* (Dana) Material Examined

Locality	Depth (m)	Station		Date	Sex			SL (mm)	Collector
		Deposition			♂	♀	♂♀		
<i>Bering Sea</i>									
Amak I.	---	----	USNM	9/7/60	7	5	14	2.3-6.5	Fiscus
Amak I.	---	----	RMNH	9/7/63	16		3	6.1-9.8	Fiscus
Unalaska I.	---	----	USNM	2/7/60	11	4	3	1.4-4.6	Fiscus
Unalaska I.	---	----	USNM	20/5/62	4		1	4.4-5.6	Fiscus
Unalaska I.	---	----	USNM	18/8/64	4	4	1	3.6-8.1	Fiscus
Nakushin Bay, Unalaska I.	---	----	RM	25/8/60	20		5	2.0-7.9	Fiscus
Nakushin Bay, Unalaska I.	---	----	USNM	25/8/62	12		4	3.1-7.5	Fiscus
Amaknak I.	---	----	USNM	23/6/62	15	6	12	1.8-4.3	Fiscus
Captain's Bay, Amaknak I.	---	----	AHF	23/6/62	4	2	6	2.5-8.6	Fiscus
Captain's Bay, Amaknak I.	---	----	USNM	19/8/62	16		3	4.7-8.6	Fiscus
Akutan Hbr., Akutan I.	---	----	RMNH	11/9/62	8		8	2.4-5.1	Fiscus
Unimak I.	---	----	USNM	26/5/62	10	1	7	2.8-6.8	Fiscus
<i>Gulf of Alaska</i>									
NE side Samalga I.	---	----	USNM	2/7/63	4			4.1-6.4	Fiscus
Tigalda I.	---	----	USNM	29/6/60	26	7	5	2.3-9.0	Fiscus
Durbin Bay, Tigalda I.	---	----	USNM	17/6/62	7	3	31	1.9-6.0	Fiscus
Nagei I., Schumagin Is.	---	----	USNM	16/6/60	10	5	8	3.1-6.4	Fiscus
Kaguyak Bay, Kodiak I.	---	----	CNM	11/5/62	6	2	1	4.0-7.6	Fiscus
Saginaw Bay	---	----	USNM	20/8/58	53	12		2.4-7.6	Montgomery
Yakutat Bay	---	----	USNM	6/99	3			5.9-6.8	---
Juneau	---	----	USNM	7/8/61	2	4		4.3-6.2	Lowenstam
<i>British Columbia</i>									
N of Cox Point, Vancouver I.	---	----	RMNH	25/6/62	4		4	4.3-8.3	Landrum
<i>Washington</i>									
Neah Bay	---	----	USNM	4/6/64	6			3.3-6.9	McLaughlin
San Juan Is.	---	----	USNM	5/61	4	1	2	4.4-7.4	Henry
San Juan I.	---	----	USNM	8/61	6	2	1	1.9-6.0	McLaughlin
Turn I., San Juan I.	---	----	USNM	28/7/61	19	17	4	1.3-6.9	McLaughlin
Mitchell Bay, San Juan I.	---	USNM, AHF	USNM	28/7/61	1			6.2	McLaughlin
Culver's Point, San Juan I.	---	----	USNM	22/6/52			1	2.3	Illig
Friday Harbor, San Juan I.	---	----	USNM	1922	1			9.6	Stevens
Port Orchard Bay	---	----	RMNH	29/6/61	6	6	1	2.1-6.4	McLaughlin
<i>Oregon</i>									
S end Neahkabrine Mt.	---	----	USNM	28/12/71	1		1	4.5-7.0	Markham

Antennular peduncles moderately short, equalling or slightly exceeding length of ocular peduncles. Ultimate and penultimate segments unarmed; basal segment with laterodistal margin slightly denticulate or spinulose; all segments usually with tufts of short setae.

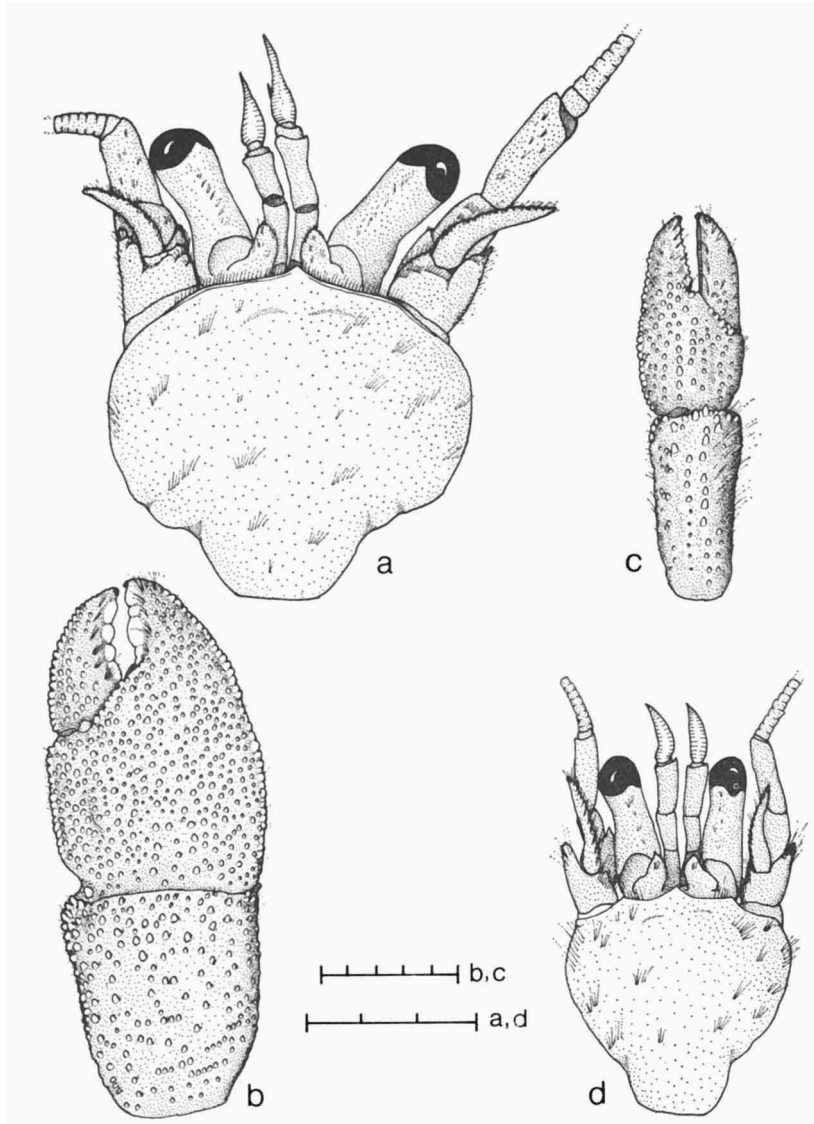


Fig. 43. a-c, *Pagurus hirsutiussculus hirsutiussculus* (Dana). a, shield; b, right chela and carpus (dorsal view); c, left chela and carpus (dorsal view). — d, *Pagurus hirsutiussculus venturensis* Coffin, shield. Scales equal 5 mm (b, c) and 3 mm (a, d).

Antennal peduncles moderately long, exceeding ocular peduncles by one-half to five-sixths length of ultimate segment; with inconspicuous supernumerary segmentation. Fifth and fourth segments unarmed, with scattered tufts of short setae. Third segment with small spine at ventromesial distal angle, often obscured by tufts of moderately long setae. Second segment with dorsolateral distal angle produced, terminating in simple or bifid spine, mesial margin strongly inflated, with 1 or 2 small spinules, lateral margin with tufts or short setae, occasionally minutely spinulose, dorsal surface usually with 1 or 2 short, transverse, denticulate or spinulose ridges and tufts of short setae; dorsomesial distal angle with small spine, mesial face with few, transverse, spinulose or denticulate ridges and tufts of short setae. First segment with small spine at laterodistal margin; ventromesial distal angle produced, with several small spines or spinules laterally. Antennal acicles moderately short, usually not reaching to distal half of ultimate peduncular segment; arcuate; mesial margin with row of transverse spinulose ridges and tufts of short setae; terminating in small spine. Antennal flagella long, usually overreaching right cheliped; each article usually with one to several minute setae.

Mandible without distinctive characters. Maxillule with proximal endite tapering; endopodite with 1 or 2 bristles on weakly produced internal lobe, external lobe usually obsolete. Maxilla with endopodite slightly inflated basally, not reflexed, equalling scaphognathite in distal extension. First maxilliped with endopodite approximately two-thirds length of exopodite; basal segment of exopodite moderately broad. Second maxilliped with basis-ischium fusion apparently incomplete. Third maxilliped with basis-ischium fusion incomplete; basis with 1-3 small spines; ischium with crista dentata well developed, 1 accessory tooth; merus with small spine at dorsodistal margin, ventral margin usually unarmed; carpus with small spine at dorsodistal margin. Sternite of mxp_3 with small spine on either side of midline, obscured by dense row of long setae.

Right cheliped moderately short and broad in small specimens, elongate and moderately slender in large specimens. Dactyl slightly less than, equaling, or slightly exceeding length of palm, moderately broad; cutting edge with row of strong calcareous teeth; terminating in small corneous tooth or claw; with longitudinal hiatus proximally; dorsomesial margin with row of small tubercles frequently inconspicuous, becoming obsolete distally, dorsal surface slightly elevated, with scattered low tubercles proximally, single row distally, with few tufts of moderately short bristles. Palm slightly inflated dorsoventrally, dorsal surface convex, with closely spaced low tubercles or less frequently granules, occasionally relatively smooth, dorsomesial margin not

delimited or with single or double row of small tubercles and few tufts of short setae, dorsolateral margin usually with row of small slightly more prominent tubercles, increasing in size on fixed finger, occasionally margin not delimited; mesial, lateral and ventral surfaces tuberculate or granular, with tufts of short setae. Carpus moderately short, slightly less than length

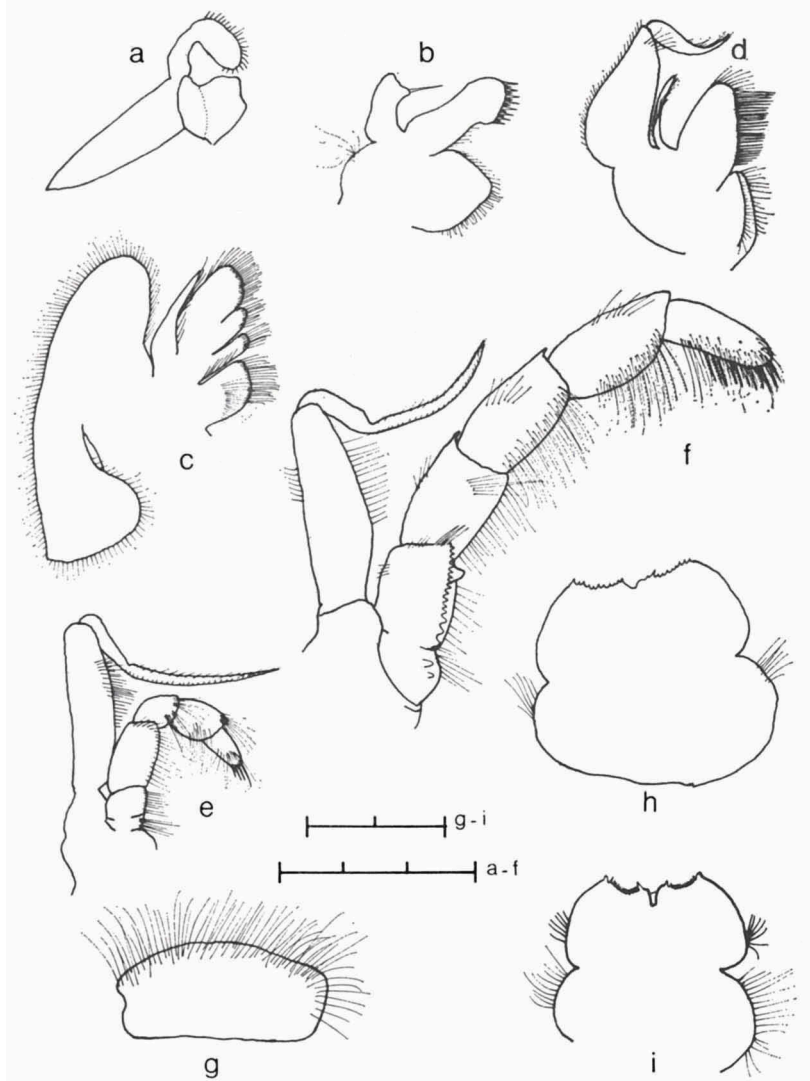


Fig. 44. a-h, *Pagurus hirsutiussculus hirsutiussculus* (Dana). a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite, P₃; h, telson. — i, *Pagurus hirsutiussculus venturenensis* Coffin, telson. Scales equal 3 mm (a-f) and 1 mm (g-i).

of merus, equalling or slightly exceeding length of palm; weakly inflated dorsoventrally; dorsal surface convex, with transverse rows of small tubercles or with scattered small tubercles or with short transverse rows of tuberculate or denticulate ridges, distal margin unarmed or slightly denticulate, dorso-mesial margin not delimited or with single or double row of small tubercles and tufts of short setae, dorsolateral margin usually not delimited; mesial and lateral faces with numerous, short, transverse, denticulate, tuberculate, or spinulose ridges and tufts of moderately short setae, distal margins usually denticulate; ventral surface with scattered small tubercles and tufts of short setae. Merus subtriangular; dorsal surface with transverse multidenticate or spinulose ridges and tufts of short setae extending onto lateral and mesial faces distally, distal margin usually spinulose, denticulate or tuberculate with row of moderately long setae; lateral face spinulose or denticulate ventrally, ventrolateral margin with row of small spines; ventral surface with scattered small spines or tubercles and tufts of long setae, usually with 1 prominent tubercle at ventroproximal margin; mesial face minutely spinulose or tuberculate with tufts of long setae. Ischium with row of small denticles on ventromesial margin, ventrolateral margin with single or double row of small denticles or tubercles, ventral surface slightly spinulose with tufts of long setae. Coxa with ventrolateral and ventromesial margins denticulate or spinulose, with tufts of long setae.

Left cheliped moderately short, usually not reaching to base of dactyl of right. Dactyl moderately long, usually equalling or slightly exceeding length of palm; cutting edge with row of small corneous teeth; terminating in small corneous claw; usually not overlapped by fixed finger; dorsomesial margin with row of very small spinules and few tufts of long setae, dorsal surface with scattered small spinules or tubercles and tufts of long bristles; mesial and ventral surfaces with tufts of setae and bristles. Palm moderately long, one-half to two-thirds length of carpus; dorsolateral margin frequently not delimited or with row of small tubercles, becoming obsolete distally on fixed finger; dorsal surface generally convex with irregular rows of small tubercles or spinules, occasionally granules, and tufts of short setae; dorsomesial margin often with irregular row of short, transverse, spinulose ridges and tufts of moderately long setae; lateral face granular or slightly spinulose; ventral surface with small tubercles and tufts of long setae. Carpus moderately long, slightly less than or equalling length of merus; dorsomesial and dorsolateral margins each with row of small, acute or subacute spines or spinulose tubercles and tufts of long setae, distal margin with few, small, acute or subacute spines or tubercles, often only denticulate or spinulose; lateral and mesial faces with transverse multidenticate or spinulose protuberances or ridges and tufts

of moderately short setae; ventral surface with tufts of short setae, distal margin denticulate. Merus subtriangular, slightly compressed laterally; dorsal margin with transverse spinulose or denticulate ridges and tufts of moderately long setae; mesial face with few, transverse, denticulate or spinulose ridges and tufts of long setae, ventromesial margin with row of prominent tubercles, decreasing in size distally and partially obscured by tufts of long setae; lateral face with transverse, multidenticulate, spinulose or tuberculate ridges and tufts of moderately short setae, ventrolateral margin with single or double row of moderately strong spines, partially obscured by tufts of long setae; ventral surface with few small spines or tubercles. Ischium with few small tubercles on ventrolateral margin, laterodistal margin denticulate or tuberculate, lateroproximal margin dorsally with row of small tubercles; ventromesial margin with irregular row of small tubercles and tufts of long setae, ventrodistal margin tuberculate, with tufts of long setae. Coxa with rows of small tubercles or denticles on ventromesial and ventrolateral margins, partially obscured by tufts of long setae.

Second pereopods moderately long, slightly overreaching right cheliped. Dactyl moderately long, slightly less than or equalling length of propodus; in lateral view, straight or slightly curved ventrally; in dorsal view, straight, or very slightly twisted, occasionally curved mesially; terminating in strong corneous claw; dorsal surface with double row of short bristles and usually 1 row of small corneous spinules; mesial face with faint longitudinal sulcus and dorsally, single or double row of small corneous spinules, ventrally tufts of long setae; lateral face with faint longitudinal sulcus and 1 or 2 rows of tufts of long setae; ventral margin with row of strong corneous spines, increasing in size distally. Propodus slightly exceeding length of carpus; dorsal margin with 1 or 2 rows of short, transverse, multidenticulate, tuberculate or spinulose protuberances or ridges and tufts of long setae, distal margin denticulate; lateral face with 2 rows of short, transverse, denticulate or spinulose ridges, and 3 rows of tufts of long setae; mesial face with tufts of long setae, distal margin with 1 or 2 strong corneous spines ventrally; ventral surface with row of corneous spines. Carpus moderately long, two-thirds to three-fourths length of merus; dorsal surface with 1 or 2 rows of spinulose tuberculate or multidenticulate protuberances and tufts of long setae, distal margin with 1 or 2 prominent, small, acute or subacute spines; lateral face with 1 or 2 irregular rows of transverse spinulose or denticulate ridges and tufts of short setae; mesial and ventral surfaces with tufts of long setae. Merus laterally compressed; dorsal surface with single to triple row of transverse denticulate or spinulose ridges and tufts of long setae, distal margin often denticulate; lateral face with transverse spinulose or

multidenticulate ridges and tufts of long setae; mesial face with scattered tufts of long setae; ventral margin with transverse spinulose ridges proximally, becoming small spines distally, partially obscured by tufts of long setae. Ischium with row of acute or subacute small spines on ventral margin; lateral face with few denticulate ridges and tufts of long setae. Coxa with rows of small spinules or denticles on ventromesial and ventrolateral margins obscured by tufts of long setae.

Third pereopods moderately long, approximately equalling length of second pereopods. Dactyl moderately long, slightly less than or equalling length of propodus; in lateral view, straight or slightly curved ventrally; in dorsal view, straight or slightly twisted; terminating in strong corneous claw; dorsal surface with 2 rows of tufts of short setae and 1 row of small corneous spinules; lateral face with faint longitudinal sulcus and 1 or 2 rows of tufts of short setae; mesial face with faint longitudinal sulcus flanked by single or double rows of small corneous spines; ventral margin with row of strong corneous spines, increasing in size distally. Propodus slightly exceeding length of carpus; dorsal surface with single to triple row of transverse, spinulose, multidenticulate or tuberculate ridges and tufts of long setae, distal margin minutely denticulate or spinulose; lateral face with 1-3 rows of tufts of long setae and 1 or 2 rows of short, transverse, denticulate ridges; mesial face with 2 or 3 rows of transverse spinulose or denticulate ridges and tufts of long setae; ventral margin with row of corneous spines or spinules, increasing in size distally. Carpus two-thirds to four-fifths length of merus; dorsal surface with 1 or 2 rows of short, transverse, spinulose, tuberculate or multidenticulate ridges and tufts of long setae, distal margin with 1 or 2 small spines or spinulose tubercles; lateral face with 2 or 3 rows of transverse spinulose or denticulate ridges and tufts of long setae; ventral and mesial surfaces with few tufts of short setae. Merus laterally compressed; dorsal surface with single to triple row of transverse, spinulose or denticulate ridges and tufts of long setae, distal margin usually denticulate; lateral face with transverse, spinulose, multidenticulate or tuberculate ridges and tufts of long setae; mesial face with few tufts of short setae; ventral margin with 1 or 2 rows of transverse denticulate ridges. Ischium with inconspicuous row of small transverse denticulate ridges, obscured by tufts of long setae. Coxa with long, dense marginal setae.

Fourth pereopods without apparent preungual process; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods subrectangular; anterior margin with long, dense setae.

Pleopods of male unpaired, pl_3 to pl_5 with exopodites moderately well developed; endopodites reduced. Pleopods of female unpaired, pl_2 - pl_4 with both rami well developed; pl_5 with exopodite moderately well developed, endopodite reduced.

Telson with posterior lobes slightly asymmetrical; separated by broad, shallow median cleft; terminal margins each with row of very small spinules; anterior lobes unarmed, margins with long setae.

Coloration. — In life: "Varies from light glaucous blue to olive which appears rather gray due to many short hairs; chelipeds drab grey with light glaucous blue granules, fingers white above and sometimes blue below; ambulatory legs having propodus white at distal end and chessylite blue at the proximal end; dactyls light glaucous blue striped longitudinally with Hessian brown. Antennae olive brown with golden yellow spots every two or three segments of the flagellum. The young differ so greatly from the adult in color that they may easily be taken for another species; chelipeds and walking legs vary from mahogany to blue black and in some cases are light olive, all are marked white or very light blue at the articulations, the white at the distal end of the carpus of the small cheliped is often triangular; they may, however, be readily recognized by the antennae which even in the very young show the markings characteristic to this species." (Stevens, 1925: 281). In preservative: Color changing to overall reddish-orange. Right chela with dactyl and fixed finger white or cream-colored. Second and third pereopods with dactyls light yellow-orange or cream, with darker longitudinal stripe, dorsally, laterally and mesially; propodi with white or cream-colored band distally; meri with patch of white dorsodistally; spinulose ridges of chelipeds and ambulatory legs often dark red. With time, all color fading to uniform straw-color.

Distribution. — Siberia (Rathbun); Komandorskie Ostrova to Sangar (Makarov, Vinogradov); Okhotsk Sea (Makarov, Kobjakova); Shikotan Tō (Kobjakova); Kuril Islands (Kobjakova, Lindberg, et al.); Zaliv Petra Velikogo (Makarov, Kobjakova, Vinogradov); Zaliv Konstantina (Vinogradov); Japan (Balss); Hakodadi (Stimpson); Hakodate (Vinogradov); Pribilof Islands to California (Rathbun, Holmes, Schmitt, Stevens); intertidal to 110 m. Replaced in southern California by *Pagurus hirsutiussculus venturensis*.

Affinities. — Among the species tentatively assigned to the "*comptus*" group, *P. h. hirsutiussculus* is most closely allied to *P. samuelis*. The similarities in the gross morphology of the two species, as well as the color patterns of the living animals, make them difficult to distinguish. Although *P. h. hirsutiussculus* is usually much more densely setose, this character is extremely

variable and it cannot be considered to be reliable. Similarly, the longer, more slender dactyls of the ambulatory legs and the shorter ocular peduncles of *P. h. hirsutiussculus*, which have been used to distinguish this species from *P. samuelis*, are also subject to considerable variation. The most reliable character thus far found to differentiate the two species is the armature of the propodal, carpal and meral segments of the chelipeds and ambulatory legs, which in *P. h. hirsutiussculus* consists of transverse, spinulose, multi-denticulate or tuberculate ridges or protuberances. Large specimens of *P. h. hirsutiussculus*, in which the right cheliped is appreciably more elongate, are often superficially quite similar to *P. middendorffii*. In addition to the armature of the ambulatory legs, the presence of a prominent tubercle on the ventral surface of the merus of the right cheliped readily distinguishes *P. h. hirsutiussculus*. The configuration of the shield of *P. h. venturensis* (fig. 43d), which appears to remain moderately constant (J. Haig, personal communication), and the armature of the telson (fig. 44i) distinguish this southern subspecies.

Discussion. — Makarov (1938b, 1962) placed *Pagurus mertensii* Brandt in synonymy with *P. h. hirsutiussculus*, basing his conclusion on a study of the remaining specimens of Brandt's collections in the Zoological Institute of the Academy of Sciences (USSR). The recent discovery of a specimen referable to *P. mertensii* [sensu stricto] has proved that this species is not conspecific with *P. h. hirsutiussculus* (McLaughlin & Haig, in press, figs. 1-3). The specimen of *P. mertensii* from Bare Island reported upon by Lenz (1901) should be referred to *P. h. hirsutiussculus*. Similarly, the reports by Stimpson (1857, 1858, 1907) of *P. mertensii* probably refer to *P. h. hirsutiussculus*.

Rathbun's (1904, 1910) record of *P. samuelis* from Sitka, Alaska was subsequently shown by Schmitt (1921) to be based on the misidentification of a specimen of *P. h. hirsutiussculus*.

P. h. hirsutiussculus differs from the diagnosis of the "comptus" group given by Forest & De Saint Laurent (1967) in the same general characters that have been noted for *P. beringanus*, *P. hemphilli*, *P. granosimanus* and *P. samuelis*, i.e., the development of a substantial propodal rasp on the dactyl of the fourth pereopod and the absence of chitinous plates on the lateral margins of the telson. However, the armature of the terminal margins of the telson, like that of *P. samuelis*, does conform to the description given for the group.

***Pagurus middendorffii* Brandt (figs. 45-47)**

Pagurus (Eupagurus) Middendorffii Brandt, 1851: 108, pl. 5 figs. 1-6 (by implication; type locality: "Ochotskischen Meere", Okhotsk Sea).

- Eupagurus middendorffii*: Stimpson, 1857: 482. — Stimpson, 1858: 250. — Stimpson, 1859a: 45. — Stimpson, 1862: 91. — Smith, 1880: 211B. — Alcock, 1905: 178. — Stimpson, 1907: 226. — Balss, 1913: 58. — Molander, 1914: 6. — Yokoya, 1939: 281, fig. 11. — Kamita, 1954-58a: 60. — Kamita, 1954-58c: 38, fig. 15. — Yamaguchi & Yamada, 1955: 132.
- Eupagurus middendorffii*: Ortmann, 1892: 301. — Doflein, 1900: 340. — Lenz, 1901: 444. — Doflein, 1902: 646. — Terao, 1913: 371. — Kobjakova, 1937: 144. — Urita, 1942: 45.
- ? *Eupagurus middendorffii*: Calman, 1898: 260. See discussion.
- Pagurus Middendorffii*: Holmes, 1900: 234.
- Pagurus middendorffii*: Rathbun, 1903: 35. — Rathbun, 1904: 160. — Rathbun, 1910: 160. — Taylor, 1912: 205. — Williamson, 1915: 477. — Derjugin & Kobjakova, 1935: 142. — Makarov, 1937: 59, fig. 7. — Makarov, 1938a: 408, fig. 1. — Makarov, 1938b: 174 (not pl. 5 fig. 6). — Vinogradov, 1947: 104. — Vinogradov, 1950: 226 (key), fig. 111. — Kobjakova, 1955: 153, pl. 38 fig. 3. — Gordan, 1956: 332. — Miyake, 1957: 88. — Kobjakova, 1958a: 232. — Kobjakova, 1958b: 251. — Shiino, 1958: 37. — Lindberg et al., 1959: 232. — Reischman, 1959: 414. — Mokiyeviskiy, 1960: 255. — Makarov, 1962: 165 (not pl. 5 fig. 6). — Kim, 1963: 203, fig. 19. — Kim, 1964: 8. — Kurata, 1964: 24, figs. 1, 2. — Codreanu, Codreanu & Pike, 1965: 238. — Kobjakova, 1966: 209, pl. 38 fig. 3. — Kobjakova, 1967: 240. — Mokiyeviskiy, 1968: 21. — Scelzo & Boschi, 1969: 166. — Kim, 1970: 7.
- Pagurus middendorfi*: Kobjakova, 1936: 191. — Birstein & Vinogradov, 1953: 224. — Forest & De Saint Laurent, 1967: 117.
- Eupagurus middendorfi*: Balss, 1957: 1717.

Holotype. — Not seen.

Material examined. — See table 17.

Table 17. *Pagurus middendorffii* Brandt Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex				SL (mm)	Collector
				♂	♀	♀♀	♀♂		
<i>Japan</i>									
Hokkaido	---	---- USNM 26294	1900	2				3.4-5.2	Jordan
<i>Bering Sea</i>									
Bering I., Commander Is.	---	---- USNM 16965	1882-83	7	3	1		3.1-9.7	Stejneger
Bering I., Commander Is.	---	---- USNM 42531	3/6/92	4	2			4.7-8.5	---

Diagnosis. — Left chela with dorsal surface convex, granular. Right cheliped elongate; dorsal surface of chela and carpus evenly granular; ventral surface of merus granular. Telson with terminal margins spinulose.

Description. — Shield varying from slightly longer than broad to broader than long; anterolateral margins slightly terraced or sloping; anterior margin between rostrum and lateral projections straight, slightly concave, or slightly sloping; posterior margin rounded; dorsal surface convex, generally smooth centrally with very few tufts of short setae; anterolateral angle slightly produced, blunt. Rostrum long, considerably exceeding lateral projections;

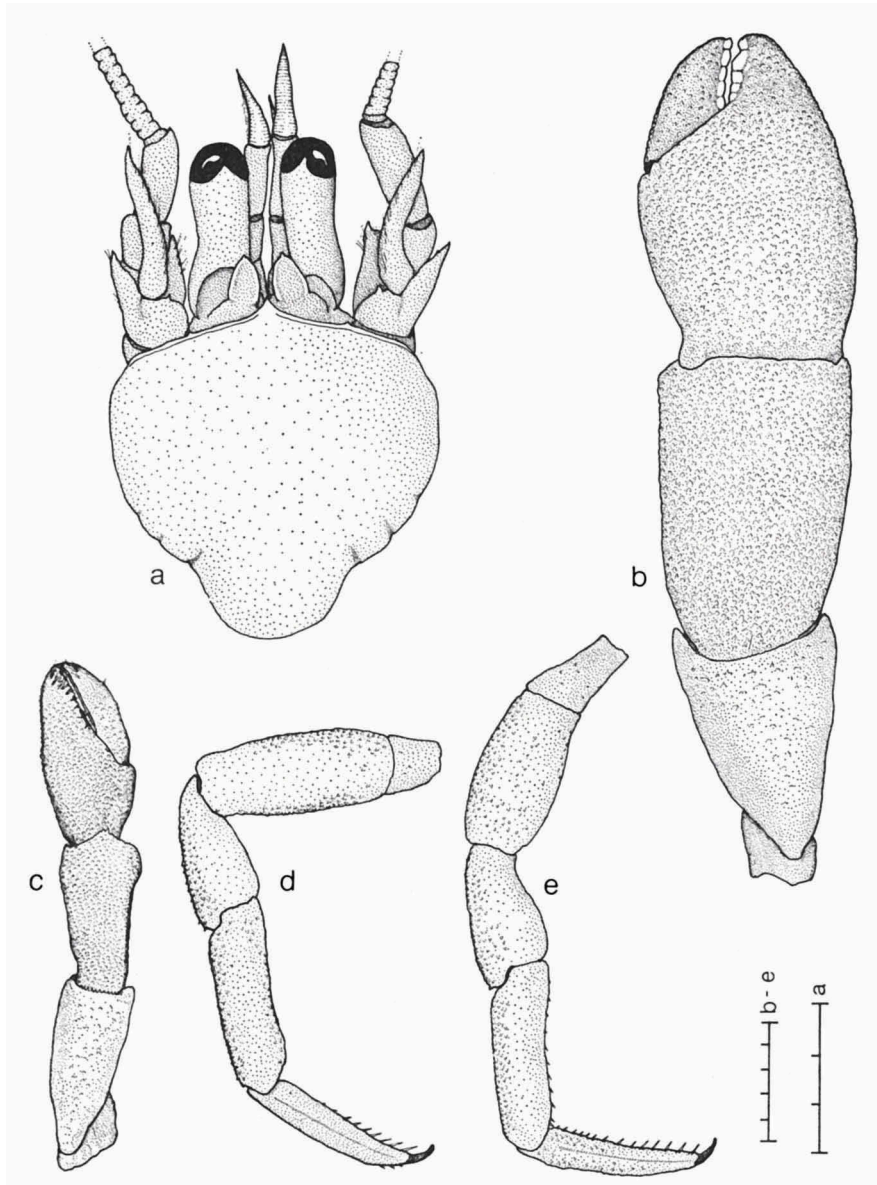


Fig. 45. *Pagurus middendorffii* Brandt. a, shield; b, right cheliped (dorsal view); c, left cheliped (dorsal view); d, left P₂ (lateral view); e, left P₃ (lateral view). Scales equal 5 mm (b-e) and 3 mm (a).

acutely triangular; terminating in small acute spine. Lateral projections broadly rounded, occasionally obsolete, with small acute or subacute spine.

Ocular peduncles short, one-third to two-thirds length of shield; inflated basally, cornea usually dilated; dorsomesial face with longitudinal row of tufts of very short setae. Ocular acicles large, subovate, with mesial and lateral margins slightly expanded; terminating acutely or subacutely with small, submarginal spine; dorsal surface concave; separated basally by one-half to three-fourths basal width of one acicle.

Antennular peduncles short, exceeding ocular peduncles by one-fourth to one-third length of ultimate segment. Ultimate and penultimate segments unarmed; basal segment unarmed or with very small spinule at ventromesial distal angle.

Antennal peduncles moderately short, exceeding ocular peduncles by one-third to two-thirds length of ultimate segment; with supernumerary segmentation. Fifth segment unarmed or with minute spinule on ventral margin. Fourth segment unarmed, with few tufts of short setae. Third segment with small spine at ventrodial margin and tufts of short setae. Second segment with dorsolateral distal angle produced, terminating in simple, bifid or occasionally trifid spine, mesial margin expanded, with 1-3 small spines, lateral margin occasionally with 1 or 2 small spinules and few tufts of short setae; dorsomesial distal angle with small spine. First segment usually with small spine on lateral face; ventrodial margin produced, with row of spinules laterally. Antennal acicles moderately short, usually not reaching distal half of ultimate peduncular segment; arcuate; terminating in small, simple or bifid acute or subacute spine; mesial margin slightly spinulose, usually with row of tufts of short setae. Antennal flagella short; articles occasionally with very short setae randomly set.

Mandible without distinctive characters. Maxillule with proximal endite subquadrate; endopodite with short bristle on internal margin proximally, 1 or 2 bristles on weakly produced internal lobe, external lobe well developed, slightly recurved, external endopodal margin usually with small bristle distally and tuft of short setae proximally. Maxilla with endopodite inflated basally, not recurved, slightly exceeding scaphognathite in distal extension. First maxilliped with endopodite approximately one-half length of exopodite; basal segment of exopodite triangular. Second maxilliped with basis-ischium fusion apparently incomplete. Third maxilliped with basis-ischium fusion incomplete; basis with 1-3 small spines; ischium with *crista dentata* well developed, 1 accessory tooth; merus with 1-4 small, subacute spines or tubercles on dorsodistal margin, ventral margin with 1-3 small spines, occasionally, unarmed; carpus with 1-4 small subacute spines or tubercles at

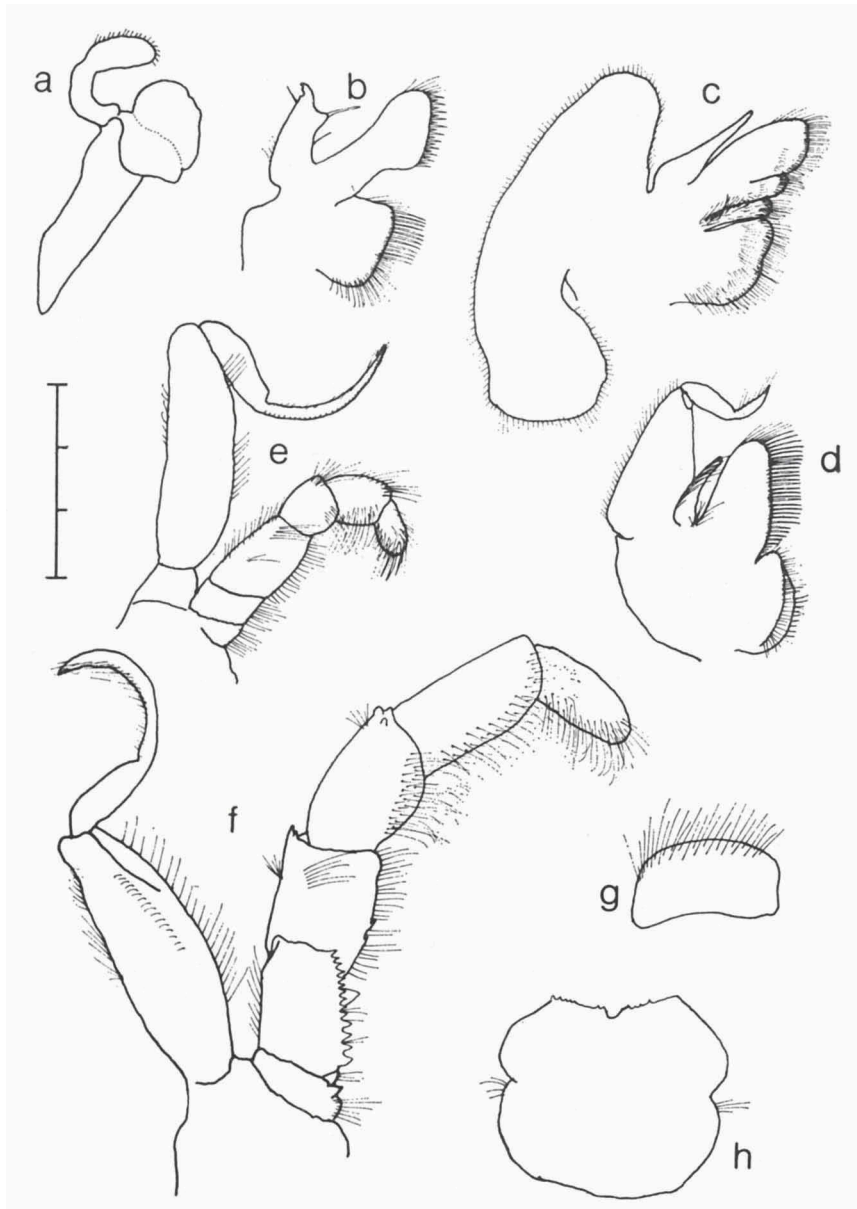


Fig. 46. *Pagurus middendorffii* Brandt. a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite, P₃; h, telson. Scale equals 3 mm.

dorsodistal margin. Sternite of m_{xp_3} with prominent, small spine on each side of midline, partially obscured by long setae.

Right cheliped moderately long and broad in small specimens, very long and moderately slender in large specimens. Dactyl short, one-half to two-thirds length of palm, strongly curved laterally; cutting edge with row of calcareous teeth, usually terminating in moderately small calcareous tooth; slightly overlapped and overreached by fixed finger; dorsomesial margin not delimited or with row of slightly prominent granules, dorsal surface convex, granular, frequently inconspicuously; ventral surface granular and with few tufts of short bristles. Palm long, two-thirds to three-fourths length of carpus, dorsoventrally inflated; dorsal surface convex, granular, often imperceptibly so, dorsomesial margin not delimited, dorsolateral margin not delimited or with single or double row of slightly more prominent granules, becoming obsolete on fixed finger; lateral, mesial and ventral surfaces granular. Carpus usually slightly exceeding length of merus, slightly inflated dorsoventrally; dorsal surface convex, granular, distal margin unarmed or slightly denticulate or tuberculate, dorsomesial and dorsolateral margins not delimited; ventral, mesial and lateral surfaces granular. Merus subtriangular; dorsal surface minutely granular, or with very small, often minutely denticulate protuberances and frequently tufts of very short setae, distal margin with row of small spinules or tubercles or denticulate; mesial and lateral faces granular, distal margins often denticulate; ventral surface with closely spaced moderately small granules, ventrolateral and ventromesial margins each with single or double row of small tubercles or moderately strong granules. Ischium with row of prominent granules or small tubercles on ventromesial margin, ventrolateral margin with 2 or 3 irregular rows of small granules. Coxa with clump of setae at ventromesial distal angle, ventrolateral margin and distal angle slightly denticulate, ventral surface minutely spinulose.

Left cheliped short, in large specimens not reaching proximal margin of right chela, in small specimens usually reaching to proximal half of palm of right cheliped; chela slightly deflected toward exterior. Dactyl moderately long, one-fourth to one-third longer than palm; cutting edge with row of small corneous teeth; terminating in small corneous claw; usually overlapped slightly by fixed finger; dorsal surface granular, with few tufts of short bristles, dorsomesial margin not delimited; ventral surface weakly granular, with tufts of short bristles. Palm moderately short, one-third to one-half length of carpus; dorsolateral surface strongly sloping, medianly rounded with very closely-spaced, frequently inconspicuous small granules; dorsomesial surface with shallow longitudinal depression or furrow proximally, dorsomesial margin not delimited; mesial, lateral and ventral surfaces granular. Carpus

moderately long, slightly less than or equalling length of merus; subtriangular, slightly inflated mesiodistally; dorsal surface granular, dorsomesial margin with irregular row of small tubercles or strong granules; mesial margin with moderately large granules or small tubercles, distal margin denticulate or

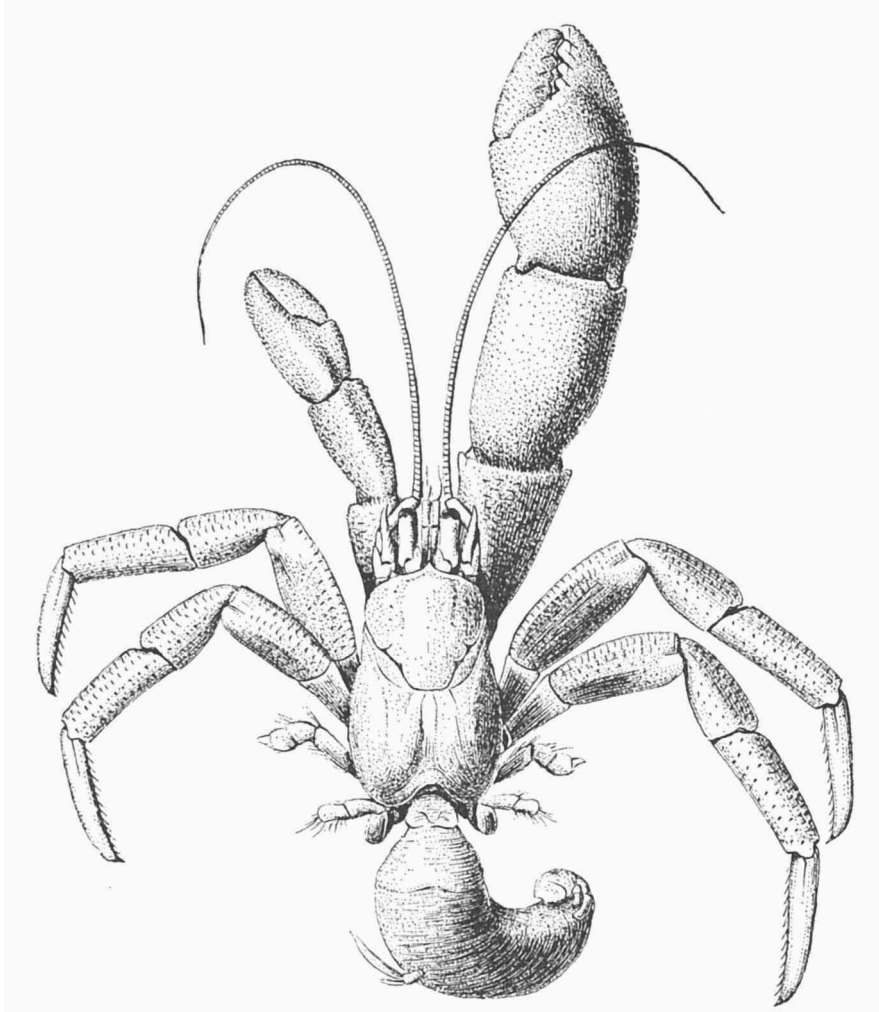


Fig. 47. *Pagurus middendorffii* Brandt. Original illustration of J. E. Benedict.

tuberculate; lateral face granular, distal margin denticulate dorsally, row of small tubercles ventrally; ventral surface granular. Merus subtriangular, slightly compressed laterally; dorsal surface granular or with minute denticulate protuberances, distal margin with 2 to several small tubercles or

spinules; mesial face minutely granular; lateral face granular or spinulose; ventral surface granular, ventromesial margin with single or double row of small tubercles. Ischium with row of small denticles on ventromesial margin, ventrolateral distal margin slightly denticulate. Coxa with clump of setae at ventromesial distal angle, ventral surface minutely spinulose.

Second pereopods moderately short, reaching to distal third of right cheliped, slightly longer in small specimens. Dactyl moderately short, slightly less than length of propodus; in lateral view, straight or slightly curved ventrally; in dorsal view, straight or slightly twisted; terminating in strong corneous claw; dorsal surface with double or triple row of tufts of very short bristles or small corneous spinules, extending onto mesial face dorsally; lateral face with faint longitudinal sulcus frequently flanked by tufts of very short bristles; mesial face with faint longitudinal sulcus flanked by 1-3 irregular rows of corneous spinules; ventral margin with row of strong, corneous spines, increasing in size distally. Propodus moderately long, slightly exceeding length of carpus; dorsal surface granular, distal margin with few, small, corneous spinules; lateral face granular, primarily dorsally and ventrally, distal margin unarmed or with 1 or 2 corneous spines ventrally; mesial face with irregular rows of corneous spinules ventrally, distal margin with cluster of small corneous spines ventrally; ventral margin with row of small corneous spines, increasing in size distally. Carpus moderately long, two-thirds to three-fourths length of merus; dorsal surface granular, becoming tuberculate or spinulose distally, distal margin with few small tubercles or spinules; lateral face with small tubercles or granules and occasionally few tufts of very short setae, distal margin occasionally denticulate; mesial and ventral surfaces with scattered small granules. Merus laterally compressed; dorsal surface granular or with very small multidenticate or spinulose protuberances, distal margin unarmed or denticulate or minutely spinulose; lateral face slightly granular; mesial face usually with scattered very small granules; ventral margin tuberculate. Ischium with row of small spinules on ventral margin. Coxa minutely spinulose on ventrolateral margin, ventromesial margin with tufts of short setae.

Third pereopods approximately equalling length of second. Dactyl moderately short, slightly less than length of propodus; in lateral view, straight or slightly curved ventrally; in dorsal view, straight or slightly twisted; terminating in strong corneous claw; dorsal surface with single to triple row of small corneous spinules and frequently tufts of short bristles, extending onto mesial face; lateral face with faint longitudinal sulcus flanked by tufts of short setae or small granules; mesial face with faint longitudinal sulcus flanked by single or double row of small corneous

spinules; ventral margin with row of strong corneous spines; increasing in size distally. Propodus moderately long, slightly exceeding length of carpus; dorsal surface granular and often with irregular rows of small corneous spinules; mesial face with irregular rows of corneous spinules; lateral face minutely granular, more prominent dorsally; ventral surface with row of corneous spines, increasing in size distally, ventromesial distal angle with cluster of corneous spines. Carpus moderately long, slightly less than or equalling length of merus; dorsal surface granular, distal margin denticulate or spinulose; lateral face unarmed or granular; mesial and ventral surfaces sparsely granular. Merus laterally compressed; dorsal surface granular or with very small, spinulose or multidenticulate protuberances, distal margin denticulate; lateral face with scattered granules, distal margin occasionally denticulate ventrally; mesial face sparsely granular; ventral surface with low, broad, multidenticulate protuberances, often practically obsolete. Ischium with row of small tubercles or denticles on ventral margin. Coxa with row of tufts of short setae on ventromesial margin, distal angle with clump of stiff setae.

Fourth pereopods without apparent preungual process; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods subrectangular, moderately broad; margin with moderately long setae.

Pleopods of male, unpaired, pl_3 - pl_5 with exopodites well developed; endopodites rudimentary. Pleopods of female unpaired, pl_2 - pl_4 with both rami well developed; pl_5 with exopodite moderately well developed, endopodite rudimentary.

Telson with posterior lobes slightly asymmetrical, left larger than right; separated by moderately broad, deep, median cleft; terminal margins each with row of small spinules; anterior lobes unarmed, margins with few short setae.

Coloration. — In life: "...olive green. [In preservative:] ... uniform reddish orange. The distal half of the dactyli of the right chela is frequently white. The carpal joints and the proximal half of the propodal joints of the walking legs have a brownish-red longitudinal stripe, broad on the carpal joints and gradually tapering on the propodal joints". (Makarov, 1962: 166).

Distribution. — Bering Sea from Bukta Lavrova (Makarov); Okhotsk Sea, Shantarskoye More (Kobjakova); Kurile Is. (Kobjakova, Lindberg, et al.); Sakhalin: east and west coast, Zaliv Aniva (Kobjakova, Lindberg, et al.); Kuneshir, Shikotan Tō (Kobjakova); Zaliv Petra Velikogo (Kobjakova); Zaliv Pos'yeta (Makarov, Mokiyevskiy); Zaliv De-Kastri (Moki-

yeveskiy); Japan: Hakodadi Bay (Stimpson); Jesso (Doflein); Hokodate (Rathbun); Todohokke (Balss); Hokkaido (Yamaguchi & Yamada); Akkeshi, Niiyama Bay, Ishikari Bay, Shirikishinai (Miyake); Bering I. (Rathbun); Aleutian Is. [?] to Vancouver (Vinogradov); [?] Sitka, Alaska (Brandt); [?] Puget Sound (Calman); intertidal.

Affinities. — In terms of superficial morphology, *Pagurus middendorffii* appears most closely allied to *P. granosimanus*, *P. h. hirsutiusculus* and *P. mertensii*. The tendencies in specimens of *P. h. hirsutiusculus*, and to a lesser extent of *P. granosimanus*, toward elongation of the right cheliped and obsolescence of the tuberculate armature of the chelipeds are similar to the condition found in *P. middendorffii*. This species is immediately distinguishable from *P. granosimanus*, however, in the absence of a pair of prominent tubercles on the ventral surface of the merus of the right cheliped. The distinctive armature of the propodal, carpal and meral segments of the chelipeds and ambulatory legs of *P. h. hirsutiusculus* readily distinguish this species from *P. middendorffii*. Brandt (1851) considered *P. middendorffii* closely related to *P. mertensii*, presumably because both species may be characterized by elongate, moderately slender chelipeds, covered with minute granules. Several characters of *P. mertensii*, however, separate it from *P. middendorffii*, e.g., a row of prominent tubercles on the dorsal midline of the carpus of the right cheliped, the elongate, slender, and strongly twisted dactyls of the second and third pereopods, and the distinctive and strong armature of the telson.

Discussion. — The reports of *P. middendorffii* from Sitka (Brandt, 1851), Puget Sound (Calman, 1898) and Vancouver (Vinogradov, 1950) could not be verified; however, it is probable that Vinogradov's record was based on the earlier literature. Although extensive collections have been made throughout Puget Sound, British Columbia, and to a lesser extent in southeastern Alaska, since the turn of the century, no specimens of *P. middendorffii* have been recorded. This fact would suggest that the early records of Brandt and Calman resulted from misidentifications of one of the common intertidal species of the area, e.g., *P. granosimanus* or *P. h. hirsutiusculus*. Therefore, distribution records east of the Aleutian Islands must be considered questionable.

Makarov's (1938b, pl. 5 fig. 6; 1962, pl. 5 fig. 6) figure is not *P. middendorffii*. As previously indicated (p. 175), the figure erroneously cited as *P. samuelis* (pl. 3 fig. 6) is more probably that of *P. middendorffii*.

Dissimilarity among the six northwestern North American species assigned to the "comptus" group by Forest & De Saint Laurent (1967) is further exemplified by *P. middendorffii*. As in the five previously discussed species,

P. middendorffii disagrees with the group diagnosis in the development of the propodal rasp of the fourth pereopod and lacks the chitinous plates on the lateral margins of the telson. In the armature of the terminal margins of the telson, this species agrees with the group diagnosis, as do *P. samuelis* and *P. h. hirsutiussculus*; however, it differs from these latter two species in most characters of the mouthparts. Although the maxillule of *P. middendorffii* is similar to that of *P. granosimanus*, the second and third maxillipeds are distinctly different.

Pagurus mertensii Brandt (figs. 48-50)

Pagurus (Eupagurus) Mertensii Brandt, 1851: 112 (in part; by implication; type locality: "Kamtschatka"; also see *P. h. hirsutiussculus*).

Eupagurus mertensi: Doflein, 1900: 341.

Parapagurus mertensii: Alcock, 1905: 172 (in part). — Gordan, 1956: 338 (in part; see discussion).

Pagurus mertensii: Williamson, 1915: 477. — McLaughlin & Haig, in press.

Pagurus hirsutiussculus: Makarov, 1938b: 181 (in part). — Makarov, 1962: 171 (in part; see discussion).

? not *Eupagurus Mertensii*: Stimpson, 1857: 483. — Stimpson, 1858: 237 (? = *Pagurus hirsutiussculus hirsutiussculus* (Dana, 1851)).

not *Eupagurus (Labidochirus) mertensii*: Benedict, 1892: 2 (by implication; = n. gen., n. sp., in press).

not *Eupagurus mertensi*: Lenz, 1901: 444 (= *Pagurus hirsutiussculus hirsutiussculus* (Dana, 1851)).

not *Eupagurus mertensii*: Stimpson, 1907: 216 (= *Pagurus hirsutiussculus hirsutiussculus* (Dana, 1851)).

Holotype. — Not seen (presumably no longer extant).

Material examined. ♂ (SL = 4.5 mm), Saint Paul I., Pribilof Is., Alaska, 1879, USNM.

Diagnosis. — Left chela with dorsal surface convex, granular, with short row of small tubercles in midline proximally. Right cheliped elongate, slender; chela with dorsal surface convex, granular; carpus with dorsal surface granular, midline with irregular row of small tubercles. Telson with terminal margins of posterior lobes with strong spines, lateral margins each with row of short, stiff bristles.

Description. — Shield slightly longer than broad; anterolateral margins sloping; anterior margin between rostrum and lateral projections concave; posterior margin roundly truncate; dorsal surface slightly convex, smooth with few tufts of short setae; anterolateral angle with small blunt protuberance. Rostrum short, not exceeding lateral projections, obtusely rounded, with tuft of short setae. Lateral projections triangular, with very small terminal spinule.

Ocular peduncles short, slightly longer than one-half shield length; stout;

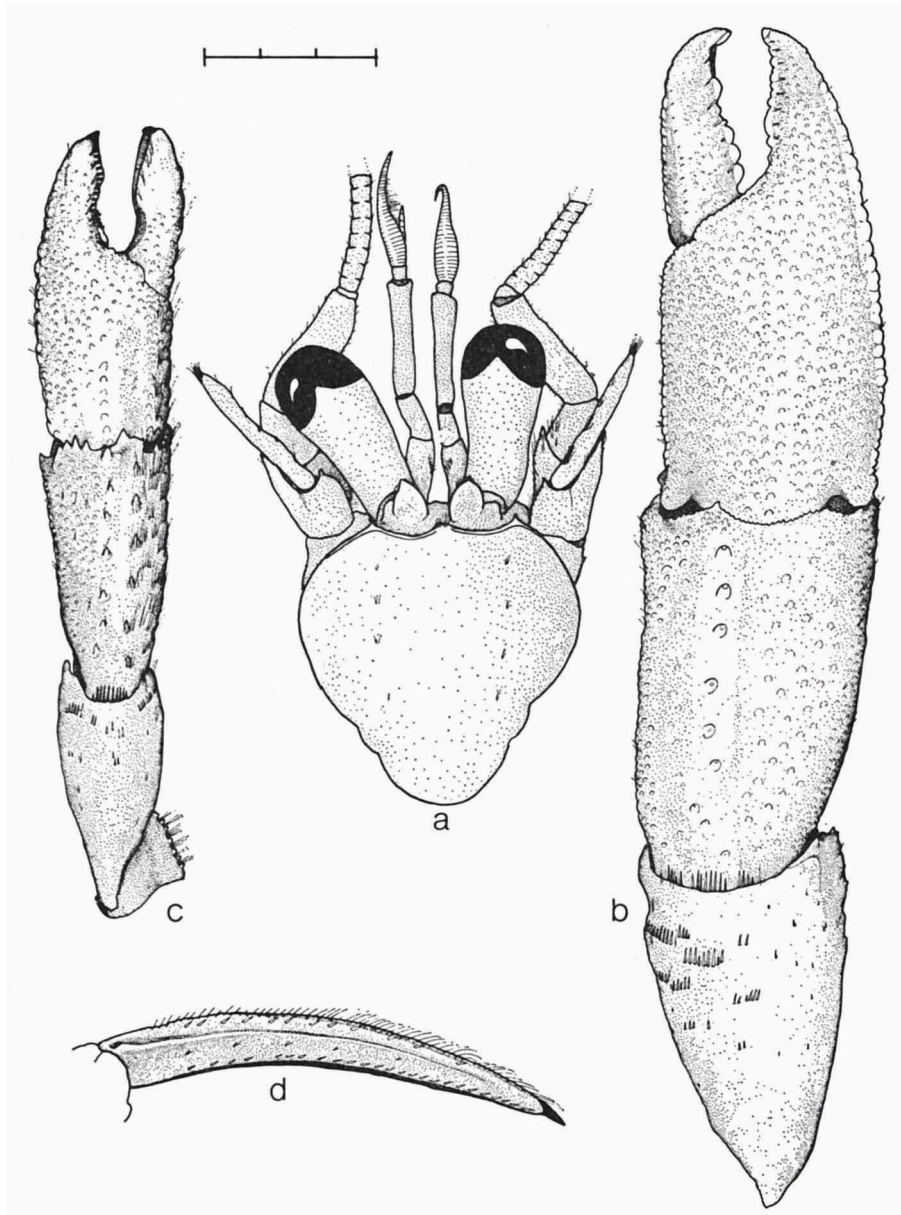


Fig. 48. *Pagurus mertensii* Brandt. a, shield; b, right cheliped (dorsal view); c, left cheliped (dorsal view); d, left P₃, dactyl (mesial view). Scale equals 3 mm.

corneal region strongly inflated. Ocular acicles large, reaching beyond mesial base of ocular peduncles; subovate with dorsal surface slightly concave; terminating subacutely, with or without small submarginal spine; distal margins with tufts of long setae; separated basally by approximately two-thirds basal width of one acicle.

Antennular peduncles moderately long, exceeding ocular peduncles by one-half length of ultimate segment; ultimate and penultimate segments unarmed, with few short stiff setae; basal segment with small spine on dorsolateral margin.

Antennal peduncles moderately long, exceeding ocular peduncles by one-half length of ultimate segment; with supernumerary segmentation. Fifth segment with dorsal and ventral row of short stiff bristles. Fourth segment with tufts of short stiff bristles. Third segment with strong spine and tufts of setae at ventromesial distal angle. Second segment with dorsolateral distal angle produced, terminating in strong simple spine, dorsal surface distally and mesial margin with short stiff bristles; dorsomesial distal angle with acute spine, mesial face with stiff setae. First segment with or without small spine on lateral margin; ventral margin with strong spine and row of short bristles. Antennal acicle moderately long, exceeding ocular peduncles; slightly arcuate; terminating in small spine and tuft of stiff bristles; mesial margin with short transverse rows of tufts of short bristles. Antennal flagella moderately long, not reaching tip of right cheliped; each article with 2 or 3 very short bristles.

Mandible without distinctive characters. Maxillule with proximal endite tapering; endopodite with 3 bristles on weakly produced anterior lobe, external lobe well developed, recurved toward interior. Maxilla with endopodite basally inflated, not reflexed, exceeding scaphognathite in distal extension. First maxilliped with endopodite approximately two-thirds length of exopodite; flagellum of exopodite very short, broad. Second maxilliped without distinctive characters. Third maxilliped with basis-ischium fusion apparently complete; basis with 1 small spine; ischium with crista dentata somewhat reduced, 1 accessory tooth; merus with small spine at dorsodistal margin. Sternite of mxp_3 unarmed, margin with row of stiff setae.

Right cheliped very elongate, slender. Dactyl moderately long, approximately four-fifths length of palm; terminating in strong, inwardly curved claw; cutting edge with short row of small corneous teeth distally, calcareous teeth on proximal two-thirds; slightly overlapped by fixed finger; with slender hiatus; dorsal surface convex, minutely granular with scattered tufts of short bristles, dorsomesial margin with row of very low tubercles; mesial and ventral surfaces tuberculate and with tufts of short setae, longer

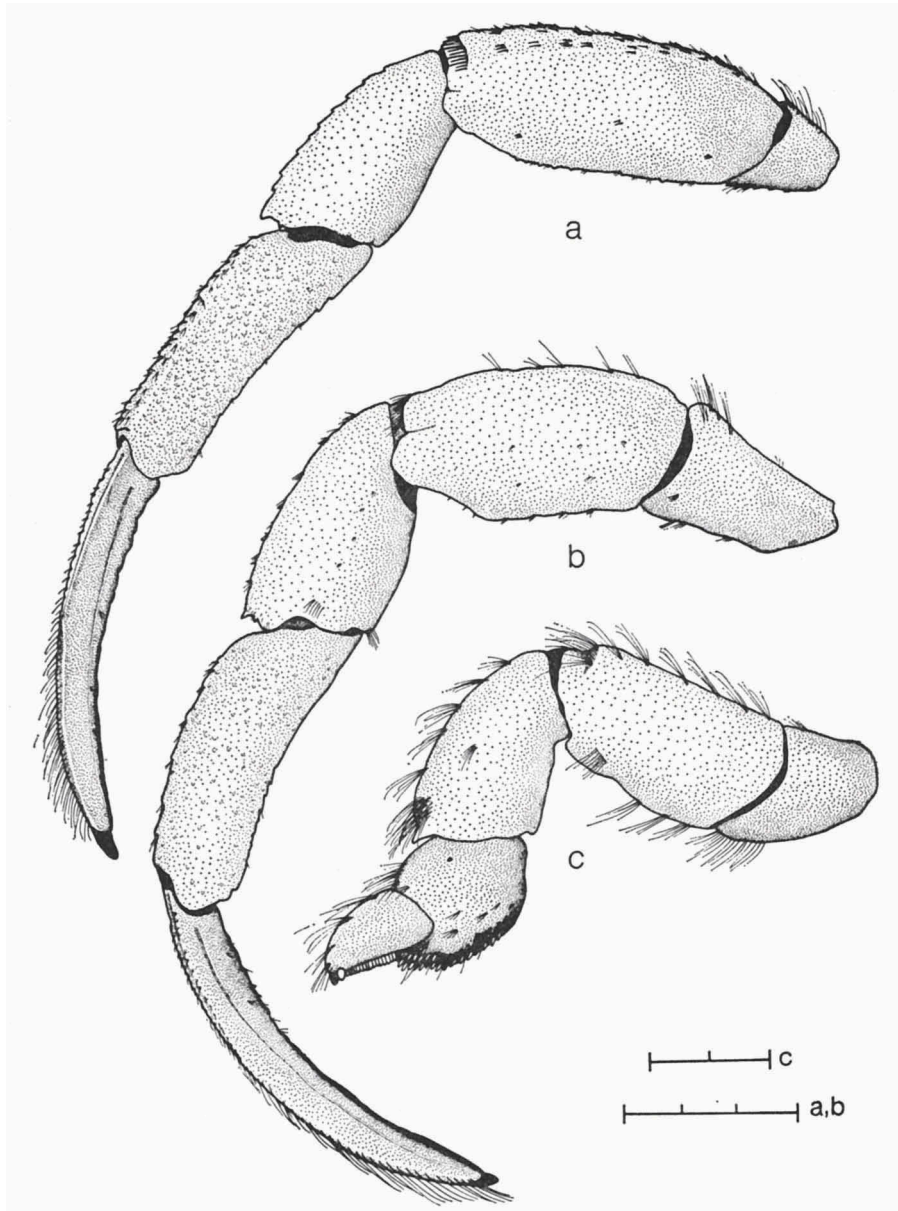


Fig. 49. *Pagurus mertensii* Brandt. a, left P₂ (lateral view); b, left P₃ (lateral view); c, left P₄ (lateral view). Scales equal 3 mm (a, b) and 1 mm (c).

and in longitudinal rows on ventral surface. Palm elongate, approximately three-fourths length of carpus, dorsoventrally inflated; dorsal surface strongly convex, with closely-spaced low granules, dorsolateral margin with row of small tubercles, becoming obsolete on fixed finger, dorsomesial margin with row of very small tubercles; mesial, lateral and ventral surfaces granular or minutely tuberculate, with tufts of stiff setae more prominent ventrally; cutting edge of fixed finger with row of calcareous teeth, distally interspersed with very small corneous teeth. Carpus long, slender, approximately equalling length of merus; dorsomesial margin with row of small spinulose tubercles, dorsal surface convex, granular with longitudinal row of small spinulose tubercles slightly mesiad of midline; mesial, lateral and ventral surfaces minutely granular. Merus triangular; dorsal margin and mesial and lateral faces dorsally, with short transverse rows of stiff bristles; mesial and lateral faces ventrally, and ventral surface minutely granular; ventrolateral margin distally with row of small spines. Ischium with row of small denticles on ventromesial margin. Coxa with stiff bristles on ventral surface mesially and distally.

Left cheliped short, reaching only to proximal margin of palm of right. Dactyl approximately one-fourth longer than palm, moderately broad; terminating in strong corneous claw; cutting edge with row of small corneous teeth, with margin strongly indented proximally; dorsal surface with low ridge proximally, 1 short row of very small tubercles and scattered small granules proximally and 2 longitudinal rows of short bristles; mesial and ventral surfaces minutely tuberculate, with longitudinal rows of moderately long setae. Palm approximately one-half length of carpus, subtriangular; dorsal surface with broad subacute ridge and row of very small spinulose tubercles, extending onto fixed finger, dorsolateral face oblique, minutely tuberculate, dorsolateral margin with row of very small tubercles becoming obsolete distally on fixed finger; dorsomesial margin with irregular double row of very small spinulose tubercles; mesial and ventral surfaces tuberculate, with tufts of long setae; cutting edge of fixed finger with row of small, calcareous teeth, interspersed with small, corneous teeth; with short moderately slender hiatus, proximally. Carpus subtriangular, approximately equalling length of merus; dorsal surface with 2 rows of very small spinulose tubercles and tufts of long setae; mesial face with spinulose ridges or protuberances and tufts of long setae; lateral and ventral surfaces tuberculate or granular. Merus narrowly triangular; dorsal margin with few corneous spinules and tufts of short bristles; mesial and lateral faces each with irregular transverse row of corneous spinules distally; ventral surface minutely granular, ventromesial and ventrolateral margins distally with small spinules. Ischium with row of

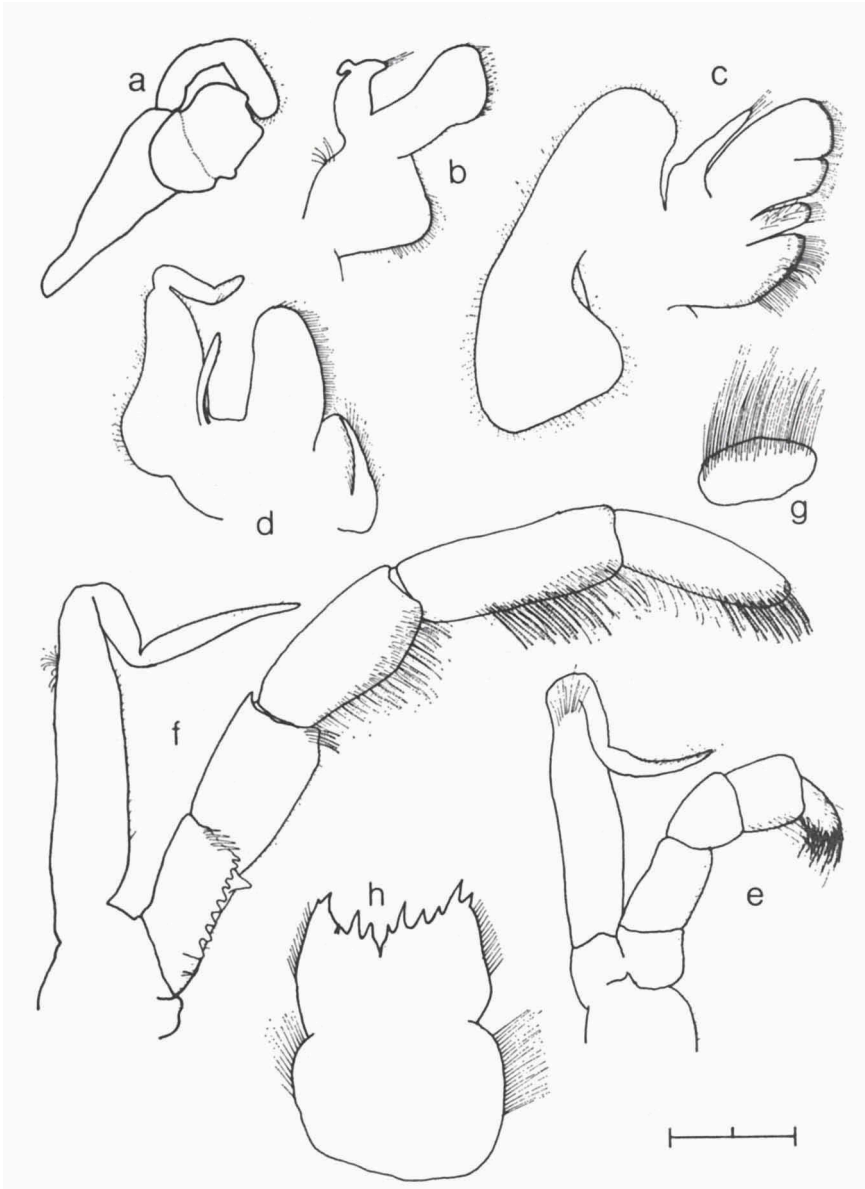


Fig. 50. *Pagurus mertensii* Brandt. a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite, P₃; h, telson. Scale equals 1 mm.

small spines on ventromesial margin and few tufts of long setae. Coxa with row of long stiff setae on ventrodistal and ventromesial margins.

Second and third pereopods long, slightly overreaching right cheliped. Second pereopod with dactyl slightly less than twice length of propodus, moderately broad; in lateral view, strongly curved ventrally; in dorsal view, strongly twisted; terminating in corneous claw; dorsal surface flattened, with 2 deep longitudinal sulci proximally separated by prominent ridge with low tubercles and tufts of long stiff setae; mesial face with very prominent longitudinal sulcus flanked above by row of small corneous spines and below by row of tufts of short setae, ventromesial margin with row of corneous spines, increasing in size distally; lateral face with longitudinal sulcus and few tufts of very short setae. Propodus approximately half again longer than carpus; dorsal surface with 2 irregular rows of very small spinulose protuberances and tufts of short setae; mesial, lateral and ventral surfaces minutely tuberculate or spinulose, with tufts of short setae. Carpus approximately one-half length of merus; dorsal margin with row of very small spines, increasing in size distally and tufts of short setae; lateral face with tufts of very short setae, 1 small spine on distal margin dorsally; mesial and ventral surfaces unarmed. Merus laterally compressed; dorsal margin with 2 irregular rows of sets of corneous spinules, distal margin with row of corneous spines; mesial and lateral faces with few corneous spinules; ventral surface with 2 irregular rows of very low tubercles and tufts of minute bristles. Ischium with row of very small spines on ventral margin. Coxa with few tufts of long setae on ventral margins.

Third pereopod with dactyl slightly less than twice length of propodus, moderately broad; in lateral view, curved ventrally; in dorsal view, strongly twisted; terminating in corneous claw; dorsal surface flattened, with 2 longitudinal sulci separated by ridge of very low tubercles and tufts of stiff setae; mesial face with prominent longitudinal sulcus and row of corneous spinules, mesioventral margin with row of corneous spines; lateral face with longitudinal sulcus and few tufts of short setae. Propodus slightly longer than carpus; dorsal surface with low spinulose protuberances and tufts of short setae; mesial, lateral and ventral surfaces tuberculate. Carpus slightly shorter than merus; dorsal surface with row of small corneous spines and tufts of short setae, 1 small spine on distal margin; mesial and ventral surfaces unarmed. Merus laterally compressed; dorsal and distal margin with tufts of long, stiff setae; mesial and lateral faces with few tufts of short setae; ventral margin with row of small corneous spinules and tufts of short setae. Ischium with tufts of long stiff setae on dorsal and ventral margins. Coxa with tufts of long setae on ventral margins.

Fourth pereopods with inconspicuous preungual process on lateral face of dactyl; propodal rasp with only 2 rows of corneous scales. Carpus with strong spine at dorsodistal margin, partially obscured by large tuft of long setae.

Fifth pereopods typical.

Sternite of third pereopods subrectangular, anterior margin with long stiff setae.

Pleopods of male unpaired, pl_3-pl_5 (pl_4 missing in this specimen as result of damage), with exopodites well developed, margins with long setae; endopodites rudimentary. Pleopods of female unknown.

Telson with posterior lobes slightly asymmetrical, left slightly larger than right; separated by deep median cleft; right terminal margin with 3 very strong spines, 1 small submarginal spine, lateral margin with row of short stiff setae; left terminal margin with 4 small and 2 very strong spines, lateral margin with row of short stiff setae; anterior lobes unarmed, margins with long setae.

Coloration. — Living color unknown. In preservative: Body and appendages pale pinkish-white; carpus of right cheliped iridescent.

Distribution. — Kamtchatka (Brandt); Alaska (Saint Paul Island, Pribilof Islands); depth range unknown.

Affinities. — *Pagurus mertensii*, although apparently confused originally with *P. h. hirsutiusculus* (cf. McLaughlin & Haig, in press), bears a much closer resemblance to *P. middendorffii*, particularly in the proportions and general configuration of the right cheliped. *P. mertensii*, however, is easily distinguished from both *P. middendorffii* and *P. h. hirsutiusculus* by its long curved and twisted dactyls of the second and third pereopods.

Discussion. — When Makarov (1938b, 1962) reexamined Brandt's (1851) remaining collections and found only specimens referable to *P. h. hirsutiusculus* in those identified as *P. mertensii*, he assumed that the two species were conspecific. He chose to retain Dana's more frequently used name, *hirsutiusculus*, for the species even though Dana's name was the junior synonym. McLaughlin & Haig (in press) recently have presented evidence to show that Brandt confounded *P. mertensii* and *P. h. hirsutiusculus* and have reestablished *P. mertensii* as a distinct species. These authors have confirmed Makarov's conclusion that *P. mertensii* Brandt was not synonymous with the species described by Holmes (1900) as *Parapagurus mertensii*.

The superficial resemblance between *Pagurus mertensii* and *Labidochirus splendescens* (Owen) referred to by Brandt (1851) may be seen in the elongate slender right chelipeds; very elongate second and third pereopods with long twisted dactyls; short stout ocular peduncles with dilated corneae;

and the iridescence of the appendages, particularly of the right chelipeds. However, *P. mertensii* does have many more morphological characters in common with both *P. h. hirsutiusculus* and *P. middendorffii*, and it is not difficult to understand Brandt's confusion of *P. mertensii* with the former species. Although "typical" specimens of *P. h. hirsutiusculus* (with the very short broad shield; rostrum often obscured by a tuft of setae; short, moderately broad and prominently tuberculate right cheliped; and very pilose appearance) are easily distinguished from *P. mertensii*, larger specimens often tend to lose some of their more readily identifiable characters. The right cheliped elongates, with the segments becoming proportionately narrower; the prominent tubercles often become sufficiently worn as to appear granular; the shield is sometimes lengthened in proportion to its width; and the characteristic pilose appearance is frequently absent.

Stimpson's (1857) report of *Eupagurus mertensii* (Brandt) [sensu lato], noted that it differed from *E. bernhardus* (= *P. ochotensis* Brandt) only in its longer and more slender chelipeds. *E. hirsutiusculus*, Stimpson remarked "differs from *E. mertensii* in its proportionably longer tarsi" (Stimpson 1857: 484). It is probable that Stimpson's material should be referred to *P. h. hirsutiusculus*. It cannot be ascertained with surety that Doflein (1900: 341) actually saw specimens of *P. mertensii* s.s., but his statement on its similarity with *P. middendorffii*, "Ist den vorigen jedenfalls sehr ähnlich, womöglich mit ihm [*P. middendorffii*] identisch", suggests that he correctly interpreted Brandt's *P. mertensii*. There can be little doubt from his remarks that Lenz's (1901) specimens were actually *P. h. hirsutiusculus*.

The superficial similarities between *P. mertensii* and some northwestern North American species presently assigned to the "comptus" group, particularly *P. middendorffii*, would suggest the inclusion of *P. mertensii* in this group. Although, as previously indicated, the "comptus" group, as currently constituted, is heterogeneous, *P. mertensii* differs from all six species in the characters of the mouthparts, the armature of the telson and in the presence of a preungual process on the dactyl of the fourth pereopod. Comparison of *P. mertensii* with specimens of *Pagurus longicarpus* Say, 1817 (UMML) and *Pagurus longimanus* Wass, 1963 (UMML) shows that it should be assigned to the "exilis" group (as emended).

***Pagurus confragosus* (Benedict) (figs. 51-54)**

Eupagurus (Trigonochirus) confragosus Benedict, 1892: 11 (in part; by implication; type locality: Alaska, herein restricted by lectotype selection to Portlock Bank, Alaska, "Albatross" station 2856; see discussion).

Pagurus confragosus: Rathbun, 1899: 555. — Rathbun, 1904: 158, pl. 4 fig. 8. — Rathbun, 1910: 158, pl. 4 fig. 8. — Taylor, 1912: 204. — Williamson, 1915: 474. — Schmitt, 1921: 134. — Hart, 1940: 95. — Gordan, 1956: 328. — McLaughlin, 1963: 27.

Pagurus (Trigonocheirus) confragosus: Holmes, 1900: 141 (by implication; misspelling of *Trigonocheirus* Benedict, Holmes, 1900: 134).

Eupagurus confragosus: Alcock, 1905: 179.

Lectotype, herein selected. — ♂ (SL = 18.4 mm), USNM 16573.

Material examined. — See table 18.

Diagnosis. — Left chela with dorsolateral surface deeply concave, midline elevated into prominent, broad crest. Right palm with dorsal surface raised into prominent triangular plateau, extending onto fixed finger as broadened, rounded, spinose or tuberculate ridge; apex without prominent horn.

Description. — Shield usually broader than long, occasionally length equaling width or slightly longer than broad; anterolateral margins somewhat terraced; anterior margin between rostrum and lateral projections concave; posterior margin rounded or truncate; dorsal surface generally smooth, with few tufts of short setae; anterolateral angle bluntly produced. Rostrum usually moderately short, equalling or slightly exceeding lateral projections, acute or obtusely triangular; occasionally with small terminal spine. Lateral projections prominent, obtusely triangular, with strong marginal spine.

Ocular peduncles moderately short, approximately one-half shield length; stout; strongly dilated in corneal region; dorsomesial face with longitudinal row of tufts of short setae. Ocular acicles with mesial margins strongly expanded, lateral margins straight or slightly expanded; terminating subovately, with small submarginal spine; separated basally by one-half to four-fifths basal width of one acicle.

Antennular peduncles moderately long, exceeding ocular peduncles by one-half to entire length of ultimate segment; ultimate and penultimate segments unarmed, with scattered tufts of short setae; basal segment with low protuberance and tuft of long setae on dorsolateral margin; occasionally with small spinule on ventromesial distal angle.

Antennal peduncles long, exceeding ocular peduncles by one-third to four-fifths length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments unarmed, with scattered tufts of short setae. Third segment with ventromesial distal angle strongly produced, terminating in strong spine, obscured by tufts of long setae. Second segment with dorsolateral distal angle produced, terminating in small simple or bifid spine, mesial margin with 3 or 4 small spines and tufts of long setae, lateral margin unarmed or with 1 small spinule and tufts of setae; dorsomesial distal angle with strong spine, mesial margin with tufts of setae, lateral margin often with small spine or spinule. First segment with small acute spine on lateral

Table 18. *Pagurus confragosus* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex				SL (mm)	Collector
				♂	♀	♀♀	♀+		
<i>Bering Sea</i>									
56°40'N, 167°02'W	100	SBL F-2 USNM	21/7/61	7				17.5-21.1	USFWS
56°40'N, 166°26'W	91	SBL F-3 USNM	21/7/61	1				19.2	USFWS
56°40'N, 164°00'W	73	SBL F-7 USNM	15/8/60	1				17.3	USFWS
56°40'N, 162°47'W	64	SBL F-9 USNM	30/7/61	1				17.8	USFWS
56°30'N, 165°31'W	88	SBL EF-4,5 USNM	16/7/61	3				9.1-16.7	USFWS
56°30'N, 164°55'W	84	SBL EF-5,5 USNM	17/7/61	1				9.1	USFWS
56°30'N, 163°42'W	73	SBL EF-7,5 USNM	12/7/61	1				12.0	USFWS
56°20'N, 167°03'W	115	SBL E-2 USNM	2/8/61	2				15.0-16.4	USFWS
56°20'N, 166°27'W	106	SBL E-3 USNM	21/7/61	1				18.1	USFWS
56°12'N, 165°33'W	95	SBL E-4 USNM	20/7/61	5				14.9-17.1	USFWS
56°20'N, 165°13'W	88	SBL E-5 USNM	17/7/61	5				11.1-19.4	USFWS
56°20'N, 164°36'W	91	SBL E-6 USNM	13/7/61	2	1			10.9-17.9	USFWS
56°20'N, 164°00'W	90	SBL E-7 USNM, RM	12/7/61	1	2			14.3-18.0	USFWS
56°20'N, 163°24'W	80	SBL E-8 USNM, CNM	8/8/60	2	13			8.4-13.5	USFWS
56°20'N, 163°24'W	88	SBL E-8 USNM	12/7/61	1				16.5	USFWS
56°18.5'N, 163°26'W	90	ABL E-8 USNM	26/6/66	1				19.7	USFWS
56°10'N, 164°55'W	95	SBL DE-5.5 USNM, RMNH	17/7/61	5	1			13.9-20.3	USFWS
56°10'N, 163°42'W	90	SBL DE-7,5 USNM	11/7/61	2				16.9-17.2	USFWS
56°00'N, 165°31'W	93	SBL D-5 USNM, AHF	14/8/60	5	2			13.3-18.6	USFWS
56°00'N, 164°36'W	91	SBL D-6 USNM	14/8/60	4				15.6-18.8	USFWS
56°00'N, 164°36'W	93	SBL D-6 USNM	10/7/61	1				19.5	USFWS
56°00'N, 164°00'W	86	SBL D-7 USNM	8/8/60	2				13.1-16.1	USFWS
56°00'N, 164°00'W	91	SBL D-7 RMNH	11/7/61	2				17.4-18.6	USFWS
56°00'N, 163°24'W	84	SBL D-8 USNM	8/8/60	1				18.8	USFWS
56°00'N, 163°24'W	91	SBL D-8 USNM	11/7/61	2	2			10.1-16.9	USFWS
56°59'N, 163°27'W	91	ABL D-8 USNM	25/6/66	3	3			11.0-16.2	USFWS
56°00'N, 162°50'W	82-90	ABL D-9 USNM	3/6/66	1				7.6	USFWS
56°00'N, 162°12'W	70	SBL D-10 USNM	5/8/60	1				7.4	USFWS
56°00'N, 162°12'W	68	SBL D-10 AHF	28/7/61	1	2			10.9-18.4	USFWS
55°40'N, 166°25'W	124	SBL C-3 USNM	29/8/60	1				16.9	USFWS
55°40'N, 166°24'W	126	SBL C-3 USNM	2/8/61	1				14.4	USFWS
55°38'N, 166°25'W	124	ABL C-3 USNM	19/7/66	2				20.5-20.7	USFWS
55°40'N, 165°49'W	113	SBL C-4 USNM	13/8/60	1				13.5	USFWS
55°40'N, 165°12'W	106	SBL C-5 USNM	9/8/60	1				19.4	USFWS
55°40'N, 164°40'W	101	SBL C-6 USNM	10/7/61	3				12.9-17.0	USFWS
55°40'N, 164°00'W	95	SBL C-7 RMNH	9/7/61	1	2			10.4-18.3	USFWS
55°41'N, 164°02'W	95	ABL C-7 USNM	12/7/66	1				14.4	USFWS

Table 18 (Continued). *Pagurus confragosus* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex				SL (mm)	Collector
				♂ ⁺	♀	♀♀	♂ ⁺		
<i>Bering Sea</i>									
56°40'N, 163°23'W	79	SBL C-8 USNM	4/8/60	1				18.0	USFWS
55°40'N, 163°23'W	80	SBL C-8 USNM	9/7/61	8	12			5.6-17.4	USFWS
55°20'N, 164°36'W	102	SBL B-6 USNM	8/7/61	1				16.7	USFWS
55°20'N, 164°00'W	90	SBL B-7 USNM	8/7/61	1				16.0	USFWS
Bristol Bay	---	----- USNM	summer 57	2				7.2-15.5	USFWS
Bristol Bay	---	----- USNM	summer 59	1	1			7.6-13.3	USFWS
<i>Gulf of Alaska</i>									
Greater Kodiak I.	---	----- USNM	summer 61	1				9.8	INPHC
56°15'N, 155°15'W	27	40P USNM	13/2/62	1				20.2	INPHC
54°27'-33'N, 159°45'W	78-128	22M, 22N USNM	6/4/62	14				9.4-19.4	INPHC
58°30'N, 150°00'W	101	61L USNM	29/6/62	2				12.3-19.6	INPHC
58°07'N, 151°36'W	124	Albatross 2856 USNM 16573, 128944	22/8/88	2	1			9.4-18.4	---
Idaho Inlet	---	----- USNM	16/3/51	2				12.3-12.6	JNC
<i>British Columbia</i>									
Queen Charlotte Sound	93-126	Albatross 4204 USNM 77438	25/6/03	1	1			5.4-8.0	---
Queen Charlotte Sound	252	Albatross 4201 USNM 77432	26/6/03	1	1			6.5-10.0	---
1.5 mi NW Klashwun Pt.	---	----- USNM	3/9/34	1				4.5	Stevens
N end Kaisen Halibut Bank	200	----- USNM	28/7/36	1				6.0	Stevens
<i>Washington</i>									
Off Strait of Juan de Fuca	206	----- USNM	17/5/60	1				5.2	BB-236
<i>Oregon</i>									
46°04.7'N, 124°39.2'W	228	---	7/5/63	1				10.5	CC

face; ventrodiscal margin produced, with small spinules laterally and distally. Antennal acicle long, exceeding length of ocular peduncles; usually strongly arcuate; terminating in small acute spine; mesial margin often spinulose and with tufts of short setae. Antennal flagella long, usually overreaching right cheliped, frequently each article with 1 or 2 short bristles.

Mandible without significant characters. Maxillule with proximal endite tapering; endopodite with 1 or 2 bristles on moderately well developed internal lobe, external lobe produced, recurved toward interior. Maxilla with endopodite basally inflated, not reflexed, slightly exceeding scaphognathite in distal extension. First maxilliped with endopodite two-thirds length of exopodite. Second maxilliped with basis-ischium partly fused. Third maxilliped with basis-ischium fusion incomplete; basis with 3 or 4 small spines or

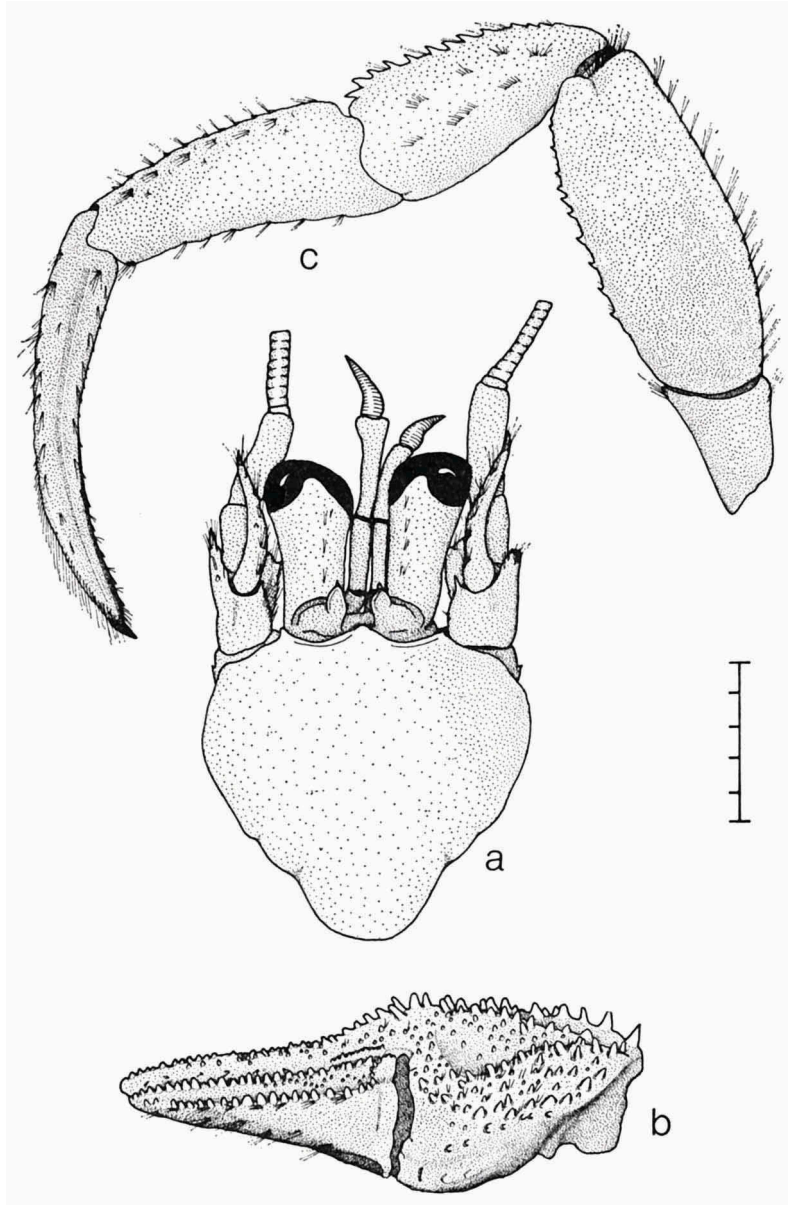


Fig. 51. *Pagurus confragosus* (Benedict). a, shield; b, right chela (mesial view); c, left P₂ (lateral view). Scale equals 5 mm.

spinules; ischium with crista dentata well developed, 1 accessory tooth, dorsal margin often with small spine; merus with strong spine at dorsodistal margin, ventral margin unarmed or with 1 or 2 spines; carpus with small spine at dorsodistal margin. Sternite of mxp_3 unarmed, or with small spine on one or both sides of midline.

Right cheliped considerably larger than left. Dactyl moderately long, equaling or slightly exceeding length of palm, arcuate distally; cutting edge with strong calcareous teeth proximally, small corneous teeth distally; terminating in small corneous claw; overreached and overlapped by fixed finger; dorsomesial margin with row of strong spines, dorsal surface elevated in midline with row of strong tubercles, becoming corneous-tipped spines distally, laterally with scattered tufts of setae and small tubercles; ventral and mesial surfaces unarmed or with few small spines and tufts of setae. Palm long, two-thirds to three-fourths length of carpus, dorsal surface with raised triangular plateau centrally, apex with cluster of strong spines extending onto fixed finger as moderately narrow ridge with several irregular rows of small spines, plateau with 3 or 4 irregular rows of moderately strong spines, mesial row originating in close proximity to proximomesial angle of palm and set at irregular oblique angle to apex, dorsal surface mesially, strongly depressed, with small spines or spinulose tubercles, dorsomesial margin with single or double row of conical often corneous-tipped spines or spinulose tubercles, dorsal surface laterally convex, proximally depressed, distally with moderately strong spines or tubercles, smaller and more closely-spaced on fixed finger, dorsolateral margin with row of strong spines, decreasing in size on fixed finger; mesial face with broad spines or tubercles and tufts of setae; lateral face and ventrolateral margin with moderately strong spines or spinulose tubercles and tufts of setae; ventral surface usually with scattered spinulose tubercles and dense tufts of setae, occasionally unarmed. Carpus equalling or exceeding length of merus, inflated distally; dorsomesial margin with row of very prominent spines, becoming double row distally, dorsal surface with 1 row of moderately strong spines mesially and scattered small spines and tufts of setae, distal margin with 2 or 3 strong spines and 1 or 2 rows of small spines or spinules, dorsolateral margin with row of moderately strong spines and tufts of long setae; lateral face usually spinulose or tuberculate, with row of small spines dorsally, distal margin with row of spines; ventral surface with broad tubercles or spinulose protuberances and tufts of long setae; mesial face with strong spines and tufts of setae, decreasing in size proximally and ventrally, distal margin with 1 or 2 rows of strong spines. Merus broadly triangular; dorsal surface with irregular, transverse rows of spinulose ridges and tufts of setae, occasionally also with

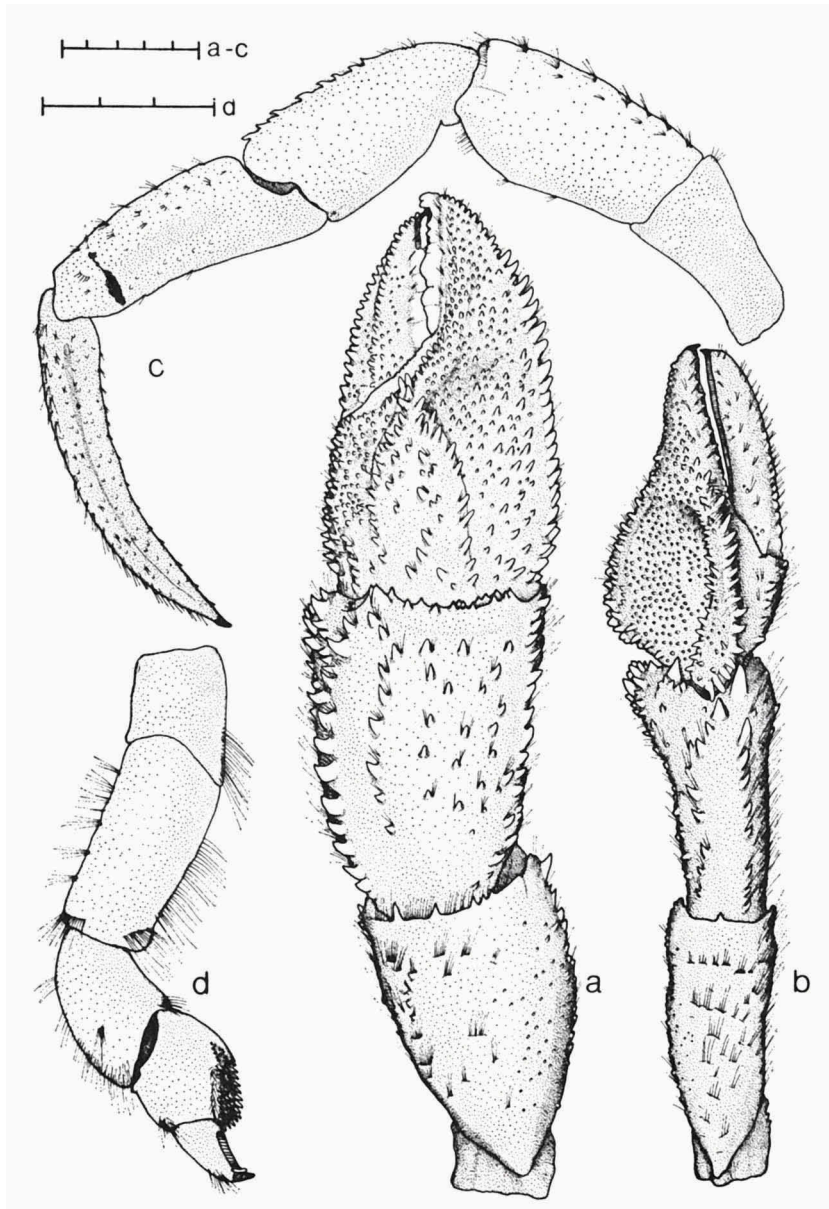


Fig. 52. *Pagurus confragosus* (Benedict). a, right cheliped (dorsal view); b, left cheliped (dorsal view); c, left P₃ (lateral view); d, left P₄ (lateral view). Scales equal 5 mm (a-c) and 3 mm (d).

few scattered small spines, distal margin with 2 or 3 strong spines; lateral face spinulose, with tufts of setae, distal margin with few small spines dorsally, ventrolateral margin with row of spines increasing in size distally; mesial face with low spinulose protuberances and tufts of long setae, ventromesial margin with double row of strong spines, increasing in size distally; ventral surface with cluster of small spines proximally and tufts of long stiff setae. Ischium with row of small spines on ventrodiscal margin, ventrolateral margin with short row of small spines proximally, distal margin with dense long setae; mesial face with row of small spines ventrally, dorsomesial distal angle with blunt tubercles. Coxa with 3 small spines on protuberant ventrodiscal lateral angle, ventrolateral margin with row of small spinules proximally, ventromesial margin and distal angle with long, dense stiff setae.

Left cheliped reaching or exceeding base of dactyl of right. Dactyl long, two to three times length of palm, moderately broad; cutting edge with row of small corneous teeth; terminating in small corneous claw; slightly overlapped by fixed finger; dorsal surface with 1 or 2 irregular rows of small spinules proximally, dorsomesial margin with row of small spines or tubercles and tufts of short setae; mesial and ventral surfaces with tufts of moderately long dense setae. Palm short, one-third to one-half length of carpus; dorsolateral margin strongly inflated proximally with single or double row of strong spines, increasing in size on fixed finger, dorsal surface deeply concave laterally with moderately closely-spaced small spines or tubercles, and sharply elevated to moderately broad crest, with single or double row of strong spines slightly mesiad of midline, often overhanging unarmed dorsomesial surface; dorsomesial margin with row of moderately strong spines, mesial face with scattered spinulose tubercles or small spines; ventral surface with scattered spinulose tubercles and tufts of setae. Carpus equalling or slightly less than length of merus; strongly inflated distoventrally, mesial and lateral faces parallel proximally; dorsal surface flattened, dorsomesial margin with row of strong acute spines, increasing in size distally, dorsolateral margin with irregular row of moderately strong spines, curving mesiad distally, and with tufts of moderately short setae; lateral face with scattered small spines or spinulose tubercles, distal margin with 1 or 2 strong spines and few small spinules, laterodistal ventral angle with cluster of moderately strong spines, ventrolateral margin with single or double row of small spines and tufts of long setae; ventral surface usually with few small spines and tufts of long setae. Merus subtriangular; dorsal margin with irregular transverse rows of short multidenticulate or spinulose protuberances or ridges and tufts of short setae, distal margin with 1-3 prominent spines; lateral face spinulose, with tufts of long setae, distal margin often with 1 or 2 small spines and

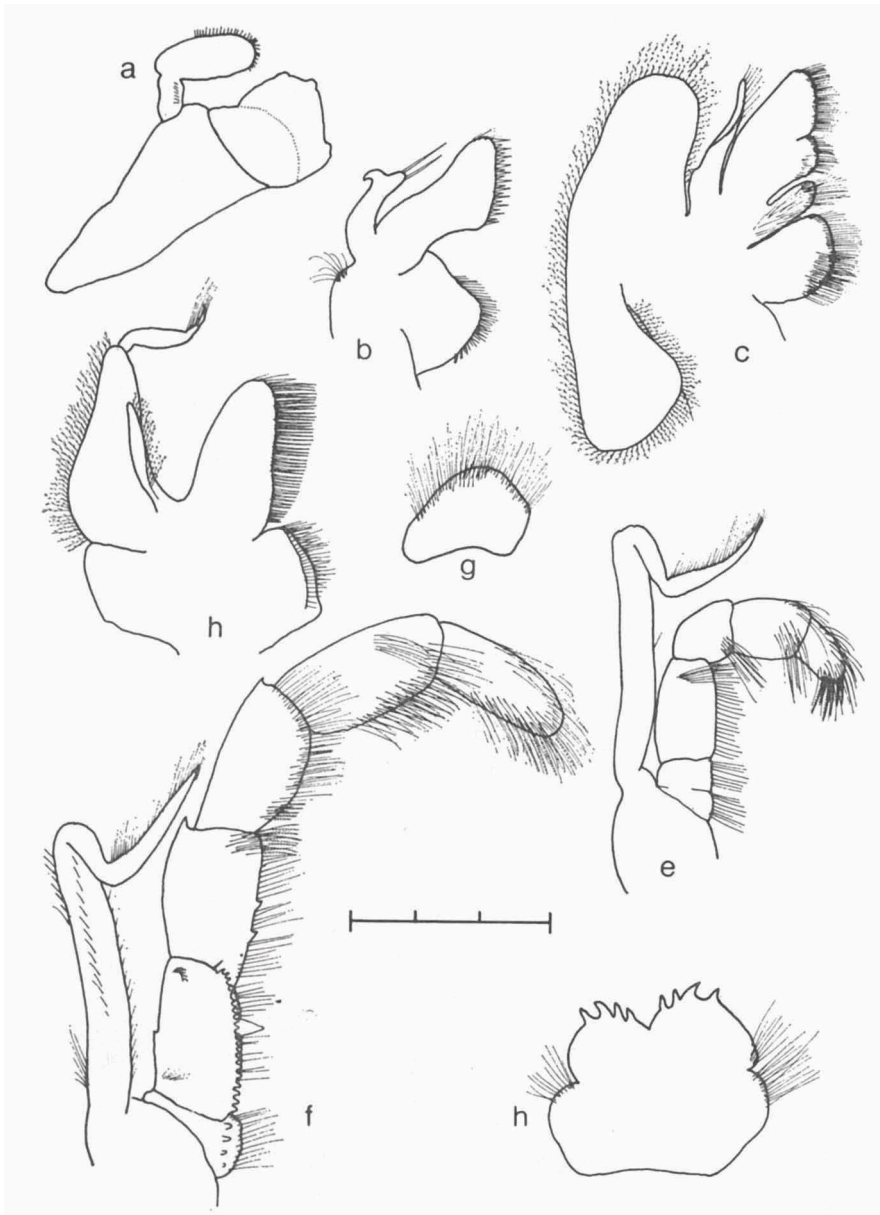


Fig. 53. *Pagurus confragosus* (Benedict). a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite P₃; h, telson. Scale equals 3 mm.

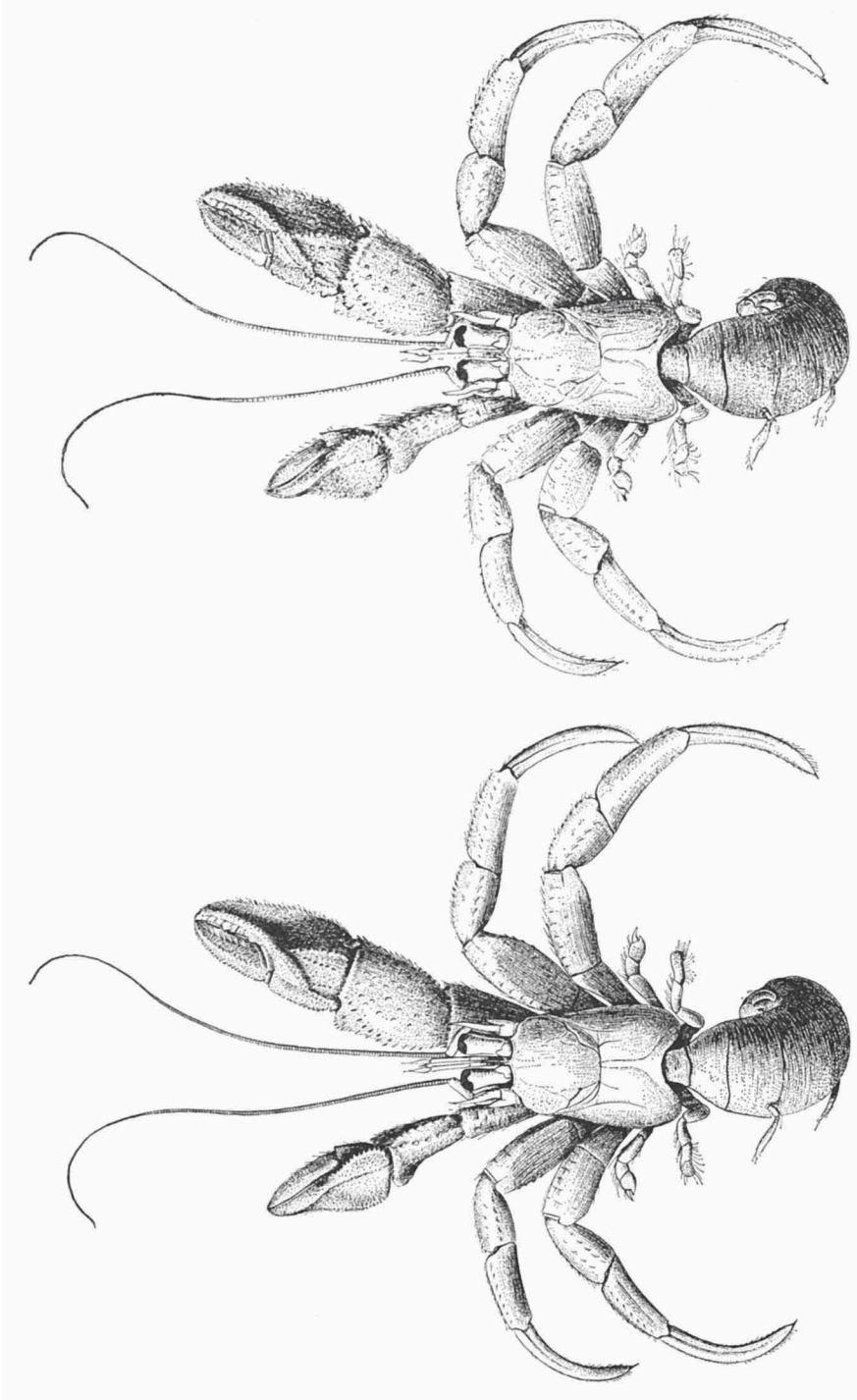


Fig. 54. *Pagurus confragosus* (Benedict). Original illustrations of J. E. Benedict.

tufts of long setae, ventrolateral margin with single or double row of strong spines, increasing in size distally; mesial face with scattered small spinules or tubercles and tufts of long setae, ventromesial margin with double row of spines and tufts of long setae, frequently becoming single row of spines distally; ventral surface with tufts of long dense setae. Ischium with row of small spines on ventromesial margin, increasing in size distally and partially obscured by tufts of long dense setae, mesial face with tufts of long setae; ventrolateral margin denticulate and with low protuberance proximally, distolateral margin usually with few spinules and tufts of setae. Coxa with row of denticles on ventrolateral margin proximally, few spinules and tufts of long setae distally; mesiodistal margin with clump of dense setae.

Second pereopods usually not overreaching right cheliped. Dactyl moderately long, one and one-fourth to one and one-half times length of propodus; in lateral view, curved ventrally; in dorsal view slightly twisted; terminating in small corneous claw; dorsal surface unarmed, with tufts of short bristles and row of long setae; mesial face with longitudinal sulcus flanked dorsally by 1 or 2 irregular rows of small spinules and ventrally by row of tufts of setae; lateral face frequently with weak longitudinal sulcus and row of tufts of short bristles; ventral margin with row of small corneous spines, increasing in size distally. Propodus equalling or slightly exceeding carpus in length; dorsal surface usually with single or double row of moderately strong spines and tufts of short setae, occasionally with low protuberances and tufts of short setae; lateral face frequently with row of low protuberances and tufts of short setae dorsally; mesial face with low protuberances and tufts of short setae; ventral margin unarmed, or with low occasionally spinulose protuberances and tufts of long setae, distal margin usually with 1-3 prominent corneous spines. Carpus approximately two-thirds length of merus; dorsal surface with row of strong often corneous-tipped spines and tufts of short setae, occasionally 1 or 2 spines on distal margin laterally; lateral face with few, irregular often oblique rows of tufts of short setae; mesial face occasionally with few tufts of short setae. Merus laterally compressed; dorsal surface flattened, with low protuberances or multidenticate tubercles and tufts of long setae, occasionally with small spines or spinules proximally; lateral face spinulose or smooth; mesial face with longitudinal furrow, ventrally lined with tufts of short setae; ventral margin usually with row of small spines and tufts of setae. Ischium with row of small spines and tufts of long setae on ventral margin; mesial face with tufts of long setae. Coxa usually unarmed, with row of tufts of moderately long setae on ventromesial margin.

Third pereopods equalling or slightly shorter than second pereopods in

length. Dactyl one and one-fourth to one and one-third times length of propodus; in lateral view, slightly curved ventrally; in dorsal view, slightly twisted, or less frequently, strongly twisted; terminating in small corneous claw; dorsal surface with single or double row of tufts of long setae; lateral face with faint longitudinal sulcus flanked by row of tufts of short setae (right) or by single or double rows of small spinules and short bristles (left); mesial face with longitudinal sulcus flanked dorsally by 1-3 rows of small spinules and ventrally by row of tufts of short setae and few corneous spinules; ventral margin usually with row of small spinules, increasing in size distally. Propodus slightly longer than carpus; dorsal surface with double row of tufts of short setae; lateral face with irregular row of tufts of short setae (right) or 1 or 2 irregular rows of tufts of short setae dorsally and short irregular row of small spinules ventrally (left); mesial and ventral surfaces usually with few tufts of short setae. Carpus equalling or slightly shorter than length of merus; dorsal margin with row of moderately strong spines and tufts of setae; mesial, lateral and ventral surfaces with scattered tufts of short setae. Merus laterally compressed; dorsal margin with 2 or 3 irregular rows of tufts of short setae; lateral and mesial faces smooth or with scattered tufts of short setae, mesial face also usually with longitudinal furrow ventrally, lined with tufts of short setae; ventral margins with tufts of short setae and frequently with small spine at distal margin. Ischium often with row of tufts of long setae on dorsal and ventral margins. Coxa usually unarmed, ventromesial margin with row of tufts of setae.

Fourth pereopods with inconspicuous preungual process at base of claw on lateral face of dactyl; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods semisubcircular, slightly skewed to left, anterior margin with long setae.

Pleopods of male unpaired, pl_3-pl_5 with exopodites well developed; endopodites reduced. Females with pleopods unpaired, pl_2-pl_4 with both rami well developed; pl_5 with exopodite moderately well developed, endopodite reduced.

Telson with posterior lobes usually slightly asymmetrical, left larger than right; separated by shallow, slender or moderately broad median cleft; right terminal margin with 3 or 4 prominent corneous spines and frequently with 1 to several very small spinules on lateral margin distally; left terminal margin with 3-5 strong corneous spines and occasionally 1-3 small spines, frequently with 1 to several small spinules on lateral margin distally; anterior lobes unarmed, with tufts of setae laterally.

Coloration. — Living color unknown. In preservative: Chelipeds uniformly brownish-orange, fading to straw color. Second and third pereopods with

dactyls light orange; propodi with broad band of mottled orange-brown distally and proximally, cream or white centrally; carpi with distal margins white, proximally mottled orange-brown; meri mottled orange-brown, fading to straw color with time.

Distribution. — Bristol Bay, Alaska to Queen Charlotte Sound, British Columbia, Strait of Juan de Fuca, Washington and Columbia River mouth, Oregon; 68-435 m.

Affinities. — All three species assigned to the "*confragosus*" group, *Pagurus confragosus*, *P. tanneri* and *P. cornutus*, possess sufficient morphological similarities and intraspecific variability so that species determinations are occasionally difficult. Separation of *P. confragosus* from *P. tanneri* (as proposed by Holmes, 1900, and Schmitt, 1921) by comparison of the inner margin of the raised triangular plateau of the right chela, which Benedict (1892) described as cutting off the inner depression of the upper surface of the palm from the proximal margin in *P. confragosus*, is not entirely reliable. Not uncommonly the inner margin of the plateau in *P. confragosus* does not extend to the proximal margin of the palm, and conversely, occasionally in *P. tanneri* the margin does extend to the proximal margin of the palm. The irregularly oblique position of this margin in *P. confragosus* appears to be more consistent and diagnostically significant. In addition, in *P. confragosus*, the apex of the plateau is generally lower, as is the rounded ridge extending onto the fixed finger. The length-width relationships of the right chela and carpus, although also subject to some degree of variation, are useful in distinguishing *P. confragosus* from *P. tanneri*. In *P. confragosus* both segments are moderately short and broad, and only slightly disproportionate increases in length occur with increased size, whereas in *P. tanneri* these segments are always very elongate and slender.

The configuration of the triangular plateau of the right chela, which in *P. confragosus* lacks a prominent "horn" at the apex and is armed with only 3 or 4 irregular, single rows of spines, and the very sparsely spinulose lateral face of the propodus of the left third pereopod are characters which distinguish this species from *P. cornutus*.

Discussion. — The type series of *P. confragosus* (USNM 16573, 128944) contains four specimens, three of which are immediately identifiable as *P. confragosus*. Recent examination of the type series has shown that the fourth specimen, which was still withdrawn into its shell, is not *P. confragosus* but rather, *P. kennerlyi* (subsequently recatalogued USNM 143953). As Benedict's (1892: 11) description of *P. confragosus* does not include any reference to characters of *P. kennerlyi*, it is apparent that Benedict overlooked this specimen in his examination of the type series of *P. confragosus*.

The single "intersex" specimen of *P. confragosus* collected suggests that it is actually hermaphroditic, as it has not only male gonopores and female pleopods, but also one female gonopore. Specimens referred to as "intersex" animals, because they possess male gonopores and female pleopods, have been noted infrequently in a few *Pagurus* species, and appear to be quite common in *Elassochirus cavimanus*; however, the occurrence of gonopores of both sexes in a specimen is extremely rare. The state of preservation of the specimen is too poor to permit histological examination of the gonads.

***Pagurus tanneri* (Benedict) (figs. 55, 56)**

Eupagurus (Trigonocheirus) tanneri Benedict, 1892: 10 (by implication; type locality: Alaska, restricted by lectotype selection to Clarence Strait, Alaska, "Albatross" station 3077).

Pagurus (Trigonocheirus) tanneri: Holmes, 1900: 140 (by implication; misspelling of *Trigonocheirus* Benedict, Holmes, 1900: 134).

Pagurus tanneri: Rathbun, 1904: 158, pl. 4 fig. 7. — Rathbun, 1910: 158, pl. 4 fig. 7. — Williamson, 1915: 481. — Schmitt, 1921: 133, fig. 86. — Makarov, 1938b: 194, pl. 5 fig. 5. — Gordan, 1956: 336. — Reischman, 1959: 410. — Makarov, 1962: 184, pl. 5 fig. 5. — Hart, 1971: 1543.

Eupagurus tanneri: Alcock, 1905: 179.

Lectotype, herein selected. — ♂ (SL = 11.2 mm), USNM 16524.

Material examined. — See table 19.

Diagnosis. — Left chela with dorsolateral surface deeply concave, midline elevated into prominent crest. Right palm with dorsal surface raised into prominent triangular plateau, extending onto fixed finger as slender spinose crest; apex of plateau somewhat elevated, but not into prominent horn; chela and carpus elongate and narrow.

Description. — Shield usually somewhat broader than long, less frequently, slightly longer than broad; anterolateral margins strongly terraced; anterior margin between rostrum and lateral projections deeply concave; posterior margin roundly truncate; dorsal surface generally smooth, with few scattered tufts of short setae; anterolateral angle with small blunt protuberance. Rostrum long, considerably exceeding lateral projections, broadly triangular, acute or subacute, usually with small terminal spine; margins with short setae. Lateral projections well developed, broadly rounded or obtusely triangular, with small terminal spine.

Ocular peduncles moderately short, one-half to two-thirds length of shield; stout, corneal region considerably dilated; dorsomesial or dorsal face with longitudinal row of tufts of short setae. Ocular acicles with mesial and lateral margins slightly expanded; terminating subacutely, usually with small submarginal spine; separated basally by approximately two-thirds to three-fourths basal width of one acicle.

Table 19. *Pagurus tanneri* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	♂♀		
<i>Gulf of Alaska</i>								
Clarence Strait	588	Albatross 3077 USNM 16524,108260	23/7/89	2	1		7.4-11.2	---
<i>Washington-Oregon</i>								
46°56.4'N, 124°50'W	640	----- USNM,AHF	10/5/63	10	7	1	6.9-12.7	CC
46°37'N, 124°52'W	640	49 USNM,EM	14/5/64	6			10.4-14.6	JNC
Off Columbia River	640	13A USNM	12/61	4	4		6.4-12.9	CC
Off Columbia River	736	15A USNM	6/3/62	3			8.5-12.8	JNC
Off Columbia River	548	----- USNM	16/3/62	1			9.4	JNC
Off Columbian River	366-823	----- USNM	5/62	7			10.2-12.7	Pereyra
Off Columbia River	732	----- USNM	27/5/62	2			11.5-12.5	Pereyra
Off Columbia River	640	----- USNM	31/8/62	5	1	2	7.6-13.6	Pereyra
Off Columbia River	274	----- USNM	22/8/63	28	2		9.7-18.1	Pereyra
Off Columbia River	320	----- USNM	22/8/63	3			13.5-14.2	JNC
Off Columbia River	412	----- USNM	23/8/62	1			15.5	Pereyra
Off Columbia River	640	----- USNM	26/8/63	6	1		6.9-12.8	CC
Off Columbia River	823	----- USNM	27/8/63	1			9.5	Pereyra
Off Columbia River	366	----- USNM	11/1/64	1	2		7.5-9.3	Pereyra
<i>Oregon</i>								
46°03'N, 124°44'W	320	----- USNM,CNM	26/1/63	5	2		6.5-14.5	JNC
46°02'N, 124°43.7'W	320	----- USNM	8/5/63	1			12.5	CC
46°01'N, 124°47'W	451	----- USNM,EMNH	25/1/63	7	2		6.1-14.0	JNC
46°00.8'N, 124°43.2'W	274	5A USNM	27/6/61	3	4		5.0-7.6	CC
46°00'N, 124°52'W	477	----- USNM	24/1/63		1		10.5	JNC
46°00'N, 124°50'W	548	11A USNM	6/12/61	1			8.5	CC
46°00'N, 124°48'W	457	----- USNM	25/1/63	8			9.4-13.5	JNC
46°00'N, 124°48'W	457	----- USNM	9/5/63	1			7.0	CC
46°00'N, 124°46'W	412	----- USNM	9/5/63	2			11.7-14.2	CC
46°00'N, 124°45'W	366	----- USNM,EM	25/1/63	8	2		7.8-13.5	JNC
46°00'N, 124°44'W	311	6A USNM	7/3/62	1			13.5	CC
46°00'N, 124°43'W	274	5A USNM	27/6/61	2			7.9-8.9	CC
46°00'N, 124°43'W	274-302	5A USNM	30/6/61	2	1		4.9-12.3	CC
46°00'N, 124°40'W	457	9A USNM,CNM	9/12/61	7	2	1	8.2-14.5	CC
45°59'N, 124°44'W	362	7A USNM	12/9/61	2			11.6-11.9	CC
45°58.5'N, 124°47'W	548	11A USNM	1/7/61	3	2		6.9-11.0	CC
45°58.5'N, 125°25'W	457	----- USNM	1/5/62	2			11.7-12.5	Pereyra
45°58'N, 124°44'W	412	8A USNM	29/6/61	1			7.6	CC
45°58'N, 124°43'W	366	7A USNM	2/7/61	1			7.0	CC

Table 19 (Continued). *Pagurus tanneri* (Benedict) Material Examined

Locality	Depth (m)	Station		Date	Sex				SL (mm)	Collector
		Deposition			♂	♀	♀♀	♂♂		
<i>Oregon</i>										
45°57.3'N, 124°49'W	640	13A	USNM	2/7/61	5				5.1-12.4	CC
45°57'N, 124°53.5'W	732	15A	USNM	3/7/61	1				9.1	CC
45°57'N, 124°53.5'W	732-757	RMNH	15A	15/9/61	1				11.5	CC
45°57'N, 124°52'W	732	USNM	15A	6/12/61	4				7.1-11.3	CC
45°57'N, 124°50'W	640	USNM	-----	24/1/63	3	1	2		8.2-11.4	JNC
45°57'N, 124°49'W	638	USNM, RMNH	13A	15/9/61	2	1			8.4-11.2	CC
45°57'N, 124°48'W	640	USNM	13A	10/12/61	2	1			9.2-11.4	CC
45°57'N, 124°45'W	502	USNM	10A	1/7/61	2	1			7.1-10.6	CC
45°56'N, 124°46'W	686	USNM	14A	12/3/62	1				11.9	CC
45°55.9'N, 124°47.3'W	686	USNM	-----	26/8/63	1	2			7.4-10.4	CC
45°55.8'N, 124°49.8'W	686	USNM	-----	13/5/63	14	3			6.6-13.4	CC
45°55'N, 124°50'W	686	USNM, RMNH	14A	11/12/61	8	1			8.9-12.9	CC
45°55'N, 124°50'W	686	USNM, RMNH	-----	23/1/63	3				9.4-12.4	JNC
45°53.8'N, 124°51.8'W	732	USNM	-----	5/10/63	3				10.2-11.2	CC
45°52.3'N, 124°52'W	823	USNM	-----	13/5/63	1	1			7.9-10.5	CC
45°52'N, 124°53'W	823	USNM	17A	16/9/61	2				8.4-12.0	CC
45°50'N, 124°50'W	823	USNM	17A	16/12/61	4				7.6-11.4	CC
45°46.5'N, 124°47'W	594	USNM	12A	1/7/61	1				12.4	CC
45°45'N, 124°48'W	686	USNM	14A	2/7/61	1				12.4	CC

Antennular peduncles long, exceeding ocular peduncles by two-thirds to entire length of ultimate segment; ultimate and penultimate segments unarmed; basal segment with small spinule on ventromesial margin.

Antennal peduncles moderately long, exceeding ocular peduncles by approximately one-half length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments unarmed, with few tufts of short setae. Third segment with ventromesial distal angle produced, terminating in strong spine, frequently with minute spinule laterally. Second segment with dorsolateral distal angle produced, terminating in acute simple or bifid spine, mesial margin with 1-6 small spines, lateral margin unarmed; dorso-mesial distal angle with strong spine and tufts of short setae. First segment with small spine on lateral face; ventrodial margin produced, with several small spines laterally. Antennal acicles long, usually greatly exceeding ocular peduncles; arcuate and slightly twisted distally; terminating in small spine; mesial margin with row of tufts of short setae; lateral margin naked. Antennal flagella long, considerably exceeding length of chelipeds, articles usually naked.

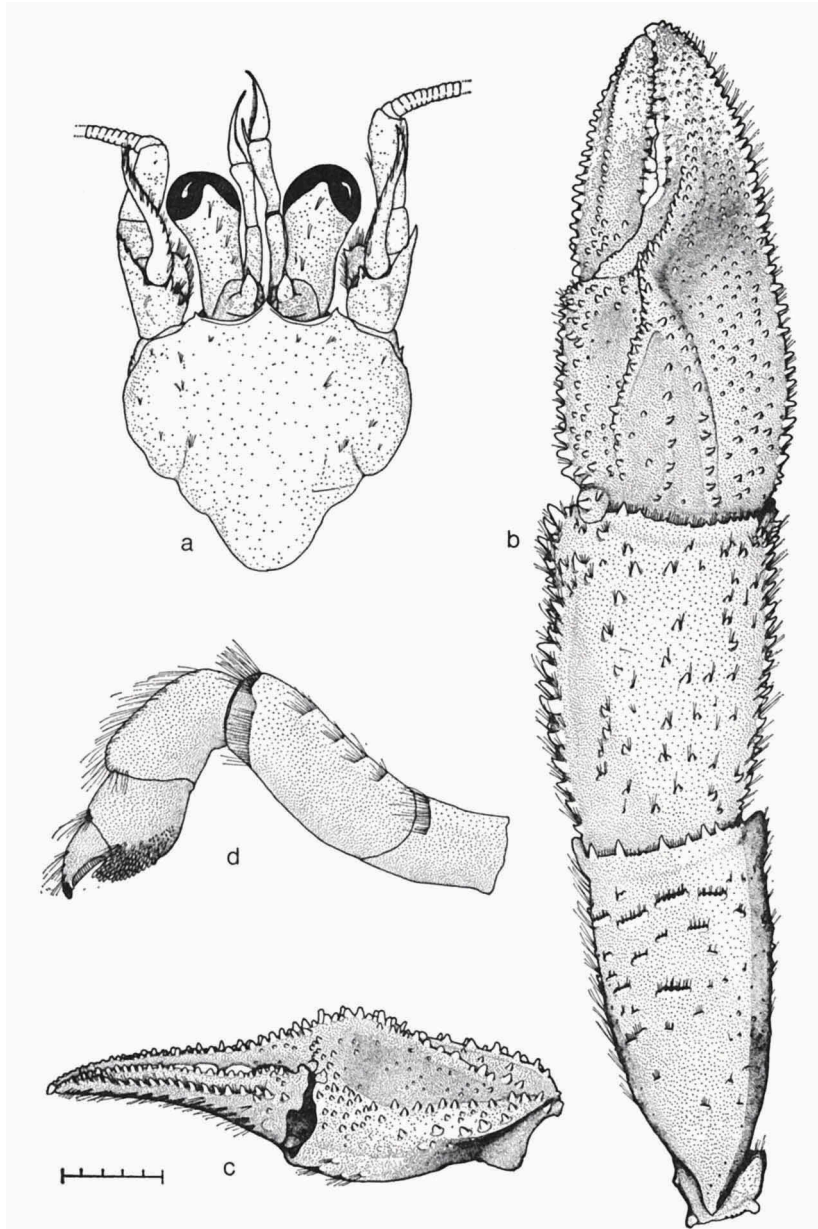


Fig. 55. *Pagurus tanneri* (Benedict). a, shield; b, right cheliped (dorsal view); c, right chela (mesial view); d, left P₄ (lateral view). Scale equals 5 mm.

Mandible without significant characters. Maxillule with proximal endite subtrapezoid; endopodite with 1 or 2 bristles on well developed internal lobe, external lobe produced, recurved toward interior. Maxilla with endopodite slightly inflated basally, not equalling scaphognathite in distal extension. First maxilliped with endopodite approximately three-fourths length of exopodite. Second maxilliped with basis-ischium partially fused. Third maxilliped with basis-ischium fusion incomplete; basis with 1-3 small spines; ischium with crista dentata well developed, with 1 accessory tooth, dorsal margin with 1 or 2 small spines or spinules; merus with 1 or 2 strong spines on ventral margin, dorsodistal margin with strong spine; carpus with spine at dorso-distal margin. Sternite of m_{xp_3} with 1 small spine on each side of midline and tufts of long setae.

Right cheliped long, slender. Dactyl slightly longer than palm, mesial margin slightly arcuate; cutting edge with calcareous teeth proximally very small corneous teeth distally; terminating in small corneous claw; often with narrow hiatus; overlapped by fixed finger; dorsomesial margin with row of small spines and few tufts of short setae, dorsal surface with median row of small spines, decreasing in size distally and few scattered spines proximally; mesial and ventral surfaces with tufts of long setae. Palm slightly greater than half length of carpus; dorsal surface with raised triangular plateau centrally, apex with cluster of spines extending onto fixed finger as single row of small spines, plateau with 3 longitudinal rows of small spines, mesially, laterally, and medianly, usually not reaching proximal margin of palm, dorsal surface mesially, strongly depressed and sparsely spinulose, dorsomesial margin with row of prominent spines, dorsal surface laterally convex proximally, depressed distally and with scattered small spines or spinules, dorsolateral margin with row of prominent spines, decreasing in size on fixed finger; lateral, mesial and ventral surfaces with low spinulose protuberances, small spines or spinules or multidenticulate tubercles and tufts of setae. Carpus approximately one-third longer than palm, somewhat ventrally inflated; dorsomesial margin with row of strong spines, dorsal surface with widely spaced small spines and tufts of short setae, distal margin with small spines and short setae; dorsolateral margin with row of moderately small spines, increasing in size distally, lateral face minutely spinulose, distal margin with few prominent spines; mesial face with multifid protuberances and tufts of setae; ventral surface with few small spines some bifid, distal margin with row of small spinules. Merus approximately one-fourth longer than carpus, triangular; dorsal surface with transverse multidenticulate ridges and tufts of setae, distal margin with widely-spaced spines, extending onto laterodistal margin; lateral face with small spinules or multidenticulate protuberances

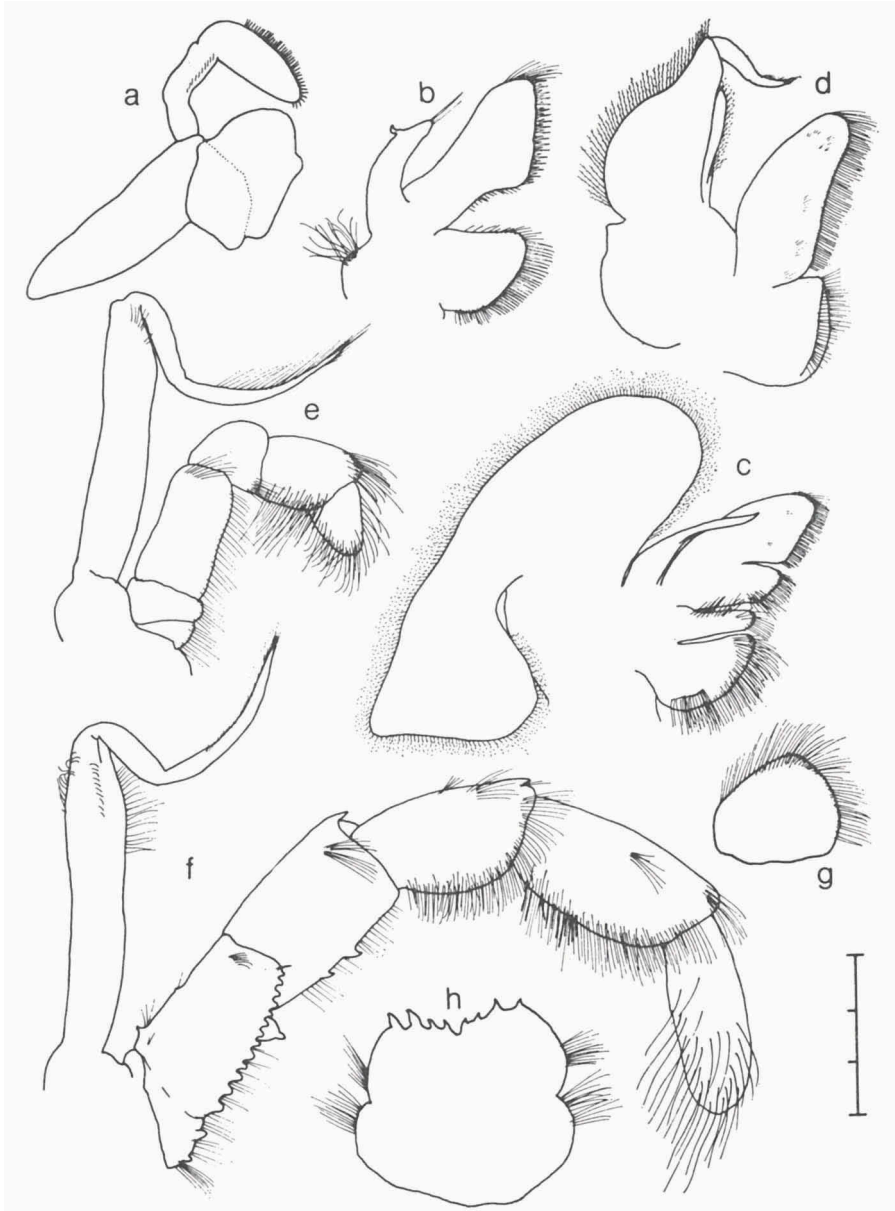


Fig. 56. *Pagurus tanneri* (Benedict). a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxps. — g, sternite, P₃; h, telson. Scale equals 3 mm.

becoming spinules distally, ventrolateral margin with row of moderately strong spines; mesial face spinulose, distal margin with few small spines dorsally, cluster of spines at ventrodistal angle, ventromesial margin with row of prominent spines; ventral surface with multidenticate tubercles or small spinules and tufts of setae. Ischium with row of small spines and tufts of long setae on ventromesial margin, ventrolateral margin with bidenticate spinules; proximodorsal margin with denticulate keel. Coxa with row of small denticles on ventrolateral margin proximally, ventromesial margin with tufts of long setae.

Left cheliped short, reaching approximately to base of dactyl of right. Dactyl long, approximately twice length of palm; subtriangular proximally, distally dorsoventrally flattened and curved ventrally; cutting edge with row of small corneous teeth; terminating in small corneous claw; dorsomesial margin with tufts of moderately long setae and often with row of very small spinules, becoming obsolete distally, dorsal surface usually with short row of small spinules proximally; ventral and mesial surfaces with tufts of setae. Palm short, less than one-half length of carpus, slender, subtriangular; dorso-lateral margin strongly inflated proximally, with row of strong spines decreasing in size distally, surface deeply concave, raised sharply into strong keel mesiad of midline; dorsal surface spinulose, keel with double row of strong acute spines proximally, becoming single row distally and extending onto fixed finger; dorsomesial margin with row of strong spines and tufts of fine dense setae; ventral surface with few scattered low protuberances or small spinules and tufts of setae. Carpus slightly less than or equalling length of merus; mesial and lateral faces parallel proximally, ventrolateral distal angle very strongly inflated with cluster of moderately strong spines; dorsal surface flattened with 2 rows of strong spines, distal margin with 2 or 3 prominent spines; mesial face with low sometimes bifid spinules, distal margin with row of small spinules; lateral face with low spinulose protuberances and tufts of long setae, distal margin with 1 or 2 prominent spines dorsally; ventral surface with scattered, low spinulose tubercles or small spinules and tufts of setae, ventrolateral margin with row of small spines, increasing in size distally. Merus laterally compressed; dorsal surface with transverse rows of multifid spinules and tufts of setae, mesial face somewhat spinulose, with tufts of short setae; lateral and ventral surfaces usually spinulose, with tufts of short setae, ventrolateral margin with row of strong spines, decreasing in size distally, ventromesial margin with row of prominent small spines. Ischium with row of spinules on ventromesial margin, ventroproximal angle with blunt protuberance. Coxa with row of small denticles on ventrolateral margin, ventromesial distal angle with cluster of small spinules, partially obscured by tufts of long setae.

Second pereopods equalling or slightly exceeding length of right cheliped. Dactyl long, approximately one-fourth longer than propodus, slender, somewhat compressed laterally; in lateral view, curved ventrally; in dorsal view, strongly twisted; dorsal margin with row of tufts of long setae, more dense distally; mesial face with faint longitudinal sulcus and row of low setae; lateral face with faint longitudinal sulcus proximally and frequently 1 or 2 rows of very short bristles; ventral margin with row of very small corneous spinules. Propodus approximately one-third longer than carpus; dorsal surface with irregular double row of small spines and few tufts of short setae; lateral, mesial and ventral surfaces with tufts of short setae, 3 small corneous spinules at ventrodistal margin. Carpus one-half to two-thirds length of merus; dorsal surface with row of strong acute spines and tufts of short setae; lateral surface usually with 1 or 2 rows of short, transverse spinulose ridges and tufts of short setae or bristles, distal margin frequently with small spine; mesial and ventral surfaces with scattered tufts of setae. Merus laterally compressed; dorsal margin with transverse rows of multidenticulate spinulose ridges and tufts of moderately short setae; mesial and lateral faces with scattered tufts of setae; ventral margin with 1 or 2 rows of small spinules and tufts of setae. Ischium with row of small spinules and tufts of short setae on ventral margin. Coxa with low protuberance at ventromesial distal angle and tuft of fine setae.

Third pereopods slightly shorter than or equalling second in length. Dactyl long, slender; in lateral view, strongly curved ventrally; in dorsal view, strongly twisted; dorsal margin with row of long stiff setae, more dense distally; mesial face usually with faint longitudinal sulcus flanked above by row of small spinules becoming obsolete distally, below by row of tufts of long setae; lateral face occasionally with faint longitudinal sulcus proximally, and 1 or 2 rows of very small bristles; ventral margin with row of very small corneous spinules. Propodus approximately one-third longer than carpus; dorsal surface with row of small spines and tufts of short setae; mesial face with scattered small spinules and tufts of setae; lateral and ventral surfaces with few tufts of short setae. Carpus one-half to two-thirds length of merus; dorsal surface with row of acute spines and tufts of short setae; lateral face with 1 or 2 rows of short transverse, frequently spinulose ridges and tufts of short setae or bristles; mesial and ventral surfaces with few tufts of setae. Merus laterally compressed; dorsal margin with row of transverse low ridges and tufts of short setae; lateral and mesial faces with few tufts of short setae; ventral margin with 2 low protuberances or tubercles on laterodistal margin. Ischium with row of tufts of very short setae on ventral margin. Coxa with few tufts of short setae one ventrolateral distal margin.

Fourth pereopods with inconspicuous preungual process at base of claw on lateral face; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods subcircular; anterior margin with long setae, and frequently small spinules medianly.

Pleopods of male unpaired, typically, pl_3 - pl_5 with exopodites moderately short, slender; endopodites vestigial; atypically, pl_2 - pl_5 with exopodites moderately short, endopodites rudimentary or vestigial. Females with pleopods unpaired, pl_2 - pl_4 , with both rami well developed; pl_5 with exopodite well developed, endopodite rudimentary.

Telson with posterior lobes slightly asymmetrical, left larger than right; separated by shallow broad median cleft; right terminal margin with 3 or 4 strong corneous spines; left terminal margin with 3-5 strong corneous spines; lateral margins each with tuft of long setae; anterior lobes with tufts of long setae.

Coloration. — Living color unknown. In preservative: Generally reddish-brown or reddish-yellow overall, with dactyls of chelipeds and second and third pereopods slightly darker. Ocular peduncles frequently circumscribed with dark band medially. Color fading in time to uniform straw tint.

Distribution. — Bering Sea (vicinity of Pribilof Islands) (Makarov); Unalaska to off San Simeon Bay, California (Rathbun, Schmitt); west of Clayocuo Sound, British Columbia (Hart); 92-1053 metres.

Affinities. — *Pagurus tanneri* is most closely related to the two other species of the "*confragosus*" group, i.e., *P. confragosus* and *P. cornutus*. *P. tanneri* is most readily distinguished from *P. cornutus* by its more elongate, slender right cheliped. In *P. tanneri* the elevated triangular plateau is armed with 3 irregular, usually single rows of spines, interspersed with very few scattered smaller spines or spinules; the spinose apex is only moderately elevated, and is continued onto the fixed finger as a slender ridge of strong spines. In *P. cornutus*, the raised triangular plateau of the chela is armed with three moderately broad ridges, each with 1 to 3 very irregular rows of spines; the spinose apex is strongly produced into a prominent "horn", and continued onto the fixed finger as a broad rounded ridge with several irregular rows of small spines or spinulose tubercles. The elongate slender right cheliped of *P. tanneri* also distinguishes this species from *P. confragosus* (also see *P. confragosus*).

Discussion. — In a small percentage of the males examined (less than 2 percent) second pleopods (pl_2) were present. Although the presence of pl_2 in males of *Pagurus* species often indicates immaturity, all of these specimens had shield lengths in excess of 11.5 mm. It is also doubtful that the presence

of these second pleopods represents an "intersex" condition, as the pleopods pl_3 to pl_5 were typically male in structure. One specimen in this collection has been classified as an "intersex"; however, this specimens has pleopods, pl_2 to pl_5 , which are female in structure. No external evidence of rhizocephalan infestation was observed in these aberrant specimens, and no correlation between parasitized animals and pleopod abnormalities has been noted during the course of this study. However, Nielsen (1970) reported the addition of a pleopod on the second abdominal somite of some male specimens of *Anapagurus laevis* (Bell, 1846) infested with a rhizocephalan. He also noted that in a specimen of *Pagurus prideauxi* Leach, 1815 (a species in which adult males lack pleopods) rhizocephalan infestation resulted in the development of a complete set of female pleopods (Nielsen, 1970: 29). It is apparent that sexuality and the effect of rhizocephalan parasitism among the northwestern North American pagurids is in need of study.

Pagurus cornutus (Benedict) (fig. 57, 58)

Eupagurus (Trigonochirus) cornutus Benedict, 1892: 12 (by implication; type locality: Alaska, here restricted by lectotype selection to Clarence Strait, Alaska, "Albatross" station 3077).

Pagurus cornutus: Rathbun, 1904: 158, pl. 5 fig. 3. — Rathbun, 1910: 158, pl. 5 fig. 3. — Taylor, 1912: 204. — Williamson, 1915: 474. — Makarov, 1937: 64. — Makarov, 1938b: 191, pl. 5 fig. 1. — Hart, 1940: 102. — Reinhard, 1944: 49. — Vinogradov, 1947: 101 (key). — Vinogradov, 1950: 227 (key). — Birstein & Vinogradov, 1951: 360. — Gordan, 1956: 328. — Kobjakova, 1956: 58. — Makarov, 1962: 1819, pl. 5 fig. 1. — Filatova & Barsanova, 1964: 72. — Filatova & Barsanova, 1969: 81. — Hart, 1971: 1542.

Eupagurus cornutus: Alcock, 1905: 179.

? not *Eupagurus cornutus*: Urita, 1942: 40 (? = *Pagurus undosus* (Benedict, 1892)).

Table 20. *Pagurus cornutus* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	♀♂		
<i>Bering Sea</i>								
55°19'N, 168°11'W	504	Albatross 3608 USNM 19118	20/8/95	2	14		8.1-15.2	---
55°38'N, 169°18'W	673	Albatross 3502 USNM 19117	17/7/93	9	6		4.4-9.5	---
54°01'N, 166°48'50"W	640	Albatross 3331 USNM 16546	21/8/90	4	2		4.1-9.8	---
<i>Gulf of Alaska</i>								
Off Trinity I.	286	Albatross 2853 USNM 16539	9/8/88	1	1		6.6-12.5	---
54°21'N, 159°49'W	548	22P AHF	4/6/62	1			6.9	INPHC
Clarence Strait	588	Albatross 3077 USNM 16541	23/7/89	1			11.4	---
Clarence Strait	---	---	1889	4	3		4.3-15.9	---
Off Indian Point	438	USNM 16545,16547 Albatross 4230 USNM 65921	7/7/03	1			9.2	---
<i>Oregon</i>								
46°02'N, 124°43.7'W	320	----- RMNH	8/5/63	1			18.7	CC

Lectotype, herein selected. — ♀ (SL = 11.4 mm), USNM 16541.

Material examined. — See table 20.

Diagnosis. — Left chela with dorsolateral face deeply concave, midline elevated into prominent, spinose crest. Right palm with dorsal surface raised into prominent, triangular plateau, extending onto fixed finger as broad, rounded, spinulose or tuberculate ridge; apex of plateau elevated and produced into prominent, often overhanging "horn".

Description. — Shield usually broader than long, occasionally length equaling width; anterolateral margins terraced; anterior margin between rostrum and lateral projections straight or concave; posterior margin rounded; dorsal surface generally smooth with tufts of short setae; anterolateral angle produced, blunt. Rostrum moderately long, equalling, or more frequently, exceeding lateral projections, triangular, acute, or rarely subacute, usually terminating in small spine. Lateral projections moderately prominent, usually obtusely triangular, occasionally broadly rounded, with moderately strong marginal or submarginal spine.

Ocular peduncles moderately short, approximately one-half shield length; strongly dilated in corneal region; dorsal or dorsomesial surface with longitudinal row of tufts of short setae. Ocular acicles subtriangular, with mesial margins strongly expanded, lateral margins straight or slightly expanded, dorsal surface slightly concave; terminating acutely with small marginal or submarginal spine; separated basally by one-fourth to entire basal width of one acicle.

Antennular peduncles long, exceeding ocular peduncles by one-third to entire length of ultimate segment: ultimate and penultimate segments unarmed and usually naked; basal segment with tufts of setae and rarely with small spinule at ventromesial margin.

Antennal peduncles long, exceeding ocular peduncles by one-third to three-fourths length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments unarmed, with scattered tufts of short setae. Third segment with ventromesial distal angle produced, terminating in strong acute spine, partially obscured by tuft of fine setae. Second segment with dorsolateral distal angle produced, terminating in moderately strong simple or bifid spine, mesial margin with 2 or 3 small spines, lateral margin unarmed; dorsomesial distal angle with prominent spine, mesial face with tufts of short setae. First segment with small spine on ventrolateral face; ventrodistal margin produced, with small spines or spinules laterally and distally. Antennal acicle moderately long, reaching distal half of ultimate peduncular segment; usually strongly arcuate; terminating in small, acute, simple or bifid spine, mesial margin with small occasionally spinulose protuberances and

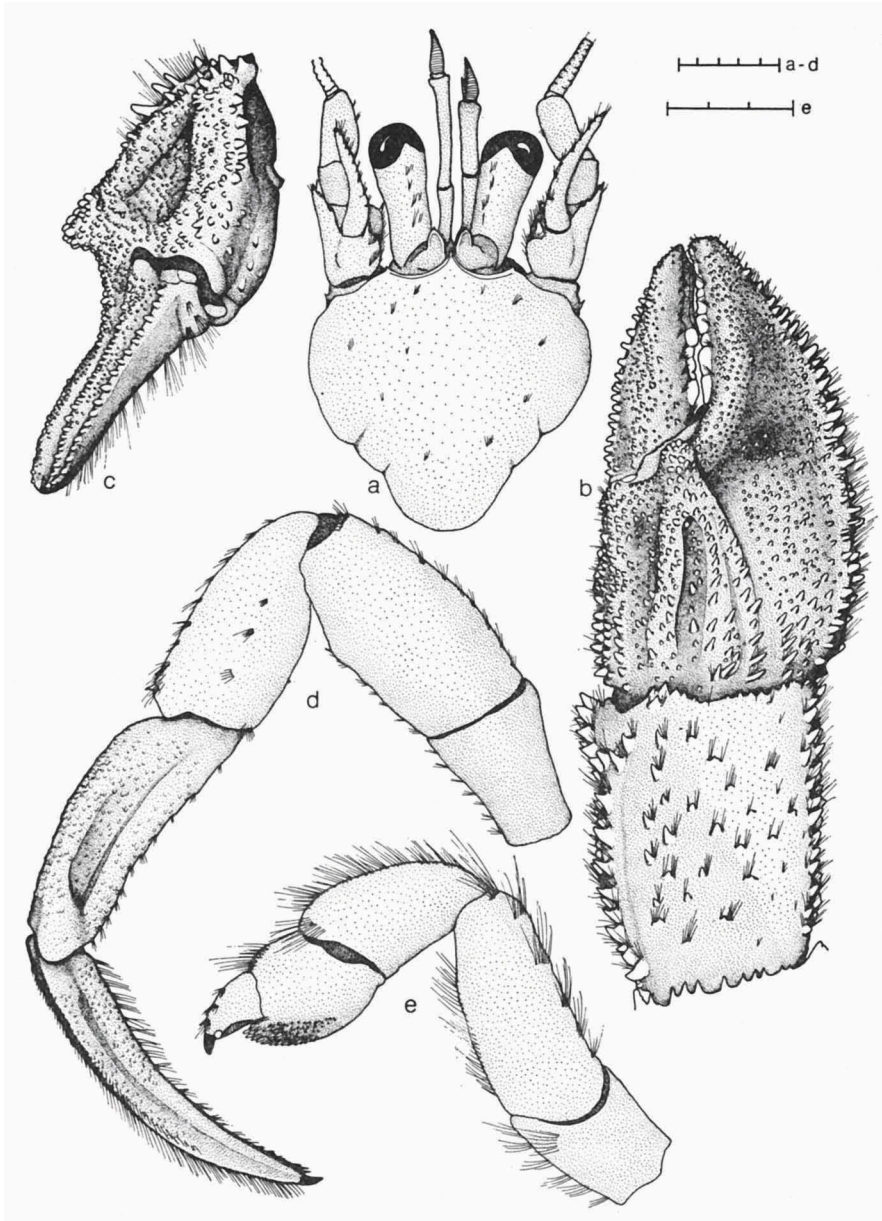


Fig. 57. *Pagurus cornutus* (Benedict). a, shield; b, right chela and carpus (dorsal view); c, right chela (mesial view); d, left P₃ (lateral view); e, left P₄ (lateral view). Scales equal 5 mm (a-d) and 3 mm (e).

tufts of short setae. Antennal flagella long, reaching or slightly exceeding tip of right cheliped; articles usually naked.

Mandible without distinctive characters. Maxillule with proximal endite subquadrate; endopodite with 2 or 3 bristles on well developed internal lobe, external lobed produced, recurved toward interior. Maxilla with endopodite slightly inflated basally, not reflexed, slightly exceeding scaphognathite in distal extension. First maxilliped with endopodite three-fourths to four-fifths length of exopodite. Second maxilliped with basis-ischium incompletely fused. Third maxilliped with basis-ischium fusion incomplete; basis with 2 or 3 small spines; ischium with crista dentata well developed and 1 accessory tooth, dorsal margin with small spinules; merus with strong spine at dorsodistal margin, ventral margin usually with 1 very strong spine; carpus with spine at dorsodistal margin. Sternite unarmed or with small spine on each side of midline, anterior margin with row of long setae.

Right cheliped with dactyl equalling or slightly exceeding length of palm; mesial margin slightly arcuate; cutting edge with row of strong calcareous teeth proximally and row of small corneous teeth distally; terminating in small corneous claw; usually with slender longitudinal hiatus; frequently overlapped by fixed finger; dorsomesial margin with row of moderately strong acute or subacute spines, dorsal surface slightly elevated in midline, with irregular row or rows of small subacute spines or tubercles, scattered small blunt or spinulose tubercles laterally and mesially; ventral and mesial surfaces with rows of tufts of long stiff setae. Palm two-thirds to four-fifths length of carpus; dorsal surface with raised triangular plateau centrally, apex strongly elevated into prominent spinose or tuberculate "horn" and extending onto fixed finger as broad ridge with several irregular rows of small tubercles or subacute spines, plateau with 3 broad ridges, mesially, laterally and medianly, each with 1-3 irregular rows of moderately strong acute or subacute spines, becoming tuberculate distally, surface with 1 or 2 secondary single or double rows of subacute spines or tubercles, dorsal surface mesially strongly depressed with scattered or moderately closely-spaced small spines or spinulose tubercles, dorsomesial margin with 2-4 irregular rows of moderately strong spines or tubercles and few tufts of setae, dorsal surface laterally, convex proximally depressed distally, with scattered or moderately closely-spaced small spines or spinulose tubercles, dorsolateral margin with single or double row of strong spines, decreasing in size on fixed finger and frequently with tufts of long occasionally dense setae; mesial face usually with irregular rows of spines or tubercles, occasionally with few, scattered spinulose tubercles and low protuberances and tufts of short setae; ventral surface occasionally tuberculate and usually

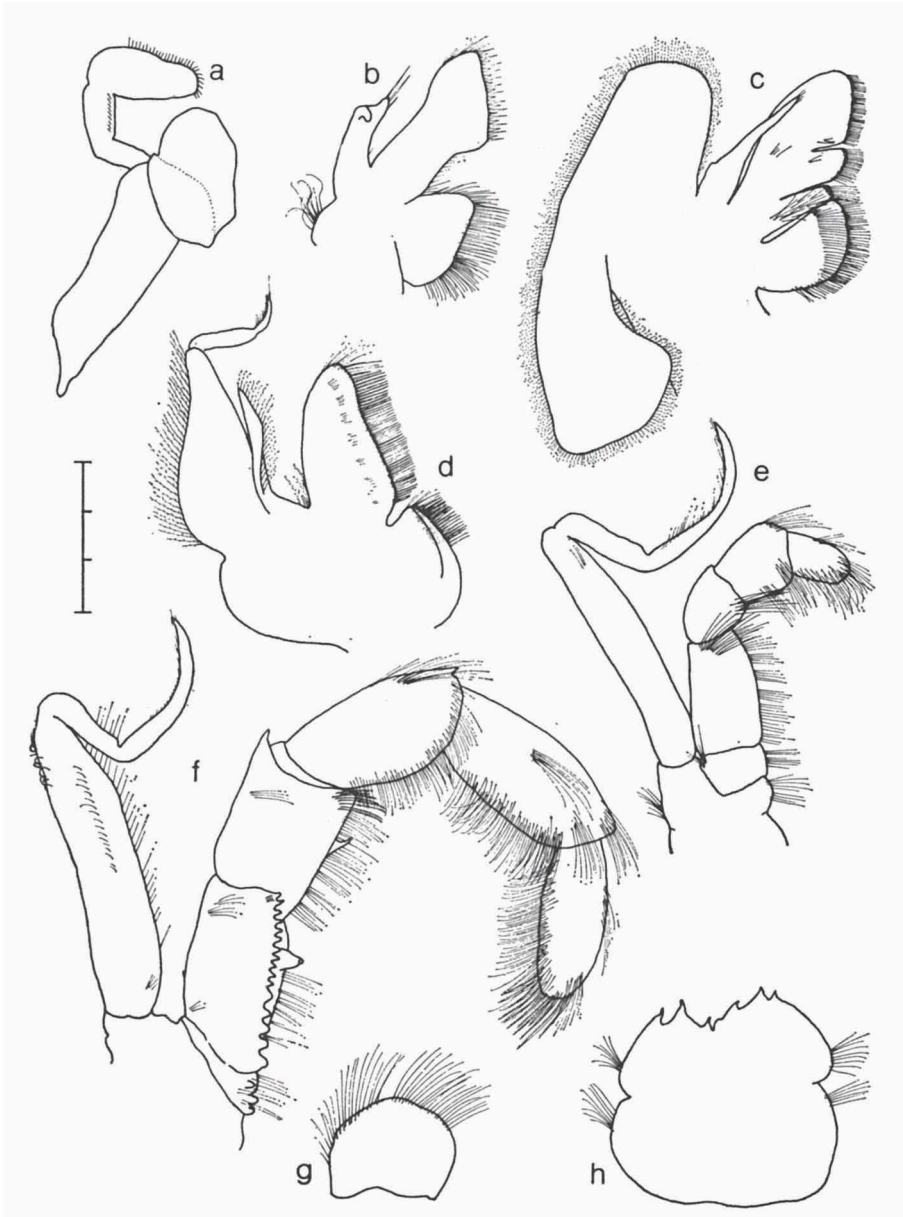


Fig. 58. *Pagurus cornutus* (Benedict). a-f, mouthparts (left, internal): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxps. — g, sternite, P₃; h, telson. Scale equals 3 mm.

with tufts of short setae; lateral face tuberculate or spinulose, with scattered tufts of setae. Carpus slightly less than or equalling length of merus; dorsal surface convex, frequently with dorsomesial distal angle inflated; dorsomesial margin with irregular single or double row of strong spines and tufts of moderately long setae, dorsal surface with scattered spines, spinulose tubercles and tufts of setae, distal margin with 1 or 2 rows of moderately strong spines, occasionally only with row of small spines or denticles, dorsomesial distal angle often with cluster of strong spines, dorsolateral margin with single or double row of moderately strong spines and tufts of setae; lateral face with scattered small spines or spinules, distal margin with row of moderately small spines, often clustered dorsally; mesial face with low tubercles or protuberances and tufts of setae, distal margin with row of small spines; ventral surface unarmed or with small often spinulose tubercles and scattered tufts of long setae. Merus subtriangular; dorsal surface with transverse, multidenticulate low ridges or protuberances and tufts of setae, distal margin with row of moderately strong spines, extending laterally and mesially; mesial face with low protuberances or tubercles and tufts of long setae and row of multidenticulate tubercles or small spines ventrally, ventromesial margin with single or double row of strong spines; lateral face with multidenticulate tubercles ventrally, ventrolateral margin with irregular single or double row of strong, often very slender spines; ventral surface with low sometimes spinulose tubercles and tufts of setae, distal margin denticulate or spinulose. Ischium with row of small spines or spinules on ventromesial margin, ventrolateral margin usually with row of multifid spinules, lateroproximal margin with low denticulate keel; mesial face sparsely spinulose. Coxa with row of small spinules on ventrolateral margin, ventromesial distal angle with clump of long setae.

Left cheliped long, extending to proximal half of dactyl of right. Dactyl long, slightly less than twice length of palm; cutting edge with row of small corneous teeth; terminating in small corneous claw; overlapped by fixed finger; dorsal surface moderately flattened, with few scattered spinules or small tubercles, dorsomesial margin with row of spinules or small tubercles, becoming obsolete distally and with tufts of short setae; ventral and mesial surfaces with tufts of setae. Palm short, approximately one-half length of carpus; dorsolateral margin strongly inflated proximally with single or double row of strong spines, surface deeply concave, with moderately closely-spaced small spines or tubercles, raised abruptly into strong keel slightly mesial of midline, keel with row of strong spines, extending onto fixed finger and becoming obsolete distally, and usually with irregular second short row of moderately small tubercles or subacute spines, dorsomesial

margin with row of short subacute spines or tubercles and tufts of setae; ventral surface with single or double row of small spines of spinulose tubercles laterally and tufts of short setae, ventromesial and mesial surfaces with low tubercles or protuberances and tufts of moderately long setae. Carpus slightly less than or equalling length of merus; lateral and mesial faces subparallel proximally, ventrolateral distal angle strongly produced, with cluster of moderately strong spines; dorsal surface flattened, with 2 rows of moderately strong spines, distal margin unarmed or with few small spines or spinules; lateral face with scattered simple or multifid tubercles and tufts of setae, distal margin dorsally produced with several strong spines, ventrolateral margin with single or double row of strong cylindrical spines; mesial face with low occasionally bifid and spinulose tubercles and tufts of long setae, ventromesial margin with tufts of long setae, occasionally with small tubercles or subacute spines; ventral surface with low tubercles or protuberances and tufts of long setae. Merus laterally compressed; dorsal surface with row of transverse occasionally spinulose, ridges and tufts of setae, distal margin usually with strong acute spine; lateral face with simple or multifid spinules, ventrolateral margin with row of strong spines and tufts of long setae; mesial face with scattered denticulate tubercles or small spinules, ventromesial margin with row of strong spines and tufts of setae; ventral surface usually unarmed, with tufts of long setae. Ischium with row of prominent spinules on ventromesial margin, mid-ventrolateral margin with low multidenticulate tubercles and tufts of long setae. Coxa with row of very small denticles on ventrolateral margin, ventromesial distal angle with tuft of long setae.

Second pereopods with right frequently slightly longer than left and overreaching right cheliped. Dactyl slightly shorter than, to one-third longer than propodus; in lateral view, curved ventrally; in dorsal view, strongly twisted; terminating in strong corneous claw; dorsal margin with row of long stiff setae, more dense distally; mesial face with moderately prominent longitudinal sulcus flanked dorsally by double row of small corneous spinules and ventrally by row of moderately long bristles; lateral face usually with faint longitudinal sulcus and few tufts of short setae; ventral margin with row of corneous spines, increasing in size distally and row of short bristles. Propodus approximately equalling length of carpus; dorsal surface with double row of low often spinulose protuberances and tufts of short setae; mesial, lateral and ventral surfaces with tufts of short setae and occasionally, few, low spinulose protuberances or tubercles. Carpus two-thirds to four-fifths length of merus; dorsal surface with 1 or 2 rows of spines, increasing in size distally; lateral face with row of short, transverse frequently spinulose

ridges ventrally; mesial and ventral surfaces usually with few tufts of setae. Merus laterally compressed; dorsal surface with 2 rows of low sometimes spinulose protuberances and tufts of setae; mesial and lateral faces usually unarmed, occasionally with scattered tufts of setae; ventral margins each usually with row of small spines, increasing in size distally. Ischium with row of small spinules on ventral margin. Coxa with row of long setae on ventromesial margin; ventroproximal angle with few small spinules.

Third pereopods with left and right dactyls and propodi dissimilar. Dactyl one-fourth to one-half longer than propodus; in lateral view, slightly curved ventrally; in dorsal view, strongly twisted; dorsal surface with row of long dense setae or stiff bristles; mesial face with longitudinal sulcus flanked dorsally by double row of small corneous spinules, ventrally by row of short bristles or setae; ventral margin with row of corneous spines, increasing in size distally and row of tufts of stiff setae; lateral face with faint longitudinal sulcus and scattered tufts of short setae (right pereopod) or with moderately prominent longitudinal sulcus flanked by tufts of short setae and proximally with closely spaced small tubercles or spinules (left pereopod). Propodus equalling or slightly exceeding length of carpus; moderately compressed laterally; dorsal surface with single or double row of low tubercles or protuberances and often with row of tufts of setae; mesial face usually with scattered tufts of short setae; ventral surface with row of tufts of setae; lateral face with few tufts of setae (right pereopod) or with broad, shallow longitudinal depression and moderately closely-spaced small tubercles or spinules (left pereopod). Carpus slightly shorter than or equalling length of merus; dorsal surface frequently with irregular single or double row of small spinules and with strong spine at distal margin; lateral, ventral, and mesial surfaces unarmed, with scattered tufts of short setae. Merus laterally compressed; dorsal surface with double row of low occasionally spinulose protuberances and tufts of setae; mesial and lateral faces unarmed, occasionally with few tufts of short setae; ventral margin with 1 or 2 rows of tufts of setae. Ischium with row of setae on ventral margin; dorsodistal margin occasionally with spinulose protuberance; lateral face often with row of small spinules dorsally. Coxa unarmed, with marginal rows of fine setae.

Fourth pereopods with preungual process at base of claw on lateral face of dactyl; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods subcircular, frequently slightly skewed; anterior margin with row of long setae and occasionally with 1 or 2 small spinules.

Pleopods of male unpaired, pl₃-pl₅ with exopodites well developed; slender; endopodites rudimentary. Females with pleopods unpaired, pl₂ with exopodite moderately short, endopodite well developed; pl₃-pl₄ with both rami well developed; pl₅ with exopodite well developed, endopodite rudimentary.

Telson with posterior lobes asymmetrical, left usually larger than right; terminal margins straight or oblique; separated by shallow, slender median cleft; right terminal margin with 1-3 moderately strong, widely spaced spines; left terminal margin with 2-4 moderately strong, widely spaced spines; lateral margins each with tuft of moderately long setae; anterior lobes unarmed, lateral margins with tufts of setae.

Coloration. — Living color unknown. In preservative: Uniform light orange or straw colored.

Distribution. — Bering Sea, northward to Cape Narvin, Komandorskaye Ostrova (Makarov, Birstein & Vinogradov); Kurile Is. (Birstein & Vinogradov); Shirskova (Filatova & Barsanova); Okhotsk Sea (Kobjakova); Bering Sea (latitude 55°38'N) to Queen Charlotte Is. (Rathbun, Makarov); Barkley Sound (Hart); off Oregon coast (latitude 46°02'N). The capture of *P. cornutus* from off the Oregon coast represents a southern extension of the range of this species. Depth range of this species is 166 to 823 meters.

Affinities. — As previously indicated, *P. cornutus* appears most closely related to *P. tanneri* and *P. confragosus*. The moderately short, broad right chela of *P. cornutus* resembles that of *P. confragosus*, in contrast to the elongate, slender chela of *P. tanneri*. However, the apex of the triangular plateau is not elevated in *P. confragosus*, whereas it is usually developed into an extremely prominent "horn" in *P. cornutus*. The apex is also raised in *P. tanneri*, but does not approach the prominence of that of *P. cornutus*. Dissimilarity in the armature of the dactyls and propodi between right and left pereopods is common to *P. cornutus* and *P. confragosus* and suggests that these two species may share a more similar habitat.

Discussion. — Urita (1942) included in his synonymy of *Eupagurus cornutus* Benedict. *Eupagurus trigonochirus* var. *paulensis* Balss. Balss' (1913) variety herein is shown to be a junior synonym of *Pagurus undosus* Benedict (p. 260). As Urita gave no indication that he had examined Balss' specimen, his conclusion regarding the synonymy of var. *paulensis* was undoubtedly based upon Balss' figures (1913, figs. 38, 39), which strongly suggests that Urita's interpretation of *P. cornutus* was incorrect.

***Pagurus trigonocheirus* (Stimpson) (figs. 59, 60, pl. 1 figs. 1, 2)**

? *Pagurus (Eupagurus) pubescens* Brandt, 1851: 111 (by implication). Not *Pagurus pubescens* Kröyer, 1838; see discussion.

- Eupagurus trigonocheirus* Stimpson, 1858: 249 (type localities: Arctic Ocean and Bering Straits, here restricted by lectotype selection to Bering Straits). — Murdoch, 1885: 138, pl. 1 figs. 1, 1a, b. — Doflein, 1900: 342. — Stimpson, 1907: 211, pl. 26 fig. 2. — Hansen, 1908: 28. — Terao, 1913: 373. — Selbie, 1921: 32. — Sivertsen, 1932: 11. — Yokoya, 1933: 83. — Kikuchi, 1947: 61. — Kubo & Asada, 1957: 255. — Evans, 1967: 402.
- Pagurus pubescens*: Richters, 1884: 405. — Kobjakova, 1937: 143. — Makarov, 1937: 55 (in part), fig. 1. — Makarov, 1938a: 417 (in part). — Makarov, 1938b: 208 (in part; not text-figs. 46-56, 63), pl. 4 fig. 1. — Vinogradov, 1947: 105. — Vinogradov, 1950: 228 (key), fig. 126. — Kobjakova, 1955: 153, pl. 38 fig. 5. — Gordan, 1956: 334 (in part). — Kobjakova, 1956: pl. 61. — Pasternak, 1957: 257. — Kobjakova, 1958a: 232. — Kobjakova, 1958b: 253. — Lindberg et al., 1959: 232. — Zarenkov, 1960: 192. — Makarov, 1962: 199 (in part; not text figs. 46-56, 63), pl. 4 fig. 1. — Kim, 1963: 302, fig. 21. — Filatova & Barsanova, 1964: 19. — Kobjakova, 1964: 325 (in part). — Kobjakova, 1966: 209, pl. 38 fig. 5. — Filatova & Barsanova, 1969: 17. Not *Pagurus pubescens* Krøyer, 1838a; see discussion.
- ? *Eupagurus pubescens*: Pfeffer, 1890: 32 (in part). — Schellenberg, 1928: 93 (in part; not figs. 71a-c; see discussion).
- Eupagurus (Trigonocheirus) trigonocheirus*: Benedict, 1892: 1 (by implication).
- Eupagurus (Trigonocheirus) brandti* Benedict, 1892: 9 (in part; by implication; type locality: Aleutian Islands, restricted by lectotype selection to north of Unimak Island, Alaska, "Albatross" station 3258; see *Pagurus brandti*).
- Pagurus brandti*: Rathbun, 1899: 555. — Rathbun, 1904: 157 (in part; ? not pl. 4 fig. 4). — Rathbun, 1910: 157 (in part; ? not pl. 4 fig. 4). — Williamson, 1915: 47 (in part). — Rathbun, 1919: 7A. — Gordan, 1956: 327 (in part). — McLaughlin, 1963: 21. — Hart, 1971: 1541. Not *Pagurus brandti* Benedict, 1892; see discussion.
- Pagurus trigonocheirus*: Rathbun, 1899: 556. — Rathbun, 1904: 157. — Rathbun, 1910: 157. — Williamson, 1915: 481. — Rathbun, 1919: 7A. — Schmitt, 1921: 133. — Derjugin & Kobjakova, 1935: 142. — Kobjakova, 1936: 191. — Van Winkle & Schmitt, 1936: 330. — Makarov, 1938b: 210. — Reinhard, 1944: 49. — MacGinitie, 1955: 169. — Gordan, 1956: 336. — Makarov, 1962: 199. — Miyake, Sakai & Nishikawa, 1962: 125. — Kim, 1964: 8. — Squires, 1964: 364, figs. i-iiB, 2B. — Squires, 1967: 1902. — Kim, 1970: 7. — McLaughlin, 1973: 564.
- Eupagurus pubescens*: Doflein, 1900: 341 (in part). — Alcock, 1905: 183 (in part). — Molander, 1914: 6. — Hofsten, 1916: 95 (in part). — Sivertsen, 1932: 9. — Kamita, 1954-58a: 60 (in part). — Kamita, 1954-58b: 44, fig. 20 (in part; not fig. 21). — Kamita, 1954-58c: 65 (in part). Not *Pagurus pubescens* Krøyer, 1838; see discussion.
- Pagurus (Trigonocheirus) trigonocheirus*: Holmes, 1900: 138 (by implication; misspelling of *Trigonocheirus* Benedict, Holmes, 1900: 134).
- Pagurus (Trigonocheirus) Brandti*: Holmes, 1900: 139 (in part; by implication; misspelling of *Trigonocheirus* Benedict, Holmes, 1900: 134; see *Pagurus brandti*).
- Eupagurus trigonocheirus*: Alcock, 1905: 17. — Urita, 1942: 41 (misspelling of *Eupagurus trigonocheirus* Stimpson).
- Eupagurus brandti*: Alcock, 1905: 178 (in part; see *Pagurus brandti*).
- Eupagurus Brandti*: Sivertsen, 1932: 11. Not *Eupagurus brandti* Benedict, 1892.
- Eupagurus pubescens* (= *trigonocheirus*): Balss, 1957: 1722.
- Eupagurus pubescens trigonocheirus*: Balss, 1957: 1727.
- Pagurus pubescens* (?): Makarov, 1966: 105, fig. 29.
- not *Eupagurus trigonocheirus*: Balss, 1913: 63 (misspelling of *Eupagurus trigonocheirus* Stimpson; = *Pagurus capillatus* (Benedict, 1892)).
- not *Pagurus trigonocheirus*: McLaughlin, 1963: 21 (= *Pagurus brandti* (Benedict, 1892)).

Lectotype, herein selected. — ♂ (SL = 7.1 mm), BM 66-41.

Material examined. — See table 21.

Table 21. *Pagurus trigonochelirus* (Stimpson) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	♂?		
<i>Chukchi Sea</i>								
Point Barrow	---	----	21/8/48	1	1	3	6.1-10.2	MacGinitie
NE Nuwuk Pt., Point Barrow	22-31	USNM 89418	4/8/63	3	1		6.2-12.2	Gonor
71°33'N, 155°53'W	161-164	USNM N-12	16/8/63	1			12.2	Gonor
71°32.5'N, 156°00'W	98	USNM N-10	16/8/63	2	1		9.8-16.8	Gonor.
71°32.5'N, 155°34'W	49-51	USNM N-14	16/8/63	6	3		4.3-16.9	Gonor
71°29.5'N, 155°41'W	36-42	RMNH,AHF N-15	16/8/63	11	2	1	7.1-12.4	Gonor
70°42'N, 150°02'W	17	EM, CNM	14/8/63	2			5.2-8.9	Gonor.
70°24'N, 161°25'W	---	USNM 23	19/8/13		1		8.4	---
69°17.2'N, 166°53'W	---	CNM 1354 57	24/8/59	3	1		3.9-14.4	JNC
69°16'N, 165°35'W	---	USNM 59	23/8/59	7	1	3	6.1-14.5	JNC
69°16'N, 164°22'W	---	USNM, RMNH 61	25/8/59	19	1		3.7-17.0	JNC
69°10.8'N, 168°34'W	---	USNM 48	20/8/59	1			12.1	JNC
69°04'N, 166°12'W	---	USNM 58	24/8/59	1			12.5	JNC
69°03'N, 164°52'W	---	USNM 60	25/8/59	1	1		9.4-13.9	JNC
69°00'N, 166°00'W	20	USNM	20/10/62	5	2		5.1-15.4	McCauley
68°47.5'N, 168°11'W	---	USNM 32	14/8/59	3	1		7.1-14.8	JNC
68°32.5'N, 167°32'W	---	USNM 28	14/8/59	1	1		8.1-10.4	JNC
68°30'N, 167°00'W	35	USNM	22/10/62		6		4.5-5.6	McCauley
68°25'N, 167°55'W	---	USNM 34	16/8/59	11	4	2	4.4-16.5	JNC
68°25'N, 167°12'W	---	USNM, AHF 33	16/8/59	3	2		4.8-13.3	JNC
68°18'N, 168°15'W	---	USNM 29	14/8/59	2	1	2	7.2-15.8	JNC
68°18'N, 166°55'W	---	USNM 25	13/8/59	3	1		6.1-13.4	JNC
68°11'N, 167°12'W	---	USNM 36	16/8/59	1	3		4.8-13.4	JNC
68°10.8'N, 166°35'W	---	USNM 37	16/8/59	1			11.6	JNC
68°10.7'N, 167°55'W	---	USNM 35	16/8/59	2	1		4.0-7.9	JNC
68°03.5'N, 168°52'W	---	USNM 30	14/8/59	4	1		6.6-16.6	JNC
68°03.5'N, 167°34'W	---	USNM 24	13/8/59		3		4.1-9.8	JNC
67°57'N, 168°34'W	---	USNM 49	20/8/59	2			15.4-16.0	JNC
67°57'N, 168°02'W	---	USNM 50	20/8/59	7			7.7-17.8	JNC
67°57'N, 165°57'W	---	USNM 39	17/8/59	2	2		2.4-9.9	JNC
67°55.6'N, 167°22'W	---	USNM 51	20/8/59	4	1	2	6.2-16.0	JNC
67°53.3'N, 166°42'W	---	USNM 52	20/8/59	8	1		8.0-16.2	JNC
67°52'N, 168°12'W	---	USNM 23	13/8/59	2	1	2	6.3-12.5	JNC
67°50'N, 166°55'W	---	USNM 20	12/8/59	3	7	3	2.9-14.0	JNC
67°44'N, 165°56'W	---	USNM, CNM 42	19/8/59	2	2		6.8-10.7	JNC
67°44'N, 165°23'W	---	USNM 40	17/8/59	2	1		4.0-5.1	JNC
67°43.8'N, 167°55'W	---	USNM 47	19/8/59		1		7.9	JNC

Table 21 (Continued). *Pagurus trigonochelirus* (Stimpson) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	♂♀		
<i>Chukchi Sea</i>								
67°43.8'N, 166°35'W	---	43	19/8/59	10	7	1	3.0-14.5	JNC
67°43.5'N, 167°12'W	---	USNM, RMNH 46	19/8/59	8		2	3.3-18.1	JNC
67°43'N, 164°44'W	---	USNM, RMNH 11	9/8/59	1			6.8	JNC
67°33.5'N, 165°02'W	---	USNM 10	9/8/59	4	1		5.9-16.9	JNC
67°31.5'N, 165°55'W	---	USNM 41	19/8/59	1	1		7.8-10.5	JNC
67°31'N, 167°12'W	---	USNM 45	19/8/59	1	1		6.5-7.8	JNC
67°31'N, 166°35'W	---	USNM 44	19/8/59	8	5	2	5.5-16.4	JNC
67°30'N, 173°45'W	34	USNM, RM ----	23/10/62	1	3		3.6-5.8	McCaughey
67°30'N, 166°47'W	---	USNM 15	10/8/59		1		9.3	JNC
67°24'N, 164°23'W	---	USNM 9	9/8/59	1			12.0	JNC
67°13'N, 167°30'W	---	USNM 14	10/8/59		1		9.4	JNC
67°06'N, 163°48'W	---	USNM 3	7/8/59	2	1		11.1-14.9	JNC
67°00'N, 166°54'W	20	USNM ----	6/10/62	3	1		5.2-9.3	McCaughey
67°00'N, 166°15'W	28	USNM ----	24/10/62	1			2.8	McCaughey
66°55.2'N, 164°20'W	---	USNM 4	8/8/59	2			9.5-17.1	JNC
66°43'N, 166°22'W	---	USNM 73	29/8/59	1	5	2	7.0-17.2	JNC
66°16'N, 166°15'W	---	USNM 2	6/8/59	1	1		8.9-10.9	JNC
65°44'N, 168°30'W	---	USNM 74	30/8/59	5	1		12.4-17.9	JNC
<i>Bering Sea</i>								
Bering Strait	---	----	----	1			7.1	---
N of East Landing, St. Paul I.	---	RM 66-41 ----	27/8/63	1			4.3	Ficus
57°40.5'N, 163°24'W	48	USNM ABL I-8	10/7/66	3			12.5-15.1	USFWS
57°20.5'N, 164°01'W	64	USNM ABL H-7	10/7/66	14	1		9.1-17.9	USFWS
57°20'N, 163°28'W	55	USNM SBL H-8	27/8/60	6			8.1-15.5	USFWS
57°20'N, 162°54'W	55	USNM SBL H-8	1/8/61	15			9.3-19.1	USFWS
57°20'N, 163°26.5'W	55	USNM ABL H-8	10/7/66	5	2		8.8-20.1	USFWS
57°17'N, 161°10'W	62	USNM SBL H-12	23/8/60	1			18.1	USFWS
57°00'N, 165°14'W	73	USNM SBL G-5	15/7/61	4			14.4-16.1	USFWS
57°00'N, 165°14'W	70	USNM ABL G-5	20/7/66	4			14.7-17.9	USFWS
57°00'N, 164°37'W	71	USNM SBL G-6	15/7/61	2			13.8-14.3	USFWS
56°58'N, 164°38'W	71	USNM ABL G-6	9/7/66	1			16.4	USFWS
57°00'N, 164°00'W	66	USNM SBL G-7	28/8/60	56	8		7.4-16.6	USFWS
57°00'N, 164°00'W	71	USNM, RMNH SBL G-7	15/7/61	27	2		8.4-19.5	USFWS
57°01'N, 164°02'W	66	USNM ABL G-7	11/7/66	26	2		8.6-18.6	USFWS
57°06'N, 163°15'W	64	USNM SBL G-8	16/8/59	2			14.0-16.9	USFWS
57°00'N, 163°24'W	62	USNM SBL G-8	16/8/60	23	1		10.6-19.6	USFWS
57°00'N, 163°17'W	64	USNM ABL G-8	30/6/66	62	5	1	10.8-21.9	USFWS

Table 21 (Continued). *Pagurus trigonochelrus* (Stimpson) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	♂♀		
<i>Bering Sea</i>								
57°00'N, 162°46'W	54	SBL G-9 USNM	16/8/60	3			19.3-19.7	USFWS
57°00'N, 162°46'W	53	SBL G-9 USNM	31/7/61	1			13.1	USFWS
57°02'N, 162°46'W	58	ABL G-9 USNM	30/6/66	10			10.9-21.5	USFWS
57°00'N, 162°13'W	60-64	SBL G-10 USNM	10/5/59	1			2.6	USFWS
57°01'N, 162°10'W	56	ABL G-10 USNM	28/6/66	2			15.9-17.7	USFWS
57°00'N, 161°34'W	70	SBL G-11 USNM	18/8/60	3			18.5-20.5	USFWS
57°00'N, 160°58'W	73	SBL G-12 USNM	18/8/60	1			14.4	USFWS
56°40'N, 165°16'W	80	SBL F-5 USNM	16/7/61	33			10.8-20.6	USFWS
56°40'N, 164°37'W	79	SBL F-6 USNM	13/7/61	7			14.9-20.6	USFWS
56°40'N, 164°33'W	79	ABL F-6 USNM	9/7/66	11			13.8-20.3	USFWS
56°40'N, 164°00'W	73	SBL F-7 USNM, RMNH	15/8/60	31			12.9-19.6	USFWS
56°40'N, 164°00'W	78	SBL F-7 USNM	14/7/61	27			10.6-19.8	USFWS
56°40'N, 163°57'W	74	ABL F-7 USNM	11/7/66	11			11.5-21.7	USFWS
56°40'N, 163°24'W	70	SBL F-8 USNM, AHF	15/8/60	16			12.2-20.6	USFWS
56°40'N, 163°24'W	79	SBL F-8 USNM	14/7/61	7			10.8-19.9	USFWS
56°37.5'N, 163°23.5'W	83	ABL F-8 USNM	26/6/66	25	3		8.6-22.0	USFWS
56°40'N, 162°47'W	64	SBL F-9 USNM	30/7/61	7	1		12.1-22.3	USFWS
56°40'N, 162°11'W	70	SBL F-10 USNM	7/8/60	2			14.0-18.2	USFWS
56°39'N, 162°12'W	70-76	ABL F-10 USNM	28/6/66	2			16.4-19.0	USFWS
56°40'N, 161°35'W	73	SBL F-11 USNM	30/7/61	3			13.4-18.2	USFWS
56°30'N, 165°31'W	88	SBL EF-4.5 USNM	16/7/61	8			9.9-19.8	USFWS
56°30'N, 164°55'W	84	SBL EF-5.5 USNM	17/7/61	15			13.3-21.5	USFWS
56°30'N, 164°18'W	88	SBL EF-6.5 USNM	13/7/61	8	1		12.4-20.5	USFWS
56°30'N, 163°42'W	86	SBL EF-7.5 USNM	12/7/61	12			7.4-19.0	USFWS
56°20'N, 165°51'W	93	SBL E-4 USNM	29/8/60	11			12.3-17.9	USFWS
56°20'N, 165°13'W	88	SBL E-5 USNM	28/8/60	1			16.7	USFWS
56°20'N, 165°13'W	88	SBL E-5 USNM	17/7/61	3			13.1-15.6	USFWS
56°20'N, 165°13'W	90	ABL E-5 USNM	20/7/66	1			14.1	USFWS
56°20'N, 164°36'W	82	SBL E-6 USNM	14/8/60	11			12.2-19.4	USFWS
56°20'N, 164°36'W	91	SBL E-6 USNM	13/7/61	3			13.6-18.4	USFWS
56°19.5'N, 164°37'W	90	ABL E-6 USNM	9/7/66	13	1		12.6-21.5	USFWS
56°20'N, 164°00'W	80	SBL E-7 USNM	15/8/60	8			13.6-21.1	USFWS
56°20'N, 164°00'W	90	SBL E-7 USNM	12/7/61	1			14.3	USFWS
56°22'N, 164°00'W	83	ABL E-7 USNM	11/7/66	9			16.3-21.5	USFWS
56°20'N, 163°23'W	88	SBL E-8 USNM	12/7/61	1			16.0	USFWS
56°21'N, 162°51'W	80	ABL E-9 USNM	3/6/66	4			15.4-18.7	USFWS
56°10'N, 164°18'W	88	SBL DE-6.5 USNM	13/7/61	3			18.6-21.7	USFWS

Table 21 (Continued). *Pagurus trigonochelirus* (Stimpson) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	♂♀		
<i>Bering Sea</i>								
55°59'N, 163°27'W	91	ABL D-8 USNM	25/6/66	1	1		11.2-15.0	USFWS
56°00'N, 162°50'W	80-82	ABL D-9 USNM	3/6/66	2			13.8-15.5	USFWS
55°40'N, 163°23'W	79	SBL C-8 USNM	4/8/60	2			14.0-15.1	USFWS
55°40'N, 163°23'W	80	SBL C-8 USNM	9/7/61	2	1		6.2-15.6	USFWS
54°39'N, 165°12'W	73	ABL Z-5 USNM	4/8/61	1			7.1	USFWS
Bristol Bay	---	----- USNM	summer 58	1			10.4	USFWS
Bristol Bay	---	----- USNM	summer 59	3			10.4-12.9	USFWS
N of Unimak I.	128	Albatross 3258 USNM 128948	1890	24	31		4.0-12.6	---
<i>Gulf of Alaska</i>								
Off Unimak I.	---	9D USNM	28/6/63	1			13.5	INPHC
Between Unimak & Shumigan Is.	---	----- USNM	summer 61	1			7.4	INPHC
58°13'N, 134°18'W	30	----- AHF	2/64	1			5.5	Gonor
58°12'N, 135°02'W	91	----- USNM, RMNH	----	4	2		3.0-5.4	Gonor

Diagnosis. — Left chela with dorsolateral face generally somewhat concave, midline with prominent, spinose crest; dorsolateral margin expanded proximally, strongly so in small specimens. Right chela with dorsal surface convex, with irregular rows of small spines. Ocular acicles with simple or bifid terminal spine, frequently with 1 or 2 accessory spinules. Rostrum moderately short, obtusely, triangular or slightly rounded. Sternite of P₃ subsemicircular.

Description. — Shield usually with length approximately equalling width, occasionally slightly longer than broad; anterolateral margins sloping or slightly terraced; anterior margin between rostrum and lateral projections straight or slightly concave; posterior margin truncate or slightly rounded; dorsal surface generally smooth centrally, slightly pitted laterally, with scattered tufts of short setae; anterolateral angle produced, blunt. Rostrum moderately short, usually equalling or slightly exceeding lateral projections, obtusely triangular, acute or subacute or occasionally slightly rounded, usually with small marginal or submarginal terminal spine. Lateral projections broadly triangular or occasionally slightly rounded, with marginal or submarginal spine.

Ocular peduncles moderately short, approximately one-half length of shield; moderately stout, slightly inflated basally, dilated in corneal region; dorsal or dorsomesial surface with longitudinal row of tufts of short setae. Ocular acicles with mesial margins expanded, lateral margins straight or

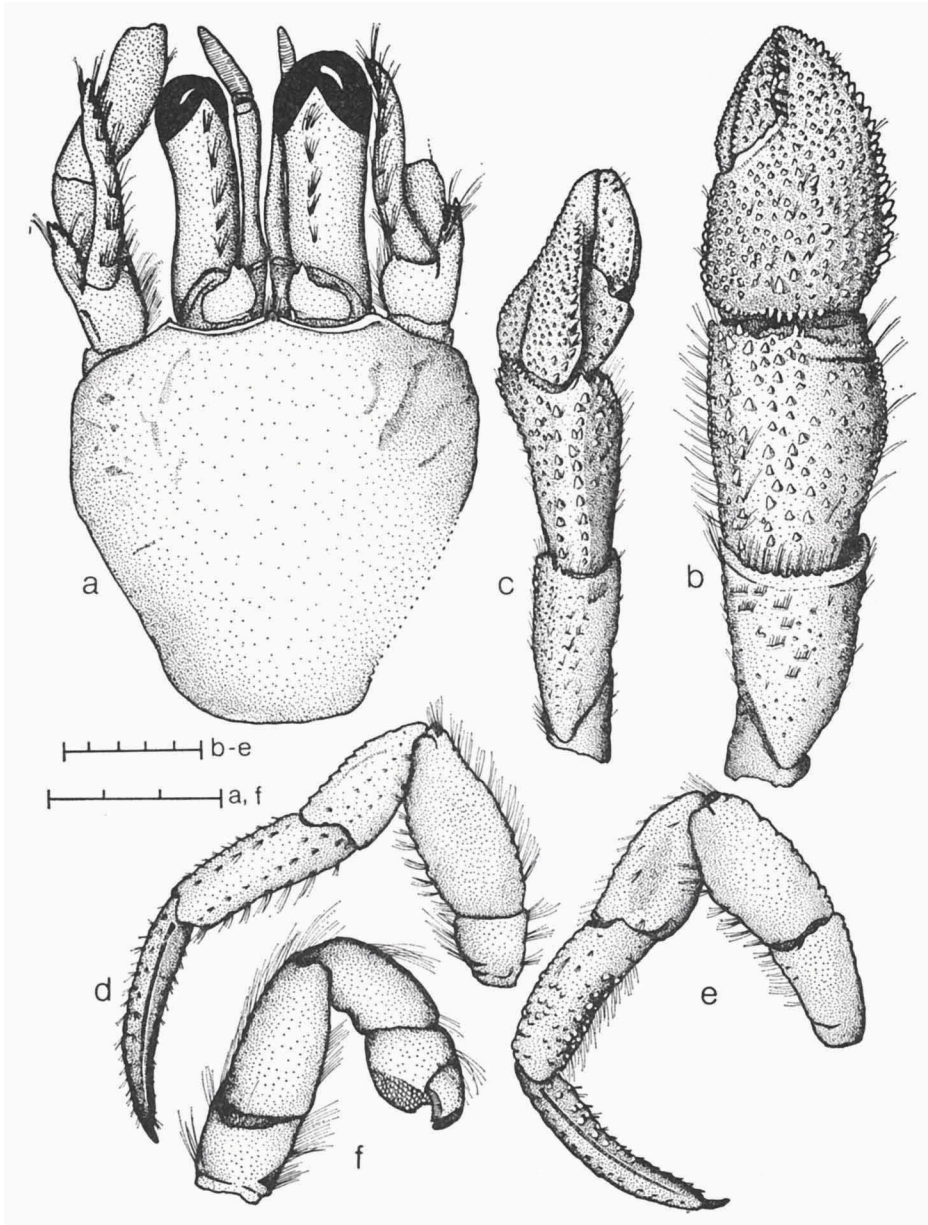


Fig. 59. *Pagurus trigonocheirus* (Stimpson). a, shield; b, right cheliped (dorsal view); c, left cheliped (dorsal view); d, left P₂ (lateral view); e, left P₃ (lateral view); f, right P₄ (lateral view). Scales equal 5 mm (b-e) and 3 mm (a, f).

slightly expanded; terminating in moderately strong simple or bifid spine, with 1 or occasionally 2 accessory spines rarely without accessory spine; separated basally by one-half to three-fourths basal width of one acicle.

Antennular peduncles moderately long, exceeding ocular peduncles by two-thirds to entire length of ultimate segment; ultimate and penultimate segments unarmed, occasionally with few tufts of short setae; basal segment with dorsomesial distal angle produced, with tuft of short setae.

Antennal peduncle moderately long, exceeding ocular peduncles by one-third to three-fourths length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments unarmed, with few tufts of short setae, or rarely fifth segment with very small spinule partially obscured by tuft of setae on ventral margin; fourth segment unarmed. Third segment with ventromesial distal angle produced, terminating in strong spine, partially obscured by tuft of setae. Second segment with dorsolateral distal angle produced, terminating in acute simple or bifid spine, 1-3 small spines on expanded mesial margin, lateral margin usually unarmed; dorsomesial distal angle with acute spine, mesial face with moderately short setae. First segment with ventrodial margin produced, usually unarmed and with short setae; lateral face with small spine. Antennal acicle moderately long, usually equalling length of ocular peduncles; often strongly arcuate; terminating in simple or bifid spine; mesial margin with spinulose protuberances and tufts of short setae. Antennal flagella long, usually exceeding tip of right cheliped, articles usually naked.

Mandible without distinctive characters. Maxillule with proximal endite subquadrate; endopodite with 2-4 bristles on produced internal lobe, external lobe moderately well developed, not recurved. Maxilla with endopodite inflated basally, not reflexed, equalling or slightly exceeding scaphognathite in distal extension. First maxilliped with endopodite approximately two-thirds length of exopodite; basal segment of exopodite with external margin convex; epipodite slightly produced, often more prominent than base of exopodite. Second maxilliped without distinctive characters. Third maxilliped with basis-ischium fusion incomplete; basis with 1-3 small spines or spinules; ischium with crista dentata well developed, 1 accessory tooth; merus with small spine at dorsodistal margin, ventral margin with 1-4 strong spines; carpus often with small spine at dorsodistal margin. Sternite of mxp_3 usually with small spine, partially obscured by tufts of setae on each side of midline.

Right cheliped moderately short and broad in small specimens, elongate and moderately narrow in large specimens; lateral margin of chela strongly arcuate. Dactyl usually equalling or slightly exceeding length of palm;

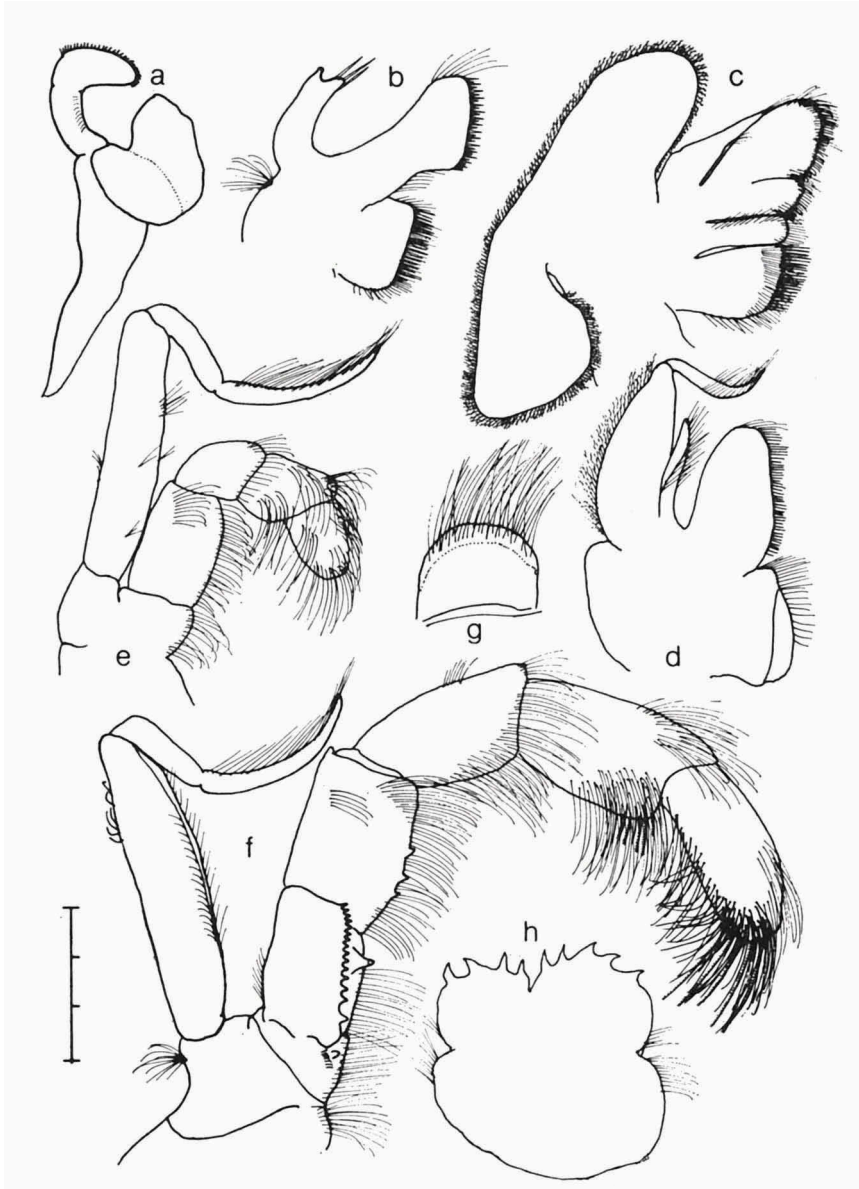


Fig. 60. *Pagurus trigonocheirus* (Stimpson). a-f, mouthparts (left, internal): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite, P₃; h, telson.

mesial margin slightly arcuate; cutting edge with row of calcareous teeth proximally, corneous teeth distally; terminating in small corneous claw; usually overlapped by fixed finger; dorsal surface slightly raised in midline with row of moderately small, often corneous-tipped closely-spaced spines, decreasing in size distally and with scattered small spines or spinulose tubercles laterally and mesially and few tufts or short setae, dorsomesial margin with single or double row of moderately small conical spines and tufts of short setae or bristles; ventral and mesial surfaces with tufts of short bristles. Palm two-thirds to five-sixths length of carpus; dorsoventrally inflated; dorsal surface convex, with very irregular rows of moderately strong, subacute or acute frequently corneous-tipped spines most prominent medianly, dorsomesial margin with single or double row of moderately small spines and few tufts of short setae, dorsolateral margin with row of moderately strong acute or subacute spines and tufts of short setae; lateral face with irregular rows of small spinulose tubercles and tufts of short setae; mesial face usually with short spines or spinulose tubercles dorsally; ventral surface with scattered spinulose tubercles and tufts of setae. Carpus equaling or exceeding length of merus; dorsal surface convex, with irregular rows of small, acute spines or spinulose tubercles, dorsomesial margin with single or double row of moderately strong spines, dorsomesial distal angle frequently with small cluster of spines, distal margin with irregular row of small spines, dorsolateral margin with single or double row of small spines and tufts of setae; lateral face with irregular rows of simple or bifid low tubercles and frequently with dense tufts of setae, distal margin usually with row of moderately strong subacute spines; mesial face usually with scattered tubercles, becoming more spinulose dorsally and tufts of setae, distal margin with single or double row of small usually subacute spines; ventral surface with scattered tubercles or spinulose protuberances and tufts of long setae. Merus subtriangular; dorsal surface with transverse denticulate ridges, becoming stronger and more spinulose distally and with tufts of short setae, distal margin with row of prominent acute spines; mesial and lateral faces usually tuberculate or spinulose, with tufts of setae; ventral surface with scattered blunt or spinulose tubercles and tufts of long setae, ventrolateral and ventromesial margins with simple or multifid tubercles or subacute spines proximally, becoming stronger and more acute distally. Ischium usually with row of small acute or subacute spines or spinulose tubercles on ventromesial margin, ventrolateral distal angle with cluster of small spinules and tufts of setae; lateroproximal margin frequently with denticulate keel. Coxa unarmed or with few small spines or spinules at ventrolateral distal angle, ventrolateral margin occasionally with cluster of

spinules proximally, ventromesial margin with tufts of long setae.

Left cheliped moderately long, usually reaching to or extending slightly beyond base of dactyl of right. Dactyl long, usually exceeding palm in length in small specimens, in large specimens most frequently equalling or slightly less than length of palm; cutting edge with row of small corneous teeth, terminating in small corneous claw, frequently overlapped by fixed finger; dorsal surface with few, scattered small spines or tubercles and tufts of short setae, dorsomesial margin with row of small acute or subacute spines, decreasing in size and becoming obsolete distally; mesial and ventral surfaces unarmed or with scattered low protuberances and tufts of setae. Palm moderately long, one-third to one-half length of carpus, subtriangular; dorso-lateral margin expanded proximally, strongly so in small specimens, with single or double row of small frequently corneous-tipped spines and tufts of setae, dorsolateral surface somewhat concave, obliquely elevated into strong crest slightly mesiad of midline, dorsal surface laterally with closely-spaced small spines or spinulose tubercles and tufts of setae, mesially with scattered small spines or tubercles, crest with single or double row of strong spines continuing onto fixed finger proximally; mesial and ventral surfaces with scattered simple or bilobed tubercles and tufts of setae, ventromesial margin with row of tubercles. Carpus varying in length from slightly less than to approximately one-third longer than merus; ventrolateral distal angle strongly produced; dorsal surface flattened, margins each with irregular row of moderately strong spines, distal margin with 1 or 2 prominent spines; lateral face with scattered spinulose tubercles or small spines and tufts of long setae, distal margin usually with row of spines, ventrodistal angle frequently with cluster of small spines; mesial face with scattered simple or multifid tubercles or small spines, distal margin with moderately strong spines; ventral surface with scattered, spinulose tubercles or small spines, margins each with row of small spines or spinulose tubercles, increasing in size distally. Merus subtriangular; dorsal surface with double row of low tubercles or transverse, spinulose ridges and tufts of short setae, distal margin usually with 1 or 2 prominent spines; lateral face with spinulose, simple or multifid tubercles or small spines and scattered tufts of setae; mesial face unarmed or with few spinules or small tubercles and tufts of moderately long setae; ventromesial margin with row of simple or multifid spines, increasing in size distally, ventrolateral margin with row of small spines or occasionally blunt tubercles and tufts of long setae. Ischium unarmed, or with row of small spinules on ventromesial margin; lateral face with tufts of long setae. Coxa usually with row of small denticles on ventrolateral margin, distal angle often with cluster of small spinules, ventromesial margin and distal angle with long setae.

Second pereopods moderately long, usually reaching to tip of right cheliped. Dactyl one-fourth to one-third longer than propodus, moderately deep; in lateral view, slightly curved ventrally; in dorsal view, slightly twisted; dorsal surface with row of low protuberances and tufts of short stiff setae; mesial face with faint longitudinal sulcus usually flanked by single or double row of corneous spinules; lateral face with longitudinal sulcus and row of tufts of short setae; ventral margin with row of corneous spines increasing in size distally. Propodus equalling or slightly exceeding length of carpus; dorsal surface with row of low protuberances and tufts of short setae; mesial face with few small protuberances or very small tubercles and scattered tufts of setae; lateral face with 2 or 3 rows of low protuberances or small occasionally spinulose tubercles and tufts of short setae; ventral margin with low protuberances, or frequently with row of small, corneous spinules and tufts of moderately long setae. Carpus one-half to three-fourths length of merus; dorsal margin with row of small spines or spinulose tubercles; mesial face with few scattered tufts of short setae; lateral face with faint longitudinal sulcus and 1 or 2 irregular rows of tufts of short setae; ventral surface unarmed or occasionally with 1 or 2 small corneous spinules on distal margin. Merus laterally compressed; dorsal margin with 1 or 2 irregular rows of transverse occasionally spinulose ridges and tufts of long setae; mesial face with scattered tufts of setae and occasionally with few small tubercles distally, ventromesial margin with single or double row of small spines and tufts of short setae; lateral face unarmed or minutely spinulose, ventrolateral margin with row of small spines and tufts of long setae. Ischium with row of small spinules on ventral margin, partially obscured by tufts of long setae; dorsal margin with row of small denticles and tufts of long setae. Coxa often with row of minute spinules at ventrolateral proximal angle, ventrolateral distal angle with 2 or 3 small denticles, mesial face with tufts of long setae; rarely unarmed.

Third pereopods frequently slightly shorter than second; dissimilar from left to right. Dactyl one-fourth to one-third longer than propodus; in lateral view slightly curved ventrally; in dorsal view, slightly twisted; terminating in strong corneous claw; dorsal surface with row of tufts of long setae; mesial face with weak longitudinal sulcus flanked by row of corneous spines; lateral face with longitudinal sulcus and 1 or 2 rows of tufts of short setae (right pereopod), or with 1 or 2 irregular rows of spinulose tubercles or small spines ventrally (left pereopod); ventral margin with row of corneous spines, increasing in size distally and tufts of short setae. Propodus slightly longer than carpus; dorsal surface with 2 or 3 rows of low frequently spinulose protuberances and tufts of short setae; mesial face with scattered

small protuberances or tubercles and tufts of short setae; lateral face with row of low protuberances and tufts of short setae (right pereopod), or irregular rows of spinulose tubercles or small spines and tufts of setae (left pereopod); ventral surface frequently slightly spinulose, with tufts of long setae. Carpus two-thirds to three-fourths length of merus; dorsal surface with row of low spinulose tubercles or small spines; ventral, lateral and mesial surfaces usually with few scattered tufts of short setae. Merus laterally compressed; dorsal margin with 1 or 2 irregular rows of low frequently spinulose protuberances and tufts of setae; lateral and mesial faces occasionally with scattered tufts of setae; ventral margin with spinulose protuberances or small spinules and tufts of long setae. Ischium with few minute spinules on dorsolateral face; ventral margin with row of very small spinules or denticles. Coxa usually unarmed, margins with tufts of long setae.

Fourth pereopods apparently without preungual process at base of claw on lateral face of dactyl; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods large, subsemicircular or subsemiovate, margin with long setae.

Pleopods of male unpaired, pl_3-pl_5 with exopodites well developed; endopodites reduced. Females with pleopods unpaired, pl_2-pl_4 with both rami well developed; pl_5 with exopodite moderately well developed; endopodite rudimentary.

Telson with terminal lobes asymmetrical, left usually considerably larger than right; separated by moderately deep, V-shaped, median cleft; right terminal margin with 3-6 strong, often widely-spaced spines, occasionally with a short row of very small corneous spinules on lateral margin distally; left terminal margin with 4-7 strong, often widely-spaced spines, occasionally with short row of small corneous spinules on lateral margin distally; anterior lobes with tufts of setae.

Coloration. — Living color unknown. In preservative: "Color reddish; feet orange, inclining to clay color, transversely barred with darker" (Stimpson 1907: 222). In the specimens examined in this study, the transverse bands of dark reddish-orange occur at the proximal and distal portions of the propodal, carpal and meral segments of the second and third pereopods; occasionally the tips of the spines retain a reddish tint.

Distribution. — Arctic Ocean, Bering Straits (Stimpson); Point Barrow (Murdoch); Chukchi Sea (Sivertsen, Makarov, Kobjakova); Bering Sea, Pribilof Is., Aleutian Is. (Rathbun); Kamchatka (Brandt, Kobjakova); Bering I. (Molander); Kuril Is., Sakhalin (Kobjakova); Tagaru Straits (Yokoya); La Perouse Straits to Nagasaki (Vinogradov); Sea of Japan

(Kobjakova); Niigata-prefecture (Terao); Noto, Huzan, Korea, Kosiki I. (Yokoya); Mamiya Straits, Aniwa and Taraika Bays (Urita); Osika (Terao); Todosaki, Kinkazan to Inuboezaki (Yokoya); subtidal to 182 meters.

Affinities. — Although most of the species assigned to the “*trigonocheirus*” group resemble one another considerably, *Pagurus trigonocheirus* is most closely allied to its Atlantic analog, *Pagurus pubescens* Kröyer. In many

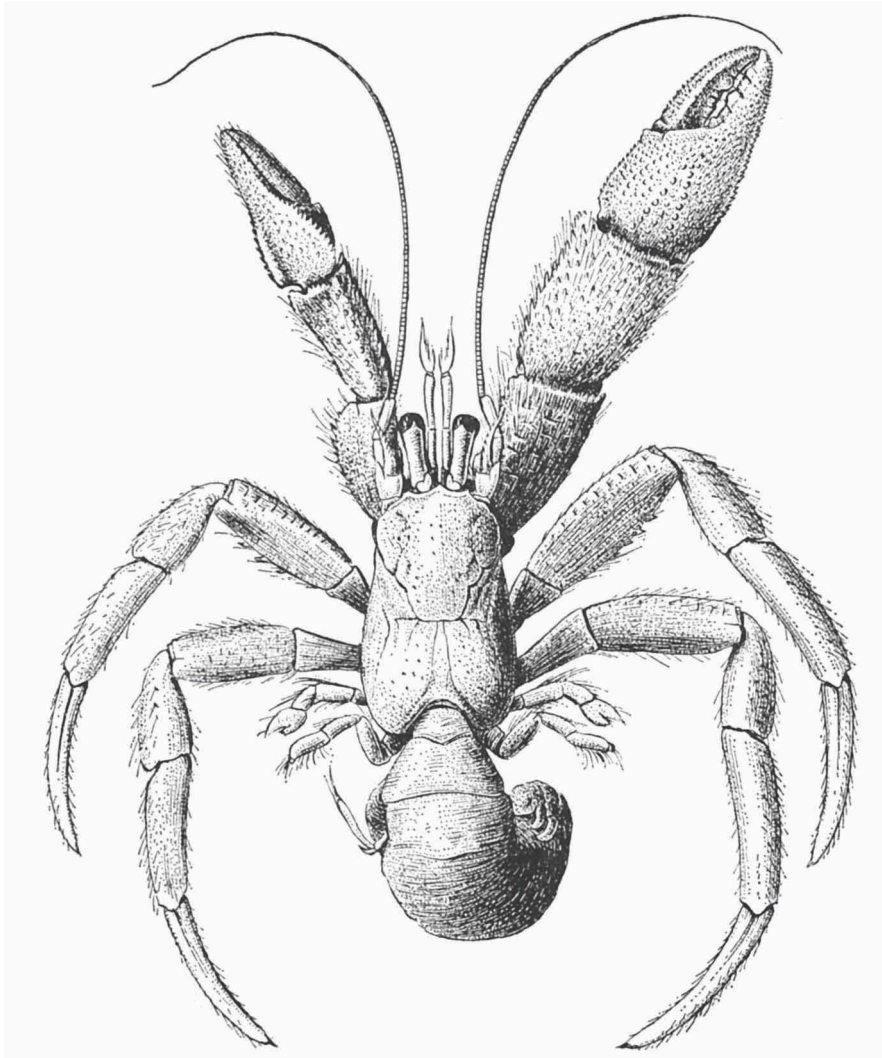


Fig. 61. *Pagurus pubescens* Kröyer. Original illustration of J. E. Benedict's *Pagurus kroyeri* (Stimpson).

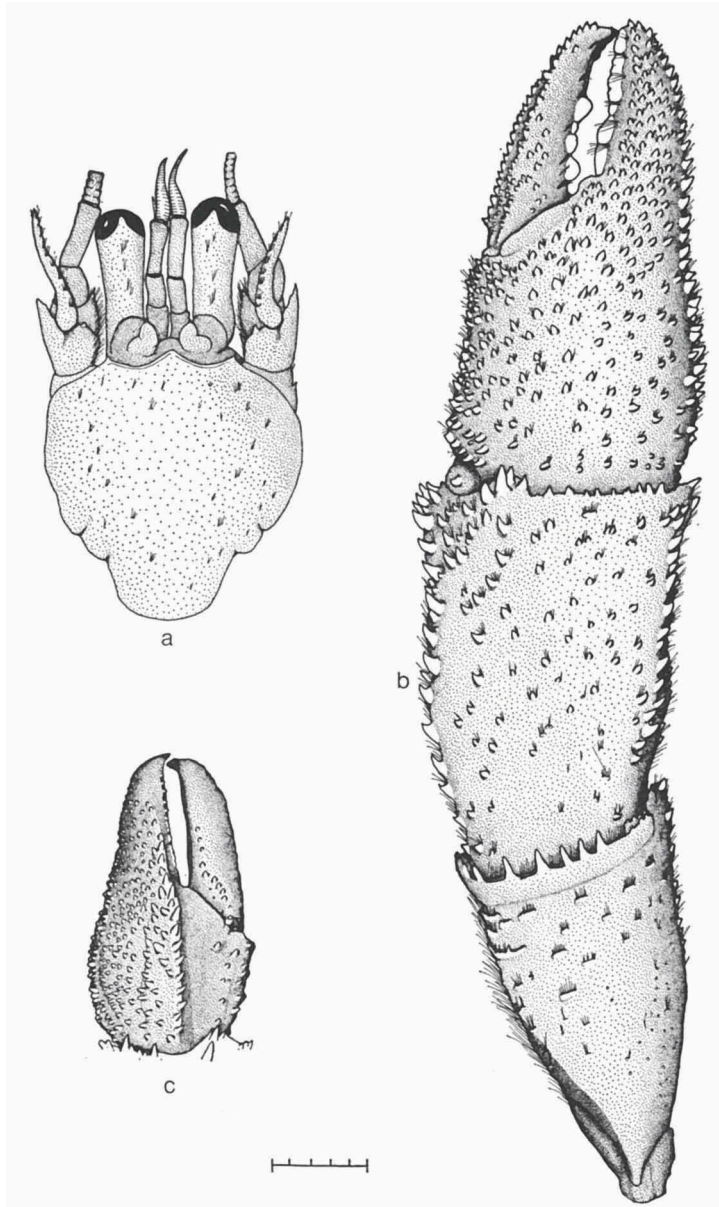


Fig. 62. *Pagurus pubescens* Kröyer. a, shield; b, right cheliped (dorsal view); c, left chela (dorsal view). Scale equals 5 mm.

respects the morphology of the two species appears identical within the range of intraspecific variation, which accounts for the many reports in the literature of the conspecificity of the two species (see discussion). When comparing the shields and cephalic appendages of the two species (figs. 59a, 62a), the most noticeable distinction is found in the ocular acicles, which are usually armed, in *P. trigonocheirus* not only with a strong, simple or occasionally bifid, terminal spine, but with 1 or 2 accessory spines, in contrast to the single terminal spine commonly present in *P. pubescens*. Differences also occur in the length-width relations of the right chelipeds; however, this relationship changes with growth. As illustrated (fig. 59b), the right cheliped of *P. trigonocheirus* has a short, broad chela and moderately elongate carpus, in contrast to the long, slender chela and moderately short carpus of *P. pubescens* (fig. 62b). In larger specimens of *P. trigonocheirus*, however, the chela tends to elongate, in relation to its width, approaching the proportions found in *P. pubescens*. One distinction, the pronounced curvature of the lateral margin of the right chela of *P. trigonocheirus*, is useful in distinguishing the two species. In *P. pubescens*, the lateral margin is relatively straight and does not appear to be altered by growth. Differences in the configuration of the left chelae are pronounced in the "type" specimens illustrated (figs. 59c, 62c) and these differences formed the basis for species separation as reported by several early carcinologists. The lateral expansion of the palm, however, is subject to considerable variation in both species, as is the armature of the crest. In *P. trigonocheirus* this expansion appears to be somewhat inversely proportional to size, frequently it is very pronounced in small specimens, but approaches the configuration of *P. pubescens* in large specimens. Observable differences are also found in the mouthparts of the two species (figs. 60a-f, 63a-f) but these characters are less accessible and, therefore, are impractical for "key" characters. The most reliable and easily observable character that may be used to distinguish *P. trigonocheirus* from *P. pubescens* is the configuration of the sternite of the third pereopods, which is subsemicircular or subsemiovalate in *P. trigonocheirus* (fig. 60g) and subrectangular in *P. pubescens* (fig. 63g).

Pagurus trigonocheirus is also closely related to *Pagurus brandti*, but is distinguished from the latter species by the prominent crest of the left chela (absent in *P. brandti*), the armature of the ocular acicles, and the apparent absence of a preungual process on the lateral face of the dactyl of the fourth pereopod.

Discussion. — The disputed taxonomic status of *P. trigonocheirus* and *P. pubescens* is well known in carcinological literature. At least in part, responsibility for the controversy is attributable to Stimpson himself, due

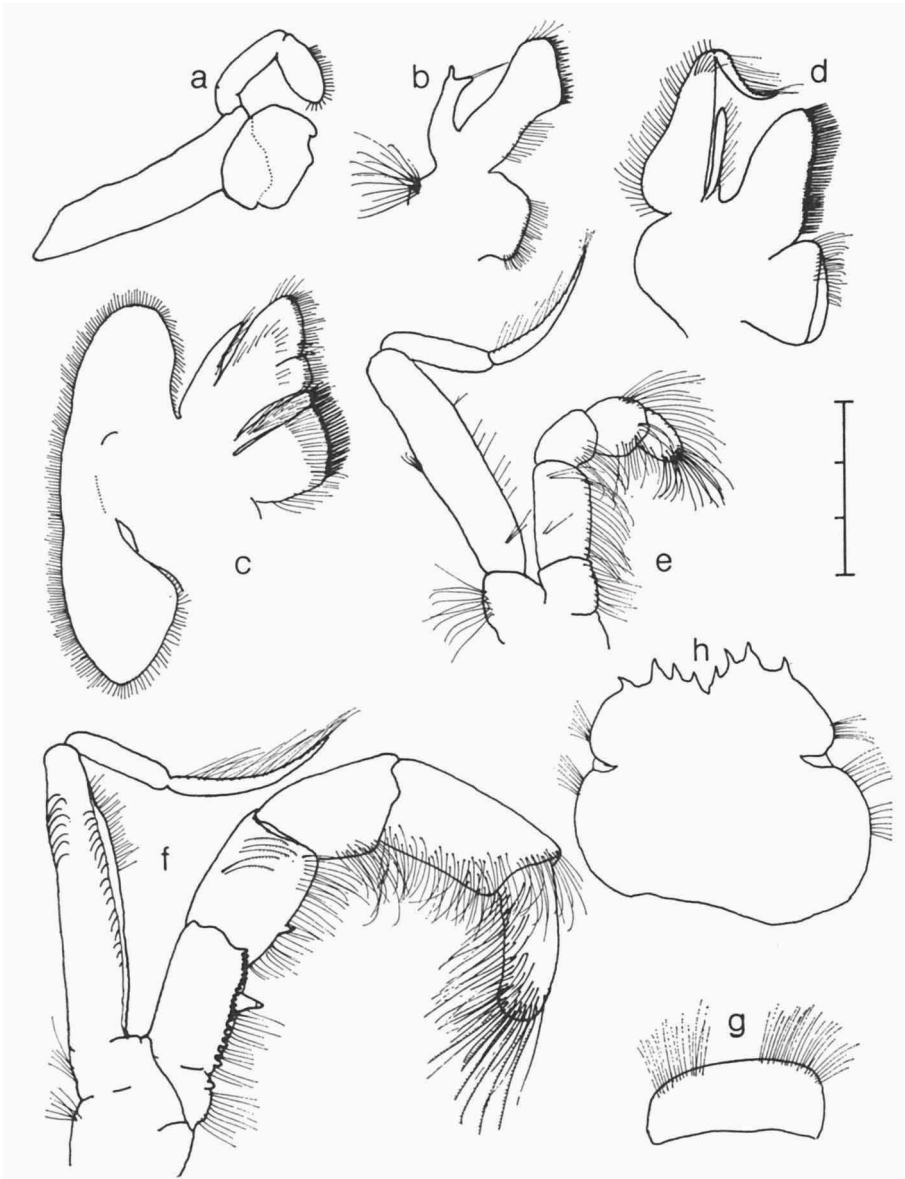


Fig. 63. *Pagurus pubescens* Kröyer. a-f mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp_1 ; e, mxp_2 ; f, mxp_3 . — g, sternite, P_3 ; h, telson. Scale equals 3 mm.

both to the brevity of his descriptions and the sequence in which they appeared, as well as in his misinterpretation of Kröyer's species. Stimpson apparently had already formed the opinion that Kröyer (1838a, 1838b, 1844) had confounded two species under the name "*pubescens*" when he (Stimpson, 1858) published his description of *Eupagurus trigonocheirus*, as he related *E. trigonocheirus* to "*E. pubescens* Brandt . . . *Pagurus pubescens* Kröyer . . . (partim)" (Stimpson, 1858: 249). Stimpson also listed for the first time, without description, *Eupagurus kroyeri* Stimpson (1858: 237). Subsequently, in his description of *E. kroyeri* (Stimpson, 1859a, 1862) he restricted *P. pubescens* (sensu Kröyer), but reported both as circumpolar species (later he credited this latter species to Brandt with no mention of Kröyer (Stimpson, 1907: 222)).

Although Sars (1886) had reported that he could find no differences between *E. kroyeri* and *E. pubescens* (Kröyer), Benedict (1892) accepted the Stimpson interpretation of *E. pubescens*, but restricted its distribution to the Atlantic. From northwestern North America, Benedict (1892: 8) described *Eupagurus capillatus* as the analog species of *E. pubescens* (sensu Stimpson), and a second new species, *Eupagurus brandti* Benedict (1892: 9), as a species closely allied to *E. trigonocheirus* and *E. kroyeri*. As Stimpson's type material had presumably all been destroyed by fire in 1871 (cf. Rathbun, 1833), Benedict could refer only to Stimpson's brief descriptions and to subsequently identified collections for his interpretations of Stimpson's species. As a result, Benedict included, in his type series of *E. brandti*, specimens unquestionably referable to both *E. trigonocheirus* and *E. brandti* (personal examination).

Although Doflein (1900) placed *E. trigonocheirus* in synonymy with *E. pubescens* (sensu Kröyer) and Hansen (1908) suggested that both *E. capillatus* and *E. brandti*, as well as *E. trigonocheirus*, would be found to be synonymous with Kröyer's species, the majority of North American and Asian carcinologists continued to regard these species as distinct from *E. pubescens* (sensu Kröyer). Balss (1913) synonymized *E. capillatus* with *E. trigonocheirus* on the basis of an erroneously identified specimen from the collections of the United States National Museum. His error was corrected by Schmitt (1921).

In a series of papers dealing with Russian pagurids, Makarov (1937, 1938a, 1938b, 1962) reaffirmed Doflein's synonymy of *P. trigonocheirus* with *P. pubescens* (sensu Kröyer), stating that in comparing large collections from the White and Barents Seas [incorrectly cited as Bering in the translation (Makarov, 1962: 199)] with those from the Far Eastern Seas, he could find no significant and consistent differences in the characters

normally used to distinguish between the two species, i.e., "... ratio between length and width of the left chela at its base, degree of pubescence, etc.". After examining a specimen identified as *P. brandti* from the U.S. National Museum (USNM 19097), Makarov (1938b, 1962) also placed this species in synonymy with *P. pubescens* (sensu Kröyer).

On the basis of the characters used, one would have to concur with Makarov's conclusions regarding a continuum in *P. trigonocheirus* and *P. pubescens* (sensu Kröyer). As previously noted (p. 248), length-width relationships in the chelipeds of both species are predominately a function of size; pubescence is extremely variable. However, Squires (1964), in a study of the relationships of the species *P. pubescens* (sensu Kröyer), *P. pubescens* (sensu Stimpson), *P. kroyeri* and *P. trigonocheirus* (see discussion of *P. capillatus*, p. 108), suggested certain characters which he believed could be used to distinguish *P. pubescens* Kröyer (= *P. kroyeri*) from *P. arcuatus* Squires (= *P. pubescens* sensu Stimpson) and *P. trigonocheirus*, i.e., the configuration of the sternite of the third pereopods and the armature and configuration of the telson.

In the course of this study I have compared a large series of specimens (53 ♂, 15 ♀) of *P. pubescens* Kröyer from the eastern coasts of the United States and Canada (CNM), Barents Sea (RMNH) and Greenland (NHMG), in addition to the 3 specimens (♂ SL = 8.4, 12.7 mm, ♀ SL = 5.7 mm) in Kröyer's type series (UZM), with the collections of *P. trigonocheirus* (800 ♂, 178 ♀; see table 21) from Point Barrow, Alaska to the Gulf of Alaska, including the recently discovered (Evans, 1967) syntype of *P. trigonocheirus* (BM 61-44). This comparison has shown that one of Squires' characters, the configuration of the sternite of the third pereopods, is sufficiently stable to be of major diagnostic significance. Use of the telson for the separation of these two species, however, proved unreliable, as this structure was found to have considerable intraspecific variation and interspecific overlap. As *P. trigonocheirus* and *P. brandti* were originally confounded, Makarov (1938b, 1962) could have been justified in placing *P. brandti* in synonymy on the basis of the specimen he examined. That specimen, from USNM 19097, was sent to Makarov on a permanent loan; therefore, there is no way to verify its identity (H. Roberts, personal communication).

Some reports of *Pagurus* (or *Eupagurus*) *pubescens* from the Pacific-Arctic have been questionably referred to *P. trigonocheirus*; however, it must be pointed out that these records could actually have referred to *P. capillatus*. Brevity of descriptions, lack of illustrations, or simply reports in species lists have made revaluations often impossible. In listings, such as

those of Alcock (1905), Williamson (1915), Gordan (1956), etc., which were compiled from the literature, my inclusion of the author's citation (in part) has been based on the species distributions indicated. The figures of *P. brandti* given by Rathbun (1904, 1910) have been questionably excluded from the partial synonymy of this species with *P. trigonocheirus*, as the figured specimen does not appear to represent the latter species. The reports of Kamita (1954-58a, 1954-58b, 1954-58c) of *Eupagurus pubescens* actually refer in part to *P. trigonocheirus* (1954-58b: 44, fig. 20) and in part to a second species, probably *Pagurus dubius* (Ortmann, 1892) (Kamita, 1954-58b, fig. 21). R. R. Makarov (1966) questionably referred larvae from the Kamchatkan region to *P. pubescens* Kröyer. However, as he noted differences between his larvae and those described for the Atlantic *P. pubescens* by MacDonald, Pike & Williamson (1957), Makarov suggested that *P. trigonocheirus*, as represented by the Kamchatkan larvae, might actually be distinct from *P. pubescens* (sensu stricto). On the basis of Makarov's findings and the data from this study, there appears to be sufficient justification to refer the reports of earlier Russian carcinologists of *P. pubescens* in the Far Eastern Seas of the USSR, Bering and Chukchi Seas, Arctic Ocean, and northwestern North America to *P. trigonocheirus*.

Pagurus undosus (Benedict) (figs. 64-66)

Eupagurus (Trigonocheirus) undosus Benedict, 1892: 18 (by implication; type locality: Bering Sea, here restricted by lectotype selection to Saint Paul Island, Pribilof Islands, Bering Sea).

Pagurus undosus: Rathbun, 1899: 556. — Rathbun, 1904: 159, pl. 4 fig. 6. — Rathbun, 1910: 159, pl. 4 fig. 6. — Williamson, 1915: 481. — Derjugin & Kobjakova, 1935: 142. — Kobjakova, 1936: 191. — Kobjakova, 1937: 144. — Makarov, 1937: 59, fig. 8. — Makarov, 1938a: 414, figs. 3a, b, 4. — Makarov, 1938b: 192, pl. 1 fig. 5. — Vinogradov, 1947: 104. — Vinogradov, 1950: 228 (key), fig. 128. — Birstein & Vinogradov, 1953: 224. — Gordan, 1956: 336. — Kobjakova, 1956: 61. — Kobjakova, 1958a: 233. — Kobjakova, 1958b: 252. — Lindberg, et al, 1959: 232. — Makarov, 1962: 182, pl. 1 fig. 5. — Filatova & Barsanova, 1964: 72. — Filatova & Barsanova, 1969: 81.

Eupagurus undosus: Alcock, 1905: 179. — Urita, 1942: 41.

Eupagurus trigonocheirus var. *paulensis* Balss, 1913: 64, figs. 38, 39 (type locality: "Pribylow-Insel St. Paul", Saint Paul I., Pribilof Is.; misspelling of *Eupagurus trigonocheirus* Stimpson, Balss, 1913: 64).

? *Eupagurus cornutus*: Urita, 1942: 40. ? Not *Eupagurus cornutus* Benedict, 1892; see discussion.

Lectotype herein selected. — ♂ (SL = 9.6 mm), USNM 15346.

Material examined. — See table 22.

Diagnosis. — Left chela with dorsolateral surface concave, midline elevated into prominent crest or keel. Right chela with dorsal surface of palm with prominent moderately broad median ridge, surface somewhat concave mesially and laterally.

Table 22. *Pagurus widosus* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	♂♀		
<i>Chukchi Sea</i>								
69°16'N, 164°22'W	---	61	25/8/59	6	3		4.5-8.8	JNC
68°30'N, 167°00'W	35	USNM, RMNH	22/10/62	1	1		5.7-6.4	McCauley
68°03'N, 166°18'W	---	USNM 19	12/8/59	3	1		7.5-15.6	JNC
<i>Bering Sea</i>								
Kamchatka	---	---	1882-83	1			12.6	Stejneger
Bering I., Commander Is.	---	USNM 16969	1882-83	2			7.5-8.5	Stejneger
Bering Sea	---	USNM 16946	1885	1			5.4	---
57°04'N, 170°24'W	48	USNM 16947	2/9/93	32	23		2.8-8.2	---
57°12'N, 169°51'W	50	Albatross 3557 USNM 19211	1/8/93	1	3		5.1-7.6	---
Saint Paul I., Pribilof Is.	---	Albatross 3510 USNM 19209	27/7/18	4			4.9-7.9	Hanna
N East Landing, St. Paul I.	---	USNM	29/8/63	1			7.9	Fiscus
East Landing, St. Paul I.	---	USNM	2/9/63	3	1		3.7-9.0	Fiscus
Off NE Point, St. Paul I.	18	USNM, BM	21/11/65	3	3		6.6-11.1	Fiscus
Halfway Pt., St. Paul I.	18	USNM, AHF	21/11/65	2			8.7-12.3	Fiscus
English Bay	---	USNM	---	1			7.4	---
Walrus I., Pribilof Is.	46	USNM 16948	23/11/65	25	4	5	3.6-14.5	Fiscus
		USNM, RMNH						

Description. — Shield length-width ratio varying from considerably longer than broad to much broader than long; anterolateral margins slightly terraced; anterior margin between rostrum and lateral projections usually slightly concave, less frequently straight; posterior margin roundly truncate or truncate; dorsal surface smooth centrally somewhat pitted laterally and with scattered tufts of short setae; lateral margins occasionally slightly spinulose; anterolateral angle with small blunt projection. Rostrum short, equalling or slightly exceeding lateral projections, broadly rounded, obtuse or acutely triangular; often with small terminal spine or spinule. Lateral projections broadly rounded, usually with small, acute submarginal spine.

Ocular peduncles moderately short, less than one-half shield length; moderately inflated basally, corneal region slightly dilated; dorsomesial face with longitudinal row of tufts of short setae. Ocular acicles reaching mesial base of ocular peduncles; mesial margins somewhat expanded, lateral margins straight or slightly expanded, dorsal surface with tuft of short setae; terminating subacutely, usually with submarginal spine; separated basally by basal width of one acicle.

Antennular peduncles moderately long, exceeding ocular peduncles by approximately two-thirds length of ultimate segment; ultimate and pen-

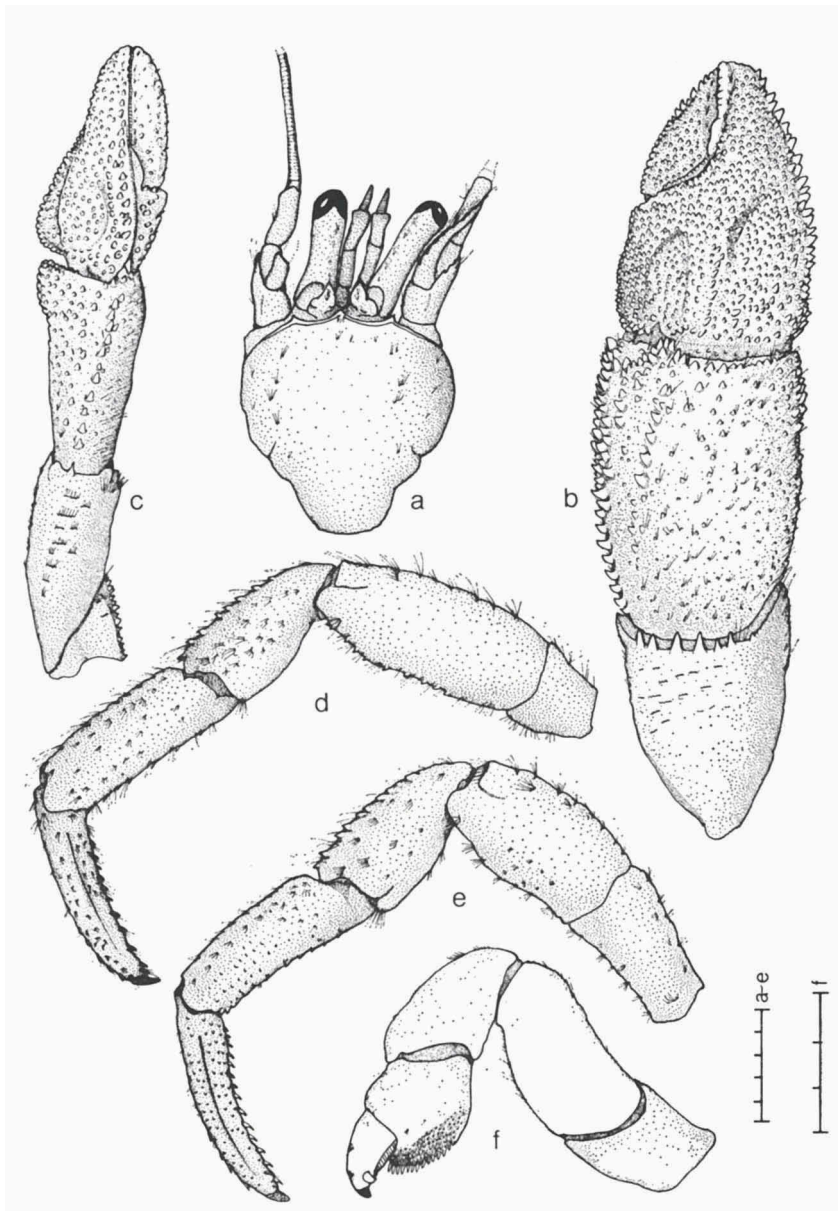


Fig. 64. *Pagurus undosus* (Benedict). a, shield; b, right cheliped (dorsal view); c, left cheliped (dorsal view); d, left P₂ (lateral view); e, left P₃ (lateral view); f, left P₄ (lateral view). Scales equal 5 mm (a-e) and 3 mm (f).

ultimate segments unarmed; basal segment often with slight protuberance or small spine on ventromesial face; dorsodistal margin usually slightly protuberant, dorsolateral margin frequently with low protuberance and tufts of short setae.

Antennal peduncles moderately long, equalling or exceeding ocular peduncles; with supernumerary segmentation. Fifth and fourth segments unarmed, with scattered tufts of short setae. Third segment with ventromesial distal angle produced, terminating in strong spine, partially obscured by tuft of short setae. Second segment with dorsolateral distal angle produced, terminating in prominent simple or bifid spine, lateral margin straight, unarmed, mesial margin angular or expanded, with 1-3 small spinules; dorsomesial distal angle with strong spine and tufts of moderately long setae. First segment with small, simple or bifid, blunt or acute spine at latero-dorsal distal angle; ventromesial distal margin produced, usually with several small spinules laterally. Antennal acicles long, equalling or slightly exceeding ocular peduncles; strongly arcuate, terminating in strong spine, partially obscured by tuft of long setae; mesial margin with low sometimes spinulose protuberances and tufts of long setae; lateral margin unarmed, or rarely with small spinule. Antennal flagella not reaching tip of right cheliped, articles usually with very short setae at irregular intervals.

Mandible without distinctive characters. Maxillule with proximal endite subquadrate; endopodite with 4 bristles on slightly produced internal lobe, external lobe reduced. Maxilla with endopodite broadly inflated basally, not reflexed, equalling scaphognathite in distal extension. First maxilliped with endopodite approximately two-thirds length of exopodite. Second maxilliped without distinctive characters. Third maxilliped with basis-ischium fusion very incomplete; basis with 2 small spines; ischium with well developed crista dentata, 1 or 2 strong accessory teeth; merus with 4-5 small spines on ventral margin, dorsodistal margin usually unarmed. Sternite of mxp_3 usually with 1 prominent, acute spine on each side of midline, occasionally with second small spinule.

Right cheliped with dactyl short, somewhat less than or equalling length of palm; arcuate, depressed distally; cutting edge with strong calcareous teeth; terminating in strong calcareous tooth. Palm strongly inflated dorso-ventrally, dorsal surface convex and medianly elevated, with broad ridge formed in proximal two-thirds by deep depressions mesial and lateral to midline, extending length of fixed finger as broad tuberculate ridge; dorsolateral surface sharply sloping, with closely-spaced spinulose tubercles; dorsolateral margin with single or double row of strong spines; dorsomesial surface and margin with closely-spaced spinulose tubercles; mesial and ventral

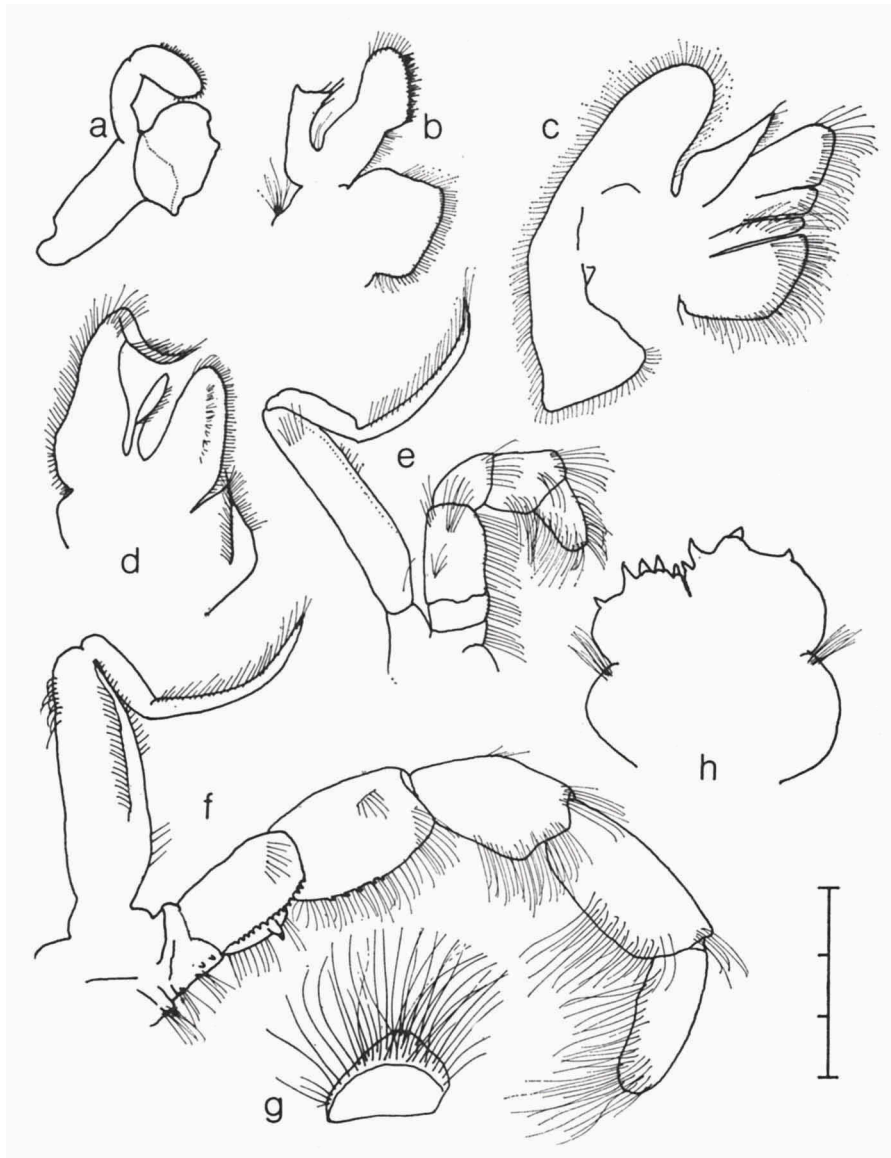


Fig. 65. *Pagurus undosus* (Benedict). a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite, P₃; h, telson. Scale equals 3 mm.

surfaces with spinulose tubercles and tufts of setae. Carpus moderately long, approximately twice length of palm; strongly inflated ventrally, exceeding palm in depth; dorsal surface with moderately strong spines mesially, spinulose tubercles laterally, distal margin spinose or denticulate; dorsolateral margin with small spines, lateral face with low spinulose tubercles or small spines and tufts of long setae, distal margin with strong spines; dorsomesial margin with irregular row of moderately short spines, mesial face with low spinulose tubercles or small spines, distal margin with small spines; ventral surface somewhat spinulose, with tufts of moderately long setae. Merus triangular; short, approximately one-half length of carpus; distal margin with several strong spines; dorsal surface with transverse rows of small denticles distally; lateral and mesial surfaces with simple or multifid spinules and few tufts of setae; ventral surface somewhat spinulose, with tufts of long setae, margins with simple or bifid spines. Ischium with row of small spinules on ventromesial margin, 2 low tubercles near ventrolateral margin. Coxa with row of minute denticles near proximal ventromesial margin.

Left cheliped reaching approximately to base of dactyl of right. Dactyl moderately long, exceeding palm by approximately one-half its own length, broad; dorsally flattened; cutting edge with fine corneous teeth; terminating in small corneous claw; dorsal surface with row of very small spinules proximally, dorsomesial margin with low, blunt widely spaced spinules and few tufts of setae; mesial and ventral surfaces with tufts of stiff bristles. Palm moderately long, approximately one-half length of carpus, subtriangular; dorsolateral margin expanded, with row of small blunt spines, surface generally convex, raised obliquely to strong keel mesiad of midline; dorsal surface with closely-spaced, small blunt or spinulose tubercles, keel with row of strong spines extending onto fixed finger; mesial and ventral surfaces with low, simple or bifid spinulose tubercles and tufts of short setae and bristles. Carpus slightly longer than merus, subtriangular, distally somewhat broadened; dorsal surface somewhat flattened, with 2 rows of moderately strong forward-directed spines and tufts of long fine setae; lateral face with closely-spaced spinulose tubercles or small spines clustered at lateroventral distal angle, margin spinulose; mesial face with few, scattered spinulose tubercles and tufts of long setae; ventral surface with few, low spinulose tubercles and dense tufts of long setae. Merus triangular; dorso-distal margin with 1 or 2 prominent spines, dorsal surface with transverse spinulose ridges and tufts of short setae; lateral face minutely spinulose; mesial face with few, scattered spinulose tubercles and tufts of setae; ventral margins each with 1 or 2 rows of spinulose tubercles, becoming small spines distally. Ischium with row of closely-spaced small spines on ventro-

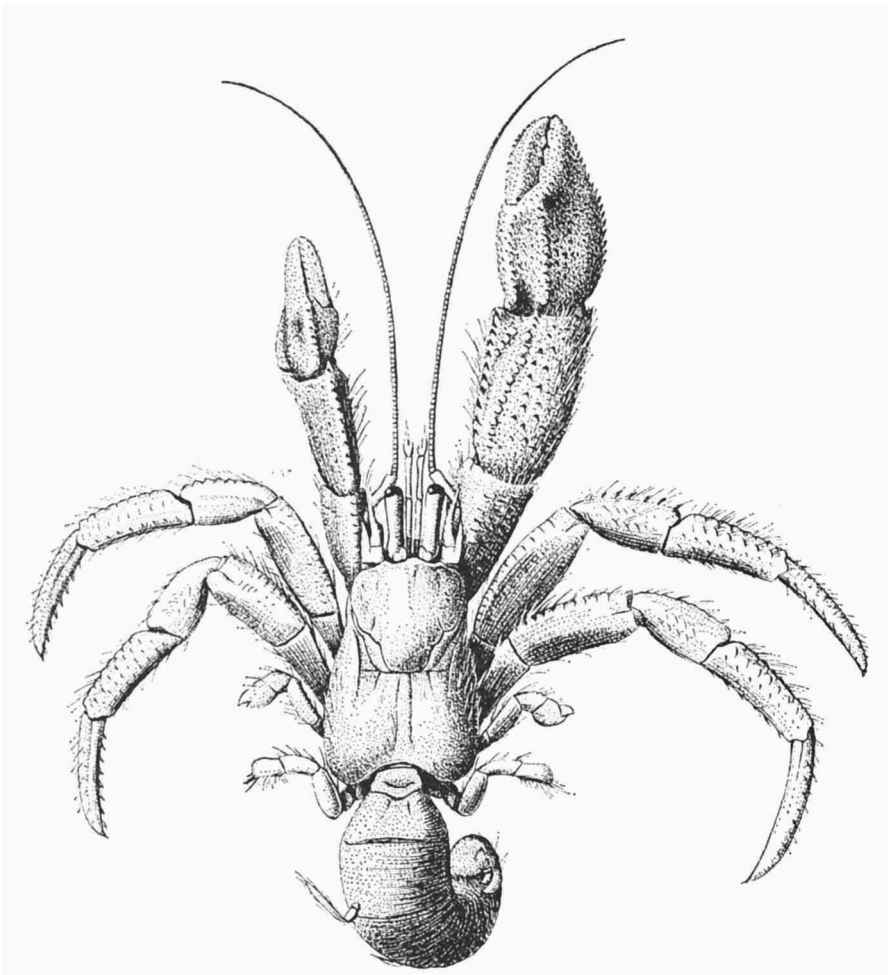


Fig. 66. *Pagurus undosus* (Benedict). Original illustration of J. E. Benedict.

mesial margin; proximal ventrolateral margin with spinulose or denticulate protuberance. Coxa with row of minute denticles on ventrolateral margin proximally and tufts of short or long setae.

Second pereiopods with dactyl equalling or slightly exceeding length of propodus, somewhat laterally compressed, moderately deep; in lateral view, curved slightly ventrally; in dorsal view, very slightly twisted; terminating in strong corneous claw; dorsal margin with 1 or 2 rows of corneous spines and tufts of short setae; mesial face with faint longitudinal sulcus flanked above with 2 or 3 rows of corneous spines and below with 1 row; ventral margin with row of strong corneous spines, increasing in size distally;

lateral face with faint longitudinal sulcus and irregular rows of tufts of short setae. Propodus somewhat longer than carpus, moderately compressed laterally; dorsal surface usually with 2 irregular rows of corneous-tipped spinules and tufts of long setae; mesial face with 2 irregular rows of tufts of long setae; lateral face with low protuberances and tufts of short setae; ventral surface with row of small spines, increasing in size distally. Carpus moderately long, approximately two-thirds length of merus; dorsal surface with row of strong spines; lateral face weakly tuberculate, often with shallow longitudinal sulcus and scattered tufts of short setae, sometimes with small spine at dorsolateral distal angle; mesial and ventral surfaces with scattered tufts of short setae. Merus laterally compressed; dorsal surface with double row of low spinulose protuberances and tufts of moderately long setae; lateral face minutely spinulose; mesial face with few, low spinulose protuberances ventrally; ventral margin with row of spines and tufts of long setae. Ischium with minute spinules and tufts of long setae on dorsal margin; ventral margin with few spinules obscured by tufts of long setae. Coxa with cluster of spinules at ventrolateral proximal angle, ventromesial margin with tufts of long setae.

Third pereopods with dactyl exceeding propodus by approximately one-third its own length; in lateral view, slightly curved ventrally; in dorsal view, slightly twisted; terminating in small corneous claw; dorsal margin usually with 1 or 2 irregular rows of small corneous spines and tufts of short setae; mesial face with faint longitudinal sulcus flanked by 2 irregular rows of small spinules; ventral margin with row of strong, corneous spines, increasing in size distally. Propodus exceeding carpus in length; dorsal surface with low spinulose protuberances and tufts of short setae; lateral face often with 1 or 2 irregular rows of small spinules and rows of tufts of short setae; ventral surface with row, occasionally double, of strong corneous spines and few tufts of short setae. Carpus slightly shorter than merus; dorsal surface with row of moderately strong spines and tufts of long setae; lateral and ventral surfaces with scattered tufts of short setae. Merus laterally compressed; dorsal surface with 2 irregular rows of low protuberances and tufts of long setae; mesial, lateral, and ventral surfaces with scattered tufts of short setae. Ischium long, only slightly shorter than merus; dorsal surface somewhat spinulose, with tufts of long setae; lateral face sometimes with row of spinules dorsally and tufts of moderately long setae; ventral margin with tufts of long setae. Coxa with row of long setae on ventrodiscal margin.

Sternite of third pereopods narrow, subtriangular or subsemicircular, margin with long setae.

Fourth pereopod with preungual process on ventrolateral margin at base of claw; propodal rasp well developed.

Fifth pereopods typical.

Pleopods of male unpaired, pl_3-pl_5 , with exopodites well developed, margins with fine setae; endopodites reduced. Pleopods of females unpaired, pl_2-pl_4 , with both rami well developed; pl_5 with exopodite well developed, endopodite reduced.

Telson with posterior lobes asymmetrical, left lobe frequently considerably larger than right; separated by deep, narrow median cleft; right terminal margin with 3 or 4 corneous spines; left terminal margin with 3-5 strong, corneous spines; anterior lobes unarmed.

Coloration. — Living color unknown. In preservative: Chelipeds pale reddish-orange with spines of carpus and distal margin of merus darker; second and third pereopods with moderately wide bands of reddish-orange at distal ends of each segment. Ocular peduncles with dark, often maroon band at base of cornea.

Distribution. — Bering Sea (Rathbun, Makarov, Vinogradov); Chaplina region (Makarov, Vinogradov); Olyntorskiy Zaliv (Vinogradov, Filatova & Barsanova), Komandorskiye Ostrova, Okhotsk Sea (Kobjakova, Vinogradov); Mys Lopatka, Mys Khayryuzovy (Vinogradov); Shikotan-Tō, Kuril Is. (Kobjakova); Sakhalin, Aniva Zaliv (Kobjakova); Sea of Japan (Soviet coast) (Kobjakova, Makarov); Aleutian Is. and Pribilof Is. (Rathbun, Makarov); Chukchi Sea; 18 to 64 m. This record of *Pagurus undosus* from the Chukchi Sea (69°16'N) is a northern extension of the range of this species.

Affinities. — Among the species assigned to the "*trigonocheirus*" group *P. undosus* is distinguishable by the sculptured appearance of the right chela. In fact, this character distinguishes the species from all other north-western North American species. The affinity of *P. undosus* to the "*trigonocheirus*" group is exhibited in the characters of the mouthparts and configuration of the telson. However, the form of the left chela and the superficial similarity of the depressions on the dorsal surface of the right chela suggest a relationship to the species of the "*confragosus*" group, *P. confragosus*, *P. tanneri* and *P. cornutus*. As the concept of species-groups in *Pagurus* is still in a formative stage, the assignment of *P. undosus* is tentative.

Discussion. — Balss (1913) described as a new variety, *Eupagurus trigonocheirus* var. *paulensis*, which he distinguished from the typical form, particularly by the character of the palm. Although his description was quite brief, his illustrations (Balss, 1913, figs. 38, 39) clearly show that this form should be referred to *Pagurus undosus*. Urita (1942) listed, without descrip-

tion, both *Eupagurus undosus* and *E. cornutus*; however, apparently the only specimens he examined were those he referred to *E. cornutus*. His inclusion of *E. trigonocheirus* var. *paulensis* as a synonym of *E. cornutus* suggests his erroneous interpretation of this species.

Pagurus brandti (Benedict) (figs. 67-69)

Eupagurus (Trigonocheirus) brandti Benedict, 1892: 9 (in part; by implication; type locality: Aleutian Islands, here restricted by lectotype selection to north of Unimak Island, Alaska, "Albatross" station 3258; see *Pagurus trigonocheirus*).

Pagurus (Trigonocheirus) Brandti: Holmes, 1900: 139 (in part; by implication; misspelling of *Trigonocheirus* Benedict, Holmes, 1900: 134; see *Pagurus trigonocheirus*).

Pagurus brandti: Rathbun, 1904: 157 (in part), ? pl. 4 fig. 4. — Rathbun, 1910: 157 (in part), ? pl. 4 fig. 4. — Williamson, 1915: 472 (in part). — Gordan, 1956: 327 (in part). See discussion.

Eupagurus brandti: Alcock, 1905: 179 (in part). — Hansen, 1908: 28. — Balss, 1913: 64. — Selbie, 1921: 32. See discussion.

Pagurus pubescens: Makarov, 1937: 55 (in part). — Makarov, 1938a: 417 (in part). — Makarov, 1938b: 208 (in part). — Gordan, 1956: 334 (in part). — Makarov, 1962: 199 (in part). See discussion.

Pagurus trigonocheirus: McLaughlin, 1963: 21. Not *Pagurus trigonocheirus* (Stimpson, 1858); see discussion.

not *Pagurus brandti*: Rathbun, 1899: 555. — Rathbun, 1919: 7A. — McLaughlin, 1963: 21. — Hart, 1971: 1541 (see *Pagurus trigonocheirus*).

? not *Pagurus brandti*: Taylor, 1912: 204 (? = *Pagurus stevensae*).

not *Pagurus brandti*: Stevens, 1925: 285, fig. 7. — Hart, 1940: 93. — Bakus, 1966: 427 (= *Pagurus stevensae*).

not *Eupagurus Brandti*: Sivertsen, 1932: 11 (= *Pagurus trigonocheirus*).

Lectotype, herein selected. — ♂ (SL = 6.8 mm), USNM 16616.

Material examined. — See table 23.

Table 23. *Pagurus brandti* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex				SL (mm)	Collector
				♂	♀	♂♀	♀♂		
<i>Chukchi Sea</i>									
66°55.2'N, 164°20'W	---	4 USNM	8/8/59	1				3.2	JNC
<i>Bering Sea</i>									
57°00'N, 164°00'W	66	SBL G-7 AHF	29/8/60	1				8.8	USFWS
56°40'N, 164°00'W	79	SBL F-7 RMNH	14/7/61	1				16.6	USFWS
54°48'N, 165°13'30"W	128	Albatross 3258 USNM 16616, 143604	24/6/90	4	2			5.0-9.5	---
Bristol Bay	---	---	summer 59	1				12.6	USFWS

Diagnosis. — Left chela with dorsal surface convex, midline elevated, rounded, with single row of strong spines; dorsolateral margin not expanded proximally. Right cheliped with chela and carpus moderately short and

broad; ventromesial margin with strong spinose protuberances. Rostrum short, obtusely triangular or rounded. Telson with terminal margins strongly spinose, lateral margins rounded.

Description. — Shield length slightly less than width or length equalling

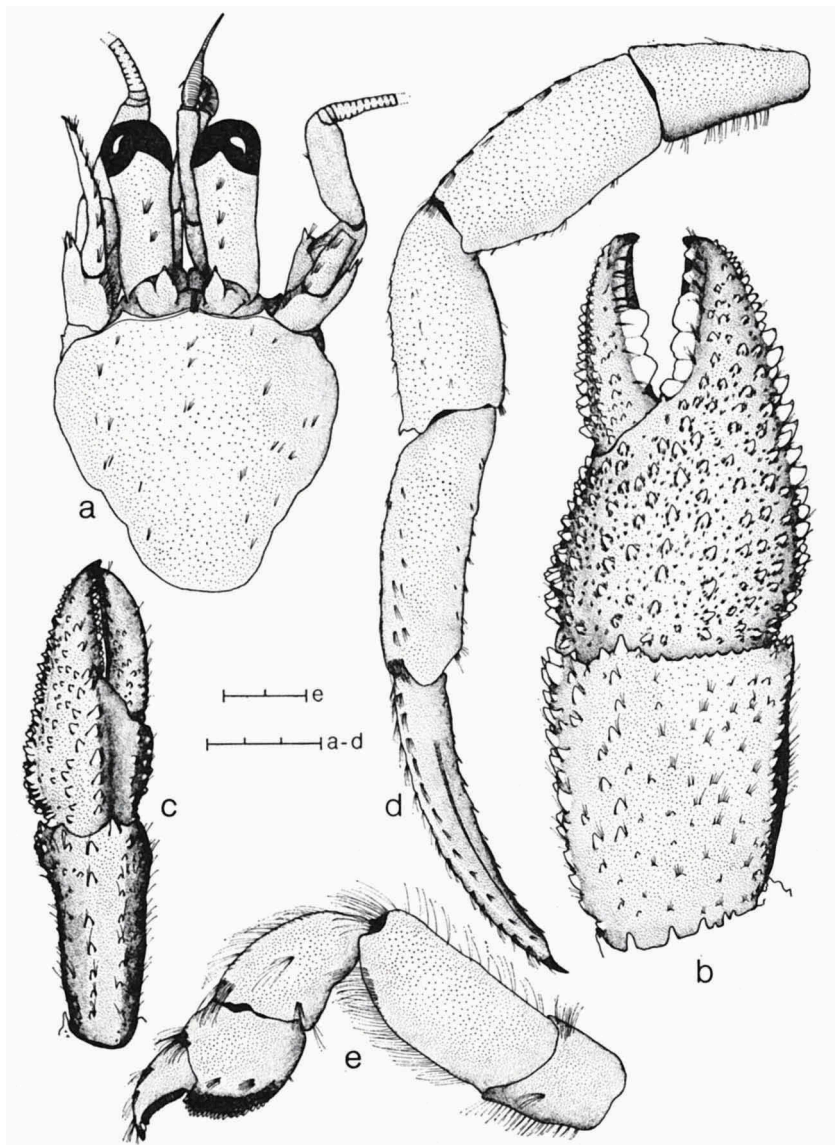


Fig. 67. *Pagurus brandti* (Benedict). a, shield; b, right chela and carpus (dorsal view); c, left chela and carpus (dorsal view); d, left P₃ (lateral view); e, left P₄ (lateral view). Scales equal 3 mm (a-d), and 1 mm (e).

width, rarely, length slightly greater than width; anterolateral margins terraced; anterior margin between rostrum and lateral projections straight or slightly concave; posterior margin rounded or roundly truncate; dorsal surface with scattered tufts of moderately short stiff setae; anterolateral angle produced, spinulose or blunt. Rostrum moderately produced, equalling or slightly exceeding lateral projections; obtusely triangular or broadly rounded, usually unarmed and with terminal tuft of long, stiff setae. Lateral projections strong, obtusely triangular or broadly rounded, with strong marginal or submarginal spine, usually directed to exterior.

Ocular peduncles moderately short, one-half to three-fourths length of shield; moderately stout, occasionally slightly inflated basally, cornea dilated; dorsomesial face with longitudinal row of tufts of short setae. Ocular acicles subtriangular, moderately slender, mesial margin slightly expanded, often with row of short setae, lateral margin straight or slightly expanded; terminating acutely or subacutely, with moderately strong submarginal spine; separated basally by three-fourths to slightly more than entire basal width of one acicle.

Antennular peduncles moderately short, exceeding ocular peduncles by one-third to one-half length of ultimate segment. Ultimate and penultimate segments unarmed, with occasional tuft of short setae; basal segment usually with small spinule at ventromesial distal angle.

Antennal peduncles moderately short, equalling or slightly exceeding length of ocular peduncles; with supernumerary segmentation. Fifth segment unarmed or with small spinule on ventral margin obscured by tuft of short setae. Fourth segment unarmed, with few tufts of short setae. Third segment with strong spine at ventromesial distal angle, partially obscured by tuft of long setae. Second segment with dorsolateral distal angle produced, terminating in strong simple or bifid spine, mesial margin inflated, unarmed or with 1 or 2 small spines or spinules, lateral margin straight with few tufts of moderately long setae; dorsomesial distal angle with small acute spine, mesial margin with tufts of long setae. First segment with small spine on lateral face distally; ventrodiscal margin produced, unarmed or with few small spinules laterally. Antennal acicles moderately long, often reaching distal third of ultimate peduncular segment; terminating in strong, usually acute spine; arcuate; mesial margin usually spinulose, with tufts of long setae. Antennal flagella long, overreaching tip of right cheliped; articles usually naked.

Mandible without distinctive characters. Maxillule with proximal endite slightly tapering; endopodite with 2 or 3 bristles on slightly produced internal lobe, external lobe moderately well developed, not recurved. Maxilla with

endopodite inflated basally, not reflexed, usually equalling scaphognathite in distal extension. First maxilliped with endopodite long, approximately three-fourths length of exopodite; basal segment of exopodite moderately slender. Second maxilliped without distinguishing characters. Third maxilliped with

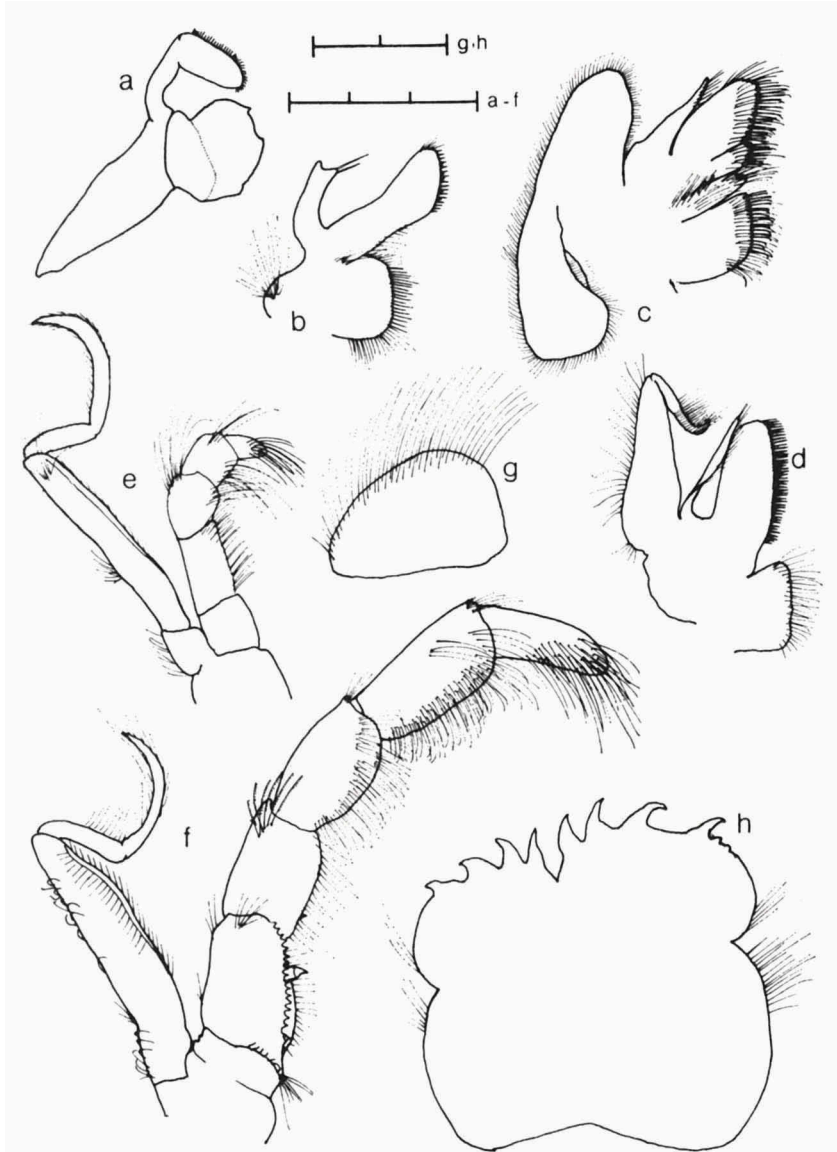


Fig. 68. *Pagurus brandti* (Benedict). a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite P₃; h, telson. Scales equal 3 mm (a-f) and 1 mm (g, h).

basis-ischium fusion incomplete; basis unarmed or with 1 or 2 small spines; ischium with crista dentata well developed, 1 accessory tooth; merus with small spine at dorsodistal margin, ventral margin unarmed or with 1 or 2 small spines or spinules. Sternite of mxp_3 with prominent spine on each side of midline, margin with few long setae.

Right cheliped usually broad and short in small specimens, more elongate in larger specimens. Dactyl moderately short, equalling or slightly exceeding length of palm; cutting edge with few, prominent calcareous teeth proximally, row of small corneous teeth distally; terminating in small calcareous or corneous tooth; slightly overlapped by fixed finger; dorsomesial margin with single or double row of prominent short spines, decreasing in size distally, dorsal surface with scattered, short conical spines or spinulose tubercles proximally, single row of small, conical, acute or subacute spines or spinulose tubercles distally and few tufts of short setae; mesial and ventral surfaces with few tufts of short setae or bristles. Palm two-thirds to four-fifths length of carpus, dorsal surface very convex, with irregular rows of short, prominent frequently corneous-tipped spines encircled by circlets of very short, stiff setae, dorsomesial margin with double or triple row of moderately short, conical often corneous-tipped spines and tufts of stiff setae, dorsolateral margin with row of strong, simple or bifid often corneous-tipped spines, decreasing in size on fixed finger and few tufts of setae; mesial face with irregular rows of simple or bidenticulate usually spinulose tubercles; ventral surface with scattered, low, occasionally spinulose, tubercles and tufts of long, fine setae; lateral face somewhat tuberculate, with tufts of moderately long setae. Carpus moderately short, equalling or slightly exceeding length of merus, increasing in breadth distally; dorsomesial margin with single or double row of moderately strong, slender usually corneous-tipped spines clustered at distal angle, dorsal surface with irregular row of moderately prominent spines mesially, and scattered small spines or tubercles and tufts of setae, distal margin slightly produced mesially with 2 or 3 strong spines, laterally margin spinulose, dorsolateral margin with row of small acute or subacute spines and tufts of short setae; lateral face tuberculate or spinulose, distal margin with row of moderately strong conical spines, ventrolateral margin with row of small spines or spinulose tubercles and tufts of moderately short setae; mesial face with scattered, low frequently spinulose tubercles and tufts of long setae, distal margin tuberculate or spinulose, ventromesial margin with 1 or 2 rows of small spines or spinulose tubercles; ventral surface tuberculate or spinulose, with tufts of long setae. Merus short, subtriangular; dorsal surface with irregular, transverse spinulose ridges, increasing in magnitude distally and extending onto lateral face

dorsally, and tufts of short, stiff setae, distal margin with 3-6 long, slender usually acute spines, extending onto laterodistal margin; lateral face spinulose, becoming tuberculate ventrally, ventrolateral margin with row of moderately strong spines; ventral surface protuberant near ventromesial distal angle, with cluster of small spines; ventromesial margin with 1 or 2 rows of small spines and tufts of long setae, mesial face with irregular vertical row of long

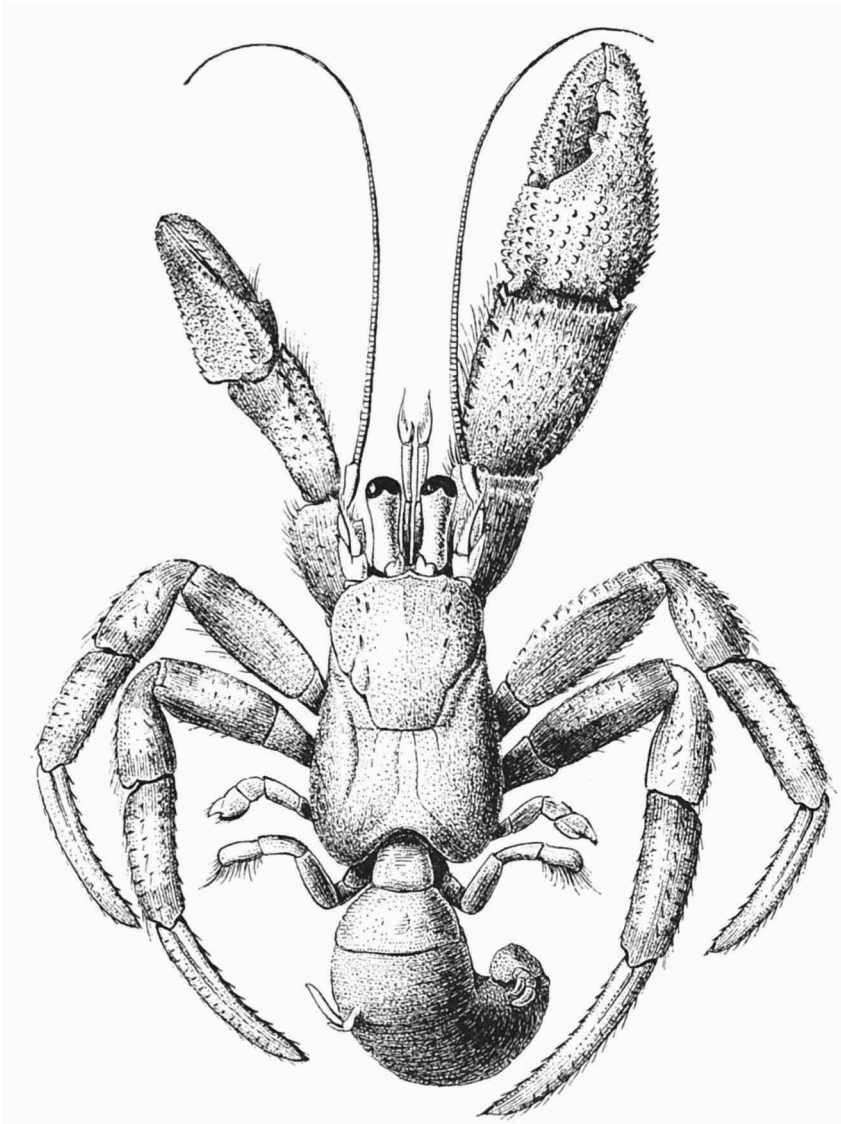


Fig. 69. *Pagurus brandti* (Benedict). Original illustration of J. E. Benedict.

setae distally. Ischium with row of small spines or spinules on ventromesial margin, ventrolateral distal margin with few small spinules obscured by tufts of long setae. Coxa with few small spinules on ventrolateral margin proximally and tufts of long setae, distal angle denticulate, ventromesial margin with clump of long setae.

Left cheliped moderately long often reaching to base of dactyl of right; moderately slender. Dactyl long, approximately one and one-half times length of palm; slightly depressed distally; cutting edge with row of small corneous teeth; terminating in small corneous claw; overlapped and overreached by fixed finger; dorsomesial margin with row of widely-spaced small spinules proximally, dorsal surface with numerous small spinules proximally, occasionally in 2 irregular rows and tufts of moderately short setae. Palm with dorsolateral margin not expanded, with single or double row of small spines decreasing in size on fixed finger distally, dorsolateral surface oblique, with few small spines and 1 irregular row of stronger spines dorsally, midline elevated with row of strong acute or subacute spines extending onto fixed finger proximally, dorsomesial surface sloping sharply, usually unarmed, dorsomesial margin with row of small subacute spines or spinulose tubercles and tufts of setae; mesial face with irregular row of small spines or spinulose tubercles; ventral surface with irregular rows of low usually spinulose protuberances and tufts of long setae. Carpus moderately long, slightly less than or equalling length of merus; dorsal surface flattened, margins each with row of prominent spines strongest laterally and tufts of long setae, distal margin with 1 or 2 prominent acute or subacute spines; lateral face with small frequently bidenticulate tubercles or spines and tufts of stiff setae, distal margin with few small spines dorsally, ventrodistal angle produced with cluster of small spines, ventrolateral margin unarmed or occasionally with few small spinulose tubercles and tufts of long setae; mesial face with low spinulose protuberances or small tubercles and tufts of long setae, distal margin with few small tubercles ventrally, ventromesial margin with row of small tubercles and tufts of long setae, or less frequently unarmed; ventral surface unarmed or with scattered, low protuberances and tufts of very long setae. Merus slightly compressed laterally; dorsal surface with 1 or 2 irregular rows of low protuberances and tufts of moderately short setae, distal margin unarmed or occasionally with 1 or 2 small spines; lateral face spinulose, ventrolateral margin with irregular row of small spines, increasing in size distally; mesial face usually unarmed, with few tufts of setae, ventromesial margin with row of small spines, increasing in size distally; ventral surface with scattered small spinules or tubercles and tufts of long setae. Ischium with row of small spinules or denticles on ventromesial margin. Coxa usually

with row of minute denticles on ventrolateral margin proximally, ventromesial distal angle with clump of long, stiff setae.

Second pereopods moderately long, equalling or slightly overreaching tip of right cheliped; slightly dissimilar from left to right. Dactyl one-fourth to one-third longer than propodus; in lateral view, slightly curved ventrally; in dorsal view, straight or slightly twisted; terminating in strong corneous claw; dorsal surface with 2 irregular rows of stiff setae, increasing in length distally; mesial face with longitudinal sulcus proximally, flanked by 1 or 2 irregular rows of corneous spinules, increasing in size distally; ventral margin with row of strong corneous spines; lateral face with weak longitudinal sulcus proximally and scattered tufts of short setae (right pereopod) and small, scattered spinulose tubercles or spinules in proximal half (left pereopod). Propodus moderately long, exceeding length of carpus by one-fourth to one-third; dorsal surface with 2 rows of low protuberances and tufts of stiff setae; lateral and mesial faces with few tufts of short setae; ventral surface with single or double, irregular row of small corneous spinules, distal margin with 2 or 3 corneous spines. Carpus two-thirds to three-fourths length of merus; dorsal surface with row of small often corneous-tipped spines, increasing in size distally; lateral face with 2 or 3 irregular rows of tufts of short setae; mesial and ventral surfaces with few tufts of short setae. Merus laterally compressed; dorsal surface with 2 irregular rows of stiff bristles or corneous spinules; lateral and mesial faces with few tufts of short setae; ventral margin with 1 or 2 rows of small spines or spinulose tubercles, occasionally only with 1 or 2 rows of stiff bristles. Ischium with rows of stiff setae on dorsal and ventral margins, occasionally ventral margin also with row of small spinules or denticles. Coxa with long marginal setae.

Third pereopods approximately equalling length of second; usually dissimilar from left to right. Dactyl one-fourth to one-third longer than propodus; in lateral view, curved ventrally; in dorsal view straight or more frequently slightly twisted; terminating in strong corneous claw; dorsal surface with 2 irregular rows of stiff bristles, increasing in length distally; mesial face with longitudinal sulcus flanked by 1 or 2 rows of corneous spinules and few tufts of short setae; ventral margin with row of strong corneous spines and tufts of setae; lateral face with weak longitudinal sulcus and tufts of short setae (right) or with irregular row of small spinules or tubercles ventrally and less frequently also dorsally (left). Propodus equalling or slightly exceeding length of carpus; dorsal surface with 2 rows of moderately short stiff setae; lateral face with tufts of short setae (right) or frequently with scattered small spines or spinulose tubercles (left); mesial face

with tufts of short setae; ventral surface with row of small corneous spines and tufts of short setae. Carpus two-thirds to three-fourths length of merus or rarely equalling length of merus; dorsal margin with row of small spines or spinulose tubercles, 1 prominent spine at distal margin; lateral, mesial and ventral surfaces with tufts of short setae; merus laterally compressed; dorsal surface with single or double row of low protuberances and tufts of stiff setae; lateral and mesial faces occasionally with few tufts of short setae; ventral margin with single or double row of long setae, or occasionally with few very small spinules or tubercles. Ischium with tufts of long setae on dorsal and ventral margins. Coxa with long fine marginal setae.

Fourth pereopods with preungual process on lateral face of dactyl at base of claw; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods subsemicircular, usually slightly skewed; margin with row of long setae.

Pleopods of male unpaired, pl_3 - pl_5 with exopodites well developed, endopodites rudimentary. Pleopods of female unpaired, pl_2 usually with exopodite short, not exceeding length of endopodite; pl_3 - pl_4 with both rami well developed; pl_5 with exopodite moderately well developed, endopodite rudimentary.

Telson with posterior lobes slightly asymmetrical, left larger than right; separated by moderately deep, V-shaped median cleft; right terminal margin with 3-5 strong corneous spines, occasionally few small accessory spinules laterally; left terminal margin with 3-6 strong corneous spines, and usually 1 to several small accessory spinules extending down lateral margin; anterior lobes unarmed, with marginal short setae.

Coloration. — Living color unknown. In preservative: Generally reddish-orange or light orange overall, with ambulatory legs showing darker bands; fading with time to uniform straw-color.

Distribution. — Chukchi Sea to Bering Sea; 60 to 80 meters.

Affinities. — *Pagurus brandti* s.s. is most closely allied to *P. trigonocheirus* and often has been confounded with it. The two species are difficult to separate, particularly larger specimens. The most reliable diagnostic character appears to be that of the left chela. In *P. brandti* the dorsal surface of the palm, although elevated, is not produced into a prominent crest, such as is found in *P. trigonocheirus*. Other characters do help to distinguish the two species, but all are more variable or much more subjective. In small specimens, the strongly expanded dorsolateral margin of the left palm of *P. trigonocheirus* immediately distinguishes this species from specimens of *P. brandti* of comparable size.

P. brandti is also closely allied to *P. dalli* and *P. stevensae*, but the considerably more elongate segments of the right cheliped, even in small specimens, of these latter two species distinguish them from *P. brandti*. In addition, the posterior lobes of the telson of *P. brandti* have the spinose terminal margins relatively level and the lateral margins rounded, in contrast to the posterior lobes of the telson of *P. stevensae*, in which the spinose terminal margins are more frequently oblique and the lateral margins are angular. The moderately narrow, subsemicircular sternite of the third pereopods of *P. brandti* may also be helpful in distinguishing this species from *P. dalli*, in which the sternite is very strongly inflated and subsemiovalate.

Discussion. — The great difficulty experienced by carcinologists in interpreting *P. trigonocheirus*, as discussed under that species, has undoubtedly also been responsible, in part, for the difficulties encountered with *P. brandti*. A reexamination of the type series (USNM 16616, 128948) showed that the great majority of the specimens were *P. trigonocheirus*. In addition, Benedict's (1892: 9) description is applicable to both *P. brandti* and *P. trigonocheirus*. Although the two species are apparently sympatric, *P. trigonocheirus* is much more abundant and it is probable that much of the material identified as *P. brandti* should be referred to *P. trigonocheirus*. Rathbun's (1904, pl. 4 fig. 4; 1910, pl. 4 fig. 4) figure of *P. brandti* cannot be referred, with certainty to either species, so it is questionably included in the synonymy of *P. brandti*.

A paratype of *P. brandti* [sensu lato], which later proved to be *P. trigonocheirus*, was used by McLaughlin (1963) to differentiate specimens of these taxa. Therefore, the names of the specimens in her report should be reversed.

A species occurring in Puget Sound and British Columbia, which closely resembled *P. dalli*, was referred by Stevens (1925) and Hart (1940) to *P. brandti*. Subsequent comparison of the Puget Sound species, *P. brandti* [sensu Stevens], with a paratype of *P. brandti* s.l. showed that these two taxa are distinct (Hart, 1971). Hart described the Puget Sound taxon as *Pagurus stevensae* Hart (1971: 1537), contrasting it with *P. brandti* s.l. and *P. dalli*. My subsequent reexamination of the paratypes of Benedict's *P. brandti* has shown that Hart actually compared *P. stevensae* with a specimen of *P. trigonocheirus*; however, I have also found *P. brandti* s.s. distinct from *P. stevensae*. Taylor (1912) also reported *P. brandti* from British Columbia. His material has not been available for review; however, it is probable that his specimens were *P. stevensae*.

The reports of Alcock (1905), Williamson (1915) and Gordan (1956) were all taken from previous literature, and must be referred, in part, to *P. trigonocheirus* and, in the report of Gordan (1956), also to *P. stevensae*.

Makarov (1938b, 1962) included *P. brandti*, as well as *P. trigonocheirus*, in the synonymy of *P. pubescens* Kröyer. His conclusion regarding *P. brandti* was based on a specimen (USNM 19097) from the National Museum of Natural History. As this specimen was sent to Makarov on a permanent loan, its identity cannot be determined, but it presumably was either *P. brandti* s.s. or *P. trigonocheirus* (also see *P. trigonocheirus*, p. 250).

Pagurus stevensae Hart (figs. 70, 71)

? *Eupagurus kroyeri* Stimpson, 1858: 237 (in part). — Stimpson, 1859a: 43 (in part; type localities: Grand Manan and Massachusetts Bay). — Stimpson, 1862: 89 (in part). See discussion.

? *Pagurus brandti*: Taylor, 1912: 204. Not *Pagurus brandti* (Benedict, 1892); see discussion.

Pagurus brandti: Stevens, 1925: 285, fig. 7. — Hart, 1940: 93. — Gordan, 1956: 327 (in part). — Bakus, 1966: 427. Not *Pagurus brandti* (Benedict, 1892); see discussion.

Pagurus stevensae Hart, 1971: 1537, figs. 17-22 (type locality: Off Malcom Island, British Columbia, 50°07'N 127°03.8'W (Hart, personal communication)).

Holotype. — ♂ (not seen).

Material examined. — See table 24

Table 24. *Pagurus stevensae* Hart Material Examined

Locality	Depth (m)	Station	Date	Sex	SL (mm)	Collector
		Deposition		♂ ⁺ ♀ ♀♀ ♀ ⁺		
<i>Bering Sea</i>						
Akun Bay, Akun I.	---	----	11/9/62	2	4.5-4.9	Fiscus
		AHF				
<i>Gulf of Alaska</i>						
Sanak I.	---	----	28/8/37	2	3.0-3.1	Scheffer
55°48'N, 156°00'W	---	USNM 90696 37R	15/6/61	1	6.4	INPHC
60°10'N, 146°15'W	66	BM 74D RMNH	25/9/62	1	7.4	INPHC
<i>British Columbia</i>						
NW Klashwun Pt.	---	----	9/3/39	1	4.6	Stevens
48°42'N, 123°28'W	---	USNM ----- USNM	7/8/63	1	6.6	Hart
<i>Washington</i>						
Friday Harbor, San Juan I.	---	----	9/23	1	9.2	Stevens
Lopez I.	---	USNM ----- RMNH	----	1	7.4	Hart

Diagnosis. — Left chela with dorsal surface convex, midline elevated, with double row of strong, divergent spines. Right cheliped with carpus very elongate, slender. Telson with terminal margins spinose, usually oblique; lateral margins angular.

Description. — Shield slightly longer than broad or length approximately

equalling width (small specimens); anterolateral margins terraced; anterior margin between rostrum and lateral projections usually concave, occasionally straight; posterior margin truncate or roundly truncate; dorsal surface smooth or slightly rugose anteriorly with scattered tufts of short setae; anterolateral

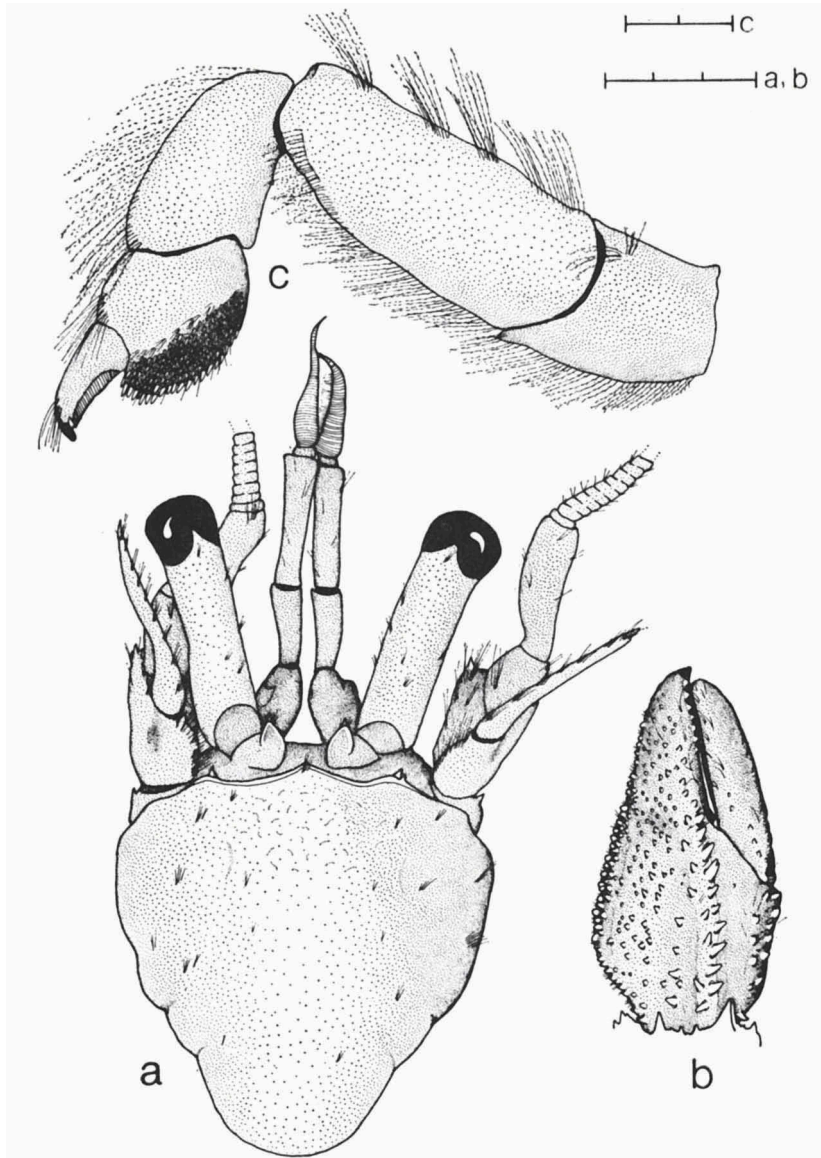


Fig. 70. *Pagurus stevensae* Hart. a, shield; b, left chela (dorsal view); c, left P₄ (lateral view). Scales equal 3 mm (a, b) and 1 mm (c).

angle produced, blunt. Rostrum short, slightly exceeding or less frequently equalling lateral projections; obtusely triangular or broadly rounded, acute or subacute with terminal tuft of short setae. Lateral projections broadly rounded or occasionally obtusely triangular, with moderately strong marginal or submarginal spine, rarely with small accessory spine.

Ocular peduncles long, two-thirds to three-fourths length of shield, cylindrical; slightly inflated basally, corneal region slightly dilated; dorsomesial and, occasionally, dorsolateral faces with longitudinal row of tufts of short setae. Ocular acicles prominent, subovate; mesial margins expanded, lateral margins straight or slightly expanded, dorsal surface slightly concave; terminating in strong, submarginal spine; separated basally by approximately basal width of one acicle.

Antennular peduncles long, exceeding ocular peduncles by one-half to two-thirds length of ultimate segment; ultimate, penultimate and basal segments unarmed, with scattered tufts of short setae.

Antennal peduncles moderately short, equalling or slightly exceeding ocular peduncles, or occasionally reaching only to base of cornea; with supernumerary segmentation. Fifth and fourth segments unarmed, with few scattered tufts of short setae. Third segment with strong spine at ventrodistal margin, partially obscured by long setae. Second segment with dorso-lateral distal angle produced, terminating in simple, bifid or multifid spine, mesial margin expanded, with 1-5 small spines, lateral margin unarmed or occasionally with small spine distally; dorsal surface with few tufts of short setae; dorsomesial distal angle with strong spine, mesial margin with row of long setae. First segment with small spine on lateral face distally; ventromesial distal margin produced, with 1-3 small spines or spinules distolaterally. Antennal acicle long, usually reaching distal fourth of antennal peduncle (large specimens) or reaching only to base of cornea (small specimens); slender, strongly arcuate; terminating in strong spine; mesial margin with row of tufts of long setae. Antennal flagella long, often overreaching right cheliped; with 1 or 2 moderately short setae every second article proximally and every fourth or fifth article distally.

Mandible without distinctive characters. Maxillule with proximal endite tapering; endopodite with 2 or 3 bristles on well developed internal lobe, external lobe strongly produced, not recurved. Maxilla with endopodite inflated basally, not reflexed, equalling scaphognathite in distal extension. First maxilliped with endopodite approximately three-fourths length of exopodite; basal segment of exopodite moderately slender. Second maxilliped without distinctive characters. Third maxilliped with basis-ischium fusion incomplete; basis with 3 or 4 small spines; ischium with crista dentata well

developed, 1 accessory tooth; merus with small spine at dorsodistal margin, ventral margin with 1 or 2 small to moderately strong spines, or occasionally unarmed. Sternite of mxp_3 with 1 small spine on each side of midline, margin with row of long setae.

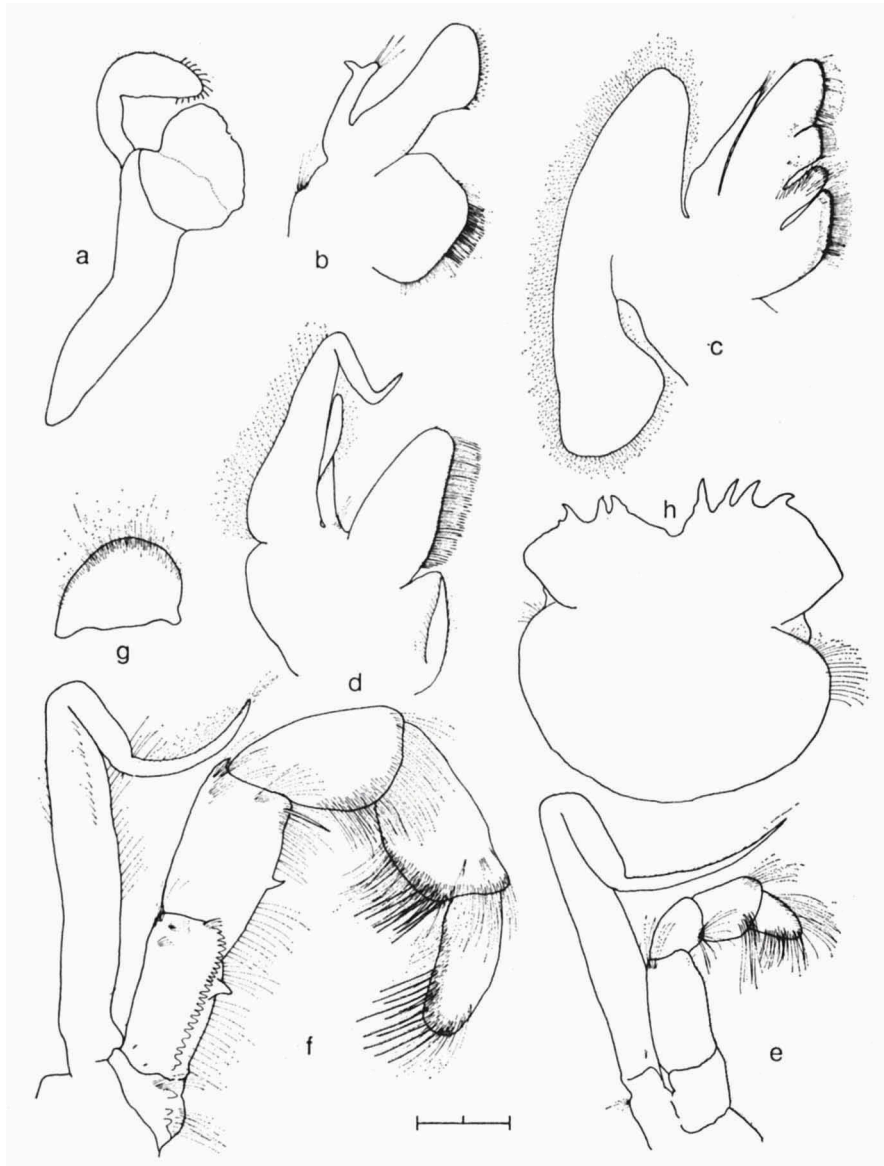


Fig. 71. *Pagurus stevensae* Hart. a-f mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp_1 ; e, mxp_2 ; f, mxp_3 . — g, sternite, P_3 ; h, telson. Scale equals 1 mm.

Right cheliped elongate, moderately slender. Dactyl moderately short, two-thirds to three-fourths length of palm; cutting edge with strong calcareous teeth proximally, small corneous teeth distally; terminating in small corneous claw; slightly overlapped by fixed finger; with narrow longitudinal hiatus; dorsomesial margin with row of moderately small spines and few tufts of setae, dorsal surface with irregular row of moderately small spines in midline, decreasing in size distally and single or double row of widely-spaced small spines near cutting edge; mesial and ventral surfaces with tufts of short setae and bristles. Palm considerably elongate, one-half to two-thirds length of carpus; dorsal surface very slightly convex with prominent, slender inverted V in midline formed by 2 rows of strong spines, laterally and mesially irregular rows of moderately small spines and circlets of short setae, dorsolateral margin with double row of strong, conical, corneous-tipped spines, extending onto fixed finger as single row and increasing in size, dorsomesial margin slightly raised with 3 or 4 irregular rows of short spines, separated from dorsal surface by moderately deep longitudinal groove; mesial face with closely-spaced small spines and tufts of moderately short setae; ventral surface with few simple or bifid, subacute or blunt spines and rows of tufts of short setae; lateral face with rows of multidenticulate or multifid tubercles and tufts of short setae. Carpus considerably elongate, slightly exceeding length of merus, strongly inflated ventrally; dorsolateral margin with row of moderately strong, slender corneous-tipped spines, clustered at distal angle, dorsal surface with simple or bifid small spines and tufts of short setae, distal margin with few moderately strong spines mesially and row of small spines laterally, dorsomesial margin with irregular double row of small spines and tufts of short setae; mesial face spinose dorsally, tuberculate ventrally, distal margin with row of small spines and tufts of short setae; ventral surface with scattered, low spinulose tubercles or small spines and tufts of setae; lateral face spinulose, distal margin with row of slender, moderately strong spines. Merus subtriangular; dorsal surface with short transverse rows of spinulose ridges and tufts of short setae, increasing in size and number distally, distal margin with 3-7 widely-spaced acute spines; lateral face spinulose, with few rows of small spines ventrally; ventrolateral margin usually with row of strong spines and tufts of setae, ventral surface with scattered small spines and tufts of long setae, ventromesial margin with row of small spines; mesial face spinulose with tufts of long setae. Ischium with row of small spinules on ventromesial margin and tufts of long setae; ventrolateral margin often with irregular row of small spinules proximally, becoming clustered distally and partially obscured by long setae. Coxa with irregular single or double row of small spinules proximally, mesial and distal margins with tufts of long setae.

Left cheliped long, often reaching to base of dactyl of right. Dactyl equalling or frequently considerably exceeding length of palm; cutting edge with row of small corneous teeth; terminating in small corneous claw; slightly overlapped by fixed finger; usually with narrow longitudinal hiatus; dorsomesial margin with row of small spines proximally becoming obsolete distally, dorsal surface with 1-3 rows of small spines or spinulose tubercles proximally and tufts of short setae distally; mesial and ventral surfaces with tufts of long setae. Palm moderately long, one-half to two-thirds length of carpus, slender; dorsolateral margin very slightly inflated proximally with single or double row of small spines, decreasing in size on fixed finger, dorsolateral surface obliquely elevated, with irregular rows of moderately small corneous-tipped spines and tufts of short setae, midline with double row of strong divergent corneous-tipped spines, extending onto fixed finger as irregular single row of small spines and becoming obsolete distally, dorsomesial surface with row of small spines and few tufts of setae; mesioventral margin with irregular row of moderately strong spines or spinulose tubercles and tufts of long setae; ventral surface with few irregular rows of low, broad spinulose tubercles and tufts of long setae. Carpus very long, slightly exceeding length of merus; subrectangular; dorsal surface flattened, with few tufts of short setae, margins each with row of moderately strong corneous-tipped spines and tufts of setae, distal margin often with cluster of strong spines; mesial face spinulose, with long setae; ventral surface with low multifid tubercles and long setae; ventrolateral margin with row of broad spinulose tubercles or spines proximally becoming strong spines distally, distal angle produced, spinose, lateral face with simple, bifid or multifid spinulose tubercles or small spines and tufts of short setae. Merus slightly compressed laterally; dorsal surface with 2 rows of spinulose ridges and tufts of short setae, distal margin unarmed or with 1 or 2 acute spines; lateral face with low protuberances or tubercles dorsally, becoming multidenticulate tubercles ventrally and small spines distally; ventral surface with scattered tubercles or small spines and tufts of long setae, ventrolateral margin with small spinulose tubercles proximally becoming strong spines distally, ventromesial margin with single or double row of moderately small spines; mesial face with few small spines or spinulose tubercles and tufts of setae. Ischium with row of small spinules on ventromesial margin; ventroproximal angle with cluster of spinules. Coxa with row of small denticles on ventrolateral margin, ventromesial and distal margins with long setae.

Second pereopods long, frequently overreaching right cheliped; right often longer than left. Dactyl moderately long, equalling or slightly ex-

ceeding length of propodus; in lateral view usually straight, occasionally, very slightly curved ventrally; in dorsal view, straight; terminating in strong, corneous curved claw; dorsal surface with double row of low frequently spinulose protuberances and tufts of long setae; lateral face often with faint longitudinal sulcus flanked by tufts of short setae; ventral margin with row of strong corneous spines, increasing in size distally; mesial face with longitudinal sulcus flanked by row of corneous spines or spinules dorsally and tufts of long setae ventrally. Propodus long, slightly exceeding length of carpus; dorsal surface with transverse often spinulose ridges and tufts of long setae; mesial and lateral faces with rows of tufts of moderately long setae, frequently originating from spinulose ridges; ventral margin with row of corneous spines, increasing in size distally and partially obscured by tufts of long setae. Carpus long, approximately three-fourths length of merus; dorsal margin with row of strong corneous-tipped spines and tufts of long setae; lateral, ventral and mesial faces unarmed, with tufts of short setae. Merus long, laterally compressed; dorsal surface with double row of transverse often spinulose ridges and tufts of setae; lateral and mesial faces with tufts of setae; ventral margin with single or double row of spines or spinulose tubercles proximally, becoming strong spines distally. Ischium with dorsal margin denticulate or spinulose and with long setae; ventral margin with long setae. Coxa with marginal rows of long, fine setae.

Third pereopods long, often overreaching right cheliped, approximately equalling length of second pereopods. Dactyl long, slightly shorter than or equalling length of propodus; in lateral view, usually straight; in dorsal view, straight; terminating in strong, curved corneous claw; dorsal surface with double row of tufts of long setae; lateral face often with weak longitudinal sulcus flanked by tufts of short setae; ventral margin with row of strong corneous spines, increasing in size distally; mesial face with moderately prominent longitudinal sulcus flanked by single or double row of small corneous spines and tufts of setae. Propodus usually slightly longer than carpus; dorsal surface with single or double row of transverse spinulose ridges and tufts of long setae; mesial and lateral faces each with weak longitudinal sulcus flanked by tufts of short setae; ventral margin with single or double row of corneous spines, increasing in size distally and often partially obscured by tufts of setae. Carpus usually slightly less than length of merus; dorsal surface with row of small spines, increasing in size distally and tufts of long setae; mesial and ventral surfaces with few tufts of short setae; lateral face with tufts of setae and frequently with few small spines or spinulose tubercles. Merus laterally compressed; dorsal surface with double row of transverse ridges and tufts of moderately short setae; lateral face

often spinulose and with few tufts of setae; ventral margin with single or double row of tufts of long setae, occasionally with small spine distally; mesial face with few tufts of setae. Ischium with tufts of setae on dorsal and ventral margins. Coxa with marginal long setae.

Fourth pereopods with inconspicuous preungual process on lateral face of dactyl at base of claw; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods large, subsemicircular; margin with row of long setae.

Pleopods of male unpaired, pl_3-pl_5 with exopodites moderately well developed; endopodites reduced. Pleopods of females unpaired, pl_2-pl_4 with both rami well developed; pl_5 with exopodite well developed, endopodite reduced.

Telson with posterior lobes asymmetrical, left considerably larger than right; generally subquadrate; separated by shallow, narrow or moderately broad, median cleft; right terminal margin with 3 or 4 large spines, often with 1 or 2 additional very small spinules; left terminal margin usually with 4 strong spines; lateral margins oblique; anterior lobes unarmed, margins with moderately long setae.

Coloration. — In life: "Shield white with red and tan reticulations; ... Segments of peduncle of antennule with median scarlet bands, flagella with orange base to aesthetes. Peduncle of antenna pale orange with red patches and flagellum reddish translucent. Eyestalk pale orange with red interrupted stripes, cornea with green and yellow surface chromatophores. Maxilliped red with white bands at junctions of segments."

"Chelipeds pinkish-brown with dark red spiny tubercles [spines] and with scattered small red spots, fingers pale pink. Walking legs with ischium white with red reticulations, merus similar but with two lighter patches medially, carpus dark red-brown with lighter patches mediolaterally, propodus with dark red stripe dorsally and one ventrally and an orange stripe midlaterally on light yellow base, dactyl with a red-brown band proximally and thin red or orange stripes, dorsally, ventrally, and midlaterally on light base with interrupted rows of red spots above median stripe."

"Small individuals are usually more brilliant in colouring than large, scarlet and orange being replaced in large specimens by an overall tan. In preserved material the colour is more drab, although the small red spots seem to persist." (Hart, 1971: 1541). In preservative: In time, all color fades and specimens become overall straw-colored.

Distribution. — Bering Sea; British Columbia to Puget Sound, Washington; 26 to 198 meters (Hart). The record of this species from the Bering Sea is a northern extension of the range.

Affinities. — *Pagurus stevensae* appears, at least superficially, most closely allied to *Pagurus dalli* and *P. brandti*. The exceptionally elongate right cheliped of *P. stevensae*, particularly the carpal segment, will distinguish this species from both *P. dalli* and *P. brandti*, as will the apical, double row of divergent spines on the dorsal midline of the left chela. In the latter two species, although the general shape of the left chela is very similar, the elevated midline bears only a single row of strong spines. In life, the white bands on the distal portions of the meri of the second and third pereopods immediately distinguish *P. dalli* from *P. stevensae*.

Discussion. — Stimpson (1859a), who described *Eupagurus kroyeri* from the northeastern coast of North America (see discussion of *P. capillatus*, p. 108), remarked that this species also occurred in Puget Sound [Washington]. *P. stevensae* does bear a closer superficial resemblance to *E. kroyeri* (= *P. pubescens* Kröyer) than do most of the other Puget Sound pagurids, and it is probable that his reference pertains to *P. stevensae*.

Stevens (1925) and subsequently Hart (1940) recorded *P. brandti* from Puget Sound, presumably because of the affinities of this species to *P. dalli* reported by Benedict (1892). Specimens remaining in the Stevens' collection, as well as the specimen (USNM 57583) from Puget Sound identified as *P. brandti* by Stevens, are referable to *P. stevensae*. It is assumed that Taylor (1912) made a similar mistake in reporting *P. brandti* from British Columbia, but his material was not available for reexamination.

P. brandti, which was recorded by Gordan (1956) from the previous literature must be referred in part to *P. stevensae* and to *P. trigonocheirus* as well as to *P. brandti*.

Hart (1971) contrasted *P. stevensae* with *P. brandti* but as she had based her conclusions on a paratype of *P. brandti* s.l., which had been erroneously identified by Benedict and should have been assigned to *P. trigonocheirus*, the differences noted pertain to differences between her new species and *P. trigonocheirus* (see discussions of *P. brandti*, p. 270).

As has been previously mentioned, Hart (1971) followed Makarov's (1938b, 1962) interpretation of the segmentation of the antennal peduncle. References in this description to the fifth and fourth antennal segments are comparable to her fourth and third segments.

P. stevensae has been grouped, for the present, in the "*trigonocheirus*" group on the basis of morphological similarities of the adults. However, preliminary larval studies (Nyblade, personal communication) suggest that this species may be distinct from other species of *Pagurus* for which the larval development is known.

Pagurus dalli (Benedict) (figs. 72-74)

Eupagurus (Trigonocheirus) dalli Benedict, 1892: 9 (by implication; type locality: Alaska, here restricted by lectotype selection to Bristol Bay, 58°23'45"N 157°42'45"W, Albatross station 3233).

Pagurus dalli: Rathbun, 1899: 555. — Rathbun, 1904: 158, pl. 4 fig. 1. — Rathbun, 1910: 158, pl. 4 fig. 1. — Taylor, 1912: 204. — Williamson, 1915: 474. — Stevens, 1925: 287, figs. 8, 9. — Wismer & Swanson, 1935: 342. — Makarov, 1938b: 206, pl. 1 fig. 4. — Hart, 1940: 93. — Reinhard, 1944: 54. — Gordan, 1956: 329. — Reischman, 1959: 410. — Makarov, 1962: 196, pl. 1 fig. 4. — Ricketts, Calvin & Hedgpeth, 1968: 262. — Hart, 1971: 1541.

Pagurus (Trigonocheirus) Dalli: Holmes, 1900: 139 (by implication; misspelling of *Trigonocheirus* Benedict, Holmes, 1900: 134).

Eupagurus dalli: Alcock, 1905: 179. — Hansen, 1908: 28. — Balss, 1913: 64. — Selbie, 1921: 32.

Lectotype, herein selected. — ♂ (SL = 8.1 mm), USNM 17494.

Material examined. — See table 25.

Table 25. *Pagurus dalli* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	♀*		
<i>Bering Sea</i>								
58°23'45"N, 157°42'45"W	13	Albatross 3233 USNM 17494, 128945	2/6/90	6	6	1	4.9-8.1	---
54°49'30"N, 165°02'W	79	Albatross 3262 USNM 16501	24/6/90	29	12		3.5-8.1	---
Walrus I., Pribilof Is.	---	----- RMMH	23/11/65	1	1		9.3-12.6	Fiscus
<i>Gulf of Alaska</i>								
Between Unimak & Shumigan Is.	---	----- USNM	summer 61	1			9.6	INPHC
Greater Kodiak I.	---	----- USNM	summer 61	2			9.8-11.9	INPHC
Off Pt. Fybus, Frederick Sound	---	----- RMMH	18/4/51	2			7.9-11.2	JNC
<i>Washington</i>								
Strait of Juan de Fuca	---	----- USNM, RMMH	9/8/61	2	7		4.1-6.8	Davis
San Juan Is.	---	----- USNM	5/8/57	1			6.9	Hart
San Juan Is.	---	----- USNM	8/61	2	1		4.8-5.1	McLaughlin
San Juan I.	---	----- USNM	8/61	1	1		5.0-5.9	McLaughlin
Friday Harbor, San Juan I.	---	----- USNM	1922	2	4		3.5-5.7	Stevens
Friday Harbor, San Juan I.	---	----- USNM	9/23	1			8.4	Stevens
San Juan Channel	110-190	USNM 57584 ----- BM, CHN	2/8/61	6	4		2.0-6.8	McLaughlin
President Channel	190	----- USNM	2/8/61	7	3		3.2-5.8	McLaughlin
President Channel	190	----- RMMH	10/8/61	3	2		3.4-6.6	McLaughlin
Peavine Pass	---	----- USNM	26/4/52	1			4.5	Illg
Lopez Sound	---	----- AHF	25/5/61	2	2		5.0-6.1	Henry
Lopez Sound	---	----- USNM	10/8/61	1	1		2.6-5.8	McLaughlin
Hood Head, Hood Canal	36	----- USNM	4/4/39	1			4.3	Stevens

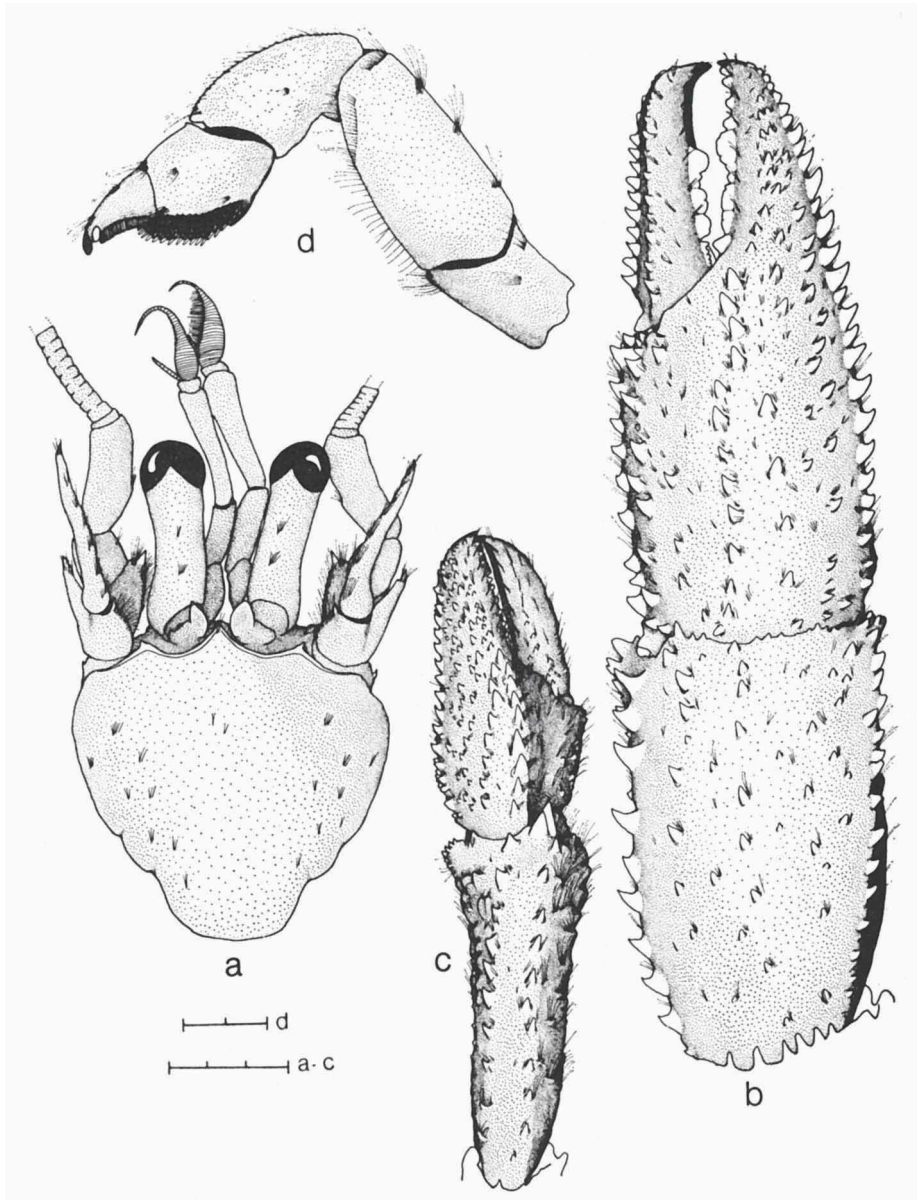


Fig. 72. *Pagurus dalli* (Benedict). a, shield; b, right chela and carpus (dorsal view); c, left chela and carpus (dorsal view); d, left P₄ (lateral view). Scales equal 3 mm (a-c)

and 1 mm (d).

Diagnosis. — Left chela with dorsal surface convex, midline elevated, with single row of strong spines. Right cheliped with chela usually very slender, elongate; ventromesial margin of merus without strong spinose protuberance. Rostrum moderately strong, triangular. Telson with terminal margins strongly spinose, lateral margins rounded.

Description. — Shield usually as broad as long, occasionally slightly longer than broad, or rarely, slightly broader than long; anterolateral margins sloping or slightly terraced; anterior margin between rostrum and lateral projections straight or slightly concave; posterior margin truncate or roundly truncate; dorsal surface with scattered tufts of moderately short setae; anterolateral angle usually with small curved spine. Rostrum moderately long, usually slightly exceeding lateral projections; acutely triangular or occasionally broadly triangular; terminating in small acute spine, and usually with terminal tuft of short setae. Lateral projections obtusely triangular or occasionally broadly rounded, with marginal or submarginal spine occasionally directed toward exterior.

Ocular peduncles moderately short, slightly longer than one-half length of shield; moderately stout; moderately inflated basally, corneal region dilated; dorsomesial and frequently, dorsolateral faces with longitudinal row of tufts of very short setae. Ocular acicles prominent, subovate; mesial margins expanded, lateral margins straight or slightly expanded, dorsal surface slightly concave; terminating subacutely with moderately strong submarginal spine; separated by three-fourths to entire basal width of one acicle.

Antennular peduncles long, exceeding ocular peduncles by one-half to three fourths length of ultimate segment; ultimate and penultimate segments unarmed; basal segment with acute spine at ventromesial distal angle, partially obscured by tuft of short setae, dorsolateral distal angle with strong spine.

Antennal peduncles moderately short, exceeding ocular peduncles by one-fourth to one-half length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments unarmed, with scattered tufts of short setae. Third segment with ventromesial distal angle produced, terminating in strong simple or bifid spine and long setae. Second segment with dorsolateral distal angle produced, terminating in small simple or bifid spine, mesial margin with 1-3 small spines and few short setae, lateral margin usually unarmed; dorsomesial distal angle with moderately small spine, mesial face with long setae. First segment with small spine on lateral face distally; ventral margin produced, usually unarmed. Antennal acicle long, reaching to distal third of ultimate antennal segment; strongly arcuate or rarely only slightly curved; terminating in strong spine; mesial margin with low pro-

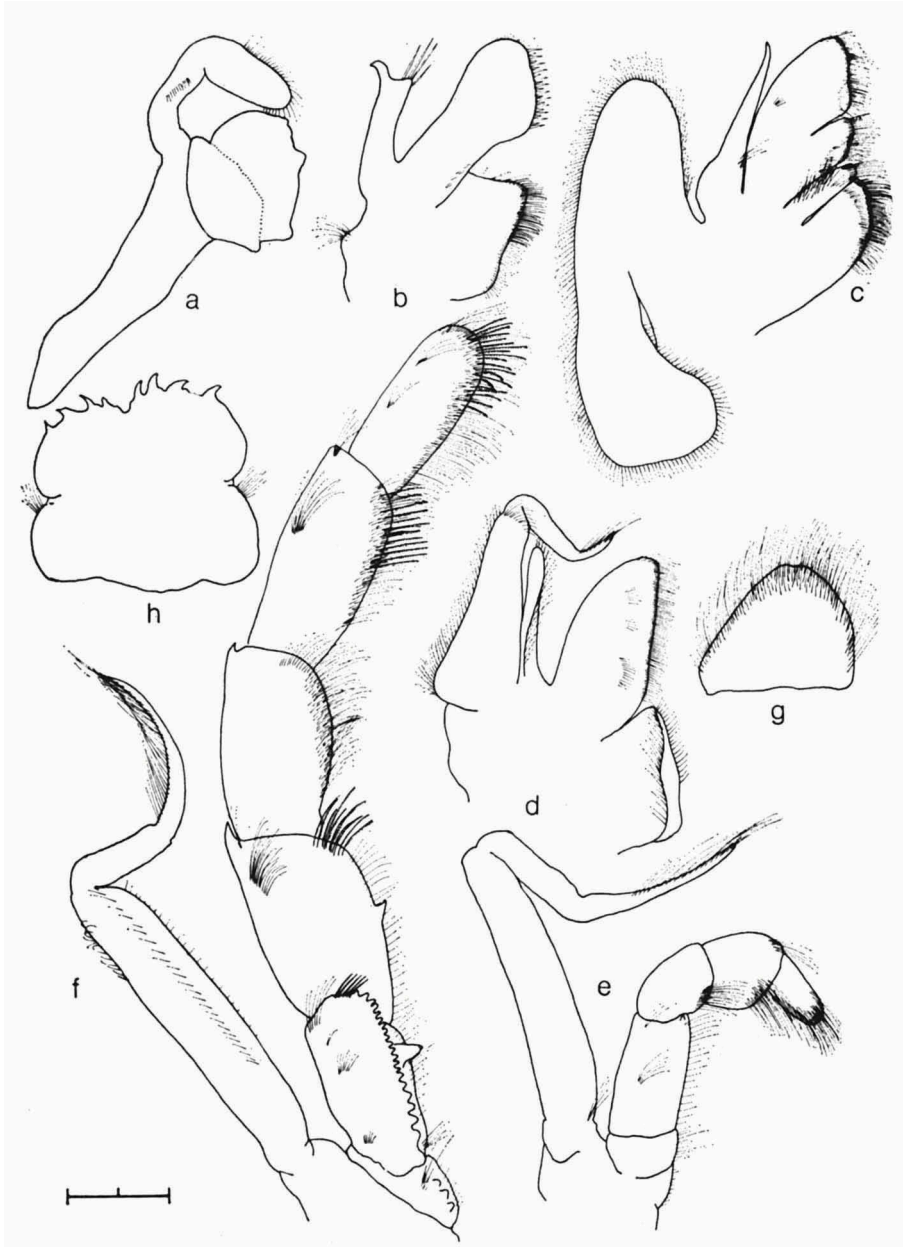


Fig. 73. *Pagurus dalli* (Benedict). a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite, P₃; h, telson. Scale equals 1 mm.

tubercles and tufts of short setae. Antennal flagella long, slightly exceeding tip of right cheliped, with few short setae, randomly set.

Mandible without distinctive characters. Maxillule with proximal endite slightly tapering; endopodite with 3 or 4 bristles on weakly produced internal lobe, external lobe very strongly produced, usually not recurved. Maxilla with endopodite strongly inflated basally, not reflexed, exceeding scaphognathite in distal extension. First maxilliped with endopodite approximately four-fifths length of exopodite; basal segment of exopodite moderately narrow. Second maxilliped without distinguishing characters. Third maxilliped with basis-ischium fusion incomplete; basis with 2-4 small spines; ischium with crista dentata well developed, 1 accessory tooth; merus with strong spine at dorsodistal margin, ventral margin with 1-3 strong spines, or occasionally, unarmed; carpus with spine at dorsodistal margin. Sternite of mxp_3 usually with 1 small spine on each side of midline, margin with long setae.

Right cheliped long, moderately slender. Dactyl moderately short, slightly less than or equalling length of palm; cutting edge with row of strong calcareous teeth proximally, corneous teeth distally, usually terminating in small corneous claw, occasionally in small calcareous tooth; slightly overlapped by fixed finger; with narrow longitudinal hiatus distally; dorsomesial margin with single or double row of strong corneous-tipped spines or occasionally with row of small conical spines, dorsal surface usually slightly elevated with row of moderately small acute spines, decreasing in size distally and few tufts of short setae laterad of midline, occasionally with only few scattered tubercles or small spines; ventral surface with rows of short bristles or setae. Palm elongate, one-half to three-fourths length of carpus, inflated dorsoventrally; dorsolateral margin with row of strong spines, decreasing in size distally on fixed finger and tufts of moderately short setae, dorsal surface slightly convex with two often very irregular rows of strong spines forming an often indistinct inverted V, laterally and mesially with few irregular rows of moderately strong often acute spines and tufts of moderately short setae, dorsomesial margin with single or double row of strong acute or subacute spines; mesial and ventral surface with scattered, low blunt or spinulose tubercles and tufts of short setae; lateral face with tufts of moderately short setae. Carpus equalling or slightly exceeding length of merus; dorsomesial margin with row of prominent, strong acute or subacute spines usually clustered at distal angle, dorsal surface with widely-spaced small spines or spinulose tubercles and tufts of moderately short setae, distal margin with 1-4 moderately strong spines and row of small spines or spinules, dorsolateral margin with row of moderately small acute or subacute spines or spinulose

tubercles and few tufts of setae; lateral surface with scattered multidenticulate protuberances or low tubercles and tufts of short setae, distal margin with single or double row of moderately strong spines; mesial and ventral surfaces with scattered simple or multidenticulate protuberances or spinulose tubercles and tufts of short setae. Merus broadly triangular; dorsal surface

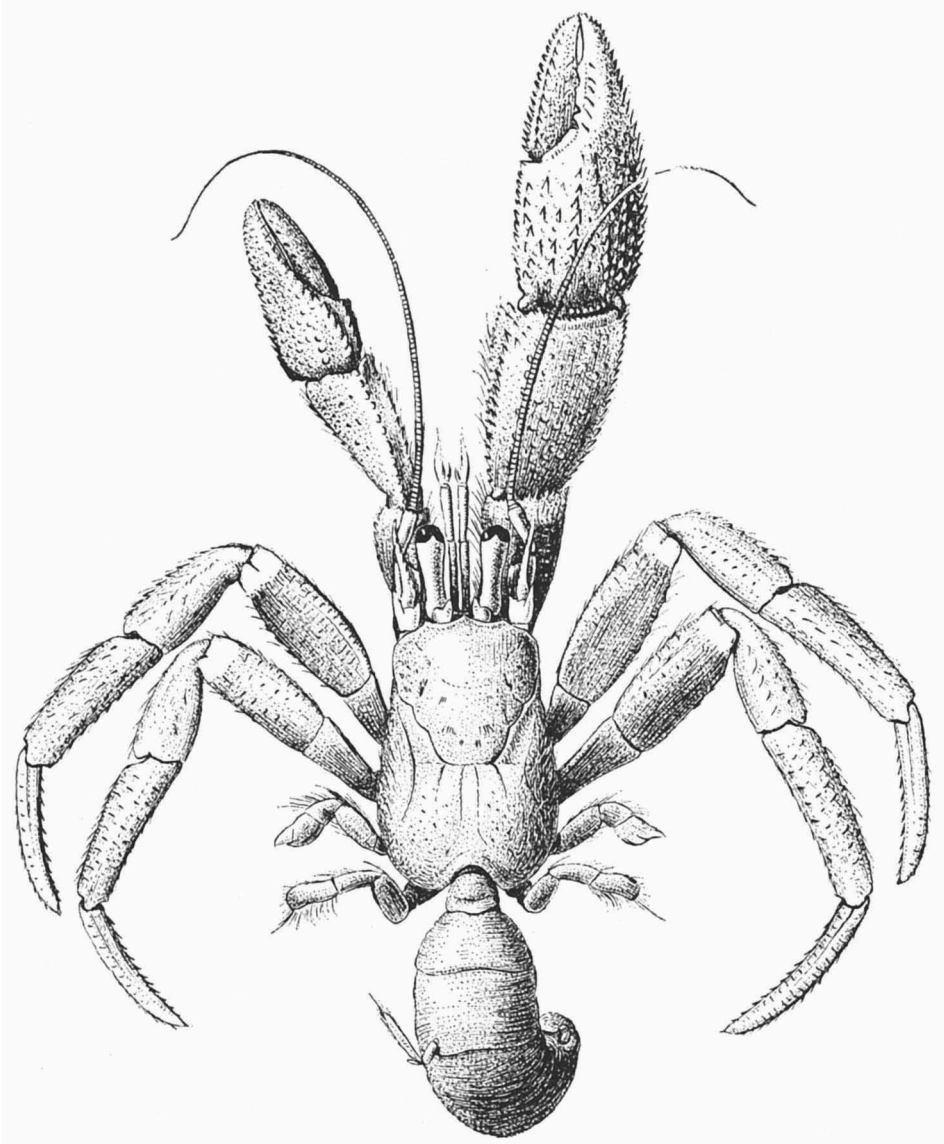


Fig. 74. *Pagurus dalli* (Benedict). Original illustration of J. E. Benedict.

with 1 or 2 irregular rows of small multidenticulate protuberances or ridges and tufts of short setae becoming stronger and more numerous distally, distal margin with several, strong acute or subacute spines and short stiff setae; lateral face granular or with low multifid spinules and tufts of setae, distal margin with row of moderately strong spines; mesial face with few, scattered multidenticulate protuberances or very small spinulose tubercles, frequently becoming small spines ventrally; ventromesial and ventrolateral margins each with row of spinulose tubercles or strong spines, increasing in size distally, ventral surface usually unarmed, with tufts of long setae. Ischium with row of denticles on ventromesial margin; ventrolateral distal angle with cluster of small spinules or blunt tubercles, ventrolateral proximal angle with 1 or 2 low tubercles or protuberances; mesial face often spinulose. Coxa with cluster of minute spinules at ventroproximal angle, ventrolateral margin with row of small spinules and tufts of long setae, distal margin denticulate, with tufts of long setae.

Left cheliped moderately short, frequently not reaching to base of dactyl of right. Dactyl moderately long, one-third to one-half times length of palm, moderately broad; cutting edge with row of small corneous teeth; terminating in small corneous claw; overlapped and usually overreached by fixed finger; dorsal surface with few small spines or tubercles proximally and scattered tufts of moderately short setae, dorsomesial margin with row of small spines or spinulose tubercles proximally and tufts of setae; ventral surface with rows of tufts of stiff bristles. Palm short, approximately one-third length of carpus; dorsolateral margin slightly inflated proximally or generally straight with single or double row of moderately strong acute or subacute spines and few tufts of short setae, dorsolateral surface oblique, with scattered small spines or tubercles and tufts of short setae, 1 irregular row of slightly stronger spines dorsally, midline elevated, rounded with row of strong acute or subacute spines extending onto fixed finger as irregular single or double row of small spines or tubercles, dorsomesial face sloping, often acutely, rarely with few small spines or tubercles and tufts of moderately long setae, dorsomesial margin with irregular short row of small spines or tubercles; mesial face with 1 or 2 irregular rows of small spines or tubercles and tufts of long setae; ventral surface with irregular row of low, frequently multidenticulate protuberances or tubercles and tufts of long setae. Carpus very elongate, slightly exceeding length of merus; dorsal surface flattened, unarmed, with few tufts of short setae, dorsomesial and dorsolateral margins each with row of moderately strong, acute or subacute spines, increasing in size distally, distal margin with 2 or 3 very strong spines, also occasionally denticulate; lateral face with irregular rows of simple

or multidenticulate protuberances or low tubercles or occasionally small spines and short setae, ventrodistal angle produced, spinose, ventrolateral margin with row of small acute or subacute spines or spinulose tubercles and tufts of short setae; mesial face with spinulose protuberances and tufts of long setae, increasing in size and number distally, distal margin frequently spinulose or denticulate; ventral surface with low simple or bifid tubercles and tufts of setae. Merus slightly compressed laterally; dorsal surface with 2 irregular rows of low occasionally spinulose protuberances and tufts of setae, distal margin with 1 or 2 strong spines or with few, small subacute spines; mesial face with low protuberances or tubercles dorsally, becoming prominent usually multidenticulate tubercles ventrally; lateral face granular or spinulose, ventrolateral margin with row of simple or multidenticulate spines, increasing in size distally; ventral surface with irregular rows of frequently multidenticulate tubercles and tufts of long setae. Ischium with row of small denticles on ventromesial margin, ventrolateral margin with small often multidenticulate tubercles and tufts of very short setae. Coxa with row of minute spinules on each ventral margin, ventromesial distal angle with clump of long stiff setae.

Second pereopods equalling or slightly exceeding tip of right cheliped, right usually slightly longer than left. Dactyl equalling or slightly exceeding length of propodus or occasionally slightly shorter than propodus; in lateral view, slightly curved ventrally; in dorsal view, straight; terminating in strong corneous claw; dorsal surface with row of corneous spinules, increasing in size distally and row of tufts of moderately short setae; lateral face with faint longitudinal sulcus flanked by tufts of short setae; mesial face with weak longitudinal sulcus flanked by 1 or 2 rows of stiff bristles or slender corneous spinules; ventral margin with row of strong, corneous spines, increasing in size distally. Propodus one and one-third to one and two-thirds times length of carpus; dorsal and dorsolateral surfaces with low protuberances and tufts of moderately short setae; lateral face frequently slightly spinulose, often with faint longitudinal sulcus; mesial face with 1 or 2 rows of tufts of short setae, often with faint longitudinal sulcus; ventral surface with irregular row of small corneous spines. Carpus one-third to two-thirds length of merus; dorsal margin with row of forward-directed often corneous-tipped spines, increasing in size distally; mesial and ventral surfaces with few tufts of short setae; lateral face with irregular rows of tufts of setae. Merus laterally compressed; dorsal surface with 2 irregular rows of low spinulose or multidenticulate protuberances and tufts of short stiff setae; lateral face spinulose or granular; mesial face rarely with few tufts of short setae; ventral margin with 1 or 2 irregular rows of small spines

or spinules, increasing in size distally, and tufts of setae. Ischium with row of small denticles and tufts of long setae on ventromesial margin; dorsal margin often with row of small spinules and tufts of long setae. Coxa with row of very small denticles on ventrolateral margin, becoming obsolete distally; ventromesial margin with row of widely-spaced minute spinules, partially obscured by row of long setae.

Third pereopods equalling length of second; left occasionally slightly shorter than right. Dactyl slightly exceeding length of propodus; in lateral view, slightly curved ventrally or less frequently straight; in dorsal view, straight or slightly twisted; terminating in strong corneous claw; dorsal surface with 1 or 2 irregular rows of small corneous spinules; mesial face with faint longitudinal sulcus flanked by irregular row of corneous spinules; ventral margin with row of corneous spines, increasing in size distally; lateral face with faint longitudinal sulcus and tufts of short setae. Propodus slightly less than twice length of carpus; dorsal and dorsolateral surfaces with low protuberances and tufts of short setae; lateral and mesial faces with 2 or 3 irregular rows of tufts of short bristles or setae, and occasionally with scattered small spinules or spinulose tubercles (left); ventral margin with row of short corneous spines, 2 or 3 corneous spines at distal margin. Carpus one-half to three-fourths length of merus; dorsal surface with row of acute or subacute spines, increasing in size distally and tufts of moderately short setae; lateral, mesial, and ventral surfaces with scattered tufts of short setae. Merus laterally compressed; dorsal surface with irregular transverse rows of low protuberances and tufts of short or long stiff setae; lateral face and less frequently mesial face with few tufts of short setae; ventral margin usually with 2 rows of very small spinules or spinulose tubercles, increasing in size distally, occasionally unarmed. Ischium with row of minute spinules on dorsal margin; lateral face usually with row of minute spinules dorsally and scattered tufts of moderately long setae; ventral margin with row of long setae. Coxa with row of fine, moderately short setae marginally.

Fourth pereopods with preungual process on lateral face of dactyl; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods prominent, subsemiovate, slightly skewed; anterior margin with long, stiff setae.

Pleopods of male unpaired, pl_3 - pl_5 with exopodites moderately well developed; endopodites rudimentary. Pleopods of female unpaired, pl_2 - pl_4 with both rami moderately well developed; pl_5 with exopodite moderately well developed, endopodite rudimentary.

Telson with posterior lobes very slightly asymmetrical, left slightly larger;

separated by usually shallow, often broad, median cleft; right terminal margin with 3 or 4 moderately strong, widely separated corneous spines; left terminal margin with 3-5 moderately strong, curved corneous spines; anterior lobes unarmed, margins with moderately short setae.

Coloration. — In life: "... overall brown with opaque white bands on the distal part of the meri of the first three pairs of pereopods" (Hart, 1971: 1541). In preservative: Generally brownish-pink, fading in time to straw-colored, with light bands at distal ends of meri of the chelipeds and second and third pereopods.

Distribution. — Bering Sea (parallel of Nunivak Island) southward to Oregon (Rathbun, Makarov, Hart); low water to 276 meters.

Affinities. — *Pagurus dalli* appears (see discussion of *P. stevensae*) most closely allied with *P. stevensae* and *P. brandti* s.s., but may be separated, in life, from both species by the white bands on the distal portions of the meri. It also differs from *P. brandti* in the shape of the right cheliped which in *P. dalli* is much more elongate and slender and in the armature of the dactyls and propodi of the second and third pereopods. The configuration of the carpus of the right cheliped and the armature of the left chela will distinguish this species from *P. stevensae*.

Discussion. — The distinctions made by Benedict (1892: 8, 9) between *P. dalli* and *P. brandti* refer in part to distinction between the former species and *P. brandti* s.s., and in part to differences between *P. dalli* and *P. trigonocheirus* (see discussion of *P. brandti*). Similarly, the distinction between *P. dalli* and *P. pubescens* cited by Makarov (1938b: 208; 1962: 197) refers to the differences between the former species and *P. brandti* s.s. and *P. trigonocheirus*.

***Pagurus townsendi* (Benedict) (figs. 75-77)**

Eupagurus (Trigonocheirus) townsendi Benedict, 1892: 13 (by implication; type locality: Alaska, here restricted by lectotype selection to Bering Sea, 53°56'50"N 167°08'15"W, "Albatross" station 3329).

Pagurus townsendi: Rathbun, 1904: 158, pl. 4 fig. 5. — Rathbun, 1910: 158, fig. 5. — Williamson, 1915: 481. — Gordan, 1956: 336.

Eupagurus townsendi: Alcock, 1905: 179.

Eupagurus (Trigonocheirus) townsendi: Sivertsen, 1932: 9 (by implication; misspelling of *Trigonocheirus* Benedict, Sivertsen, 1932: 9).

Lectotype, herein selected. — ♂ (SL = 12.4 mm), USNM 16668.

Material examined. — See table 26.

Diagnosis. — Left chela with dorsolateral surface markedly concave, midline elevated into prominent crest bearing 1 or 2 rows of strong spines.

Table 26. *Pagurus townsendi* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex				SL (mm)	Collector
				♂	♀	♂♀	♀♂		
<i>Bering Sea</i>									
55°51'N, 169°18'W	673	Albatross 3502	17/7/93	3				9.0-14.2	---
53°56'50"N, 167°08'15"W	730	USNM Albatross 3329	21/8/90	1	1			5.1-12.4	---
53°37'10"N, 167°50'10"W	520	USNM 16668,128941 Albatross 3325 USNM 16669	20/8/90	1	1			6.2-12.9	---

Right cheliped elongate, moderately slender; chela with dorsal surface convex.

Description. — Shield approximately as long as broad or broader than long (small specimens); anterolateral margins strongly terraced; anterior margin between rostrum and lateral projections somewhat concave; posterior margin rounded; dorsal surface generally smooth or slightly pitted, with tufts of short setae; anterolateral angle with small blunt protuberance. Rostrum long, greatly exceeding lateral projections, triangular, acute, often with small terminal spine. Lateral projections acutely or obtusely triangular, with small terminal spine.

Ocular peduncles short, less than one-half shield length; corneal region often strongly dilated; dorsal surface with longitudinal row of short setae. Ocular acicles usually reaching beyond mesial base of ocular peduncles; mesial margins strongly expanded, lateral margins straight or weakly expanded, distal margins with short setae; terminating subacutely, with small marginal or submarginal spine; separated basally by slightly more than basal width of one acicle.

Antennular peduncles long, exceeding ocular peduncles by two-thirds to entire length of ultimate segment; ultimate and penultimate segments unarmed, with few scattered tufts of fine setae; basal segment with moderately prominent protuberance and tuft of short bristles on dorsolateral margin, usually with small protuberance on dorsomesial margin proximally.

Antennal peduncles moderately long, exceeding ocular peduncles by approximately two-thirds length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments unarmed, with few tufts of short setae on ventral margins. Third segment with ventromesial distal angle produced, terminating in strong acute spine, partially obscured by tuft of short setae. Second segment with dorsolateral distal angle produced, terminating in strong simple or bifid spine, lateral margin straight, mesial margin angular or expanded, with 2 or 3 spines; dorsomesial distal angle with strong spine and tufts of short setae. First segment with small spine

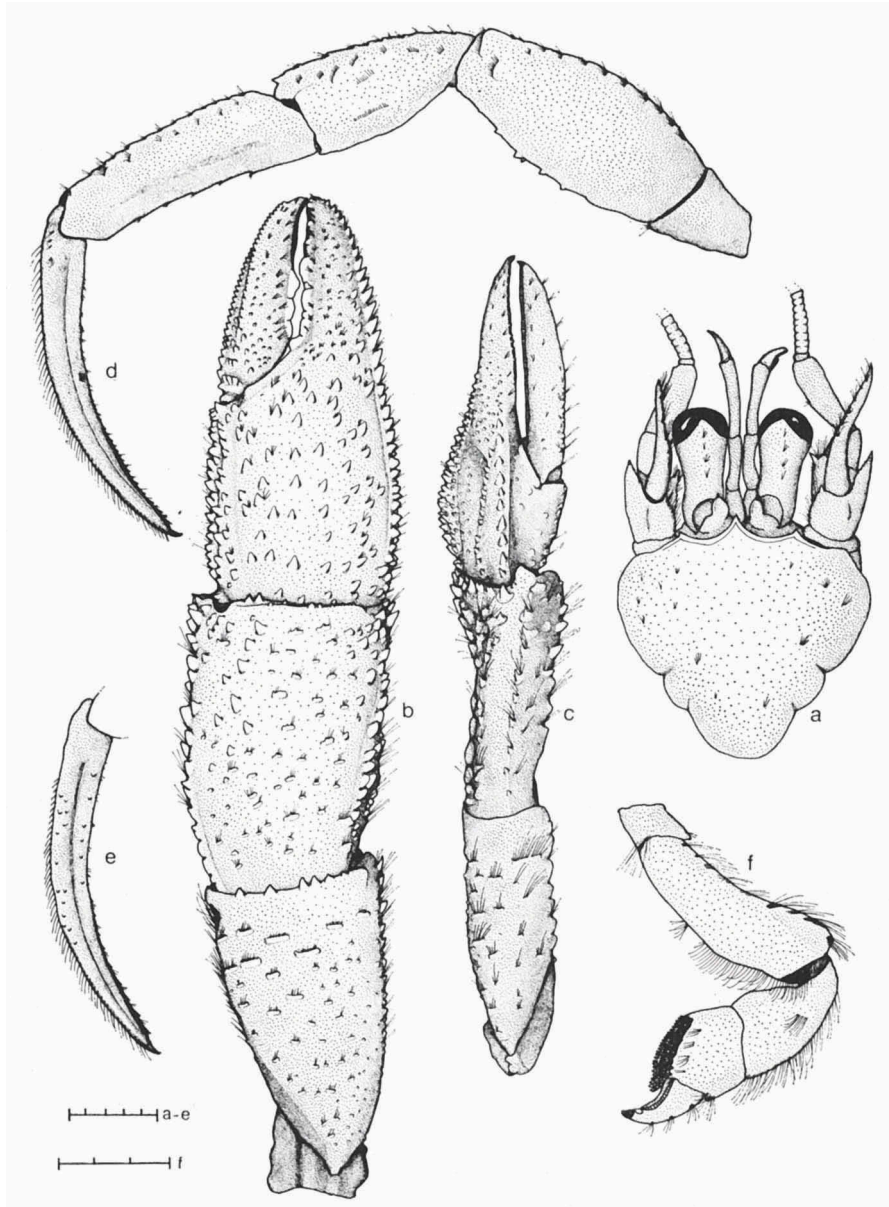


Fig. 75. *Pagurus townsendi* (Benedict). a, shield; b, right cheliped (dorsal view); c, left cheliped (dorsal view); d, left P₂ (lateral view); e, left P₃, dactyl (lateral view); f, right P₄ (lateral view). Scales equal 5 mm (a-e) and 1 mm (f).

or spinule on laterodistal margin; ventromesial distal margin produced with several small spinules laterally and tufts of short setae. Antennal acicles long, usually greatly exceeding ocular peduncles; arcuate; terminating in small spine, partially obscured by tuft of setae; mesial margin with low protuberances and tufts of moderately short setae. Antennal flagella long, usually overreaching right cheliped, articles usually without setae.

Mandible without distinctive characters. Maxillule with proximal endite subquadrate, endopodite with 1 or 2 bristles on well developed internal lobe, external lobe poorly developed. Maxilla with endopodite inflated basally, not reflexed, slightly exceeding scaphognathite in distal extension. First maxilliped with endopodite approximately one-half length of exopodite. Second maxilliped without distinctive characters. Third maxilliped with basis-ischium fusion incomplete; basis with 1 spine and frequently 1 or 2 small spinules; ischium with well developed crista dentata, 1 accessory tooth; merus with 1 or 2 small spines on ventral margin, dorsodistal margin with small spine; carpus with small spine at dorsodistal margin. Sternite of m_{x_3} with 1 small spine on each side of midline, partially obscured by moderately long bristles.

Right cheliped with dactyl long, approximately equalling length of palm, mesial margin slightly arcuate; cutting edge with row of strong calcareous teeth proximally, small corneous teeth distally; terminating in small corneous claw; sometimes overlapped by fixed finger; dorsal surface subtriangular, with scattered small spines more sparse distally, 2 longitudinal rows of tufts of short bristles, apex with row of conical, corneous-tipped spines; dorsomesial margin with row of closely-spaced, small corneous-tipped spines and tufts of long setae; mesial and ventral surfaces with low protuberances and tufts of moderately short stiff setae or bristles. Fixed finger slightly arcuate distally; cutting edge with row of strong calcareous teeth proximally, small corneous teeth distally, interspersed with few, small calcareous teeth. Palm elongate, slender, dorsoventrally inflated, with dorsal and ventral surfaces convex; dorsal surface with irregular rows of tubular corneous-tipped spines and tufts of short setae; dorsomesial margin with double row of strong spines and tufts of long setae, mesial face with 2 rows of broad multifid tubercles and tufts of short setae; dorsolateral margin with row of moderately strong spines and tufts of long setae, lateral face with row of conical spines dorsally, scattered spinulose tubercles ventrally; ventral surface with 2 or 3 irregular rows of multifid tubercles and tufts of moderately long stiff bristles. Carpus long, approximately one-third longer than palm, moderately slender; dorsomesial margin with single or double row of strong spines and tufts of long setae, dorsal surface with scattered spines,

distal margin with tufts of short setae and few small spines, decreasing in size laterally; dorsolateral margin with row of closely-spaced small spines, lateral face with low broad tubercles and tufts of moderately long setae, laterodistal angle slightly produced with strong conical spines, distal margin

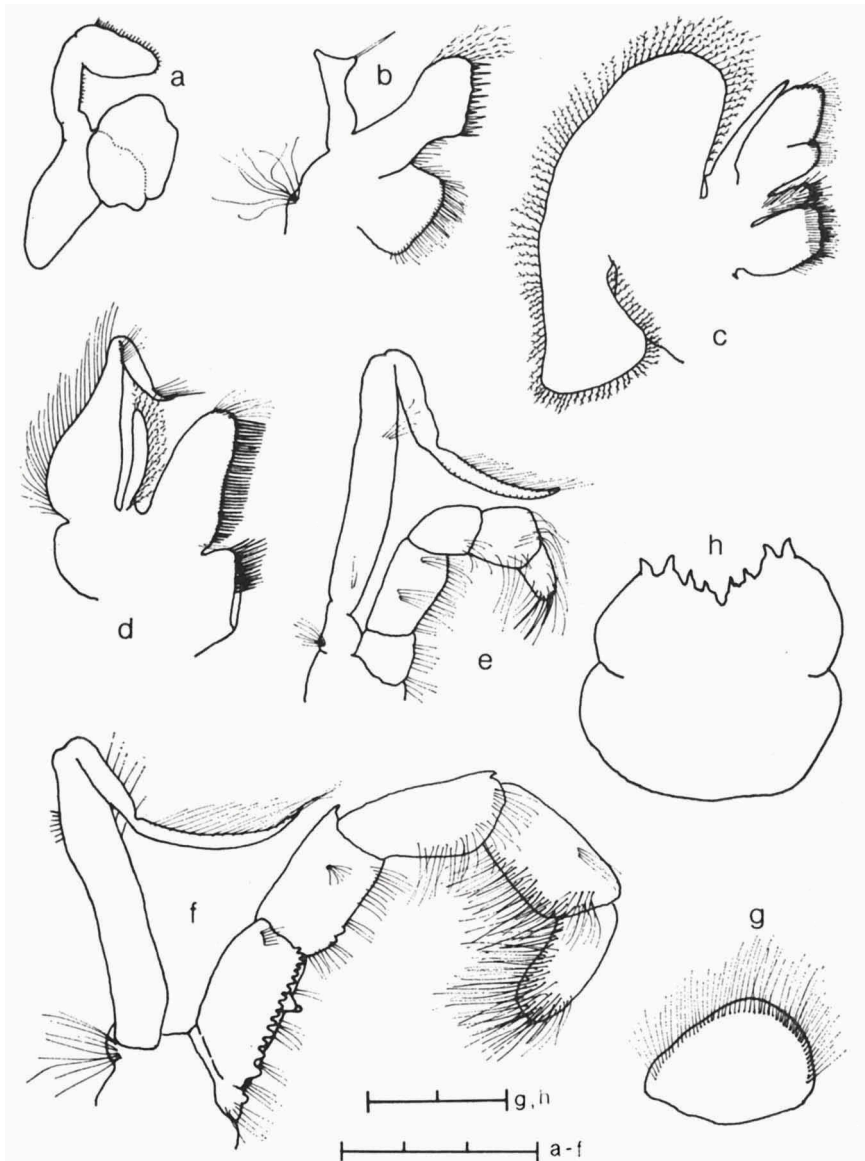


Fig. 76. *Pagurus townsendi* Benedict). a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxps. — g, sternite, P₃; h, telson. Scales equal 3 mm (a-f) and 1 mm (g, h).

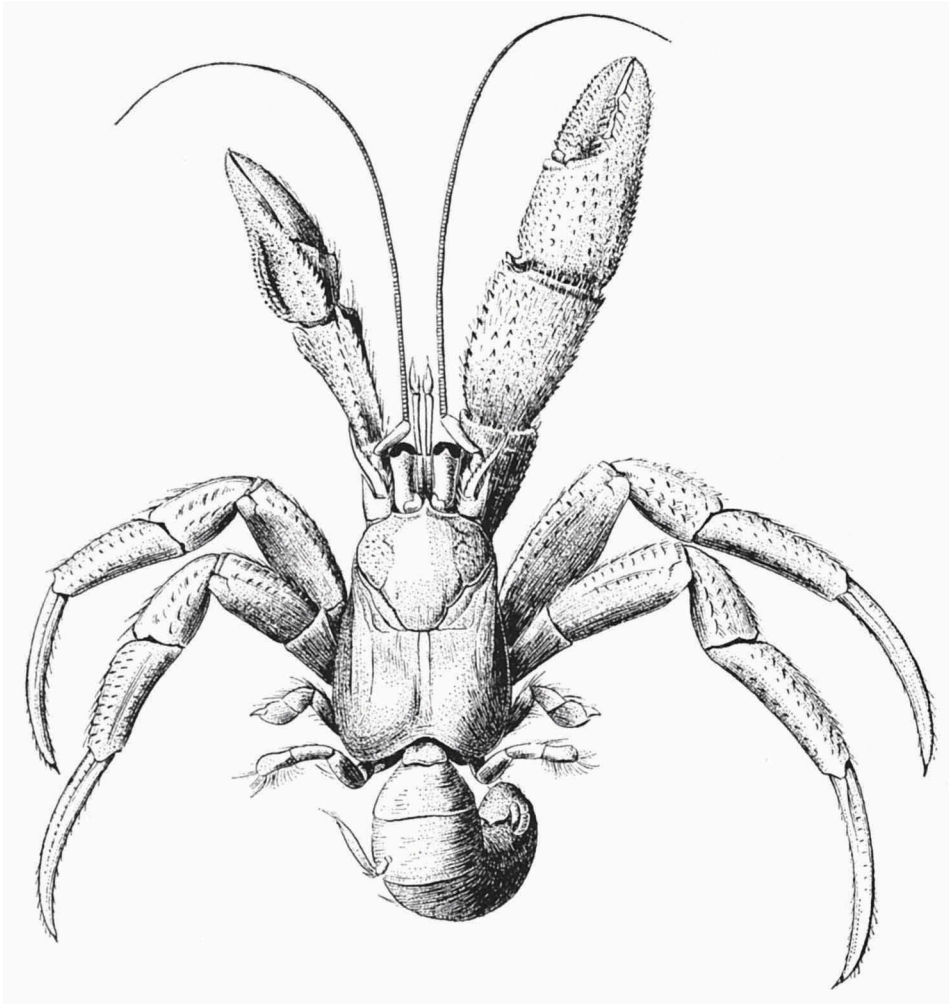


Fig. 77. *Pagurus townsendi* (Benedict). Original illustration of J. E. Benedict.

ventrally with row of subacute spines; mesial face with low protuberances, becoming spinulose distally and tufts of setae, dorsodistal angle produced, with strong conical spines, distal margin ventrally with row of small conical spines; ventral surface with scattered, low tubercles, ventromesial margin with row of simple or multifid spines. Merus approximately equalling carpus in length, triangular; dorsal margin with row of low protuberances becoming transverse spinulose rows distally and tufts of long setae, distal margin dorsally, laterally and mesially with prominent small spines; lateral face slightly rugose or denticulate, ventrolateral margin with small multifid

spines proximally, increasing in size and becoming simple or multifid distally; ventral surface with scattered low protuberances and tufts of long setae, ventromesial margin with 2 rows of simple or multifid spines. Ischium with small subacute spine and tuft of setae on dorsodistal margin; ventromesial margin with row of small spinules, increasing in size distally, ventral surface with few scattered spinules and tufts of short setae, ventrolateral margin with row of small spines. Coxa with row of small spinules on ventrolateral margin, clusters of long setae on ventromesial distal angle and ventromesial margin.

Left cheliped moderately long, reaching proximal third of right dactyl, slender. Dactyl long, approximately three times length of palm, somewhat flattened, distally depressed; cutting edge with row of very closely-spaced, small corneous teeth; terminating in small claw; considerably overlapped by fixed finger; dorsomesial margin with row of very small spinules and tufts of short setae, dorsal and ventral surfaces with tufts of setae or bristles. Palm broadly inflated ventrolaterally, strongly curving mesially onto margin of fixed finger; dorsal surface elevated into prominent crest slightly mesiad of midline, with double row of tubular corneous-tipped spines, decreasing in size distally and extending onto proximal third of fixed finger as single row laterally, dorsal surface sloping acutely, with small tuberculate spines and pronounced depressed area distally; dorsolateral margin with double row of small corneous spines, becoming obsolete on fixed finger distally; dorsal surface mesially with few very small tubercles, dorsomesial margin with row of small spines; ventral surface with low multidenticulate tubercles proximally and tufts of long setae, surface acutely angular on fixed finger distally. Carpus long, approximately twice length of palm, subtriangular; dorsal surface flattened, distolateral surface strongly produced ventrally; dorsal surface with 2 rows of moderately strong spines and tufts of short setae; dorsolateral distal angle with 1 or 2 spines, lateral face with scattered low, often multifid, protuberances and tufts of long setae, distal margin ventrally with row of small spines; mesial face with low, frequently multidenticulate protuberances in 2 oblique rows distally and tufts of short setae, distal margin with few small spines dorsally, strong spines ventrally; ventral surface with spinulose tubercles and tufts of long setae, ventrolateral margin with irregular row of small spines, becoming double row distally. Merus equalling carpus in length, laterally compressed; dorsal margin with small, transverse protuberant ridges and tufts of setae; mesial face tuberculate, with strong, transverse tuberculate or spinulose ridge distally and tufts of long setae; lateral face tuberculate, ventrolateral margin with multidenticulate tubercles proximally, becoming row of strong spines distally,

ventromesial margin with irregular row of strong spines. Ischium with row of small simple or bifid spines on ventromesial margin, ventroproximal angle with low blunt protuberance. Coxa with denticulate ventroproximal angle, ventrolateral margin with row of minute spinules and tufts of setae, distal margin with 2 strong spinules laterally, clump of long setae mesially.

Second pereopods overreaching chelipeds, right somewhat longer than left. Dactyl exceeding propodus by one-third to one-half its own length; in lateral view, strongly curved ventrally; in dorsal view, strongly twisted; terminating in small corneous claw; dorsal margin with row of short setae, more dense distally; lateral face with weak longitudinal sulcus and row of short setae ventrally; ventral margin with row of corneous spinules, increasing in size distally. Propodus somewhat laterally compressed; dorsal surface with double row of transverse protuberances and tufts of short setae; lateral face slightly concave, glabrous or with row of tufts of short setae; mesial and ventral surfaces with tufts of short setae. Carpus shorter than propodus; dorsal surface of right side with row of moderately strong spines and tufts of short setae, left side with strong spine at distal margin, surface with low sometimes spinulose protuberances and tufts of short setae; lateral surface occasionally with weak longitudinal sulcus, usually with irregular transverse rows of tufts of short setae; mesial and ventral surfaces with few tufts of short setae. Merus one-third to one-fourth longer than carpus, laterally compressed; dorsal margin with double row of low protuberances and tufts of short setae; lateral and mesial faces with few tufts of setae; ventral margin with 2 rows of small spines distally, usually 1 row proximally. Ischium frequently with row of small spinules and tufts of setae on ventral margin; dorsal margin occasionally with row of minute denticles. Coxa with tufts of moderately long setae marginally.

Third pereopods approximately equalling length of second, right slightly longer than left. Dactyl one-third to one-fifth longer than propodus; in lateral view, strongly curved ventrally; in dorsal view, strongly twisted; terminating in small corneous claw; dorsal margin with row of short setae more dense distally; lateral face with longitudinal sulcus on left flanked by small spinules proximally, on right by few scattered tufts of very short setae; mesial face with longitudinal sulcus and few tufts of short setae; ventral margin with row of corneous spinules and tufts of short setae. Propodus slightly compressed laterally; left lateral face slightly concave; dorsal margin with 1 or 2 rows of spinulose protuberances and tufts of short setae; lateral and mesial faces with few scattered tufts of very short setae; ventral margin with row of tufts of setae. Carpus approximately three-fourths length of propodus; dorsal surface with 1 or 2 rows of very small spinules and 1

moderately strong spine at distal angle on right side, left side with strong spine at dorsodistal angle, surface with 1 or 2 rows of low protuberances and few short setae; lateral face with tufts of very short setae frequently in transverse rows; mesial and ventral surfaces with few scattered setae. Merus equalling or slightly exceeding length of carpus, laterally compressed; dorsal margin with 1 or 2 rows of transverse low protuberances and tufts of short setae; ventral, mesial and lateral surfaces occasionally with tufts of short setae. Ischium long; dorsal and ventral margins with tufts of short setae. Coxa with few tufts of setae.

Fourth pereopods with inconspicuous, preungual process at base of claw on lateral face of dactyl; propodal rasp well developed.

Fifth pereopods typical.

Sternite of third pereopods generally subsemicircular, slightly skewed to left; anterior margin with long, fine setae.

Pleopods of male unpaired, pl_3 - pl_5 with exopodites well developed; endopodites rudimentary. Females with pleopods unpaired, pl_2 - pl_4 with both rami well developed, exopodites approximately twice length of endopodites; pl_5 exopodite moderately well developed, endopodite rudimentary.

Telson with posterior lobes symmetrical or asymmetrical, left often slightly larger than right; separated by moderately broad, V-shaped median cleft; right terminal margin usually with 4 corneous spines; left terminal margin with 3 or 4 corneous spines. Anterior lobes unarmed.

Coloration. — Living color unknown. In preservative: Color faded to uniform straw tint; ocular peduncles with reddish-brown tint.

Distribution. — Pribilof Islands to Unalaska Island and Schumagin Bank, Alaska (Rathbun); 519 to 1143 meters.

Affinities. — At present no species-group assignment can be made for *Pagurus townsendi*. In the development of the prominent crest on the left chela, *P. townsendi* appears related to the species of the “*confragosus*” group. Similarities with this group are also seen in the short ocular peduncles with prominently dilated corneae, and in the elongate, curved and slightly twisted dactyls of the second and third pereopods. However, certain characters of the mouthparts and the development of a long, slender, unsculptured right cheliped suggest that this species may be more closely related to the species of the “*trigonocheirus*” group. Superficially, *P. townsendi* also appears to be related to *P. rathbuni*; however, these two species differ substantially in characters afforded by the mouthparts. The deeply concave dorsolateral face and prominent, spinose crest of the left chela and the slender, elongate and unsculptured right chela immediately distinguish *P. townsendi* from other northwestern North American species.

Discussion. — With the exceptions of Benedict's original description (Benedict, 1892: 13) and the report by Rathbun (1904, 1910), references to *P. townsendi* are merely literature citations. From this it would appear that *P. townsendi* is a deep-water species (284-625 fms, Rathbun, 1904: 158) restricted in its range to the southern Bering Sea and Aleutian Islands. This species, however, does have a superficial resemblance to the controversial European species *Pagurus pubescens*, and if little attention were given to the configuration of the left chela, *P. townsendi* could be mistaken for *P. pubescens*. Although the depth distribution reported by Makarov (1938b: 210; 1962: 197) and Kobjakova (1966: 209) for specimens referred to *P. pubescens* from the Far Eastern Soviet Seas did not exceed 300 meters, these authors also reported *P. pubescens* from the eastern Chukchi and Bering Seas, southward to Oregon to a depth of 900 meters. *Pagurus trigonocheirus*, the species most frequently confused with *P. pubescens*, is not known from depths greater than 183 meters; therefore, it is possible that some of these deep-water specimens recorded as *P. pubescens* should have been referred to *P. townsendi*.

***Pagurus rathbuni* (Benedict) (figs. 78-80)**

- Eupagurus (Trigonocheirus) rathbuni* Benedict, 1892: 14 (by implication; type locality: Alaska, here restricted by lectotype selection to Bering Sea, 56°18'N 164°34'10"W, "Albatross" station 3256).
- Pagurus rathbuni*: Rathbun, 1899: 556. — Rathbun, 1904: 158, pl. 4 fig. 2. — Rathbun, 1910: 158, pl. 4 fig. 2. — Williamson, 1915: 481. — Derjugin & Kobjakova, 1935: 142. — Kobjakova, 1936: 191. — Kobjakova, 1937: 144. — Makarov, 1937: 56, fig. 2. — Makarov, 1938a: 413. — Makarov, 1938b: 203, pl. 3 fig. 3. — Vinogradov, 1947: 105. — Vinogradov, 1950: 228 (key), fig. 127. — Birstein & Vinogradov, 1953: 233. — Gordan, 1956: 335. — Kobjakova, 1956: 50. — Kobjakova, 1958a: 256. — Kobjakova, 1958b: 233. — Lindberg, et al., 1959: 232. — Zarenkov, 1960: 190. — Makarov, 1962: 193, pl. 3 fig. 3. — Miyake, Sakai & Nishikawa, 1962: 125. — McLaughlin, 1963: 22. — Filatova & Barsanova, 1964: 42. — Filatova & Barsanova, 1969: 45.
- Pagurus (Trigonocheirus) Rathbuni*: Holmes, 1900: 134 (by implication; misspelling of *Trigonocheirus* Benedict, Holmes, 1900: 134).
- Eupagurus rathbuni*: Alcock, 1905: 179. — Urita, 1942: 42, figs. 12a, b. — Balss, 1944: 188.
- Eupagurus (Trigonocheirus) polaris* Sivertsen, 1932: 8, pl. 2 fig. 3 (type locality: "Chukotsk Sea", 72°44'N 180°13'E, "Maud" station 7; misspelling of *Trigonocheirus* Benedict, Sivertsen, 1932: 8).
- Eupagurus (Trigonocheirus) rathbuni*: Sivertsen, 1932: 9 (by implication; misspelling of *Trigonocheirus* Benedict, Sivertsen, 1932: 8).
- Pagurus (Trigonocheirus) polaris*: Gordan, 1956: 333.

Lectotype, herein selected. — ♂ (SL = 13.9 mm), USNM 16694.

Material examined. — See table 27.

Diagnosis. — Left chela very elongate, fingers strongly depressed distally; dorsal surface convex, midline elevated, spinose, without distinct crest. Right

Table 27. *Pagurus rathbuni* (Benedict) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex				SL (mm)	Collector
				♂	♀	♀♀	♂♂		
<i>Chukchi Sea</i>									
71°29.5'N, 155°41'W	36-43	----	16/8/63	1	1			11.1-14.3	Gonor
69°40'N, 178°45'W	44	USNM ----	10/10/62	1				2.9	McCauley
69°16'N, 165°36'W	---	59 USNM	24/8/59	1				5.7	JNC
69°10'N, 168°34'W	---	48 USNM	20/8/59	3				9.5-13.8	JNC
68°25'N, 167°55'W	---	34 USNM	16/8/59	2				4.0-12.1	JNC
68°18'N, 168°15'W	---	29 USNM	14/8/59	5				8.1-13.7	JNC
68°03.5'N, 168°52'W	---	30 USNM	14/8/59	1				13.3	JNC
67°57'N, 168°34'W	---	49 USNM, AHF	20/8/59	3	2			10.9-16.9	JNC
67°57'N, 168°02'W	---	50 RMNH	20/8/59	4	3			7.5-12.7	JNC
67°50'N, 166°55'W	---	20 USNM	12/8/59	1				15.9	JNC
67°43.8'N, 167°55'W	---	47 USNM	19/8/59		1			7.8	JNC
67°43.8'N, 166°35'W	---	43 USNM	19/8/59	1				10.8	JNC
67°43.5'N, 167°12'W	---	46 USNM	19/8/59		1			10.2	JNC
67°31'N, 166°35'W	---	44 USNM	19/8/59	2				7.7-8.9	JNC
67°30'N, 166°47'W	---	15 USNM	10/8/59		1			9.1	JNC
67°27'N, 165°32'W	---	12 USNM	10/8/59	1	1			3.4-4.1	JNC
<i>Bering Sea</i>									
57°20'N, 163°26.5'W	50	ABL H-B CNM	10/7/66	1	1			10.6-10.7	USFWS
57°00'N, 165°49.5'W	73	ABL G-4 USNM, RMNH, BM	20/7/66	57	2			8.9-16.4	USFWS
57°00'N, 165°14'W	73	SBL G-5 USNM	15/7/61	4				12.9-15.0	USFWS
56°58'N, 164°38'W	71	ABL G-6 USNM	9/7/66	4	1			7.4-16.2	USFWS
56°40'N, 165°16'W	80	SBL F-5 USNM	16/7/61	2				10.5-13.7	USFWS
56°40'N, 164°37'W	79	SBL F-6 USNM	13/7/61	4				12.5-15.1	USFWS
56°40'N, 164°33'W	78	ABL F-6 USNM, RMNH	9/7/66	29	4			7.9-17.7	USFWS
56°30'N, 165°31'W	88	SBL EF-4,5 USNM	16/7/61	3				11.9-13.6	USFWS
56°30'N, 164°18'W	88	SBL EF-6,5 USNM	13/7/61	2				13.4-14.1	USFWS
56°20'N, 165°51'W	93	SBL E-4 USNM	29/8/60	5	1			8.8-14.3	USFWS
Bristol Bay	---	----	summer 59	1				12.6	USFWS
56°18'N, 164°34'10"W	90	Albatross 3256 USNM 16694,128940	14/6/90	9	10			3.5-17.1	---

cheliped elongate; carpus with shallow depression at dorsomesial distal angle, with tuft of long setae (♂) or naked (♀).

Description. — Shield slightly broader than long, or occasionally, length equalling width, rarely, slightly longer than broad; anterolateral margins terraced or slightly concave; anterior margin between rostrum and lateral projections concave; posterior margin truncate or rounded; anterolateral angle blunt, rarely produced; dorsal surface generally smooth or slightly

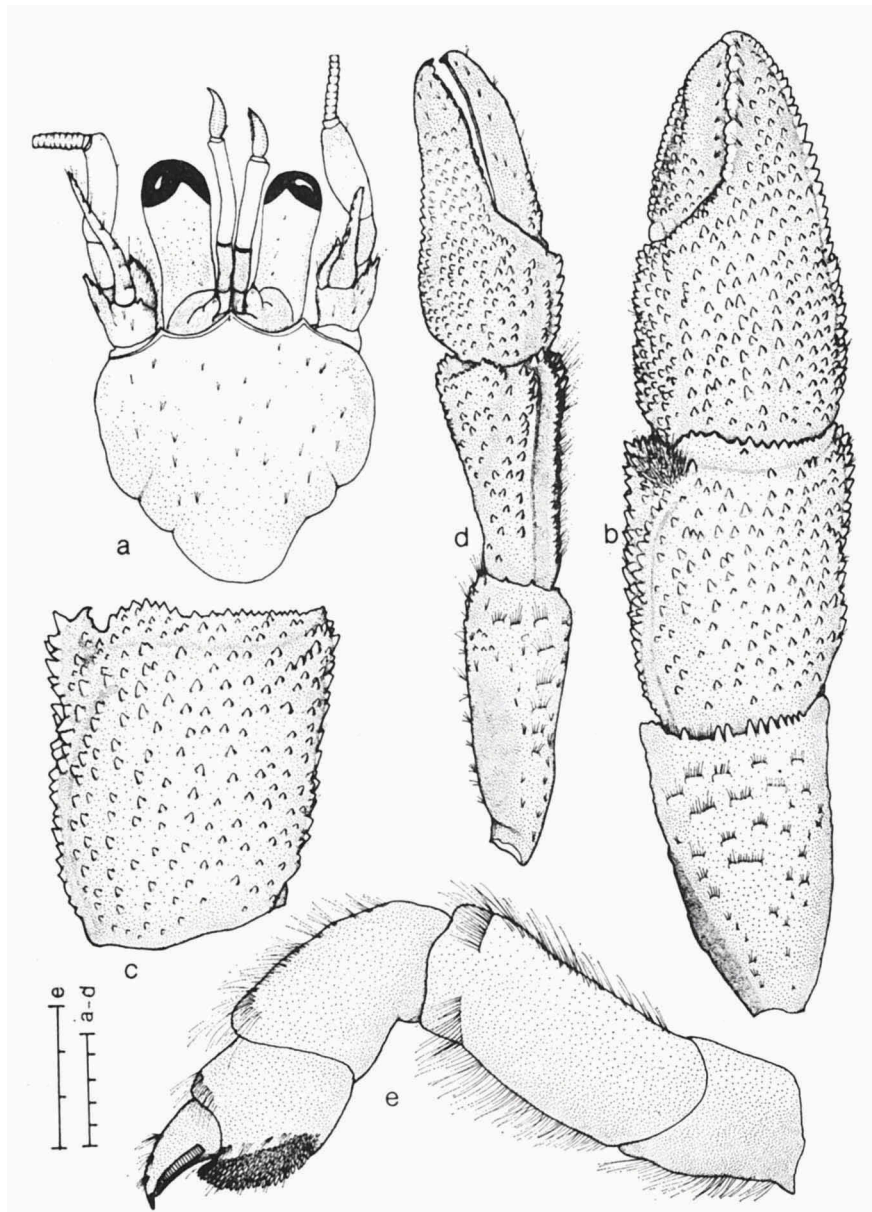


Fig. 78. *Pagurus rathbuni* (Benedict). a, b, d, e, ♂; c, ♀. a, shield; b, right cheliped (dorsal view); c, right cheliped, carpus (dorsal view); d, left cheliped (dorsal view); e, left P₄ (lateral view). Scales equal 5 mm (a-d) and 3 mm (e).

pitted laterally, with scattered tufts of short setae. Rostrum moderately long, exceeding lateral projections; most frequently triangular, acute or subacute; usually with small terminal spine and tuft of setae. Lateral projections broadly triangular, with small or prominent marginal or submarginal spine.

Ocular peduncles short, one-half to two-thirds length of shield; stout; corneal region dilated; dorsal or dorsomesial face with longitudinal row of short setae. Ocular acicles with mesial margins expanded or sloping, lateral margins straight or slightly expanded, dorsal surface slightly concave with tuft of short setae; terminating acutely or subacutely, with small or prominent marginal or submarginal spine, occasionally with 1 or 2 very small accessory spinules; separated basally by two-thirds to slightly more than basal width of one acicle.

Antennular peduncles long, exceeding ocular peduncles by two-thirds to entire length of ultimate segment; ultimate and penultimate segments unarmed, with tufts of short setae; basal segment with spinulose protuberance or small spinule at ventrodiscal margin, prominent protuberance and tufts of short setae on dorsolateral face.

Antennal peduncles long, exceeding ocular peduncles by one-third to three-fourths length of ultimate segment; with supernumerary segmentation. Fifth segment unarmed or with minute spinule on ventral margin, partially obscured by tuft of setae. Fourth segment with tufts of short setae. Third segment with small spine at ventromesial distal angle, partially obscured by tuft of setae. Second segment with dorsolateral distal angle produced, terminating in small simple or bifid spine, mesial margin inflated, with 2-4 small spines and few short setae, lateral margin straight, occasionally with 1 or 2 small spines or spinules and with tufts of long setae, dorsal surface with scattered tufts of setae; dorsomesial distal angle with small spine, mesial face with tufts of setae, occasionally with 1 or 2 very small spinules. First segment usually with small spine or spinule on lateral face distally; ventrodiscal margin produced, with row of small spines laterally and distally. Antennal acicle long, usually reaching to distal half of ultimate antennal segment; usually strongly arcuate; mesial face with row of low spinulose protuberances and tufts of moderately long setae. Antennal flagella long, slightly exceeding tip of right cheliped; naked or with few randomly set short bristles.

Mandible without significant characters. Maxillule with proximal endite tapering; endopodite with 2-4 bristles on strongly developed internal lobe, external lobe strongly produced, not recurved. Maxilla with endopodite inflated basally, frequently slightly reflexed, slightly exceeding scaphognathite in distal extension. First maxilliped with endopodite approximately

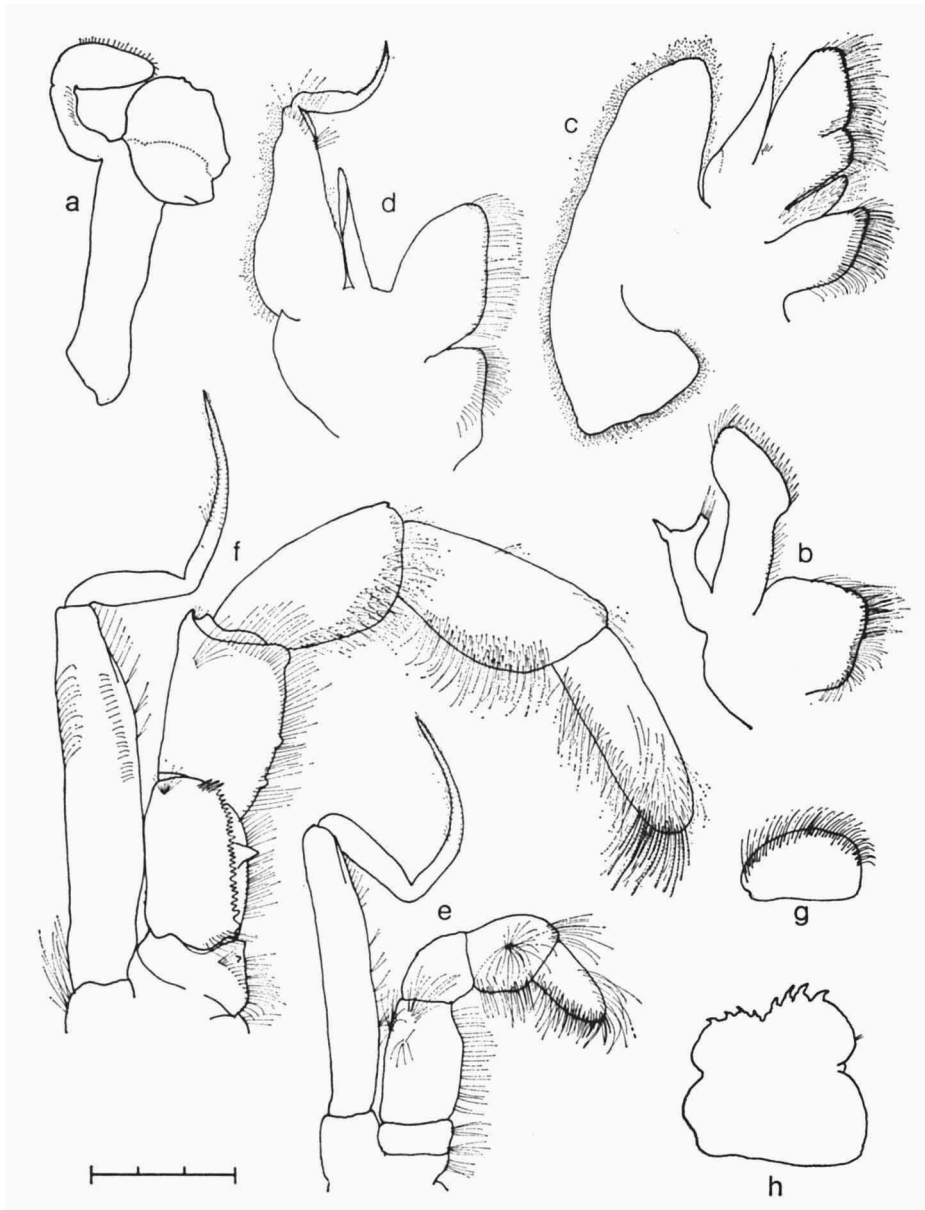


Fig. 79. *Pagurus rathbuni* (Benedict). a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite, P₃; h, telson. Scale equals 3 mm.

one-half length of exopodite. Second maxilliped with basis-ischium partly fused. Third maxilliped with basis-ischium fusion incomplete; basis with 1 or 2 small spines; ischium with crista dentata well developed, 1 accessory tooth, dorsal margin frequently with 1 or 2 very small spinules; merus with strong spine at dorsodistal margin, ventral margin with 2 to several small spines; carpus with small spine at dorsodistal margin. Sternite of mxp_3 with small spine or spinule on each side of midline, partially obscured by row of moderately short, stiff setae.

Right cheliped long, moderately slender. Dactyl moderately long, usually equalling or slightly exceeding length of palm, occasionally shorter than palm; moderately broad; cutting edge with calcareous teeth proximally, small corneous teeth distally; terminating in strong corneous claw; overlapped by fixed finger; dorsal surface with scattered small spines or tubercles proximally, slightly elevated in midline with irregular row of small, conical often corneous-tipped tubercles or spines, becoming regular row of closely-spaced tubercles distally, dorsomesial margin with row of moderately small conical spines; ventromesial margin with row of moderately strong spinulose tubercles and tufts of setae proximally, ventral surface unarmed, with 2 rows of tufts of long setae. Palm long, two-thirds to three-fourths length of carpus; slightly inflated dorsoventrally; dorsal surface convex, with moderately closely-spaced, small spines or tubercles, dorsolateral margin with row of moderately prominent spines, increasing in size distally and tufts of short setae, dorsomesial margin with single or double row of small spines; mesial face with closely-spaced small spines; ventral surface usually with simple or bifid, spinulose tubercles and tufts of setae. Carpus equalling or slightly exceeding length of merus; slightly inflated ventrally; with notable sexual dimorphism; dorsal surface convex, with moderately closely-spaced, small, conical acute or subacute spines, dorsomesial distal angle with prominent shallow depression and several small spines obscured by patch of dense, moderately long fine setae (in males), or completely devoid of setae (in females), distal margin with single or double row of moderately prominent conical spines and few tufts of setae, dorsolateral margin with single or double row of moderately small simple or bifid spines and tufts of short setae; lateral and mesial faces with scattered small spines or tubercles and tufts of setae, distal margins with moderately strong, simple or bifid, occasionally multifid spines; ventral surface with small blunt or spinulose tubercles or occasionally small spines and tufts of setae. Merus subtriangular; dorsal surface with irregular transverse rows of spinulose protuberances or ridges and short setae, distal margin dorsally, mesially and laterally with prominent, slender spines; lateral face with small spinules, becoming multidenticulate

ventrally; mesial face with irregular rows of low protuberances and tufts of short setae dorsally, scattered spinules or tubercles ventrally; ventrolateral and ventromesial margins each with irregular row of strong spines, ventral surface with scattered small spines and tufts of moderately long setae. Ischium with row of subacute spinules on ventromesial margin, ventrolateral margin with cluster of small spines or spinules proximally, extending onto distal margin as row of small spines; ventral and lateral surfaces with few, small spinules or denticles. Coxa with ventrolateral distal angle produced, denticulate; ventroproximal angle with cluster of small spinules, ventrolateral

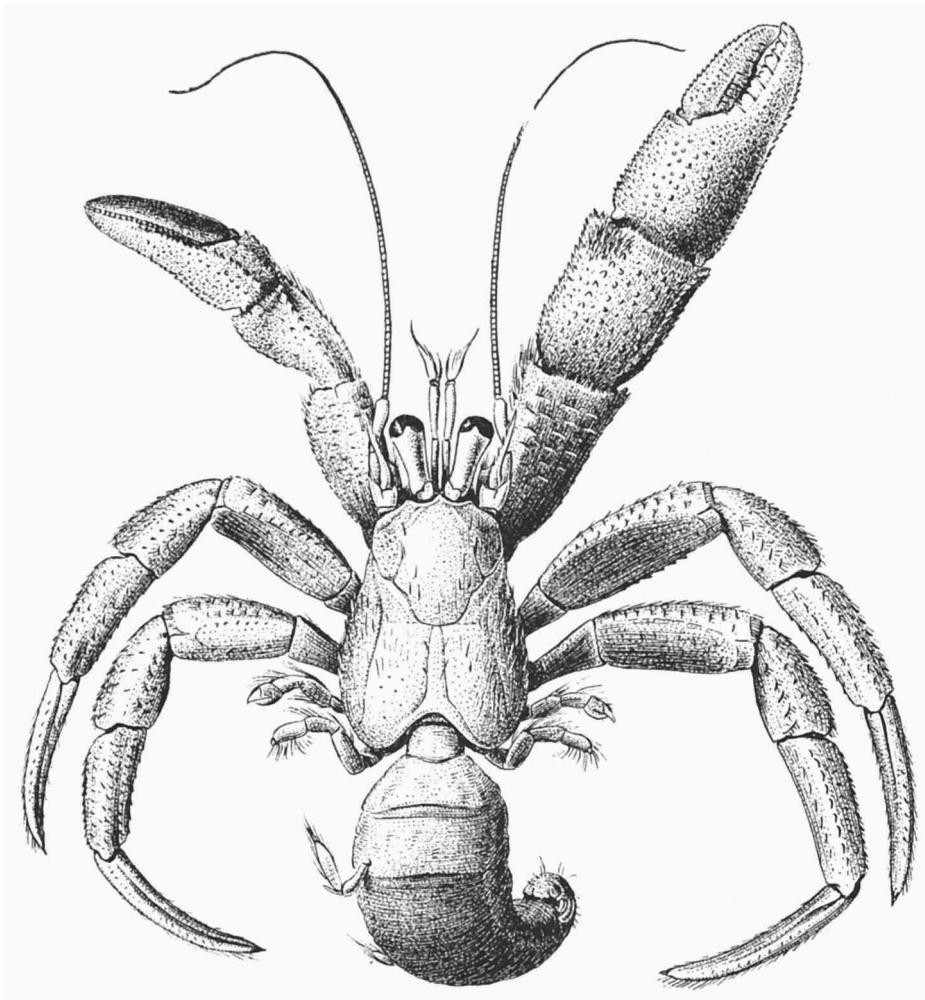


Fig. 80. *Pagurus rathbuni* (Benedict). Original illustration of J. E. Benedict.

margin spinulose, ventral surface and ventromesial distal angle with tufts of long setae.

Left cheliped long, often reaching to distal half of dactyl of right; slender. Dactyl long, one and one-half to two and one-half times length of palm; strongly depressed distally; cutting edge with row of small corneous teeth; terminating in small corneous claw; overlapped by fixed finger; dorsal surface flattened, with few, small frequently corneous-tipped spines proximally and row of tufts of short setae, dorsomesial margin with row of small spines proximally and tufts of setae; ventral surface with row of tufts of setae. Palm moderately short, one-third to two-thirds length of carpus; dorsal surface strongly elevated in midline, with irregular double row of moderately small spines extending onto fixed finger proximally, dorsolaterally surface strongly sloping with irregular rows of small acute or subacute spines, rarely extending beyond proximal half of fixed finger, dorsolateral margin with single or double row of moderately prominent small spines, becoming obsolete on fixed finger distally, dorsomesial surface sloping, often very acutely, with irregular row of moderately small acute or subacute spines or with scattered small tubercles, dorsomesial margin with 2 rows of strong, conical, corneous-tipped spines; mesial face with row of spinules or spinulose tubercles and tufts of setae; ventral surface with 3 or 4 rows of spinulose, frequently bifid tubercles or protuberances and tufts of long setae. Carpus long, equalling or slightly exceeding length of merus; dorsal surface flattened or with wide, shallow longitudinal depression, dorsolateral and dorsomesial margins slightly elevated, each with row of moderately prominent spines and frequently with tufts of setae, distal margin usually with 2 or 3 strong spines; lateral face with scattered small spines or spinulose tubercles, distal margin with row of small spines, ventrolateral distal angle produced, spinose; mesial face with scattered, small simple or multifid tubercles or small spines and tufts of setae, distal margin with row of small spines; ventromesial and ventrolateral margins each with row of small spines, ventral surface with scattered small spines or tubercles or occasionally only spinulose protuberances and tufts of long setae. Merus subtriangular, slightly compressed laterally; dorsal margin with 1 or 2 rows of low, transverse spinulose or denticulate ridges and short setae, distal margin unarmed or with 1 or 2 moderately small spines; mesial face with multidenticulate protuberances and tufts of setae; lateral face with low spinulose or multidenticulate protuberances or tubercles and small simple or bifid spines distally and ventrally; ventral surface with spinulose tubercles or small spines, occasionally only with few low protuberances and tufts of setae, ventromesial and ventrolateral margins each with single or double row of spines, increasing in size distally

and tufts of setae. Ischium with row of small spinules on ventromesial margin, lateral face and ventrolateral margin usually spinulose, proximally 1 or 2 prominent low protuberances or tubercles. Coxa with row of denticles on ventrolateral margin; ventromesial margin with long setae distally, ventroproximal angle spinulose.

Second pereiopods long, equalling or slightly overreaching tip of right cheliped. Dactyl moderately short, slightly exceeding length of propodus; in lateral view, curved ventrally; in dorsal view, strongly twisted; terminating in small corneous claw; dorsal surface with row of tufts of long stiff setae, increasing in length distally; mesial face with longitudinal sulcus flanked by row of tufts of moderately dense setae; lateral face with faint longitudinal sulcus proximally, longitudinal row of tufts of setae dorsally; ventral margin with row of corneous spines or spinules, increasing in size distally, and row of tufts of moderately short bristles. Propodus one-third to one-half longer than carpus; dorsal surface with low protuberances and tufts of setae, distal margin with 1-3 small spines, occasionally unarmed; lateral and mesial faces usually with few low protuberances and tufts of short setae; ventral surface with low frequently spinulose protuberances and tufts of short setae. Carpus moderately short, two-thirds to three-fourths length of merus; dorsal surface with row of moderately small occasionally corneous-tipped spines and tufts of short setae; lateral face with faint longitudinal sulcus and frequently with longitudinal row of tufts of short setae; ventral surface with tufts of short setae. Merus moderately long; laterally compressed; dorsal surface with 1-3 rows of transverse low protuberances or ridges, frequently spinulose or multidenticulate and with tufts of short stiff setae; lateral and mesial faces with scattered tufts of short setae; ventrolateral and ventromesial margins each with row of small spines, increasing in size distally. Ischium with row of small spines on ventral margin partially obscured by tufts of long setae. Coxa with row of stiff setae on ventromesial margin; ventroproximal angle with cluster of small spines.

Third pereiopods moderately long, usually slightly shorter than second pereiopods, rarely exceeding tip of right cheliped. Dactyl approximately equalling length of propodus; in lateral view, curved ventrally; in dorsal view, strongly twisted; terminating in small corneous claw; dorsal surface with 1 or 2 rows of stiff setae, increasing in length distally; mesial face with weak longitudinal sulcus flanked by row of tufts of dense stiff setae; lateral face with faint longitudinal sulcus flanked by row of short stiff bristles, occasionally with 1 or 2 rows of small corneous spinules (left pereiopod); ventral surface with row of small corneous spinules or spines, increasing in size distally. Propodus moderately long, one-fourth to one-third longer

than carpus; dorsal surface with irregular rows of short, transverse multi-denticulate or spinulose protuberances or ridges and tufts of short stiff setae; lateral face with irregular rows of small tubercles or spinulose protuberances and tufts of short setae, occasionally only very weakly tuberculate; mesial face with tufts of short setae or occasionally slightly tuberculate; ventral margin with tufts of setae. Carpus one-half to two-thirds length of merus; dorsal surface with single or double row of small spinules, increasing to moderately prominent spines distally, and tufts of short setae; lateral face with irregular rows of tufts of short setae; mesial and ventral surfaces with few scattered tufts of short setae. Merus laterally compressed; dorsal surface with 1-3 irregular rows of spinulose or multidenticate, transverse protuberances and tufts of short setae; mesial and lateral faces with few scattered tufts of setae, ventromesial and ventrolateral margins each with row of small spinules or spinulose tubercles, increasing in size distally, and tufts of setae. Ischium with 2 or 3 small spinules or spinulose tubercles on dorso-lateral face distally; ventral margin with row of small spinules, obscured by tufts of setae. Coxa with row of tufts of setae on ventromesial margin.

Fourth pereopods with inconspicuous preungual process at base of claw on lateral face of dactyl; propodal rasp very well developed.

Fifth pereopods typical.

Sternite of third pereopods roundly rectangular, margin with dense, moderately long, stiff setae.

Pleopods of male unpaired, pl_3 - pl_5 with exopodites well developed; endopodites rudimentary. Pleopods of female unpaired, pl_2 with exopodite short, endopodite well developed; pl_3 - pl_4 with both rami well developed; pl_5 with exopodite well developed, endopodite rudimentary.

Telson with posterior lobes slightly asymmetrical, left lobe slightly larger than right; separated by small median cleft; right terminal margin with 3-5 moderately strong spines, occasionally with 1 or 2 small spinules on lateral margin; left terminal margin with 4-6 moderately strong spines, often with few small spinules on lateral face; anterior lobes with marginal tufts of setae.

Coloration. — Living color unknown. In preservative: Chelipeds light reddish-orange to straw-color; pereopods light orange or straw-color with darker band at distal end of propodal, carpal and meral segments.

Distribution. — East Siberian Sea, at mouth of Kolyma River to Zaliv Petra Velikogo (Vinogradov, Makarov); Kamchatka (Kobjakova, Makarov, Vinogradov, Rathbun); Okhotsk Sea (Kobjakova); Svyatoy Iony to Ayon ($52^{\circ}21'N$) (Vinogradov); Kuril Is. (Kobjakova); Sakhalin, Aniva Zaliv (Kobjakova); Pacific Ocean: Svyatoy Iony to Okhotsk Guba (Vinogradov); O. Iturup (Lindberg, et al.). Sea of Japan (Kobjakova); Tottori, Niigata

(Miyake, et al.); Anbetu (Urita); Chukchi Sea (Sivertsen, Makarov, Rathbun, Vinogradov); Bering Sea, Pribilof Is. (Rathbun). Chukchi Sea, Arctic Ocean to Point Barrow, Bering Sea; 9 to 210 meters.

Affinities. — *Pagurus rathbuni* shows some superficial resemblance to *P. dalli*, *P. brandti* and *P. stevensae* and, on the characters of the mouthparts, particularly the similarities in the maxillules, may, perhaps, be considered closely allied to these species. The males of *P. rathbuni* are immediately distinguishable not only from these species, but from all the northwestern North American species, by the characteristic patch of setae at the dorsomesial distal angle of the carpus of the right cheliped. In the females, where the setae are absent, the characteristic depression is also diagnostic but not as readily discernible. However, the elongate left chela with its ventrally curved dactyl and fixed finger also distinguishes *P. rathbuni*.

Discussion. — *Pagurus rathbuni* is one of the few northwestern North American pagurids which exhibits a consistent sexually dimorphic character, i.e., a patch of setae at the dorsomesial distal angle of the right carpus of males only. Benedict (1892) apparently did not realize this fact, as it is the only distinguishing character he gave for the species. Makarov noted the absence of the patch of setae in some specimens; however, he attributed this absence to young specimens only. Few small males were examined in the course of this study; however, specimens with shield lengths of 5.5 to 7.6 millimeters had developed the characteristic patch of setae, although the patches were less densely setose in these specimens.

Makarov (1938b, 1962) referred *Eupagurus (Trigonocheirus) polaris* Sivertsen to *P. rathbuni* without comment. Having examined the type of *E. polaris* (♀, SL = 9.7 mm, Zool. Mus. Oslo, F. 826), I can confirm the synonymy of the two nominal taxa.

As in the case of *P. townsendi*, no species-group assignment has been made for *P. rathbuni*. In some characters of the mouthparts it appears related to the "*trigonocheirus*" group; however, the reflexed basal portion of the endopodite of the maxilla and the incomplete fusion of the basis-ischium of the second maxilliped are not characters of the group.

Elassochirus Benedict

Bernhardus Dana, 1851: 267 (in part). — Dana 1852b: 122 (in part). — Dana, 1852c: 267 (in part). — Dana 1852d: 440 (in part).

Elassochirus Benedict, 1892: 1. Type species, by original designation *Bernhardus tenuimanus* Dana, 1851: 269. Gender: masculine. Founded as a subgenus of *Eupagurus* Brandt, 1851.

Diagnosis. — Shield calcified; posterior carapace membranous.

Eleven pairs of phyllobranchiate branchiae.

Maxillipeds widely separated basally. Basis-ischium of mxp_3 incompletely fused; crista dentata well developed, with one accessory tooth; merus with or without spine at dorsodistal margin. Maxillule with endopodal external lobe well developed, recurved.

Ocular acicles subrectangular; dorsal surface with deep, longitudinal furrow.

Chelipeds grossly unequal, right greatly exceeding left. Left cheliped with approximately 90° counterclockwise torsion.

Fourth pereopods subchelate; propodal rasp well developed; dactyl with "type A, P_4 structure" on lateral face.

Males with paired gonopores; coxae of P_5 equal; no sexual tubes.

Females with paired gonopores.

No paired pleopods in either sex.

Abdomen well developed; uropods asymmetrical.

Distribution. — Japanese Seas (Miers, Miyake, Yokoya); Okhotsk Sea (Vinogradov); Bering Sea, Gulf of Alaska, eastern North Pacific Ocean as far south as Washington.

Affinities. — *Elassochirus* appears most closely related to the genera *Pagurus* and *Pylopagurus*. It may be distinguished from *Pylopagurus* by the absence of paired first pleopods in the females. The marked torsion of the chelipeds, particularly that of the left, and the deeply furrowed ocular acicles distinguish this genus from *Pagurus*. The presence of a "type A, P_4 structure" distinguishes *Elassochirus* from all other genera presently assigned to the Paguridae.

Discussion. — Within the genus *Eupagurus* (= *Pagurus*), Benedict (1892) established the subgenus *Elassochirus* for several species characterized by large, operculate right chelipeds, reduced left chelipeds and semicylindrical to acute ocular acicles. He also included in *Elassochirus* two additional species, *Eupagurus munitus* Benedict and *Eupagurus gilli* Benedict, noting, however, that they lacked the operculate right chelae common to the other species of the subgenus. As the type species, Benedict designated *Eupagurus tenuimanus* (Dana).

Recent investigators have shown that as Benedict defined *Elassochirus*, it represented a heterogeneous aggregate of species. Six of the eleven species originally assigned to the subgenus have since been transferred to *Pylopagurus*, i.e., *Pylopagurus californensis* (Benedict), *P. roseus* (Benedict), *P. corallinus* (Benedict), *P. coronatus* (Benedict), *P. varians* (Benedict), and *P. crevicornis* (Benedict) (cf. Glassell, 1937; Walton, 1954; Westervelt, 1967; Haig, Hopkins, & Scanland, 1970). Of the remaining species, *Pagurus curacaoensis* (Benedict) appears to be a valid *Pagurus*;

the status of *Pagurus mexicanus* (Benedict) is uncertain and the species is not known to this author. *Pagurus tenuimanus*, *P. gilli*, and *P. munitus* (= *P. cavimanus* Miers), however, share several significant characters which distinguish them from both *Pagurus* and *Pylopagurus*. For these species, *Elassochirus* Benedict is herein restricted and raised to generic rank, with its type species, *Bernhardus tenuimanus* Dana.

Perhaps the most significant morphological character which separates *Elassochirus* from *Pagurus* is the apparent torsion of the left cheliped. Carcinologists generally have described the carpus of the left cheliped in these species as spinulose or spiny on the "inferior" margin (e.g., Dana, 1851, 1852c; Benedict, 1892; Holmes, 1900; Stevens, 1925; Makarov, 1938b, 1962). Preliminary studies of the internal structure of the cheliped indicate that this margin is morphologically the dorsal margin of the laterally compressed carpus and that, in life, this segment is carried perpendicularly. The dish-shaped palm has been twisted counterclockwise approximately 90 degrees from the horizontal plane, bringing the dactyl into a position dorsal to the fixed finger (figs. 82b, 85c, 88c). Torsion, although in the opposite direction (clockwise) and to a far lesser degree, also occurs in the right cheliped. This fact was also noted by Makarov (1938b, 1962); however, he referred to it as an oblique articulation of the carpus (in *P. gilli*).

Also characteristic of *Elassochirus* is the prominent, circular structure ("type A, P₄ structure") on the median lateral face of the dactyl of the fourth pereopod. As previously indicated, a somewhat similar structure, referred to as a preungual process occurs in the members of some species-groups within *Pagurus*. The differences in position and superficial morphology immediately distinguish the two structures; however, too little information is available to permit speculation on structural or functional homology.

Key to the species of *Elassochirus*

1. Carpus of right cheliped strongly compressed in mesial-lateral axis, expanded into "wing-like" projections; hand not operculate, spinose or tuberculate 2
- Carpus of right cheliped not strongly compressed in mesial-lateral axis, or expanded; hand operculate, spinose or tuberculate *E. tenuimanus* (Dana)
2. Right cheliped with dorsal carpal surface with irregular, median row(s) of small spines or spinules *E. cavimanus* (Miers)
- Right cheliped with dorsal carpal surface unarmed *E. gilli* (Benedict)

***Elassochirus tenuimanus* (Dana) new combination (figs. 81-84)**

Bernhardus tenuimanus Dana, 1851: 269 (type locality: "in freto 'Puget' Oregonensi", Puget Sound, Washington). — Dana 1852c: 269. — Dana, 1852d: 477. — Dana, 1855: 9, pl. 27 figs. 7a-c.
Eupagurus tenuimanus: Stimpson, 1857: 483. — Stimpson, 1858: 237. — Stimpson, 1859a:

47. — Smith, 1880: 211B. — Faxon, 1895: 55. — Calman, 1898: 260. — Harrington, 1898: 215. — Walker, 1898: 274. — Lenz, 1901: 445, figs. 6, 7. — Alcock, 1905: 178. — Stimpson, 1907: 216.

Eupagurus (Elassochirus) tenuimanus: Benedict, 1892: 1 (by implication).

Pagurus (Elassocheirus) tenuimanus: Holmes, 1900: 148 (by implication; misspelling of *Elassochirus* Benedict, Holmes, 1900: 135).

Pagurus tenuimanus: Rathbun, 1904: 160. — Rathbun, 1910: 160. — Taylor, 1912: 205. — Williamson, 1915: 481. — Stevens, 1925: 293, fig. 14. — Fraser, 1932: 64. — Makarov, 1937: 64, fig. 17. — Makarov, 1938b: 179, pl. I fig. 2. — Hart, 1940: 102. — Vinogradov, 1947: 102 (key). — Vinogradov, 1950: 228 (key), fig. 115. — Birstein & Vinogradov, 1953: 224. — Gordan, 1956: 336. — Makarov, 1962: 169, pl. I fig. 2. — McLaughlin, 1963: 23.

Holotype. — Not seen; presumably no longer extant.

Material examined. — See table 28.

Diagnosis. — Right chela usually greatly enlarged, operculate, dorsal surface spinose or tuberculate; carpus of right cheliped, in dorsal view, subtriangular, not laterally expanded.

Description. — Shield usually slightly longer than broad, occasionally length equalling width; anterolateral margins terraced; anterior margin between rostrum and lateral projections straight or slightly concave; posterior margin roundly truncate; dorsal surface generally smooth, with few tufts of setae; anterolateral angle not produced. Branchiostegites with few setae on distal margin. Rostrum obtusely rounded or broadly triangular, slightly exceeding lateral projections; usually terminating in minute spine. Lateral projections obtusely triangular, terminating in strong spine.

Ocular peduncles moderately short, somewhat less than one-half shield length, stout; often slightly inflated basally, strongly dilated in corneal region, with prominent median constriction; dorsomesial face with longitudinal row of tufts of very short setae. Ocular acicles long, subrectangular with lateral and mesial margins subparallel, elevated, with very prominent longitudinal furrow; terminating subacutely with submarginal spine; dorsal surface with tufts of short setae proximally; separated basally by approximately two-thirds basal width of one acicle.

Antennular peduncles long, exceeding ocular peduncles by one-half to entire length of ultimate segment. Ultimate and penultimate segments with few tufts of short setae; basal segment with small rather broad spine on ventromesial distal margin, and few tufts of short setae.

Antennal peduncles moderately long, exceeding ocular peduncles by one-third to one-half length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments with tufts of short setae. Third segment with very strong acute spine encircled by long setae at ventrodistal margin; ventromesial margin with row of short setae. Second segment with dorso-

Table 28. *Elassochirus tenuimanus* (Dana) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	♂♀		
<i>Bering Sea</i>								
56°40'N, 160°59'W	66	SBL F-12 USNM	18/8/60	2			10.6-18.2	USFWS
56°23'N, 161°02'W	64	SBL E-12 USNM	9/8/59	1			5.4	USFWS
56°20'N, 161°00'W	51	SBL E-12 USNM	19/8/60	2			14.6-18.1	USFWS
55°40'N, 162°49'W	53	SBL C-9 USNM,AHF	4/8/60	3	2		12.9-19.7	USFWS
55°20'N, 163°24'W	51	ABL B-8 USNM	14/7/66	1			14.2	USFWS
55°00'N, 164°36'W	60	SBL A-6 USNM	2/8/60	1			17.5	USFWS
54°39'N, 165°12'W	73	SBL Z-5 USNM, BM	4/8/61	9	1		9.9-19.8	USFWS
Bristol Bay	---	---	summer 59	2			2.4-5.9	USFWS
Bristol Bay	---	---	summer 57	2			13.1-14.2	USFWS
Akutan Harbor, Akutan I.	---	---	12/9/62	2			7.5-12.2	Fiscus
Unalaska	---	---	18/8/64	2	1		10.1-15.3	Fiscus
<i>Gulf of Alaska</i>								
Parlof Bay	27-31	---	25/7/37	3	2		3.1-5.2	Williams
56°39'N, 155°15'W	54-73	40M USNM	10/2/62	2	1		17.4-21.2	INPHC
56°15'N, 155°15'W	27	40P USNM	13/2/62		1		18.5	INPHC
55°30'N, 161°30'W	---	15B USNM	24/9/61	1			14.3	INPHC
Auke Village recreation area	2	---	27/4/63	1			23.5	Gonor
Idaho Inlet	---	---	16/3/51	1			12.4	JNC
<i>British Columbia</i>								
1.5 mi NW Klashwun Pt.	---	---	3/9/34	1			8.0	Stevens
<i>Washington</i>								
Strait of Juan de Fuca	---	---	9/8/61	3	2	1	3.8-9.8	Davis
Callam Bay	60	2312.1 USNM	12/7/35	1	2		3.0-9.0	Stevens
Roulweather Bluff	---	1-4-1 USNM	1/7/32	1			4.9	Stevens
Waldron Bay	---	---	29/7/61	4	2		3.1-10.6	Ray
President Channel	192	---	10/8/61	4	7		2.9-8.8	McLaughlin
San Juan Is.	---	---	7/8/32	1	1		3.4-10.2	Stevens
San Juan Is.	---	---	5/61	2	1		4.2-6.1	Henry
San Juan Is.	---	---	8/61	7	9	2	3.9-11.0	McLaughlin
San Juan Channel	110-192	USNM, RMNH	2-3/8/61	12	7		3.0-8.2	McLaughlin
Friday Harbor, San Juan I.	---	---	1922	2	2		3.6-14.7	Stevens
Lopez Sound	36	---	10/8/61	8	2	2	3.6-8.2	McLaughlin
Admiralty Inlet	60	---	17/3/35	1			4.6	Stevens

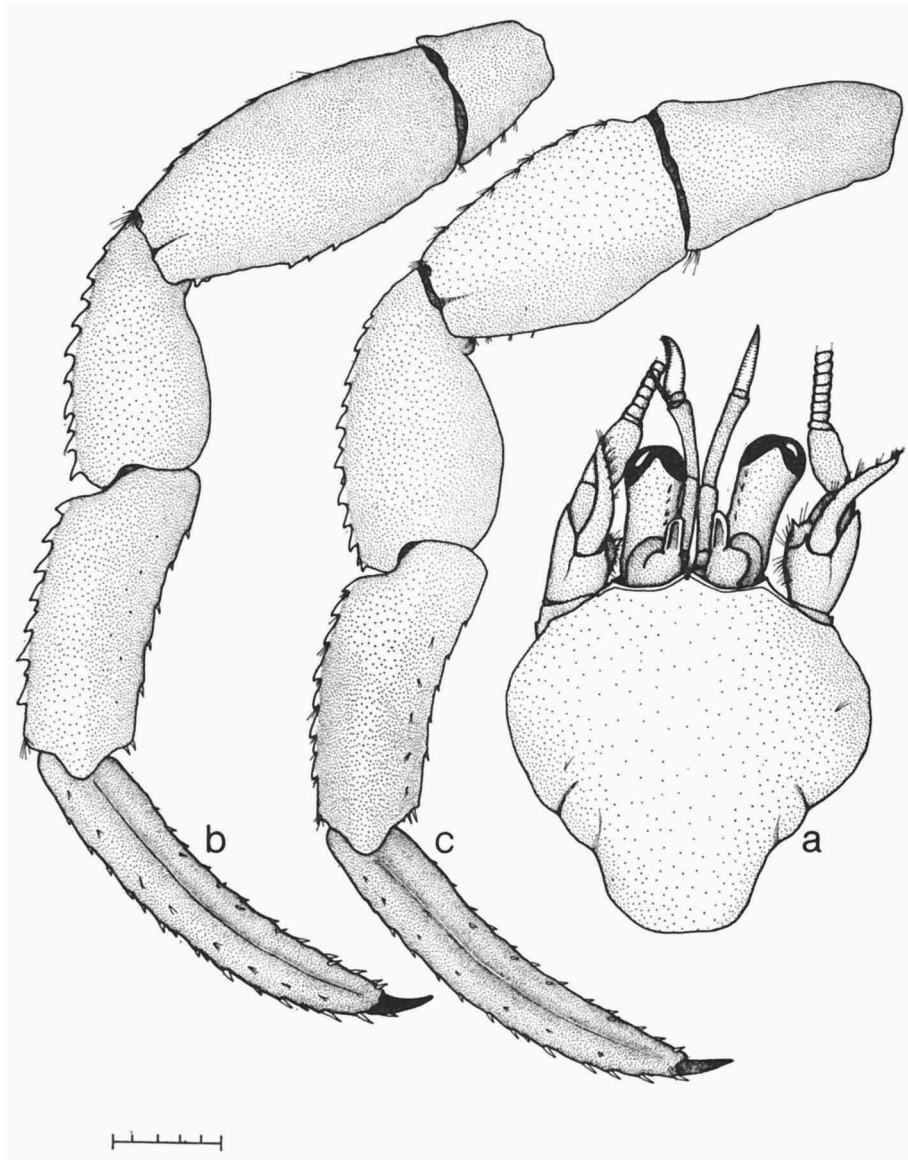


Fig. 81. *Ellassochirus tenuimanus* (Dana). a, shield; b, left P₂ (lateral view); c, left P₃ (lateral view). Scale equals 5 mm.

lateral distal angle strongly produced, terminating in simple or bifid spine, lateral margin straight, with few tufts of setae, mesial margin expanded, with 2 or 3 small spines; dorsal surface with weak longitudinal sulcus, dorso-mesial distal angle with strong acute spine, small accessory spine and tufts of long setae on mesial face. First segment with ventrodistal margin produced, 5 or 6 small spines laterally; laterodistal angle with small spine. Antennal acicles long, often exceeding proximal half of ultimate peduncular segment; strongly arcuate; terminating in small simple or bifid spine; mesial margin with row of tufts of short setae. Antennal flagella long, usually exceeding right cheliped; each article with 1 or 2 very short bristles.

Mandible without distinctive characters. Maxillule with 1 or 2 bristles on moderately well developed internal lobe of endopodite, external lobe produced, recurved toward interior. Maxilla with endopodite inflated basally, reflexed, somewhat exceeding scaphognathite in distal extension. First maxilliped with endopodite approximately four-fifths length of exopodite. Second maxilliped with basis-ischium partly fused. Third maxilliped with basis-ischium fusion incomplete; 1 small spine on basis; ischium with crista dentata well developed, 1 accessory tooth; merus with ventral margin usually unarmed, 1 small spine at dorsodistal margin. Sternite of m_{xp_3} unarmed, with dense, long, marginal setae.

Right cheliped grossly larger than left; overreaching second and third pereopods; palm with some degree of clockwise torsion. Dactyl usually equalling or slightly exceeding length of palm; dorsoventrally compressed, considerably broadened proximally; cutting edge with row of strong, calcareous teeth; terminating in prominent calcareous tooth; dorsal surface with elevated longitudinal ridge armed with irregular double row of closely spaced tubercles, delimited laterally by moderately deep longitudinal furrow, remaining surface area with scattered small tubercles; dorsomesial margin with row of prominent tubercles; mesial and ventral surfaces with closely spaced small tubercles. Palm slightly longer than one-half length of carpus, strongly inflated dorsoventrally, margins compressed, lateral margin slightly arcuate, mesial margin strongly expanded; fixed finger short, very broad with prominent ridge mesially; dorsal and ventral surfaces with closely spaced tubercles, dorsomesial and dorsolateral margins with strong tuberculate spines. Carpus approximately one-fourth longer than merus, considerably more slender than palm; dorsal surface convex, with irregular rows of moderately strong, often widely spaced subacute spines; dorsomesial margin with row of very strong, acute spines, distal margin with row of small spines; lateral and mesial faces tuberculate or spinulose; ventral surface with distomesial region strongly excavated, distolateral margin with 4 prominent simple

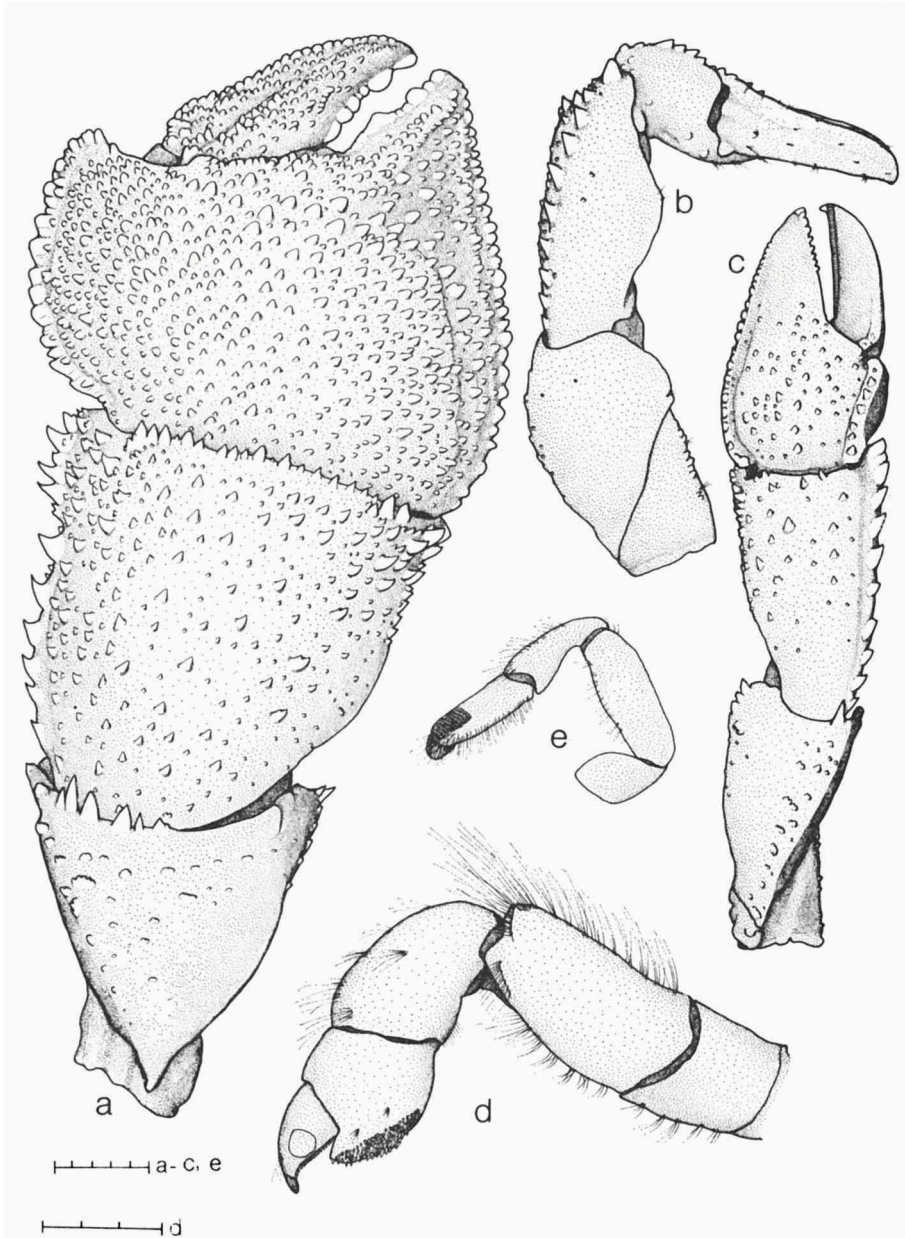


Fig. 82. *Ellassochirus tenuimanus* (Dana). a, right cheliped (dorsal view); b, left cheliped (dorsomesial view); c, left cheliped (laterodorsal view); d, left P₄ (lateral view); e, left P₅ (lateral view). Scales equal 5 mm (a-c, e) and 3 mm (d).

or bifid spines. Merus broadly triangular; dorsal surface with short row of raised, multifid spinose scales, extending onto mesial face distally; mesio-distal and dorsodistal margin with moderately strong spines; lateral face often spinulose or weakly tuberculate, ventrolateral margin with row of spines, strongest distally; ventromesial proximal angle with blunt tubercle. Ischium with row of very small subacute tubercles and few tufts of setae on ventral margin, ventromesial distal angle with tuft of coarse bristles. Coxa with irregular row of small tubercles on ventrolateral margin, ventroproximal angle with cluster of small spinulose tubercles, ventromesial distal angle with tuft of coarse bristles.

Left cheliped short, reaching only to middle third of right chela; with strong degree of counterclockwise torsion. Dactyl approximately one-third longer than palm, thick; cutting edge with row of very small corneous teeth; terminating in prominent corneous claw; slightly overlapped by fixed finger; dorsal surface flattened, unarmed, with corneous ridge near dorsomesial proximal angle. Palm and fixed finger with margins elevated, dorsal surface slightly convex; dorsomesial margin with row of strong corneous-tipped tubercles, dorsolateral margin with corneous tuberculate ridge, surface with conical blunt spines or spinulose tubercles, extending onto fixed finger proximally; lateral face slightly concave, with scattered tubercles and tufts of short bristles, ventrolateral margin with distinct ridge not extending onto fixed finger; mesial face with few low, broad tubercles or protuberances; ventral surface unarmed and with few tufts of short bristles. Carpus approximately twice length of palm; morphological dorsal surface lying in horizontal plane, margin with row of strong conical spines, irregularly interspersed with very small spines; lateral face with widely spaced irregular rows of blunt tuberculate spines, distal margin with few small spines and tufts of short setae; ventral and mesial surfaces somewhat tuberculate, with scattered tufts of short setae. Merus slightly less than or equalling carpus in length, triangular; dorsal margin with single or double row of spinulose tubercles or transverse spinulose ridges distally; 2 or 3 small spines on distal margin; mesial and lateral faces usually glabrous; ventral surface with scattered tufts of setae, ventrolateral distal margin with row of small spines, increasing in size distally. Ischium with row of small spines on ventral margin, partially obscured by tufts of long setae; ventrolateral proximal margin with broad protuberance. Coxa with row of small spines on ventrolateral margin proximally, few spinules near ventrolateral distal angle; ventromesial and dorsal margins with tufts of long setae.

Second pereopods with dactyl exceeding propodus by one-third to one-half its own length, moderately deep; terminating in strong corneous claw;

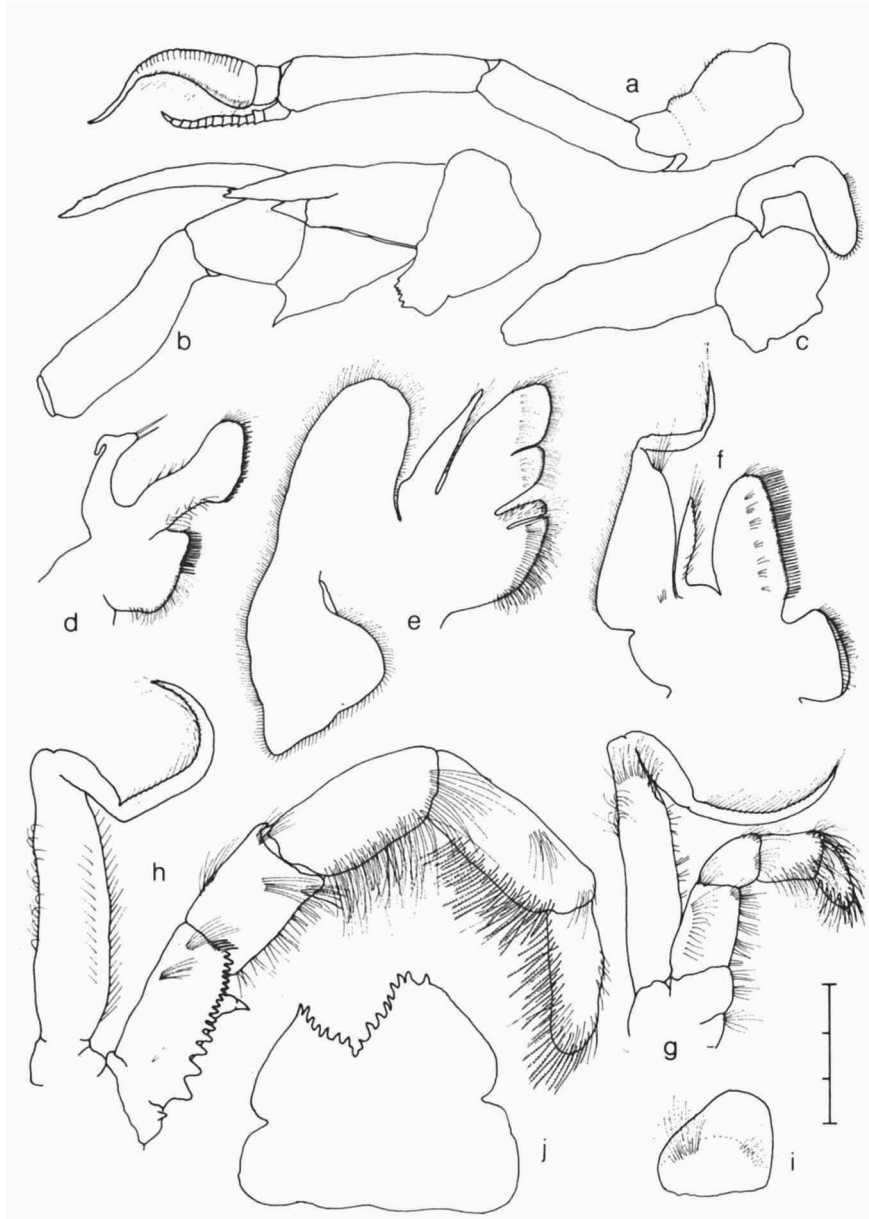


Fig. 83. *Ellassochirus tenuimanus* (Dana). a, antennule (lateral view); b, antennal peduncle (lateral view); c-h, mouthparts (left, internal face): c, mandible; d, maxillule; e, maxilla; f, mxp₁; g, mxp₂; h, mxp₃. — i, sternite, P₃; j, telson. Scale equals 3 mm.

in lateral view, strongly curved ventrally; in dorsal view, straight; dorsal margin with single or double row of corneous spines, increasing in size distally; mesial face with prominent longitudinal sulcus flanked by row of strong corneous spines; lateral face with prominent longitudinal sulcus

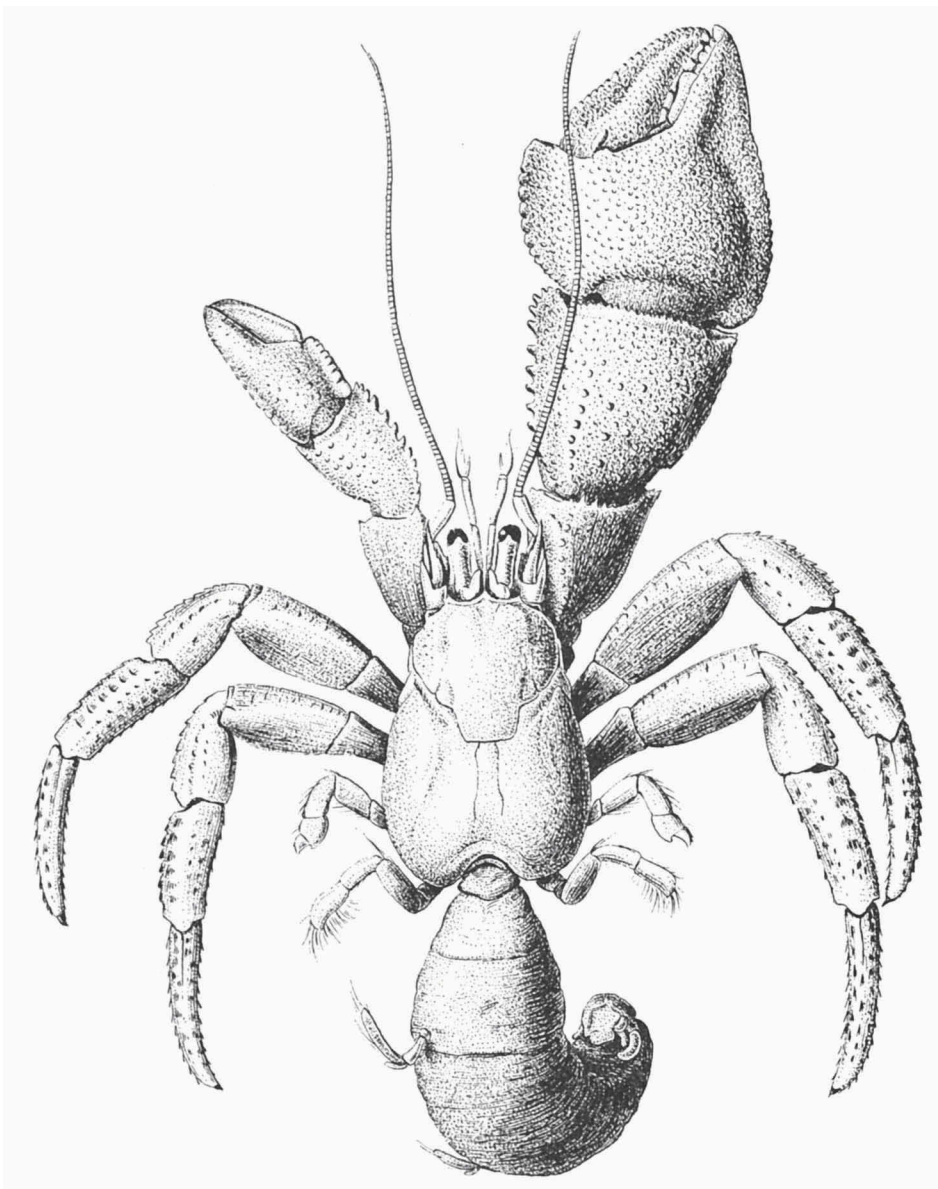


Fig. 84. *Ellassochirus tenuimanus* (Dana). Original illustration of J. E. Benedict.

flanked by row of short bristles; ventral margin with row of corneous spines. Propodus usually slightly longer than carpus; dorsal margin with 1 or 2 rows of moderately strong spines; mesial face with row of protuberant corneous spines and row of tufts of short bristles; lateral face with 2 or 3 rows of tufts of short bristles; ventral margin with 1 or 2 rows of corneous spines. Carpus slightly shorter than merus; dorsal margin with row of strong spines; lateral face usually without longitudinal sulcus; mesial, lateral and ventral surfaces with tufts of short setae. Merus laterally compressed; dorsal margin with irregular rows of tufts of short setae or bristles, distal margin with row of short bristles; ventral margin with row of minute spinules, 1 strong spine at ventrolateral distal angle. Ischium with only few scattered tufts of setae. Coxa with several minute spinules at ventrolateral distal angle; ventromesial margin with tufts of long setae.

Third pereopods with dactyl approximately twice length of propodus, terminating in strong corneous claw; in lateral view, curved ventrally; in dorsal view, slightly twisted; dorsal margin with irregular double row of corneous spines; mesial face with prominent longitudinal sulcus flanked above by single or double row of strong corneous spines, below by single row of corneous spines; lateral face with prominent longitudinal sulcus flanked by 1 or 2 rows of tufts of short bristles; ventral margin with row of strong corneous spines, increasing in size distally. Propodus slightly shorter than carpus; dorsal margin with row of low, protuberant corneous spines; mesial face with scattered corneous spinules; lateral face with tufts of short bristles; ventral margin with row of corneous spines, 2 or 3 corneous spines at ventromesial distal angle. Carpus approximately equalling length of merus; dorsal margin with row of moderately strong spines; lateral, mesial and ventral surfaces with tufts of short bristles. Merus laterally compressed; dorsal and ventral margins each with double row of short bristles, dorsodistal margin with short bristles; mesial and lateral faces with few scattered tufts of short setae. Ischium with tufts of short setae on dorsal and ventral margins. Coxa with row of tufts of long, stiff setae on ventromesial and ventrodistal margins.

Fourth pereopods with prominent "type A, P₄ structure" on median lateral face of dactyl, row of corneous denticles marginally. Propodus with prominent rasp on ventrolateral face.

Fifth pereopods as in *Pagurus*.

Sternite of third pereopods roundly rectangular; anterior margin with long setae.

Pleopods of male, pl₃-pl₅, unpaired, with exopodite well developed, margins with long, fine setae; endopodites reduced. Females with pleopods, pl₂-pl₄,

unpaired, both rami well developed; exopodites with tufts of setae terminally, endopodites with tufts of very long setae; pl₅, unpaired, exopodite well developed, endopodite rudimentary.

Telson with posterior lobes usually triangular, asymmetrical, left lobe considerably larger than right; separated by prominent median cleft; right terminal margin with 6-10 strong spines, strongest at terminolateral angle; left terminal margin with 7-12 strong spines, strongest at terminolateral margin. Anterior lobes unarmed.

Coloration. — In life: "... Chelipeds natal brown to blue with chrome at both the proximal and distal ends, spines white; carpus natal brown tinged with maroon, tubercles white tipped; hand cinnamon. Ambulatory legs with merus similar to that of chelipeds; first three segments from the distal end pale olive buff to chrome spotted and streaked longitudinally with maroon. Flagellum of antennae cinnamon with a maroon line extending full length of both the outer and inner surfaces" (Stevens, 1925: 294). In preservative: Chelipeds fading to reddish-orange, dactyls, propodi, and carpi of second and third pereopods spotted and longitudinally streaked with red.

Distribution. — Aleutian Islands west to Komandorskiye Ostrova (Makarov, Vinogradov); Zaliv Olga (Makarov); Aleutian Islands southward to Straits of Juan de Fuca and Puget Sound (Rathbun, Stevens); Bare Island (Lenz); Bering Sea (McLaughlin); intertidal to 224 meters.

Affinities. Superficially, *Elassochirus tenuimanus*, appears most closely related to several species of the genus *Pylopagurus*, because of the operculate form of the right cheliped; however, the absence of paired first pleopods in the females immediately distinguishes it from species of *Pylopagurus*. Similarly, the operculate and tuberculate right chela immediately distinguishes this species from the other known species of *Elassochirus*.

***Elassochirus cavimanus* (Miers) new combination (figs. 85-87)**

Eupagurus cavimanus Miers, 1879: 21, 48, pl. 3 fig. 1 (type locality: 41°40'N 141°10'E, Tsugaru Strait). — A. Milne Edwards & Bouvier, 1900: 257. — Alcock, 1905: 178. — Terao, 1913: 365. — Yokoya, 1933: 81.

Eupagurus (Elassochirus) munitus Benedict, 1892: 19 (by implication; type locality: Alaska, here restricted by lectotype selection to south entrance, Akutan Pass, Alaska, "Albatross" station 2843).

Pagurus (Elassocheirus) munitus: Holmes, 1900: 150 (by implication; misspelling of *Elassochirus* Benedict, Holmes, 1900: 135).

Pagurus munitus: Rathbun, 1904: 151, pl. 5 fig. 2. — Rathbun, 1910: 151, pl. 5 fig. 2. — Williamson, 1915: 479. — Gordan, 1956: 332. — McLaughlin, 1963: 6.

Eupagurus munitus: Alcock, 1905: 179.

? *Eupagurus gotoi* Terao, 1913: 366, fig. 2 (type locality: Aomori Prefecture, Japan; see discussion).

Pagurus cavimanus: Makarov, 1938b: 178, fig. 68b. — Vinogradov, 1950: 226 (key). — Birstein & Vinogradov, 1953: 224. — Yamaguchi & Yamada, 1955: 132. — Gordan,

1956: 327. — Kobjakova, 1956: 56. — Miyake, 1957: 87. — Kobjakova, 1958a: 231. — Kobjakova, 1958b: 252. — Lindberg et al., 1959: 232. — Makarov, 1962: 169, fig. 68b. — Miyake, Sakai & Nishikawa, 1962: 125. — McLaughlin, 1963: 21. — Birkeland, 1971: 194. — Hart, 1971: 1542.

Pagurus cavimanus?: Makarov, 1938b: 154, 302. — Makarov, 1962: 146.

Pagurus cavimanus munitus: Makarov, 1938b: 155. — Makarov, 1962: 147.

Pagurus gilli cavimanus: Makarov, 1938b: 178. — Makarov, 1962: 168.

? *Pagurus gotoi*: Gordan, 1956: 330.

not *Eupagurus cavimanus*: Balss, 1913: 58, fig. 34 (= *Elassochirus gilli* (Benedict, 1892)).

not *Eupagurus munitus*: Balss, 1913: 58 (= *Elassochirus gilli* (Benedict, 1892)).

not *Pagurus cavimanus*: Makarov, 1938b: 155. — Makarov, 1962: 147 (= *Elassochirus gilli* (Benedict, 1892)).

Holotype of *Eupagurus cavimanus* Miers. — ♂ (SL = 6.3 mm), BM 73-28. Lectotype of *Eupagurus munitus* Benedict, herein selected. — ♀ (SL = 15.9 mm), USNM 16633. Holotype of *Eupagurus gotoi* Terao. — Not seen.

Material examined. — See table 29.

Table 29. *Elassochirus cavimanus* (Miers) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex				SL (mm)	Collector
				♂+	♀	♀♀	♀+		
<i>Japanese Seas</i>									
41°40'N, 141°10'E	---	---- BM 73-28	----	1				6.3	---
<i>Bering Sea</i>									
East Landing, St. Paul I.	26	---- USNM	27/8/63	1				3.6	Fiscus
55°40'N, 162°23'W	80	SBL C-8 RMNH	29/7/61	2				4.4-16.9	USFWS
54°39'N, 165°12'W	73	SBL Z-5 RMNH, AHF	4/8/61	2	3	1		8.3-16.8	USFWS
53°39'N, 165°56'W	82	Albatross 2843 USNM 16633, 140581	28/7/88	1	1			9.4-15.9	---
Off Cape Cheerful, Unalaska I.	91	---- USNM	18/11/65	1				8.2	Fiscus
NW off Unimak I.	---	Albatross 3258 USNM 16646	----	8	17	5		7.5-17.1	---
<i>Gulf of Alaska</i>									
Between Unimak & Shumagin Is.	---	---- USNM	summer 61	1				9.5	INPHC
Greater Kodiak I.	---	---- USNM	summer 61	2		1		11.1-12.2	INPHC
57°54'N, 155°00'W	32	41A USNM	11/5/61	1	1			13.6-14.4	INPHC
58°23'N, 134°58'W	95	---- RMNH	1/7/63	1				19.3	Gonor
58°18'N, 135°55'W	56	1A USNM	14/7/61	2	1			17.4-21.1	INPHC
58°12'N, 135°02'W	---	---- BM, CNM	1/7/63	2		3		10.4-17.1	Gonor
Alexander Archipelago	---	---- USNM	14/7/61	1		1		18.0-21.1	INPHC
Phonah	---	---- USNM	20/3/51	1				19.1	JNC
Pt. Highland, Frederick Sound	---	---- USNM	14/9/32	2	1			7.9-11.9	Stevens
Off Pt. Pybus, Frederick Sound	---	---- USNM	18/4/51	1	1			6.3-7.6	JNC
<i>British Columbia</i>									
N end Kaisen Halibut Bank	199	---- USNM	28/7/36	1				7.4	Stevens

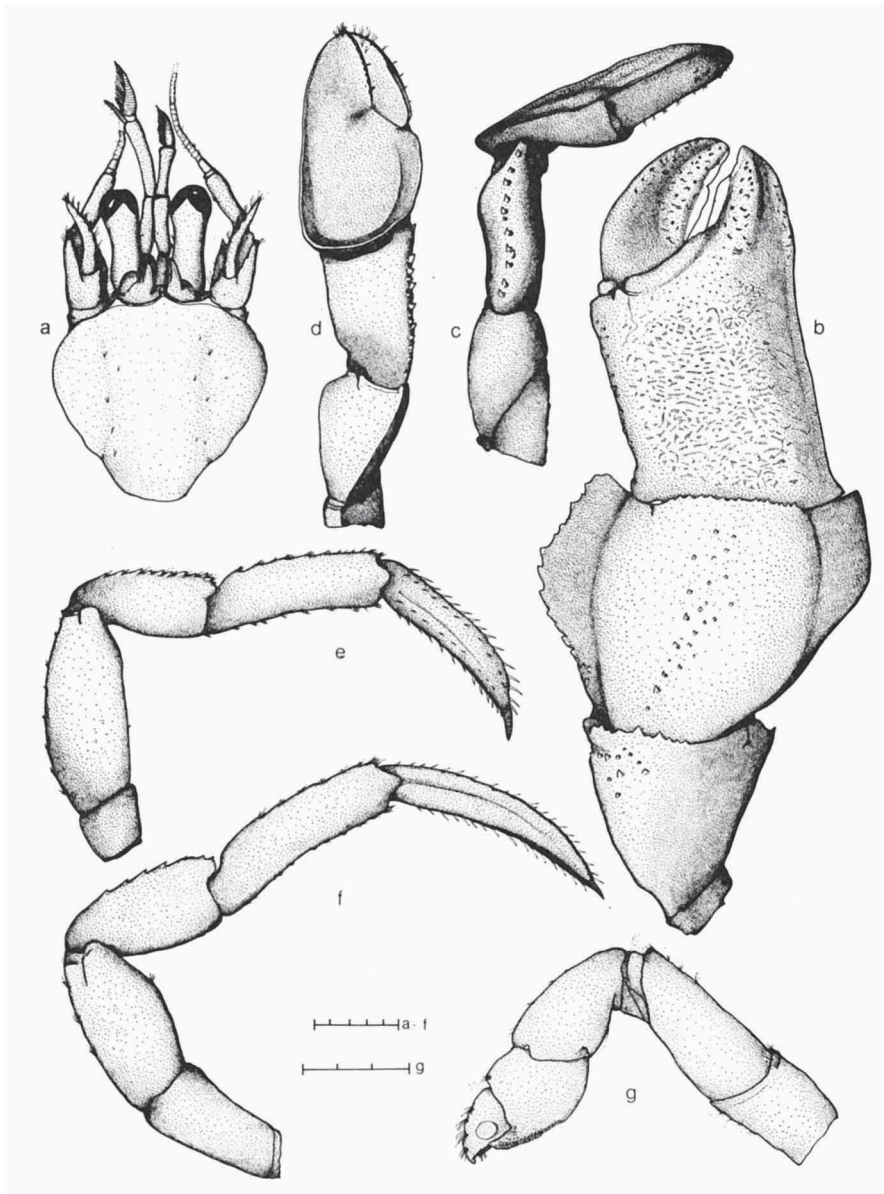


Fig. 85. *Ellassochirus cavimanus* (Miers). a, shield; b, right cheliped (dorsal view); c, left cheliped (dorsomesial view); d, left cheliped (laterodorsal view); e, right P₂ (lateral view); f, right P₃ (lateral view); g, left P₄ (lateral view). Scales equal 5 mm (a-f) and 3 mm (g).

Diagnosis. — Right cheliped with carpus strongly compressed in mesial-lateral axis, expanded into "wing-like" projections; dorsal surface with median longitudinal row of small spines or spinules.

Description. — Shield slightly longer than broad to somewhat broader than long; anterolateral margins terraced; anterior margin between rostrum and lateral projections straight or slightly concave; posterior margin truncate or broadly ovate; dorsal surface generally smooth, with few tufts of setae; anterolateral angle produced, spinulose. Branchiostegites with tufts of setae marginally. Rostrum moderately long, exceeding lateral projections; acutely or obtusely triangular, often with small marginal or submarginal spine. Lateral projections obtuse or broadly rounded, usually with strong marginal or submarginal spine.

Ocular peduncles moderately short, one-half or less length of shield, stout, inflated basally and in corneal region, dorsal surface often with tufts of short setae. Ocular acicles long, generally slender; subrectangular with lateral and mesial margins subparallel, elevated with prominent, longitudinal median furrow; terminating subacutely, usually with submarginal spine, occasionally with tuft of short setae; separated basally by one-half to two-thirds basal width of one acicle.

Antennular peduncles long, exceeding ocular peduncles by one-half to entire length of ultimate segment; all segments unarmed, often with few tufts of short setae.

Antennal peduncles moderately short, usually equalling or slightly exceeding ocular peduncles, occasionally reaching only to cornea; with supernumerary segmentation. Fifth and fourth segments unarmed, with few tufts of short setae. Third segment with strong acute spine at ventromesial distal angle, ventral margin with tufts of short setae. Second segment with dorso-lateral distal angle strongly produced, terminating in simple or bifid spine, lateral margin straight, unarmed, mesial margin strongly inflated, unarmed or with 1-3 small spines; dorsomesial distal angle with small spine or tubercle. First segment with small spine at laterodistal angle; ventromesial distal margin produced, usually with 1-3 spinules laterally, rarely unarmed. Antennal acicles moderately long, usually equalling or exceeding ocular peduncles; strongly arcuate; terminating in small spine; mesial margin with low protuberances and tufts of short setae, lateral margin unarmed. Antennal flagella short, usually not exceeding length of right cheliped; most articles with few very short setae.

Mandible without distinctive characters. Maxillule with proximal endite subquadrate; endopodite with 2 bristles on produced internal lobe, external lobe well developed, recurved toward interior. Maxilla with endopodite

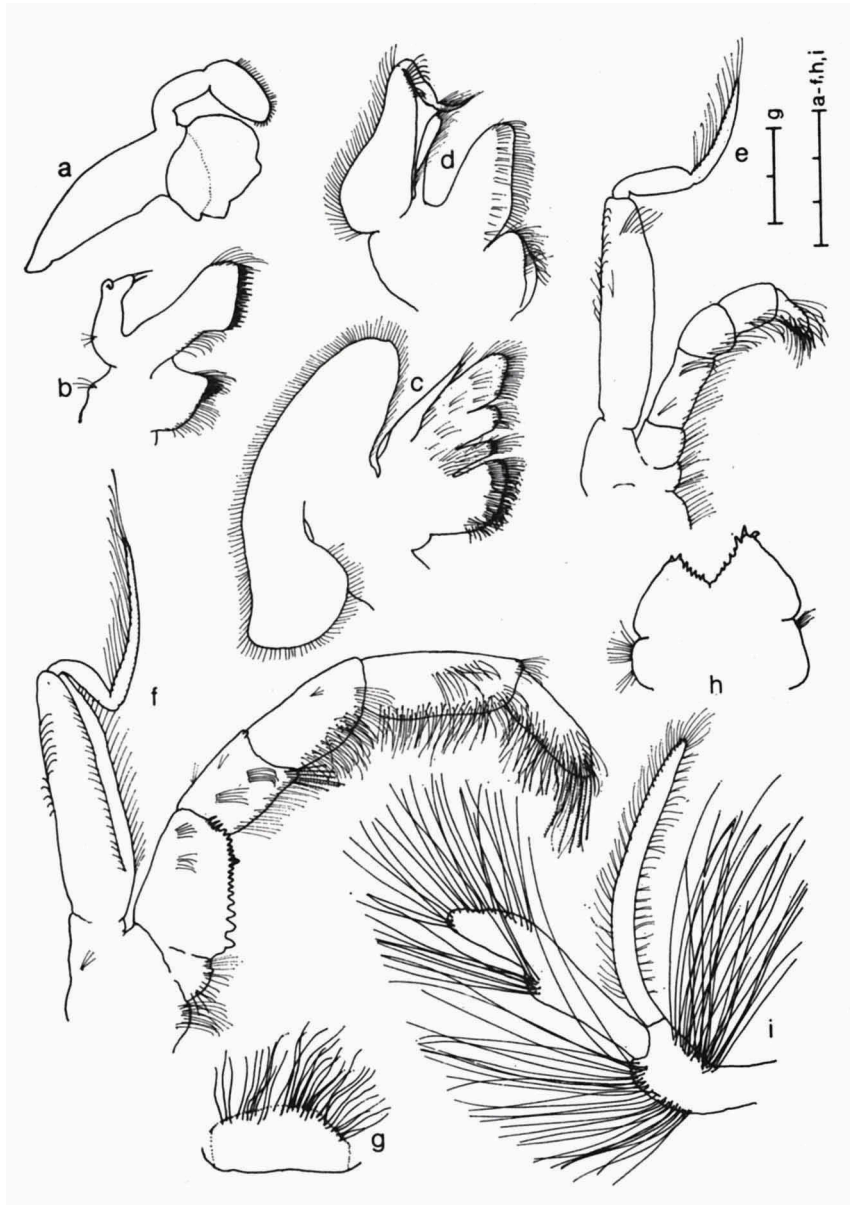


Fig. 86. *Ellassochirus cavimanus* (Miers). a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite, P₃; h, telson; i, ♂, pl₃. Scales equal 3 mm (a-f, h, i) and 1 mm (g).

broadly inflated basally, reflexed, slightly less than or equalling scaphognathite in distal extension. First maxilliped with endopodite approximately two-thirds length of exopodite. Second maxilliped with basis-ischium partially fused. Third maxilliped with basis-ischium fusion incomplete; basis with 1 small spine; ischium with crista dentata well developed, 1 accessory tooth; merus with 1 small spine at dorsodistal margin, ventral margin unarmed or with 1 small spine. Sternite of mxp_3 unarmed, with row of long setae.

Right cheliped considerably larger than left; overreaching second and third pereopods; palm with some degree of clockwise torsion. Dactyl usually slightly longer than palm; mesial margin strongly arcuate; tip depressed; cutting edge with row of strong calcareous teeth; terminating in minute corneous claw, usually noticeably worn; slightly overlapped by fixed finger. Dorsal surface with prominent longitudinal groove, pitted and somewhat rugose; mesial and ventral surfaces slightly rugose. Palm with dorsal surface convex, faintly reticulate, more pronounced in large specimens; margins parallel, lateral margin somewhat elevated, dorsolateral proximal angle produced; mesial margin spinulose or tuberculate; ventral surface slightly convex, faintly rugose; fixed finger short, broad; dorsal surface convex with prominent depression laterally; cutting edge with strong calcareous teeth; terminating in calcareous tooth. Carpus approximately one-fourth longer than palm; very strongly produced and compressed mesially and laterally into "wing-like" projections: dorsal surface angularly convex, with single or double row of small spines or spinulose tubercles proximally, becoming more widely scattered distally; distal margin with row of small simple or bifid spines; mesial margin with row of strong spines, blunt distally, mesial face spinulose; lateral margin strongly reflexed proximally, forming deep hollow on ventrolateral surface, unarmed; ventral surface concave in regions of "wings", glabrous. Merus short, approximately two-thirds length of carpus, triangular; dorsal, dorsolateral, and dorsomesial surfaces with clusters of small acute spines or spinules distally; dorsodistal margin with strong spines extending mesially and laterally; ventrolateral distal margin with 2-3 strong spines, ventromesial distal angle with blunt tubercles. Ischium with few, low spinulose tubercles on ventromesial margin; low broad tubercles on ventrolateral margin proximally. Coxa with low tubercle on ventrolateral surface distally, ventroproximal angle with broad tubercle.

Left cheliped moderately short, reaching to distal half of palm of right cheliped, slender, somewhat triangular; with strong degree of counter-clockwise torsion. Dactyl somewhat exceeding palm in length, thick; cutting edge with small corneous teeth; terminating in small corneous claw; slightly overlapped by fixed finger; dorsal surface unarmed, dorsomesial margin

somewhat elevated proximally, with few tufts of bristles distally; mesial and ventral surfaces with tufts of bristles. Palm and fixed finger with dorsal surface concave, margins strongly elevated; lateral and ventral surfaces with few tufts of short bristles; cutting edge with row of small corneous teeth, interspersed with small calcareous teeth. Carpus one-third to one-half longer than palm; morphological dorsal surface lying in horizontal plane, margin with row of moderately strong spines; lateral, mesial and ventral surfaces usually glabrous. Merus slightly less than or equalling carpus in length, triangular; dorsal margin with row of small spinules, 1 or 2 moderately strong

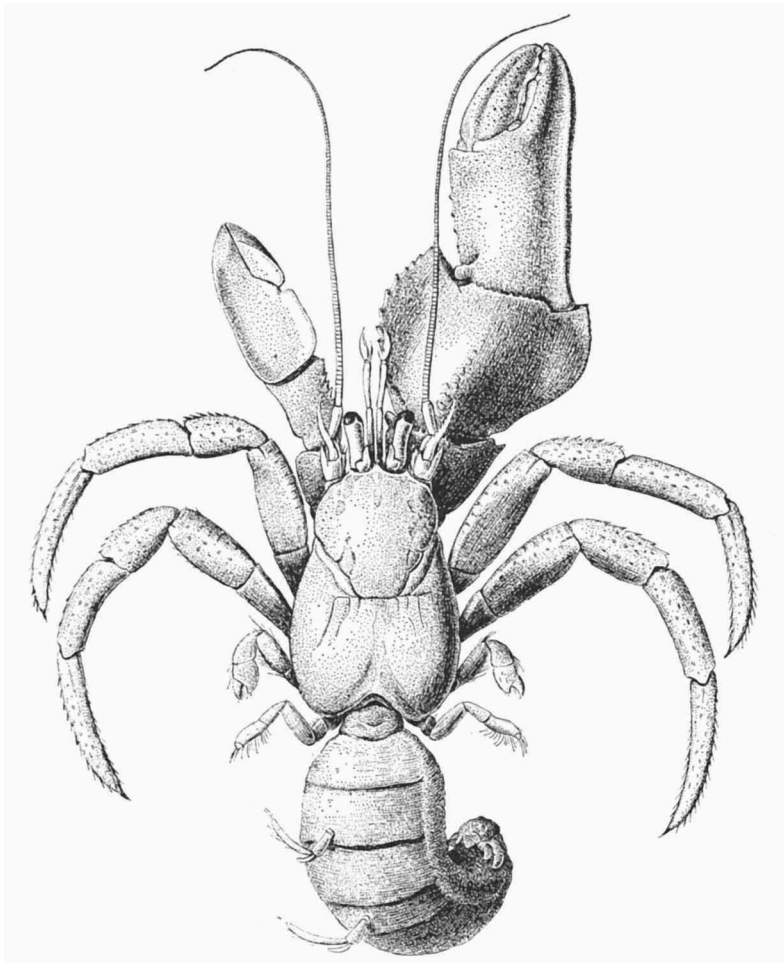


Fig. 87. *Ellassochirus cavimanus* (Miers). Original illustration of J. E. Benedict of *Eupagurus munitus* Benedict.

spines on dorsodistal margin; ventrolateral distal margin with 2-3 spines, occasionally with small spine at ventrolateral distal angle. Ischium with low broad protuberances on ventrolateral proximal margin, ventromesial margin with tufts of setae. Coxa with long setae at ventromesial distal angle.

Second pereopods with dactyl approximately one-fourth longer than propodus, moderately deep, laterally compressed; terminating in strong corneous claw; in lateral view, curved slightly ventrally; in dorsal view, straight, or curved slightly mesially; dorsal margin with irregular double row of strong corneous spines, increasing in size distally; mesial face often with faint longitudinal sulcus and usually with single or double row of corneous spinules and tufts of short bristles; lateral face with weak longitudinal sulcus proximally and tufts of short bristles; ventral margin with row of strong, corneous spines and tufts of short bristles. Propodus slightly longer than carpus, laterally compressed; dorsal margin with single or double row of corneous spinules; mesial and lateral faces usually glabrous; ventral margin with 1 or 2 rows of corneous spinules, increasing in size distally, 2 strong corneous spinules at distal margin. Carpus approximately three-fourths length of merus; dorsal surface with row of small spines; remaining surfaces unarmed, often with few tufts of short bristles. Merus laterally compressed; dorsal margin with row of low protuberances and tufts of short bristles; ventral margin with row of small spinules, decreasing in size distally. Right ischium usually with row of small spines or spinules; left ischium unarmed, with few tufts of setae. Coxa with tufts of fine setae on ventromesial margin.

Third pereopods with dactyl equalling or slightly exceeding propodus in length, moderately deep; terminating in strong corneous claw; in lateral view, curved slightly ventrally; in dorsal view, straight or curved slightly mesially; dorsal margin with double row of strong corneous spinules; mesial face often with faint longitudinal sulcus and 1 or 2 irregular double rows of strong corneous spinules and few tufts of short setae; lateral face usually with weak longitudinal sulcus proximally and tufts of short setae; ventral margin with row of strong corneous spines, increasing in size distally. Propodus equalling or slightly exceeding length of carpus, somewhat compressed laterally; dorsal margin with double or triple row of small corneous spinules; mesial and lateral faces glabrous; ventral margin with double row of small corneous spinules, increasing in size distally. Carpus slightly shorter than merus; dorsal surface with row of small spinules becoming more prominent distally and few tufts of setae; mesial, lateral and ventral surfaces unarmed. Merus laterally compressed; dorsal and ventral surfaces each with 1-3 rows of short bristles. Ischium unarmed, ventral margin with row of setae. Coxa with tufts of fine setae on ventromesial margin.

Fourth pereopods with prominent "type A, P₄ structure" on median lateral face of dactyl. Propodus with narrow rasp on ventrolateral face.

Fifth pereopods as in *Pagurus*.

Sternite of third pereopods varying from roundly rectangular to sub-semiovate, slightly skewed to left; margin with row of long setae.

Pleopods of male normally unpaired, pl₃-pl₅ with exopodite well developed, with fine, marginal setae, endopodite reduced; rarely with vestige of paired pl₂; occasionally with pl₅ absent. Females with pleopods unpaired, pl₂-pl₄ with exopodites moderately well developed with long, fine marginal setae; endopodites well developed, somewhat "paddle-shaped" distally, with tufts of long thick setae; pl₅ with exopodite moderately well developed, endopodite reduced. Intersex specimens usually with pl₂-pl₄ unpaired, moderately well developed, both rami as in females, rarely pl₂ absent; pl₅ unpaired, normal; gonopores of fifth coxal segments as in normal males.

Telson with posterior lobes asymmetrical, left lobe larger than right; sub-triangular or triangular; separated by prominent, median cleft; right terminal margin with 3-11 corneous spines, strongest at terminolateral angle; left terminal margin with 5-11 corneous spines, strongest at terminolateral angle, rarely with 1 spine on lateral margin distally. Anterior lobes unarmed.

Coloration. — In life: "Hand brick red, cutting edge cream. Carpus and merus lavender-purple with spines and margins red. Legs dark, brick red with white spots, at base of each brown hair and generally over surface. Spots crescent-shaped" (J. Gonor, field notes). In preservative: Color fading to cream and purple on cheliped, light red with white spots on ambulatory legs. Eventually fading to straw color overall. Ocular peduncles usually retain dark, reddish-purple tint.

Distribution. — Japan, Sado Island, Tugaru Strait (Yokoya), northern Japan (Miers, Yamaguchi & Yamada); Sea of Japan, Sakhalin, Kuril Islands (Kobjakova); Tottori, Niigata (Miyake, Sakai & Nishikawa); La Perouse to southern Japan (Vinogradov); Okhotsk Sea, Sakhalin, Kuril Islands (Lindberg, et al); Bering Sea, Aleutian Islands, Gulf of Alaska, British Columbia (Hart); Cobb Seamount (Birkeland); 36 to 252 meters.

Affinities. — *Elassochirus cavimanus* is most closely allied to *E. gilli*. In life, the striking purple of the carpus of *E. cavimanus* immediately distinguishes it from *E. gilli* with its solid red-orange chelipeds. In preserved material where color has been lost, several morphological characters can be used to separate the two species. The least variable, and most reliable character is found in the armature of the right chelipeds. In *E. cavimanus*, the middorsal surface of the carpus is angular and armed with a series of small spines or spinules; whereas, in *E. gilli*, the middorsal surface of the carpus

is rounded and completely devoid of spines. The spinose distal margin of the merus of the left cheliped and the generally more acute ocular acicles of *E. cavimanus* also distinguish this species from *E. gilli*.

Discussion. — Balss (1913) first placed *Eupagurus munitus* Benedict in synonymy with *Elassochirus cavimanus* (Miers); however, Balss' illustration (1913, fig. 34) is of *Elassochirus gilli*, not of *E. cavimanus* (see discussion of *E. gilli*). Careful comparison of the holotype of *Elassochirus cavimanus* (BM 73-28) with the lectotype of *Eupagurus munitus* (USNM 16633) has confirmed the conspecificity of the two species; the name *E. cavimanus* has priority.

The illustration given by Miers (1879, pl. 3 fig. 1) of *Elassochirus cavimanus* does not agree with the holotype nor with Miers' description of the right cheliped. As figured, the lateral margin of the palm ("lower margin" of Miers) is arcuate; the convex dorsal surface ("outer surface" of Miers) is smooth. In his description, Miers accurately refers to the "... hand with upper and lower margins parallel ..."; of the dorsal surface he states "... convex and slightly punctulated on its outer surface ..." (Miers, 1879: 48). It is perhaps a result of this erroneous illustration of *E. cavimanus* that A. Milne-Edwards & Bouvier (1900) related this species to *Pagurus carneus* (Pocock, 1889), a species with which *E. cavimanus* has little similarity.

In a study of the decapods of Japan, Terao (1913) described a new species of pagurid, *Eupagurus gotoi*, differentiating it from *Elassochirus cavimanus* on the basis of the convexity of the dorsal surface of the merus of the right cheliped (as opposed to "... trigonous, concave on its outer surface...", Miers, 1879: 48) and more prominent rostrum. Yokoya (1933) placed Terao's species in synonymy with *E. cavimanus*, but did not discuss his designation. Miyake (1957) lists the holotype of *Pagurus gotoi* (Terao) under material examined for *E. cavimanus*; however, he does not cite *P. gotoi* as a synonym of *E. cavimanus*. Miers' (1879: 48) statement (supra cit.), that the outer surface of the merus is concave, is incorrect; the dorsal margin of the holotype is triangularly convex; however, the condition of the specimen suggests that it may have been collected just after a molt, before the integument had hardened. The lateral surface of the merus is deeply indented distally, apparently from injury or damage. Terao's (1913: 368) description, but not his illustration of *Eupagurus gotoi*, refers to the "spinulose inner and upper margins" of the left carpus. As *E. cavimanus* lacks spinules except on its "displaced" dorsal margin, its identity with Terao's species must remain questionable until it is possible to reexamine the type of *Pagurus gotoi* (Terao). It is also not known whether *P. gotoi* has a "type A, P₄ structure".

It is apparent that Makarov (1938b, 1962) had great difficulty in determining the status of *E. cavimanus*, *E. gilli* and *Eupagurus munitus*. Although he followed the work of earlier carcinologists in his synonymies of *E. cavimanus* (including *Eupagurus munitus*), in his discussion of species distributions Makarov (1962: 147) suggested the possible synonymy of *E. gilli* with *E. cavimanus* and then gave subspecific status to *Eupagurus munitus* (= *Pagurus cavimanus munitus*). However, in his discussion of *E. gilli* (Makarov, 1938b: 176; 1962: 168) he suggested *E. cavimanus* as a subspecies of *E. gilli*. The present study has shown, that although *Eupagurus munitus* is synonymous with *E. cavimanus*, the latter species is distinct from *E. gilli*.

In addition to the taxonomic problems involving *E. cavimanus*, this study has brought out an interesting biological phenomenon. Of the 67 specimens of *E. cavimanus* examined, the sexes were approximately equally represented; however, of the 36 males, 30 percent appeared to be "intersexes". These males all possessed well developed gonopores on the coxae of the fifth pereopods and no indications of gonopores on the coxae of the third pereopods. However, all, with one exception (pl_2 missing), had pleopods pl_2-pl_4 with both rami well developed and strongly resembling the female pleopod structure. In contrast, normal males, with one exception, lacked any vestige of pl_2 , and pleopods pl_3-pl_5 were typical in the marked reduction of the endopodites. As the specimens examined represented collections made over a period of 70 years and covered a geographical area extending from southeastern Alaska through the Bering Sea to Japan, this abnormality cannot be considered a restricted, local phenomenon. None of the specimens were sufficiently well preserved to permit histological examination of gonadal tissues; therefore, it is impossible to adequately interpret the present findings. Although it is possible that these specimens may have developed secondary female sexual characters as the result of rhizocephalan infestation, no evidence of parasitism could be found through external examination. As previously indicated (p. 225), apparently intersex specimens have been found in several species of northwestern North American pagurids; however, the frequency of this aberrancy is highest in *E. cavimanus*. It is also interesting to note that Terao (1913: 368) remarked on the atypical pleopod development of his male of *Eupagurus gotoi*.

***Elassochirus gilli* (Benedict) new combination (figs. 88-90)**

Eupagurus (Elassochirus) gilli Benedict, 1892: 20 (by implication; type locality: Alaska, here restricted by lectotype selection to Nazan Bay, Atka I., Alaska).

Pagurus (Elassochirus) Gilli: Holmes, 1900: 135 (by implication; misspelling of *Elassochirus* Benedict, Holmes, 1900: 135).

- Pagurus gilli*: Rathbun, 1904: 161, pl. 5 fig. 10. — Rathbun, 1910: 161, pl. 5 fig. 10. — Williamson, 1915: 476. — Stevens, 1925: 291, figs. 12, 13. — Makarov, 1937: 65, fig. 18. — Makarov, 1938b: 176, fig. 68a, pl. 3 fig. 1. — Hart, 1940: 102. — Vinogradov, 1947: 101 (key). — Vinogradov, 1950: 226 (key), fig. 114. — Gordan, 1956: 330. — Kobjakova, 1956: 57. — Reischman, 1959: 410. — Makarov, 1962: 166, fig. 68a, pl. 3 fig. 1. — McLaughlin, 1963: 6.
- Eupagurus gilli*: Alcock, 1905: 179.
- Eupagurus cavimanus*: Balss, 1913: 58, fig. 34. Not *Eupagurus cavimanus* Miers, 1879; see discussion.
- Eupagurus minutus*: Balss, 1913: 58. Not *Eupagurus minutus* Benedict, 1892.
- Eupagurus porcellanus*: Molander, 1914: 4, pl. 1 fig. 2 (type locality: "Behring Island").
- Pagurus cavimanus*: Makarov, 1948b: 155. — Makarov, 1962: 147. Not *Pagurus cavimanus* (Miers, 1879); see discussion.
- Pagurus minutus*: Makarov, 1938b: 309. Not *Pagurus minutus* (Benedict, 1892); see discussion.
- Pagurus porcellanus*: Gordan, 1956: 333.

Lectotype, herein selected. — ♂ (SL = 13.8 mm), USNM 16904.

Material examined. — See table 30.

Diagnosis. — Carpus of right cheliped compressed on mesial-lateral axis, expanded into "wing-like" projections; dorsal surface rounded, unarmed.

Description. — Shield usually somewhat longer than broad; anterolateral margins slightly terraced; anterior margin between rostrum and lateral projections straight or slightly concave; posterior margin roundly truncate; dorsal surface generally smooth; anterolateral angle slightly produced, blunt. Branchiostegites with short setae marginally. Rostrum moderately long, exceeding lateral projections; obtusely or acutely triangular with acute terminal spine. Lateral projections obtuse or broadly rounded, with small marginal or submarginal spine.

Ocular peduncles short, less than one-half length of shield, stout; slightly inflated basally; dorsomesial face occasionally with few setae. Ocular acicles moderately long; subrectangular with lateral and mesial margins subparallel, elevated, with prominent longitudinal furrow; terminating subacutely, occasionally with small submarginal spine not visible from above; separated basally by one-half to two-thirds basal width of one acicle.

Antennular peduncles long, usually exceeding ocular peduncles by two-thirds to three-fourths length of ultimate segment; all segments unarmed, with few tufts of setae.

Antennal peduncles moderately long, exceeding ocular peduncles by one-fourth to one-half length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments unarmed. Third segment with strong spine at ventromesial distal angle, ventral margin with tufts of short setae. Second segment with dorsolateral distal angle produced, terminating in small simple or bifid spine, lateral margin straight, unarmed, mesial margin inflated, unarmed;

Table 30. *Elassochirus gilli* (Benedict) Material Examined

Locality	Depth (m)	Station		Date	Sex			SL (mm)	Collector
		Deposition			♂	♀	♂♀		
<i>Bering Sea</i>									
Bristol Bay	---	----		1956	1			18.8	USFWS
Bristol Bay	---	USNM		summer 59	2	2		6.6-16.6	USFWS
Samalga I.	---	USNM		11/9/62	2	1		7.5-10.2	Fiscus
Akutan Harbor, Akutan I.	---	ABF		26/8/62	1			13.5	Burdick
Shagak Bay, Adak I.	---	USNM		1/9/56	1			14.2	---
Eider Pt., Unalaska I.	---	USNM		3/8/63	3	6		3.8-7.4	Fiscus
Nazan Bay, Atka I.	---	RMNH		----	6	6		6.7-13.8	Dall
		USNM 16904,128943							
<i>Gulf of Alaska</i>									
Parlof Bay	27-31	----		25/7/37	1			3.7	Williams
55°41'N, 155°15'W	36	USNM 40T		13/2/62	1	1		12.4-16.3	INPHC
Auke Village recreation area	18	USNM		7/4/64	1			20.4	Gonor
Taku Harbor	---	RM		22/5/63	1			9.8	Gonor
58°12'N, 135°02'W	---	USNM		1/7/63	1			7.8	Gonor
Off Pt. Pybus, Frederick Sound	---	USNM		18/4/51	2			7.8-9.5	JNC
Amaknak I.	---	USNM		2/9/60	2	1		5.9-7.4	Henry
		RMNH							
<i>British Columbia</i>									
N end Kaisen Halibut Bank	200	----		28/7/36	1			5.7	Stevens
Victoria	---	USNM		10/6/60	1			8.4	Hart
		USNM							
<i>Washington</i>									
San Juan I.	---	----		8/61	1			15.9	McLaughlin
		USNM							
Rocky Bay, San Juan I.	---	----		8/61	1	1		5.6-8.8	McLaughlin
		CNM							
Friday Harbor, San Juan I.	---	----		1922	1			4.6	Stevens
		USNM							
Lummi I.	---	----		spring 63	1			12.0	Milburn
		RMNH							
Point Thatcher	---	----		30/8/32	1			9.0	Stevens
		USNM							
Turn I.	---	----		15/7/24	1			15.1	Lazier
		USNM							

dorsomesial distal angle with small spine. First segment with ventromesial distal margin produced, with 1 or 2 small spines laterally; laterodistal angle with small spinule. Antennal acicles moderately long, often reaching distal half of ultimate peduncular segment; strongly arcuate; terminating in small spine; mesial margin with tufts of short setae. Antennal flagella short, not exceeding length of right cheliped; articles frequently with very short setae.

Mandible without distinctive characters. Maxillule with proximal endite subquadrate; endopodite with 2 bristles on produced internal lobe, external lobe well developed, recurved toward interior. Maxilla with endopodite inflated basally, reflexed, slightly exceeding scaphognathite in distal extension.

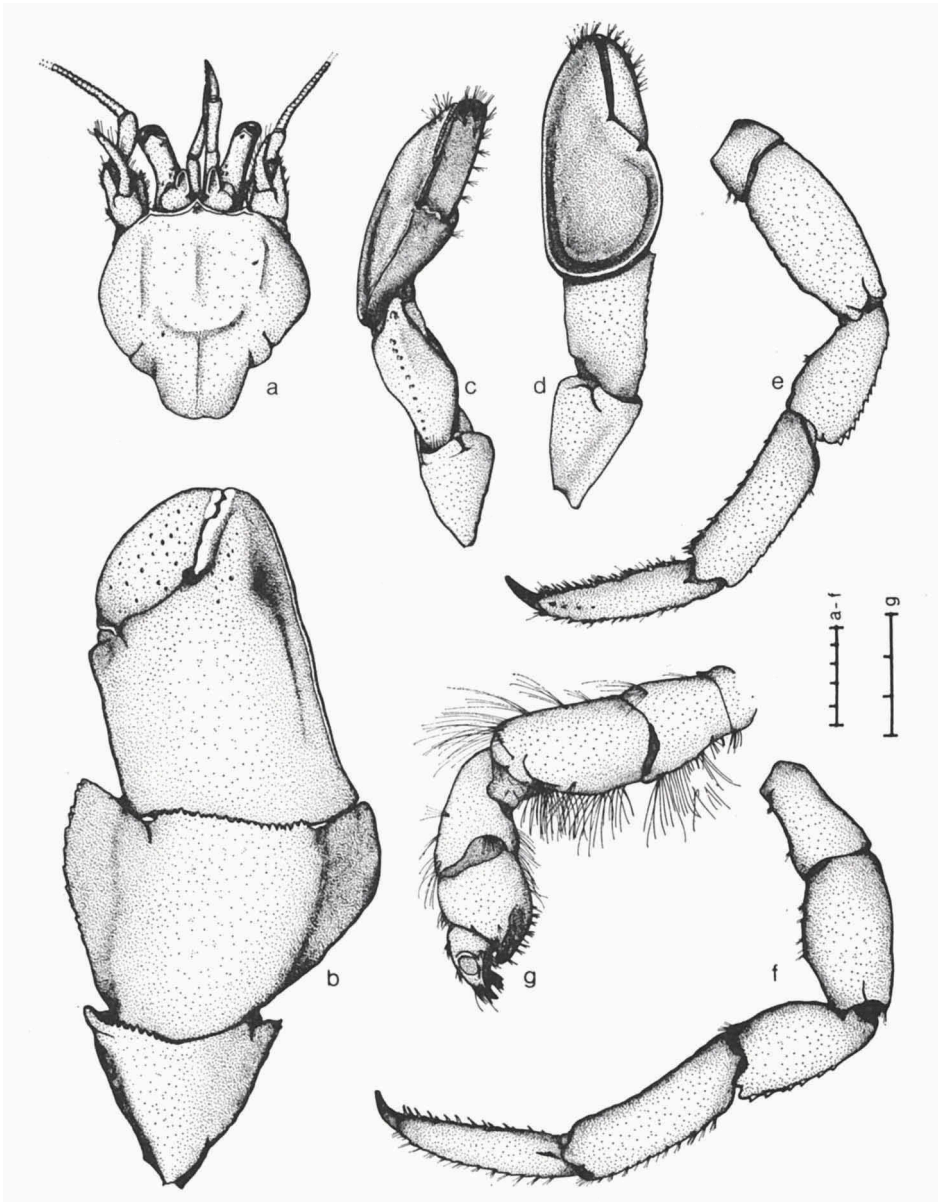


Fig. 88. *Ellassochirus gilli* (Benedict). a, shield; b, right cheliped (dorsal view); c, left cheliped (dorsomesial view); d, left cheliped (laterodorsal view); e, right P₂ (lateral view); f, right P₃ (lateral view); g, left P₄ (lateral view). Scales equal 5 mm (a-f) and 3 mm (g).

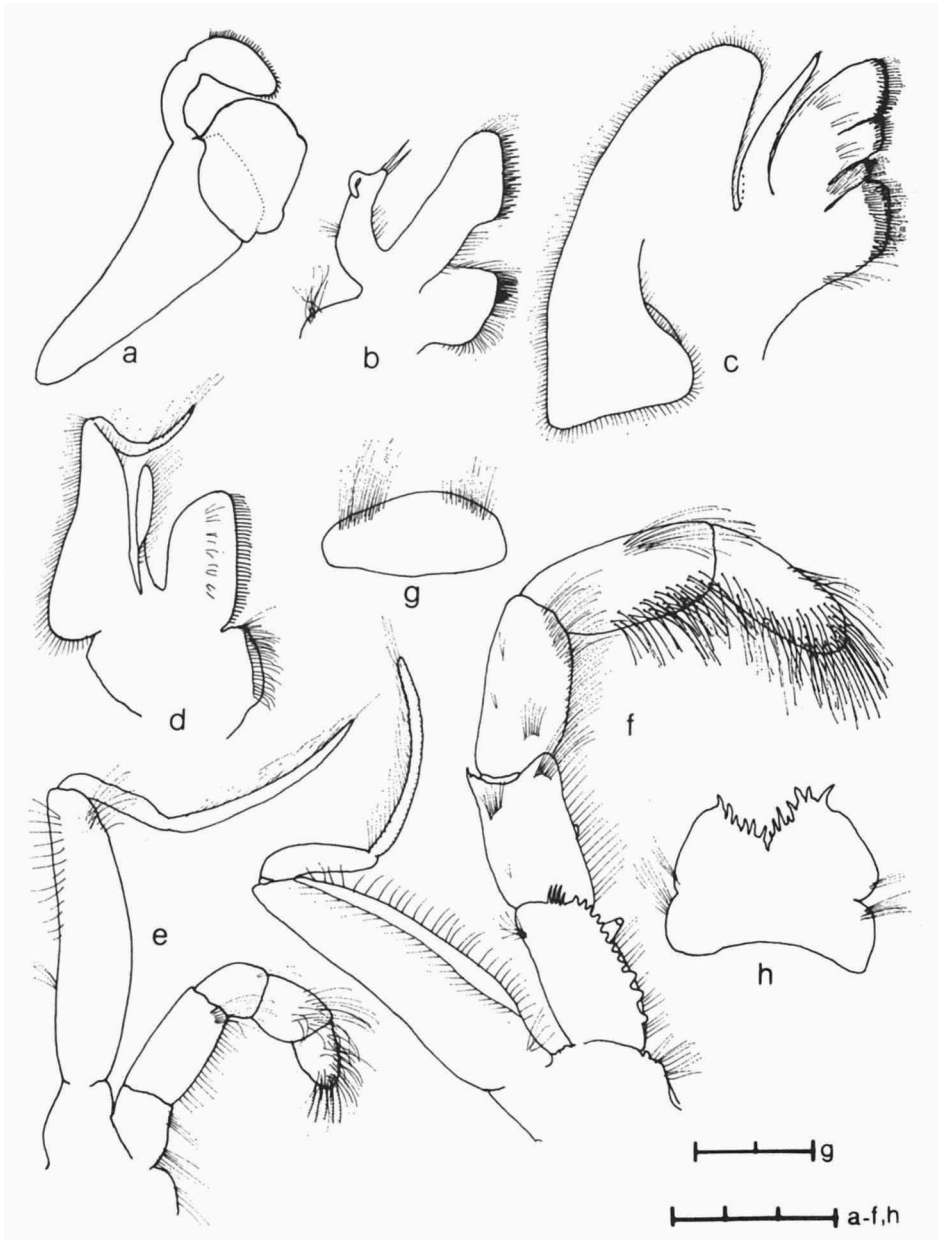


Fig. 89. *Ellassochirus gilli* (Benedict). a-f, mouthparts (left, internal face): a, mandible; b, maxillule; c, maxilla; d, mxp₁; e, mxp₂; f, mxp₃. — g, sternite, Ps; h, telson. Scales equal 3 mm (a-f, h) and 1 mm (g).

First maxilliped with endopodite approximately four-fifths length of exopodite. Second maxilliped without distinctive characters. Third maxilliped with basis-ischium fusion incomplete; basis with 1 small spine; ischium with crista dentata well developed, 1 accessory tooth; merus with small spine at dorsodistal margin, rarely 1 small spine on ventral margin. Sternite of mxp₃ unarmed, with row of long marginal setae.

Right cheliped considerably larger than left; overreaching second and third pereopods; palm with some degree of clockwise torsion. Dactyl equal to or slightly exceeding length of palm; mesial margin strongly arcuate; tip depressed; cutting edge with row of cusped calcareous teeth; terminating in strong calcareous tooth; overlapped by fixed finger; dorsal surface somewhat pitted or with tufts of very short setae; mesioventral and ventral surfaces slightly rugose. Palm with dorsal surface convex, smooth; margins approximately parallel, lateral margin elevated, dorsolateral proximal angle slightly produced; mesial margin straight; ventral surface convex, glabrous; fixed finger short, broad, dorsal surface convex, with strong depression laterally; cutting edge with prominent calcareous teeth; terminating in calcareous tooth. Carpus longer than palm; very strongly produced and compressed mesially and laterally into "wing-like" projections; dorsal surface strongly convex in midline, unarmed; distal margin denticulate; mesial face with low tubercles, margin with row of spinulose or blunt tubercles, becoming obsolete distally; lateral margin reflexed proximally forming deep hollow on ventrolateral surface, unarmed; ventral surface concave in regions of "wings", glabrous. Merus short, approximately two-thirds length of carpus, triangular; dorsal and dorsomesial surfaces with few spinules distally, lateral face unarmed; dorsodistal margin with small spines extending mesially and laterally; ventrolateral distal angle somewhat produced, margin with few subacute tubercles; ventromesial proximal angle with large blunt tubercle. Ischium with row of small tubercles and few stiff bristles on ventral margin. Coxa with cluster of small spinules on and approximating ventrolateral margin; ventromesial distal angle with tufts of long stiff setae.

Left cheliped moderately short, reaching to distal half of right palm; distally somewhat ovate with strong degree of counterclockwise torsion. Dactyl equalling or slightly exceeding length of palm, deep; cutting edge with row of closely-spaced, small corneous teeth; terminating in small corneous claw; overlapped by fixed finger; dorsal surface unarmed, with few tufts of short bristles, dorsomesial margin slightly elevated proximally; mesial and ventral surfaces with scattered tufts of short bristles. Palm and fixed finger with dorsal surface concave, margins strongly elevated; lateral and ventral surfaces with few tufts of short bristles; cutting edge with row

of small corneous denticles, interspersed with very small calcareous teeth. Carpus approximately one and one-half times length of palm; morphological dorsal surface lying in horizontal plane, margin with row of small spines; lateral face faintly pitted; ventral and mesial surfaces glabrous. Ischium with few tufts of short setae on ventromesial margin. Coxa with row of moderately long setae on ventrodistal margin, ventrolateral margin with small tuft of long setae; ventroproximal angle occasionally with few small spinules.

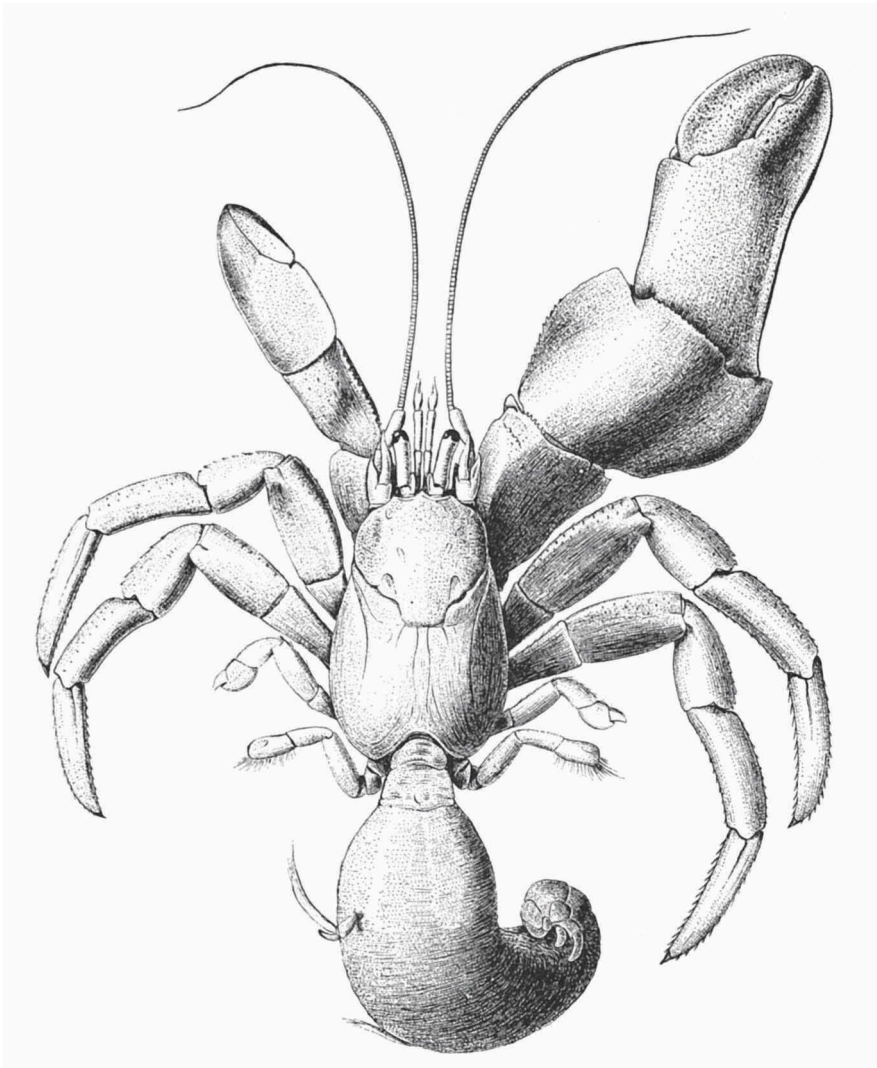


Fig. 90. *Ellassochirus gilli* (Benedict). Original illustration of J. E. Benedict.

Second pereiopods with dactyl slightly longer than propodus, moderately deep, laterally compressed; terminating in strong corneous claw; in lateral view, straight; in dorsal view, straight or slightly curved mesially; dorsal margin with double row of moderately strong corneous spines; mesial face often with faint longitudinal sulcus flanked by double row of corneous spines, smaller ventrally; lateral face with weak longitudinal sulcus proximally and 2 rows of very short bristles; ventral margin with row of strong corneous spinules; lateral face with scattered tufts of short setae; mesial face glabrous; ventral surface with double or triple row of small corneous spinules, increasing in size distally. Carpus slightly shorter than merus; dorsal surface with row of small spines; remaining surfaces unarmed. Merus laterally compressed; dorsal margin with double row of small protuberances and tufts of short setae; ventral margin with row of small spines, ventrolateral distal margin occasionally with few small spinules. Ischium with row of small spines and tufts of setae on ventral margin. Coxa with few tufts of setae.

Third pereiopods with dactyl approximately equalling propodus in length, moderately deep; terminating in corneous claw; in lateral view, straight; in dorsal view, curved slightly mesially; dorsal margin with double row of corneous spines, increasing in size distally; mesial face frequently with faint longitudinal sulcus and 2 irregular double rows of corneous spines; lateral face with weak longitudinal sulcus proximally and row of tufts of short bristles; ventral margin with row of corneous spines, increasing in size distally, and few tufts of setae. Propodus approximately one-fifth longer than carpus, laterally compressed; dorsal margin with double or triple row of small corneous spinules; lateral and mesial faces glabrous; ventral margin with double row of small corneous spinules. Carpus equalling merus in length; dorsal surface with row of small spines; lateral, mesial and ventral surfaces unarmed. Merus laterally compressed; unarmed, with few tufts of short setae. Ischium with few tufts of setae on ventral margin. Coxa with few tufts of fine setae on ventromesial face.

Fourth pereiopods with prominent "type A, P₄ structure" on median lateral face of dactyl. Propodus with rasp on ventrolateral face.

Fifth pereiopods as in *Pagurus*.

Sternite of third pereiopods roundly rectangular, generally narrow; with tuft of long bristles on each side of midline near anterior margin.

Pleopods of male unpaired, pl₃-pl₅, with exopodites moderately well developed, with fine marginal setae; endopodites reduced. Females with pleopods unpaired, pl₂-pl₄, with exopodites moderately well developed, with fine marginal setae; endopodites well developed, somewhat inflated distally,

superior face concave, margins upturned, with tufts of long thick setae; pl₅ with exopodite moderately well developed, endopodite reduced.

Telson with posterior lobes asymmetrical, left larger than right; sub-triangular; separated by prominent, slender median cleft; right terminal margin with 6-9 corneous spines; left terminal margin with 4-9 corneous spines. Anterior lobes unarmed.

Coloration. — In life "orange chrome to grenadine red, fingers and outer margin of large hand outlined with white and having small white pits, which are also present on the fingers of the small hand and on the first three joints of the ambulatory legs" (Stevens, 1925: 292). In preservative: Carapace, antennal and antennular peduncles fading to light orange and then to straw color; ocular peduncles almost white, except for faint reddish, cylindrical band at base of cornea. Chelipeds and ambulatory legs red-orange, fading in time to straw color; dactyl and fixed finger, and lateral margin of palm of right cheliped outlined in white; dorsal surface with small white spots distally; lateral faces of dactyls and propodi of ambulatory legs with faint white spots.

Distribution. — Komandorskiye Ostrova, Aleutian Islands south to Revil-lagigedo Island, Kamchatka, Mys Lopatka, Japan Sea (Soviet Harbor) (Makarov); Komandorskiye Ostrova to Lopatka, Tatar Strait to Aleutian Islands (Vinogradov); Bering Island (Molander, Rathbun); Puget Sound, South-eastern Alaska (Stevens); subtidal to 64 meters.

Affinities. — *Elassochirus gilli*, as previously mentioned, is very similar to *E. cavimanus*, but may be distinguished from the latter species by its distinctive red-orange coloration in life, and by the unarmed dorsal surface of the carpus of the right cheliped.

Discussion. — Balss (1913) placed *Eupagurus munitus* Benedict in synonymy with *Eupagurus cavimanus* Miers and his synonymy has been followed by subsequent carcinologists. Balss (1913: 60) referred to "... ein von Benedict bestimmtes Exemplar seines *Eupagurus munitus* ..." which he used for his comparison and synonymy. No other details of this specimen were given, so that it is impossible to verify the identification of Benedict's specimen. Balss' (1913, fig. 34) illustration of *E. cavimanus* (= *E. munitus*), however, lacks the armature on the carpus of the right cheliped and reticulation of the dorsal surface of the right palm, and, therefore, must be referred to *Elassochirus gilli*. Two specimens collected by the "Vega" Expedition (1879) from Bering Island were described by Molander (1914) as a new species of pagurid, *Eupagurus porcellanus*. There can be no doubt, from his description and illustration, that this species is synonymous with *Elassochirus gilli*.

Makarov (1938b, 1962) compared specimens from the collections of the Zoological Institute, Academy of Sciences (USSR) with a specimen of

Eupagurus munitus from the National Museum of Natural History (USNM 16646, incorrectly cited as USNM 16656). As his specimens apparently did not agree with *Eupagurus munitus* (= *Elassochirus cavimanus*), Makarov referred his collections to *Pagurus gilli* and extended the range of the latter species to Kamchatka and the Sea of Japan (Soviet Harbor). I have re-examined the remaining 30 specimens in the lot of USNM 16646 and confirmed the identity of the specimens as Benedict's *E. munitus*. As Makarov's material is not presently available, the broad, sympatric distribution of *Elassochirus gilli* and *Elassochirus cavimanus* (= *Eupagurus munitus*) must be tentatively accepted. Makarov's inclusion of California, which was later repeated by Vinogradov (1950), in the range of *E. gilli* in the eastern Pacific is erroneous. This error appears to have resulted from Makarov's confusion of *Eupagurus munitus* with the California species, *Eupagurus minutus* Benedict, 1892, a primary homonym of *Eupagurus minutus* Hess, 1865, and subsequently renamed *Eupagurus benedicti* Bouvier, 1898.

Labidochirus Benedict

Eupagurus Brandt, 1851: 105 (in part).

Labidochirus Benedict, 1892: 2. Type species, by original designation, *Pagurus splendescens* Owen, 1839: 81. Gender: masculine. Founded as a subgenus of *Eupagurus* Brandt, 1851.

Libidochirus Benedict, 1892: 26 (erroneous spelling of *Labidochirus* Benedict, 1892: 2).

Diagnosis. — Carapace, exclusive of branchiostegites, generally heavily calcified throughout; posterior carapace broader than shield.

Eleven pairs of phyllobranchiate branchiae.

Maxillipeds widely separated basally. Basis-ischium of mxp₃ incompletely fused; crista dentata well developed, with one accessory tooth; merus with or without spines or denticles at dorsodistal margin. Maxillule with proximal endite tapering to apex; endopodal external lobe vestigial or lacking.

Ocular acicles very narrowly triangular; obscured basally by anterior margin of shield.

Chelipeds subequal or unequal, right larger than left.

Fourth pereopods simple, not subchelate; propodal rasp reduced.

Males lacking pleopods in adults; with paired gonopores; coxae of P₅ equal; without sexual tubes.

Females with paired gonopores; pleopods unpaired.

Abdomen reduced; uropods asymmetrical.

Zoeae with carapace bearing pronounced dorsal carina; posterior portion formed of raised platform bearing posterolateral carapace spines (cf. Nyblade & McLaughlin, in press).

Distribution. — Japan (Balss); Notooro Peninsula (Urita); Sakhalin (Yokoya); Kamchatka (Owen); Okhotsk Sea, Arctic Ocean, Point Barrow and westward to mouth of Kolyma River (Makarov), Chukchi and Bering Seas; Gulf of Alaska and southward to Washington and Puget Sound.

Affinities. — *Labidochirus* appears most closely allied to *Porcellanopagurus* Filhol, 1885, as redefined by Forest (1951a, b). This genus is also similar in many characters to *Pagurus*; however, in the form of the adults, the distinctive armature of the raised shield and strong calcification of the posterior portion of the carapace immediately distinguish *Labidochirus* from both *Porcellanopagurus* and *Pagurus*. Several characters of the larvae of this genus are also distinctive.

Discussion. — Benedict (1892) established *Labidochirus* as a subgenus of *Eupagurus* Brandt (= *Pagurus* Fabricius) for *Pagurus splendescens* Owen, 1839, *Pagurus mertensii* Brandt, 1851 (sensu Benedict), and *Eupagurus parvus* Benedict, 1892, and designated *P. splendescens* as the type species. Benedict's criterion for relating these three species appears to have been only the superficial similarity in the shapes of the left chelae. The species, misidentified as *Pagurus mertensii* by Benedict, and later referred to *Parapagurus* by Holmes (1900), has more recently been transferred to a

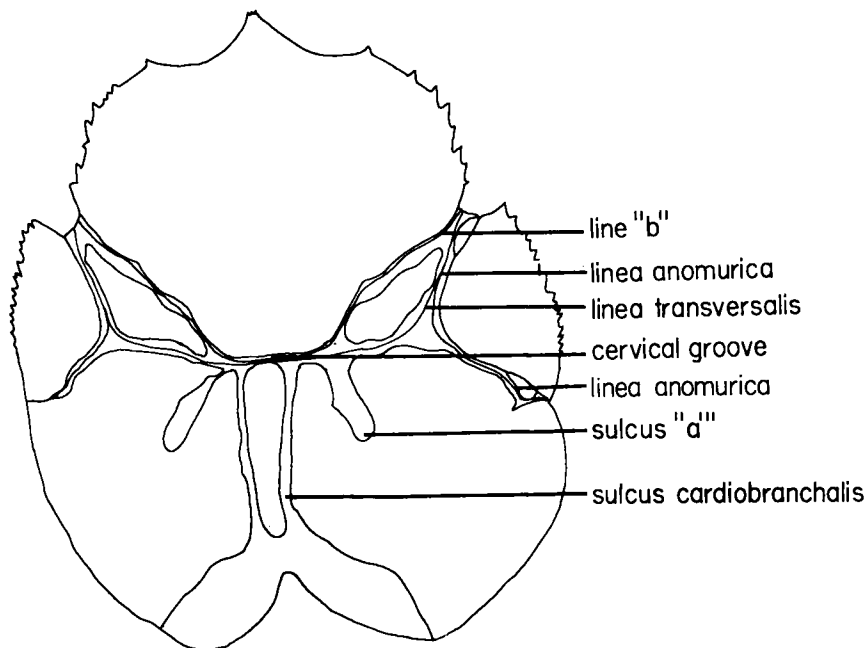


Fig. 91. Diagrammatic cephalothorax of *Labidochirus splendescens* (Owen), showing positions of lineae and sulci.

new genus (cf. McLaughlin & Haig, in press). *Pagurus parvus* apparently has not been reported since Benedict's original publication, except for the literature citations of Alcock (1905) and Gordan (1956). Benedict's short diagnosis, however, is sufficient to distinguish the generic dissimilarities between *P. parvus* and Owen's species. The present study has shown that the morphology of *P. splendescens* is sufficiently distinct to warrant exclusion of this species from the genus *Pagurus*, as typified by its type species, *Pagurus bernhardus* (Linnaeus, 1758), even though the heterogeneity of the genus is well recognized. This distinctiveness of *P. splendescens* has been substantiated by its larval development (cf. Nyblade & McLaughlin, in press). Consequently, Benedict's subgenus, *Labidochirus*, herein is restricted and raised to generic rank.

Considerable similarity between *L. splendescens* and the Japanese species, *Pagurus anomalus* (Balss, 1913) has been noted by Balss and by Makarov (1938b, 1962). On the basis of the descriptions of the species by these authors, and the personal examination, including mouthparts, of *P. anomalus* (USNM 72373), this species is also assigned to *Labidochirus*.

The lineae and sulci of the pagurid carapace, as described by Boas (1926), as previously noted, are somewhat modified in *Labidochirus* (fig. 91). From the branchiostegal region, the lineae anomurica and transversalis appear on the dorsal surface of the carapace at the dorsolateral proximal angles of the shield. Together they proceed posteromedianly in a wide, often uncalcified furrow to the level of the cervical groove. At this point, the linea anomurica is directed laterally to the margin of the carapace; the linea transversalis continues medianly to the cervical groove, providing the posterior delineations for two raised, strongly calcified "islands". Line "b", also appearing on the dorsal surface at the dorsolateral proximal angles of the shield and lying in a deep, often uncalcified furrow, traverses the dorsal surface in close approximation to the posterolateral margin of the shield and provides the anterior delineation of the prominent "islands". The sulcus cardiobranchialis appears on either side of the midline of the posterior carapace as a deep, often uncalcified, furrow. A second sulcus, present, but poorly defined in most *Pagurus* species, and unnamed by Boas, is very prominent anterolateral to the sulcus cardiobranchialis in *Labidochirus*. It is referred to herein as sulcus "a" [bc (branchiocardiac groove) of Pilgrim, 1973]. A somewhat similar pattern of development of the lineae and sulci is seen in one group of pagurids, i.e., the "*bernhardus*" group; however, development is considerably less pronounced.

Key to the species of *Labidochirus*

1. Chelipeds unequal, right considerably larger than left; rostrum terminating in series of small denticles; anterolateral and lateral margins of shield with moderately strong

- spines *L. splendescens* (Owen)
 — Chelipeds subequal; rostrum terminating in strong, acute, simple spine; anterolateral and lateral margins of shield with extremely strong spines . . . *L. anomalus* (Balss)

Labidochirus splendescens (Owen) new combination (figs. 91-95)

Pagurus splendescens Owen, 1839: 81, pl. 25 figs. 1, 1a (type locality: "Kamtschatka"). — Richters, 1884: 405. — Rathbun, 1899: 556. — Rathbun, 1904: 161. — Rathbun, 1910: 161. — Taylor, 1912: 205. — Williamson, 1915: 481. — Rathbun, 1919: 8A. — Stevens, 1925: 295, figs. 15, 16. — Wismer & Swanson, 1935: 342. — Kobjakova, 1936: 191. — Van Winkle & Schmitt, 1936: 330. — Kobjakova, 1937: 143. — Makarov, 1937: 62, fig. 14. — Makarov, 1938b: 197, pl. 4 fig. 2. — Hart, 1940: 102. — Reinhard, 1944: 53. — Vinogradov, 1947: 103. — Vinogradov, 1950: 226 (key), figs. 120a, b. — MacGinitie, 1955: 169. — Gordan, 1956: 335. — Kobjakova, 1956: 57. — Kobjakova, 1958a: 233. — Kobjakova, 1958b: 252. — Lindberg et al., 1959: 232. — Reischman, 1959: 410. — Zarenkov, 1960: 190. — Wolff, 1961: 14, fig. 2d. — Makarov, 1962: 187, pl. 4 fig. 2. — McLaughlin, 1963: 22. — Filatova & Barsanova, 1964: 22. — Filatova & Barsanova, 1969: 21. — Reese, 1969: 349.

Pagurus (Eupagurus) splendescens: Brandt, 1851: 111 (by implication).

Eupagurus splendescens: Stimpson, 1858: 237. — Murdoch, 1885: 138. — Harrington, 1897: 215. — Calman, 1898: 260. — Doflein, 1900: 343. — Alcock, 1905: 178. — Balss, 1913: 62, figs. 36, 37, pl. 2 fig. 2. — Molander, 1914: 6. — Borradaile, 1916: 121, fig. 11. — Von Hofsten, 1916: 94. — Sivertsen, 1932: 11.

Eupagurus (Labidochirus) splendescens: Benedict, 1892: 2 (by implication).

Pagurus (Labidocheirus) splendescens: Holmes, 1900: 135 (by implication; misspelling of *Labidochirus* Benedict, Holmes, 1900: 135).

Holotype. — Not seen.

Material examined. — See table 31.

Diagnosis. — Chelipeds unequal, right considerably larger than left, elongate, slender; integument iridescent. Rostrum terminating in series of small denticles; anterolateral and lateral margins of shield with moderately strong spines; lateral projections produced, each with strong terminal spine.

Description. — Shield broader than long, laterally expanded, somewhat raised throughout; anterolateral margins sloping, spinulose or spinose; anterior margin between rostrum and lateral projections concave; lateral margins with 4 or 5 prominent spines; posterior margin truncate; dorsal surface furrowed, covered with spinulose or tuberculate scales or broad, often spinulose protuberances and rows of short bristles. Rostrum very strongly produced, greatly exceeding lateral projections; elevated, overhanging ocular acicles; terminating in series (2-5) of small denticles. Lateral projections each with strong, acute spine. Branchiostegites uncalcified except on spinulose anterodorsal margins; surfaces densely setose.

Posterior carapace broadly inflated, calcified except near posteromedian margin; anterolaterally, strongly produced, margins spinous; dorsal surface with prominent spinulose or tuberculate scales or protuberances and rows of short bristles; posterolateral surfaces with dense long setae. Cephalothoracic lineae and sulci generally conspicuous in broad uncalcified furrows.

Table 31. *Labidochirus splendescens* (Owen) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex				SL (mm)	Collector
				♂+	♀	♀♀	♀+		
<i>Chukchi Sea</i>									
71°32.5'N, 156°00'W	98	N-10 USNM	16/8/63	1	1			9.3-10.2	Gonor
71°32.5'N, 155°34'W	49-51	N-14 USNM	16/8/63	1				7.6	Gonor
71°29.5'N, 155°41'W	36-42	N-15 RMNH, AHF	16/8/63	2	2	5		8.4-10.2	Gonor
70°42'N, 150°02'W	16	----- USNM	14/8/63	2	3			6.7-10.2	Gonor
69°40'N, 178°45'W	46	----- USNM	10/10/62	2				5.5-6.4	McCauley
69°16'N, 165°36'W	---	59 USNM, RM	24/8/59	9	9	3		3.8-9.7	JNC
69°16'N, 164°22'W	---	61 USNM	25/8/59	3	1			4.5-10.9	JNC
69°05'N, 167°30'W	---	56 USNM	24/8/59	1				4.8	JNC
69°04'N, 166°12'W	---	58 USNM	24/8/59	2	2			6.6-7.5	JNC
68°31.5'N, 166°54'W	---	26 USNM	13/8/59	1	1			7.9-8.2	JNC
68°30'N, 167°00'W	35	----- USNM	22/10/62	1	2			6.0-7.1	McCauley
68°25'N, 167°55'W	---	34 USNM	16/8/59	1	2			4.9-8.2	JNC
68°25'N, 167°12'W	---	33 USNM	16/8/59	2	1			6.9-14.9	JNC
68°18'N, 168°15'W	---	29 USNM	14/8/59	1				10.0	JNC
68°18'N, 166°55'W	---	25 USNM	13/8/59	1				7.5	JNC
68°11'N, 167°12'W	---	36 USNM	16/8/59	1				9.2	JNC
68°10'N, 166°35'W	---	37 USNM	16/8/59	2				5.2-8.9	JNC
68°03.5'N, 167°34'W	---	24 USNM	13/8/59	1				4.6	JNC
67°55.6'N, 167°22'W	---	51 USNM	20/8/59	1				8.0	JNC
67°53.3'N, 166°42'W	---	52 USNM	20/8/59	1				7.1	JNC
67°50'N, 166°55'W	---	20 USNM	12/8/59	1				7.4	JNC
67°44'N, 165°23'W	---	40 USNM	17/8/59	1	1			5.3-7.6	JNC
67°44'N, 165°56'W	---	42 USNM, CNM	19/8/59	2	1			4.4-14.0	JNC
67°43'N, 164°44'W	---	11 USNM	9/8/59	1				6.4	JNC
67°43.8'N, 166°35'W	---	43 USNM	19/8/59	1	2			6.4-6.7	JNC
67°33.5'N, 165°02'W	---	10 USNM, RMNH	9/8/59	5	7	5		3.4-14.9	JNC
67°31.5'N, 165°55'W	---	41 USNM, AHF	19/8/59	3	3			4.6-8.4	JNC
67°31'N, 166°35'W	---	44 USNM	19/8/59	3				9.9-11.0	JNC
67°27'N, 165°32'W	---	12 USNM	10/8/59	2				5.6-6.5	JNC
67°24'N, 164°23'W	---	9 USNM	9/8/59	1	1			6.1-8.2	JNC
67°06'N, 167°56'W	29	----- USNM	7/10/62	1				16.7	McCauley
67°06'N, 163°48'W	---	3 USNM	7/8/59	1	1			10.7-10.8	JNC
67°00'N, 166°54'W	22	----- USNM	6/10/62	2	1			8.7-17.8	McCauley
67°00'N, 166°15'W	28	----- USNM	24/10/62	1				9.1	McCauley
66°58'N, 165°36'W	---	7 USNM	8/8/59	1				5.5	JNC
66°57'N, 166°00'W	20	----- USNM	6/10/62	1				6.3	McCauley
66°43.5'N, 166°14'W	---	6 USNM	8/8/59	1				3.3	JNC

Table 31 (Continued). *Labidochirus splendescens* (Owen) Material Examined

Locality	Depth (m)	Station Deposition	Date	Sex			SL (mm)	Collector
				♂	♀	♀*		
<i>Bering Sea</i>								
58°00'N, 160°52'W	46	ABL J-12 USNM	17/6/66	1			15.5	USFWS
58°02'N, 160°12'W	51	ABL J-13 USNM	18/6/66	1			10.4	USFWS
57°40.5'N, 163°24'W	48	ABL I-8 USNM	10/7/66	29	3		7.6-16.5	USFWS
57°42.5'N, 162°51'W	42	ABL I-9 USNM	29/6/66	1			16.6	USFWS
57°38'N, 156°40'W	48	SBL I-14 USNM	21/8/60	1			17.4	USFWS
57°20.5'N, 164°01'W	64	ABL H-7 USNM	10/7/66	3			11.2-14.6	USFWS
57°20'N, 163°26.5'W	50	ABL H-8 USNM, RMNH	10/7/66	15	3	2	7.5-16.8	USFWS
57°22'N, 162°44'W	48	ABL H-9 USNM	20/6/66	3			12.4-15.3	USFWS
57°20'N, 159°42'W	51	SBL H-11 AEF	20/8/60	3	2		8.1-17.0	USFWS
57°00'N, 165°49.5'W	73	ABL G-4 USNM	20/6/66			2	7.0-7.6	USFWS
57°00'N, 164°00'W	66	SBL G-7 USNM	23/8/60	2			10.6-12.5	USFWS
57°00'N, 164°00'W	71	SBL G-7 USNM	15/7/61	1	1		11.0-11.6	USFWS
57°00'N, 163°24'W	62	SBL G-8 USNM	16/8/60	2			6.3-8.4	USFWS
57°00'N, 163°19'W	64	ABL G-8 USNM	30/6/66	2			8.6-13.6	USFWS
56°40'N, 165°13'W	76	ABL F-5 USNM	20/7/66	3	1		6.9-13.4	USFWS
56°40'N, 164°00'W	73	SBL F-7 USNM	15/8/60	2			11.3-12.4	USFWS
56°30'N, 165°31'W	88	SBL EF-4.5 USNM	16/7/61	1			8.1	USFWS
56°30'N, 164°18'W	88	SBL EF-6.5 USNM	13/7/61	1			14.3	USFWS
56°00'N, 165°44'W	91-93	ABL E-4 USNM	21/7/66	1			8.0	USFWS
56°19.5'N, 164°37'W	90	ABL E-6 USNM	9/7/66	2			9.6-11.3	USFWS
56°20'N, 164°00'W	80	SBL E-7 USNM	15/8/60	1			11.6	USFWS
56°22'N, 164°00'W	83	ABL E-7 USNM	11/7/66	1			11.4	USFWS
56°18.5'N, 163°26'W	89	ABL E-8 USNM	26/6/66	1	1		6.5-7.3	USFWS
Bristol Bay	---	USNM ----	summer 59	1	1		7.2-9.7	USFWS
<i>Gulf of Alaska</i>								
55°39'N, 157°15'W	84	32K USNM	11/7/61	1			15.6	INPHC
58°12'N, 135°02'W	---	RMNH ----	1/7/63	1	1		7.7-7.8	Gonor
<i>Washington</i>								
San Juan Is.	---	USNM ----	5/61	1			5.4	Henry
San Juan Is.	---	USNM ----	8/61	2			6.8-10.5	McLaughlin
Friday Harbor, San Juan I.	---	USNM ----	1922	3			7.5-9.0	Stevens
Lopez Pass	---	USNM ----	25/8/61	1			2.5	McLaughlin
Lopez Sound	36	USNM RMNH ----	11/8/61	2			8.4-9.0	McLaughlin
Parker Reef, N of Orcas I.	11-73	USNM ----	24/7/52	1			8.5	Illg

Ocular peduncles very short, less than one-half shield length, strongly constricted near midlength, markedly dilated in corneal region; dorsomesial face with longitudinal row of very short setae. Ocular acicles obscured basally by overhanging rostral base and anterior margin of shield; very

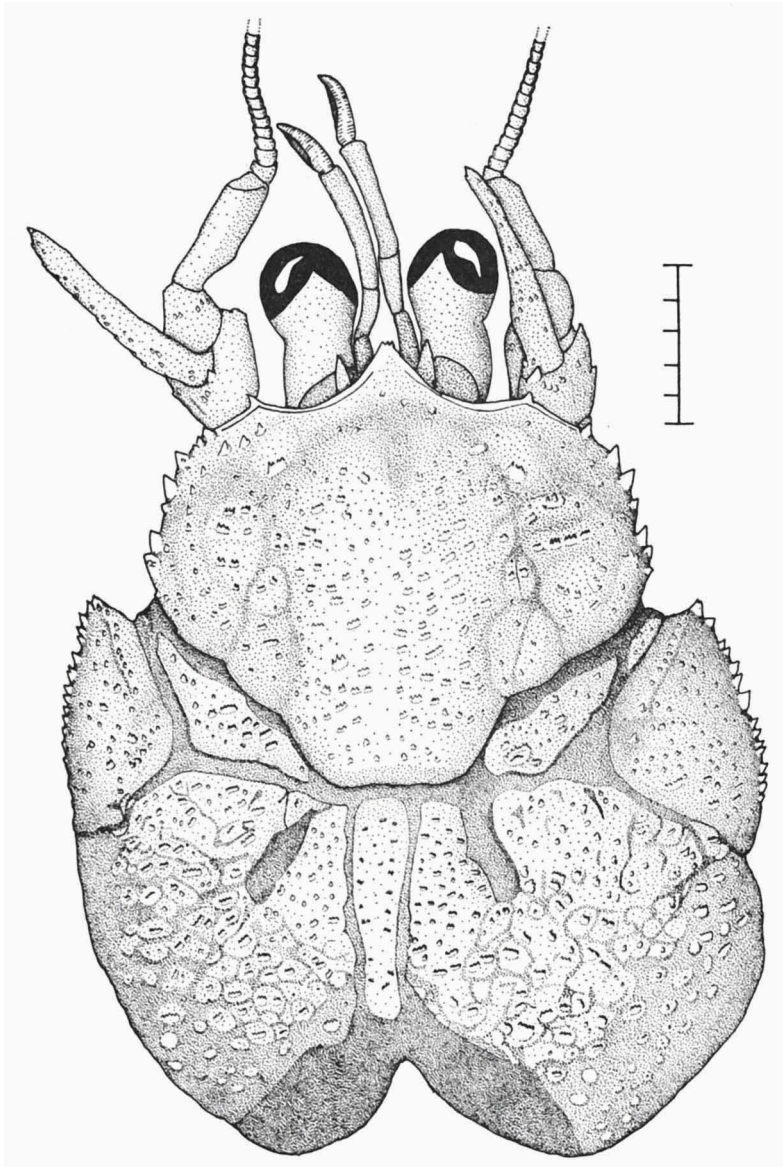


Fig. 92. *Labidochirus splendescens* (Owen), shield. Scale equals 5 mm.

elongate, narrowly triangular; terminating subacutely with small submarginal spine; separated basally by basal width of one acicle.

Antennular peduncles long, exceeding ocular peduncles by entire length of ultimate segment. Ultimate and penultimate segments unarmed, with few scattered short setae; basal segment with small spine at ventromesial margin.

Antennal peduncles long, exceeding ocular peduncles by one-third to one-half length of ultimate segment, but shorter than antennular peduncles; with supernumerary segmentation. Fifth segment unarmed, with few tufts of short setae. Fourth segment usually unarmed, less frequently with few small spinules on dorsal or mesial face. Third segment with strong spine at ventromesial distal angle. Second segment with dorsolateral distal angle produced, terminating in strong bifid spine, with 1 or 2 small spines laterally and 1-5 spines dorsally; dorsal surface with strong, longitudinal sulcus and several small spinules, dorsomesial distal angle with strong spine, distal margin often with 1 or 2 small spines. First segment with ventromesial distal margin produced and with several small spines laterally; laterodistal margin with 1 or 2 small spines. Antennal acicles moderately long, equalling or slightly exceeding length of antennal peduncle; in dorsal view, twisted distally; slightly arcuate; dorsal and mesial surfaces with numerous small spines or irregular, short transverse rows of small spinules; terminating in small spine. Antennal flagella very long, often overreaching right cheliped; each article with 1 or 2 minute bristles.

Mandible without significant characters. Maxillule with proximal endite tapering to apex; 3-5 bristles on moderately well developed internal lobe of endopodite, external lobe vestigial or absent. Maxilla with endopodite basally inflated; equalling or slightly exceeding scaphognathite in distal extension. First maxilliped with endopodite approximately one-half length of exopodite. Second maxilliped with propodal segment laterally compressed, strongly inflated dorsally. Third maxilliped with basis-ischium fusion incomplete; basis unarmed; ischium with crista dentata well developed, 1 accessory tooth; merus unarmed or with 1 to several small denticles on dorsodistal margin, ventral margin often with small spine or spinule; carpus unarmed or often with few small denticles at dorsodistal margin. Sternite of mxp_3 with small spine on each side of midline, anterior margin with long, dense setae.

Right cheliped with dactyl slightly shorter than or equalling length of palm, broadened, somewhat thickened; mesial margin angular; cutting edge with row of strong calcareous teeth; terminating in small corneous claw; strongly overlapped and overreached by fixed finger; dorsal surface elevated in region of midline to sharp ridge with row of spinulose tubercles and short bristles, mesially sloping acutely, with 2 rows of short bristles; dorsomesial

margin with row of small spinules, decreasing in size distally; mesial and ventral surfaces with irregular rows of moderately long stiff setae. Palm moderately long, usually equalling or slightly exceeding length of carpus, slender, somewhat dorsoventrally inflated; fixed finger strongly arcuate distally; dorsolateral margin with row of small corneous-tipped spines,

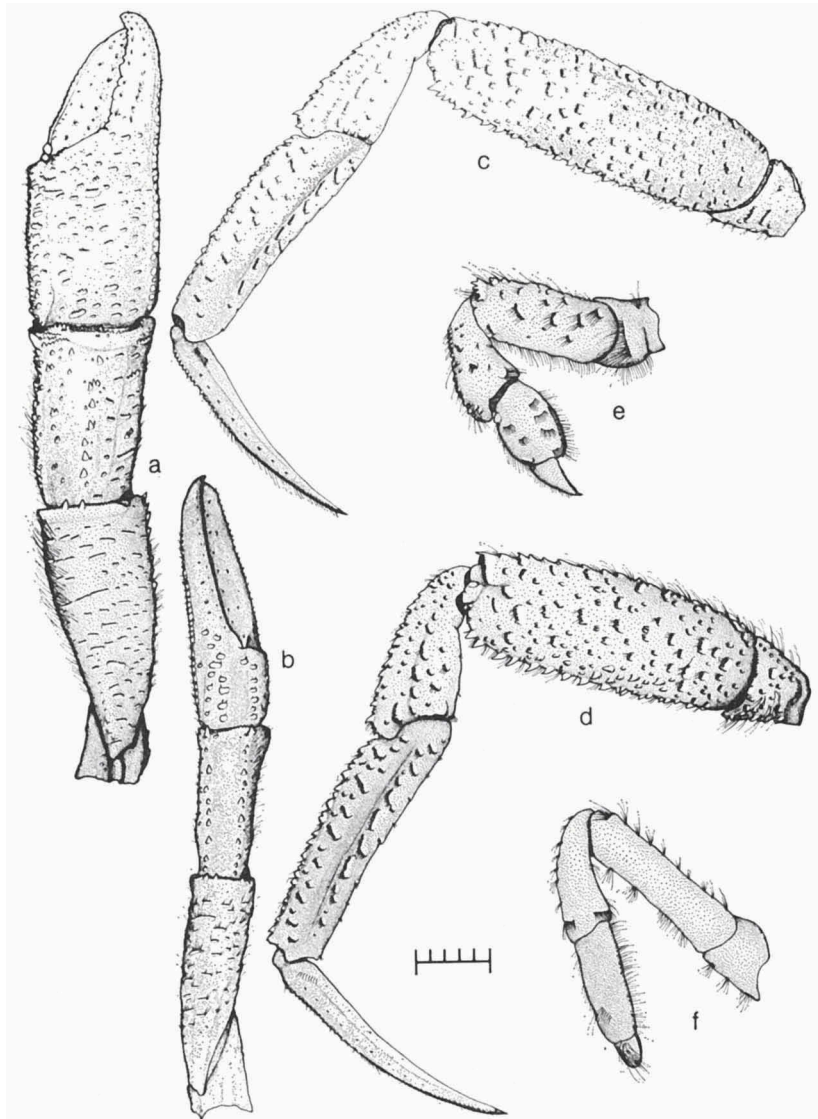


Fig. 93. *Labidochirus splendescens* (Owen). a, right cheliped (dorsal view); b, left cheliped (dorsal view); c, left P₂ (lateral view); d, left P₃ (lateral view); e, left P₄ (lateral view); f, left P₅ (lateral view). Scale equals 5 mm.

decreasing in size on fixed finger, dorsal surface with several very irregular rows of small conical spines or spinulose squamiform tubercles, strongest in midline and forming indistinct inverted V; dorsomesial margin with row of squamiform spinulose tubercles; lateral, mesial and ventral surfaces with closely-spaced, squamiform spinulose tubercles and tufts of long setae. Carpus one-half to two-thirds length of merus; dorsodistal margin with 1 or 2 prominent spines and adjacent row of small spinules, dorsal surface with 4 irregular rows of multifid spines, largest on dorsolateral margin; dorsomesial margin with row of strong spines, increasing in size distally and tufts of long setae; ventral and mesial surfaces with multifid spinulose tubercles and tufts of long setae. Merus long, triangular; distal margin with 2 strong spines and adjacent row of small spinules; all surfaces with transverse spinulose ridges and long setae; ventrolateral margin distally with row of strong spines, partially obscured by long setae, ventromesial margin with row of smaller spines distally. Ischium with row of very small spinules on ventromesial margin, ventrolateral margin with series of multifid spinulose tubercles and tufts of long setae; ventral surface spinulose; lateral face with few bifid or multifid tubercles, dorsolateral proximal margin with low, spinulose keel and tufts of setae. Coxa with row of small spinules on dorsolateral margin; ventrolateral distal margin with row of small spines, ventromesial margin with tufts of long setae.

Left cheliped very long, usually reaching beyond base of dactyl of right; slender, strongly depressed distally. Dactyl approximately twice length of palm; cutting edge with row of corneous teeth; terminating in strong corneous claw; considerably overlapped and overreached by fixed finger; dorsomesial margin with row of small spinules proximally, mesial face usually with row of small spinules and several rows of tufts of short bristles; ventral surface with 1 or 2 rows of moderately long bristles. Palm approximately one-half length of carpus; dorsal surface elevated in midline, with 2 prominent rows of multifid, spinulose tubercles and tufts of short setae, extending onto fixed finger proximally as single row of small spines, laterally row of small multifid spinulose tubercles and short setae; dorsal lateral margin with row of multifid spinulose tubercles, becoming obsolete distally on fixed finger; dorsomesial margin with row of small, spinulose squamiform tubercles and few tufts of setae; lateral face with row of small spinules and tufts of long setae; ventral surface with several irregular rows of tufts of long stiff setae. Carpus approximately two-thirds length of merus, slender; dorsolateral and dorsomesial margins each with row of strong acute spines, dorsal surface with few, small scattered spines, distal margin with spinules and short setae; lateral face with 3 or 4 rows of spinulose ridges and tufts of short setae,

ventrolateral distal margin with few small spines; mesial face with longitudinal rows of transverse spinulose ridges and moderately long setae, ventromesial distal angle with few small spines; ventral surface with scattered, low spinulose tubercles and tufts of setae. Merus long, triangular; all sur-

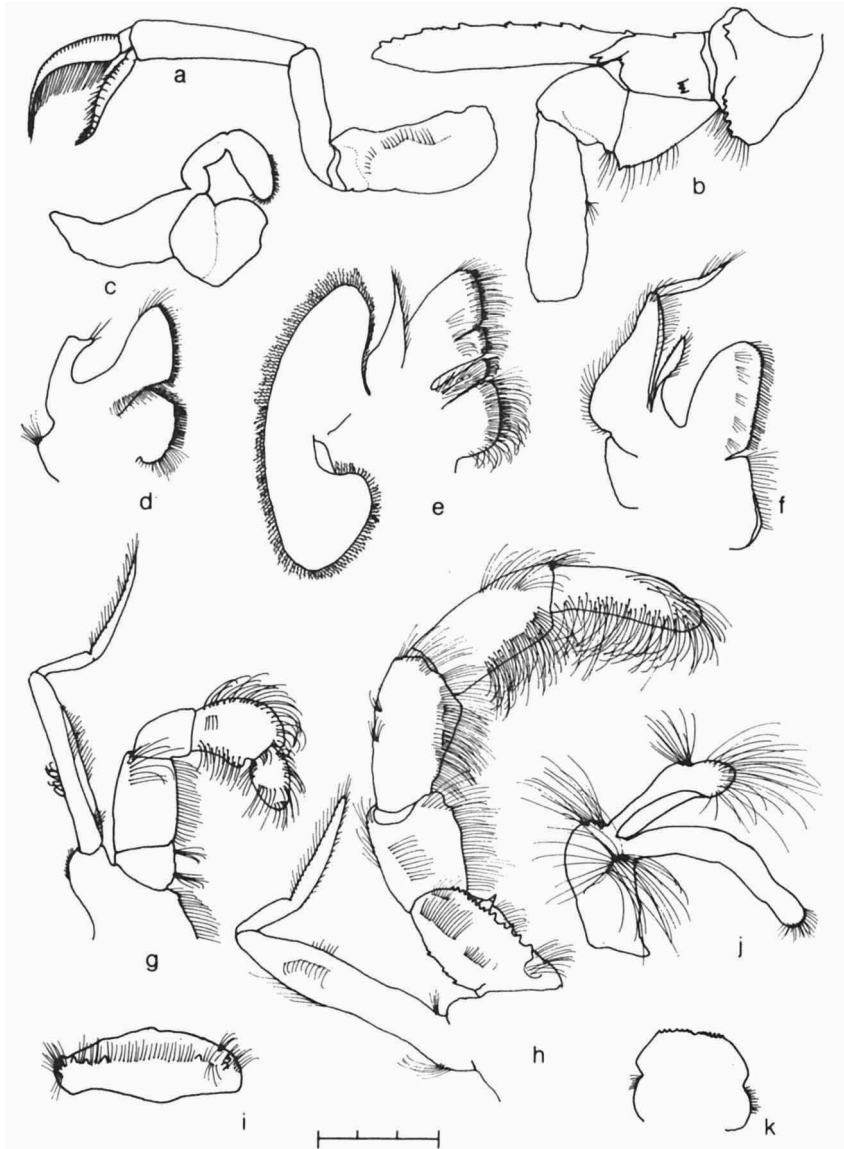


Fig. 94. *Labidochirus splendescens* (Owen). a, antennule (lateral view); b, antennal peduncle (lateral view); c-h, mouthparts (left, internal face): c, mandible; d, maxillule; e, maxilla; f, mxp₁; g, mxp₂; h, mxp₃. — i, sternite, P₃; j, ♀, pl₃; k, telson. Scale equals 3 mm.

faces with irregular rows of transverse spinulose ridges and tufts of long setae; ventrolateral margin with row of simple or multifid spines, distal margin serrate and with 2 or 3 moderately strong spines dorsally. Ischium with row of small spinules on dorsomesial margin; ventral surface with low spinulose tubercles or small spinules, ventrolateral distal angle with small spines obscured by long setae, ventrolateral proximal margin with low spinulose keel. Coxa with row of small spinules on ventrolateral margin, ventromesial margin with tufts of long setae.

Second pereopods with dactyl long, slightly longer than propodus; terminating in long, slender corneous claw; in lateral view, somewhat curved ventrally; in dorsal view, slightly twisted; dorsal margin with row of small spines proximally, tufts of short, dense stiff setae distally; lateral and mesial faces each with longitudinal sulcus flanked by row of short setae, set transversely on mesial face; ventral margin with row of corneous spines, increasing in size distally. Propodus moderately long, approximately one-fourth to one-third longer than carpus; dorsal margin with single or double row of spinulose ridges and tufts of short setae, distal margin denticulate; lateral face with prominent longitudinal row of spinulose ridges and several spinulose squamiform tubercles dorsally, prominent longitudinal sulcus and row of strong, transverse spinulose ridges and tufts of short bristles ventrally; mesial face with 2 or 3 irregular rows of transverse, multifid spinulose ridges; ventral surface with row of spinulose tubercles. Carpus approximately one-half length of merus; dorsal surface with single or double row of multifid spines, 1 or 2 prominent spines near distal angle; lateral and mesial faces with irregular rows of spinulose ridges and tufts of short bristles; ventral surface with few tufts of short setae. Merus long, laterally compressed; dorsal margin with 2 rows of spinulose ridges, strongest laterally, distal margin usually with 1 moderately strong spine and series of small spinules extending laterally and mesially; lateral face with closely-spaced spinulose ridges and short setae, ventrolateral margin with spinulose ridges proximally, strong spines distally; mesial face with few small tubercles or spinules, ventromesial margin with row of small spinulose tubercles. Ischium with row of small spinules on ventromesial margin, ventral surface with squamiform spinulose tubercles and tufts of long setae; dorsal margin with row of small spinules and tufts of long setae. Coxa with irregular, double row of minute spinules on ventromesial margin, distal margin with minute spinules mesially and laterally; ventral surface and ventrolateral margin with multifid spinulose tubercles and tufts of long setae.

Third pereopods with dactyl long, slightly longer than propodus, slender; terminating in long, slender corneous claw; in lateral view, somewhat curved

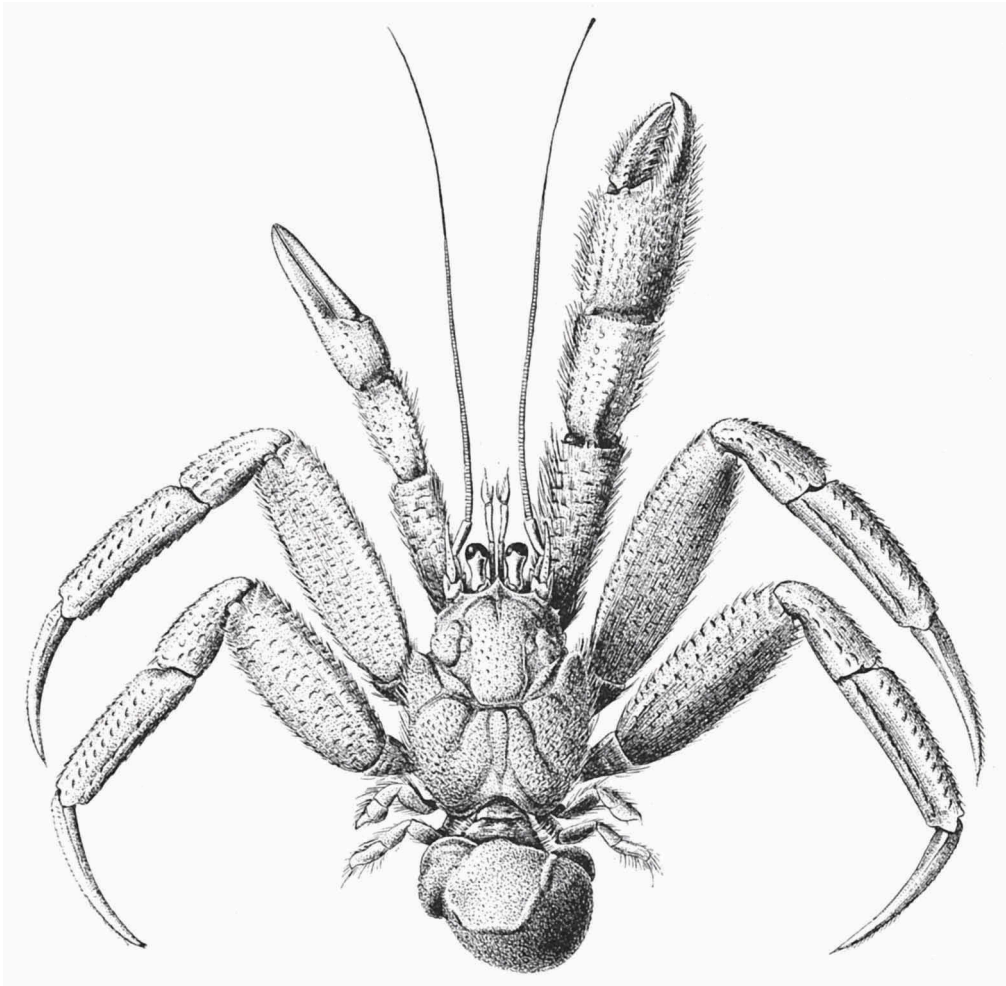


Fig. 95. *Labidochirus splendescens* (Owen). Original illustration of J. E. Benedict.

ventrally; in dorsal view, slightly twisted; dorsal margin with row of minute spinules obscured by row of short setae; lateral and mesial faces each with prominent longitudinal sulcus flanked by row of tufts of setae, set transversely on mesial face; ventral margin with row of corneous spinules, increasing in size distally. Propodus long, approximately one-third longer than carpus; dorsal surface with row of multifid spines and tufts of short setae; mesial face with 3 rows of transverse, multifid spinulose ridges and scattered tufts of short setae; lateral face with transverse spinulose ridges dorsally, prominent longitudinal sulcus and row of strong, transverse spinulose ridges and tufts of short setae ventrally; ventral surface with row of multifid

spinulose tubercles. Carpus moderately long, approximately one-half length of merus; dorsal surface with double row of small simple or multifid spines, increasing in size distally; lateral and mesial faces with series of rows of transverse spinulose ridges; ventral surface with few tufts of short setae. Merus long, laterally compressed; dorsal surface with 2 rows of strong, transverse spinulose ridges, strongest laterally, distal margin with 1 or 2 strong spines and series of small spinules, extending laterally and mesially; lateral face with closely spaced, multifid spinulose ridges, ventrolateral margin with double row of multifid spines proximally, single row of very strong subacute spines distally; mesial face with few small spinules ventrally. Ischium with tufts of setae dorsally and ventrally; ventral surface with row of small spinules and cluster of spinules at distal margin; lateral face with numerous spinulose ridges and tufts of setae; dorsolateral margin with row of small spines. Coxa with row of spinulose ridges on ventrolateral margin, ventrodistal margin with row of small spines laterally, small blunt spines or spinules mesially; ventral surface with spinulose ridges.

Fourth pereopods simple, not subchelate; propodal rasp consisting of only 1 or 2 rows of corneous scales. Segments with surface armature similar to that of second and third pereopods.

Fifth pereopods as in *Pagurus*.

Sternite of third pereopods broad, subrectangular, with 3 or 4 spines laterally, 2 or 3 spines near midline, partially obscured by long setae.

Abdomen reduced, membranous. Pleopods absent in adult males. Females with pleopods unpaired, pl_2 - pl_4 with both rami well developed; pl_5 with exopodite moderately well developed, endopodite rudimentary.

Telson with posterior lobes generally symmetrical; separated by shallow median cleft; terminal margin of each posterior lobe with row of very small, corneous spinules; anterior lobes unarmed, with tufts of short setae laterally.

Coloration. — In life: "Varying in shade from light brown to light mauve, with metallic iridescence of pink, green, pale violet and golden tints; tubercles appearing darker. The ventral surfaces of the chelipeds and ambulatory legs vary from pale pinkish yellow to pale mauve; the dactyli are dark olive green with white tips. Inner surfaces of the antennules have a bronze or golden sheen" (Makarov, 1962: 188, after Stevens). In preservative: The general color is maroon, fading to pinkish yellow with age; however, the metallic iridescence is usually retained.

Distribution. — Arctic Ocean from Kolyma River to Point Barrow (Makarov); Chukchi Sea to Southern Okhotsk Sea (Vinogradov, Kobjakova); Saklinskiy Zaliv (Vinogradov); Kamchatka to Nagayeva Bukta (Kobjakova); Anadyrskiy Zaliv (Filatova & Barsanova); Sakhalin (Lindberg

et al., Kobjakova); Kuril Islands (Lindberg et al.); Shikotan-Tō, Sea of Japan (Kobjakova); Commander Islands (Murdoch); Chukchi and Bering Seas, southward through Gulf of Alaska to Washington and Puget Sound; subtidal to 412 meters.

Affinities. — *Labidochirus splendescens* appears to be closely related to *Labidochirus anomalus* (Balss) of Japanese waters. The two species are best distinguished by the armature of the shield. In *L. anomalus* the anterolateral margins of the shield are armed with exceptionally long spines; the lateral projections are similarly armed with very long spines, and the rostrum, which terminates in a simple, acute spine, reaches approximately to the base of the corneae of the ocular peduncles. In contrast, the armature of the shield of *L. splendescens*, although prominent, is much less pronounced. The spines on the anterolateral margins are much smaller, as are the spines of the lateral projections. The rostrum reaches only to the proximal part of the ocular peduncles and terminates in several small denticles. The dorsal surface of the shield is spinulose and tuberculate in this species, whereas, in *L. anomalus* it is strongly spinose.

Discorsopagurus new genus

Pylopagurus: Stevens, 1925: 296 (in part; not *Pylopagurus* A. Milne-Edwards & Bouvier, 1893).

Orthopagurus Stevens, 1927: 245 (in part).

Type species. — *Pylopagurus schmitti* Stevens, 1925: 298.

Gender. — Masculine.

Diagnosis. — Shield calcified; posterior carapace membranous.

Eleven pairs of phyllobranchiate branchiae.

Maxillipeds widely separated basally. Basis-ischium of mxp₃ incompletely fused; crista dentata well developed, with one accessory tooth. Mxp₁ with exopodite bearing multiarticulate flagellum. Maxillule with endopodal external lobe moderately well developed, not recurved.

Antennal peduncle with third segment lacking spine at ventromesial distal angle.

Chelipeds unequal, right larger than left.

Fourth pereopods subchelate; propodal rasp well developed; dactyl apparently lacking preungual process at base of claw.

Males with paired gonopores; coxae of P₅ equal; no sexual tubes.

Females with paired gonopores.

No paired pleopods in either sex.

Abdomen well developed, straight or slightly flexed, not twisted; tergites in form of paired, incompletely fused, chitinous or weakly calcified plates; sixth tergite strongly calcified, with margins upturned. Uropods symmetrical.

Telson without median transverse constriction; terminal margin entire.

Distribution. — Sea of Japan (Makarov); Kuril Islands and southern Sakhalin (Kobjakova, Lindberg et al.); Pacific coast of Iturup (Lindberg et al.); British Columbia (Hart); Puget Sound and Straits of Juan de Fuca, Washington (Stevens, Hart).

Affinities. — *Discorsopagurus* appears, at least superficially, closely allied to *Orthopagurus* Stevens and *Pylopagurus* A. Milne-Edwards & Bouvier; however, the form of the telson and the partial fusion of the abdominal tergites suggest some relationship with the Parapaguridae, as redefined by De Saint Laurent (1972). Although *Discorsopagurus* is assigned to the Paguridae, its phylogenetic position within the family is uncertain.

Etymology. — The name, *Discorsopagurus*, is derived from the Latin, *discors*, meaning disagreeing and, *Pagurus*, a kind of crab, and indicates nonconformity of this genus in the structure of the abdominal tergites and telson.

Discussion. — Stevens (1927) established the genus *Orthopagurus* for two western North American species formerly assigned to the genus *Pylopagurus*, i.e., *Pylopagurus minimus* (Holmes) and *P. schmitti* Stevens, because the females of both species lacked the paired first pleopods characteristic of the genus. Stevens, however, did not designate a type species for *Orthopagurus*. Subsequently, Makarov (1938b) designated *Orthopagurus minimus* (Holmes) as the type species.

In the present study, both species have been reexamined in detail and several characters, not observed by previous carcinologists, have been noted which show conclusively that *O. minimus* and *O. schmitti* are not congeneric. Therefore, it has been necessary to restrict the definition of *Orthopagurus* to that typified by Holmes' species and establish a new genus for *O. schmitti*.

***Discorsopagurus schmitti* (Stevens) new combination (figs. 96, 97)**

Pylopagurus schmitti Stevens, 1925: 298, figs. 17-22 (type locality: off Point Caution, Washington, U.S.A.).

Orthopagurus schmitti: Stevens, 1927: 249, figs. 2-4. — Hart, 1930: 105. — Derjugin & Kobjakova, 1935: 142. — Hart, 1937: 192, figs. 4D, 11C, D, pl. 1 fig. 4. — Makarov, 1937: 65, fig. 19. — Makarov, 1938a: 420. — Makarov, 1938b: 228, pl. 2 fig. 1. — Gurney, 1939: 98. — Hart, 1940: 95. — Gurney, 1942: 262. — Reinhard, 1944: 49. — Vinogradov, 1950: 230 (key), fig. 129. — Gordan, 1956: 321. — Kobjakova, 1956: 51. — MacDonald, Pike & Williamson, 1957: 255. — Serène, 1957: 111. — Dechancé & Forest, 1958: 275. — Kobjakova, 1958a: 233. — Kobjakova, 1958b: 252. — Lindberg et al., 1959: 232. — Reischman, 1959: 410. — Wolff, 1961: 20. — Dechancé, 1962: 383. — Makarov, 1962: 217, pl. 2 fig. 1. — Provenzano, 1968b: 640.

Phylopagurus schmitti: Hart, 1930: 105 (misspelling of *Pylopagurus schmitti* Stevens, 1925).

Orthopagurus (Pylopagurus) schmitti: Fraser, 1932: 64.

Holotype. — ♂ (SL = 3.1 mm), USNM 58822.

Material examined. — See table 32.

Table 32. *Discorsopagurus schmitti* (Stevens) Material Examined

Locality	Depth (m)	Station		Date	Sex			SL (mm)	Collector
		Deposition			♂	♀	♂		
<i>Washington</i>									
Crescent Bay	18-36	----	-----	10/10/41	1			4.5	---
		USNM	-----						
San Juan Is.	145	----	-----	3/7/25	1			3.3	Stevens
		RMNH	-----						
San Juan I.	---	----	-----	8/61	1			3.2	McLaughlin
		USNM	-----						
Friday Harbor, San Juan I.	---	----	-----	1922	2			3.1-3.7	Stevens
		USNM, RMNH	-----						
Friday Harbor, San Juan I.	---	----	-----	6/25	1			2.9	Stevens
		USNM	-----						
Minnesota Reef, San Juan I.,	73	----	-----	13/7/25	1			2.8	Stevens
		USNM	-----						
Davis Bay, Lopez I.	27	----	-----	12/7/27	3	4		2.4-3.4	Stevens
		AHF, RMNH	-----						
Off Lopez I.	---	----	-----	21/6/25	1	1		2.2-2.8	Stevens
		BM	-----						
Lopez I.	27-54	----	-----	6/25		5		1.8-2.8	Stevens
		USNM	-----						
Flat Point, Lopez I.	---	----	-----	23/6/27	2			2.9-3.1	Stevens
		USNM	-----						
Outer Bay, Lopez I.	36	----	-----	3/7/39	1			3.1	Stevens
		USNM	-----						

Diagnosis. — Articles of antennal flagella each with several moderately long or long setae. Right chela with dorsal surface of fixed finger level or slightly convex, spinulose. Left chela with slight degree of clockwise torsion; dorsal surface usually slightly convex. Telson without median transverse constriction; terminal margin entire.

Description. — Shield usually somewhat longer than broad; anterolateral margins sloping; anterior margins between rostrum and lateral projections straight or slightly concave; posterior margin truncate or roundly truncate; dorsal surface with scattered tufts of short setae; anterolateral angle blunt. Rostrum moderately prominent, obtusely triangular or occasionally somewhat rounded, considerably exceeding lateral projections; terminating acutely or subacutely, often with small terminal spine. Lateral projections obtusely triangular or broadly rounded; with moderately prominent or prominent submarginal spine or occasionally unarmed.

Ocular peduncles moderately short, two-thirds to three-fourths length of shield; moderately stout, slightly inflated basally and slightly dilated in corneal region; dorsal or dorsomesial surface with row of tufts of short setae. Ocular acicles moderately prominent, subtriangular; terminating acutely or subacutely with strong submarginal spine; mesial margins usually expanded, lateral margins usually straight, dorsal surface with prominent tuft of short setae; separated basally by slightly more than or entire basal width of one acicle.

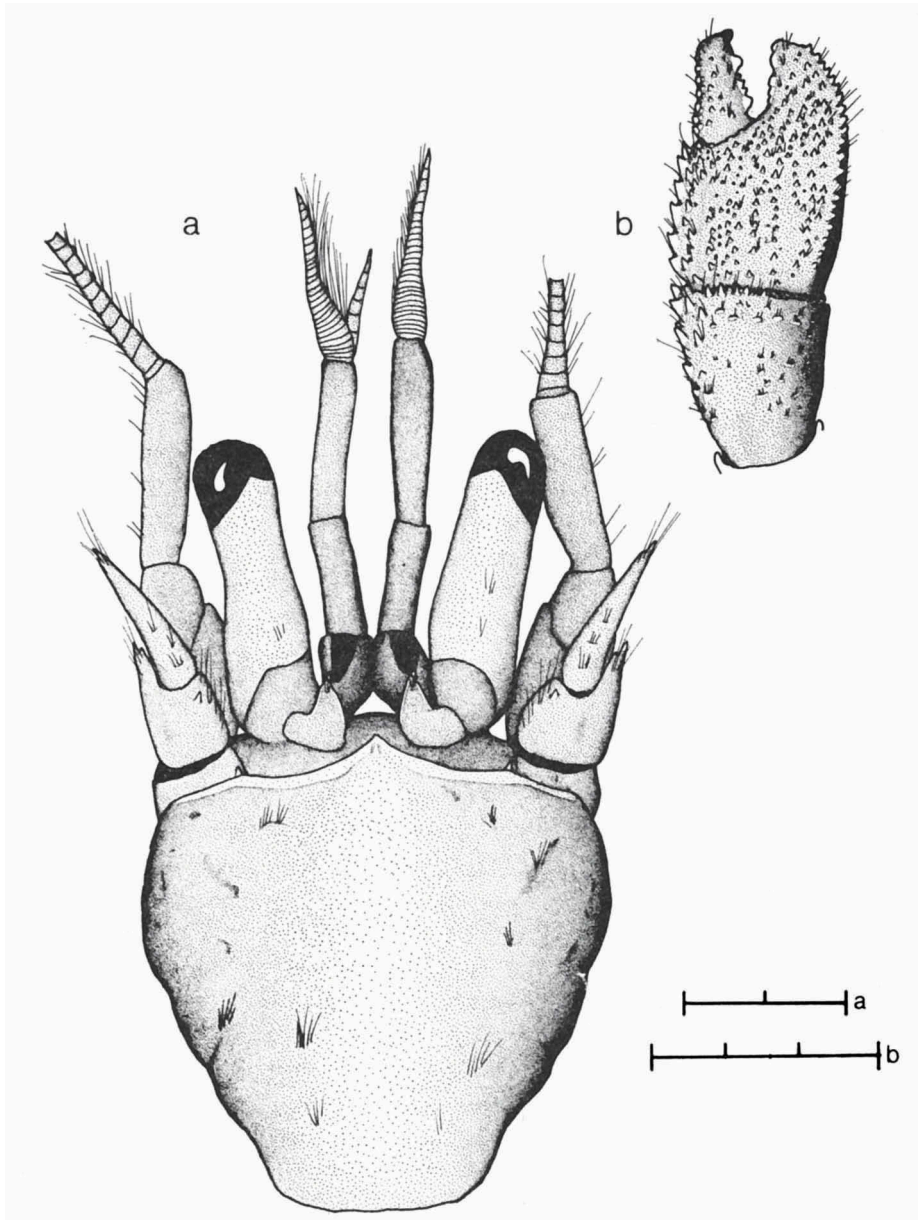


Fig. 96. *Discorsopagurus schmitti* (Stevens). a, shield; b, right chela and carpus (dorsal view). Scales equal 3 mm (b) and 1 mm (a).

Antennular peduncles moderately short, exceeding ocular peduncles by one-fourth to three-fourths length of ultimate segment. Ultimate, penultimate and basal segments unarmed.

Antennal peduncles moderately short, exceeding the ocular peduncles by one-fourth to one-half length of ultimate segment; with supernumerary segmentation. Fifth, fourth and third segments with few tufts of short setae. Second segment with dorsolateral distal angle produced, terminating in small, simple or bifid spine and tuft of stiff setae, mesial margin with 1-4 small spines or spinules, lateral margin with tufts of stiff setae; dorsomesial distal angle with small spine often obscured by tuft of stiff setae, mesial margin with tufts of setae. First segment with lateral face unarmed or occasionally with small spinule, ventral margin produced, unarmed or with 1 to 4 small spinules laterally. Antennal acicle moderately short, rarely overreaching ultimate peduncular segment; terminating in small spine partially obscured by tuft of stiff setae; mesial and lateral margins unarmed, dorsal surface with few tufts of stiff setae. Antennal flagella short, not reaching to tip of right cheliped; each article with several long setae.

Mandible without distinguishing characters. Maxillule with proximal endite subquadrate or slightly rounded; endopodite with 1 bristle on moderately well developed internal lobe, external lobe well developed, not recurved. Maxilla with endopodite basally inflated, not equalling scaphognathite in distal extension. First maxilliped with endopodite approximately two-thirds length of exopodite. Second maxilliped with basis-ischium fusion incomplete. Third maxilliped with basis-ischium fusion incomplete; basis with 1 or 2 spines; ischium with crista dentata well developed, with proximal tooth considerably more prominent than irregularly spaced remaining teeth, and with one strong accessory tooth; merus and carpus unarmed. Sternite of mxp_3 usually with 1 acute spine on each side of midline.

Right cheliped somewhat larger than left. Dactyl moderately short, slightly less than or equalling length of palm, moderately deep; cutting edge with row of calcareous teeth proximally, row of small corneous teeth distally, terminating in small corneous claw; dorsomesial margin with row of small spines or spinulose tubercles and tufts of stiff setae, dorsal surface with few scattered small spinules and frequently with irregular rows of short stiff setae, mesial face often slightly spinulose, ventral surface with tufts of long stiff setae. Palm moderately long, two-thirds to three-fourths length of carpus; dorsomesial margin with row of moderately strong conical spines, often corneous-tipped, and tufts of stiff setae, dorsal surface with several very irregular rows of small spines or spinules often extending to tip of fixed finger, dorsolateral margin with row of small spines, increasing in size

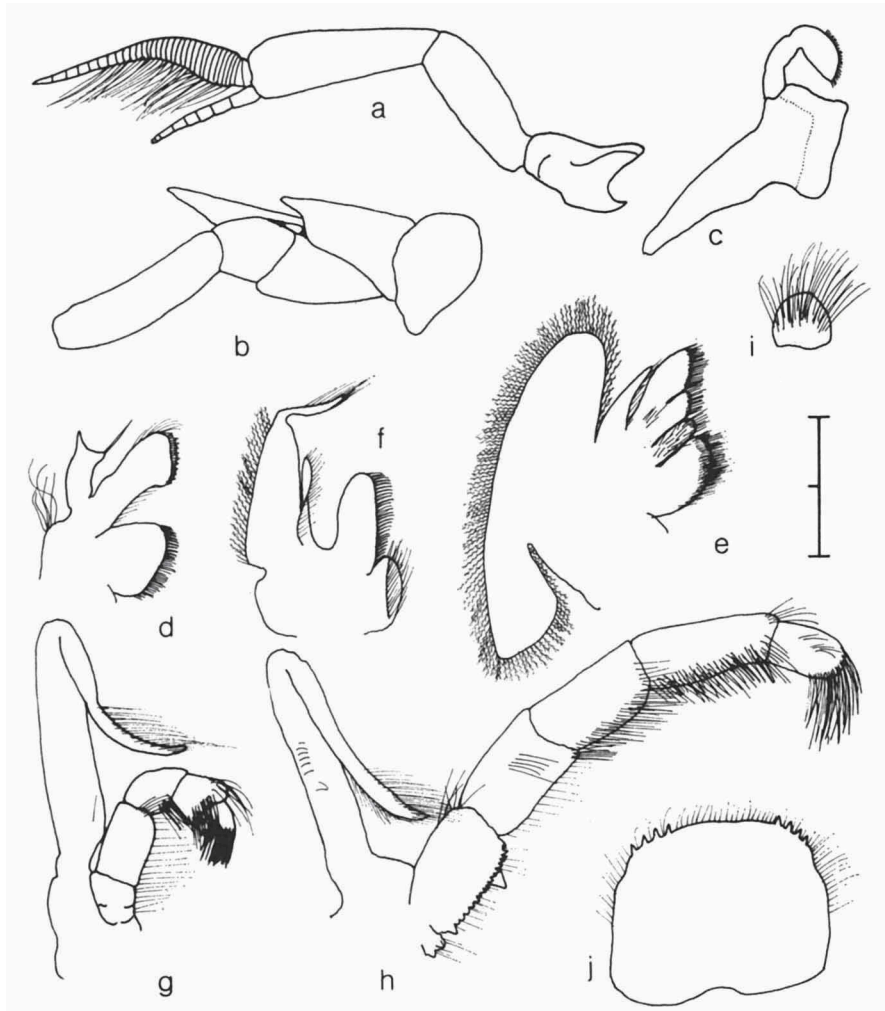


Fig. 97. *Discorsopagurus schmitti* (Stevens). a, antennule (lateral view); b, antennal peduncle (lateral view); c-h, mouthparts (left, internal face): c, mandible; d, maxillule; e, maxilla; f, mxp₁; g, mxp₂; h, mxp₃. — i, sternite, P₃; j, telson. Scale equals 1 mm.

distally; lateral face often slightly spinulose and with tufts of stiff setae; ventral and mesial surfaces with tufts of long stiff setae. Carpus short to moderately long, one-half to four-fifths length of merus; dorsomesial margin with single or double row of small spines or spinulose tubercles, increasing in size distally, dorsal surface with 1-3 irregular rows of small spines mesially and scattered small spinules or spinulose protuberances laterally, distal margin with row of small spines; dorsolateral margin not particularly delimited,

lateral face spinulose or denticulate and with scattered tufts of short setae; ventrolateral margin slightly denticulate, ventral and mesial surfaces with tufts of moderately long setae. Merus subtriangular; dorsal surface with row of low protuberances and tufts of long setae, distal margin with row of stiff setae; mesial and lateral faces somewhat spinulose ventrally, ventromesial margin with single or double row of small spines or denticulate tubercles proximally, extending distally as row of small spines, ventrolateral margin with row of low spinulose tubercles or protuberances and tufts of long setae. Ischium with row of small denticles on ventromesial margin. Coxa with tufts of long setae on distal margin.

Left cheliped moderately long, often reaching to or beyond base of dactyl of right. Chela with slight degree of clockwise torsion. Dactyl moderately long, equalling or slightly exceeding length of palm; cutting edge with row of small corneous teeth; terminating in small corneous claw; slightly overlapped by fixed finger; dorsomesial margin with row of small spinules or spinulose tubercles and tufts of short setae proximally, dorsal surface with scattered small spines or spinules in proximal half; mesial face slightly spinulose or tuberculate with rows of tufts of long setae; ventral surface with few tufts of long stiff setae. Palm moderately long, approximately two-thirds to three-fourths length of carpus; dorsolateral margin with single or double row of small spines, increasing in size on fixed finger, dorsal surface generally convex, with irregular rows of small spines or spinulose tubercles and tufts of short setae; dorsomesial margin with row of small spinules, mesial face slightly tuberculate and with tufts of long setae; ventral surface with tufts of long stiff setae; lateral face frequently slightly spinulose or tuberculate and with numerous tufts of stiff setae. Carpus moderately long, approximately two-thirds to three-fourths length of merus; dorsal surface with two rows of moderately strong spines tending to become clustered near dorsomesial distal angle, distal margin with several small spines and tufts of long setae; mesial face with spinulose or denticulate ridges and tufts of long stiff setae dorsally and distally; lateral face somewhat spinulose, distal margin with row of small spines; ventrolateral distal margin somewhat denticulate, ventral surface with tufts of long setae. Merus subtriangular; dorsal surface with row of low, somewhat spinulose protuberances or ridges and tufts of long setae; mesial and lateral faces with few tufts of short setae; ventromesial margin with row of small spines, ventrolateral margin with irregular row of low, often spinulose or denticulate protuberances or ridges, both margins with tufts of long setae. Ischium with row of small spinules or tubercles on ventromesial margin. Coxa with tufts of long setae on ventromesial distal angle and ventromesial margin.

Second and third pereopods moderately long, second pair often equalling or slightly exceeding length of right cheliped, third pair usually somewhat shorter; both pairs similar in armature and pilosity. Dactyls usually short and broad, occasionally moderately long and somewhat slender, approximately two-thirds to three-fourths length of propodi; in lateral view, straight or slightly curved ventrally; in dorsal view, straight or slightly curved mesially; terminating in very strong corneous claws; dorsal surfaces each with single or double row of tufts of long stiff setae; lateral faces each with scattered tufts of moderately short setae, rarely also with weak longitudinal sulcus; mesial faces each frequently with weak longitudinal sulcus flanked by row of tufts of long setae, occasionally without sulcus; ventral margins each with row of very strong corneous spines, increasing in size distally. Propodi moderately long, usually equalling or slightly exceeding length of carpi; dorsal surfaces each usually with double or triple row of small spines or spinulose tubercles partially obscured by tufts of long stiff setae; lateral and mesial faces each with 1 or 2 rows of long setae; ventral margins each with row of long setae and usually with few corneous spines or spinules distally (second pereopods). Carpi moderately short, approximately one-half length of meri; dorsal surfaces each with irregular row of transverse spinulose or denticulate ridges proximally becoming single or double row of small spines or spinulose tubercles distally, or with double row of small spines, and with tufts of long setae; lateral, mesial and ventral surfaces with scattered tufts of setae. Meri moderately long, laterally compressed; dorsal surfaces each with row of low often spinulose protuberances and tufts of long setae; lateral and mesial faces usually glabrous; ventral margins each with row of tufts of long stiff setae and occasionally few corneous spines or spinules. Ischia each with row of long stiff setae on ventral margin and occasionally few small spines or spinules. Coxae each with rows of setae on ventromesial and ventrodial margins.

Fourth pereopods subchelate; dactyl apparently without preungual process at base of claw; propodal rasp well developed.

Fifth pereopods chelate.

Sternite of third pereopods semicircular, with central tuft of long setae.

Pleopods of male unpaired, pl_3-pl_5 with exopodites moderately well developed, endopodites reduced, or with pl_2-pl_5 moderately well developed, rami unequally developed (see discussion). Pleopods of females unpaired, pl_2-pl_4 with both rami moderately well developed; pl_5 with exopodite moderately well developed, endopodite reduced.

Telson without transverse median constriction; terminal margin entire, with 4 or rarely 3 small spines near each posterolateral angle.

Coloration. — In life: "Pale pinkish buff to white with irregular spots and bands of orange cinnamon; the fingers being tipped with apricot orange; the fingers of the large hand are armed on the inner margins with large white, tubercular teeth; antennae orange vinaceous" (Stevens, 1925). In preservative: Overall pale orange, fading to straw color.

Distribution. — Sea of Japan [Soviet shores] (Makarov); Shikotan-Tō (Kobjakova); west Sakhalin (Kobjakova); Kuril Islands and southern Sakhalin (Kobjakova, Lindberg, et al); Pacific coast of Iturup (Lindberg, et al); British Columbia (Hart); Puget Sound and Straits of Juan de Fuca, Washington (Stevens, Hart); 6-220 meters.

Affinities. — The phylogenetic affinities of this species are not presently known; however, it bears a superficial resemblance to another tube dwelling pagurid, *Orthopagurus minimus*, which has a similar pattern of distribution. *D. schmitti* is distinguished from *O. minimus*, on sight, by the configuration and armature of the right chela. In the former species the dorsal surface of the chela is usually slightly convex and armed over all with small spines or spinules; whereas, in the latter species the dorsal surface of the chela is somewhat concave distally and unarmed or only slightly spinulose.

Discussion. — Descriptions of *D. schmitti* by earlier authors have not included any mention of pleopod number in the males. Of the nine males examined in the course of the present study, five had pleopods, pl₃ to pl₅ only, developed. The remaining four had pleopods pl₂ to pl₅ developed. Of these four specimens, evidence of rhizocephalan infestation was present in only one. On the basis of such a small sample it is not possible to determine whether the variation in pleopod number is the result of parasite infestation or inherent variability within the species.

Orthopagurus Stevens

Pylopagurus: Stevens, 1925: 296 (in part; not *Pylopagurus* A. Milne-Edwards & Bouvier, 1893).

Orthopagurus Stevens, 1927: 245 (in part). Type species by subsequent designation by Makarov (1938b: 227): *Pagurus minimus* Holmes, 1900: 145. Gender: masculine.

Paguritta Melin, 1939: 50. Type species by monotypy, *Paguritta gracilipes* Melin, 1939: 51. Gender: masculine.

Orthopaguropsis Serène, 1957: 108. Type species, by original designation, *Orthopagurus harmsi* Gordon, 1935: 630 (senior subjective synonym of *Paguritta gracilipes* Melin, 1939). Gender: masculine.

Diagnosis. — Shield calcified; posterior carapace membranous.

Eleven pairs of phyllobranchiate branchiae.

Maxillipeds widely separated basally. Basis-ischium of mxp₃ incompletely fused; crista dentata well developed, with one accessory tooth. Maxillule

with endopodal external lobe rudimentary or vestigial.

Chelipeds unequal, right considerably larger than left.

Fourth pereopods subchelate; propodal rasp well developed; dactyl apparently lacking preungual process at base of claw.

Males with paired gonopores; coxae of P₅ equal; no sexual tubes.

Females with paired gonopores.

No paired pleopods in either sex.

Abdomen well developed, straight or slightly flexed, not twisted; tergites chitinous, usually in form of paired lateral plates, fifth pair fused; sixth tergite strongly calcified, with margins upturned. Uropods symmetrical or nearly so. Telson with prominent median transverse constriction; terminal margin with shallow or deep median cleft.

Distribution. — Tatar Strait (Makarov); Takenoura (Melin); Viet Nam (Serène); Christmas Island (Gordon); west coast of North America, from British Columbia to San Diego, California (Hart).

Affinities. — In the operculate form of the right cheliped, *Orthopagurus* appears allied to *Pylopagurus*, but may be readily distinguished from this genus by the absence of paired pleopods on the first abdominal segment of the females (present in *Pylopagurus*) and by the symmetrical uropods. *Orthopagurus* may be distinguished from the superficially very similar *Discorsopagurus* in having a median transverse constriction in the telson.

Discussion. — As previously indicated, *Orthopagurus* was established by Stevens (1927) for two superficially congeneric species formerly assigned to *Pylopagurus*. Gordon (1935) described a new species from the Indo-West Pacific which she questionably assigned to *Orthopagurus*. Her uncertainty regarding the generic placement of her species was due to the absence of pleopods in her single male specimen. Subsequently, Makarov (1938b), in a revision of the North Pacific anomuran fauna, designated *O. minimus* (Holmes) as the type species of *Orthopagurus*. Basically he repeated Stevens' generic key characters and diagnosis, and did not expand the generic definition to include *Orthopagurus harmsi* Gordon. Shortly thereafter, Melin (1939), in a partial revision of the Paguridea, erected the genus *Paguritta* for a new species, *Paguritta gracilipes* Melin, which he characterized as having a straight abdomen and symmetrical uropods, and no pleopods in the males. In his discussion of the genera of the Paguridae, Melin indicated no awareness of Stevens' *Orthopagurus* or of Gordons' ? *Orthopagurus harmsi*. Serène (1957), after finding additional male specimens of *Orthopagurus harmsi* and confirming the absence of pleopods in the males, concluded that this character alone was sufficient to remove *O. harmsi* from *Orthopagurus*. For this species Serène established the genus *Orthopaguroopsis*.

In all other generic characters Serène stated that *O. harmsi* agreed with *O. minimus*. Although Melin (1939) was one of the major proponents of the significance of pleopod number (or absence) in generic considerations, Serène apparently did not associate Melin's *Paguritta* with his own *Orthopaguropsis*. Forest (1961), in a study of another new genus, *Paguridium* Forest, which is also characterized, in part, by the absence of pleopods in the males, reviewed the descriptions of *Paguritta* and *Orthopaguropsis* and their respective nominal species. He concluded that not only were the two genera synonymous, but that the species were also synonyms. Because *Paguritta* had priority over *Orthopaguropsis* and *Orthopaguropsis harmsi* had priority over *Paguritta gracilipes*, Forest designated the new combination *Paguritta harmsi* (Gordon).

I have not personally examined either Gordon's or Melin's species; however, from their descriptions, as well as those of Serène and Forest, there is sufficient evidence to conclude that the only presumably generic difference between *Paguritta harmsi* (Gordon) and *Orthopagurus minimus* (Holmes) is the absence of pleopods in the males. It has been shown by De Saint Laurent (1970b) and McLaughlin & Haig (in press) that intrageneric variation in both pleopod number and the presence or absence of pleopods in the males does occur and that this character in itself is of no generic consequence. Therefore, both *Paguritta* Melin and *Orthopaguropsis* Serène must be considered junior objective synonyms of *Orthopagurus* Stevens as herein restricted.

Key to the species of *Orthopagurus*

1. Articles of antennal flagella each with long setae bearing 2 series of minute setules. Males lacking unpaired pleopods *O. harmsi* Gordon
- Articles of antennal flagella each with few very short setae or naked. Males with pl₃-pl₅ usually moderately well developed *O. minimus* (Holmes)

Orthopagurus minimus (Holmes) (figs. 98, 99)

- Pagurus (Trigonocheirus) minimus* Holmes, 1900: 145 (by implication; misspelling of *Trigonocheirus* Benedict, Holmes, 1900: 134; type locality: off San Diego, California).
Pagurus minimus: Rathbun, 1904: 160. — Rathbun, 1910: 160.
Eupagurus "minimus": Alcock, 1905: 179.
Parapagurus minimus: Hilton, 1918: 54.
Pylopagurus minimus: Schmitt, 1921: 144, pl. 16 figs. 1a-c. — Balss, 1924: 760. — Stevens, 1925: 299. — MacGinitie, 1937: 1032, pl. 1 fig. 6. — MacGinitie & MacGinitie, 1949: 295, figs. 139, 140. — Gordan, 1956: 340.
Orthopagurus minimus: Stevens, 1927: 247, fig. 1. — Gordon, 1935: 634. — Makarov, 1937: 66, ? fig. 20. — Makarov, 1938a: 420. — Makarov, 1938b: 227. — Hart, 1940: 95. — Vinogradov, 1950: 230 (key). — Gordan, 1956: 321. — Serène, 1957: 114. — Kobjakova, 1958a: 245. — Lindberg et al., 1959: 232. — Makarov, 1962: 216. — Hart, 1971: 1542.

Orthopagurus minimus?: Kobjakova, 1956: 59.
not *Eupagurus ? minimus* Chevreux & Bouvier, 1892a: 253 (= *Paguridium minimum*
(Chevreux & Bouvier, 1892)).

Holotype. — Not seen.

Material examined. — See table 33.

Table 33. *Orthopagurus minimus* (Holmes) Material Examined

Locality	Depth (m)	Station		Date	Sex				SL (mm)	Collector
		Deposition			♂	♀	♀♀	♀+		
<i>British Columbia</i>										
Tasu Hbr., Queen Charlotte Is.	---	----		14/6/35	1				2.9	Hart
			Hart							
Tasu Hbr., Queen Charlotte Is.	---	----		27/6/35		1			2.4	Hart
			Hart							
Skidegate, Queen Charlotte Is.	---	----		----		1			3.4	---
			USNM 52675							
<i>California</i>										
Off San Francisco Bay	60-66	Albatross	5790	22/10/12	1				3.0	---
			USNM 53014							
Corona Del Mar	---	----		10/4/54	1				5.6	MacGinitie
			USNM 103772							

Diagnosis. — Articles of antennal flagella each with few short setae or naked. Right chela with dorsal surface of fixed finger concave, unarmed or slightly spinulose. Left chela with dorsomesial surface strongly oblique.

Description. — Shield longer than broad; anterolateral margins sloping or slightly terraced; anterior margin between rostrum and lateral projections straight or slightly concave; posterior margin roundly truncate; dorsal surface slightly rugose anteriorly and with scattered tufts of short setae; anterolateral angle blunt. Rostrum moderately long, usually considerably exceeding lateral projections, broadly triangular, acute or subacute, usually without terminal submarginal spine and with tuft of moderately long setae. Lateral projections obtusely triangular or broadly rounded, unarmed or with very small submarginal spinule.

Ocular peduncles moderately short, one-half to two-thirds length of shield; stout, slightly inflated basally, corneal region slightly dilated; dorsal or dorsomesial surface with irregular longitudinal row of tufts of short setae. Ocular acicles moderately prominent, subovate, terminating subacutely, with small submarginal spine; mesial margins usually expanded, lateral margins straight or slightly expanded, dorsal surface level or somewhat concave; separated basally by two-thirds to entire basal width of one acicle.

Antennular peduncles moderately short, exceeding ocular peduncles by one-fourth to one-half length of ultimate segment. Ultimate and penultimate segments unarmed; basal segment with small spine at ventrodorsal margin.

Antennal peduncles moderately short, equalling or slightly exceeding length

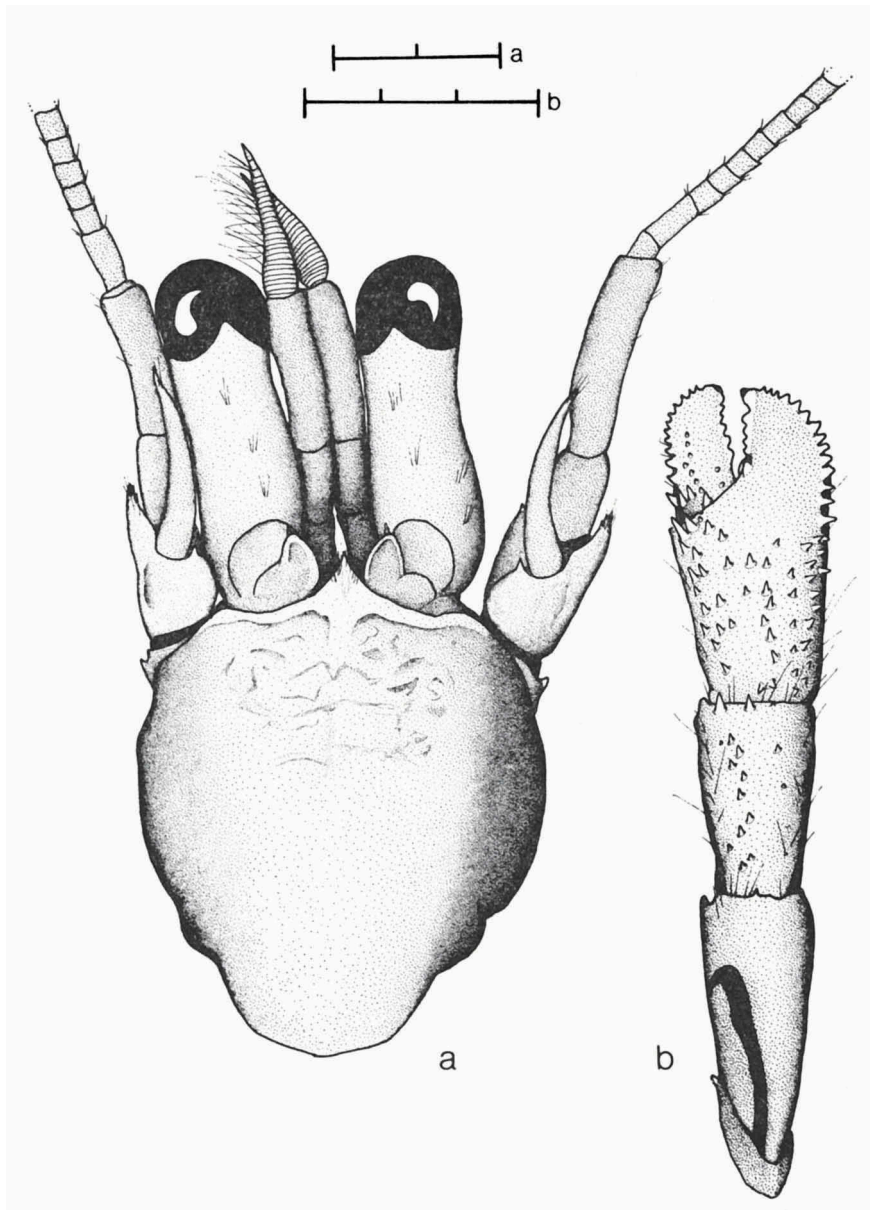


Fig. 98. *Orthopagurus minimus* (Holmes). a, shield; b, right cheliped (dorsal view). Scales equal 3 mm (b) and 1 mm (a).

of ocular peduncles; with supernumerary segmentation. Fifth and fourth segments with few scattered tufts of setae. Third segment with small spine or spinule at ventrodistal margin, partially obscured by tuft of setae. Second segment with dorsolateral distal angle produced, terminating in small simple or bifid spine and tuft of moderately short setae, mesial margin with 1-4 small spines distally, lateral margin unarmed; dorsomesial distal angle with moderately strong spine or occasionally only small spinule. First segment with strong spine at laterodistal margin, ventral margin somewhat produced, with 1 or 2 small spinules laterally. Antennal acicle moderately short, usually reaching only to proximal half of ultimate peduncular segment; terminating in moderately strong spine and tuft of setae; mesial and lateral margins unarmed, with few tufts of setae. Antennal flagella moderately long, usually overreaching right cheliped; each article with few short setae or bristles or occasionally naked.

Mandible without distinctive characters. Maxillule with proximal endite tapering; endopodite with 1 bristle on well developed internal lobe, external lobe vestigial or absent. Maxilla with endopodite somewhat basally inflated, slightly shorter than or equalling the scaphognathite in distal extension. First maxilliped with endopodite approximately one-half length of exopodite. Second maxilliped with basis-ischium fusion incomplete. Third maxilliped with basis-ischium fusion incomplete; ischium with crista dentata well developed, 1 accessory tooth; merus and carpus unarmed. Sternite of mxp_3 unarmed or with 1 small spine on one or both sides of midline.

Right cheliped considerably larger than left; chela, in dorsal view, straight or somewhat expanded distally. Dactyl short, approximately one-half to three-fourths length of palm, moderately broad and deep; cutting edge with row of strong calcareous teeth, terminating in very small corneous claw; often with prominent hiatus between dactyl and fixed finger; dorsomesial margin with row of strong, conical corneous-tipped spines, decreasing in size distally, dorsal surface relatively level, with scattered small corneous-tipped spines and few tufts of short setae; mesial and ventral surfaces with rows of tufts of stiff setae. Palm long, exceeding length of carpus by approximately one-fourth to one-third or occasionally equalling length of carpus; dorsal surface usually slightly convex proximally, usually level or concave distally and on fixed finger and with irregular rows of small or moderately small, conical corneous-tipped spines, usually not continuing onto fixed finger; dorsolateral margin with irregular row of very small spines or spinules proximally, becoming regular row of strong corneous-tipped spines distally and decreasing in size on fixed finger, dorsomesial margin with row of small spines becoming strong spines at dorsomesial distal angle; mesial, lateral

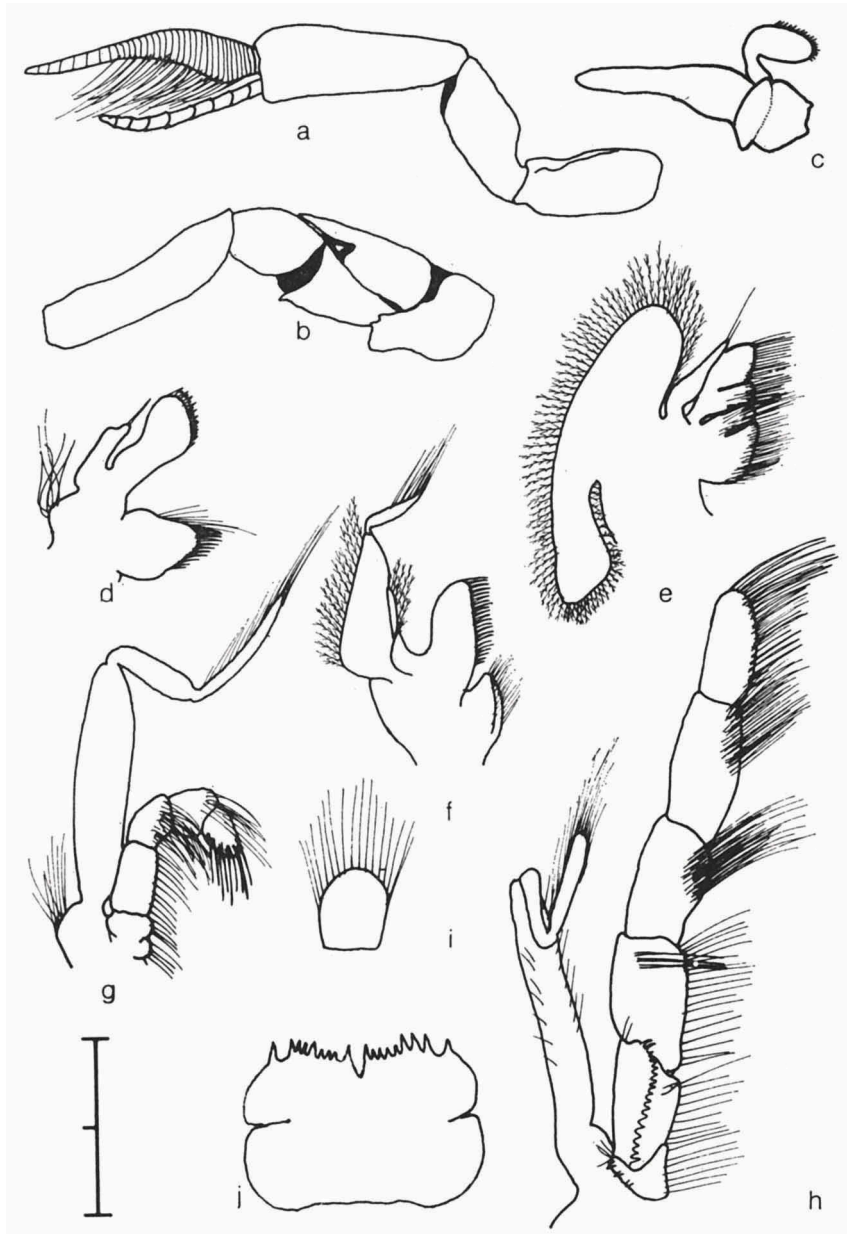


Fig. 99. *Orthopagurus minimus* (Holmes). a, antennule (lateral view); b, antennal peduncle (lateral view); c-h, mouthparts (left, internal face): c, mandible; d, maxillule; e, maxilla; f, mxp₁; g, mxp₂; h, mxp₃. — i, sternite, P₈; j, telson. Scale equals 1 mm.

and ventral surfaces with tufts of long setae. Carpus moderately short, equalling or somewhat less than length of merus; subtriangular; dorsomesial margin with row of small spines partially obscured by tufts of long setae, dorsal surface with 1-3 irregular rows of small spines or spinules and few tufts of long setae, distal margin with 2 or 3 moderately strong or occasionally small spines; lateral, ventral and mesial surfaces with scattered tufts of short setae. Merus moderately short, subtriangular; dorsal margin with row of tufts of long setae, distal margin with 1 or 2 small spines; mesial, lateral and ventral surfaces with scattered setae, ventromesial margin with row of small spines or low protuberances or tubercles. Ischium with row of small spines on ventromesial margin, partially obscured by tufts of long setae. Coxa with clump of setae at dorsomesial distal angle, mesial face with few tufts of long setae.

Left cheliped short, usually reaching only to proximal margin of right chela. Dactyl moderately long, approximately one-fourth to one-third longer than palm; cutting edge with row of small corneous teeth, terminating in small corneous claw; slightly overlapped by fixed finger; dorsal surface with 2 rows of tufts of long setae, dorsomesial margin usually not delimited; mesial and ventral surfaces with tufts of long setae. Palm with dorsal surface elevated in midline, dorsolateral surface generally convex and with 2 irregular rows of small corneous-tipped spines extending onto fixed finger proximally, dorsomesial surface strongly oblique; dorsolateral margin with single or double row of small spines, decreasing in size distally; lateral and ventral surfaces with tufts of long setae. Carpus moderately long, approximately equalling length of merus; dorsal surface with 2 rows of moderately strong corneous-tipped spines, distal margin with 2 or 3 strong spines partially obscured by tufts of long setae; lateral, mesial and ventral surfaces with tufts of long setae, more dense mesially. Merus with single or double row of low, often spinulose protuberances and tufts of long setae; lateral and mesial faces with few tufts of short setae; ventromesial margin with row of small spines increasing in size distally, ventrolateral margin usually with row of low protuberances and tufts of long setae. Ischium with row of small denticles on ventromesial margin, partially obscured by tufts of long setae. Coxa with clump of long setae at ventromesial distal angle, ventromesial margin with long setae.

Second pereopods moderately short, often not reaching to dactyl of right cheliped. Dactyl usually short, moderately broad, occasionally moderately long and slender, two-thirds to three-fourths length of propodus, or occasionally slightly longer than propodus; in lateral view, straight, or occasionally slightly curved ventrally; in dorsal view, straight; dorsal surface with row

of tufts of moderately long setae; lateral face with few scattered setae; mesial face with longitudinal sulcus proximally and a row of corneous spinules on distal one-half to two-thirds, increasing in size distally; ventral margin with row of very strong corneous spines, increasing in size distally; terminating in strong corneous claw. Propodus moderately long, one-fourth to one-third longer than carpus; dorsal surface with row of tufts of long stiff setae; lateral and mesial faces with irregular rows of tufts of short to moderately long setae; ventral surface with row of small corneous spines or spinules obscured by tufts of long setae. Carpus moderately long, two-thirds to three-fourths length of merus; dorsal margin with row of small corneous-tipped spines, increasing in size distally and partially obscured by tufts of long setae; lateral, mesial and ventral surfaces with tufts of long setae. Merus laterally compressed; dorsal surface with row of tufts of long setae, occasionally with double row of long setae; lateral face usually glabrous; mesial face with tufts of setae; ventral margin with row of small spines or spinules or occasionally with few small widely spaced spinules and tufts of long setae. Ischium with few small spinules on ventral margin obscured by tufts of long stiff setae. Coxa with row of long setae on ventromesial margin.

Third pereopods moderately short, approximately equalling length of second. Dactyl usually short, moderately broad, occasionally moderately long and slender, two-thirds to three-fourths length of propodus, rarely longer than propodus; in lateral view, straight or rarely slightly curved ventrally; in dorsal view, straight; terminating in strong corneous claw; dorsal surface with row of tufts of moderately long setae; lateral face with few tufts of setae; mesial face with longitudinal sulcus proximally and row of corneous spinules increasing in size distally; ventral margin with row of strong corneous spines, increasing in size distally. Propodus moderately long, one-fourth to one-third longer than carpus; dorsal surface with row of tufts of long stiff setae; lateral and mesial faces with rows of tufts of short to moderately long setae; ventral surface with row of corneous spines or spinules and tufts of long setae. Carpus moderately long, approximately equalling length of merus; dorsal margin with row of tufts of long setae, 1 small spine at dorsodistal margin; lateral, mesial and ventral surfaces with tufts of long setae. Merus laterally compressed; dorsal surface with row of tufts of long setae; mesial and ventral surfaces with tufts of long setae; lateral face usually glabrous. Ischium with row of tufts of long setae on ventral margin. Coxa with row of setae on ventromesial margin.

Fourth pereopods subchelate; dactyl apparently without preungual process at base of claw; propodal rasp well developed.

Fifth pereopods chelate.

Sternite of third pereopods subovate; anterior margin with row of long setae.

Pleopods of male unpaired, pl_3 - pl_5 with exopodites moderately well developed, endopodites reduced. Pleopods of females unpaired, pl_2 - pl_4 with both rami moderately well developed, pl_5 with exopodite moderately well developed, endopodite reduced.

Telson with posterior lobes generally symmetrical; subrectangular; separated by shallow to deep median cleft; both terminal margins with row of prominent corneous spines, strongest laterally; anterior lobes unarmed.

Coloration. — In life: "General color reddish, with spots of darker red, larger cheliped a darker red than rest of body, especially at distal end; ocular peduncles with a median, transverse, light colored band" (Holmes). In preservative: Overall reddish, fading with time to straw color.

Distribution. — Tatar Strait (Makarov); east Sakhalin (Kobjakova); British Columbia to San Diego, California (Hart); 11-64 meters.

Affinities. — As previously indicated, *Orthopagurus minimus* bears a superficial resemblance to *D. schmitti*. In addition to the distinguishing characters of the genus, *O. minimus* may be distinguished by the configuration and armature of its somewhat operculate right chela.

Discussion. — Holmes (1900) originally described this species as *Pagurus minimus*, apparently not realizing that the name was preoccupied by *Eupagurus minimus* Chevreux & Bouvier, 1892a. Alcock (1905) noted that Holmes' name was preoccupied; however, he did not suggest a replacement name for the species. Schmitt (1921) transferred Holmes' *P. minimus*, without comment, to the genus *Pylopagurus* and subsequently, Stevens (1927) placed it in *Orthopagurus*. Later, Makarov (1938b) designated *Orthopagurus minimus* as the type species of the genus. In the interim, *Eupagurus minimus* Chevreux & Bouvier was supplementally redescribed and illustrated by Chevreux & Bouvier (1892b: 106, pl. 2 figs. 21-25) and recorded by Monod (1933) and Forest (1955, 1956). This species was subsequently transferred to *Paguridium* Forest (Forest, 1961). *O. minimus* is a junior homonym of *P. minimum*; however, as *Eupagurus* and *Pagurus* are not considered the same nominal genus (L. B. Holthuis, personal communication), although they are objectively synonymous, the species names are not primary homonyms. According to the Rules of Nomenclature (Art. 59b), a secondary junior homonym must be replaced only if the two species-group taxa are considered congeneric. As *Orthopagurus minimus* is not congeneric with *Paguridium minimum*, Holmes' name need not be replaced.

Schmitt (1921) and Stevens (1927) characterized *O. minimus* by its distally broadened right chela. Even though relatively few specimens were

available for the present study, considerable variation was observed in the configuration of the right chela. Similarly, marked variation was observed in the length-width relationships of the dactyls of the second and third pereopods. Characters which appear more constant, and therefore, diagnostic for this species, include the configuration of the left chela, i.e., the strongly oblique dorsomesial face; the articles of the antennal flagella, which are naked or only sparsely setose; and the shape and armature of the telson.

PARAPAGURIDAE

Parapagurus Smith

Parapagurus Smith, 1879: 50. Type species by monotypy: *Parapagurus pilosimanus* Smith, 1879: 51. Gender: masculine.

Sympagurus Smith, 1883: 37. Type species by original designation: *Sympagurus pictus* Smith, 1883: 37. Gender: masculine.

Diagnosis. — Eleven pairs of phyllobranchiate or trichobranchiate branchiae.

Maxillipeds widely separated basally. Basis-ischium of mxp_3 usually incompletely fused; ischium with crista dentata without accessory tooth. Exopodite of mxp_1 without multiarticulate flagellum.

Ocular acicles usually small, denticulate or entire.

Epistome with labral or interantennular spine(s).

Chelipeds unequal, right considerably larger than left. Left chela and carpus laterally compressed.

Fourth pereopods subchelate.

Males with paired gonopores; usually with paired pleopods on first and second abdominal segments, occasionally without paired pleopods.

Females with single gonopore on left coxa, P_3 ; no paired pleopods.

Abdominal tergites entire.

Telson entire, posterior margin without pronounced median cleft.

Distribution. — Worldwide.

Discussion. — The species of *Parapagurus* have long been a source of systematic confusion and problems of misidentification are common. Recently De Saint Laurent (1972) published a revision of the Parapaguridae, in which she drastically subdivided *Parapagurus*. Although descriptions or diagnoses were not given for many of the species and subspecies, most were illustrated sufficiently to permit recognition. This work will be a major contribution in the clarification of species identifications of *Parapagurus*.

Parapagurus pilosimanus benedicti De Saint Laurent

(figs. 100, 101)

Parapagurus sp. indet.: Rathbun, 1904: 162. — Rathbun, 1910: 162.

Parapagurus armatus: Reinhard, 1944: 56, fig. 7A. — Reischman, 1959: 409 (nomen nudum; not *Parapagurus armatus*: Ross, 1967: 305).

Parapagurus pilosimanus benedicti De Saint Laurent, 1972: 103, pl. I fig. 6 (type locality: "Albatross" sta. 5699, Point Sur Light, 36°30'N 122°00'W).

Holotype. — Not seen.

Material examined. — See table 34.

Table 34. *Parapagurus pilosimanus benedicti* de Saint Laurent Material Examined

Locality	Depth (m)	Station	Date	Sex			SL (mm)	Collector
		Deposition		♂	♀	♀♂		
<i>Washington-Oregon</i>								
Off Columbia River	1554	----	17/5/62	5			6.4-9.0	Pereyra
		USNM						
Off Columbia River	1463	----	17/5/62		1		6.0	Pereyra
		USNM						
Off Columbia River	1902	----	10/6/62	2	1		6.0-8.0	Pereyra
		USNM						
Off Columbia River	1372	----	28/8/63	3	3		5.4-8.6	Pereyra
		USNM						
Off Columbia River	1646	----	9/2/63	1			6.6	Pereyra
		USNM						
Off Columbia River	1555	----	9/8/63		2		5.3-5.6	Pereyra
		USNM						
Off Columbia River	1829	----	28/5/64	1	2		5.8-7.4	Pereyra
		USNM						
<i>Oregon</i>								
45°55'N, 125°09'W	1555	----	29/5/64	6			5.5-8.1	Pereyra
		USNM, RMNH						
45°54'N, 125°05'W	1555	----	15/5/63	6	1	9	4.8-7.3	Pereyra
		USNM, AHF						
45°50'N, 124°52'30"W	1097	23A	9/6/62	28	6	21	5.2-10.9	CC
		USNM, RMNH						
45°43'N, 125°13'W	1902	AHF, CNM, BM	28/5/64	24	7	7	4.8-9.9	Pereyra
		USNM, RMNH						
45°37.1'N, 124°54.6'W	1372	----	15/5/63	3	1		6.0-9.1	Pereyra
		USNM						

Diagnosis. — Ocular acicles usually bifid. Right cheliped with fixed finger and dactyl moderately short and broad. Propodus of third pereiopods with dorsal surface unarmed.

Description. — Shield broader than long, or rarely, width equalling length; anterolateral margins straight or somewhat sloping or less frequently slightly terraced; anterior margin between rostrum and lateral projections straight or sloping; posterior margin broadly rounded; dorsal surface slightly rugose laterally and frequently with few small spinules; anterolateral angle unarmed. Rostrum usually broadly rounded, occasionally obtusely triangular and subacute, rarely acute; slightly exceeding or occasionally considerably exceeding lateral projections; usually unarmed, occasionally with small submarginal spinule; frequently distally depressed. Lateral projections broadly rounded, very slightly produced or obsolete, unarmed.

Ocular peduncles moderately short, one-half to two-thirds length of shield; somewhat inflated basally, corneal region somewhat dilated, corneae usually

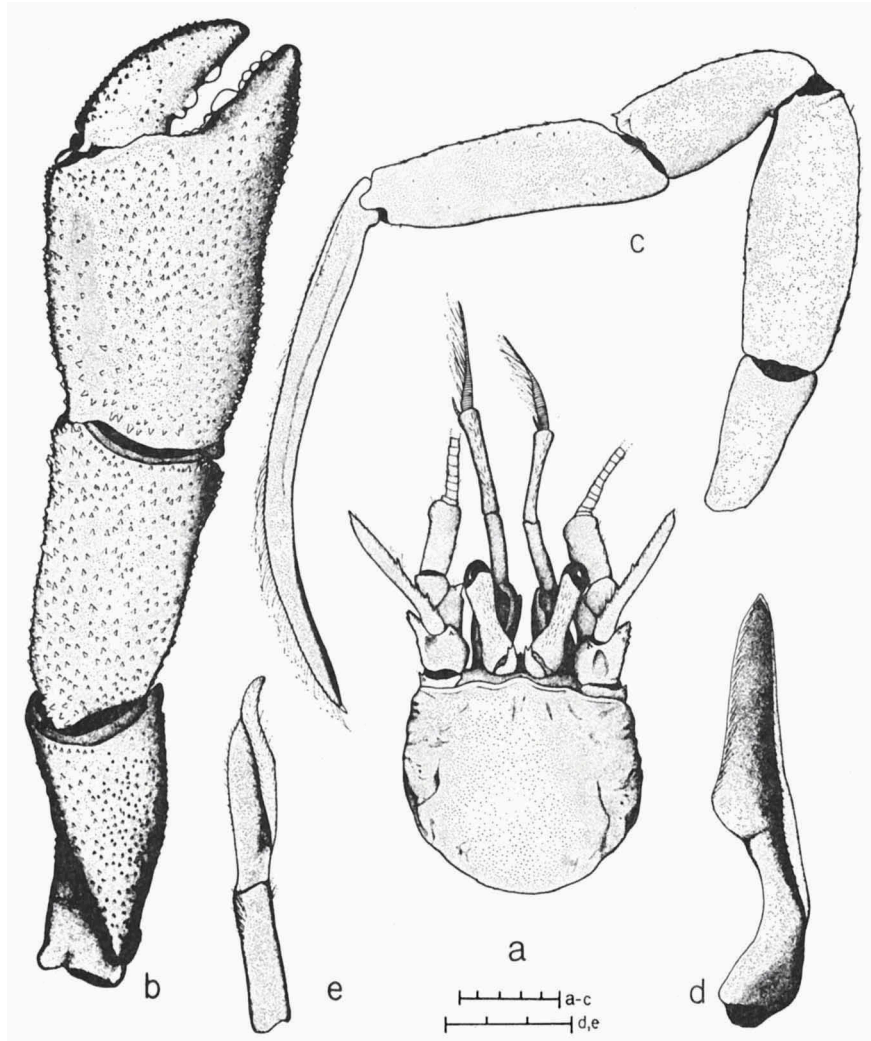


Fig. 100. *Parapagurus pilosimanus benedicti* De Saint Laurent. a, shield; b, right cheliped (dorsal view); c, left P₃ (lateral view); d, ♂ pl₁ (internolateral view); e, ♂ pl₂. Scales equal 5 mm (a-c) and 3 mm (d, e).

reduced; dorsal surface with numerous short setae in longitudinal band. Ocular acicles slender, subtriangular; mesial margins often strongly depressed, lateral margins straight or slightly oblique; terminating most frequently in bifid spine, often in simple spine, occasionally in trifid spine; separated basally by one-fourth to one and one-half basal width of one acicle, rarely approximate.

Antennular peduncles exceptionally long, exceeding ocular peduncles by entire length of ultimate segment and usually by one-half to entire length of penultimate segment. Ultimate segment with row of short setae on dorsal surface. Penultimate segment often with few short setae. Basal segment with moderately strong spine at ventromesial distal margin; lateral face with 2 or 3 small spines distally, dorsolateral margin with strong spine.

Antennal peduncles moderately short, exceeding ocular peduncles by one-fourth to two-thirds length of ultimate segment; with supernumerary segmentation. Fifth and fourth segments with few tufts of short setae. Third segment with strong spine at ventromesial distal margin and few tufts of moderately long setae. Second segment with dorsolateral distal angle produced, terminating in simple, bifid or multifid spine, lateral margin with 1-6 small spines or spinules, dorsal face often with several small spines or spinules, mesial face usually with 1-4 small spines; dorsomesial distal angle with small spine or rarely unarmed and with tuft of setae. First segment with 1 or 2 small spines on lateral face distally; ventral margin produced, with 1-6 small spines laterally. Antennal acicle long, approximately equalling length of ultimate peduncular segment; terminating in acute spine, mesial margin with row of moderately long setae and usually with short row of widely spaced small spines proximally. Antennal flagella long, overreaching tip of right cheliped; each article usually with 1 or 2 short bristles.

Mandible without distinguishing characters. Maxillule with proximal endite subquadrate; endopodite with 3-5 bristles on well developed internal lobe, external lobe rudimentary. Maxilla with endopodite equalling scaphognathite in distal extension. First maxilliped with endopodite exceeding exopodite in distal extension; exopodite without multiarticulate flagellum. Second maxilliped with basis-ischium fusion incomplete. Third maxilliped with basis-ischium fusion incomplete; basis with 1 or 2 strong spines; ischium with crista dentata developed as series of irregularly sized teeth, no accessory tooth; merus and carpus unarmed. Epistome with prominent interantennular spine. Sternite of mxp_3 with small spine on each side of midline.

Chelipeds grossly unequal, right greatly exceeding left. Both chelae and carpi, particularly, with very dense, moderately long fine setae usually completely obscuring armature. Right cheliped with dactyl set at oblique angle to palm; dactyl moderately short, two-thirds to three-fourths length of palm; cutting edge with row of strong calcareous teeth proximally, row of very small corneous teeth distally; terminating in small corneous claw; dorsal and mesial surfaces with scattered small spinules or spinulose tubercles; ventral surface unarmed. Palm moderately long, three-fourths to four-fifths length of carpus; somewhat inflated dorsoventrally; usually moderately

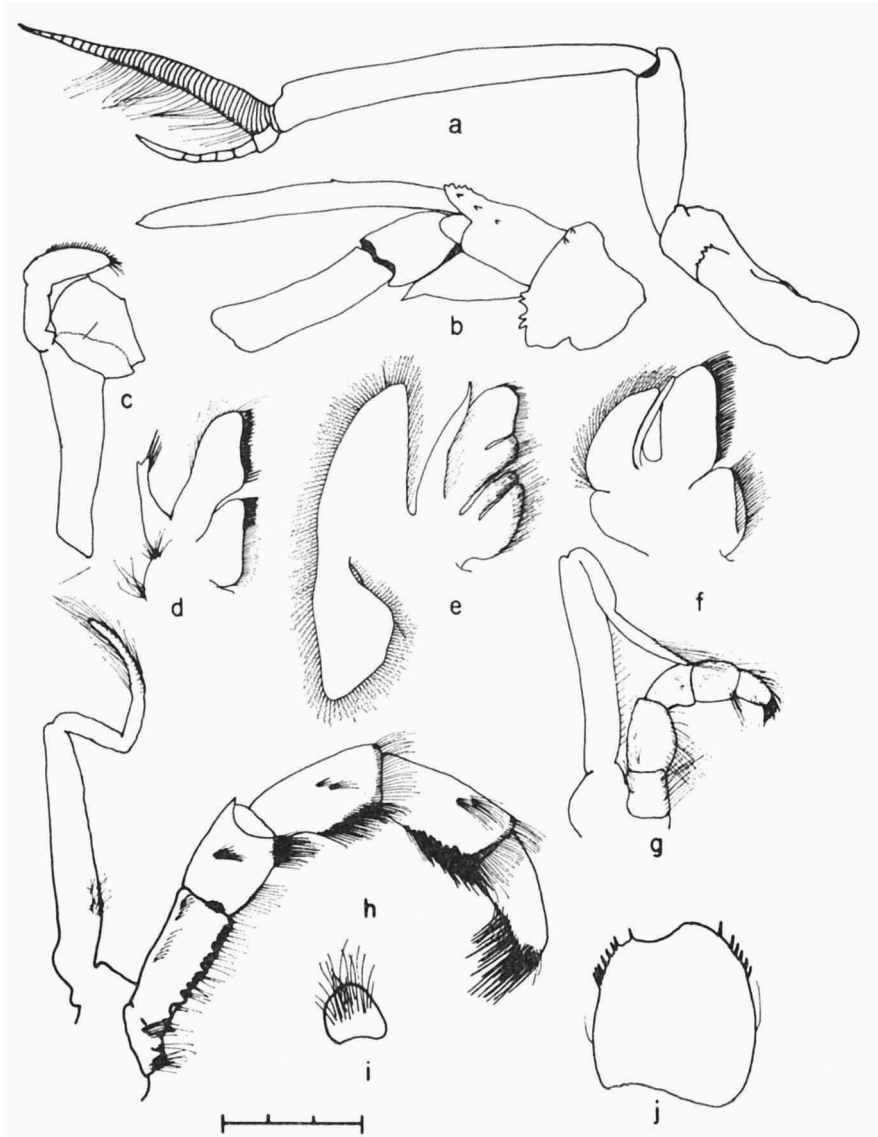


Fig. 101. *Parapagurus pilosimanus benedicti* De Saint Laurent. a, antennule (lateral view); b, antennal peduncle (lateral view); c-h, mouthparts (left, internal face): c, mandible; d, maxillule; e, maxilla; f, mxp₁; g, mxp₂; h, mxp₃. — i, sternite, P₃; j, telson. Scale equals 3 mm.

slender, occasionally quite slender, rarely moderately broad; dorsolateral and dorsomesial margins not noticeably delimited, all surfaces with numerous small spines, spinules or spinulose tubercles. Carpus moderately long, equaling or exceeding length of merus; dorsolateral and dorsomesial margins not noticeably delimited, all surfaces with numerous small spines or spinules, strongest at dorsomesial distal angle. Merus moderately short, subtriangular; dorsal, lateral and ventral surfaces each with numerous spines or spinulose tubercles; ventromesial margin with irregular single or double row of small spines, mesial face with few small spinules distally, and occasionally dorsally. Ischium with row of small spines on ventromesial margin; dorsal and lateral surfaces with few small spinules, ventral surface frequently also with scattered small spinules. Coxa with row of long setae on ventromesial margin, ventroproximal angle with few small spines.

Left cheliped short, usually not reaching to base of dactyl of right; chela and carpus somewhat laterally compressed. Dactyl long, approximately twice length of palm; set somewhat obliquely to palm; cutting edge with row of small corneous teeth; terminating in small corneous claw; dorsal surface with few scattered spinules proximally, dorsomesial margin not delimited; lateral and ventral surfaces unarmed. Palm short, one-fifth to one-third length of carpus; somewhat dorsoventrally inflated; dorsal surface with irregular rows of small spines or spinulose tubercles, usually not continuing onto fixed finger; lateral and mesial faces with numerous small spinules or spinulose tubercles; ventral surface with 2 irregular rows of small spinules laterally. Carpus moderately long, usually equalling or slightly exceeding length of merus; dorsal, lateral and ventral surfaces each with scattered small spinules or spinulose tubercles, strongest at dorsomesial distal angle; mesial face unarmed, or with few small spinules. Merus subtriangular; dorsal surface with row of very small spinules; lateral face spinulose; ventral surface with numerous small spines or spinules, ventromesial margin with irregular row of small spines; mesial face unarmed. Ischium with single or double row of small spines or spinulose tubercles on ventral margin; dorsal margin usually with few small spinules. Coxa with row of long setae on ventromesial margin; ventroproximal angle with few small spines.

Second and third pereopods long, overreaching tip of right cheliped; slender; not dissimilar from left to right. Dactyls long, usually one and one-half to twice length of propodus; slender; in lateral view, curved ventrally; in dorsal view, strongly twisted distally; dorsal surfaces each with row of stiff setae increasing in length distally, occasionally with very faint, short longitudinal sulcus and few spinules proximally (P_3); lateral faces each with weak longitudinal sulcus and often with scattered tufts of setae; ventral

margins unarmed; mesial faces each with longitudinal sulcus and double row of stiff bristles, frequently also with few scattered corneous spinules. Propodi equalling or somewhat exceeding length of carpi; dorsal surfaces each with row of stiff, occasionally spiniform bristles; lateral faces sometimes slightly tuberculate or granular; ventral and mesial surfaces unarmed. Carpi moderately short, one-half to two-thirds length of meri; dorsal surfaces each usually with irregular row of small spinules, and with 1 moderately prominent spine at distal margin; lateral faces each with scattered tufts of short setae; mesial and ventral surfaces unarmed. Meri laterally compressed; dorsal margins each usually with row of low protuberances and tufts of short bristles; lateral faces frequently slightly spinulose ventrally; ventral margins each with irregular single or double row of small spines or spinules; mesial faces unarmed. Ischia each with row of small spinules on ventral margin and few tufts of short setae. Coxae each with row of short setae on ventromesial margin; ventroproximal angle with few small spines (P_2) or unarmed (P_3).

Fourth pereopods subchelate; dactyl without preungual process; propodal rasp well developed.

Fifth pereopods chelate.

Sternite of third pereopods semisubovate with tuft of long setae centrally, and frequently with 1 or 2 small spines.

Pleopods of males with first and second paired; modified; pl_3 - pl_5 with exopodites well developed, endopodites reduced or rudimentary. Pleopods of females unpaired, pl_2 - pl_4 with both rami well developed; pl_5 with exopodite well developed, endopodite rudimentary.

Telson without transverse median constriction; terminal margin concave medianly or almost straight, without median cleft and with 6-12 spines laterally and extending down lateral margins.

Coloration. — In life: unknown. In preservative: Basically shield and appendages white, but collections of silt in setae of chelipeds often give impressions of greyish coloration.

Distribution. — Pacific coast of North America from Alaska to Gulf of Panama (De Saint Laurent); 750-1902 meters.

Affinities. — *Parapagurus pilosimanus benedicti* is considered by De Saint Laurent (1972) to be the Pacific analog of *Parapagurus p. pilosimanus* Smith. *P. p. benedicti* may be distinguished from the second and more southern North American subspecies, *Parapagurus pilosimanus abyssorum* Henderson, 1888, only with considerable difficulty. The differences in the configuration of the right chela illustrated by De Saint Laurent (1972, pl. 1 figs. 6, 7) are of some value; however, in the series of *P. p. benedicti*

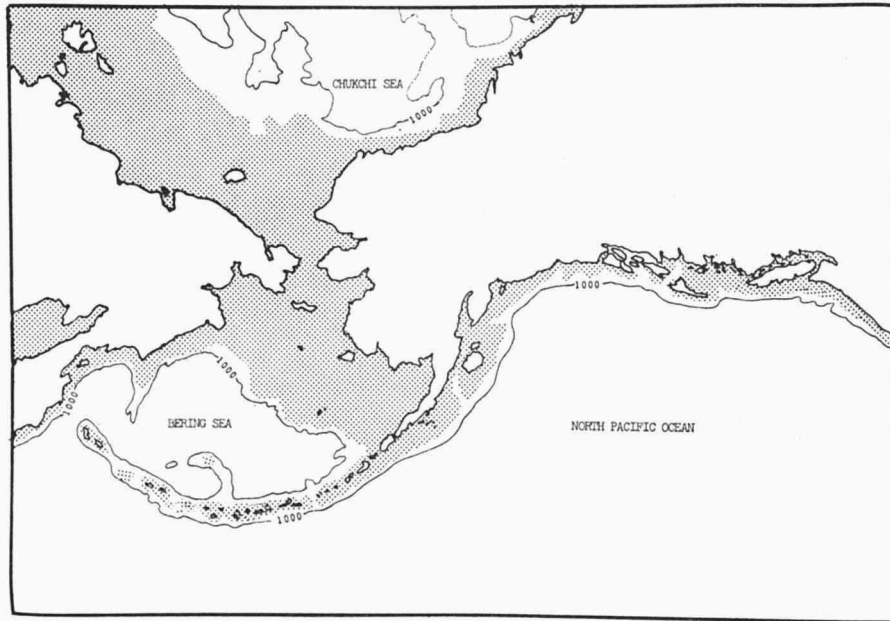
examined, notable variations were found in this character. Although De Saint Laurent (1972: 103) cited the divided ocular acicles as a distinguishing character for *P. p. benedicti*, she reported that 17% of her sample (12 specimens) had the ocular acicles entire. In the present series (148 specimens) 25% were found with the acicles entire. I have examined only 4 lots (11 specimens) presumably referable to *P. p. abyssorum* from the California and Gulf of California collections of the Allan Hancock Foundation. The most notable difference between these specimens and those of *P. p. benedicti* was the presence of a row of very small spines or spinules on the dorsal surfaces of the propodi of the third pereopods in the former species.

Discussion. — As indicated by De Saint Laurent (1972), Benedict considered the Pacific form of *Parapagurus pilosimanus* distinct from Smith's (1879) Atlantic species. In several lots in the collections of the National Museum of Natural History, Benedict labelled this species "*Parapagurus armatus*". Benedict's manuscript name was never published, and Rathbun (1904, 1910) simply referred to the species as *Parapagurus* sp. indet. During his examination of the national collections for rhizocephalan parasites, Reinhard (1944) discovered a species whose host was identified as "*Parapagurus armatus*". Not realizing that this name had not been validated by publication, Reinhard published a figure (1944, fig. 7A) of his host species with the caption "*Parapagurus armatus*". As no diagnosis of the host was given, this name, according to the Code of Zoological Nomenclature, must be considered a nomen nudum. Reischman (1959) apparently followed Reinhard's host identification when he reported on the rhizocephalan, *Angulosaccus tenuis* Reinhard, 1944. Ross' (1967) reference to *Parapagurus armatus* from Pemba Strait near Zanzibar obviously does not refer to the North Pacific species of *Parapagurus*; however, it is impossible to determine to which species of *Parapagurus* he had reference or from whom his identification was obtained.

ZOOGEOGRAPHY

Although our knowledge of marine communities is, in general, still very limited, benthic infaunal communities have received considerably more attention (cf. Thorson, 1957) than have epifaunal communities. But even for the latter, zoogeographical and ecological information is far better documented than it is for such non-commercial, migratory, epifaunal decapods as the pagurids. Makarov's (1938b, 1962) account of the distribution of pagurids in the Far Eastern Seas of the USSR is perhaps the most complete survey to date. While his emphasis was primarily on the seas adjoining the Soviet

Union, he included considerable data obtained from earlier literature on the distribution of pagurid species from northwestern North America. From data compiled in the present study, it is now possible to expand Makarov's concepts of species distributions. Makarov proposed four distributional groupings of species, i.e.



Map 1. General map of the oceans adjacent to northwestern North America, showing area of the Continental Shelf (shaded) and the contour of the 1000 fathom curve. (Azimuthal Equidistant projections centered on the North Pole. Adapted from Atlas Plate 3: "Top of the World", November 1965, National Geographic Society).

(1) Species with a broad distribution, occurring in the Seas of Japan and Okhotsk, and the Bering and Chukchi Seas. In this group he included *P. pubescens* [= *P. trigonocheirus*], *P. rathbuni* and *P. capillatus*.

(2) Species almost exclusively confined to the Sea of Japan.

(3) Species with an amphi-Pacific distribution, i.e., occurring in the Seas of Japan and Okhotsk, and connected by the Aleutian Islands to western North America. He considered that, with one exception, species of this group did not enter the Bering Sea. He listed *P. hirsutiussculus*, *P. undosus*, *P. middendorffii*, *P. ochotensis* and *P. gilli* [= *Elassochirus gilli*] in this group.

(4) Species with discontinuous distributions, i.e., occurring in the Sea of Japan and on the shores of western North America, but not recorded in the

intervening region. This group included *P. samuelis* [s.l.], *Orthopagurus schmitti* [= *Discorsopagurus schmitti*] and *O. minimus*.

In considering the northwestern North American species, both parallels and expansions of Makarov's groupings can be made. In considering species with broad distributions, i.e., species occurring not only in the Seas of Japan and Okhotsk, the Bering and Chukchi Seas, but also in the Gulf of Alaska and coasts of the United States and Canada, our list would include Makarov's three species, *P. trigonocheirus*, *P. rathbuni* and *P. capillatus*, and in addition, *Labidochirus splendescens*. However, the inclusion of the Chukchi Sea, with its specialized circulation patterns (cf. Sverdrup, Johnson & Fleming, 1942) seems unnecessarily restrictive. Several other species have amph-Pacific distributions similar to the aforementioned species, except that they have not yet been recorded from the Chukchi Sea. Some of these species were included by Makarov in his third group on the premise that these species did not enter the Bering Sea. More recent surveys have shown this not to be correct. Therefore, I would expand Makarov's group of species having broad distributions to include all those species exhibiting amph-Pacific distributions. This group would then include, not only *P. trigonocheirus*, *P. rathbuni*, *P. capillatus*, and *L. splendescens*, but also, *P. ochotensis*, *P. aleuticus*, *P. h. hirsutiusculus*, *P. cornutus*, *Elassochirus cavimanus* and *E. gilli*.

A grouping of exclusively northwestern North American species, somewhat parallel to Makarov's second group of species, those restricted to the Sea of Japan, can also be proposed. Two principal subdivisions of such a group are suggested by present records of species distributions; however, as sampling in areas of the Gulf of Alaska and eastern Bering Sea has been of limited scope, such subdivision does not appear justified. This group, therefore, includes both those species known only from the Aleutian Islands southward along the coasts of Alaska, British Columbia and the western coast of the United States, and those whose range also extends northward into the Bering and, in one instance, Chukchi Seas. This group includes: *Pagurus armatus*, *P. quaylei*, *P. setosus*, *P. caurinus*, *P. beringanus*, *P. samuelis* s.s., *P. granosimanus*, *P. hemphilli*, *P. tanneri*, *P. dalli*, *P. stevensae*, *P. confragosus*, *Paguristes ulreyi*, *P. turgidus* and *Elassochirus tenuimanus*.

Makarov considered as a fourth group, those species with discontinuous distribution, i.e. *Discorsopagurus schmitti* and *Orthopagurus minimus*. Another species with apparent discontinuous distribution is *Pagurus kenneerlyi*. The actual discontinuity suggested by the records of the collections of these three species may simply reflect the lack of collections in the specialized

habitats of the first two species (dwelling in polychaete tubes), and misidentification of the third species.

One additional small group of species is recognized among the northwestern North American species, i.e., those species recognized only from the Bering, and/or Chukchi Seas and the Sea of Okhotsk and other Asian waters. This group includes *Pagurus brandti*, *P. mertensii*, *P. undosus* and *P. midendorffii*.

Although several species exhibit "southern submergence" (cf. Ekman, 1953: 151) in the more southern portions of their ranges, only two northwestern North American species can be considered actual bathyal (500 to 4000 meters) species. As deep collections in the western North Pacific and Bering Sea are few in number, the distributions of these species, *Pagurus townsendi* and *Parapagurus pilosimanus benedicti* are poorly recorded.

SUMMARY

In the course of this study, a total of 6168 specimens of northwestern North American pagurids of the families Diogenidae, Paguridae and Parapaguridae have been critically examined. The species have been redescribed in detail and illustrated, and certain generic revisions have been made in the Paguridae. In addition to *Labidochirus* Benedict (1892), which was elevated to generic rank (cf. also Nyblade & McLaughlin, in press), a second subgenus, *Elassochirus*, herein has been similarly elevated. Even with the transfer from *Pagurus* for such notably distinctive species as *Elassochirus tenuimanus*, *E. gilli* and *E. cavimanus*, the heterogeneity of the former genus is still quite apparent. An attempt has been made to group the remaining *Pagurus* species according to their morphologic and presumably phylogenetic affinities, following the species-group concept previously proposed by Forest & De Saint Laurent (1967). This attempt has not always been successful, nor are the resultant groupings entirely satisfactory, and must be considered of a preliminary nature. However, through the presentation of descriptions of several characters only recently recognized for their diagnostic and phylogenetic significance, it is hoped that this study will provide a basis for future revisionary work.

Not only has the heterogeneity of *Pagurus* been recognized in its northwestern North American species, but similarly, heterogeneity in the genus *Orthopagurus* s.l. has been discovered. As a consequence, a new genus has been established for one of the three species formerly assigned to *Orthopagurus*, and two existing genera have been placed in synonymy with *Orthopagurus* s.s.

The availability of large series of specimens in several of the more problematical species has provided the opportunity to resolve numerous taxonomic ambiguities which have long plagued carcinologists. In addition, it has been possible, through these series, to qualitative measure the significance of presumed diagnostic characters, particularly those subject to intraspecific variation and allometric growth. Although no "new" characters have been recognized, the emphasis, in the species descriptions, has been placed on characters that have been found to be least affected by growth and environmental influences.

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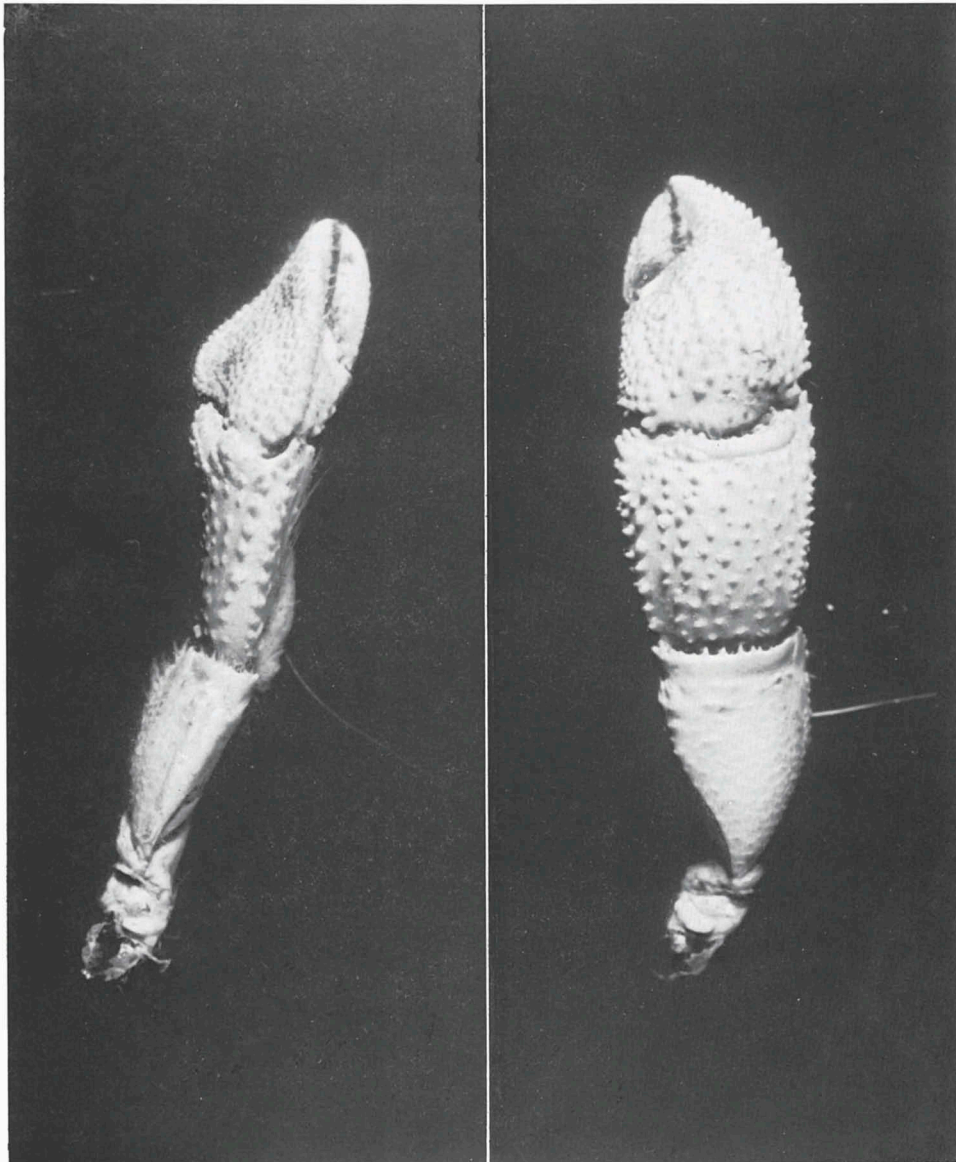
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Pagurus trigonocheirus (Stimpson), lectotype (BM 66-41), left and right cheliped in dorsal view. (Photo by E. J. McGeorge).