B. No paired appendages on anterior abdominal segments of either sex. Fourth pair of legs subchelate.

1. Left cheliped much larger than the right; fingers somewhat spooned. *Dardanus*, p. 126.

2. Left cheliped only slightly larger than the right; fingers acuminate. *Holopagurus*, p. 127.

II. External maxillipeds widely separated at base. Right cheliped larger than the left. (As the characters of the following genera are not equally applicable to both sexes, a key including the species of all three is given on page 128.)

A. A pair of appendages on the first abdominal segment either of male only or of female only. Fingers of chelipeds opening and closing obliquely.

1. A pair of appendages on the first and second abdominal segments of the male only. *Parapagurus*, p. 144.

2. A pair of appendages on the first abdominal segment of the female only. *Pylopagurus*, p. 142.

B. No paired appendages on first or second abdominal segment of either sex. Fingers of chelipeds opening and closing horizontally. *Pagurus*, p. 130.

I. External maxillipeds approximated at the base. Chelipeds equal or subequal, or left larger than the right.

Genus **Paguristes** Dana

Chelipeds similar, equal, subequal or one (usually the left) may be larger than the other. Fourth pair of legs simple. External maxillipeds approximated at base. Abdomen with paired appendages other than the uropods on the first two segments in the male, and the first segment of the female.

KEY TO THE CALIFORNIA SPECIES OF PAGURISTES

I. Eye-stalks moderately stout, two-thirds to three-quarters as long as width of anterior portion of carapace.

A. Upper surface of hands strongly spined with numerous dark-tipped spines. Eye-stalks of more or less uniform width throughout their entire length. Teeth of front subequal; rostriform tooth reaching about to bases of eye scales.

1. Hands very broad, only about one-fifth longer than wide, outer margin strongly convex; immovable finger at base about twice as wide as movable one. (Not known north of San Francisco.) *bakeri*, p. 124.

2. Hands much narrower, about one-third or more than one-third, longer than wide, outer margin but slightly bowed out; immovable finger at base subequal or but slightly wider than movable one. *turgidus*, p. 123.

B. Upper surface of hands coarsely granulate, armed only with three short stout spines on inner margin behind the dactyl. Distal half of eye-stalks about same width as cornea, proximal half abruptly enlarged, about half again as wide. Rostriform tooth of front reaching to tips of eye scales or slightly beyond, much more prominent, larger and more acute than lateral teeth. (Known only from San Pedro.)

parvus, p. 124.

II. Eye-stalks long and slender, about as long as or slightly longer than greatest width of anterior portion of carapace. Rostriform tooth of front longer, more prominent, and more acute than lateral teeth, reaching to or beyond bases of eye scales. Hands much as in *P. turgidus*. (Not known north of Monterey.)

ulreyi, p. 125.

Paguristes turgidus (Stimpson)

Plate 18, figures 1 and 8

Eupagurus turgidus Stimpson, Proc. Boston Soc. Nat. Hist., **6**, 484, pl. 21, fig. 1, 1857.

Paguristes turgidus Holmes, Occas. Papers Calif. Acad. Sci., **7**, 151, 1900.

Characters.—Hands only moderately broad, about one-third or more than one-third longer than wide, outer margin but slightly bowed out; immovable finger at base subequal with or but slightly wider than movable finger, upper surface of hands strongly spined with numerous dark-tipped spines. Eye-stalks about three-fourths as long as width of anterior portion of carapace. Antennal flagella sparsely haired. Teeth of front subequal, rostriform tooth reaching about to bases of eye scales.

Dimensions.—Type: length 76.2 mm. Length of carapace in the Biological Survey specimens ranged between 10 and 20 mm.

Color.—Yellowish, obscured by the hirsute covering; eye peduncles and internal antennae with a longitudinal streak of crimson (Stimpson).

Type Locality.—Puget Sound.

Distribution.—From British Columbia to San Diego, California, to a depth of 254 fathoms.

Biological Survey of San Francisco Bay.—Paguristes turgidus was dredged at three outside stations, D 5788, 5789, 5806, ranging in depth from 13 to 68 fathoms, with an accompanying temperature range of 9.3° to 11.1° C and a salinity range of 34.0 to 34.3.

Paguristes parvus Holmes

Plate 17, figure 1

Paguristes parvus Holmes, Occas. Papers Calif. Acad. Sci., 7, 151, pl. 2, fig. 26, 1900.

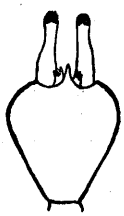


Fig. 83. *Paguristes parvus,* dorsal view of anterior portion (from Holmes).

Characters.—Rostriform tooth of front long and prominent, reaching to tips of eye scales or beyond, very much larger and more acute than lateral teeth. Upper surface of hands coarsely granulate, armed only with three short, stout spines on inner margin behind the dactyl. Length of eye-stalks measured from orbital margin about two-thirds the width of the anterior portion of the carapace; distal half of eye-stalks about same width as cornea, proximal half abruptly enlarged, about half again as wide.

Dimensions.—Type: length 12.7 mm.

Type Locality.—White's Point, near San Pedro, California.

Remarks.—In the collection of the U. S. National Museum there is a *Paguristes* which is undoubtedly a cotype of Holmes's *parvus.* The label reads, "San Pedro, California; littoral among rocks; July 23, 1895; S. J. Holmes." Except that the eye scales are cut into two instead of three points it fits the description given by Holmes very closely. The specimen is a female about 12.7 mm. in length, the length given by Holmes for the type.

Paguristes bakeri Holmes

Plate 18, figures 2 and 6

Paguristes bakeri Holmes, Occas. Papers Calif. Acad. Sci., 7, 152, 1900; Hilton, Jour. Ent. Zool., Pomona Coll., 8, 63, figs. 11, 12, 1916.

Characters.—Hands very broad, only about one-fifth longer than wide, outer margin strongly convex; immovable finger about twice as wide at base as movable finger; upper surface of hands strongly spined with numerous dark tipped spines. Eye-stalks about three-fourths, more rarely seven-eighths, as long as width of anterior portion of carapace. Antennal flagella sparsely haired. Teeth of front subequal, rostriform tooth reaching about to bases of eye scales.

Dimensions.—Types, female: length 63.5 mm.; males: length 114.3 and 127 mm. In the Biological Survey material the length of carapace ranged between 9 and 35 mm., mostly about 25 mm. long.

Color.—General color dark reddish, legs more or less colored with blue (Holmes).

Type Locality.—San Diego, California.

Distribution.—From San Francisco to San Diego, California, and the Gulf of California, to a depth of 116 fathoms.

Remarks.—Occasional specimens have the eye-stalks almost as long as the greatest width of the anterior portion of the carapace, but the characteristic broad hands will always serve to distinguish *P. bakeri* from the other species here listed.

Biological Survey of San Francisco Bay.—Paguristes bakeri was only taken at three of the seventeen outside dredging stations, D 5787, 5789, 5790, all between 33 and 46 fathoms. One specimen was taken at the first, and the third station, on a "very fine, green sand" bottom, while two specimens were obtained at the second, on "very coarse variegated sand with a small proportion of fine sand." At each of these stations this species was associated with *Pagurus ochotensis,* in addition at the second with *Paguristes turgidus,* and at the last with *Pylopagurus minimus.* Seven other specimens, also in company with *Pagurus ochotensis,* were obtained on the fishing grounds by the commercial trawlers, July, 1912. The bottom temperature range as observed for this species was 9.4° to 11.0° C; salinity 33 to 34.3.

Paguristes ulreyi sp. nov.

Plate 18, figures 3, 4, 5, and 7

Description.—Anterior portion of carapace longer than wide; front tridentate, rostriform tooth triangular, acute, extending forward at least to base of the eye scales, exceeding lateral teeth by one-half their length; lateral teeth blunt and somewhat tuberculiform. Eye-stalks comparatively very long and slender, length measured from orbital margin about as long as greatest width of anterior portion of carapace, or slightly longer; eye scales each with four to five spiniform teeth at tip; third segment of antennular peduncle exceeds cornea by one-fourth its length. Antennae thickly long-haired beneath, few short hairs above.

Chelipeds equal, hairy; merus spined on upper or anterior edge and on inner border of lower face, outer border of lower face of merus in occasional specimens slightly rugose, and in one specimen from Monterey somewhat spinulose; carpus with five stout spines on upper inner edge; upper surface of hand well spined with dark tipped spines, which are larger on the outer anterior edge of the immovable finger; inner edge of palm behind the dactyl armed with three prominent spines, with two much smaller ones below on inner face, and intermediate between them. Hands somewhat like those of *P. turgidus,* one-third to sometimes nearly one-half longer than wide, but with fingers less acuminate.

Ambulatory legs very hairy on inner or anterior face of dactylus and propodus, anterior pair more so than in any of the species listed in this paper, armature of anterior pair much as in *P. bakeri.*

Dimensions.—Holotype, male (Cat. No. 50427, U. S. N. M.): length 59 mm., length of carapace 22 mm., of anterior portion 12 mm., greatest width of anterior portion of carapace 10 mm., length of right cheliped 33 mm., of hand 13 mm., width of hand 7 mm., length of eye-stalk measured from orbital margin 10 mm. Of paratype, female: length 51 mm., length of anterior portion of carapace 9 mm., width 8 mm., length of eye-stalk measured from orbital margin 8 mm.

Type Locality.—Off Point Loma, San Diego, California ("Albatross" station 4304), 25 fathoms.

Distribution.—Monterey to off San Diego, California, and San Geronimo Island, Lower California, to a depth of 32 fathoms.

Remarks.—Differs from *P. perrieri* Bouvier (Bull. Mus. d'Hist. Nat., p. 7, 1895) in having the eye scales toothed or incised and not entire, longer antennular peduncles, which exceed the eye-stalks instead of falling considerably short of them, and in having the antennal flagella well haired beneath instead of sparsely so. This species is named after Dr. Albert B. Ulrey, Director of the Venice Marine Biological Station, Venice, California.

Genus **Dardanus** Paulson

Chelipeds with few exceptions dissimilar and unequal, the left being much the larger; the finger tips are corneous and blackened and somewhat spooned, especially those of the smaller hand. The fourth pair of legs subchelate. External maxillipeds approximated at the base. No paired appendages on the anterior abdominal segments of either sex.

Dardanus jordani sp. nov.

Plate 17, figures 3 and 4

Description.—Carapace depressed, greatest width across branchial regions about five-sixths the length measured on the median line, sparsely setose, tufts of hairs occurring principally on the antero-lateral margins; median sinuosity of front exceeded by the acutely tipped lateral projections, and itself medially very slightly concave.

The eye-stalks, which slightly exceed the antennular peduncle, are dorsally somewhat flattened and are slightly shorter than the frontal border of the carapace; measured from the anterior margin of the carapace, their length is slightly greater than the width and about as long as the anterior portion of the carapace; the corneae occupy a little more than one-fourth the length of the stalk; the inner anterior margin of the eye scale is incised, forming four or five small teeth, the outermost of which are but mere granulations of the margin.

Chelipeds and legs rather setose toward distal extremities, sparsely so proximally, and well provided with spines on upper and outer faces of dactylar and propodal joints, carpal joints with but comparatively few spines; spines of inner margin of hands and carpal joints of chelipeds stronger than the rest. Hand of large cheliped about twice as long as greatest width, outer margin somewhat concave just below level of bases of fingers (more so than shown in plate 17, fig. 4, owing to slightly oblique presentation of the hand in photographing); fingers about one-fifth shorter than rest of hand; carpus except for the distal third (distal half, measured on outer margin) of its length but little more than two-thirds the width of the hand, but in that portion widening abruptly to form a shelf-like offset toward its antero-external angle to accommodate the width of the proximal margin of the hand. This feature is not well shown in the plate cited, for the reason given above; the offset actually occupies nearly a third of the distal margin of the carpus. Small hand, about two and one-sixth times as long as wide, similar to but narrower than the large hand, outer margin of hand also concave but more evenly so from base to tip; fingers one-sixth longer than the palm, and gaping slightly throughout their entire length except for the black corneous tips.

Dimensions.—Type, male: (Cat. No. 3093, U. S. N. M.) length of carapace 21 mm., of anterior portion 10.5 mm., of large hand 17 mm., width 9 mm., length of large cheliped measured in a straight line (chord) 34 mm.

Type Locality.—San Francisco Bay, collected in 1880 by Dr. D. S. Jordan.

Remarks.—Similar to *D. wood-masoni* Alcock (1905, p. 85, pl. ix, fig. 3), from the Maldive and Andaman Islands, but the large cheliped is relatively not so long. As described, the length of the large cheliped of *D. wood-masoni,* measured in a straight line (chord), is twice that of the sagittal line of the carapace, while that of our species measured in the same manner is but one and a-half as long as such a line. Moreover, as figured by Alcock the anterior portion of the carapace is wider than long and a little shorter than the rest (soft posterior portion) of the carapace measured on the median line. In our species the anterior portion of the carapace is a little longer than wide and equal to the posterior portion in length. *D. wood-masoni* does not show the sudden reduction in width of the carpus of the larger cheliped from the wide distal margin to the narrower proximal portion.

This specimen is a rather remarkable find in that it represents a great northward extension of the range of the genus on the Pacific coast of America. Strange to say it has not been taken since or elsewhere on the coast. Dr. Jordan, to whom I have submitted the tin tag (no. 627) found in the bottle with the specimen says, "Undoubtedly the locality is correct because I took a good deal of pains to pick up such things around San Francisco, . . ., but I fear that I cannot add anything. We used to follow the Chinese shrimp-fishermen with their fine nets about the Bay, and a good many crabs came in in that way." It was entered in the museum catalogues in 1881.

Genus **Holopagurus** Holmes

Left cheliped slightly larger than the right. Fourth pair of legs subchelate. External maxillipeds approximated at base. No paired appendages on the anterior abdominal segments of either sex.

Holopagurus pilosus Holmes

Plate 17, figure 2

Holopagurus pilosus Holmes, Occas. Papers Calif. Acad. Sci., 7, 154, 1900; Alcock, Indian Decapod Crust., pt. II, fasc. 1, pp. 25, 162, 1905.

Characters.—Median projection of front small, blunt, and rounded, reaching about as far forward as, but not exceeding lateral ones. Carapace from corneae of eye-stalks to posterior margin characteristically and strikingly triangular in general appearance. Eye-stalks set very close together, about two-thirds the length of the anterior portion of the carapace, corneae not dilated. Anterior portion of carapace, taken alone, is quite square in form. Chelipeds of similar form, furnished with long hairs and short spines; hands horizontally flattened and covered with scattered spines, which are larger and more thickly set near the rounded margins; palms gently convex, but with a transverse depression just anterior to the base of the fingers, which makes them appear pronouncedly bent upward, larger hand widest across base of the fingers, beyond which it is abruptly contracted, fixed finger rather narrow a short distance beyond the base; smaller hand relatively narrower than the larger, inner and outer faces parallel, fixed finger not so much contracted beyond the base as in the larger hand, its outer margin evenly convex near the base and not slightly concave like its fellow. Dactyls of ambulatory legs long, gently curved, flattened toward the tip, subcylindrical at the

base, about twice the length of the upper side of the propodi, strongly twisted, and armed only with very short, corneous spinules.

Dimensions.—Type: length 114.3 mm., large cheliped 11 mm. longer than smaller one. Length of carapace of the single Bay specimen 28 mm.

Color.—General color yellowish white, the antennae are blue and the anterior portions of the carapace have more or less the same coloration; a peculiar reddish coloration occurs in different parts of the body, notably on either side of the cardiac area of the carapace (Holmes).

Type Locality.—Off San Diego, California, dredged in 25 fathoms.

Distribution.—San Francisco to San Diego, California, to a depth of about 30 fathoms.

Biological Survey of San Francisco Bay.—In the collection there is a single specimen, without a label, undoubtedly taken outside the bay.

II. External maxillipeds widely separated at the base. Right cheliped larger than the left.

KEY TO THE CALIFORNIA SPECIES OF PAGURUS, PYLOPAGURUS, AND PARAPAGURUS

I. Dactyls of second and third pairs of legs more or less strongly twisted, longer than anterior portion of carapace, often nearly as long as entire carapace.

A. Large hand with a prominent longitudinal ridge, forming one side of a median subtriangular area, each side of which the palm is deeply excavate; large surface of small hand oblique, triangular and also deeply excavate. (Off California, known only from 211 + fathoms.)
Pagurus tanneri, p. 133.

B. Large hand not ridged or excavated, upper surface spiny, flat or convex; inconspicuously or long haired.

1. Large surface of small hand horizontal; hair on hands short, not reaching to end of spines.
Pagurus ochotensis, p. 130.

2. Large surface of small hand triangular, oblique; hair on hands much longer than, and practically obscuring, spines. (Off California, known only from 240 + fathoms.)
Pagurus capillatus, p. 132.

II. Dactyls not twisted. Small hand more or less swollen; large surface more or less triangular, oblique or vertical; hand in some cases subcylindrical.

A. Upper surface of large hand strongly spined; spines in seven longitudinal rows; both hands thickly set with stiff bristles. (Off California, known only from 266 + fathoms.)
Pagurus setosus, p. 136.

B. Upper surface of large hand granulate or smooth, rarely sharply (spiniform) granulate; sparsely if at all hairy.

1. Dactyls at most but little if any longer than anterior (firm or hard) portion of carapace; never more than one-third again as long.

a. Large hand with upper surface convex, more or less evenly rounded.

i. Small hand not very feeble, at least one-half as wide as greatest width of large hand.

a. Median projection of front triangular and acute.

i. Carpus of large cheliped deeper than wide; inner face flat and perpendicular, forming a sharply distinct angle with the inferior or lower face. Small hand very much compressed laterally, deeper than wide, sides (inner and outer faces) subparallel. Anterior portion of carapace very long, about one-third longer than wide; not hairy, smooth and shining. (Not known south of Monterey Bay.)

Pagurus hemphillii, p. 142.

ii. Carpus of large cheliped not deeper than wide; inner face rounded off below and passing more or less evenly into the inferior or lower surface. Small hand wider than deep, more flattened than compressed; sides laterally swollen rather than parallel. Carapace more or less hairy.

* Anterior portion of carapace wider than long, more or less squarish or squat looking. Eye-stalks short and stout. Acicle typically exceeding eye-stalks, often, however, not so long. Dactyls of ambulatory legs about as long as propodi.

Pagurus hirsutiusculus, p. 137.

** Anterior portion of carapace longer than wide. Eye-stalks moderately stout. Acicle never exceeding eye-stalks. Dactyls quite short and stout, appearing shorter than propodi, sensibly stouter than in preceding species. (Not known north of Humboldt County.)

Pagurus samuelis, p. 139.

b. Median projection of front rounded, short, and low, very blunt or broadly rounded.

i. Small hand with outer face flat-triangular, forming a distinct angle with inferior or lower face; lower face smooth though hairy. Large hand more or less coarsely and irregularly granulate. Ambulatory legs moderately or extremely hairy. (Not known south of Monterey Bay.)

Pagurus beringanus, p. 135.

ii. Small hand with outer face more or less swollen-triangular, not forming a distinct angle with under side; edge evenly rounded; lower face granulated like the outer, scarcely if at all hairy. Large hand more or less evenly and finely granulated. Ambulatory legs sparsely if at all hairy.

Pagurus granosimanus, p. 141.

ii. Small hand comparatively very feeble, less than one-third greatest width of palm of larger hand. Large hand more or less suborbicular, feebly granulated on palm. Median projection of front sharply triangular, acute. (Not known north of Santa Catalina Island.)

Pagurus californiensis, p. 143.

b. Large hand transversely concave at base of fingers, trough-shaped, or more or less discoidal, with raised margins; bent at an angle with the wrist.

i. Greater part of upper surface of large hand markedly discoidal, flat, with raised margins which posteriorly separate it from a narrow convex basal (proximal) portion filling in the angle which the upper surface makes with the wrist, or carpus. (Not known north of Santa Monica Bay.)

Pylopagurus holmesi, p. 144.

ii. Transversely concave, trough-shaped portion of large hand not marked off from and passing over rather evenly into convex basal (proximal) portion.

Pylopagurus minimus, p. 144.

2. Dactyls of ambulatory legs exceedingly long and slender, almost as long as entire carapace, more than one and a half times as long as anterior portion of carapace. Median projection of front prominent, somewhat elongate, tip rounded, sides subparallel.

Parapagurus mertensii, p. 146.

Genus **Pagurus** Fabricius

No paired appendages, except the uropods on the abdomen of either sex. External maxillipeds widely separated at base; exopodites of all three pairs of maxillipeds flagellate. Chelipeds usually dissimilar and unequal, the right being much the larger; very rarely (not in the California species) are they subequal. Fourth pair of legs subchelate.

Pagurus ochotensis Brandt

Pagurus (*Eupagurus*) *bernhardus* var. C, *spinimana;* or sp. *ochotensis* Brandt *in* Middendorff, Reise in den äussersten Norden und Osten Sibiriens, Bd. II, Zool., Th. I, p. 108, 1851.

Pagurus ochotensis Holmes, Occas. Papers Calif. Acad. Sci., **7**, 137, 1900; Benedict, Proc. U. S. Nat. Mus., **23**, 463, text fig., 1901; Rathbun, H. A. E., **10**, 157, 1904.

Characters.—Large surface of small hand horizontal, thickly set with slender spines; large hand likewise spiny; both hands hairy, hairs not reaching to the ends of the spines. Anterior portion of carapace wider than long; front tridentate, median and lateral teeth triangular, acute, of about equal prominence. Eye-stalks short and stout, about one-half the length of the anterior portion of the carapace. Acicle much longer than eye-stalks. Dactyls of ambulatory legs spinous, twisted, nearly as long as entire carapace.

Dimensions.—Type: length of carapace 31.8 mm., width 27.5 mm. Length of carapace of Bay specimens generally between 6 and 12 mm.

Color.—Color of dried specimen, yellowish, spotted and banded with red (Brandt). Of alcoholic specimens is straw yellow. Slender streaks of red run longitudinally on the carpal, propodal, and dactyl joints of the ambulatory legs. The merus joints have two transverse streaks of the same color (Benedict).

Type Locality.—Okhotsk Sea.

Distribution.—From Unalaska to San Diego, California, 6 to 80 fathoms (Rathbun). Okhotsk Sea (Brandt). Japan (Stimpson) (Balss).

Biological Survey of San Francisco Bay.—Pagurus ochotensis is the most abundant and widely distributed of the hermit crabs occurring outside of the bay. It was taken at eight (D 5785–5787, 5789–5792, 5806) of the seventeen outside stations. These represent eight of the nine outside stations which were made seaward of the San Francisco bar, that is to say, all stations outside the bar at which the depth did not exceed 46 fathoms. At the station of least depth, D 5806, 13

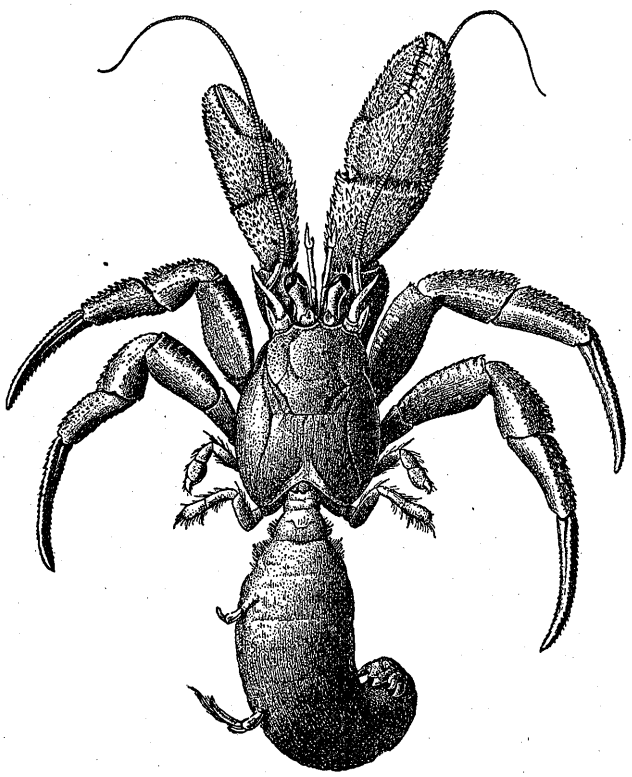


Fig. 84. *Pagurus ochotensis,* natural size (after Benedict, U. S. N. M.).

to 14 fathoms, only two specimens were obtained; at the other stations, which were made in 19 or more fathoms, from eight to forty specimens were taken. The bottom, except at D 5790 and D 5791, was "very fine green sand" ("grey" at D 5806); at D 5790 it was rather "very coarse variegated sand with small proportion of fine sand," while at D 5791 very little bottom material other than "refuse and garbage" was indicated. Except as noted above (D 5806), D 5791 with its "refuse and garbage" bottom returned the least number of specimens, viz., eight, thirteen in one case and twenty or more in each of the

others being recorded for the sandy bottom stations. Three specimens were taken on the fishing grounds by the commercial trawlers, July, 1912. As recorded during the survey the bottom temperature and salinity ranges for the species are respectively 9.4° to 11.1° C and 33.1 to 34.3.

Pagurus capillatus (Benedict)

Eupagurus capillatus Benedict, Proc. U. S. Nat. Mus., **15**, 8, 1892.
Pagurus capillatus Holmes, Occas. Papers Calif. Acad. Sci., **7**, 138, 1900; Rathbun, H. A. E., **10**, 157, pl. 4, fig. 3, 1904.
Pagurus trigonochirus Balss, Abh. der k. Bayer. Akad. Wiss. II, Math.-phys. Klasse, Suppl., 9 Abh., p. 63, 1913 (part).

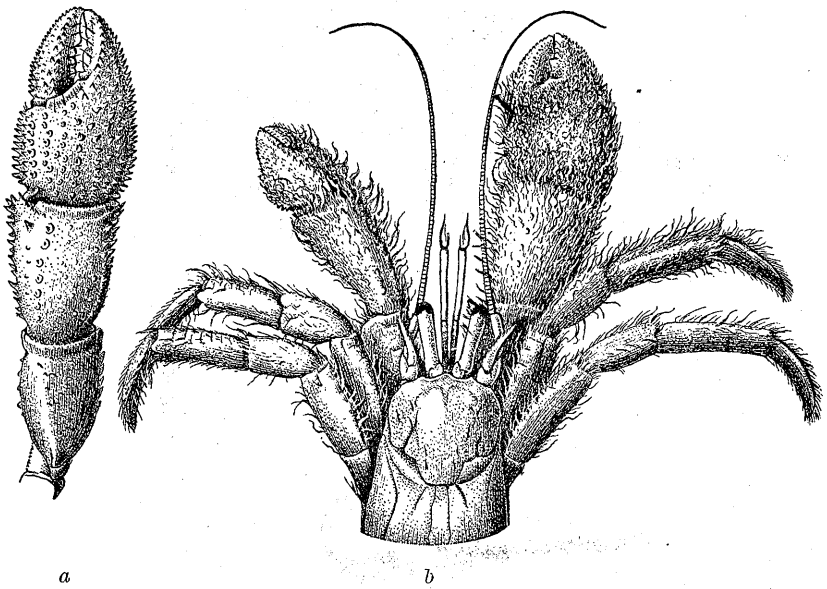


Fig. 85. *Pagurus capillatus*, about natural size; *a*, large (right) cheliped with hairs removed to show spining; *b*, dorsal view of anterior portion, with hands unfortunately foreshortened (U. S. N. M.).

Characters.—Anterior portion of carapace a little longer than wide; median projection of front broadly rounded, lateral projections each armed with an acute submarginal tooth. Eye-stalks long and slender, more than two-thirds as long as the anterior portion of the carapace. Acicle not quite reaching the tip of the eye. Large hand rather sparsely set with sharp stout spines; both hands very hairy, hairs much longer than the spines, often holding mud and dirt. Ambulatory legs stout; dactyls slightly twisted.

Dimensions.—Type, male: length of carapace 26 mm., of anterior portion of carapace 15 mm., width of anterior portion 14 mm., length of larger cheliped 72 mm., of hand 30 mm.

Type Locality.—Norton Sound, Alaska, 12 fathoms.

Distribution.—Arctic Ocean southward through Bering Strait to Kamchatka and California, 3 to 240 fathoms (Rathbun). The single California record for this species is from 240 fathoms, off Santa Cruz.

Remarks.—Balss (1913, p. 63) considers *Pagurus capillatus* (Benedict) identical with *P. trigonocheirus* (Stimpson) (1907, p. 221), basing his remarks upon a specimen of the former received from the U. S. National Museum. However, with his conclusion I am unable to agree, having the type of *P. capillatus* before me. The differences between the two are unmistakable: in *P. capillatus* the antennal scale does not exceed the eye, in *P. trigonocheirus* it does and usually considerably; the eye-stalks of the former are the more slender, the length to breadth being about as 5:1, while in the latter the relation is about 4:1, Balss giving 3.9:1 as an average of five specimens. Moreover the triangular outer face of the smaller hand of *P. trigonocheirus* has its proximal upper and lower margins much bowed out (as is well shown in Stimpson's figure (*Op. cit.*, pl. xxvi, fig. 2), making that face so broadly triangular that its greatest width is contained in its length only twice; in *P. capillatus* the width of the same face of the smaller hand is contained in its length three times. The shape of this triangular outer face of the small hand which in fig. 85, *b* is foreshortened and therefore does not show its proper proportions, is very similar to that of *P. setosus* (p. 136, fig. 88), but relatively not so long as compared to its width; in *P. setosus* the outer face of the smaller hand is about four times as long as wide, in *P. capillatus,* as stated above, three times as long as wide. Further the large hand is more hairy in fresh specimens of *P. capillatus,* and not quite so narrow triangularly as in *P. trigonocheirus.*

Pagurus tanneri (Benedict)

Eupagurus tanneri Benedict, Proc. U. S. Nat. Mus., **15**, 10, 1892.
Pagurus tanneri Holmes, Occas. Papers Calif. Acad. Sci., **7**, 140, 1900; Rathbun, H. A. E., **10**, 158, pl. 4, fig. 7, 1904.

Characters.—Large hand with a prominent ridge beginning at the articulation of the carpus near the inner angle of the palm, running diagonally across it and along the inner portion of the immovable finger; this ridge is joined a little behind the gape of the fingers by another, running across the palm from near its outer proximal angle; these ridges enclose a subtriangular area, either side of which the palm is deeply excavated; subtriangular area armed with five or six short spines; outer depression of hand with a few spiny granules; inner depression unarmed. Outer face of small hand subtriangular and deeply concave; upper margin armed with a single row of spines, a short row of spines from the carpal margin unites with this row, making it appear double for a part of its length in small specimens. Anterior portion of carapace as wide as or wider than long; median projection of front triangular, much longer, and projecting much farther forward than the subacute, broadly triangular lateral teeth, the ends of which are furnished with a terminal spine. Eye-stalks about two-thirds as long as anterior portion of carapace. Acicle exceeding eye-stalk by nearly half its length. Dactyls of ambulatory legs about as long as entire carapace.

Dimensions.—Type, male: length of carapace 31 mm., of anterior portion of carapace 18 mm., width of anterior portion 19 mm., length of larger cheliped 102 mm., of hand 40 mm. Many of the specimens from off California are but half the size of the type.

Type Locality.—Clarence Strait, Alaska, 322 fathoms ("Albatross" station 3077).

Distribution.—From Iliuliuk Harbor, Unalaska, to off San Simeon Bay, California, 50 to 559 fathoms (Rathbun). Off California this species is not known to occur in less than 211 fathoms.

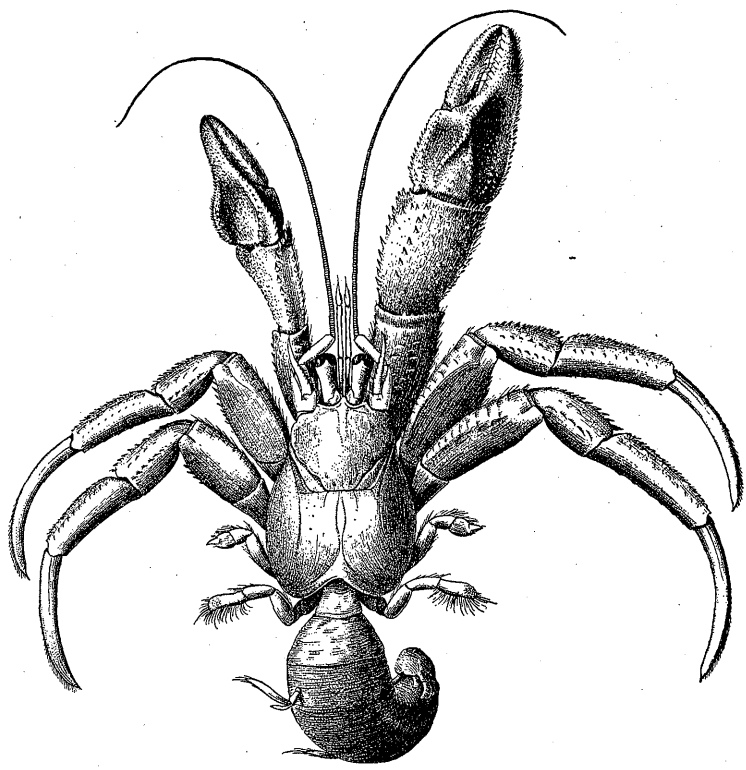


Fig. 86. *Pagurus tanneri,* slightly reduced (U. S. N. M.).

Remarks.—This species is closely related to *P. confragosus* (Benedict, 1892, p. 12), the present known range of which extends from the Bering Sea to off the Columbia River, Oregon, but as Dr. Benedict remarks, "The two species are readily separated by the inner side of the raised triangle of the large hand. In this species [*P. confragosus*] it cuts off the inner depression of the upper surface from the proximal margin of the palm, while in *tanneri* this depression is allowed to reach the margin by a curvature of the ridge."

Pagurus beringanus (Benedict)

Eupagurus beringanus Benedict, Proc. U. S. Nat. Mus., **15**, 17, 1892.
Eupagurus newcombei Benedict, Proc. U. S. Nat. Mus., **15**, 17, 1892.
Pagurus beringanus Rathbun, H. A. E., **10**, 159, pl. 5, fig. 5, 1904.

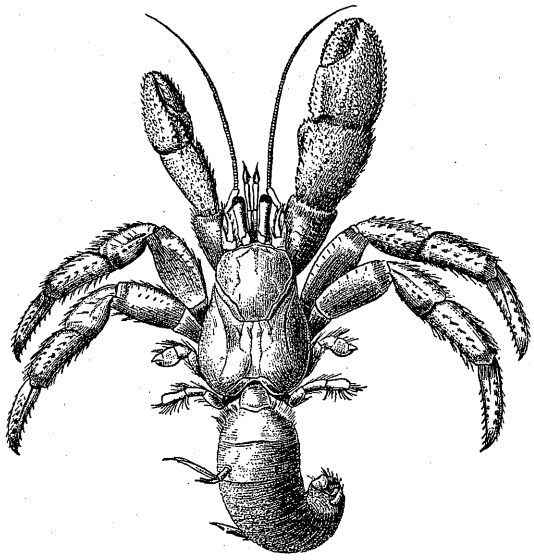


Fig. 87. *Pagurus beringanus,* × 1¼ (U. S. N. M.).

Characters.—Median projection of front short and low, very blunt, or broadly rounded. Small cheliped with outer face of hand flat-triangular, forming a distinct angle with the smooth though hairy inferior or lower face; carpus with upper or anterior edge with eight or more close set, equidistant spines in a row, occasionally but rarely with a smaller number of spines. Large hand more or less coarsely and irregularly granulate, granules at times tending to become spiniform tubercles, always with a distinct Λ-shaped design of larger granules from base of inner edge of immovable finger to base of palm, inner arm of Λ continued on carpus to its proximal inner angle; immovable finger slightly excavated on upper surface, making tip appear bent upward. Ambulatory legs quite or very hairy.

Dimensions.—Type, male: length of carapace from tip of rostrum to posterior border of carapace, 21 mm., length of larger cheliped 45 mm.

Color.—The distal ends of the joints of the legs are bright red. Both proximal and distal ends of dactyls are red. The light portions of the legs are spotted with red (Benedict).

Type Locality.—Bristol Bay, 12 fathoms (''Albatross'' station 3231).

Distribution.—Bering Sea (latitude of Nunivak) southward, along the Aleutian Islands and coast of Alaska to Monterey, California, 5 to 19 fathoms (Rathbun).

Remarks.—*P. newcombei* (Benedict) is included in *P. beringanus,* as it seems to be scarcely distinct. The species varies in the sharpness of the tubercles or spines of the chelipeds (Rathbun).

Pagurus setosus (Benedict)

Eupagurus setosus Benedict, Proc. U. S. Nat. Mus., **15**, 19, 1892.
Pagurus setosus Rathbun, H. A. E., **10**, 159, pl. 5, fig. 1, 1904.

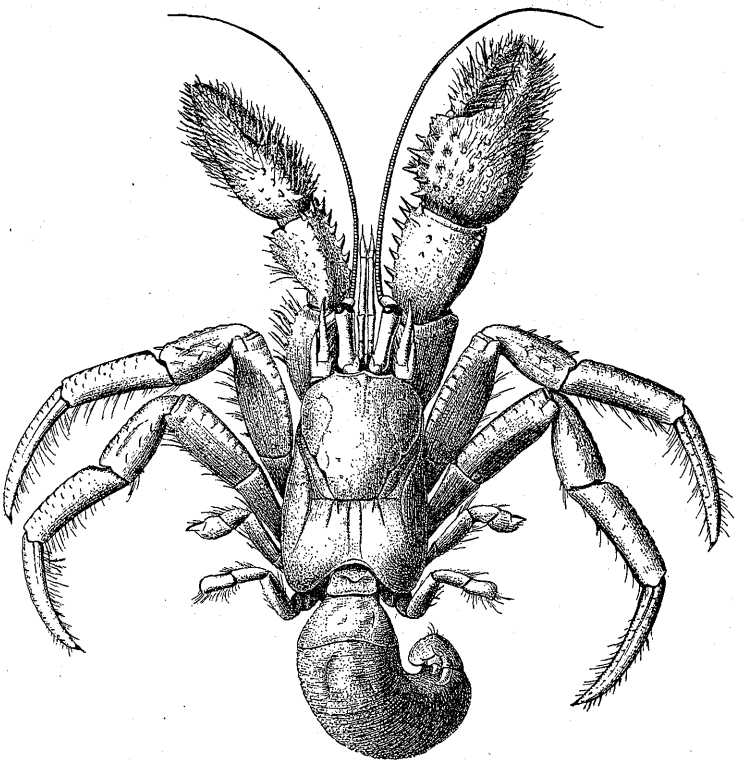


Fig. 88. *Pagurus setosus,* about natural size (U. S. N. M.).

Characters.—Carapace a little longer than broad, median projection of front rounded, a little in advance of the lateral projections, which because of a submarginal spine appear acute. Eye-stalks but slightly more than half as long as anterior portion of carapace. Acicle exceeds eye-stalks by nearly one-fourth its length. Both hands are thickly set with stiff bristles; large hand traversed by seven longitudinal rows of spines, counting marginal rows. Ambulatory legs pubescent, upper margins devoid of spines except on carpus of anterior pair, dactyls not twisted; one-third longer than anterior part of carapace.

Dimensions.—Type, male: length of carapace 21 mm., of anterior portion of carapace 14 mm., width of anterior portion 13 mm., length of larger cheliped 48 mm., of hand 21 mm.

Color.—In formalin the legs are banded with crimson red, hair dirt color (Rathbun).

Type Locality.—Sitka, Alaska.

Distribution.—From Kadiak, Alaska, to off Santa Cruz Island, California, 50 to 266 fathoms.

Remarks.—Except for a slight twisting of the dactyls *P. capillatus* in general appearance is very similar to *P. setosus,* but neither is the large hand proportionally so long nor are its more numerous spines nearly so strong or so distinctly arranged in longitudinal rows. In specimens of the same size the spines on the large hand of *P. capillatus* are only half the size of those of *P. setosus.* The large hand of *P. setosus* is about twice as long as wide, with more depressed fingers than those of *P. capillatus.* The large hand of *P. capillatus* is usually one and a-half times as long as wide, occasionally one and three-fourths times as long as wide. I have seen one specimen only in which the hand was longer, about twice as long as wide; but the characteristic armature of the large hand precludes any confusion as to its identity. Furthermore, the triangular outer face of the small hand of *P. setosus* is more rounded and not so prominently and broadly triangular as that of *P. capillatus,* being about four times as long as wide. In *P. capillatus* the triangular outer face of the small hand is about three times as long as wide.

Pagurus hirsutiusculus (Dana)

Plate 16, figure 4

Bernhardus hirsutiusculus Dana, Proc. Acad. Nat. Sci. Phila., **5**, 70, 1851; Crust. U. S. Expl. Exped., pt. I, p. 443, 1852, pl. 27, fig. 3, 1855.

Pagurus hirsutiusculus Holmes, Occas. Papers Calif. Acad. Sci., **7**, 143, 1900; Rathbun, H. A. E., **10**, 159, 1904; Hilton, Jour. Ent. Zool., Pomona Coll., **8**, 63, 1916.

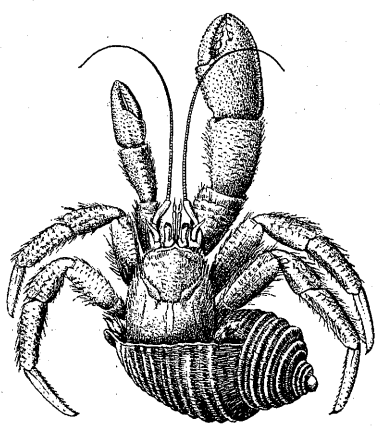


Fig. 89. *Pagurus hirsutiusculus,* × ⅔ (U. S. N. M.).

Characters.—Anterior portion of carapace wider than long, squarish or squat looking; median projection of front triangular, acute. Eye-stalks short and stout. Acicle typically exceeds eye-stalk but frequently falls short of it. Carpus of large cheliped not deeper than wide, inner and lower faces not meeting at a distinct angle. Small hand wider than deep, outer face oblique, triangular, more or less swollen. Carapace and ambulatory legs more or less hairy; dactyls moderately stout, about as long as propodi.

Dimensions.—Type: length 31.8 mm. The carapace of the specimens taken in the Bay averaged between 6 to 9 mm. in length, the longest being about 12 mm. long.

Color.—In formalin body and legs pinkish red. Segments of second and third pairs of feet white at distal ends; dactyli striped longitudinally with pinkish and white (Rathbun). In life antennae are greenish, with alternating large and small golden yellow spots every two or three segments of the flagellum; every segment of first ten spotted; distal segment of antennal peduncle not spotted, plain color. Distal half of propodi of ambulatory legs white, occasionally with slight reddish or pinkish cast, never marked, so far as I have been able to ascertain, with blue; the rest of joint marked with stripes of bluish or greenish brown, corresponding with stripes as the dactyls; dactyls similar to those of *P. samuelis*, either without orange or with a mere trace of it; stripes distinct and more pronounced throughout their length. Large hand often whitish or greenish white.

Type Locality.—Puget Sound.

Distribution.—St. Paul Island, Pribilofs (T. Kincaid), Aleutian Islands to San Diego, California; Siberia, Kamchatka (Rathbun). Japan (Stimpson) (Balss). Low tide to 17 fathoms.

Remarks.—The specimen figured above is very true to type *P. hirsutiusculus* from the Aleutian Islands. I have seen no specimens from California which are quite so large as the one figured or with such great length of acicle (antennal scale) and breadth of carapace. The carapace as figured appears more squat than is often the case. The eye-stalks in the California specimens are proportionately thicker.

The breadth of carapace, thickness of eye-stalks, length of antennal scales and dactyls, general appearance of the larger hand, and color in life, will always serve to distinguish this species from *P. samuelis.*

Biological Survey of San Francisco Bay.—Pagurus hirsutiusculus is the common hermit crab of the bay and is found in littoral and more shoal waters, principally of the middle bay where it is well distributed (see plate 8).

There is only one record from the upper bay, a single specimen dredged in 4 to 24 feet (D 5757), on a fine grayish-black, very muddy sand bottom. Six specimens were obtained at four (10%) of the lower bay stations (D 5723, 5766, 5768, 5781), which, except for D 5766, where three specimens were obtained from a soft mud bottom in 3 to 4 fathoms in Alameda Creek, were dredged on more or less shelly bottoms, at rather widely distributed stations: D 5723, 9½ to 11 fathoms, "black, sticky mud streaked with brown, many shells, clinkers" and abundant ophiurans, off Mission Rock; D 5768, 1 to 3 fathoms, hard shelly bottom, off Alameda; D 5781, 3 to 12 feet in the oyster beds, between Point San Bruno and Point San Mateo.

In the middle bay *Pagurus hirsutiusculus* is recorded from thirteen (18%) of the dredging stations, of which all but three were made at depths varying from 5 feet to 5 fathoms (D 5705, 5708, 5744, 5753, 5755, 5756, 5763, 5764, 5765, 5773, 5778, 5779, 5826). The three deeper stations (D 5705, 5708, 5826) ranged from 7 to 12 fathoms in depth, and at the deepest of these (D 5708), in 10 to 12 fathoms,

ten specimens were taken, the greatest number obtained at any one station. Otherwise the average number of specimens per haul (middle bay only) was one and eight-tenths. Less than one-third (four) of the stations were made on more or less hard bottom, sandy, rocky or both; two hauls were made through the eel grass patches around Angel Island (D 5763, 5764), while seven were either wholly or at least predominantly muddy bottom.

In addition a number of specimens were collected along the rocky shores of the middle bay: two at Point Bonita; six at Sausalito on different occasions; twenty-two at Red Rock, and twenty-five at Richmond, north of the Standard Oil Pier.

The extremes of the correlated temperatures and salinities observed for this species are, respectively, 10.8° to 14.2° C and 17.5 to 31.7. That *Pagurus hirsutiusculus* was not dredged outside is probably due to the combined effect of depth and character of bottom rather than to temperature or salinity, in view of its wide geographic distribution as cited above.

As most of our survey specimens were found inhabiting the shells of *Thais lamellosa* and *Nassa mendica*, it would be interesting to compare their distribution with that of *Pagurus hirsutiusculus* although it should be remembered that hermit crabs sometimes transport shells for considerable distances (Sumner, 1911, p. 153). With the appearance of Packard's *Molluscan Fauna from San Francisco Bay* (1918, pp. 332, 336), I find that the distribution of *Pagurus hirsutiusculus* coincides with the former at eight stations (D 5708, 5723, 5753, 5755, 5773, 5779, 5781, 5826) and the latter at four (D 5705, 5755, 5773, 5779). *Pagurus hirsutiusculus* was also found at three stations from which Packard (1918, p. 332) records *Nassa fossata* (D 5744, 5763?, 5764?).

Pagurus samuelis (Stimpson)

Plate 16, figures 2 and 3

Eupagurus samuelis Stimpson, Proc. Boston Soc. Nat. Hist., **6**, 86, 1857; Ann. Lyc. Nat. Hist. N. Y., **7**, 90, pl. 1, fig. 8, 1859 (1862); Ortmann, Zool. Jahrb., Abt. f. Syst., **6**, 301, pl. 12, fig. 12, 1892. *Pagurus samuelis*, Holmes, Occas. Papers Calif. Acad. Sci., **7**, 144, 1900; Rathbun, H. A. E., **10**, 160, pl. 5, fig. 7, 1904; Hilton, Jour. Ent. Zool., Pomona Coll., **8**, 63, 1916.

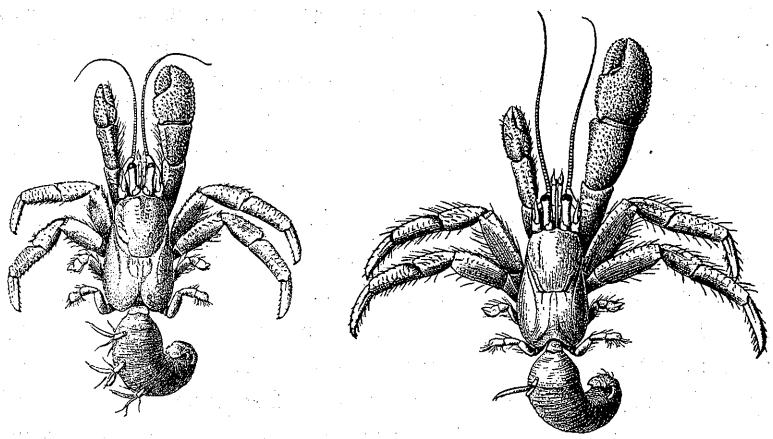
Characters.—Anterior portion of carapace longer than wide; median projection of front triangular, acute. Eye-stalks only moderately stout. Acicle never exceeding eye-stalk. Carpus of large cheliped not deeper than wide, inner and lower faces not meeting at a distinct angle. Small hand wider than deep; outer

face oblique, triangular, more or less swollen. Carapace and ambulatory legs more or less hairy; dactyls quite short and stout, appearing shorter than propodi, sensibly stouter than in *P. hirsutiusculus*.

Dimensions.—Type: length 19.1 mm. See also *Remarks* below.

Color.—Yellowish (Stimpson). The dactyls are of a bluish color with a longitudinal reddish stripe on the sides; distal ends of the propodi bluish (Holmes). In life antennae are reddish brown; upper surface of distal segment of peduncle with a narrow golden stripe. Distal third of propodi of ambulatory legs blue or white, suffused with blue proximally, the rest of joint marked with stripes of bluish or greenish brown; dactyls blue, becoming white near tip, suffused with pale reddish orange just before corneous claw, with three more or less distinct bluish or greenish red-brown stripes. Large hand usually a dark bluish green, fingers tipped with white, on small hand often edged with orange.

Type Locality.—Tomales Bay, California.



a *b*

Fig. 90. *Pagurus samuelis; a*, ♀, natural size; *b*, ♂, × 1½ (U. S. N. M.).

Distribution.—Humboldt County (Holmes) to San Diego, California (Rathbun). Japan (Stimpson, Ortmann, doubted by Holmes) (Balss).

Remarks.—Figure *a* is that of a female true to type; figure *b*, that of a young male which still partially retains the beaded edge so characteristic of young males, and young and adult females, the original description, and subsequent illustrations. Examination of the extensive collection of this species in the U. S. National Museum showed that the large cheliped in the male becomes with age quite elongate and smoothly granulate comparatively, the beaded outer edge of the hand disappearing completely. The largest *P. samuelis* male I have seen was collected by the Venice Marine Biological Station at the foot of the San Pedro Breakwater, February 21, 1913, and measures 42 mm. from tip of rostrum to end of telson; carapace is 18 mm. long, the anterior portion 7.5 mm., and length of the propodus, carpus, and merus of the large cheliped, taken together, 28 mm.

This is the first instance of sexual dimorphism in adult American hermit crabs of which I am aware. The isolated adult male and female with respect to the character of the large cheliped seem to be two very distinct species; in all other characters, however, there is a close correspondence which precludes any separation. In a lot of over one hundred specimens from Pacific Grove both extremes

and all intergrading forms are represented according to age and development.

A specimen previously reported from Sitka, Alaska, proves to be *P. hirsutiusculus,* and Holmes's record thus becomes its northern limit.

Biological Survey of San Francisco Bay.—Pagurus samuelis is apparently of very exceptional occurrence in San Francisco Bay, very unlike the closely related *P. hirsutiusculus.* The only specimen of *P. samuelis* found was in a lot of twenty-five *P. hirsutiusculus* gathered along the tidal zone of the Richmond shore, just north of the Standard Oil pier.

Pagurus granosimanus (Stimpson)

Eupagurus granosimanus Stimpson, Ann. Lyc. Nat. Hist. N. Y., **7**, 90, 1859 (1862).

Pagurus granosimanus Holmes, Occas. Papers Calif. Acad. Sci., **7**, 146, 1900; Rathbun, H. A. E., **10**, 160, pl. 5, fig. 8, 1904.

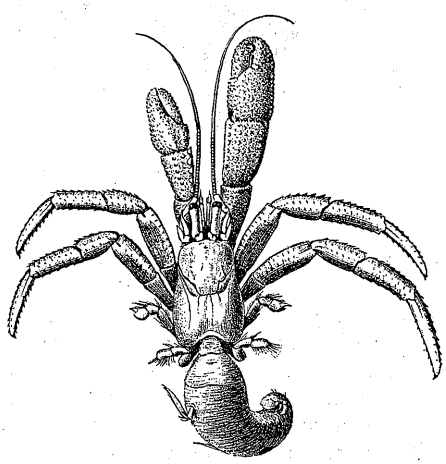


Fig. 91. *Pagurus granosimanus,* natural size (U. S. N. M.).

Characters.—Median projection of front short and low, very blunt or broadly rounded. Small cheliped with outer face of hand more or less swollen-triangular, not forming a distinct angle with under side, edge evenly rounded; lower face granulated like the outer, scarcely if at all hairy; six or fewer, more or less separated spines, or, at times, spiniform tubercles on upper or anterior edge of carpus. Large hand more or less evenly and finely granulated, rarely with even an indistinct Λ-shaped design indicated on palm, granules forming it never larger than those covering the rest of the palm. Ambulatory legs sparsely if at all hairy.

Dimensions.—Type, length of carapace 10.9 mm., width of front, measured between bases of outer antennae, 5.6 mm.

Color.—Deep red, with white tubercles on the chelae, and darker red spines on the carpus and merus of chelipeds. Ambulatory legs red, with small white spots;

dactyli with broad white band at middle (Rathbun). Tubercles on underside of meros white. In life the maculations are light blue or yellowish (Stimpson).

Type Locality.—Monterey, California.

Distribution.—Unalaska to Ensenada, Lower California. Beach to 15 fathoms (Rathbun).

Pagurus hemphillii (Benedict)

Eupagurus hemphillii Benedict, Proc. U. S. Nat. Mus., **15**, 16, 1892.
Pagurus hemphillii Holmes, Occas. Papers Calif. Acad. Sci., **7**, 147, 1900; Rathbun, H. A. E., **10**, 160, pl. 5, fig. 9, 1904.

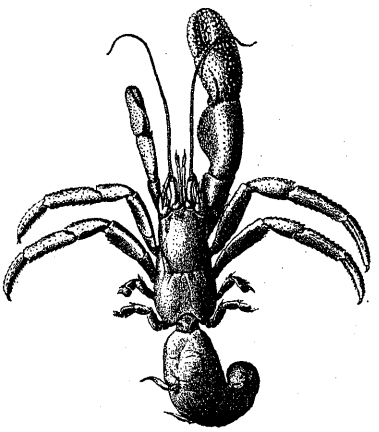


Fig. 92. *Pagurus hemphillii*, type ♂, natural size (U. S. N. M.).

Characters.—Carpus of large cheliped with a very deep, flat, perpendicular inner face, forming a sharply distinct angle with the inferior or lower face, depth of carpus greater than width. Base of immovable finger of large hand somewhat excavated above, with a quite evident though evenly rounded and not abrupt depression near the outer margin, causing the finger to appear bent upward. Small hand very much compressed laterally, not swollen, deeper than wide, sides (inner and outer faces) subparallel. Anterior portion of carapace very long, about one-third longer than wide, not hairy, smooth and shining; median projection of front triangular, acute. Acicle shorter than the eye-stalks; eye-stalks comparatively long and slender. Ambulatory legs scarcely if at all hairy.

Dimensions.—Type, male: length from tip of rostrum to end of telson 42 mm., length of carapace 17 mm. This is the largest specimen seen; there are in the U. S. National Museum two other specimens, measuring in length respectively 23 and 25 mm.

Color.—In alcohol bright red, the tips of the dactyls light colored (Benedict). Holmes says, "there is a well marked light spot on the sides of the dactyls near the end."

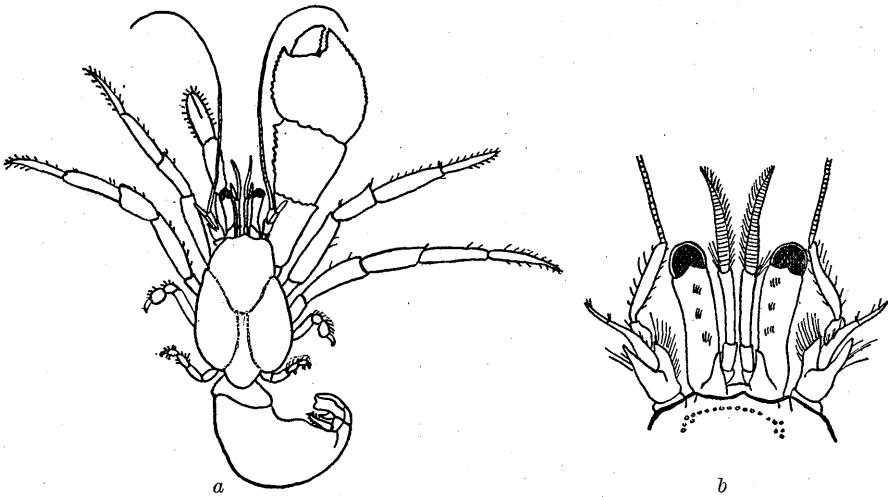
Type Locality.—Monterey, California.

Distribution.—British Columbia to Monterey, California.

Pagurus californiensis (Benedict)

Eupagurus californiensis Benedict, Proc. U. S. Nat. Mus., **15**, 21, 1892; Faxon, Mem. Mus. Comp. Zool. Harvard College, **18**, 55, pl. 11, fig. 2–2*e*, 1895.

Pagurus californiensis Holmes, Occas. Papers Calif. Acad. Sci., **7**, 149, 1900; Rathbun, H. A. E., **10**, 161, 1904.



a *b*

Fig. 93. *Pagurus californiensis*, ♂, × 2; *a*, dorsal view; *b*, anterior portion of carapace, enlarged (after Faxon).

Characters.—Small hand very feeble, less than one-third the greatest width of the palm of larger hand. Large hand more or less suborbicular, feebly granulated on palm. Anterior portion of carapace about as broad as long, median projection of front triangular, acute. Eye-stalks moderately long and slender, about three-fourths as long as anterior portion of carapace. Acicle not exceeding eye-stalks. Ambulatory legs glossy, nearly smooth; from upper distal margin of carpus a small spine extends forward over propodus; dactyls thin, pubescent, not twisted, but little curved, spinulous below, and exceeding length of the propodi.

Dimensions.—Two male types: length 26 mm. and 20 mm., respectively.

Color.—Alcoholic specimens nearly orange in color, the ambulatory legs crossed by bands of a lighter color. There is a band of lighter color near the middle of the ocular peduncles (Holmes).

Type Locality.—California.

Distribution.—From Monterey Bay or Santa Catalina Island, California, to Gulf of California, 8 to 58 fathoms.

Genus **Pylopagurus** Milne Edwards and Bouvier

Abdomen with paired appendages, other than the uropods on the first abdominal segment in the female only. External maxillipeds widely separated at base; exopodites of all three pairs of maxillipeds flagellate. Chelipeds dissimilar and unequal, the right vastly the larger; large hand more or less operculiform, greater part of upper surface transversely concave, trough-shaped, or discoidal with raised margins; bent at an angle to the wrist. Fourth pair of legs subchelate.

Pylopagurus minimus (Holmes)

Plate 16, figures 1*a*, 1*b*, and 1*c*

Pagurus minimus Holmes, Occas. Papers Calif. Acad. Sci., 7, 145, 1900.

Characters.—Median projection of front triangular, acute, lateral ones rounded; anterior portion of carapace about as wide as long. Chelipeds pubescent; large hand oblong, widening distally to a short distance beyond the base of the movable finger; base of the hand armed with anteriorly inclined spines, strongly convex longitudinally, giving hand the appearance of being bent downward; fixed finger broad, outer edge evenly rounded, sharp, upturned, and armed with anteriorly directed spines, the upper surface smooth and concave; movable finger broad, widest a little beyond its articulation, outer margin sharp, spiny, evenly curved, upper surface nearly smooth and concave; inner margin of both fingers furnished with large, white, tubercular teeth; small hand narrow, rounded, fingers longer than palm. Dactyls of ambulatory legs slender, curved, tapering from the base, spiny below, and longer than the propodi.

Dimensions.—Type, female: length 10 mm.

Color.—General color reddish, with spots of darker red, larger cheliped a darker red than the rest of the body, especially at the distal end; ocular peduncles with a median, transverse, light colored band (Holmes), described from a single female specimen carrying numerous pale green eggs.

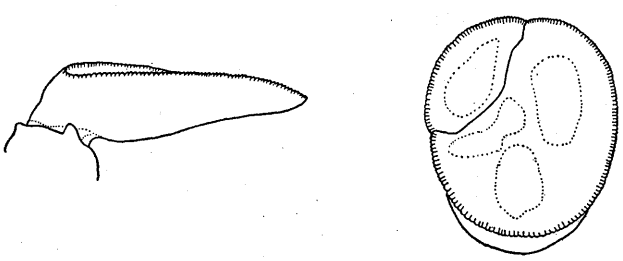
Type Locality.—Off San Diego, dredged in 30 fathoms (Holmes).

Distribution.—Skidegate, Queen Charlotte Sound, British Columbia; San Francisco, Monterey Bay, Laguna Beach, and San Diego, California, 15 to 35 fathoms.

Remarks.—This species is best distinguished by the character of the larger hand, which is convex at the narrow base, both longitudinally and transversely, while the distal portion is nearly smooth, longitudinally straight, but transversely concave (Holmes). Has been found in worm tubes (Benedict) and in *Dentalium* ("tooth") shells between the Farallones and Golden Gate.

Biological Survey of San Francisco Bay.—A single specimen of *Pylopagurus minimus* was dredged at D 5790, 33 to 35 fathoms, in company with *Pagurus ochotensis*, and *Paguristes bakeri*.

Pylopagurus holmesi sp. nov.



a *b*

Fig. 94. *Pylopagurus holmesi*, ♂, large hand; *a*, external-lateral view, × 6½; *b*, view of flat upper face, slightly smaller.

Description.—Median projection of front narrow, triangular, acute, about twice as long as wide at the base and reaching well beyond the middle of the narrow, lanceolate eye scales, i.e., to or nearly to their acutely pointed tips; lateral projections of front but slightly in advance of the base of the median projection, rounded; anterior portion of the carapace about as wide as long, or a little less. Eye-stalks compressed, scarcely if at all widening distally; reaching about to the middle of the terminal segment of the antennular peduncle when extended, and falling a little short of the antennal peduncle but slightly exceeding the antennal scale. Chelipeds not hairy, greater part of upper surface of large hand discoidal, widest at level of the bases of the fingers, with raised, finely incised, denticulate margins, which posteriorly separate discoidal face from a narrow, transversely and longitudinally convex basal (proximal) portion that fills in the angle which the upper surface makes with the wrist, or carpus; granules on upper face of carpus not confluent, distinct; the fingers are wide and flattened, widest distal to articulation of movable finger, outer margins but continuations of the denticulate raised outer margins of palm; small hand narrow, rounded, palm and fingers subequal, fingers slightly gaping. Dactyls of ambulatory legs strongly compressed, spinulous above and below, and terminating in a long, corneous claw.

Dimensions.—Type, male (Cat. No. 53330, U. S. N. M.): length over all 30 mm., of carapace and rostrum 7.5 mm., of large hand 7.5 mm., of discoidal upper face of hand 6 mm., width of same 5 mm.

Type Locality.—Santa Catalina Island, California; taken by the Venice Marine Biological Station near Catalina Harbor (station T 156).

Distribution.—From Santa Catalina Island, and San Pedro to San Diego, California, 10 to 30 fathoms.

Remarks.—This species, though remarkably like *P. discoidalis* (Milne Edwards) (see Milne Edwards and Bouvier, Mem. Mus. Comp. Zool., **14**, 18, 76, pl. vi, figs. 7–14) from the West Indian region, differs sufficiently to be considered a distinct species. The rostriform median projection of the carapace of *P. discoidalis* is broadly triangular, about as wide at the base as long, the denticulations of the raised margins of the upper face of the large hand are less incised, rather more crenulate than denticulate; the granules on the carpus of the large cheliped are more or less confluent, forming transverse scabrous lines or ridges rather than rows of distinct granules. In many of the specimens of *P. discoidalis* the upper face of the hand is as much as one and a-half times as long as wide, with the tip of the immovable finger extending slightly beyond that of the movable one. A number of specimens have broader, rounder hands, with subequal fingers, as have all the specimens of *P. holmesi* which I have examined.

Genus **Parapagurus** Smith

Abdomen with paired appendages other than the uropods on the first and second segments in the male only. External maxillipeds widely separated at base; exopodite of first pair of maxillipeds non-flagellate. Chelipeds dissimilar and unequal, the right being vastly the larger. Fourth pair of legs subchelate. In the female there is only one oviduct, which opens on the coxa of the third left thoracic leg.

Parapagurus mertensii (Brandt)

Plate 16, figure 5

Pagurus mertensii Brandt, *in* Middendorff, Reise in den äussersten Norden und Osten Sibiriens, Bd. II, Zool., Th. I, p. 112, 1851.

Parapagurus mertensii Holmes, Occas. Papers Calif. Acad. Sci., 7, 155, 1900; Rathbun, H. A. E., 10, 162, pl. 5, fig. 6, 1904.

Characters.—Median projection of front prominent, somewhat elongate, tip rounded, sides subparallel, lateral projections small; anterior portion of carapace about as wide as long. Eye-stalks short, about one-half length of anterior portion of carapace. Chelipeds pubescent, spiny, very unequal; right cheliped very large, carpus long, inner and outer margins spiny, convex upper surface armed with two rows of short spines, hand long, narrow, dorso-ventrally flattened, and bent inward at a slight angle to the carpus, rounded upper surface with small, subserially arranged granules which become more prominent on the fingers, inner and outer margins sharp, granulo-denticulate and parallel; left cheliped long, slender and attenuate, carpus subcylindrical, with three rows of spines on the upper surface, hand narrow, much longer than the carpus, palm very short, fingers long, narrow, and curved downward. Dactyls of ambulatory legs exceedingly long and slender, armed below with numerous spines.

Dimensions.—Type: length of carapace 19.1 mm., width 14.8 mm.

Type Locality.—Kamchatka.

Distribution.—Kadiak Island, Alaska, to off San Nicolas Island, California, 77 to 266 fathoms.

Remarks.—This species affords one of those curious cases of commensalism with colonies of hydroids sometimes found among deep sea pagurids. The colony of hydroids covering the shell in which the crab lives forms a membranous growth which extends beyond the boundary of the shell and in course of time, according to Dr. Benedict, causes the shell to disappear, leaving its inhabitant with a membranous instead of a calcareous domicile. In the specimen which I have the covering is partly formed by the tip of a broken shell but mainly by an extension of the membranous growth formed by the colony of hydroids. This arrangement certainly affords the crab the advantage of allowing it to grow without having to undergo the troublesome experience of changing lodgings (Holmes).

Family LITHODIDAE

Body crab-like. Abdomen more or less firm, in part at least; often segmented, bent under thorax; no tail-fan developed, uropods absent. Carapace quite firm all over. First pair of legs chelate; fourth pair like the third; fifth pair very small and folded under the carapace, making it appear superficially that the members of this family have but four pairs of legs, a character which easily distinguishes it from any other family of Decapods.

KEY TO THE CALIFORNIA GENERA OF THE LITHODIDAE

I. Abdomen soft, more or less loosely inflexed, unsegmented; at most only basal (second), and two terminal segments stiffened by thin calcareous plates; reinforcement of basal segment usually consisting of a pair of narrow marginal plates and a pair of lateral plates, between which there may be a median plate; abdomen occasionally armed with calcified granules or short spines.

A. Carapace not spiny on upper surface; rostrum short, simple, triangular.
1. Carapace and legs much flattened and more or less hairy or pubescent; lateral margins of carapace with a few small teeth or spines. Anterior margin of ambulatory legs deeply incised, incisions hidden by hairiness of legs. (Not known south of Monterey.)
Hapalogaster, p. 148.
2. Carapace not so flattened, moderately convex, somewhat roughened, granular on upper surface, slightly setose but not hairy; lateral margins unarmed. Ambulatory legs subcylindrical, very sparsely haired. (Not known south of Pacific Grove.)
Oedignathus, p. 150.

B. Carapace distinctly flattened and covered with numerous subequal spines; rostrum terminated by strong spines. Legs spiny, with long hairs arising from tip of spines. (Not known south of Monterey.)
Acantholithodes, p. 152.

II. Abdomen segmented, and subdivided into more or less well calcified plates, which are usually applied quite closely to the thoracic sternum; basal (second) segment always provided with a pair of marginal and a pair of lateral plates, and a median plate; plates either separated by sutures or more or less completely fused with one another; abdomen quite smooth or armed with more or less prominent tubercles or spines; occasionally abdominal plates have a central membranous area.

A. Abdominal plates with characteristic raised and rounded papillated edges enclosing a central membranous area; median and lateral plates of basal (second) segment distinct. Ambulatory legs about as long as greatest width of carapace. Outline of carapace practically forming an equilateral triangle; upper surface with two deep pits within a triangular excavated area, surrounded by rounded papillated tubercles. (Not known south of Monterey.)
Phyllolithodes, p. 153.

B. Abdominal plates without a central membranous area.
1. Ambulatory legs shorter than the greatest width of the carapace, usually much shorter.
a. Carapace broadly oval, convex, smooth, and produced into lateral expansions, which completely conceal the ambulatory legs, forming a large expanded dorsal shield. Basal (second) abdominal segment entire. (Not known south of Monterey.)
Cryptolithodes, p. 154.
b. Carapace not so produced, more crab-like in appearance, more or less prominently tuberculated.
i. Outline of carapace practically forming an equilateral triangle; with a deep semilunar fossa separating the smooth hemispherical cardiac region from the other more or less coarsely tuberculated regions of the carapace. Plates of basal (second) abdominal segment distinct. (Not known south of Crescent City.)
Rhinolithodes, p. 157.
ii. Outline of carapace roughly pentagonal or hexagonal, very convex, roughened, with many close set, short tubercles and fewer more or less prominent subconical tubercles. Basal (second) abdominal segment entire. (Not known south of Monterey.)
Lopholithodes, p. 155.

2. Ambulatory legs considerably longer than greatest width of carapace, often about twice or nearly twice as long.
   a. Abdomen well calcified, median row of plates of segments three to five replaced by a membranous area well armored with numerous spiny, calcified nodules. Carapace more or less strongly spined, not less than four sharp-pointed spines on gastric region.
      i. Plates of basal (second) abdominal segment distinct, separated by sutures. (Known only from 155 + fathoms.)
      Paralithodes, p. 160.
      ii. Plates of basal (second) abdominal segment more or less fused, either completely so, or with median and lateral or lateral and marginal plates fused together. (Known only from 301 + fathoms.)
      Lithodes, p. 161.
   b. Abdomen more or less leathery, median row of plates of segments three to five distinct and separate; basal (second) segment entire. Upper surface of carapace more or less tuberculated or covered with numerous short, blunt spines, only one sharp spine on gastric region. (Known only from 625 + fathoms.)
   Paralomis, p. 158.

The genera of this family are for convenience divided into two groups, based primarily on the character of the abdomen, corresponding to the major divisions of the above key (Brandt, 1850, p. 259; Bouvier, 1896*a*, p. 16). The apparent basal segment of the abdomen is in reality the second, while the last, or terminal (ultimate) segment, or plate represents the telson.

I. Abdomen soft, more or less loosely inflexed, unsegmented; at most only basal (second) and two terminal segments, stiffened by thin calcareous plates; reinforcement of basal segment usually consisting of a pair of narrow marginal plates and a pair of lateral plates, between which there may be a median plate; abdomen occasionally armed with calcified granules or short spines. Carapace more or less distinctly flattened, occasionally slightly but never strongly convex, lyrate or roughly quadrilateral; front moderately broad; rostrum scarcely if at all exceeding the eye-stalks. (Group II, p. 153.)

Genus **Hapalogaster** Brandt

Carapace, chelipeds, and ambulatory legs much flattened and more or less hairy or pubescent; lateral margins of carapace with a few small teeth or spines. Basal (second) abdominal segment with a thin, transverse, calcareous lateral plate on either side; a pair of marginal plates present but small and inconspicuous.

KEY TO THE CALIFORNIA SPECIES OF HAPALOGASTER

I. Hand of larger cheliped densely covered with short hair, somewhat roughened or granulated at the insertions of the hair, not spinous or tuberculated except for one or more small calcareous tubercles on inner face, behind articulation of the dactyl. Lateral margins of carapace with not more than two small teeth on each side. (From Cape Mendocino to Monterey.)
cavicauda, p. 149.

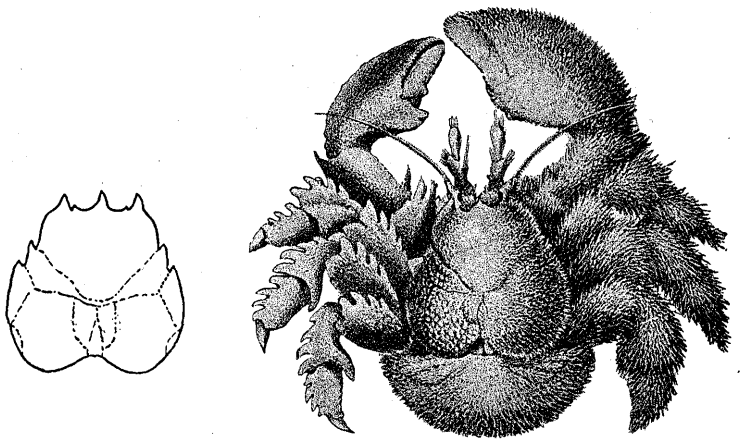
II. Hand of larger cheliped finely pubescent and armed with three longitudinal rows of spines; a row of small spines on the inner edge and two rows of larger spines on the outer surface of the hand, with a broad smooth interval between them. Lateral margins of the carapace with from four to six teeth on each side. (Not known south of Humboldt Bay.)

grebnitzkii, p. 150.

Hapalogaster cavicauda Stimpson

Plate 29, figure 1

Hapalogaster cavicauda Stimpson, Ann. Lyc. Nat. Hist. N. Y., **7**, 81, pl. 1, fig. 7, 1859 (1862); Bouvier, Ann. Sci. Nat. (7), **18**, 166, pl. 12, fig. 29, 1895; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 113, 1900.



a *b*

Fig. 95. *Hapalogaster cavicauda; a,* dorsal view of carapace, ♂ (after Bouvier); *b*, ♂, natural size (after Stimpson).

Characters.—Body and legs densely covered with short hair. Carapace nearly smooth but roughened or granulated at the insertions of the hairs. The portion of the anterolateral margin of the carapace in front of the cervical groove is convex, sublaminate, edentate, and separated from the portion behind by an incision; two marginal teeth at the origin of the sutures. Anterior margins of ambulatory legs deeply incised, forming four or five closely approximated teeth on each of the larger joints; the incisions are hidden by the hairiness of the legs. Hand of larger cheliped with one or more small, calcareous tubercles on inner face only, behind articulation of the dactyl. The calcareous plates on the basal (second) segment are widely separated by a membranous interval, in which there is no median plate; left side of abdomen of female is coriaceous and segmentally incised.

Dimensions.—Type: length of carapace 18.3 mm., width 21.1 mm.

Type Locality.—Monterey, California. Common under rocks at low tide.

Distribution.—From Cape Mendocino to San Clemente Island, California.

Hapalogaster grebnitzkii Schalfeew

Plate 29, figure 2

Hapalogaster grebnitzkii Schalfeew, Mélanges Biol. **13**, 329, figs. 3*a*–3*b*, Bull. Acad. Imp. Sci. St. Petersb., **35**, 335, 1892; Bouvier, Ann. Sci. Nat. (8), **1**, 19, 1896; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 115, 1900; Rathbun, H. A. E., **10**, 163, 1904.

Fig. 96. *Hapalogaster grebnitzkii,* dorsal view of carapace, reduced (after Schalfeew).

Characters.—Carapace and legs finely pubescent; margin of carapace behind the cervical groove armed with five spines, which decrease in size posteriorly. Legs armed with setose spines. Hand of right, or larger cheliped armed with two rows of spines on the outer surface and a row of small spines on the inner edge; there is a broad smooth unarmed interval between the two rows of spines on the outer surface. Abdomen as in *H. cavicauda.*

Dimensions.—Largest specimen of type lot: length of carapace 18 mm., width 18.5 mm.

Type Localities.—Bering Islands and Kadiak, Alaska.

Distribution.—From Bering Sea off the Pribilofs and Cape Newenham southward, along the Aleutian Islands to Sitka, Alaska; Bering Island; Humboldt Bay, California.

Remarks.—Bouvier thinks that this species is but a variety of *H. mertensii* Brandt, which ranges from Atka, one of the Aleutian Islands, eastward and southward to Puget Sound. In view of their overlapping ranges this might well be the case. The chief difference between them is in the number of longitudinal rows of spines on the right hand: *H. grebnitzkii* has three, while *H. mertensii* has four. Holmes notes still another difference, viz., the absence of a spine behind the gape of the fingers of the smaller hand of *H. grebnitzkii;* but for this difference the small hands of each would be spined alike.

Genus **Oedignathus** Benedict

Carapace moderately convex, somewhat roughened, granular on upper surface, slightly setose, but not hairy; lateral margins unarmed. Ambulatory legs subcylindrical, very sparsely haired. Abdomen much as in *Hapalogaster.*

Oedignathus inermis (Stimpson)

Plate 19, figure 1

Hapalogaster inermis Stimpson, Ann. Lyc. Nat. Hist. N. Y., **7**, 243, 1860 (1862).
Hapalogaster brandti Schalfeew, Mélang. Biol., **13**, 330, figs. 1, 5*b*, Bull. Acad. Imp. Sci. St. Petersb., **35**, 336, 1892.
Oedignathus inermis Holmes, Occas. Papers Calif. Acad. Sci., **7**, 119, 1900.
Oedignathus brandti Holmes, *ibid.*, **7**, 118, pl. 1, figs. 17–20, 1900.
Oedignathus inermis Rathbun, H. A. E., **10**, 163, 1904.
Dermaturus inermis Balss, Abh. der k. Bayer. Akad. Wiss., II, Math.-phys. Klasse, Suppl., 9 Abh., p. 71, 1913.

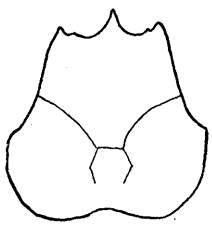


Fig. 97. *Oedignathus inermis,* outline of carapace (after Holmes).

Characters.—Carapace more or less completely covered with flat scale-like plates or minute squamae, which are setose along the anterior margin. Chelipeds very unequal and covered with low, granulated, wart-like tubercles; hand of larger cheliped large and swollen, fingers somewhat gaping at the base, the tips excavated within. Calcareous plates on the two terminal abdominal segments inconspicuous; the margin of the left side of the abdomen in the female only is somewhat hardened and segmentally incised.

Dimensions.—Type: length of carapace 10 mm., width posteriorly 9.7 mm. Of a specimen examined by Holmes, length of carapace from tip of the rostrum to posterior emargination 15.5 mm., width 15.5 mm., length of large cheliped 40 mm., length of small cheliped 28 mm.

Type Locality.—Puget Sound.

Distribution.—Unalaska to Pacific Grove, California (Rathbun). Japan (Balss).

Remarks.—Miss Rathbun has very little doubt concerning the identity of Schalfeew's species with that of Stimpson. She remarks that Stimpson's type was smaller than any examples in the National Museum.

Biological Survey of San Francisco Bay.—There are two specimens of *Oedignathus inermis* in the survey collection: a very small one with a carapace about 3 mm. long, taken from between the tide levels at Point Bonita, and a larger one with a carapace 25 mm. in length, which unfortunately bears no label but which was probably obtained at or near the same locality.

Genus **Acantholithodes** Holmes

Carapace flattened and hispid with numerous short setose spines. Chelipeds and ambulatory legs armed with numerous similar though larger and stronger spines. Basal (second) and two terminal abdominal segments stiffened by thin calcareous plates, remainder of abdomen membranous.

Acantholithodes hispidus (Stimpson)

Plate 19, figure 2

Dermaturus hispidus Stimpson, Ann. Lyc. Nat. Hist. N. Y., 7, 242, 1860; Bouvier, Ann. Sci. Nat. (7), 18, 174, pl. 11, figs. 3, 16, pl. 12, figs. 2, 16, 31, 1895.

Acantholithodes hispidus Holmes, Proc. Calif. Acad. Sci. (2), 4, 575, 1895; Occas. Papers Calif. Acad. Sci., 7, 120, 1900.

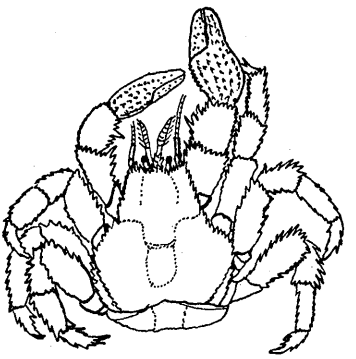


Fig. 98. *Acantholithodes hispidus*, outline of ♂ (after Bouvier).

Characters.—Rostrum prominent and terminated by strong spines. Branchial regions of carapace with a slight depressed area; between cardiac and gastric regions there is quite a sharp, narrow cleft. Abdomen, short, broad, and soft; integument spiny, spines not so large as on carapace; on basal (second) segment a median plate, two wide lateral plates and two narrow marginal ones; the plate on the penultimate segment is oblong; the last one, representing the telson, is small, rounded, and about as long as wide.

Dimensions.—Type, female: length of carapace 21.6 mm., width anteriorly 10.9 mm., posteriorly 22.9 mm. Of a specimen examined by Holmes, length of carapace from tip of rostrum 58 mm., width of carapace 56 mm.

Color.—Fingers bright red, with white tuberculiform teeth, and black horny tips, rest of body yellow, except hands, which are suffused with tinge of red from fingers (Stimpson).

Type Locality.—Monterey Bay, California, from stomachs of fishes.

Distribution.—Off Moorovskoy Bay, Alaska ("Albatross" station 3319), to Monterey, California, to a depth of 73 fathoms.

Biological Survey of San Francisco Bay.—There is one specimen of *Acantholithodes hispidus* in the collection without a label, but it

was undoubtedly taken along with *Randallia ornata* in course of several experimental trials with a 40-foot otter-trawl in 10 to 30 fathoms outside of Golden Gate, April 6, 1914.

II. Abdomen segmented and subdivided into more or less well calcified plates which are usually applied quite closely to the thoracic sternum; basal (second) segment always provided with a pair of marginal and a pair of lateral plates, and a median plate; plates either separated by sutures or more or less completely fused with one another; abdomen quite smooth or armed with more or less prominent tubercles or spines; occasionally abdominal plates have a central membranous area. Carapace quite strongly convex, at least in the gastric region; roughly triangular, pentagonal or hexagonal; front usually more or less narrow; rostrum usually exceeding the eye-stalks. (Group I, p. 148.)

Genus **Phyllolithodes** Brandt

Carapace triangular, provided with rounded tubercles, which surround an excavated area on the dorsal surface; lateral margins armed with spines. Abdominal plates with a central membranous area.

Phyllolithodes papillosus Brandt

Plate 22, figure 2

Phyllolithodes papillosus Brandt, Bull. Phys. Math. Acad. St. Petersb., **7**, 175, 1849; Bouvier, Ann. Sci. Nat. (7), **18**, 174, pl. 11, fig. 12, pl. 12, figs. 14, 25, pl. 13, fig. 1, 1895; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 122, 1900; Rathbun, H. A. E., **10**, 164, 1904.

Fig. 99. *Phyllolithodes papillosus,* ventral view of abdomen, ♂ (after Bouvier).

Characters.—Carapace with two deep pits within triangular area on dorsal surface. Rostrum prominent, ending in two tuberculiform horns, below with a subacute median spine. Chelipeds and ambulatory legs thickly covered with long, flattened, obtusely ending papillated spines, somewhat like narrow, flattened plates in appearance; these are largest on the merus and carpus, diminishing toward the tip. Abdomen furnished with calcareous plates, with distinct, characteristic raised and rounded papillated edges, within which there is a central membranous area; median and lateral plates separated by a suture.

Dimensions.—Type: length of carapace 46.6 to 48.7 mm., width 42.4 mm.

Type Locality.—Kadiak Island, Alaska.

Distribution.—Unalaska to Monterey, California. To a depth of at least 16 fathoms (Rathbun).

Genus **Cryptolithodes** Brandt

Carapace transverse, broadly oval, nearly smooth, high in the middle, and laterally produced into wide expansions which completely conceal the ambulatory legs, forming a large, expanded dorsal shield. Abdomen flattened, triangular, fitting neatly into a depression of the sternum; behind the entire basal (second) segment the abdomen bends abruptly; the three following segments are divided into a median row of plates, with a series of lateral plates on either side; penultimate segment is devoid of lateral plates, and conceals the minute triangular telson.

KEY TO THE CALIFORNIA SPECIES OF CRYPTOLITHODES

I. Hands tuberculated. Rostrum narrowing distally, end rounded, without distinct anterolateral angles. Abdomen crossed by transverse ridges. (Not known south of Monterey.)

typicus, p. 154.

II. Hands smooth. Rostrum widened toward distal end, which is transverse, with distinct antero-lateral angles, and often but not always with a small median tooth. Abdomen smooth. (Not known south of Pacific Grove.)

sitkensis, p. 155.

Cryptolithodes typicus Brandt

Plate 20, figures 1 and 2

Cryptolithodes typicus Brandt, Bull. Phys.-Math. Acad. St. Petersb., **7**, 185, 1849, **11**, 254, 1853; Stimpson, Jour. Boston Soc. Nat. Hist., **6**, 572, pl. 19, 1857; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 124, 1900; Rathbun, H. A. E., **10**, 164, 1904; Way, Puget Sd. Mar. Sta. Publ., **1**, 352, fig. 5, 1917.

Characters.—Carapace about twice as wide as long, with lateral expansions rarely advanced even as far as half the length of the rostrum, orbital sinus never very deep, never as deep as half the length of the rostrum. Rostrum narrowing distally, end rounded, no distinct anterolateral angle. Hands tuberculated, with several tuberculous ridges on the outer surface. Abdomen crossed by transverse ridges, lateral plates with more or less raised margins.

Dimensions.—Type: length 33.9 mm., width 48.7 mm.

Color.—Blackish brown on dorsal side, light gray on ventral (Way). Several specimens preserved in the U. S. National Museum, greenish in alcohol.

Type Locality.—Northern California.

Distribution.—Unalaska, Alaska, to Monterey, California, to a depth of 7 fathoms.

Cryptolithodes sitchensis Brandt

Plate 20, figures 3 and 4

Cryptolithodes sitchensis Brandt, Bull. Phys.-Math. Acad. Imp. Sci. St. Petersb., **11**, 254, 1853; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 125, pl. 2, figs. 21–25, 1900.

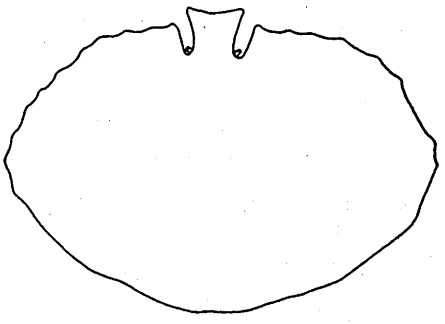


Fig. 100. *Cryptolithodes sitchensis,* natural size.

Characters.—Carapace usually about one and two-thirds as wide as long, with lateral expansions produced forward almost the entire length of the rostrum, at least two-thirds its length, forming a large, deep, rounded orbital sinus on either side. Rostrum widened toward distal end, which is transverse, with distinct antero-lateral angles and often, but not always, with a small median tooth. Hands smooth, with but a single, usually very faint rounded, longitudinal ridge a little below the middle of the outer surface. Abdomen smooth, lateral plates flat.

Dimensions.—Type: length of carapace 23.9 mm., greater width 57.2 mm. Of specimens examined by Holmes: males, length of carapace 16 to 47 mm., width 23 to 64 mm.; females, length of carapace 25 to 36.5 mm., width 36 to 49.5 mm. Length of carapace of specimen listed below 40 mm.

Color.—Males, in fresh condition, uniform bright red color; females, red but with a purplish tinge, irregularly marked with blotches of a lighter color (Holmes). Also reddish in alcohol.

Type Locality.—Sitka, Alaska.

Distribution.—From Sitka, Alaska, to Pacific Grove, California.

Remarks.—The specimen figured is one given me by Mr. D. L. Emery, who collected it at Tunitas Glen, July 4, 1913.

Genus **Lopholithodes** Brandt

Carapace broad, pentagonal or hexagonal above, with margins and upper surface armed with setose tubercles and fewer, more or less prominent, subconical ones; a peculiar smooth, wart-like prominence occurs on either side of the median gastric area. Ambulatory legs short, tuberculated, and capable of being folded under the carapace. Basal (second) segment of abdomen entire, the three following segments with lateral plates, also with small marginal plates on one or both sides; penultimate joint devoid of lateral plates, telson very small.

KEY TO CALIFORNIA SPECIES OF LOPHOLITHODES

I. Tubercles of chelipeds and ambulatory legs spiniform; carpus of chelipeds with outer edge excavated, forming a smooth, deep, rounded sinus, which when approximated to the shallower corresponding sinus on the anterior edge of the first pair of ambulatory legs forms a striking, smooth, nearly circular hole, or foramen.
foraminatus, p. 157.

II. Tubercles on legs generally rounded, blunt, and knob-like; carpus of chelipeds without a smooth, deep, rounded sinus on outer edge. (Not known south of Monterey.)
mandtii, p. 156.

Lopholithodes mandtii Brandt

Plate 21, figure 1

Lopholithodes mandtii Brandt, Bull. Phys.-Math. Acad. Imp. Sci. St. Petersb., **7**, 174, 1849.

Echinocerus cibarius White, Proc. Zool. Soc. London, **47**, pls. 2, 3, 1848; Bouvier, Ann. Sci. Nat. (7), **18**, 184, pl. 11, fig. 13, pl. 12, 1895.

Lopholithodes mandtii Holmes, Occas. Papers Calif. Acad. Sci., **7**, 128, 1900; Way, Puget Sd. Mar. Sta. Publ., **1**, 356, fig. 12, 1917.

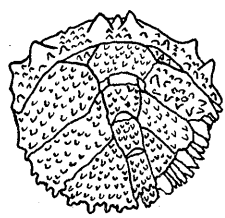


Fig. 101. *Lopholithodes mandtii,* ventral view of abdomen, ♀ (after Bouvier).

Characters.—Carapace strongly convex; gastric, cardiac, and branchial regions each with a prominent elongate, subconical tubercle, subacute on gastric area, blunt and rounded on others; anterolateral margin armed with a variable number of about eight, prominent, blunt spines and several smaller spines; a large knob-like prominence at each posterolateral angle, separated from the last anterolateral spine by a conspicuous sinus, two similar smaller prominences on either side of the middle of posterior margin of carapace. Rostrum short and consisting of a strong subconical tubercle, above the base of which is a knob bearing two lateral tubercles with generally a tubercle above, and behind the notch between them. Tubercles on legs generally rounded, blunt, and knob-like. Basal abdominal segment is strongly concave behind, especially in the female, and at nearly right angles to the carapace; there are two very prominent tubercles near the middle and several smaller ones on the margins, the remaining segments studded with numerous subconical tubercles.

Dimensions.—Type: length of carapace 152.4 to 177.8 mm., width about 177.8 to 203.2 mm.

Color.—Very brilliant, scarlet or orange, with bright purple markings particularly on ventral part of the body and the spines on the legs (Way).

Type Locality.—Sitka, Alaska.

Distribution.—Sitka, Alaska, to Monterey, California.

Lopholithodes foraminatus (Stimpson)

Plate 21, figure 2

Echinocerus foraminatus Stimpson, Ann. Lyc. Nat. Hist. N. Y., 7, 79, 1859 (1862); Newcombe, Bull. Nat. Hist. Soc. Brit. Col., p. 27, pl. 3, 1893.
Lopholithodes foraminatus Holmes, Occas. Papers Calif. Acad. Sci., 7, 130, 1900.

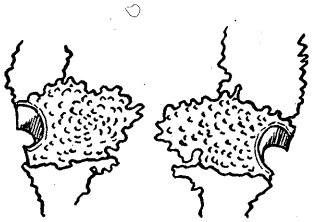


Fig. 102. *Lopholithodes foraminatus*, dorsal view of carpus of chelipeds, ♂, × nearly ¼ (after Newcombe).

Characters.—Carapace depressed; gastric region elevated, furnished with a short, sharp, conical tubercle near the middle and a group of smaller tubercles near posterior end; cardiac region with a few short, subconical tubercles; from posterior gastric region an irregular line of tubercles extends to the posterolateral angles of the carapace; external to the orbits there are three spines in a nearly transverse line, behind which the anterolateral margin is at first concave and then strongly convex ; the spines on the convex portion of the margin are large and subconical; behind the convex portion the margin is concave and devoid of spines; posterior margin arcuated and studded with conical tubercles. Rostrum rather short, with median spine, and cluster of spiny tubercles above the base. Tubercles of chelipeds and ambulatory legs spiniform; carpus of chelipeds with outer edge excavated, forming a smooth, deep, rounded sinus, which when approximated to the shallower corresponding sinus on the anterior edge of the carpus of the first pair of ambulatory legs forms a striking, smooth, nearly circular hole, or foramen, from which this species derives its name and by which it is distinguished from all others. Abdomen similar to that of *L. mandtii*.

Dimensions.—Type: length of carapace 132.1 mm., width 214.9 mm.

Type Locality.—Off the coast of California, near San Francisco.

Distribution.—Victoria, British Columbia, to off San Diego, California, to a depth of 299 fathoms.

Remarks.—Easily recognized by the remarkable foramen between the chelipeds and the first ambulatory legs (Holmes).

Genus **Rhinolithodes** Brandt

Carapace triangular, with a deep semilunar fossa separating the smooth hemispherical cardiac region from the other regions of the carapace, which are roughly and more or less coarsely tuberculate, and raised above the cardiac region. Plates of basal (second), and three following abdominal segments distinct.

Rhinolithodes wosnessenskii Brandt

Plate 22, figure 1

Rhinolithodes wossnesenskii Brandt, Bull. Phys.-Math. Acad. Imp. Sci. St. Petersb., **7**, 174, 1849 (typographical error for *wosnessenskii*).

Rhinolithodes wosenessenskii Newcombe, Bull. Nat. Hist. Soc. Brit. Col., p. 28, pl. 3, 1893; Way, Puget Sd. Mar. Sta. Publ., **1**, 354, fig. 11, 1917.

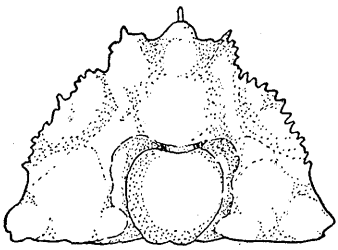


Fig. 103. *Rhinolithodes wosnessenskii,* dorsal view of carapace, × ⅝ (after Newcombe).

Characters.—Chelipeds and ambulatory legs armed with short, stout, pointed spines, bearing at their tips a few coarse hairs. Abdomen unornamented except for numerous small papilliform tubercles.

Dimensions.—Type: length of carapace 42.4 mm., width at posterior margin 48.7 mm.

Color.—Of carapace grayish tan, with orange markings in the depressions on the dorsal side, on the tubercles of posterior part of carapace, and on abdomen and branchial region. Legs not highly colored but grayish tan like the general color of carapace (Way).

Type Locality.—Sitka and Kadiak, Alaska.

Distribution.—Kadiak, Port Etches, and Sitka, Alaska; Crescent City, California.

Genus **Paralomis** White

Carapace coarsely granulate, tuberculate, or armed with numerous short, often blunt spines; gastric region usually with a strong, sharply pointed spine. Basal (second) segment entire; median plates of third to fifth segments distinct, often separated from one another by a membranous interval, covered by calcified nodules; lateral plates of these segments subequal in both sexes.

KEY TO THE CALIFORNIA SPECIES OF PARALOMIS

I. Carapace spiny, particularly marginal, gastric, and rostral regions. Ambulatory legs angular, not at all compressed, with spines arranged in rows on angles or ridges. (Known only from 625 + fathoms.)
multispina, p. 159.

II. Carapace tuberculated, margins spiny, a single acute spine on gastric region. Ambulatory legs much compressed, anterior and posterior margins set with sharp spines. (Known only from 688 + fathoms.)
verrilli, p. 159.

Paralomis multispina (Benedict)

Plate 23; plate 30, figures 7 and 8

Leptolithodes multispinus Benedict, Proc. U. S. Nat. Mus., **17**, 484, 1894.
Paralomis multispina Bouvier, Ann. Sci. Nat. (8), **1**, 25, 1896.
Leptolithodes multispina Rathbun, H. A. E., **10**, 165, 1904.

Original Description.—The carapace is about as broad as long; the areolations are well defined. On the median line at the summit of the gastric region there is a sharp spine about 4 mm. in length. The lateral margins are armed with from twelve to sixteen spines about 3 mm. in length. In the young and in some of the adults there are small spines on the branchial region. A semicircular line of six or seven spines marks the limits of the branchial and intestinal regions. The carapace is thickly studded with blunt spines, each terminating in a flattened face or surface cut obliquely to the surface of the carapace; this face is encircled by a fringe of short, stiff bristles. The rostrum consists of a simple median spine with two basal spines. Under the rostrum proper there is a very short, conical spine homologous with the subrostral spine of *Lithodes;* behind the spine are one or more spinules. The abdomen in the male is composed, after the second segment, of several rows of leathery plates; the second segment is better calcified and harder. The abdomen of the female is twisted to the right as in *Lithodes.*

The chelipeds are moderately slender and extend almost to the distal end of the carpal joints. The spines on the inner margin of the carpal segments are the most prominent. The ambulatory legs are long and slender and thickly set with spines. The spines of the merus are not so distinctly arranged in rows as on the carpal and propodal segments; there is, however, a distinct row on the upper margin. The spines of the carpus are arranged in eight more or less distinct rows; on the propodal segment the spines are arranged in six full rows and two half rows. There are four short rows of spines on the proximal end of the dactylus. The dactyli are compressed, slightly bent, and a little twisted (Benedict).

Dimensions.—Specimen of average size: length 80 mm., width 78 mm., distance from tip to tip of ambulatory legs 360 mm. (Benedict).

Type Locality.—Off Queen Charlotte Islands, British Columbia, 876 fathoms ("Albatross" station 2860).

Distribution.—From off Shumagin Bank, Alaska, to off San Diego, California, 625 to 876 fathoms (Rathbun).

Paralomis verrilli (Benedict)

Plate 24; plate 30, figures 5 and 6

Pristopus verrilli Benedict, Proc. U. S. Nat. Mus., **17**, 486, 1894.
Paralomis verrilli Bouvier, Ann. Sci. Nat. (8), **1**, 25, 1896.
Pristopus verrilli Rathbun, H. A. E., **10**, 165, 1904.

Original Description.—The carapace is verrucose, the areolations prominent. The gastric region is much elevated and is surmounted by a small spine. On each side, on the border of the branchial region, there is a deep pit. A groove runs from the pits to the depression between the gastric and cardiac regions. There are about twelve spines, two to three mm. in length on the lateral border of the carapace. The posterior boundary of the intestinal region is marked by a semicircular row of tubercles. The cardiac region is triangular; the apex of the triangle cuts well into the intestinal region where the depression that marks it runs into a deep slit or oblong median depression. The frontal margin is broad and straight. The spines of the anterior angles and the orbital spines point forward; the orbital spines are a little the longer. Between the spine on the angle and the orbit there is a row of smaller spines and one or two granules. The trispinose rostrum is composed of a bifurcate rostrum proper and the subrostral spine which extends much beyond the two upper rostral spines. The antennal

scale tapers to a sharp point and has three sharp spines or branches on each side. The lateral plates on the left of the abdomen in the female are fringed with short, slender, blunt spines.

The chelipeds extend a little beyond the middle of the propodal segment of the first pair of ambulatory feet. The right cheliped is stouter than the left. The prehensile edges of its fingers are strongly tubercular. The upper margin of the palm is spiny; there are also some small spines on the middle and on the lower margin. There are three long spines on the inner margin of the carpus. The left cheliped is similar but smaller, and the prehensile edges of the fingers are sharp. The ambulatory feet are wide and much compressed. The anterior and posterior margins are armed with sharp spines, alternating in general large and small. On the upper surface of the proximal end of the merus of the fourth pair of feet there is a row of fine spines; the corresponding spines on the third pair of feet are smaller, and on the second pair still smaller (Benedict).

Dimensions.—Type: length of carapace and rostrum 90 mm., rostrum 9 mm., width of carapace 82 mm.

Type Locality.—Off the Pribilof Islands, 688 fathoms.

Distribution.—Pribilof Islands, to off Cortez Bank, California, 688 to 822 fathoms (Rathbun).

Genus **Paralithodes** Brandt

Carapace armed with a number of strong, long spines. Third to fifth abdominal segments with median plates replaced by a membranous area covered by calcified, often spinous nodules; lateral plates of these segments in the female are very much larger on the left side than on the right; plates of basal (second) segment distinct, separated by evident sutures.

KEY TO THE CALIFORNIA SPECIES OF PARALITHODES

I. Rostrum bifurcate, tip with two well developed divergent horns; anterior lateral spines of rostrum reaching to apex of bifurcation of rostrum. (Known only from 211 + fathoms.)

rathbuni, p. 160.

II. Rostrum simply bifid or split, two terminal spines thus formed approximated; anterior lateral spines of rostrum not reaching half way to bases of terminal spines. (Known only from 155 + fathoms.)

californiensis, p. 161.

Paralithodes rathbuni (Benedict)

Plate 26; plate 27; plate 29, figures 6 and 7; plate 30, figures 3 and 4

Lithodes rathbuni Benedict, Proc. U. S. Nat. Mus., **17**, 482, 1894.
Paralithodes rathbuni Bouvier, Ann. Sci. Nat. (8), **1**, 23, 1896.
Lithodes rathbuni Holmes, Occas. Papers Calif. Acad. Sci., **7**, 131, 1900.

Original Description.—Carapace of male armed with long spines on the different regions; also with longer spines on the margins. There are four on the gastric; two short and two long on the cardiac region. The branchial region has six spines of various lengths. The posterolateral margin has the longest spine, being 26 mm. in length on one side and 23 mm. on the other. Both have lost their points. Anterior to this there are three spines, the shortest unbroken one being 17 mm. long; on the margin posterior to the longest spine there are four spines, the longest of which is 14 mm. in length and the shortest 8 mm. The rostrum is composed of five branches; the main stem is sharply bent upward and

is strongly bifurcate; the lower horn is almost on the horizontal line of the body, and projects forward more like the usual main portion of the rostrum; the lateral branches arise at the base and project forward. The movable spine of the antenna is very long and slender; there is a short branch or spine on its outer and upper margin near the base.

The right cheliped is slender and rather weak. Its longest spine is situated on the distal upper margin of the merus. There are upwards of twelve spines on the carpus. On the median outer surface of the palm there are two rows of four spines each. The fingers gape at the base; their prehensile edges are tubercular. The left cheliped is smaller and more slender than the right. The cutting edges of the fingers run back to the gape, or a little more than one-half their length. The ambulatory legs are slender and very spiny; the spines are from 3 to 5 mm. in length (Benedict).

Dimensions.—Type, male: length of carapace exclusive of broken rostrum 65 mm., width 68 mm.

Type Locality.—Off San Simeon Bay, California, 211 fathoms ("Albatross" station 3191; 1 male).

Distribution.—Also taken by the "Albatross" off San Diego, California, 201 to 220 fathoms (two female specimens, one each from stations 4359 and 4367).

Paralithodes californiensis (Benedict)

Plate 25; plate 30, figures 1 and 2

Lithodes californiensis Benedict, Proc. U. S. Nat. Mus., **17**, 483, 1894.

Paralithodes californiensis Bouvier, Ann. Sci. Nat. (8), **1**, 23, 1896.

Lithodes californiensis Holmes, Occas. Papers Calif. Acad. Sci., **7**, 131, 1900.

Original Description.—This species is remarkably like the preceding, except in the relative length of its spines and the form of the rostrum. The spines of the carapace are much shorter and stouter, but occupy the same relative position. On the lateral margin there are two long spines; the one above the third ambulatory foot equals in length, but is much stouter than the one similarly placed on the preceding species. The most marked difference between the two species is in the rostrum; in both specimens of *L.* [*P.*] *californiensis* the rostrum is bifid, while in *L.* [*P.*] *rathbuni* it is bifurcate, the tip being composed of two well developed divergent horns. The subrostral spine extends almost as far as the rostrum proper. The chelipeds are as in *L.* [*P.*] *rathbuni,* except that the spines are shorter and that there is less gape in the right hand and more in the left (Benedict).

Dimensions.—Type, female: length of carapace and rostrum 95 mm., width of carapace 82 mm.

Type Locality.—Off Santa Cruz Island, California, 155 fathoms ("Albatross" station 2949; two females).

Distribution.—Also taken by the "Albatross" off San Diego, California, 141 to 167 fathoms (station 4358; 1 female).

Genus **Lithodes** Latreille

Like *Paralithodes* except that plates of basal (second) abdominal segment are more or less fused, either completely or with median and lateral, or lateral and marginal plates fused together.

Lithodes couesi Benedict

Plate 28; plate 29, figures 3, 4, and 5

Lithodes couesi Benedict, Proc. U. S. Nat. Mus., **17**, 481, 1894.

Original Description.—This species reminds one of *L. maia* [L.]. The largest spines of the carapace are arranged about the margin; they are slender and sharp. The longest are situated at the outer orbital angles, the antennal angles, the hepatic regions, and three on the margin of the branchial regions. The spines on the intervening spaces of the margin are more numerous and much smaller. The surface of the carapace is set with short, sharp, conical spines. The gastric region is swollen and well defined. The cardiac region is barely indicated between the confluent branchial regions. The depression between the gastric and cardiac regions is very deep. The rostrum is 20 mm. long, and made up as in *L. maia,* but the terminal portion beyond the distal lateral branches is slender and bifid rather than bifurcate, as in *L. maia;* the basal branches are a little farther forward. The scale is rudimentary; the spine at the outer angle is branched at the base, the branch consisting of a single short, sharp spine on the outer surface. The abdomen is without spines; the spines of *L. maia* are replaced by tubercles; those of the first segment are very much closer together than the corresponding spines in *L. maia.* The tubercles on the lower margin of the second segment are low, and somewhat oblong at base; those in the center of segment are larger.

The chelipeds are slender and weak. The armature of the fingers of the right hand is slight; the fingers gape. The fingers of the left hand are long and slender and gape at base. The spines of the chelipeds and ambulatory legs are numerous and arranged about as in *L. maia,* but are shorter (Benedict).

Dimensions.—Type, male: length of carapace and rostrum 105 mm.; width of carapace 81 mm.

Type Locality.—North of Unalaska; 399 fathoms ("Albatross" station 3329, 1 male).

Distribution.—Bering Sea to off San Diego; 301 to 530 fathoms.

Remarks.—From the Shumagin Banks, Alaska ("Albatross" station 3338), Benedict records three young specimens which he refers to this species "without hesitation." Regarding them he says: "The rostrum differs in being bifurcate as in *L. maia.* It is possible that additional specimens of the adult might show the rostrum to be bifurcate rather than bifid." This does not prove to be the case, however, for two adult males from off San Diego ("Albatross" stations 4400 and 4333) have the characteristic rostrum of the type. Two other young specimens were also taken off San Diego in 500 to 530 fathoms ("Albatross" station 4335).

Family GALATHEIDAE

Body shrimp-like. Abdomen bent upon itself but not folded up against the thorax; tail-fan well developed, adapted for swimming. First legs chelate, greatly elongated, slender. Antennal peduncle four-jointed owing to fusion of true second and third joints; flagellum long.

KEY TO THE CALIFORNIA GENERA OF THE GALATHEIDAE

I. Latero-inferior regions of carapace greatly swollen so that epimeral structures, sides of carapace, are visible in dorsal view. Rostrum long and slender, with a supraorbital tooth on either side of the base. Abdomen dorsally unarmed. (From ninety miles southwest of San Francisco southward.)
Pleuroncodes, p. 163.

II. Latero-inferior regions of carapace not bulging, not visible from above.
A. Eyes faceted and well pigmented. Integument crisp. Exopodite of first maxilliped terminating in a flagellum.
1. Rostrum broad, flattened dorsoventrally, laterally toothed. Abdomen dorsally unarmed. (Known from off Santa Cruz Island.)
Galathea, p. 163.
2. Rostrum long and slender, spine-like, laterally compressed, unarmed; with a well developed supraorbital spine on either side of the base. Abdomen often unarmed dorsally.
Munida, p. 164.
B. Eyes opaque, non-faceted, and devoid of pigment. Integument thick, and very strongly calcified. Exopodite of first maxilliped not terminating in a flagellum. Rostrum elongate triangular, with or without lateral spines. Abdomen generally armed dorsally.
Munidopsis, p. 167.

Genus **Pleuroncodes** Stimpson

Carapace with latero-inferior regions swollen so that epimeral structures, sides of carapace, are visible from above. Rostrum long and slender, spiniform, with a supraorbital tooth on either side of the base. Abdomen dorsally unarmed.

Pleuroncodes planipes Stimpson

Plate 31, figure 2

Pleuroncodes planipes Stimpson, Ann. Lyc. Nat. Hist. N. Y., 7, 245, 1860.—Holmes, Occas. Papers Calif. Acad. Sci., 7, 112, 1900.

Characters.—Carapace more or less convex, tapering anteriorly, transversely rugose, anterior edges of rugae fringed with closely set short hairs; with the exception of a few spinules behind the supraorbital teeth carapace is devoid of spines above; there is a spine at the rounded anterolateral angle, behind which there are a few spines on the lateral margin. Rostrum long and slender, scabrous above, and continued upon the carapace as a carina; supraorbital teeth spine-like, confluent at base with rostrum. Chelipeds slightly hairy; ambulatory legs scabrous, with penultimate joints distinctly flattened and ciliated.

Dimensions.—Type, male: length of carapace, rostrum included, 24.1 mm., greatest width 13.7 mm.

Type Localities.—Pacific Ocean, lat. 24° N, long. 130° W, and Monterey, California.

Distribution.—From ninety miles southwest of San Francisco, California, to 150 miles southwest of Cape St. Lucas, Lower California.

Remarks.—This species lives in the open ocean and is sometimes found in vast quantities in the Pacific Ocean off the American coast. In March, 1859, it was thrown ashore in considerable numbers at Monterey, California (Stimpson).

Genus **Galathea** Fabricius

Rostrum flattened dorsoventrally, rather broad, laterally toothed. Ocular peduncles distally dilated only slightly if at all. Abdominal segments unarmed. Carapace more or less evenly convex, tapering somewhat anteriorly, transversely rugose, anterior edges of rugae fringed with closely set, short hairs, dorsal surface with one or more pairs of sharp spines, lateral margins spiny.

Galathea californiensis Benedict

Galathea californiensis Benedict, Proc. U. S. Nat. Mus., **26**, 247, fig. 1, 1902; Rathbun, H. A. E., **10**, 166, 1904.

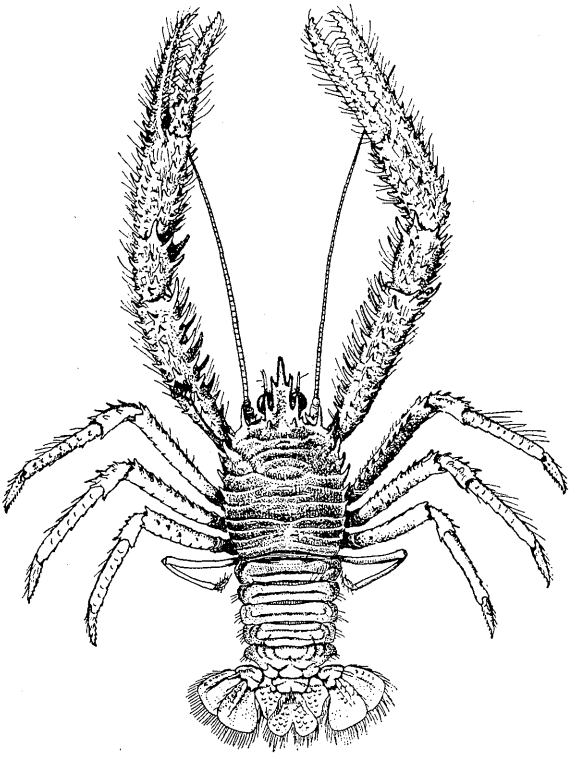


Fig. 104. *Galathea californiensis*, ♂, × ¾ (from Benedict, U. S. N. M.).

Characters.—Rostrum more than twice as long as the eyes, broad, flattened dorsoventrally, armed with two pairs of stout spines, sides parallel between spines; a pair of small spines at angle formed by base of rostrum and front. There are six spines on the margin of the carapace behind the antennal spine; on the gastric region there is a pair of spines directly behind the posterior pair on the rostrum. Chelipeds long, stout, very spiny, and moderately hairy.

Dimensions.—Type, male: length from the front to end of the telson 61 mm., length of cheliped 100 mm.

Type Locality.—Off Santa Cruz Island, California, 150 fathoms ("Albatross" station 2946).

Distribution.—From Monterey Bay, California, to off Cerros Island, off Lower California, 57 to 2182 fathoms.

Genus **Munida** Leach

Rostrum long, slender, styliform, with a well developed supraorbital spine on either side of the base. Eyes generally large and well pigmented, ocular peduncles usually markedly dilated distally. Integument crisp. Carapace more or less

evenly convex, tapering somewhat anteriorly, transversely rugose, anterior edges of rugae fringed with closely set, short hairs, dorsal surface with one or more pairs of sharp spines, lateral margins spiny. One or more of the abdominal segments often with a series of spinules on the anterior margin.

KEY TO THE CALIFORNIA SPECIES OF MUNIDA

I. Abdomen and posterior margin of carapace unarmed.
quadrispina, p. 165.

II. Second, third and fourth segments of abdomen, and posterior margin of carapace armed with spines. (Known only from 158+ fathoms.)
hispida, p. 166.

Munida quadrispina Benedict

Munida quadrispina Benedict, Proc. U. S. Nat. Mus., **26**, 269, fig. 17. 1902; Rathbun, H. A. E., **10**, 166, 1904.

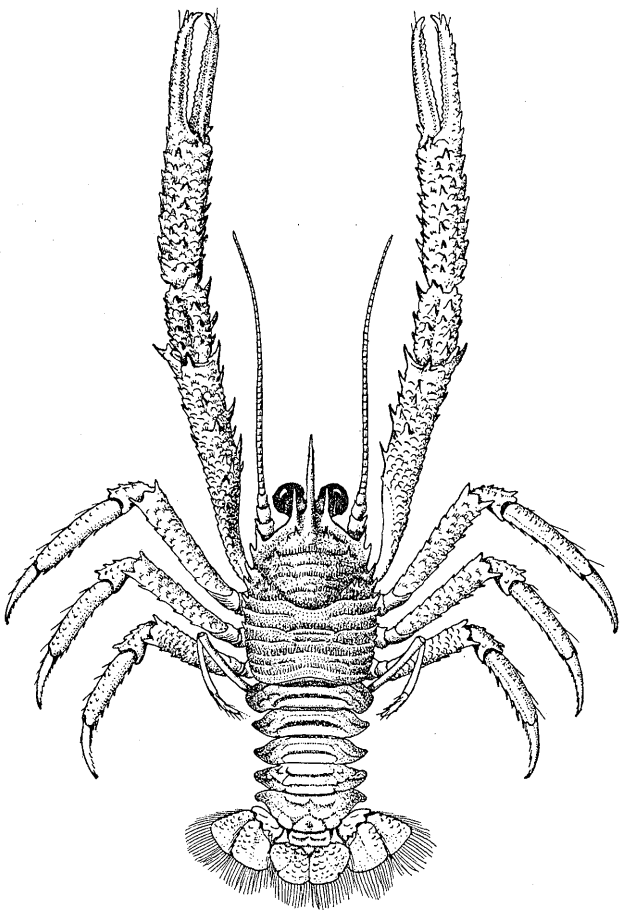


Fig. 105. *Munida quadrispina*, × 1½ (from Benedict, U. S. N. M.).

Characters.—Abdomen unarmed. Rostrum long, slender, spine-like, laterally compressed, unarmed, moderately serrate above and slightly so below. The straight, slender supraocular spines do not reach quite to the ends of the eyes and are united to the rostrum for nearly one-half their length. The marginal spines of the carapace vary from eight to ten on a side; there are six spines on the gastric area, four in a line in the usual place behind the supraocular spines, and one on each side near the hepatic region; the terminal spines of the line are very weak and small; but one spine occupies the anterior branchial region; posterior margin unarmed. Chelipeds well set with spines and spinules, not hairy.

Dimensions.—Type, length 35 mm.

Type Locality.—Off Cape Beale, Vancouver Island, British Columbia, 66 fathoms ("Albatross" station 2878).

Distribution.—From Sitka, Alaska, to Los Coronados Islands, Lower California, 50 to 638 fathoms.

Remarks.—Probably the species designated by Owen as *M. gregaria* (Rathbun).

Munida hispida Benedict

Plate 31, figure 3

Munida hispida Benedict, Proc. U. S. Nat. Mus., **26**, 260, fig. 10, 1902.

Characters.—Second, third, and fourth segments of abdomen armed; second and third with two rows of spines, fourth with one; second of the double rows wanting in all but the largest specimens. Rostrum more than twice as long as supraocular spines, slightly sigmoid and minutely serrate. Supraocular spines little longer than the eyes, stout at base, and tapering rapidly to a sharp point. Marginal spines of carapace, not counting those at anterolateral angles, from seven to ten on a side; gastric spines small, with a much smaller pair placed anteriorly and closer together; on median line of gastric region there are five or six spines, and on a ridge behind these is a row of spinules; a number of spinules are scattered over the anterior portion and the sides of this area; there are about sixteen spinules on the triangular area, a spine on the branchial area just behind the apex of the triangle, and another paired spine behind this; posterior border of carapace armed with from ten to about eighteen low spines. Chelipeds stout, prismatic, and spinose; not hairy.

Dimensions.—Type, male: length from extremities of the rostrum and telson 83 mm., length of right cheliped 186 mm., merus 70 mm., palm 53 mm., fingers 30 mm. Specimen from off Santa Catalina Island (plate 31, figure 3): length of carapace and rostrum 20 mm., of right cheliped 36 mm.

Type Locality.—Off Galapagos Islands, 271 fathoms ("Albatross" station 2817).

Distribution.—Also taken off Santa Catalina Island, 178 to 195 fathoms ("Albatross" station 4410); off La Jolla, California, 158 fathoms (Scripps Institution, haul 1157); and northwest of Cerros Island, Lower California, 171 fathoms ("Albatross" station 2987).

Remarks.—The variation between the large specimen taken for the type and the smaller specimens is considerable. The carapace of the smaller ones lack many of the spinules, and the spines are larger; the fourth segment of the abdomen may show only two small protuberances in place of the row of spines. The chelipeds are much shorter, and they are armed with definite rows of spines; the palm is prismatic, and the prehensile edges of the fingers are in contact throughout. The rostrum in some of the smallest is slightly bent upward. With all this variation, however, the specimens intergrade, and in my opinion give no ground for separation (Benedict).

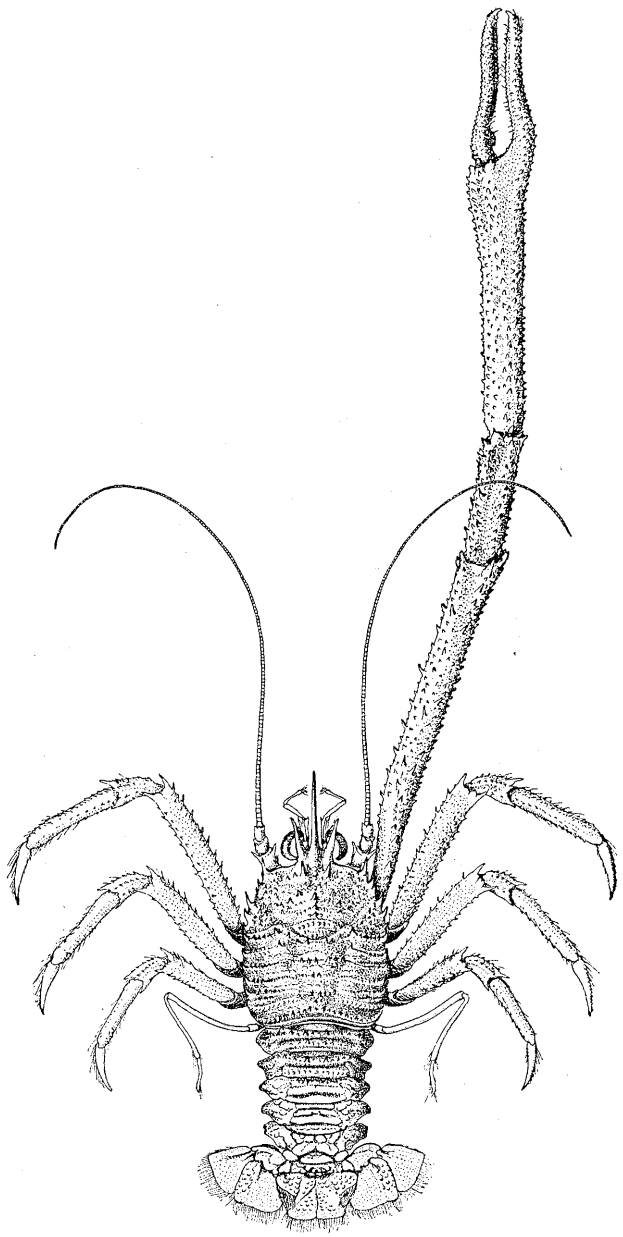


Fig. 106. *Munida hispida,* type, × ⅗ (from Benedict, U. S. N. M.).

Genus **Munidopsis** Whiteaves

Rostrum well developed; sometimes with a small supra-antennal tooth or spine on either side but never with a long supraorbital spine. Eyes opaque, non-faceted, and devoid of pigment. Integument very strongly calcified. Carapace generally

quite flat, more or less quadrilateral in outline, dorsal surface usually rugose, sometimes spinose, but occasionally glabrous, and either prominently or obscurely tuberculated.

KEY TO THE CALIFORNIA SPECIES OF MUNIDOPSIS

I. Abdomen unarmed. Eye-stalks spined above. Rostrum acuminate, laterally unarmed. Chelipeds hairy. (Known only from 684+ fathoms.)
verrilli, p. 169.

II. Abdomen armed with spines or tubercles.
A. Rostrum laterally spined. Eye-stalks spined above. Dorsal armature of abdomen not confined to median line. Chelipeds hairy. (Known only from 302 + fathoms.)
hystrix, p. 168.
B. Rostrum not armed with lateral spines, acuminate. Eye-stalks not spined. Dorsal armature of abdomen confined to median line.
1. Anterior margin of carapace with a small, serrated lobe on either side of base of rostrum behind ocular peduncle; lateral margins arcuate. Chelipeds hairy. (Not known north of Santa Catalina Island.)
aspera, p. 171.
2. Anterior margin of carapace straight, at right angles to lateral margins; lateral margins straight. Chelipeds not hairy.
quadrata, p. 170.

Munidopsis hystrix Faxon

Munidopsis hystrix Faxon, Bull. Mus. Comp. Zool., **24**, 183, 1893; Mem. Mus. Comp. Zool., **18**, 89, pl. 19, figs. 1, 1*a*, 1895; Rathbun, H. A. E., **10**, 166, 1904.

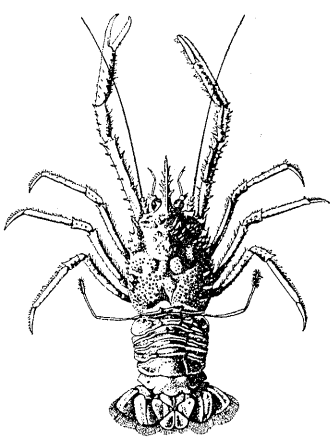


Fig. 107. *Munidopsis hystrix,* × about ¾ (after Faxon).

Characters.—Rostrum long, lightly curved upward from the base to the tip, and armed with from two to five spines on each side; spines unsymmetrically arranged on the two sides. Eye-stalks armed with a single spine above. Carapace setose and thickly covered with small spinous tubercles; three spines of special prominence on the gastric area disposed in the form of a triangle, with apex

directed backward; one on the cardiac area; two (rarely six) on the hind margin of the carapace; one on each branchial area; there is a spine at the external angle of the orbit, and the lateral margin of the carapace is spinose. Second, third and fourth segments of abdomen conspicuously two-ridged; the second segment has a pair of small spines on the anterior ridge, and another pair nearer the median line on the posterior ridge; third segment also with a pair of spines on the anterior ridge, and occasionally with a third spine in the median line on the posterior ridge. Chelipeds long, hairy, and very spiny from the proximal end of the merus to the base of the fingers.

Dimensions.—Type, ovigerous female: length 48.5 mm.; length of carapace 26 mm.; breadth 15 mm.; length of rostrum 8 mm.

Type Localities.—Off Tres Marias Islands ("Albatross" stations 3424 and 3425), 676 to 680 fathoms, and off Acapulco, Mexico ("Albatross" station 3417), 493 fathoms.

Distribution.—From off Anacapa Island, California, to off Acapulco, Mexico; 302 to 680 fathoms.

Munidopsis verrilli Benedict

Munidopsis verrilli Benedict, Proc. U. S. Nat. Mus., **26**, 291, fig. 34, 1902.

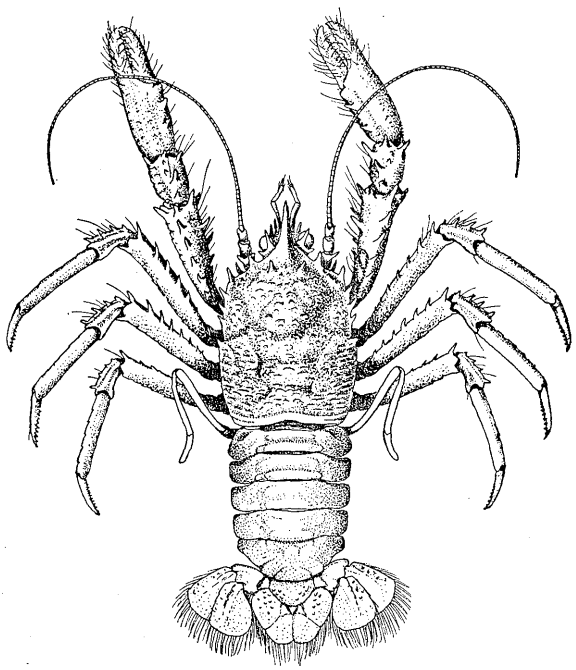


Fig. 108. *Munidopsis verrilli,* × 1⅔ (from Benedict, U. S. N. M.).

Characters.—Abdomen unarmed. Rostrum slender and triangular in cross section, upper margin running back as a carina to a point behind the spines of the gastric region. Front, from base of rostrum to a point under the anterolateral spine, is nearly straight and is at an angle of about forty-five degrees to the median line. Eye-stalks armed with two spines, of which the inner is much the longer.

Carapace is iridescent; the short and rather elevated rugae are hairy. Merus and carpus of ambulatory legs spiny. Merus of chelipeds triangular in cross-section, with four spines on the upper ridge and two on the inner; carpus with five or six spines; two prominent ones on the crest of the palm; prehensile edges of fingers evenly dentate.

Dimensions.—Type: length of carapace and rostrum 22 mm., of rostrum about 5 mm.; length of hand 13 mm.

Type Locality.—Off San Diego, California, 822 fathoms ("Albatross" station 2923).

Distribution.—From Monterey Bay, California, to off Cerros Island, Lower California, 684 to 1084 fathoms.

Munidopsis quadrata Faxon

Munidopsis quadrata Faxon, Bull. Mus. Comp. Zool., 24, 188, 1893; Mem. Mus. Comp. Zool., 18, 97, pl. 23, fig. 1, 1895; Rathbun, H. A. E., 10, 167, 1904.

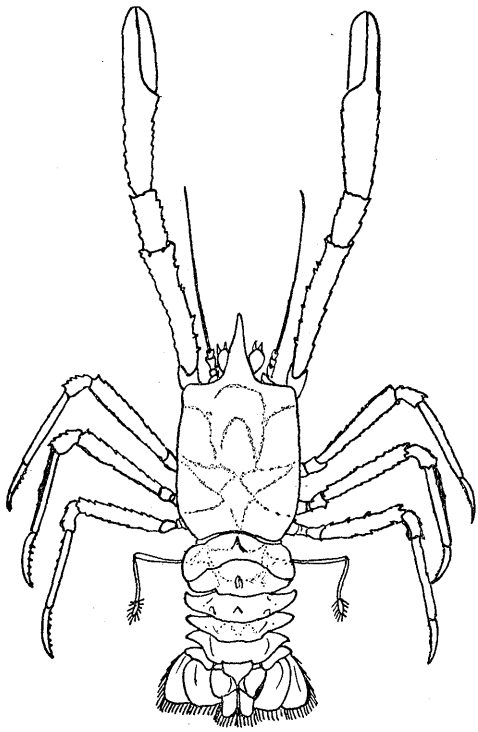


Fig. 109. *Munidopsis quadrata,* × about 2 (after Faxon).

Characters.—Lateral margins of carapace straight, at right angles to straight anterior margin, upper surface spineless but furnished with scattered low, squamous tubercles; central part of the gastric region prominent above the anterior branchial lobes, from which it is separated by deep pits; a prominent transverse ridge on the cardiac region forms the posterior wall of a deep fossa. Second segment of abdomen armed with a median spine, which is curved forward, third

and fourth segments with a very prominent ridge, which bears an acute median tooth. Length of rostrum variable, but always exceeding eye-stalks, usually by twice their length. Chelipeds not hairy.

Dimensions.—Type: length of body 29 mm., length of carapace 15.5 mm., width of carapace 9 mm.

Type Locality.—Off Tres Marias Islands, 676 fathoms ("Albatross" station 3424).

Distribution.—From off Destruction Island, Washington, to Tres Marias Islands, Mexico; 134 to 859 fathoms; also at 47 and 60 fathoms, off Wilmington, California, and Los Coronados Islands, respectively. Usually between 350 and 700 fathoms (Rathbun).

Munidopsis aspera (Henderson)

Plate 31, figure 1

Elasmonotus asper Henderson, Ann. Mag. Nat. Hist. (5), **16**, 416, 1885; "Challenger" Rept., Zool., **27**, Anomura, p. 163, pl. 19, fig. 4, 1888.
Munidopsis aspera Rathbun, H. A. E., **10**, 167, 1904.

Characters.—Lateral margins of carapace arcuate, anterior margin with small serrated lobe on orbital border behind ocular peduncle, upper surface beset with irregular subacute tubercles, some of which are more prominent and even compound toward median line of gastric area, tubercles more numerous elsewhere toward lateral and posterior margins and two of large size are situated on the cardiac area overhanging a shallow transverse groove; intervening spaces finely granular. Second and third abdominal segments are each provided with a prominent median tubercular elevation, the surface of which is roughened; scattered tubercles of small size present toward lateral margins of same segments, posterior segments smooth. Length of rostrum variable, usually twice length of eye-stalks, though in some male specimens it scarcely exceeds their length. Chelipeds hairy.

Dimensions.—Type, ovigerous female: length of body 28 mm., length of chelipeds 27 mm.

Type Localities.—Off Patagonia, 425 fathoms, and off coast of Brazil, 1500 fathoms.

Distribution.—Also taken by the "Albatross" from off Santa Catalina and San Clemente islands, California, to Straits of Magellan and Galapagos islands, 57 to 782 fathoms. Mostly between 400 and 600 fathoms. Brazil, 1500 fathoms (Henderson).

Family Albuneidae

First pair of legs subchelate; second to fourth legs with last joint curved and flattened. Carapace flattened, without wings to cover the legs. Third maxillipeds narrow, with exopodites. Abdomen bent under thorax; tail-fan not adapted for swimming.

Key to the California Genera of Albuneidae

I. Eye-peduncles very slender, elongated, cylindrical, and articulated in the middle. (Not known north of San Francisco.)
Blepharipoda, p. 172.

II. Eye-peduncles lamellate, compressed, almost squamiform, cornea rudimentary. (Not known north of San Pedro.)
Lepidopa, p. 172.

Genus **Blepharipoda** Randall

Eye-peduncles very slender, elongated, cylindrical, and articulated in the middle. Antennae with an acicle. Third maxillipeds with third or merus joint narrow and similar to the fourth, or carpus, which is not produced at its antero-external angle.

Blepharipoda occidentalis Randall

Plate 31, figure 6

Blepharipoda occidentalis Randall, Jour. Acad. Nat. Sci. Phila., **8**, 131, pl. 6, 1839; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 104, 1900; Rathbun, H. A. E., **10**, 167, 1904; Baker, Rept. Laguna Mar. Lab., **1**, 102, 1912.

Characters.—Carapace oblong, scabrous in front, smooth and punctate behind, tapering posteriorly, somewhat obliquely elevated toward the center, which is faintly carinate; median projection of front spiniform; anterolateral margin with three large spines and a smaller fourth one some distance back; longitudinal median ridge with a spine at anterior end only. Antennules not exceeding the length of the carapace. Telson suborbicular, thick and convex in the middle, but with sides laminate.

Dimensions.—Type, length about 50.8 mm.

Type Locality.—San Diego, California.

Distribution.—From San Francisco, California (D. S. Jordan), to San Quentin Bay and Rosalia Bay, Lower California (Rathbun).

Remarks.—This large species is one of the most remarkable crustaceans on the coast, found occasionally on sandy shores below low tide. Boys locate them with their feet while in bathing and dive for them (Baker).

Genus **Lepidopa** Stimpson

Eye-peduncles lamellate, compressed, almost squamiform, cornea rudimentary. Antennae with a very small acicle. Third maxillipeds with the fourth joint produced at its antero-external angle into a lobe, which reaches to or beyond the distal extremity of the fifth (penultimate) joint.

Lepidopa myops Stimpson

Plate 31, figure 4

Lepidops myops Stimpson, Ann. Lyc. Nat. Hist. N. Y., **7**, 241, 1860 (1862); Miers, Jour. Linn. Soc. London (Zool.), **14**, 333, pl. 14, fig. 16, 1879.

Lepidopa myops Holmes, Occas. Papers Calif. Acad. Sci., **7**, 105, 1900; Benedict, Proc. U. S. Nat. Mus., **26**, 892, fig. 4, 1903.

Characters.—Carapace somewhat square, about as long as wide, marked with transverse grooves; median projection of front rounded; anterolateral margin with a single spine; longitudinal median ridge unarmed. Antennules more than twice as long as carapace. Telson of male triangular, broad, rounded on the sides at its proximal and acute at its distal extremity; telson of female ovate, triangular, more rounded and obtuse at its distal extremity.

Dimensions.—Type, female: length of carapace 10.4 mm., width 11.9 mm.

Type Locality.—Cape St. Lucas, Lower California.

Distribution.—From San Pedro, California, to Cape St. Lucas, Lower California.

Family Hippidae

First pair of legs simple; second to fourth legs with last joint curved and flattened. Carapace subcylindrical, with wings which cover the legs. Third maxillipeds broad, without exopodites. Abdomen bent under thorax; tail-fan not adapted for swimming.

Genus **Emerita** Gronovius, Benedict

Antennae with flagellum very long, robust, multiarticulate, and strongly ciliated, normally hidden, coiled beneath the external mouth parts. Third pair of maxillipeds with ischium very small, and merus very large; terminal joint narrow and compressed. Dactyls of first pair of legs oval and lamellate.

Emerita analoga (Stimpson)

Plate 31, figure 5

Hippa analoga Stimpson, Proc. Boston Soc. Nat. Hist., **6**, 85, 1857; Miers, Jour. Linn. Soc. London (Zool.), **14**, 324, pl. 5, fig. 10, 1879; Ortmann, Zool. Jahrb., Abt. f. Syst., **6**, 537, pl. 26, fig. 1, 1892; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 103, 1900.

Emerita analoga Rathbun, H. A. E., **10**, 168, 1904; Weymouth and Richardson, Smithson. Misc. Coll., **59**, no. 7, 1912; Mead, Univ. Calif. Publ. Zool., **16**, 431, 1917.

Fig. 110. *Emerita analoga,* dorsal view, natural size.

Characters.—Carapace oblong-oval, very convex, and marked with irregular transverse, crenulated lines, which become much less marked toward the sides and the posterior end; median projection of front subtriangular but rounded at the tip; lateral lobes triangular and acute, projecting further forward than median lobe, from which they are separated by round, smooth sinuses. Eye-stalks long and very slender. Merus of maxillipeds with lobe at antero-internal angle rounded. Telson narrowly triangular, acute; outer surface convex, smooth, and glossy.

Dimensions.—Length of carapace 29 mm., width 23 mm., length of telson 19 mm., width of telson 9.5 mm., length of abdomen when extended 37 mm. The ratio of the length of the carapace to its width is quite variable (Holmes). The length of the carapace of the Biological Survey specimens ranged from 10 to 25 mm., averaging about 17 mm.

Color.—A bluish or cinereous color above and yellowish white below; the fringing hairs are mostly black (Stimpson).

Type Locality.—California.

Distribution.—According to Holmes this species extends from Oregon to Panama. The collections in the U. S. National Museum range from Drake's Bay, California, to San Bartolomé Bay, Lower California, and from Peru to Chile. The intermediate region (from Lower California to Panama) is represented by *E. emerita* (Fabricius), which occurs also on the Atlantic side of tropical America (Rathbun).

Remarks.—The sand crab inhabits a strip of beach in or near the wash of the waves. Here it is distributed from the high-tide limit, for a given tide, to a short distance beyond the point where the waves strike the sand, but the center of abundance is that portion washed by each wave....

Although occasionally found singly, *Emerita* is essentially a gregarious animal. It occurs in large "beds," which are marked by small V-shaped ripples in the sand. Here, as Leidy has said of the eastern form, they are as thick as currants in plum pudding. If one turns over the sand of one of these beds he will find the sand crab in incredible numbers lying within a few inches of the surface. In these places adults and young of both sexes may be found associated. Generally mature females and males are at once distinguished by the difference in size.... For this reason collections often consist of females only, the smaller males being regarded as young. Measurements of the carapace of 27 specimens (length from rostrum to median posterior dorsal margin) of each sex collected at Pacific Grove give the following: average of males (all with enlarged genital papillae) 12.4 mm., range 10.5 to 14.5 mm.; average of females (all egg-bearing) 21.4 mm., range 17 to 25.5 mm. The males are without pleopods, while the second, third and fourth segments of the abdomen of the females are provided with them. The telson of the adult female is more heavily ciliated along its lateral margin and is somewhat wider than that of the male. The following are measurements of two typical specimens: female, length of carapace 20.3 mm., length of telson 13 mm., width of telson 6.9 mm., width 53% of length; male, length of carapace 11 mm., length of telson 7.6 mm., width of telson 3.3 mm., width 43% of length. (Weymouth and Richardson.)

Biological Survey of San Francisco Bay.—There are only three specimens of *Emerita analoga* in the bay collection: one, which was apparently alone, was dug up in the sand on the beach skirting the Presidio shore west of Fort Point; another was obtained while seining on the Fort Baker beach, and the third was taken, also in the seine, on the beach west of Blunt Point, on the southern shore of Angel Island. Owing to lack of more intensive sandy beach collecting no definite statements can be made regarding the distribution and occurrence of this species in the region covered by the survey.

Family PORCELLANIDAE

Body crab-like. Abdomen bent under and folded against the thorax; tail-fan well developed. First pair of legs chelate, moderately elongate, stout; fifth pair small and elevated so that they rest on the carapace.

KEY TO CALIFORNIA GENERA OF THE PORCELLANIDAE

I. Epimera (pleural, subbranchial, or lateral portions of the carapace) entire. Chelipeds equal or subequal, broad and flattened; carpus more or less elongated.

Petrolisthes, p. 178.

II. Epimera posteriorly broken up, the posterior portion of the subbranchial region subquadrate and separated from the larger anterior portion by a membranous or cutaneous interspace. Chelipeds unequal, thick, and more or less roughened; carpus short.

Pachycheles, p. 175.

Genus **Pachycheles** Stimpson

Carapace rounded, ovate, at least as broad as long, with lateral margins marked by an elevated line; front somewhat deflexed, a little prominent at the middle, and subacute, but never dentated, with its apex concealed by pubescence; epimera posteriorly broken up, the posterior portion of the subbranchial region subquadrate and separated from the larger anterior portion by a membranous or cutaneous interspace. First or basal joint of antennal peduncle produced and joined to the margin of the carapace; second joint at some distance from the orbit. Chelipeds unequal, thick, and more or less roughened, carpus short.

The species of this genus, listed below, in general appearance are all very much alike; the carapace is round-ovate; front short, depressed, and pubescent; chelipeds unequal, either the right or left the larger; carpus with two to three rows of the granules more prominent than the rest; ambulatory legs more or less pubescent on upper margin; propodi and dactyli spinulous below.

KEY TO THE CALIFORNIA SPECIES OF PACHYCHELES

I. Chelipeds rugose, granulated, and tuberculated above, and furnished with a prominent, naked, granulated tubercle on the median distal portion of the palm, near the gape of the fingers. Lateral (not terminal) plates of telson in one piece.

A. Chelipeds covered with a thick, dense, even, velvety pubescence, which also fills the gape between the fingers of the larger hand. (Santa Monica Bay to San Diego.)

holosericus, p. 177.

B. Chelipeds with only a few scattered, coarse hairs on upper surface, and with only a few if any in the gape of the fingers.

rudis, p. 176.

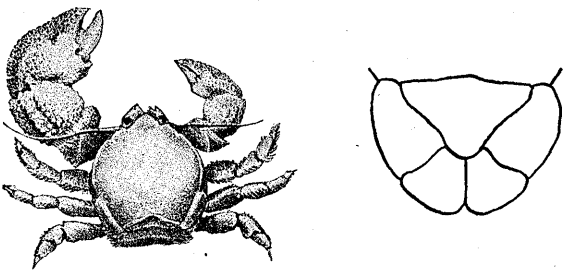
II. Chelipeds evenly rounded and not tuberculated above, quite uniformly granulated; granules hidden beneath a short, thick pubescence, interspersed with numerous tufts of longer hairs; gape between the fingers of the larger hand filled with a dense, bushy pubescence. Lateral plates of telson composed of two pieces, a small rounded proximal portion, and a large distal portion which alone constitutes the lateral plate of the other species of *Pachycheles* here listed. (Not found south of San Francisco Bay.)

pubescens, p. 177.

Pachycheles rudis Stimpson

Plate 33, figure 2

Pachycheles rudis Stimpson, Ann. Lyc. Nat. Hist. N. Y., 7, 76, pl. 1, fig. 5, 1859 (1860); Lockington, Ann. Mag. Nat. Hist. (5), 2, 394, 1878; Holmes, Occas. Papers Calif. Acad. Sci., 7, 109, 1900; Rathbun, H. A. E., 10, 168, pl. 6, fig. 6, 1904; Baker, Rep. Laguna Mar. Lab., 1, 102, 1912.



a *b*

Fig. 111. *Pachycheles rudis*, ♀; *a*, dorsal view, natural size (from Stimpson); *b*, telson, × 2.

Characters.—Chelipeds unequal, with a rugose, irregularly tuberculated and granulated upper surface, provided with a few scattered coarse hairs, of which only a few, if any, are to be found in the gape of the fingers of the larger hand. In the sulci between the granules there is a faint pubescence, which is scarcely evident to the naked eye and which never in the least obscures any of the granulations.

The large, prominent, granulated tubercle on the median distal portion of the palm is low and rounded, about as high as wide at the base, or less; occasionally several longitudinal lines of larger granules are evident behind the large tubercle but they are always more or less inconspicuous and never attain the prominence of those similarly placed in *P. holosericus*.

The immovable finger of the larger hand exceeds half the length of the movable one; on the cutting edge of the movable finger, near its base, there is a large, white bilobed or double tooth, while near the upper end of the cutting edge of the immovable finger there is a large tuberculiform tooth. The laminate anterior margin of the carpus is granulate along the edge, giving it a minutely denticulate appearance; rarely if ever is there any suggestion of larger teeth, other than the one comprising the entire laminate portion.

The telson is composed of five plates; a central (triangular), two terminal, and two lateral.

Dimensions.—Type, male: length of carapace 10.9 mm., width 11.7 mm.

Type Locality.—Monterey, California.

Distribution.—Kadiak, Alaska, to San Diego, California; Lower California (Lockington).

Pachycheles holosericus sp. nov.

Plate 33, figure 3

Description.—Chelipeds unequal, covered on upper surface with a dense, even, velvety pubescence, covering all but the more prominent tubercles and granules, which are arranged in three rows behind the large tubercle on the median distal portion of the palm and the tips and outer surfaces of the fingers, but filling the gape between the fingers of the larger hand. Pubescence in older specimens extends over the outer portion of the lower surface of the joints of the chelipeds.

There are two rows of granulated tubercles behind the large one near the gape of the fingers; one row of three or four lying in a line immediately behind it, and a second, usually of six, between this row and the row of sharply prominent granules, forming the upper edge of the outer margin of the palm. The large tubercle is approximately twice as high as wide at the base. On the cutting edge of the movable finger of the larger hand, near its base, is a single large, shining white tooth; the fixed or immovable finger is less than half the length of the movable one. The anterior, or inner margin of the carpus is laminate, and cut into a number of spine-tipped, deeply incised, laciniate teeth.

The telson, as in *P. rudis,* is composed of five plates: a central (triangular), two terminal, and two lateral.

The type specimen, a large ovigerous female (Cat. No. 50156, U. S. N. M.) was received from the Venice Marine Biological Station at Venice, California, under the number "Acc. 165." The carapace measures 18 mm. long and 19 mm. wide.

Distribution.—I have also seen specimens from Long Beach, Laguna Beach, La Jolla, and San Diego, California.

Pachycheles pubescens Holmes

Plate 33, figure 4

Pachycheles pubescens Holmes, Occas. Papers Calif. Acad. Sci., **7**, 110, 1900; Balss, Abh. der k. Bayer. Akad. Wiss., II, Math.-phys. Klasse, Suppl., 9 Abh., p. 32, figs. 22–23, 1913.

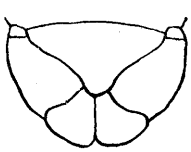


Fig. 112. *Pachycheles pubescens,* telson of large ♀, × 2.

Characters.—Chelipeds unequal, evenly rounded, not rugose or tuberculated, but quite uniformly granulated; granules completely or nearly hidden by the short, thick pubescence which covers the upper surface, extending almost to the tips of the fingers, filling the gape between them with a dense, bushy growth; interspersed are numerous tufts of longer, stiffer hairs, which arise from the anterior side of the bases of many of the granules.

On the cutting edge of the movable finger of the larger hand, near its base, there is a large, white, bilobed or double tooth; immovable finger is about half or less than half as long as the movable one. The laminate anterior edge of the carpus is cut into two to four roughly triangular teeth, armed with secondary denticles.

The telson composed of seven plates: a central (triangular), two terminal, and two lateral, each of which has a smaller plate separated off at its proximal end. These smaller plates together constitute a second pair of lateral plates which are characteristic of this species as compared with the other two listed above.

Dimensions.—Type: length of carapace 15 mm., width 15 mm.; of the largest specimen I have examined: length of carapace 18 mm., width 19 mm.

Type Localities.—Drake's Bay, Farallon Islands and Humboldt County, California.

Distribution.—From Port Orchard, Puget Sound, Washington, to Monterey Bay, California. I have seen specimens from both of these localities and Oakland, California, as well, where a single specimen was taken by Henry Hemphill. Misaki, Japan (Balss).

Genus **Petrolisthes** Stimpson

Carapace subovate; front triangular, with a more or less undulated margin, which may be either smooth or dentated; epimera (pleural, subbranchial, or lateral portions of the carapace) entire. First or basal joint of antennal peduncle very short, not reaching the upper margin of the carapace; the second joint is flattened and more or less cristate. Chelipeds equal or subequal, broad and flattened; carpus more or less elongated.

KEY TO THE CALIFORNIA SPECIES OF PETROLISTHES

I. Carpus of chelipeds about twice as long as wide, or less; minutely granulated or finely tuberculated, never very rough.

A. Carpus with parallel anterior and posterior margins, about twice as long as wide; upper surface with irregularly scattered small and tiny tubercles; lobe at inner margin if present never very prominent and not interfering with parallelism of margins. Carapace finely striated over entire surface, except in cardiac region; anterior branchial and gastric regions with small, irregularly placed tubercles, which scatteringly follow the areolations. Merus of ambulatory legs hairy.

eriomerus, p. 180.

B. Carpus of chelipeds with sides not parallel, with a prominent lobe at inner angle, and a distinct distal convergence of anterior and posterior margins, almost invariably one and one-half times as long as wide; surface of carpus granulated rather than tuberculated, anterior margin usually smooth, lobe at inner angle well granulated. Carapace similar to preceding, but with a longitudinal convexity greater and more pronounced than any of the species here listed. Merus of ambulatory legs not hairy.

cinctipes, p. 179.

II. Carpus of chelipeds about two and one-third times as long as wide, or longer; anterior and posterior margins subparallel; carpus either very smooth or very rough.

A. Carpus very smooth, punctate, or minutely and almost imperceptibly scaled or tuberculated, more than two and one-half times as long as wide. Carapace smooth and flattened, though distinctly areolated, minutely striated on branchial regions, tending to become punctate elsewhere, never tuberculate. Merus of ambulatory legs not hairy. (Not known north of Monterey.)

gracilis, p. 181.

B. Carpus rough, covered with overlapping, scale-like rugae, between two and one-third and two and one-half times as long as wide. Carapace strongly rugose, broken up into scale-like projections, most prominent anteriorly, anterior edges of rugae piliferous. Ambulatory legs very hairy. (Not known north of San Pedro.)

rathbunae, p. 181.

Petrolisthes cinctipes (Randall)

Plate 32, figure 1

Porcellana cinctipes Randall, Jour. Acad. Nat. Sci. Phila., **8**, 136, 1839.

Porcellana rupicola Stimpson, Jour. Boston Soc. Nat. Hist., **6**, 480, pl. 19, fig. 2, 1857.

Petrolisthes cinctipes Holmes, Occas. Papers Calif. Acad. Sci., **7**, 107, 1900; Rathbun, H. A. E., **10**, 168, 1904; Baker, Rept. Laguna Mar. Lab., **1**, 102, 1912.

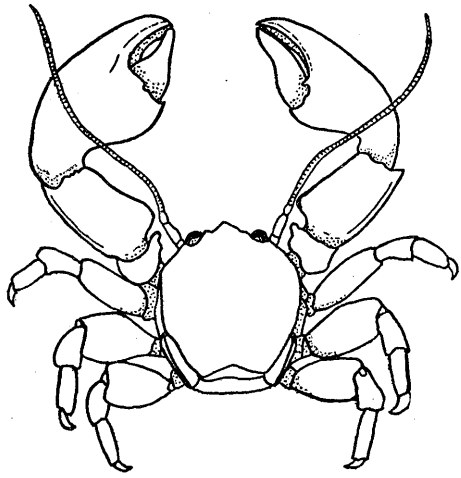


Fig. 113. *Petrolisthes cinctipes,* natural size.

Characters.—Carpus of chelipeds one and one-half times as long as wide, anterior and posterior margins distinctly convergent distally; anterior or inner margin with a prominent lobe at inner angle; general surface of carpus granulated rather than tuberculated; anterior margin usually smooth, lobe at inner angle well granulated. Carapace similar to *P. eriomerus* but with a greater and more pronounced longitudinal convexity. Merus of ambulatory legs not hairy.

Dimensions.—Type: length a little over 15.2 mm. Length of carapace of specimens collected in San Francisco Bay ranged from 2.5 to 13 mm., the greater number were about 11 mm. long.

Color.—Dark purplish red (Stimpson). Reddish brown anteriorly, blue posterolaterally; three posterior pairs of feet blue, fasciate with white (Randall).

Type Locality.—Sandwich Islands (doubtful).

Distribution.—From Vancouver Island, British Columbia, to the Gulf of California (Rathbun).

Remarks.—This species can always be distinguished by the short, stout carpus; by the fact that the merus joint of the ambulatory legs is not hairy and attains the greatest width, or dilation near the distal end, particularly in the third pair of legs. Baker states "the 'flat-crab' is common under stones between tides."

Biological Survey of San Francisco Bay.—This littoral species was only taken twice, one specimen among the rocks at Sausalito and four others in rocky places along the Richmond shore, north of the Standard Oil pier. Those from the latter locality are very small, juvenile specimens. *Petrolisthes cinctipes* is doubtless of more common occurrence than the above records, based on a very limited number of shore stations, seem to show, for Stimpson reported, "It is abundant in some parts of San Francisco Bay."

Petrolisthes eriomerus Stimpson

Plate 32, figure 2

Petrolisthes eriomerus Stimpson, Ann. Lyc. Nat. Hist. N. Y., **10**, 119, 1871; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 108, pl. 1, fig. 15, 1900.

Fig. 114. *Petrolisthes eriomerus,* cheliped (after Holmes).

Characters.—Carpus of chelipeds about twice as long as wide, anterior and posterior margins parallel, upper surface with irregularly scattered small and tiny tubercles; lobe at inner angle, if present at all, never prominent and not interfering with parallelism of margins. Carapace finely striated over entire surface, except in cardiac region; anterior branchial and gastric regions with small, irregularly placed tubercles, which scatteringly follow the areolations. Merus of ambulatory legs hairy.

Dimensions.—Largest of several specimens collected at Half Moon Bay, May 11, 1913, measured: length of carapace 10 mm., width 10.5 mm., length of carpus of cheliped 8 mm., width 3 mm.

Type Locality.—Mendocino, California.

Distribution.—From British Columbia to Lower California.

Remarks.—Differs from *P. cinctipes* in that the chelipeds are longer and smoother with narrower parallel-sided carpus, and in having hairy, less dilated merus joints of the ambulatory legs (Holmes).

Petrolisthes gracilis Stimpson

Plate 32, figure 4

Petrolisthes gracilis Stimpson, Ann. Lyc. Nat. Hist. N. Y., **7**, 74, 1859 (1862); Lockington, Ann. Mag. Nat. Hist. (5), **2**, 396, 1878.

Characters.—Carpus of chelipeds long and narrow, about three times, or nearly three times as long as wide, anterior and posterior margins subparallel; upper surface very smooth, punctate, or at most very minutely and inconspicuously (microscopically) scaled or tuberculated. Carapace smooth and flattened, though distinctly areolated, minutely striated on branchial regions, tending to become punctate elsewhere, never tuberculate. Merus of ambulatory legs not hairy.

Dimensions.—Type: length of carapace 11.2 mm., width 10.4 mm. Of specimens in the U. S. National Museum: length of carapace 10 to 15 mm., width 9.5 to 16 mm.

Color.—Reddish (Stimpson).

Type Locality.—Guaymas, Mexico.

Distribution.—Monterey, Santa Catalina Island, and Pacific Grove, California; Guaymas, Mexico.

Petrolisthes rathbunae Schmitt

Plate 32, figure 3

Petrolisthes rathbunae Schmitt (MS), Hilton, Jour. Ent. Zool., Pomona Coll., **8**, 72, fig. 6, 1916 (figure only, not specifically recognizable).

Description.—Entire animal quite rough, scabrous. Carapace strongly striated and rugose, rugae forming anteriorly directed scale-like projections and ridges, more pronounced at anterior end of carapace. Lines between rugae on carapace beset with short hairs, which are more thickly set on demarcation lines of areolations. Dorsal surface of carapace generally flat, with broadly triangular rostral process, sharply depressed from a line connecting the posterior margins of the orbits. Second segment of antennal peduncle slightly more than the length of the third, well scaled; segments of flagellum alternately furnished on lateral margins with long and short hairs. Upper and lower surface of chelipeds covered with squamiform tubercles, more prominent dorsally and on dorsal ridges. Carpus two and one-third to two and one-half times as long as wide, edges practically parallel, finely denticulated on anterior margin in adult; distinctly saw-toothed in young specimens. Posterior and ventral surface of carpus and entire merus covered with overlapping, scale-like rugae, which on carpus form a dorsal posterior ridge no rougher than general surface of carpus, and which ends distally in a tooth. The inner edge of the palm and outer edge of the movable finger are similarly scaled. Ambulatory legs and plates of abdomen scaled, as well as carpus, merus, and ischium of external maxillipeds. All joints of legs well beset with hairs, both edges of abdominal segments fringed with hairs, closely set short hairs interspersed with longer ones. Most hairy of west coast species of *Petrolisthes*.

Dimensions.—Type (Cat. No. 49176, U. S. N. M.), male: length of carapace 18 mm., width 17 mm., length of carpus of cheliped about 16 mm., width of carpus 6 mm.; of a female: length and width of carapace each 17 mm., length of carpus of cheliped 14 mm., width of carpus 5 mm.

Color.—A comparatively fresh specimen in formalin, received from Prof. W. A. Hilton, has a general ground color of salmon, fading out to a paler, more yellowish tint toward posterior edge of carapace, proximal portions of ambulatory

legs, and on under parts, becoming bluish white on sternum. Flagella of antennae transparent claret color. Larger scale-like projections of rugae on anterior portion of carapace and chelipeds spotted with brick red, the two to three spots of red to each of the scales on the carapace giving it an apparently tuberculated appearance. Hairs yellowish. A few scattered spots of brick-red occur on the first few abdominal segments.

Type Locality.—San Clemente Island, California (H. N. Lowe).

Distribution.—There are specimens in the United States National Museum from Monterey, Santa Monica, and San Pedro bays, and Santa Rosa, San Clemente, and Santa Catalina islands. I have also seen a specimen collected at Laguna Beach by Prof. W. A. Hilton of Pomona College.

Remarks.—This species has been named in honor and appreciation of Dr. Mary J. Rathbun, associate in zoology of the Smithsonian Institution.

In general appearance and coloration it resembles *P. agassizii* Faxon (Bull. Mus. Comp. Zool., 24, 174, 1893; Mem. Mus. Comp. Zool., 18, 69, pl. 15, fig. 1, 1895), but it is readily distinguishable in that it lacks the three teeth which are so prominent on the anterior border of the carpus of the chelipeds of that species.

Tribe BRACHYURA

KEY TO THE SUBTRIBES OF THE BRACHYURA

I. Mouth-field (endostome) triangular, narrowed in front, produced forward over epistome to form a gutter; efferent branchial channels opening at middle of endostome; third maxillipeds more or less narrow, not expanded into flat, lid-like structures as in other crabs. Carapace more or less circular. Female openings generally on sternum. First pleopods wanting in female.

Oxystomata, p. 185.

II. Mouth-field roughly square.

A. Last pair of legs abnormal, small, and subdorsal in position, as are often also the legs of the fourth pair. Antennae long, flagellum equal to more than one-half width of carapace; antennules without special fossettes; sometimes a common orbito-antennulary fossa present. Female openings coxal. First pleopods present in female. (Not known north of Monterey Bay.)

Dromiacea, p. 182.

B. Last pair of legs normal, rarely reduced, not dorsal. Antennae short, never equal to one-half width of the carapace; antennules usually lodged in special fossettes. Female openings sternal, rarely coxal. First pleopods wanting in female.

Brachygnatha, p. 191.

Subtribe DROMIACEA

KEY TO THE SUPERFAMILIES AND THE CALIFORNIA FAMILIES OF THE DROMIACEA

I. Sternum of female with a pair of obliquely longitudinal grooves. Eyes and antennules almost always retractile into common orbito-antennulary pits. Rudimentary uropods usually present. (Superfamily *Dromiidea.*)

Dromiidae, p. 183.

II. Sternum of female without longitudinal grooves. Eyes not retractile into orbits nor antennules into pits. Uropods never present. (Superfamily *Homolidea.*)

Homolidae, p. 183.

Family Dromiidae

Carapace subglobular, rarely flattened; no *lineae anomuricae* (a pair of longitudinal suture lines on the carapace); sternum of female traversed for more or less of its extent by two obliquely longitudinal grooves. Eyes and antennules almost always retractile into common orbito-antennulary pits. External maxillipeds generally operculiform. Legs of moderate size, fourth and fifth pairs short, subdorsal in position, and furnished with a small, hook-like nail. Sixth segment of abdomen generally with rudimentary uropods.

Genus **Dromidia** Stimpson

Carapace convex and pilose, the hair being often of considerable length; front narrow, hepatic regions more or less concave, or excavated anteriorly. Sternal sulci in the female approximated at their extremities in either a single or more or less bifurcated tuberculiform projection, situated between the bases of the chelipeds.

Dromidia larraburei Rathbun

Plate 33, figure 1

Dromidia sarraburei Rathbun, Proc. U. S. Nat. Mus., **38**, 553, pl. 48, fig. 4, 1910 (error for *larraburei;* named for Señor Don Carlos Larrabure y Correa).

Dromidia segnipes Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, p. 15, pl. 1, figs. 1–2, 1910.

Characters.—Densely covered with fur except ends of fingers and dactyli. Carapace high, subglobular; anterolateral margins directed toward the buccal angles and armed with four to six small teeth or tubercles; from the last tooth an oblique furrow runs across the branchial region; front vertical, tridentate. Chelipeds short, stout, equal; fingers deeply channeled inside, gaping at base. First and second pairs of ambulatory legs broad, dactyli with curved horny tip and a row of spines beneath; third and fourth pairs narrower, subdorsal, and prehensile, fourth shorter, dactyli strongly curved, fifth recurved, both folding against a spinous process on the propodus.

Dimensions.—Type, ovigerous female: length of carapace 28.2 mm., width 30 mm. Of specimens taken in Monterey Bay, by Weymouth, male: length of carapace 15 mm., width 15.7 mm., length of antennal flagellum 11 mm.; female: length of carapace 15.7 mm., width 16.3 mm., length of antennal flagellum 10 mm.

Color.—In alcohol yellowish tan, tips of chelipeds flesh color; color in life similar (Weymouth).

Type locality.—Bay of Sechura, west of Matacaballa, Peru, depth about 5 fathoms.

Distribution.—Also from Monterey Bay and Long Beach, California, Magdalena Bay, Lower California, and the Galapagos Islands, shallow water.

Family Homolidae

Carapace longer than broad, more or less quadrilateral, ovoid, or urn-shaped; *lineae anomuricae* (a pair of longitudinal suture lines on the carapace) usually present; sternum of female not longitudinally grooved. Eyes not retractile into orbits nor antennules into pits. External maxillipeds pediform or subpediform. Legs long and slender, only fifth pair dorsal and reduced in size. Uropods wholly absent.

Genus **Homola** Leach, Alcock

Carapace deep, longer than broad, more or less quadrilateral, or urn-shaped, with deep vertical sides; gastric region well demarcated and occupying the anterior half of the carapace; hepatic region well developed, hepatic (or anterolateral) spine some distance behind the level of the supra-orbital spine; *linea anomurica* distinct and dorsal; front narrow, forming a rostrum, which is either entire or bifid, and has a spine, often of large size, on either side of its base. Propodus of last pair of legs dilated near basal end and never twice the length of the dactyl.

Homola faxoni sp. nov.

Plate 31, figure 7

Description.—Carapace more or less quadrilateral, exclusive of rostral spine, a little longer than broad, greatest width at about posterior fourth of carapace; entire surface more or less obscured by a rather thick, short pubescence.

The supraorbital spines, one on either side of the base of the rostrum, are quite stout, surpassing the rostrum both in size and length, and each on its upper or posterior margin is provided with two small, hooked spines. Behind and a little closer together than the supraorbital spines there are two much less prominent ones on the anterior part of the gastric region. External to each of these there is a spine of like size, about in line with the tubercle on the apex of the gastric convexity and the superior hepatic spine at the anterolateral angle of the carapace; a tubercle also between the median gastric tubercle and the outermost of the anterior gastric spines, one on each side. The hepatic region is well developed and below the stout spine at anterolateral angle of the carapace there is a smaller, inferior hepatic spine. Marking the lateral margin of the dorsal surface of the carapace behind the superior hepatic spine is a row of four slightly smaller spines on the branchial region, paralleling the *linea anomurica*, and decreasing in size from before backward. There are sundry other tubercles rather regularly arranged in more or less definite groups on the various regions of the carapace.

Hairs covering chelipeds and legs longer than those on carapace; row of sharp, hooked spines on upper margin of merus of all except the last pair of legs, the largest of the series overhanging the articulation with the carpus at the superior distal angle of the joint; a spine, similarly placed, occurs on the merus of the last pair of legs; fingers of chelipeds one-third the entire length of the hand, and dark colored.

Abdomen also thickly pubescent, two basal segments, each armed with a sharp median tubercle.

Dimensions.—Type, female (Cat. No. 53331, U. S. N. M.): length of carapace, including rostrum 45 mm., of rostrum 5 mm., greatest width of carapace 36 mm., length of last leg to distal extremity of propodus 66 mm., of next preceding leg to distal extremity of merus 47 mm.

Type Locality.—Off Point Loma, 67 to 73 fathoms (''Albatross'' station 4309).

Distribution.—Only known from off Point Loma, about southwest eight to ten miles, 67 to 135 fathoms.

Remarks.—This species is most closely related to *Homola cuvieri* (Risso) (see Roux, Crust. Médit., p. 86, pl. vii, 1828, and Milne Edwards and Bouvier, Expéd. Sci. du *Travailleur* et *Talisman*, Crustacés décapodes, pt. 1, p. 10, 1910) of the

Mediterranean region, but the carapace is more quadrilateral, much more pubescent, and not so conspicuously and strongly granulated, being only finely and obscurely granulated beneath its pubescence.

In *H. cuvieri* the spines forming the lateral series on the branchial region behind the superior hepatic spine are six to eight in number, diminishing posteriorly to mere granulations; the inferior hepatic spine is the larger; there is a well defined median line of granulations containing two or three conspicuous spiniform tubercles, extending between the inner pair of the anterior gastric spines toward the rostrum, of which no counterpart exists in *H. faxoni;* also the legs of *H. cuvieri* are more slender and less flattened, the merus of the fourth leg, for example, measured on the flat, dorsally-turned side being almost seven times as long as wide, while the same joint in *H. faxoni* is only about five and one-half times as long as wide.

This species apparently belongs to the subgenus *Paromola* Alcock (1901, p. 61), but has a longer fifth leg than his definition admits; to be included that portion of Alcock's characterization would have to be slightly changed.

From the only other homolid of this subgenus on the west coast of America, *Homola* (*Paromola*) *rathbuni* Porter (Rev. Chilena Hist. Nat., **12**, 88, pl. viii, 1908), our species differs in having a more quadrilateral carapace and longer fifth legs as compared with Prof. Porter's figure, which was unaccompanied by a description owing to loss of the type by fire.

Subtribe OXYSTOMATA

Key to the California Families of the Oxystomata

I. Abdomen hidden under thorax; antennae small; legs normal in size and position. Carapace rounded and crab-like.

A. Afferent openings to gill chambers lie in front of the chelipeds; maxillipeds not completely closing buccal cavern, the palp always exposed. (Not known north of the Farallones.)

Calappidae, p. 190.

B. Afferent openings to gill chambers lie on either side of mouth at base of third maxillipeds; maxillipeds not completely closing buccal cavern, the palp hidden by triangular merus. (Not known north of Mendocino County.)

Leucosiidae, p. 187.

II. Abdomen not hidden under thorax; antennae large; last two pairs of legs reduced in size and articulated higher than preceding pair, so as to lie on dorsal surface of body, subprehensile, with hook-like end joints. Afferent openings to gill chambers near bases of the chelipeds. Carapace short and subcircular or more or less squarish. (Not known north of Santa Catalina Island or possibly Monterey.)

Dorippidae, p. 185.

Family Dorippidae

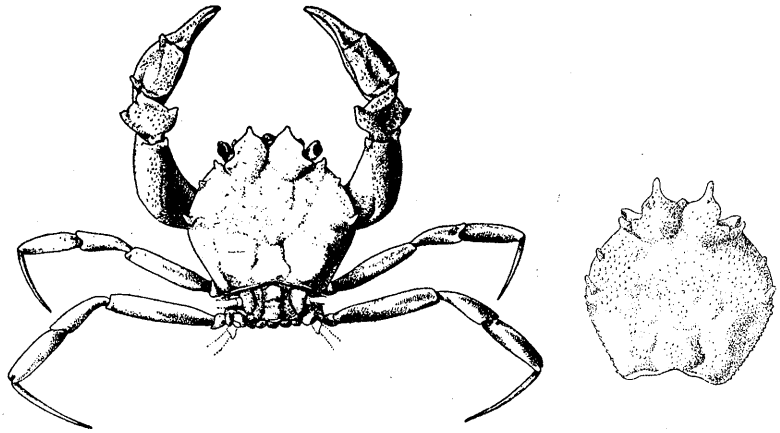
Abdomen not hidden under thorax. Carapace short, subcircular, or more or less squarish. Antennae large. Last two pairs of legs reduced in size and articulated higher than preceding pair, so as to lie on dorsal surface of body, subprehensile, with hook-like end joints. Afferent openings to gill chambers near bases of the chelipeds.

Genus **Cyclodorippe** Milne Edwards and Bouvier

Carapace subcircular; efferent (excurrent) openings to gill chambers contiguous, in a common channel which extends to the frontal margin. Antennules free and long; antennal peduncle narrow. No flagellum on the exopodites of the third maxillipeds. Eyes present, eye-stalks short and stout. Male and female genital openings coxal.

Cyclodorippe plana Rathbun

Cyclodorippe plana Rathbun, Amer. Nat., 34, 519, 1900.
Clythrocerus planus Rathbun, H. A. E., 10, 168, pl. 9, fig. 4, 1904; Nininger, Jour. Ent. Zool., Pomona Coll., 10, 36, figs. 9 and 10, 1918.



a *b*

Fig. 115. *a, Cyclodorippe plana*, ♂, × 6; *b, Cyclodorippe*, ♂, sp.?, × 6 (from Rathbun, U. S. N. M.).

Characters.—Carapace subcircular, a little broader than long; dorsally flat, finely granulate, granules larger toward outer margin; the front is occupied by two triangular lobes, each tipped with a blunt tooth; lobes separated from each other by a broad ∨-shaped sinus, which is prolonged on dorsal surface by a broad, shallow depression continued to the gastric region; outer margin of each lobe slightly concave; outer orbital tooth narrow, blunt, well marked. A little in front of middle of lateral margin is a tooth somewhat larger than the orbital, directed forward and slightly outward; at one-third the distance from orbital to this branchial tooth is a much smaller triangular tooth directed outward. Anterior end of buccal cavern and of merus of outer maxillipeds project slightly in front of median sinus of front.

Dimensions.—Type, male: length of carapace to end of horns 3.4 mm., width 3.7 mm.; female: length 2.8 mm., width 3 mm.

Color.—Carapace speckled with small black spots, in alcohol (Rathbun).

Type Locality.—Southern California, either at Catalina or Monterey, doubtless the former, as another specimen has since been collected there.

Distribution.—The U. S. National Museum has recently received four other specimens, an ovigerous female taken off Point Fermin in 10 fathoms by the Venice Marine Biological Station, and two males and an ovigerous female collected at Laguna Beach by W. A. Hilton.

Remarks.—Another male (fig. *b* above) dredged at Santa Catalina Island in 1863 by Dr. J. G. Cooper, measuring 4.3 mm. long to end of horns and 4.2 mm. wide, differs notably from the more typical forms in the following particulars: "The frontal lobes are prolonged in cylindrical blunt spines; the upper orbital margin has an inner rectangular sinus, while the fissure next the outer tooth is larger than in the typical form; the first tooth of the lateral margin is nearer the posterior tooth, than it is to the orbital tooth; the surface is more uneven, and more coarsely granulate. The legs are absent. I think the differences are not those of age, and indicate a distinct species, to which, however, I hesitate to give a name on account of the poor condition of the specimen" (Rathbun, 1904*a*, p. 169).

... these crabs surely receive their full share of attention in the aquarium. They persist in carrying about upon their backs pieces of shell, pebbles, sticks, fragments of seaweed, or entire shells with their living contents, and seem much embarrassed without some such covering. When placed in a glass dish where nothing else was available, one seized a snail shell more than twice its own size and seemed perfectly content when it had this firmly gripped upon its back. They are found in 15–20 fathoms of water on gravel and shell beds. The two rear pairs of legs are peculiarly modified into upturned hooks for gripping objects carried on their backs. And the dorsal surface of the carapace is reduced to a plane (Nininger).

Family Leucosiidae

Carapace crab-like; more or less rounded, very hard, afferent (incurrent) openings to gill chambers lie on either side of mouth at base of third maxillipeds. Third maxillipeds completely close the buccal cavern; the three terminal joints (constituting palp) wholly concealed by the triangular fourth (merus) joint. Antennae small. Legs normal in size and position. Abdomen hidden under the thorax. Male and female genital openings sternal.

Genus **Randallia** Stimpson

Carapace strongly convex, subhemispherical, evenly rounded at sides, with two lobes or teeth at posterior margin. Front narrow, very short, with a concave anterior margin. Merus of third maxillipeds subtriangular, not much shorter than the ischium, reaching nearly as far forward as the front. Chelipeds rather long; merus subcylindrical; hand narrow; fingers acute and somewhat compressed. Ambulatory legs of moderate length; joints not dilated; dactyls styliform.

Key to the California Species of Randallia

I. Carapace of adult nearly smooth, sensibly longer than wide; space between posterior median pair of spines or tubercles less than between median and lateral. Young with unequal, more or less rough tubercles.

ornata, p. 188.

II. Carapace covered with large, pearly, beadlike, more or less equal tubercles; carapace suborbicular, but slightly longer than wide; space between posterior median pair of spines or tubercles greater than between median and lateral. (Not known north of San Diego.)

bulligera, p. 189.

Randallia ornata (Randall)

Ilia ornata Randall, Jour. Acad. Nat. Sci. Phila., **7**, 129, 1839.

Randallia ornata Stimpson, Jour. Boston Soc. Nat. Hist., **6**, 471, pl. 19, fig. 3, 1854; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 100, 1900; Rathbun, H. A. E., **10**, 170, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, p. 18, pl. 1, fig. 3, 1900; Baker, Rep. Laguna Mar. Lab., **1**, 102, 1912.

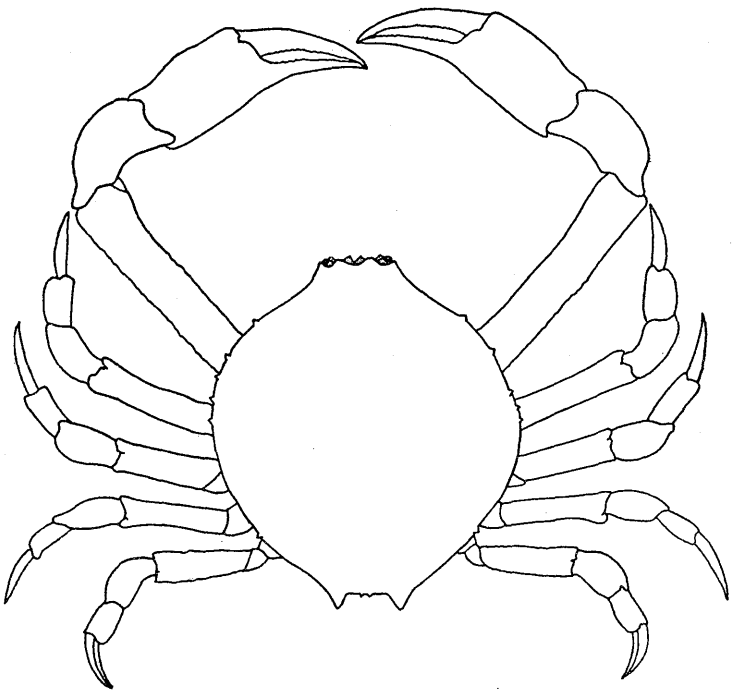


Fig. 116. *Randallia ornata,* natural size.

Characters.—Carapace of adult nearly smooth, but furnished anteriorly with a few scattered granules and a few larger granulations at the sides; sensibly longer than wide; there is a small tubercle on the posterior portion of the branchial region; posterior margin of carapace elevated, granulated and furnished with two pointed tubercles; space between posterior median pair of spines or tubercles less than between median and lateral. Young with quite numerous, unequal and more or less rough tubercles.

Dimensions.—Type, female: length 30.5 mm. The carapace of the only specimen taken in connection with the Survey was 43 mm. in length.

Color.—Disk variegated with sanguineous spots confluent anteriorly; anterior feet variegated with red (Randall). The carapace is of a light color marbled with reddish patches which are larger in front (Holmes).

Type Locality.—California.

Distribution.—From Mendocino County, California, to Magdalena Bay, Lower California; 5½ to 51 fathoms (Rathbun).

Remarks.—Varies greatly in the prominence of the granules on the carapace (Rathbun).

Biological Survey of San Francisco Bay.—One specimen of *Randallia ornata* was taken outside of San Francisco Bay in 10 to 30 fathoms, April 6, 1914, while making several experimental trials with a 40-foot otter-trawl.

Randallia bulligera Rathbun

Randallia bulligera Rathbun, Proc. U. S. Nat. Mus., **21**, 614, pl. 44, fig. 6, 1898; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 101, 1900; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, p. 19, 1910.

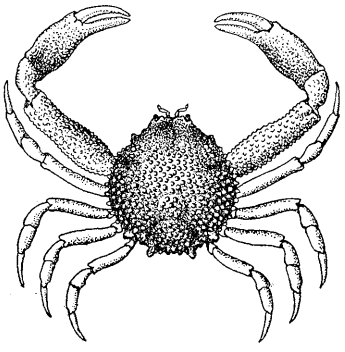


Fig. 117. *Randallia bulligera*, ♂, × 1⅔ (from Rathbun, U. S. N. M.).

Characters.—Carapace covered with large, pearly, bead-like, more or less equal tubercles; carapace suborbicular, but slightly longer than wide; space between posterior median spines or tubercles greater than between the median and lateral. Anterolateral angles of the buccal cavity produced in front of the orbital margin and deeply three-lobed.

Dimensions.—Type, male: length on median line 11.6 mm., width 11.5 mm.; ovigerous female: length 12.8 mm., width 12.6 mm.

Color.—Much as in *R. ornata.*

Type Locality.—Magdalena Bay, Lower California, 12 fathoms.

Distribution.—Off San Diego, California, 30 fathoms (Holmes), and Magdalena Bay, Lower California, 12 fathoms (''Albatross'' station 2831) (Rathbun); Monterey Bay, 10 fathoms (Weymouth).

Remarks.—I am inclined to think that the specimens called *R. bulligera* by Weymouth are especially rough-coated young of *R. ornata.* For as Holmes remarks the former is ''easily distinguished from *ornata* by the numerous beadlike tubercles on the carapace and the lobes at the anterior end of the buccal area.''

Family CALAPPIDAE

Carapace rounded, crab-like; afferent (incurrent) openings to gill chambers lie in front of the chelipeds. Third maxillipeds do not completely close the buccal cavern; palp of maxillipeds always exposed. Antennae small. Legs normal in size and position. Abdomen hidden under the thorax. Male genital openings coxal, female sternal.

Genus **Mursia** Leach, Desmarest

Carapace strongly convex, transversely oval, with a strong lateral spine on each side; front narrow. Chelipeds large; when folded fitting close to the body; hands large, compressed distally, widened, surmounted by a laminate and dentate crest, and furnished with a longitudinal, granulated ridge near the lower side of the outer surface.

Mursia gaudichaudii (Milne Edwards)

Platymera gaudichaudii Milne Edwards, Hist. Nat. Crust., **2**, 108, 1837; Milne Edwards and Lucas, *in* D'Orbigny's Voy. dans l'Amér. Mér., **6**, pt. 1, p. 28, 1843, pl. 13, 1847; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 99, 1900; Rathbun, H. A. E., **10**, 170, 1904.

Mursia gaudichaudii Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 19, 1910.

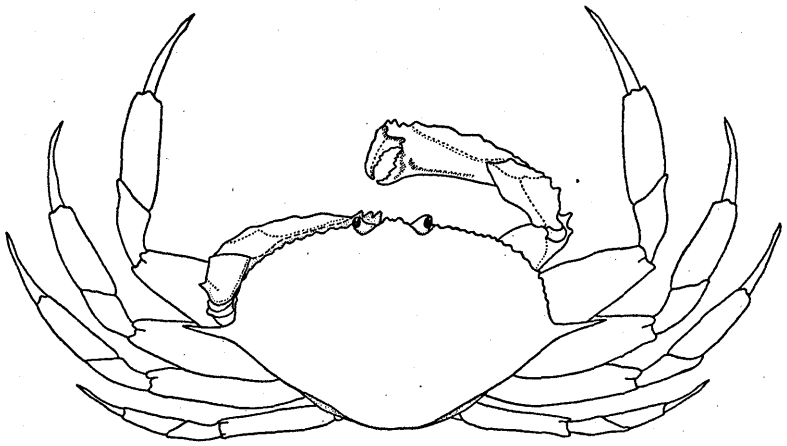


Fig. 118. *Mursia gaudichaudii* (after Milne Edwards and Lucas).

Characters.—Carapace strongly convex; anterior margin of front truncated and strongly concave when seen from in front; postorbital tooth very small; anterolateral margin regularly arcuated, armed with about fifteen small teeth separated by concave interspaces; lateral spine large, straight, subcylindrical. Hands of chelipeds furnished with several small tubercles on outer surface; ridge on lower portion of outer surface very large, bearing a small tooth near proximal

end; superior crest more or less hairy, armed with six teeth; there is a granulated ridge on the lower side of hand; immovable finger short, subtriangular, flattened, depressed; outer margin of movable finger prominent, granulated, when closed is at right angles to the palm.

Dimensions.—Type: length 76.2 mm.; of specimen examined by Holmes: length of carapace 41 mm., width between tips of lateral spines 79 mm., length of lateral spine 12 mm.

Color.—Reddish (Milne Edwards).

Type Locality.—Coast of Chile.

Distribution.—From the Farallon Islands, California, to Chile; 26 to 218 fathoms.

Subtribe BRACHYGNATHA

KEY TO THE SUPERFAMILIES OF THE BRACHYGNATHA

I. Fore part of body narrow, usually forming a distinct pointed or spined rostrum; carapace more or less triangular, branchial region inflated, hepatic small. Orbits usually incomplete.
Oxyrhyncha, p. 191.

II. Fore part of body broad; rostrum usually reduced or wanting; carapace usually wide, oval, round or square, never with hepatic region greatly reduced. Orbits nearly always well enclosed.
Brachyrhyncha, p. 216.

Superfamily OXYRHYNCHA

KEY TO THE CALIFORNIA FAMILIES OF THE OXYRHYNCHA

I. Chelipeds rarely much greater than other legs, very mobile. Basal joint of antennae well developed, usually fused with epistome and often with the front. Orbits usually more or less incomplete.
Inachidae, p. 192.

II. Chelipeds very much longer and heavier than other legs, not especially mobile. Basal joint of antennae small, short, and not fused with epistome or front. Orbits well formed, complete. (Not known north of the Gulf of the Farallones.)
Parthenopidae, p. 191.

Family PARTHENOPIDAE

Basal joint of antennae (more correctly the coalesced second and third joints) small and short, not fused with the epistome or front, imbedded with the next joint in the narrow hiatus between the front and the inner suborbital angle; infra-ocular space is mainly occupied by the lower wall of the orbit. Orbits well formed, complete. Chelipeds much longer and heavier than other legs, not especially mobile.

Genus **Heterocrypta** Stimpson

Carapace triangular, transverse, lateral margins greatly produced and concealing the ambulatory legs; a conspicuous depression separating gastric from cardiac and branchial regions; rostrum simple; pterygostomian region with a strongly marked ridge. Chelipeds greatly developed, trigonal.

Heterocrypta occidentalis (Dana)

Cryptopodia occidentalis Dana, Amer. Jour. Sci. (2), **18**, 430, 1854.
Heterocrypta occidentalis Holmes, Occas. Papers Calif. Acad. Sci., **7**, 44, 1900; Rathbun, H. A. E., **10**, 170, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 21, pl. 2, figs. 4–5, 1910.

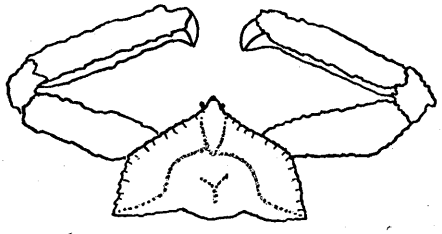


Fig. 119. *Heterocrypta occidentalis*, ♂, × ⅘ (after Dana).

Characters.—Carapace broadly triangular; rostrum triangular, subacute, not depressed; median region narrow, flattened upper surface bounded by two granulated ridges, which converge to a point behind; cardiac region furnished with a three-sided, pyramidal elevation, edges of which are usually granulated; posterior margin of carapace not produced over the abdominal segments. Outer portion of orbit with a superior and an inferior fissure. Chelipeds long, trigonal; hand about as long as merus, angles prominent and dentate, sides concave; immovable finger short, deflexed; movable finger short but longer than immovable one, when closed its outer margin nearly at right angles to the long axis of the hand.

Dimensions.—Type: width of carapace 31.8 mm.

Color.—Reddish (Holmes). Tips of tubercles white, ridges bearing tubercles a light purplish hue, remainder of carapace mottled with numerous minute spots of white and purplish tint, giving a pink effect which closely approaches white. Ambulatory legs usually a light yellow (Weymouth).

Type Locality.—Monterey, California.

Distribution.—From Gulf of the Farallones to San Diego, California, and Los Coronados Islands; 13 to 36 fathoms (Rathbun).

Family INACHIDAE (MAIIDAE)

Basal joint of antennae (more correctly the coalesced second and third joints) well developed, usually fused with the epistome and often with the front, usually occupying a great part of the infra-orbital space. Orbits usually more or less incomplete. Chelipeds rarely much greater than other legs, very mobile.

KEY TO THE CALIFORNIA GENERA OF THE INACHIDAE

I. Basal joint of antennae extremely slender throughout its length and usually long. Length of basal antennal joint, measured from raised margin of endostome to insertion of free joints, greater than or at least equal to the combined width of the joints and that portion of the epistome or antennular fossettes lying between them, measured from bases of eye-stalks (middle of lower orbital margin). Eyes without orbits and not concealed. Rostrum simple except in *Oregonia*, in which it is bifid.

A. Rostrum simple.

1. Postocular spine small and distant from the eye or absent.

a. Chelipeds fairly short and stout, dactyl about one-half total length of hand, no supraocular spine. Carapace not spiny, elongate, pyriform, narrowed in front; hepatic region tumid, with two not very prominent tubercles, the larger above and in front of the smaller. (Not known north of Monterey Bay.)

Podochela, p. 195.

b. Chelipeds long and slender, dactyl about one-fourth total length of hand; a prominent supraocular spine. Carapace spiny. (Not known north of Monterey.)

Anasimus, ♂, p. 196.

2. Postocular spine prominent and close to eye. Chelipeds moderately short and stout, dactyl about one-half total length of hand.

a. A prominent acute, supraocular spine. Carapace spiny. A low tubercle or spine on first abdominal joint. (Not known north of Monterey.)

Anasimus, ♀, p. 196.

b. Upper margin of orbit prominent, but without supraocular spine. Carapace furnished with tubercles and granulations. A prominent spine-like tubercle on first abdominal joint. (Not known north of Monterey Bay.)

Inachoides, p. 199.

B. Rostrum bifid, composed of two long, slender, contiguous spines. Postocular spine prominent, slender, acute, inclined forward and situated some distance behind orbit. Chelipeds rather slender, dactyl about one-half total length of hand. (Not known south of Monterey Bay.)

Oregonia, p. 198.

II. Basal joint of antennae not extremely slender, often very wide. Length of basal antennal joint less than distance between lower orbital margins; usually in the proportion of two to three. Rostrum bifid except in *Epialtus,* where it may be either bifid or simple.

A. Basal joint of antennae truncate-triangular. Eyes without true orbits, eye-stalks very short, either concealed beneath a supraocular spine, or sunk in the sides of a huge beak-like rostrum. Postocular spine, if present, with anterior face convex or flattened so that cornea of retracted eye is always visible from above. Exognath of outer maxillipeds widest in distal half, tapering abruptly.

1. Antennae concealed beneath the rostrum. Lateral margins of carapace not markedly flattened or produced. Surface of carapace smooth or undulated. Rostrum bifid or simple.

Epialtus, p. 200.

2. Antennae not concealed beneath the rostrum. Rostrum bifid.

a. Lateral margins of carapace not markedly flattened or produced; with two large lobes or teeth on each side; upper surface with spines or tubercles.

Pugettia, p. 205.

b. Lateral margins of carapace markedly flattened and produced, entire lateral portions of carapace wing-like; upper surface smooth or nearly so.

Mimulus, p. 204.

B. Basal joint of antennae usually either extensively produced outward or with one or more distal spines. Eyes with orbits. Postocular spine cupped, or with dense growth of hair on anterior face so that cornea of retracted eye is partially concealed from above. Exognath of outer maxillipeds widest in basal half, tapering gradually. Rostrum bifid.

1. No preocular spine.
   a. Carapace but slightly longer than wide; surface uneven, tuberculated or spiny. Rostrum short, flattened, and notched.
   Chionoecetes, p. 209.
   b. Carapace much longer than wide; surface smooth, devoid of spines. Rostrum composed of two narrow, divergent spines, united basally, for half their length. (Not known north of San Pedro.)
   Pelia, p. 210.
2. A preocular spine.
   a. Postocular spine flattened and densely hairy on anterior face. Carapace with numerous or very prominent tubercles or spines. Rostrum bifid. (Not known north of Point Reyes.)
   Loxorhynchus, p. 212.
   b. Postocular spine deeply cupped on anterior face and without hairs.
      i. Rostrum composed of two long, slender, straight, cylindrical spines, diverging from the base. Carapace pyriform, inflated, and covered with sharp spines of unequal length.
      Chorilia, p. 208.
      ii. Rostrum composed of two short, flattened horns.
         a. Rostral horns extremely flattened and leaf-like, about one-quarter length of carapace. Orbits deep. Outer margin of basal antennal joint flattened and produced, not spiny. Carapace subpyriform, furnished with rounded tubercles.
         Scyra, p. 213.
         b. Rostral horns very short, one-ninth to one-tenth length of carapace. Orbits shallow. Outer margin of basal antennal joint not produced, spiny. Carapace suborbicular, tuberculated. (Not known north of Monterey Bay.)
         Herbstia, p. 215.

As can be seen from a review of the above key, the genera of the Inachidae arrange themselves into two major groups, based on the proportions of the basal antennal joints. In order to facilitate the presentation of generic definitions, they are so grouped below:

I. Basal joint of antennae extremely slender throughout its length and usually long; length measured from raised margin of endostome to insertion of free joints greater than or at least equal to the combined width of the joints and that portion of the epistome or antennular fossettes lying between them, measured from bases of eye-stalks (middle of lower orbital margin). (Group II, p. 200.)

Genus **Podochela** Stimpson

Carapace somewhat depressed, elongate triangular; gastric region narrow, swollen. Rostrum short, entire, triangular or arcuate; basal article of antennae very narrow, longitudinally sulcate in the middle. Eyes projecting laterally; postorbital tooth remote from eye, either well developed or reduced to a granule. Sternum of male either nearly smooth or deeply channeled between the segments; of female concave, deep, margins elevated, laminate, forming a capsule. Abdomen of male with last two segments and of female with last three segments coalesced, counting telson. Chelipeds of moderate length, merus curved, trigonal; palm either slender or dilated. Ambulatory legs slender, subprehensile.

Podochela hemphillii (Lockington)

Microrhynchus hemphillii Lockington, Proc. Calif. Acad. Sci., **7**, 30, 1877.
Podochela hemphillii Holmes, Occas. Papers Calif. Acad. Sci., **7**, 17, 1900; Rathbun, H. A. E., **10**, 171, pl. 10, fig. 2, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, p. 26, pl. 2, fig. 6, 1910; Nininger, Jour. Ent. Zool., Pomona Coll., **10**, 39, fig. 14, 1918.

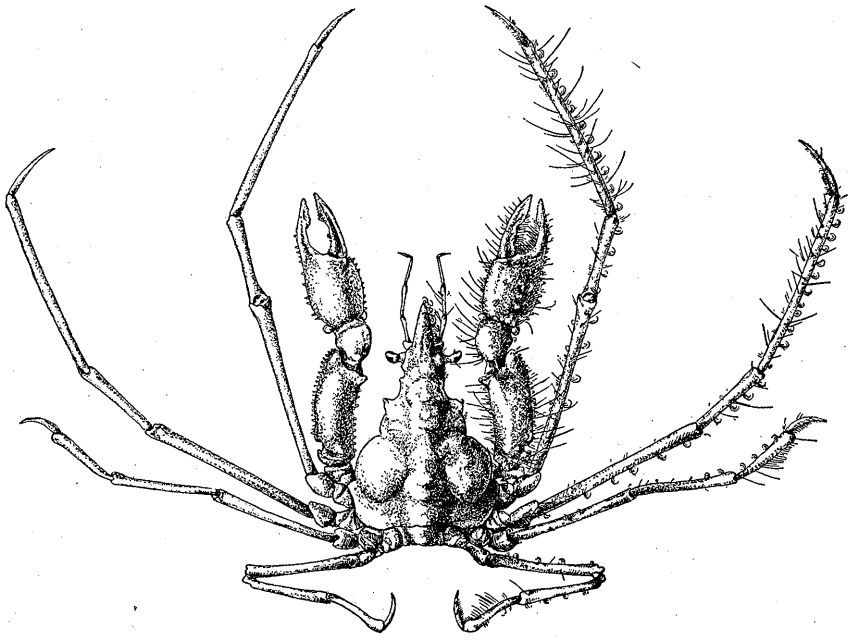


Fig. 120. *Podochela hemphillii*, ♂, × 1¼ (from Rathbun, U. S. N. M.).

Characters.—Carapace pyriform; gastric region prominent, rounded, and bearing tufts of curved setae; hepatic regions tumid, bearing two not very prominent tubercles, the larger above and in front of the smaller; cardiac region separated by shallow grooves from the branchial and bearing a prominent elevation; branchial regions flattened or tumid. Rostrum variable in length, sometimes broadly, sometimes narrowly triangular, acute, and bearing two double rows of

curved setae above. No supraocular tooth or spine; the area between the two projecting rims of the orbits is concave; there is no tooth at the posterior margin of orbit, but there may be a small one a short distance behind it. Basal joint of antennae with a longitudinal ridge on its posterior half or two-thirds with a groove on either side. Chelipeds of male robust; hand oblong, incurved, palm inflated, fingers shorter than the palm, gaping at base and meeting along distal half or two-thirds of their length; chelipeds of female are smaller and more slender; hands subcylindrical, fingers nearly straight.

Dimensions.—Type, male: length 19.1 mm., width 8.4 mm.

Type Locality.—San Diego, California.

Distribution.—From Monterey Bay, California, to Gulf of California. Recorded from 8 to 47 fathoms, and perhaps occurs in shallower water (Rathbun).

Remarks.—This species was fairly common among the masses of red seaweed dredged from a depth of 10–20 fathoms. They are marked with reddish brown, but are always so covered over with decorative fragments of seaweed that even their form is almost indistinguishable. In the aquarium these creatures were very interesting. Their principal occupation was that of decorating themselves. Seizing a fragment near one end, that end was thrust into the mouth and chewed for some time, then transferred to some part of the carapace or legs, and by means of a peculiar and oft repeated twisting movement of the head [hand?] it was so firmly fastened that it would under almost all circumstances remain in the position in which it had been placed. The chewing led us to suspect a cementing element in the saliva, but on examination of the carapace it was found that each piece of seaweed was impaled on several of the stiff recurved hairs which occur in clumps over the carapace and legs (Nininger).

Genus **Anasimus** Milne Edwards

Carapace pyriform, convex, regions well defined; rostrum simple, slender; postorbital and supraorbital spine present. Basal article of antennae long and narrow, with spine at distal end. Abdomen and sternum granulate. Ambulatory legs very slender, decreasing more or less in length from first to fourth pairs, about twice, or more than twice, the length of the carapace; dactyls long.

Anasimus spinosus (Rathbun)

Erileptus spinosus Rathbun, Proc. U. S. Nat. Mus., **16**, 227, 1893; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 21, 1900; Rathbun, H. A. E., **10**, 171, pl. 10, fig. 1, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, p. 27, pl. 3, fig. 7, 1910.

Anasimus rostratus Rathbun, Proc. U. S. Nat. Mus., **16**, 226, 1893; H. A. E., **10**, 171, pl. 10, fig. 4, 1904.

Characters.—Carapace spinous; two spines on the median line, one on posterior part of gastric region, the other on cardiac; there are two spines on each branchial region and one on each protogastric region; lateral margins spinulous; rostrum slender, spinulous on margin; supraorbital spine prominent; postorbital spine in male small and at some distance from the eye, in female prominent and close to eye, defining the orbit. Chelipeds of male long and slender, about three times as long as carapace; hand slender, slightly flattened vertically, increasing in width toward distal end; fingers arched, gaping for one-half their length; dactyl about one-fourth total length of hand. Chelipeds of female weak, about one and one-half times as long as carapace; hands granulous; fingers nearly as long as palm (about one-half total length of hand), not gaping, in contact.

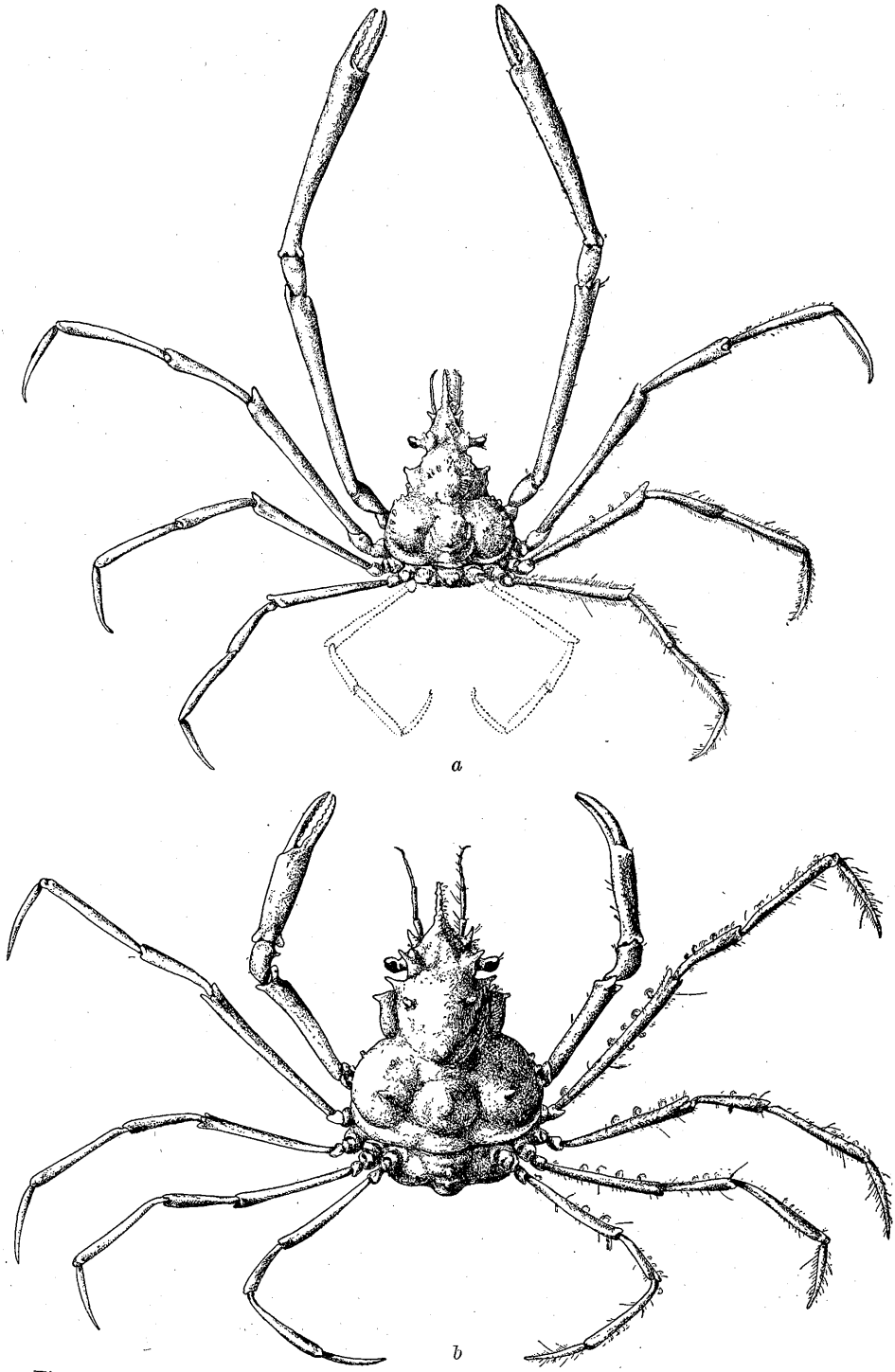


Fig. 121. *Anasimus spinosus; a*, ♂, × 3⅜; *b*, ♀, × 5 (from Rathbun, U. S. N. M.).

Dimensions.—Types, male: length 10 mm., width 6 mm., length cheliped about 28 mm.; female: length 7.5 mm., width 5 mm.

Type Locality.—Off San Diego, California, 36 fathoms ("Albatross" station 2934).

Distribution.—Monterey Bay or Santa Catalina Island; and from San Pedro to San Diego, California, to a depth of 36 fathoms; also northwest of Cerros Island, Lower California, 58 fathoms.

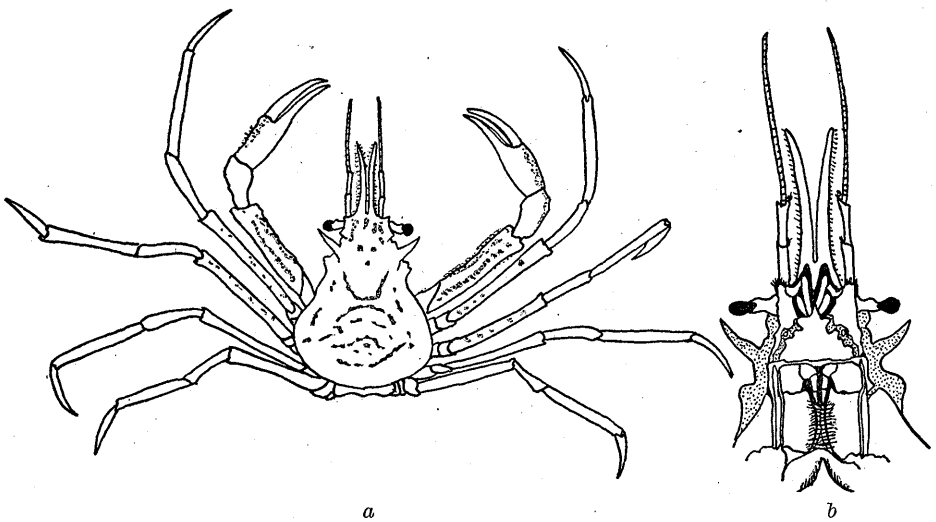
Remarks.—It is through the kindness of Miss Rathbun that I am able to here unite *Anasimus* and *Erileptus*. In working over material of these genera collected by the Venice Marine Biological Station she discovered their identity; *Erileptus spinosus* proved to be the male of *Anasimus rostratus*.

Genus **Oregonia** Dana

Carapace flattened, not spinose. Rostrum consisting of two long, slender, contiguous spines. Postocular spine present, prominent. Chelipeds rather slender, length variable. Ambulatory legs of moderate length, penultimate joint similar to preceding one, not dilate and compressed.

Oregonia gracilis Dana

Oregonia gracilis Dana, Amer. Jour. Sci. (2), **11**, 270, 1851; Crust. U. S. Expl. Exped., **1**, 106, 1852, pl. 3, fig. 2, 1855; Doflein, S. B., Math.-phys. Klasse, K. Abh. der Bayer. Akad. Wiss., **29**, 183, 1899; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 19, 1900; Rathbun, H. A. E., **10**, 171, 1904; Way, Puget Sd. Mar. Sta. Publ., **1**, 369, fig. 20, 1917.



a *b*

Fig. 122. *Oregonia gracilis*, ♂; *a*, dorsal view, × ⅘; *b*, ventral view of anterior portion, × 1⅗ (after Dana).

Characters.—Carapace subtriangular, more or less setose and roughened by minute prominences; median, cardiac, and branchial regions tumid. Rostrum bifid, composed of two long, slender, contiguous spines; postocular spine prominent, slender, acute, inclined forward and situated some distance behind the orbit.

Chelipeds rather slender; hand long, slender, smooth, incurved; dactyl about one-half total length of palm.

Dimensions.—Type, male: length of carapace 30.2 mm., width 21.2 mm. The specimen taken outside of Golden Gate measured, carapace and rostrum over all, 28 mm.

Color.—Tan or gray, with dots and small markings of red; color however cannot be seen until decorative material is removed (Way).

Type Locality.—Puget Sound.

Distribution.—From Bering Sea at Nunivak and Bering Island, to Monterey Bay; 5 to 135 fathoms. Japan (Balss).

Biological Survey of San Francisco Bay.—Oregonia gracilis though not taken in connection with any of the regular bay stations was obtained in July, 1912, by Mr. Johnston while observing the trawling operations of the A. Paladini Company on the fishing grounds outside of Golden Gate (approximately located in the general vicinity of D 5785–5787, 39 to 41 fathoms). The only temperature records available for the fishing grounds were made in October of the same year when the bottom temperature ranged from 9.8° to 11.0° C, and the salinity 33.8 to 34.2.

Genus **Inachoides** Milne Edwards and Lucas

Carapace longer than broad, cardiac, branchial and gastric regions swollen. Rostrum short and simple, with triangular base terminating in a spine; basal article of antennae with an antero-external tooth. No supraocular spine, post-ocular present, usually well developed and directed forward. Merus of outer maxillipeds cut at the antero-internal angle for the insertion of the palp; antero-external angle rounded. Abdomen of male with last two segments and of female with last three segments coalesced, inclusive of the telson; first segment armed with a spine or spine-like tubercle. Chelipeds enlarged, palms swollen; ambulatory legs slender, moderately long, first pair longest; subprehensile, propodal joints more or less enlarged distally; dactyls curved, folding against the propodi.

Inachoides tuberculatus (Lockington)

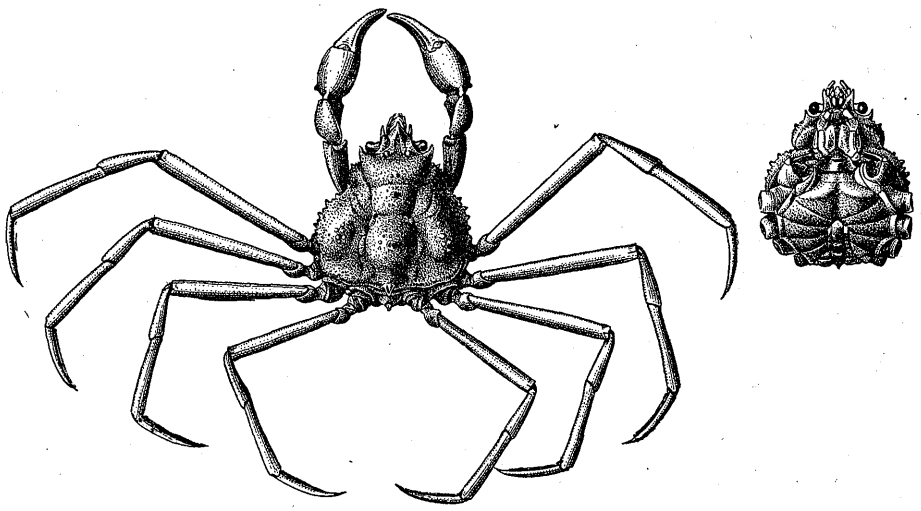
Inachus tuberculatus Lockington, Proc. Calif. Acad. Sci., 7, 30, 1877.

Inachoides magdalenensis Rathbun, Proc. U. S. Nat. Mus., 16, 228, 1893; H. A. E., 10, 171, 1904.

Dasygyius tuberculatus Holmes, Occas. Papers Calif. Acad. Sci., 7, 27, 1900; Rathbun, H. A. E., 10, 172, fig. 92, pl. 10, figs. 3, 3*a*, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 27, pl. 3, fig. 8, 1910.

Characters.—Carapace broadly triangular, pyriform, convex; surface granulate and tuberculate, with fine pubescence; tubercles tend to become spinous on lateral margins and on summit of branchial regions; on median line there is a spiny tubercle on the posterior part of gastric region, and a stout, spine-like tubercle on cardiac and on intestinal region. The median spines present in adult males become tuberculate in females and in smaller specimens, and the gastric tubercle is often absent. There is also a shorter spine-like tubercle on first

abdominal segment, pointing upward and backward. Rostrum acute; tips of post-orbital spines pointing forward; upper margin of orbit prominent but without supraocular spine. Basal antennal joint with outer margin prolonged into a slightly incurved spine. Sternum conspicuously granulate, or tuberculate, pubescent, deeply grooved between segments. Chelipeds of male short, rather stout, granulate; hand broad, inflated; fingers nearly as long as palm, gaping at base. Chelipeds of female more slender than in male; margins of hand parallel; fingers slightly gaping.



a *b*

Fig. 123. *Inachoides tuberculatus*, ♂, × 1½; *a*, dorsal; *b*, ventral view (from Rathbun, U. S. N. M.).

Dimensions.—Types, male: length 19.1 mm., width 14 mm.; female: length 14.2 mm., width 9.7 mm.

Type Locality.—San Diego Bay, California.

Distribution.—From Monterey Bay, California, to Panama Bay, Panama, 4 to 45 fathoms (Rathbun).

Remarks—Inachoides magdalenensis and *Dasygyius tuberculatus* are apparently one and the same species, and at Miss Rathbun's suggestion I have here combined them.

II. Basal joint of antennae not extremely slender, often very broad; length less than the distance between lower orbital margins, usually in the proportion of two to three. (Group I, p. 194.)

Genus **Epialtus** Milne Edwards

Carapace smooth or slightly tuberculated; margins not incised, with two or more lateral projections, sometimes very largely developed. Rostrum broad, triangular or oblong, bifid, or two spined, or entire. Basal antennal joint enlarged at base and narrowing distally; flagellum of antennae concealed beneath the rostrum. Preocular spine present or absent. Ambulatory legs stout, subcylindrical.

KEY TO THE CALIFORNIA SPECIES OF EPIALTUS

I. First tooth of the anterolateral margin large and prominent. Sides of carapace in front of posterior lateral teeth nearly parallel.

A. Rostrum obtuse, triangular, entire; no postocular spine. (Not known north of Monterey or Catalina Harbor.)
bituberculatus, p. 203.

B. Rostrum bifid, a small postocular spine, and a small triangular preocular spine.
productus, p. 201.

II. First tooth of the anterolateral margin small, not prominent. Sides of carapace convergent anteriorly between the two pairs of lateral teeth. Rostrum prominent, depressed, flattened above and having a small, triangular notch at the tip. No preocular spine, postocular small. (Not known north of Santa Barbara.)
nuttallii, p. 202.

Epialtus productus Randall

Epialtus productus Randall, Jour. Acad. Nat. Sci. Phila., **8**, 110, 1839; Rathbun, R., The Fisheries and Fishery Industries of the U. S., sec. 1, 778, pl. 268, 1884; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 22, pl. 1, fig. 1, 1900; Rathbun, H. A. E., **10**, 173, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 28, fig. 9, 1910; Baker, Rep. Laguna Mar. Lab., **1**, 100, 1912.

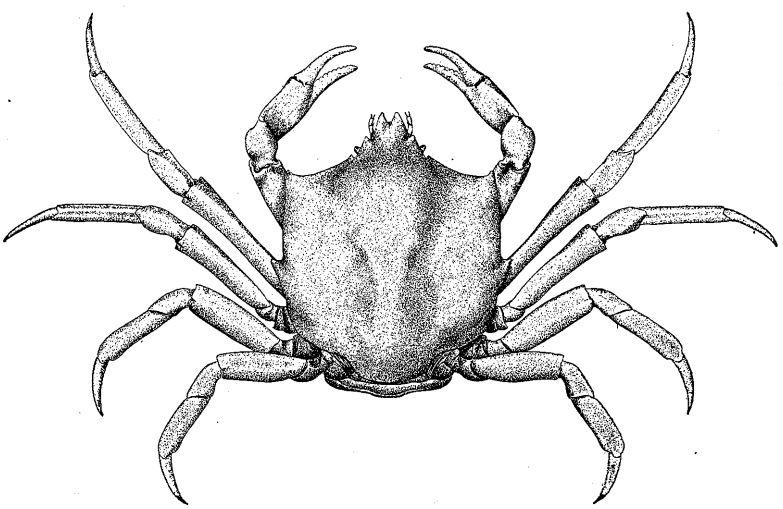


Fig. 124. *Epialtus productus*, × about ⅔ (from Rathbun, R., U. S. N. M.).

Characters.—Carapace smooth, sides in front of posterior lateral teeth nearly parallel; first tooth of anterolateral margin large and prominent. Rostrum bifid, deeply notched, inner margins of the horns slightly concave, outer convex. Preocular spine small, triangular; postocular also small. Chelipeds stouter and except in old males shorter than first ambulatory legs; hand long and narrow, palm oblong, subcarinate above, becoming inflated with age; fingers slender, bent

downward and curved inward, inner margins dentate and contiguous throughout their length, except in old males, in which they may become more or less gaping at the base.

Dimensions.—Type, female: length of carapace, inclusive of rostrum, about 44.5 mm. Large male: length, tip of rostrum to back of carapace 170 mm., width at first anterolateral tooth 84 mm., length of chelipeds 195 mm.; large female: length 92 mm., width 78 mm., length of chelipeds 90 mm. (Weymouth). Length of carapace for the Bay specimens ranged from 3 to 67 mm., mostly about 25 mm.

Color.—In life color varies from dark brown to tan, the lighter shades being found in young and apparently recently moulted individuals, in which also the dark spots mentioned by Holmes are inconspicuous or absent. Under parts reddish, often bright brick red, sometimes with light markings on the coxae of the ambulatory legs and on the external maxillipeds (Weymouth). Color reddish brown to olive brown, mottled with small, round spots of a darker hue (Holmes).

Type Locality.—California.

Distribution.—From British Columbia to Lower California (Rathbun).

Remarks.—There may be small, setose tubercles on the median region of young specimens, but they disappear with age, and there are two rows of curved setae on the upper side of the rostrum which persist for a longer time. Old specimens are almost devoid of hairs or setae of any kind (Holmes).

The young of the "kelp crab" are very common in the tide pools, clinging to *Fucus* and other brown algae, but mature specimens are found only in the kelp beds (Baker).

Biological Survey of San Francisco Bay.—Epialtus productus was only found in or near large patches of kelp: four fairly large specimens were taken August 1, 1912, below the low tide mark, from the extensive beds east of Point Bonita; one very large, one medium sized, and nine very small specimens, all told, were obtained on various occasions from the more or less abundant growths of kelp along the Sausalito shore; and one small specimen was dredged in 2 to 3 fathoms (D 5778), in the vicinity of the kelp patches off the rocky portions of the Presidio shore, east of Fort Point.

Epialtus nuttallii Randall

Epialtus nuttallii Randall, Jour. Acad. Nat. Sci. Phila., **8**, 109, pl. 3, 1839; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 23, 1900; Rathbun, H. A. E., **10**, 173, 1904.

Characters.—Carapace ovate, convex, smooth; first tooth of anterolateral margin small, not prominent, sides of carapace convergent anteriorly between the two pairs of lateral teeth. Rostrum prominent, depressed, flattened above, and having a small triangular notch at the tip. No preocular spine, postocular small.

Dimensions.—Type, male: length of carapace about 101.6 mm., inclusive of rostrum, greater width a little over 76.2 mm., female but half the size.

Color.—Dark purplish color, besprinkled with testaceous spots, becoming large and somewhat ocellate behind, and still larger and brighter on the under side of the body (Randall).

Type Locality.—California.

Distribution.—From Santa Barbara to Ballenas Bay, Lower California (Rathbun).

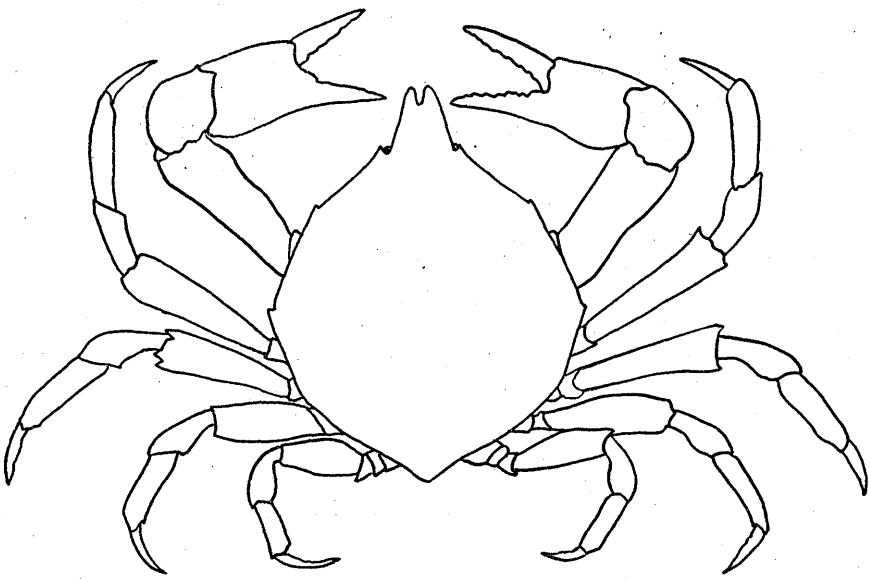


Fig. 125. *Epialtus nuttallii*, ♀, × ⅔ (after Randall).

Epialtus bituberculatus Milne Edwards

Epialtus bituberculatus Milne Edwards, Hist. Nat. Crust., **1**, 345, pl. 15, fig. 11, 1834; Rathbun, Bull. U. S. Fish. Comm., **20**, pt. 2, 60, 1900 (1901); H. A. E., **10**, 173, 1904.

Fig. 126. *Epialtus bituberculatus*, natural size (after Milne Edwards).

Characters.—Carapace subpentagonal, with two tubercles on gastric region and two lateral teeth or lobes very variable in shape and relative size. In the typical form the lobes are separated by a shallow sinus, the carapace is distinctly wider at the posterior lobe; the rostrum is triangular, obtuse, and entire. In the varieties the width at the hepatic region may equal that at the branchial region, the anterior lobe is much more prominent, and may be either broad and obtuse or narrow and spiniform. Sometimes one lobe or both has a tubercle on its anterior margin. The rostrum varies in length and shape, and may be either triangular or oblong, entire or emarginate, sometimes constricted near the base. In the typical form the preocular teeth are obsolete but are present though small in some of the varieties; postocular tooth wanting. Abdomen of male with fourth and fifth segments fused. Chelipeds variable; hand in typical form wide, of moderate length, widening slightly toward distal end; movable finger with a tooth near its base; in the varietal forms the hand may be cristate, widening rapidly toward the fingers.

Dimensions.—Types: length from 6.4 to 8.5 mm.

Type Locality.—Coast of Chile.

Distribution.—Southern California (either Catalina Harbor or Monterey) to Chile; Indian River, Florida, to Rio de Janeiro; Bermudas (Rathbun). A specimen has also been collected at Laguna Beach, California, by W. A. Hilton.

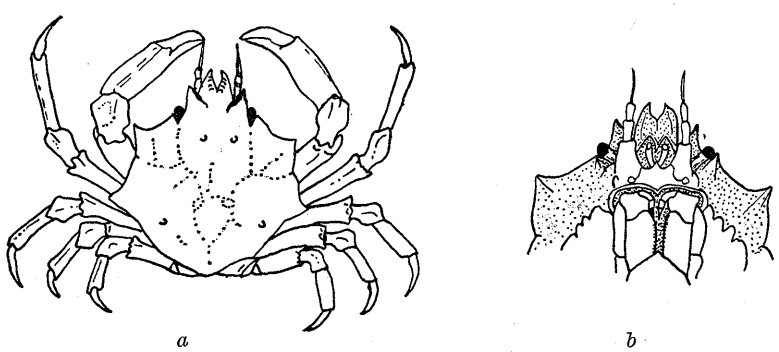
Remarks.—Should be readily recognizable by its small size, as compared with *E. productus,* and by its entire rostrum.

Genus **Mimulus** Stimpson

Carapace flattened, smooth or nearly so, more or less pentagonal; lateral portions laminate, much produced, wing-like, anterolateral margin cut by a narrow fissure into two closely approximate lobes. Rostrum short, bifid, horizontal. Basal antennal joint enlarged at base and narrowing distally. Orbits incomplete below, but furnished above with a preocular and postocular spine. First pair of ambulatory legs exceeding others.

Mimulus foliatus Stimpson

Mimulus foliatus Stimpson, Ann. Lyc. Nat. Hist. N. Y., 7, 200, pl. 3, fig. 1, 1860 (1862); A. Milne Edwards, Crust. Rég. Mex., pt. 5, p. 145, pl. 18, fig. 4, 1879; Holmes, Occas. Papers Calif. Acad. Sci., 7, 23, 1900; Rathbun, H. A. E., 10, 173, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 30, pl. 4, figs. 12–13, 1910.



a *b*

Fig. 127. *Mimulus foliatus,* ♂; *a,* dorsal view, × about 1⅓; *b,* ventral view of anterior portion, × about 2 (after Milne Edwards).

Characters.—Carapace flattened and marked with several undulations; lateral expansions a little reflexed, margin behind incision nearly twice the length of that in front; anterolateral and posterolateral angles wide, latter somewhat produced; median region tumid, and bearing two small obsolescent tubercles, in front of which there may be two rows of curved setae; posterior part of branchial region also with an obsolescent tubercle. Rostral horns short, flattened, with convex outer margins, the notch between them narrowly triangular and setose; on upper side of rostrum there are two double rows of curved setae. Preocular tooth large, triangular, acute; postocular small and pointing obliquely downward, separated by a fissure from preocular. Chelipeds of male large; hand oblong, fingers bent downward and curved inward, somewhat gaping near base, distally dentate;

chelipeds of females and young males relatively smaller; fingers contiguous and dentate along entire inner margin. Abdomen of female elliptical, seven-jointed, counting telson; of male, widest at third segment, narrowing rapidly to fifth which is about equal to sixth, telson narrow and longer than preceding joint.

Dimensions.—Type, male: length of carapace 27.9 mm., width 33.8 mm.; of specimen examined by Holmes, length of carapace 30 mm., greater width 32 mm.

Color.—A dull purplish tone, the legs crossed by light bands (Holmes). The young and even mature (egg-bearing) individuals show considerable variation in color, being in general tan or light reddish with the lateral expansions and marks on the cardiac region lighter in some cases, almost white. One specimen had the entire surface of the carapace, except the rostrum, the abdomen and the chelipeds clear white, while the remainder of the legs and rostrum were bright red. The legs in the majority show more or less distinct banding. The adults are often partially covered by a growth of bryozoa or sponges (Weymouth).

Type Locality.—Monterey, California, taken from the stomach of percoid fishes, "Cabesones."

Distribution.—From Unalaska, Alaska, to Mazatlan, Mexico (Rathbun).

Genus **Pugettia** Dana

Carapace with upper surface furnished with spines or tubercles; margins behind eyes produced into an alate expansion, behind which it is somewhat constricted. Rostrum two-spined. Basal antennal joint enlarged at base and narrowing distally; flagellum of antennae not entirely covered by the rostrum. Preocular spine present, large.

Key to the California Species of Pugettia

I. Postorbital projection a triangular tooth.

A. Hepatic expansion very wide (postocular spine and first anterolateral tooth united by a leaf-like expansion of the carapace). Merus of chelipeds with a prominent, irregularly dentate carina on the upper side, carpus cristate. Ambulatory legs with merus and propodus more or less carinated above. Ischium of maxillipeds with a longitudinal groove, exognath also grooved.

gracilis, p. 206.

B. Hepatic expansion narrow, transverse (postocular spine and first anterolateral tooth acute and distinct). Merus of chelipeds bears a few tubercles on the upper side but no carina; the inner side may become strongly ridged in adult males, but it is generally rounded in young males and females, the carpus has two or three carinae, which become more or less prominent in old males. Ambulatory legs with merus and propodus not crested. Surface of ischium of maxillipeds plane, but sometimes bearing a trace of a longitudinal groove, exognath not grooved.

richii, p. 207.

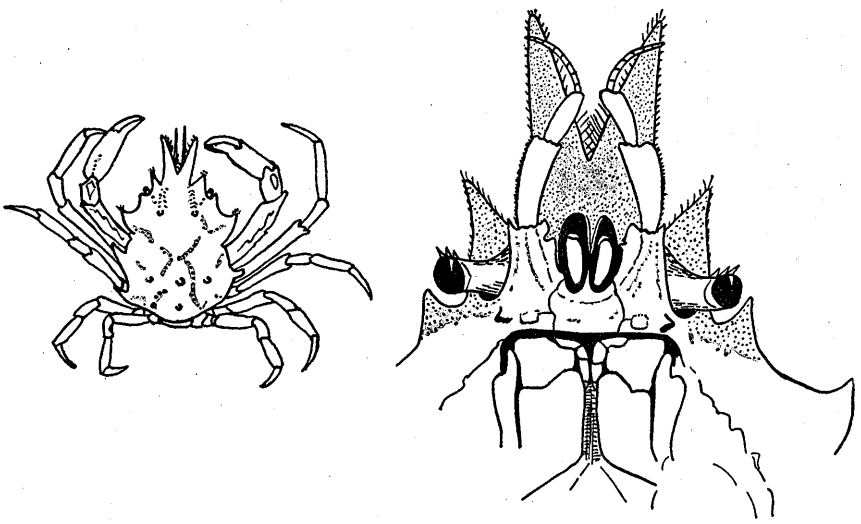
II. Postorbital projection an obtuse lobe. Merus of chelipeds with an irregular carina on the upper and inner margins, carpus strongly carinated on the inner and upper margins, and irregularly ridged on outer side. Ambulatory legs with joints not carinated. Ischium of maxillipeds grooved. (Not known north of San Pedro.)

dalli, p. 208.

Pugettia gracilis Dana

Plate 33, figure 7

Pugettia gracilis Dana, Amer. Jour. Sci. (2), **11**, 268, 1851; Crust. U. S. Expl. Exped., **1**, 117, 1852, pl. 4, fig. 3, 1855; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 25, 1900; Rathbun, H. A. E., **10**, 173, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 29, pl. 4, fig. 10, 1910; Way, Puget Sd. Mar. Sta. Publ., **1**, 370, fig. 21, 1917.



a *b*

Fig. 128. *Pugettia gracilis*, ♂; *a*, dorsal view, × 4/5; *b*, ventral view of anterior portion, × 3 1/5 (after Dana).

Characters.—Carapace lyrate to broadly ovate, tuberculated; number and position of tubercles similar to *P. richii*, except middle anterior tubercle is small and sometimes obsolete, and cardiac tubercle may become scarcely visible in old specimens. Rostrum less prominent than in *P. richii*. Preocular tooth quite broad, postocular tooth triangular, acute, and pointing more nearly forward than in *P. richii*. Hepatic expansion very wide, postocular spine and first anterolateral tooth united by a leaf-like expansion of the carapace; posterior margin of first anterolateral tooth nearly longitudinal. Posterolateral tubercle smaller than in *P. richii*. Ischium of maxillipeds with a longitudinal groove; exognath also grooved. Merus of chelipeds with a prominent, irregularly dentate carina on upper side; carpus cristate.

Dimensions.—Type, female: 33.9 mm., width across from tip to tip of lateral spines 23.9 mm.

Color.—Of dorsal surface usually greenish brown, and of ventral side much lighter; but specimens found among red algae are a brilliant red (Way).

Type Locality.—Puget Sound.

Distribution.—From Aleutian Islands to southern California, low tide to 40 fathoms (Rathbun).

Remarks.—In the figure given above, the left side of the carapace shows posteriorly an abnormal occurrence of a second spine.

Pugettia richii Dana

Plate 33, figure 6

Pugettia richii Dana, Amer. Jour. Sci. (2), **11**, 268, 1851; Crust. U. S. Expl. Exped., **1**, 118, 1852, pl. 4, fig. 4, 1855; Holmes, Occas. Papers Calif. Acad. Sci., 7, 24, 1900; Rathbun, H. A. E., **10**, 173, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 30, pl. 4, fig. 11, 1910.

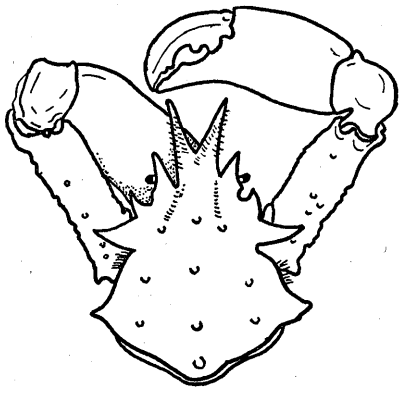


Fig. 129. *Pugettia richii*, ♂, dorsal view of carapace and chelipeds, × 4/5 (after Dana).

Characters.—Carapace ovate, tuberculated; median region tumid and furnished with four tubercles, the three anterior of which are nearly abreast (median one a little in advance of the others); two double rows of curved setae in front of lateral tubercles, and two similar rows on the rostrum; cardiac and intestinal regions each with a tubercle; two tubercles on branchial region, one before the other. Rostrum prominent, horns divaricate and convex above, triangular notch between them hairy. Preocular tooth acute and directed forward, outward and upward; postocular acute and triangular. Hepatic expansion of carapace narrow, transverse, postocular and first anterolateral tooth acute and distinct; at posterolateral angle of carapace there is a prominent pointed tubercle. Surface of ischium of maxillipeds plane, but sometimes bearing a trace of a longitudinal groove; exognath not grooved. Chelipeds large in adult males, much shorter and more slender in females; the merus bears a few tubercles on the upper side but no carina, but it is generally rounded in young males and females; the carpus has two or three carinae which become more or less prominent in old males; hands compressed, upper edge acute; fingers shorter than the palm, and gaping at the base in old males.

Dimensions.—Type, male: length of carapace 48.7 mm., width between tips of teeth across gastric region 32.6 mm., width between tips of teeth across cardiac region 36 mm. Large male: from tip of rostrum to back of carapace 40 mm., width between the tips of the posterior teeth 30 mm. (25 mm. between their bases) (Weymouth).

Color.—In life red, varying from bright to dark, and often closely matching certain of the encrusting corallines (Weymouth).

Type Locality.—California.

Distribution.—British Columbia to San Diego, California, low tide (Rathbun).

Pugettia dalli Rathbun

Plate 33, figure 5

Pugettia dalli Rathbun, Proc. U. S. Nat. Mus., **16**, 232, 1893; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 26, 1900; Rathbun, H. A. E., **10**, 173, pl. 2, figs. 1, 1*a*, 1904.

Characters.—Carapace subtriangular, tuberculated; tubercles on gastric region much as in *P. richii* but anterior and posterior tubercles are small and obsolescent; a large tubercle on the cardiac region and one on the intestinal; branchial regions without areolations; there is an upturned spine on the posterolateral margin; on the hepatic region there is a slender transverse spine, curved slightly forward. Rostrum similar to that of *P. richii* but more slender, widely divergent. Preocular tooth acuminate; postocular tooth is thin, obtuse, its upper surface flattened and inclined downward at an angle of about forty-five degrees. Ischium of maxillipeds grooved. Chelipeds of male large; merus with an irregular carina on upper and lower margins; carpus strongly carinated on inner and upper margins and irregularly ridged on the outer side; hand large, wider than in *P. richii,* upper edge acute, fingers strongly gaping at base, meeting only at tips, a tooth on movable one near base; chelipeds of female smaller, hand narrower, fingers not gaping at base. Ambulatory legs much more slender than in specimens of *P. richii* of equal size.

Dimensions.—Type, male: length of carapace 11 mm., width without spines 6.5 mm., length of cheliped 13 mm., width of hand 3.3 mm.

Type Locality.—Southern California.

Distribution.—From San Pedro, California, to San Geronimo Island, Lower California; 6½ to 30 fathoms (Rathbun).

Remarks.—This species is much smaller than *P. richii,* which is found in the same localities, and it is at once distinguished from the latter by the hepatic region; in *P. richii* it is dilated in two flattened, horizontal spines, while in *P. dalli* it is furnished with one slender spine and a flattened obtuse oval tooth not horizontal (Rathbun).

Genus **Chorilia** Dana

Carapace pyriform, inflated, and spiny. Rostrum composed of two long, slender, straight, cylindrical spines, diverging from the base. Basal antennal joint large, furnished distally with a spine; flagellum usually exposed and visible from above at the sides of the rostrum. Preocular spine prominent, acute; postocular acute, deeply cupped on anterior face, and without hairs. Ambulatory legs elongated, subcylindrical, unarmed; first pair usually much the longest.

Chorilia longipes Dana

Chorilia longipes Dana, Amer. Jour. Sci. (2), **11**, 269, 1851; Crust. U. S. Expl. Exped., **1**, 91, 1852, pl. 1, fig. 5, 1855.
Hyastenus longipes Rathbun, Proc. U. S. Nat. Mus., **16**, 85, pl. 7, 1893.
Hyastenus (*Chorilia*) *longipes*, Holmes, Occas. Papers Calif. Acad. Sci., **7**, 33, 1900.
Chorilia longipes Rathbun, H. A. E., **10**, 174, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 33, pl. 6, fig. 16, 1910.

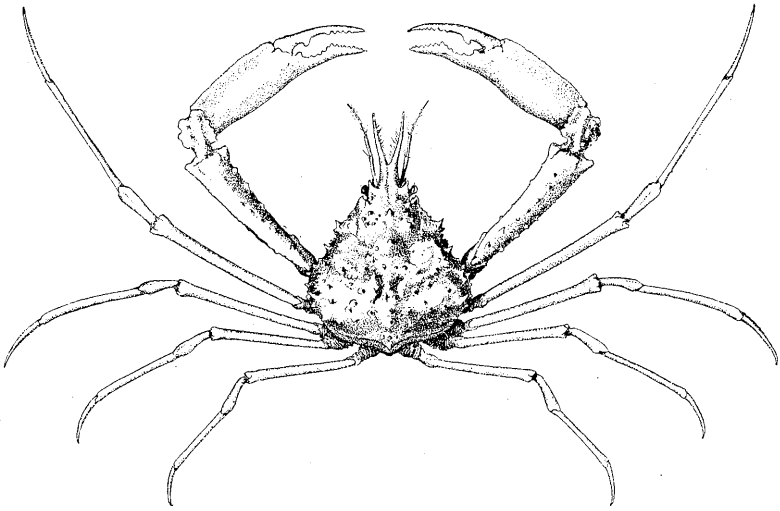


Fig. 130. *Chorilia longipes*, ♂, × nearly ½ (from Rathbun, U. S. N. M.).

Characters.—Carapace covered with sharp spines of unequal length. Rostrum long, spines nearly straight, pubescent, and divergent. Basal antennal joint armed at its external angle with a slender spine, with two smaller spines on margin behind it. Postocular spine points obliquely downward. Hands of chelipeds long, slender, compressed; palm subcarinated above, nearly smooth, and generally having a small tubercle on the outer side near the articulation; fingers long and slender. Legs and many parts of the body are covered with a short pubescence.

Dimensions.—Type, female: length of carapace 40.2 mm., greatest width 21.2 mm.

Type Locality.—Oregon.

Distribution.—From lat. 57° N, off Kadiak, Alaska, to lat. 32° N, off San Diego, California; 27 to 603 fathoms.

Genus **Chionoecetes** Krøyer

Carapace broad, depressed, more or less tuberculated or spinose. Rostrum short, flattened, notched, not depressed. Basal antennal joint very narrow, with a terminal spine; flagellum short. No preocular spine; postocular present; orbits shallow, open above so that the short, thick eye-peduncles are visible from above when retracted. Ambulatory legs more or less compressed.

Chionoecetes tanneri Rathbun

Chionoeccetes tanneri Rathbun, Proc. U. S. Nat. Mus., **16**, 76, pl. 4, figs. 1–4, 1893; H. A. E., **10**, 174, 1904; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 40, 1900; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 35, pl. 7, fig. 19, 1910.

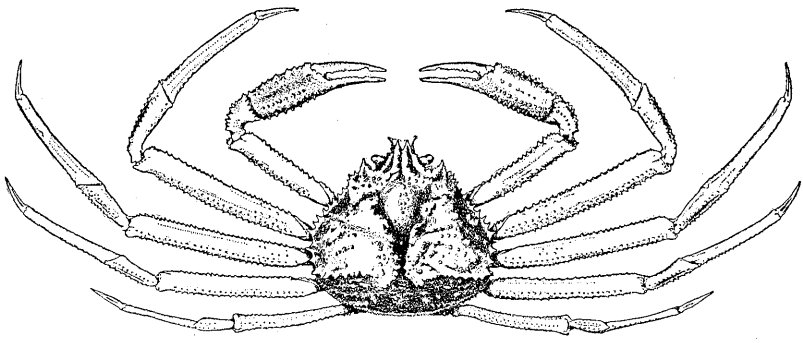


Fig. 131. *Chionoecetes tanneri*, ♂, × 3/16 (from Rathbun, U. S. N. M.).

Characters.—Carapace a little wider than long; much swollen at branchial regions, which are distended both vertically and laterally, concealing the lateral margin of the carapace; carapace covered with spines, the most conspicuous being arranged in irregular rows, one of which extends transversely across the anterior part of the gastric region; a second row extends from behind the orbits diagonally backward across the branchial region; a third from near inner angle of branchial region almost transversely to the outer margin, from which point a row of long spines extends forward along the lateral margin and is continued on the pterygostomian regions; this marginal row of long spines while forming the apparent lateral margin really overhangs and conceals the real margin. Small sharp spines border the orbits, the outer margin of the postocular teeth, and the inferolateral and posterior margins. Second segment of abdomen of male is bent downward at extremities in almost a right angle; there is a transverse ridge of spiny tubercles on the sternum in front of the abdomen; anterior to this ridge the sternum is deeply excavated.

Dimensions.—Type, male: length of carapace from base of rostral horns 119 mm., width without spines 130 mm.

Type Locality.—Gulf of the Farallones, California, 29 fathoms ("Albatross" station 3100).

Distribution.—From Bering Sea to off San Diego, California (lat. 32° 17′ N); 29 to 1625 fathoms (Rathbun).

Genus **Pelia** Bell

Carapace subpyriform. Rostrum composed of two divergent spines which are united at the base. Basal antennal joint elongated, its distal portion visible from above, at sides of rostrum; flagellum well developed. No preocular spine; postocular present; orbits small, with a superior and an inferior marginal hiatus, upper orbital margin smooth. First ambulatory legs much longer than the others.

KEY TO THE CALIFORNIA SPECIES OF PELIA

I. Male with fingers of chelae widely gaping; palm oblong, inflated; edges obtuse and subparallel.

tumida, p. 211.

II. Male with fingers of chelae meeting throughout the extent of their inner edges, except for a small narrow slit at the base; palm slender, more or less elongated, not inflated, only slightly enlarged, edges tapering distally.

clausa, p. 211.

Pelia tumida (Lockington)

Plate 34, figures 5 and 6

Pisoides (?) tumidus Lockington, Proc. Calif. Acad. Sci., **7**, 30, 67, 1877.
Pelia tumida Holmes, Occas. Papers Calif. Acad. Sci., **7**, 35, 1900.

Characters.—Carapace pyriform, rounded, tumid, covered with pubescence, but entirely devoid of spines; there is a small rounded tubercle on the summit of the gastric region, and a small rounded elevation on cardiac region; rostrum depressed, elongated, nearly one-half the length of the carapace, bifurcated for about half its length; horns narrow, diverging, and slightly upturned at the tip; no preorbital spine, postorbital small; basal antennal joint considerably longer than wide and devoid of teeth with the exception of one at the antero-external angle. Chelipeds unarmed; hand oblong, inflated, edges obtuse and parallel; fingers widely gaping.

Dimensions.—Type, male: length, 17 mm., width 11.4 mm.

Type Locality.—San Diego, California.

Distribution.—Santa Monica Bay, and Santa Catalina Island, California, to Magdalena Bay, Lower California.

Pelia clausa Rathbun

Plate 34, figures 1, 2, 3, and 4

Pelia pacifica Rathbun (not Milne Edwards), Proc. U. S. Nat. Mus., **16**, 90, 1893.
Pelia clausa Rathbun, Mem. Mus. Comp. Zool., **35**, 72, 1907.

Characters.—Very similar to *P. tumida*, with rostral horns slightly shorter, comparatively, and possibly a little more divergent, but differing markedly in the character of the hands of the male. In the males of *P. clausa* the fingers of the chelae meet throughout the extent of their inner edges, except for a small narrow slit at the base; the palm is slender and more or less elongated, only slightly enlarged, with edges tapering distally.

Dimensions.—Type, male: length of carapace 13.4 mm., width 8.5 mm.

Type Locality.—Southern California.

Distribution.—From Santa Monica Bay, California, to Magdalena Bay, Lower California (Rathbun).

Remarks.—The females of *P. clausa* are very similar to those of *P. tumida*. The differences are more comparative than apparent. In *P. clausa* the fingers and palm of the female are more slender, and the palm is less inflated.

Genus **Loxorhynchus** Stimpson

Carapace spiny or tuberculated. Rostrum two spined, spines coalescent at base and then divergent. Basal antennal joint enlarged, subquadrate, and having a laterally projecting spine at the outer angle. Preocular and postocular spines prominent; postocular flattened and densely hairy on anterior face, so that cornea of retracted eye is partially concealed from above; orbits interrupted by a deep sinus above and below.

KEY TO THE CALIFORNIA SPECIES OF LOXORHYNCHUS

I. Hepatic region with two large spines; carapace with numerous nearly equal tubercles; sparingly hairy or smooth in adult.
grandis, p. 212.

II. Hepatic region with one large spine; carapace with from nine to twelve prominent tubercles; covered with a short, thick, felt-like coat of hair.
crispatus, p. 213.

Loxorhynchus grandis Stimpson

Loxorhynchus grandis Stimpson, Proc. Boston Soc. Nat. Hist., **7**, 85, 1857; Jour. Boston Soc. Nat. Hist., **6**, 452, pl. 20, fig. 1, pl. 22, fig. 1, 1875; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 29, 1900; Rathbun, H. A. E., **10**, 175, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 31, pl. 5, fig. 14, 1910; Baker, Rep. Laguna Mar. Lab., **1**, 102, 1912.

a *b*

Fig. 132. *Loxorhynchus grandis*, ♀, × ½; *a*, ventral; *b*, lateral view of rostral region (after Stimpson).

Characters.—Carapace broadly ovate, with numerous nearly equal tubercles; sparingly hairy or smooth in the adult; hepatic region with two large spines. Rostrum much deflexed, curved almost in a direction at right angles with the horizontal axis of the body. Preocular spine large, often more or less double pointed.

Dimensions.—Type, female: length of carapace 141 mm., width 115.3 mm. A large specimen taken at San Diego measured 186.4 mm. in length and 148.6 mm. in width (Stimpson).

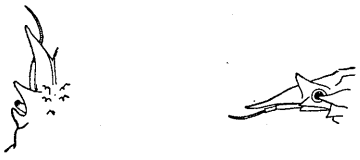
Color.—Color of exposed parts is reddish, inclining to roseate, becoming yellowish, white on the sides. Fingers white (Stimpson).

Type Locality.—Coast of California, near San Francisco.

Distribution.—From Point Reyes and the Farallon Islands to San Diego, California; 6½ to 68 fathoms.

Loxorhynchus crispatus Stimpson

Loxorhynchus crispatus Stimpson, Jour. Boston Soc. Hist., **6**, 453, pl. 22, figs. 2–4, 1875; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 30, 1900; Rathbun, H. A. E., **10**, 175, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 32, pl. 5, fig. 15, 1910.



a *b*

Fig. 133. *Loxorhynchus crispatus*, ♂, × ½; *a*, dorsal; *b*, lateral view of rostral region (after Stimpson).

Characters.—Carapace rather narrowly triangular, not nearly so wide or inflated as in *L. grandis;* covered with a short, thick felt-like coat of hair; with nine to twelve prominent tubercles; hepatic region with one large spine. Rostrum but slightly depressed as compared with *L. grandis* and with more divergent horns.

Dimensions.—Type, male: length of carapace 87.6 mm., greatest width 57.4 mm. The carapace of a single specimen brought in from Point Reyes was 57 mm. in length.

Color.—Beneath the pubescence bluish white, the rostrum, spines, and feet being of a bright carmine hue (Stimpson). In alcohol the color ranges from reddish brown to tan; the carapace after removal of the hair often shows red markings, especially about the tubercles (Weymouth).

Type Locality.—San Miguel Island, California.

Distribution.—From Point Reyes and the Farallon Islands to San Diego, California; 4 to 53 fathoms.

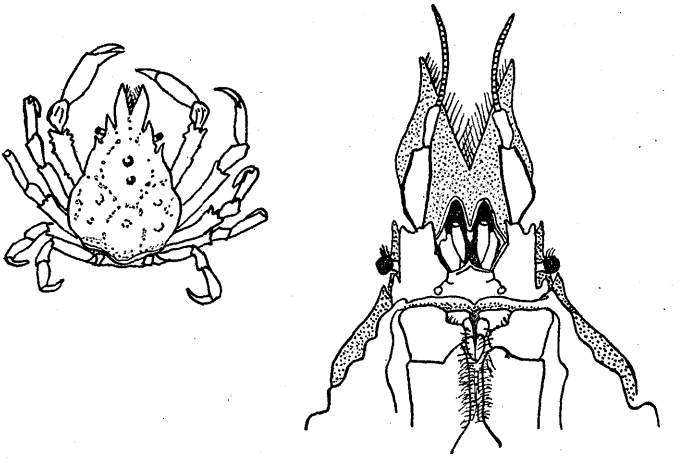
Remarks.—These crabs are generally found so thickly covered with foreign growth, such as hydroids, seaweeds, bryozoans and sponges, that in their natural environment they are scarcely recognizable as crabs at all (Holmes).

Genus **Scyra** Dana

Carapace subpyriform, tuberculated, but not spinose. Rostrum composed of two short, flattened horns. Basal antennal joint deeply concave, with outer margin flattened and produced but not spiny; next two joints flattened, with thin, broad lateral expansions. Preocular spine present, acute; postocular deeply cupped on anterior face and without hairs; orbits small, deep, with a fissure above and below, the lower and sometimes the upper being open.

Scyra acutifrons Dana

Scyra acutifrons Dana, Amer. Jour. Sci. (2), **11**, 269, 1861; Crust. U. S. Expl. Exped., **1**, 95, 1852, pl. 2, fig. 2, 1855; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 41, 1900; Rathbun, H. A. E., **10**, 175, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 33, pl. 6, fig. 17, 1910; Way, Puget Sd. Mar. Sta. Publ., **1**, 371, fig. 27, 1917.



a *b*

Fig. 134. *Scyra acutifrons*, ♂; *a*, dorsal view, × 4/5; *b*, ventral view of anterior portion, × 3 1/5 (after Dana).

Characters.—Carapace furnished with rounded tubercles; gastric region with an acute tubercle near the center, behind which is a larger and more obtuse tubercle; branchial regions bearing a large projecting tubercle, in front of which is an elevated prominence, which may bear several small tubercles though often it is quite smooth; cardiac region with a large tubercle; a smaller one on the intestinal region. Rostrum short, horns ovate-lanceolate, about one-quarter the length of the carapace. Chelipeds of male large, hand long, narrow, compressed, palm below the wide carina often inflated; fingers deflexed and in old males gaping at base, in which case there is generally a large tooth near the base of the movable finger.

Dimensions.—Type, male: length of carapace 27.5 mm., width 18 mm.

Color.—Dull, usually gray or tan with more or less red on chelipeds and walking legs; usually so encrusted with bryozoans that it is difficult to see the color. Like other spider crabs, they are usually covered with a variety of decorative materials. Sponges, hydroids, and bryozoans are used by them more than algae (Way).

Type Locality.—Oregon.

Distribution.—From Kadiak, Alaska, to San Diego, California. Low tide to 40 fathoms (Rathbun).

Remarks.—The individuals of this species vary considerably with age. In old males the tubercles on the carapace are rougher and more prominent, the posterior tubercle on the branchial region projecting over the sides of the carapace; the horns of the rostrum become widened at the base; the chelipeds are

much larger. In the female the tubercles on the carapace are smoother; those on the gastric region being small or obsolescent (Holmes). Regarding spine-like processes on basal antennal joint of figure given above and mentioned in the description given by Holmes, in his paper cited in synonymy above, Weymouth says, "The anterior external angle of the basal antennal joint is somewhat produced but seems hardly to form a spine as stated by Holmes. The 'two spines or teeth on the outer margin' behind this are seldom prominent, the anterior being a little more than an undulation of the margin." "Like most of the spider crabs this species is generally so overgrown with sponges and other forms as to conceal the color."

Genus **Herbstia** Milne Edwards

Carapace broadly triangular, subpyriform or ovate, tuberculated or spinose. Rostrum short, composed of two short flattened, acute horns, somewhat dilated at the base. Basal antennal joint narrowing distally, outer margin not produced, spiny, distal portion not entirely covered by the rostrum. Merus of ambulatory legs spinose. With or without preocular spines; postocular present; deeply cupped on anterior face and without hairs; orbits shallow.

Herbstia parvifrons Randall

Herbstia parvifrons Randall, Jour. Acad. Nat. Sci. Phila., 7, 170, 1839; Holmes, Occas. Papers Calif. Acad. Sci., 7, 38, 1900.

Herbstia (Herbstiella) camptacantha A. Milne Edwards, Crust. Rég. Mex., 78, pl. 18, fig. 3, 1879; Holmes, Occas. Papers Calif. Acad. Sci., 7, 37, 1900.

Rhodia parvifrons Rathbun, H. A. E., 10, 175, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 34, pl. 7, fig. 18, 1910.

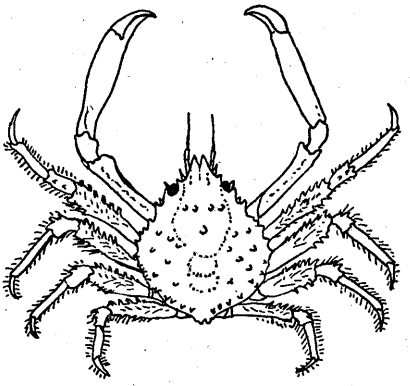


Fig. 135. *Herbstia parvifrons*, ♂, × about 1¼ (after Milne Edwards).

Characters.—Carapace ovate, punctate, flattened above, armed with several small tubercles and somewhat hairy; gastric region in front with four, at times inconspicuous tubercles in a transverse row, a median rounded tubercle on the posterior portion of the gastric region; three or four small tubercles on the cardiac region, and about five on each branchial region; two tubercles in a transverse line, on the intestinal area. Rostral horns very short, one-ninth to one-tenth the length

of the carapace. Spine at antero-external angle of basal antennal joint prominent; on margin behind it there are two spines, posterior of which is sometimes reduced to a small blunt tooth. Preocular spine present acute; there is a small spine or tooth on margin of orbit above postocular tooth, while below it there is a spine on the inferior orbital margin; beside postocular tooth anterolateral margin is furnished with about five spines, and there are several smaller ones on the postero-lateral margin.

Dimensions.—Type: length of carapace scarcely 25.4 mm.

Color.—Carapace is light tan mottled with dark brown; the ambulatory legs are banded with reddish brown and the chelipeds, with the exception of the light tips of the fingers, are a still more pronounced red, usually covered with sponges of various kinds and the like (Weymouth).

Type Locality.—Western America.

Distribution.—From Monterey Bay, California, to Acapulco, Mexico; low tide to 40 fathoms.

Remarks.—Miss Rathbun has called my attention to the fact that the genus *Herbstia* is not invalidated by *Herbstium* of Leach, 1823, hence its restoration above.

Superfamily BRACHYRHYNCHA

KEY TO THE CALIFORNIA FAMILIES OF THE BRACHYRHYNCHA

I. Carapace usually round or transversely oval, circular rather than square; squarish in the Goneplacidae. Frontal region not markedly broad, generally produced horizontally in lobes or teeth. Frontal and lateral margins produced into spines, or teeth. Palp of third maxillipeds articulates at or near antero-internal angle of merus. Male genital openings coxal.

A. Legs flattened and more or less distinctly adapted for swimming. Antennules fold back transversely or obliquely. Front with or without median tooth. Outer maxillipeds not overlapping endostome. (Only one specimen ever reported north of Santa Monica Bay.)

B. Legs not adapted for swimming.

Portunidae, p. 236.

1. Antennules fold back longitudinally. Front with several teeth, one of which is median. Outer maxillipeds overlapping endostome.

a. Carapace subcircular; antennal flagella long and hairy. (Known only from northern California.)

Atelecyclidae, p. 234.

b. Carapace broadly oval; antennal flagella usually short, more or less hairy.

Cancridae, p. 217.

2. Antennules fold back transversely or obliquely. Front generally divided by a median notch.

a. Carapace more or less transversely oval. Fingers of chelipeds more or less curved. Fronto-orbital border not equalling width of carapace.

Xanthidae, p. 238.

b. Carapace squarish. Fingers of chelipeds practically straight longitudinally. Fronto-orbital border nearly equalling width of carapace. (Not known north of San Pedro.)

Goneplacidae, p. 248.

II. Carapace usually square or squarish, more or less quadrilateral in outline, lateral margins nearly parallel. Frontal region usually broad, bent downward, usually without teeth or sharp lobes. Palp of third maxillipeds does not articulate at or near the inner angle of the merus. Position of male genital openings peculiar since they lie upon the sternum and are connected with the copulatory appendages on the abdomen by means of furrows excavated in the sternum.

A. Small commensal or symbiotic crabs with front, orbits and eye-stalks usually very small. Carapace often more or less membranaceous, frequently more or less rounded.

Pinnotheridae, p. 249.

B. Free-living crabs, with front, orbits, and eye-stalks not especially reduced. Carapace hard and firm, lateral margins either strictly parallel or only slightly arched.

1. Third maxillipeds with more or less of a gap left between them. Front usually markedly wide, eye-stalks of moderate size. Dactyls of ambulatory legs compressed, and armed with strong spines. The base of the abdomen in the male usually covers the whole width of the last thoracic sternum.

Grapsidae, p. 269.

2. Third maxillipeds almost or quite close to the mouth. Front moderately or very narrow; orbits transversely lengthened, eye-stalks usually very long. Dactyls of ambulatory legs styliform and devoid of spines. The base of the abdomen usually does not cover the whole width of the last thoracic sternum between the last pair of legs.

Ocypodidae, p. 277.

Family Cancridae

Carapace broadly oval, front with several teeth, one of which is median. Antennules fold back longitudinally. Antennal flagella usually short and more or less hairy. Third maxillipeds overlapping endostome.

Genus **Cancer** Linnaeus

Carapace transverse, subelliptical, often indistinctly areolated; front narrow, cut into five teeth or lobes. Eye-stalks short; orbits small, with two fissures in both upper and lower margins. Basal antennal joint usually somewhat enlarged and united with the front, thus excluding the flagellum from the orbit.

Key to the California Species of Cancer

(For key to the California specimens of Cancer 20 mm. and less in width see p. 219)

I. Anterolateral and posterolateral margins meeting at a distinct angle; carapace widest at ninth or tenth (sometimes eighth) tooth; nine, ten or eleven teeth.

A. Front markedly produced beyond outer orbital angles, forming five subequal teeth. Fingers of chelipeds dark-tipped.

productus, p. 220.

B. Front not markedly produced beyond outer orbital angles, formed of five unequal teeth; outer teeth larger and more widely separated from the three median teeth than these are from each other.

1. Carapace widest at tenth anterolateral tooth; posterolateral margin behind it entire, without teeth; anterolateral teeth with more or less prominent serrations anteriorly. Fingers of chelipeds without dark color.

magister, p. 229.

2. Carapace widest at ninth (sometimes eighth) anterolateral tooth; always with at least a rudimentary tenth and sometimes an eleventh tooth behind it on the posterolateral margin.

a. Anterolateral teeth low, projecting less than one-third the length of base, not spiny-pointed. Fingers of chelipeds without dark color. Merus of outer maxillipeds elongated, rounded anteriorly. (These characters, except those of the fingers of the chelipeds, do not hold in very small specimens, for which see key on p. 219.)

gracilis, p. 232.

b. Anterolateral teeth not low, projecting more than one-third the length of base, often spiny-pointed. Fingers of chelipeds dark-tipped. Merus of outer maxillipeds not elongated, truncated anteriorly.

i. Carpus of cheliped with two spines, one above at distal end and a second below this on inner angle; hand roughened and armed above with two or more spines, sometimes inconspicuous.

a. Anterolateral teeth acute, strongly produced, alternately large and small; carapace pubescent.

i. Tenth anterolateral tooth conspicuous, eleventh present; dactyl of cheliped spiny. Carapace strongly areolated.

gibbosulus, p. 226.

ii. Tenth anterolateral tooth inconspicuous, eleventh not present; dactyl of cheliped not spiny. Carapace slightly areolated. (Not known north of Half Moon Bay.)

jordani, p. 228.

b. Anterolateral teeth broadly triangular, not strongly produced, subequal. Carapace strongly areolated, not pubescent. (Not known north of San Diego.)

amphioetus, p. 223.

ii. Carpus of cheliped with a single spine above at distal end; hand smooth or granulated, without spines.

a. Carapace widest at eighth anterolateral tooth, eleventh distinct; under parts spotted or blotched with reddish.

antennarius, p. 224.

b. Carapace widest at ninth anterolateral tooth, tenth inconspicuous; under parts of uniform light color. (Not known north of Long Beach.)

anthonyi, p. 227.

II. Anterolateral and posterolateral margins not meeting at a distinct angle; carapace widest at seventh or eighth tooth; twelve or thirteen teeth. Dark color on dactyls of chelipeds reaching more than half the length of the outer margins, movable finger almost entirely dark colored. Merus of outer maxillipeds with antero-external angle produced.

oregonensis, p. 234.

KEY TO THE CALIFORNIA SPECIMENS OF CANCER, 20 MM. AND LESS IN WIDTH

I. Front markedly produced, formed of five subequal teeth, of which the median is the most advanced; anterolateral teeth never spiny-pointed; carapace never pubescent. Fingers of chelipeds with dark color. Color pattern of carapace extremely variable, from more or less uniform color to prominent longitudinal lines.

productus, p. 220.

II. Front not markedly produced, formed of five unequal teeth, the outer teeth larger and more widely separated from the three median teeth than these from each other.

A. Carapace widest at ninth or tenth anterolateral tooth.

1. Carapace widest at tenth anterolateral tooth, which is always the last; posterolateral margin unbroken, entire. Carpus of cheliped with a single spine above, at distal angle; hand light colored, fingers without dark color.

magister, p. 229.

2. Carapace widest at ninth anterolateral tooth.

a. Tenth anterolateral tooth (counting that next to the eye as one) prominent.

i. Tenth anterolateral tooth usually spiny-pointed, never broadly rounded; rarely an eleventh tooth.

a. Carpus of cheliped with two prominent spines (not counting that at hinge), one above, at distal end, and the second below it, at inner angle.

i. Tenth anterolateral tooth projecting laterally beyond carapace as seen from above; carapace comparatively smooth, without pubescence. Hand of cheliped light colored; fingers without dark color.

gracilis, p. 232.

ii. Tenth anterolateral tooth projecting dorsally, not reaching beyond outline of carapace as seen from above; carapace hairy, markedly areolated, granulated, granules in scattered groups. Hand of cheliped light colored; fingers with blotch of dark color, extreme tips light colored.

gibbosulus, p. 226.

b. Carpus of cheliped with a prominent spine above, at distal end; below this, at inner angle, an inconspicuous spine sometimes present. Carapace granulated, granules crowded. Hand of cheliped light colored, fingers with blotch of dark color, extreme tips light colored.

antennarius, p. 224.

ii. Tenth anterolateral tooth broadly rounded, never spiniform, an eleventh tooth invariably present; carapace prominently areolated, tending to become tuberculated, not hairy; teeth blunt, lamellate. Palm of cheliped with double row of tubercles on upper edge, and fingers almost wholly dark colored, much as in *C. oregonensis*. (Not known north of San Diego.)

amphioetus, p. 223.

b. Tenth anterolateral tooth absent or represented by a rudiment.

i. Carapace finely pubescent; anterolateral teeth alternately large and small, more or less narrowly triangular, spiny-pointed. Carpus of cheliped with two spines, one above at distal end, and a second less conspicuous spine below this, at inner angle; hand dark colored, fingers darker than palm, extreme tips light colored. (Not known north of Half Moon Bay.)

jordani, p. 228.

ii. Carapace smooth or sparsely and coarsely pubescent; anterolateral teeth alternately large and small only in very young specimens (5 mm. or less); teeth broadly triangular becoming quite blunt anteriorly. Carpus of cheliped with a spine above at distal end and only in very young a second minute spine below this at inner angle. (Not known north of Long Beach.)

anthonyi, p. 227.

B. Carapace widest at seventh or eighth anterolateral tooth; anterolateral and posterolateral margins not meeting at a distinct angle; marginal teeth tending to become blunt, lamellate with age. Carapace well areolated and more or less tuberculated, usually strongly so. In larger specimens the carpus is armed much as in *C. antennarius* above; in smaller specimens tubercles supplant the spines; upper edge of palm with a double row of blunt tubercles, fingers almost wholly dark colored.

oregonensis, p. 234.

Cancer productus Randall

Cancer productus Randall, Jour. Acad. Nat. Sci. Phila., **8**, 116, 1839; Dana, Crust. U. S. Expl. Exped., **1**, 156, 1852; pl. 7, fig. 3, 1855; Lockington, Proc. Calif. Acad. Sci., **7**, 94, 1877; Rathbun, R., The Fisheries and Fishery Industries of the U. S., sec. 1, 771, pl. 262, 1884; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 47, 1900; Rathbun, H. A. E., **10**, 175, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 40, pl. 8, figs. 20–24, 1910.

Characters.—Front markedly produced beyond outer orbital angles, forming five subequal, generally obtuse teeth which lie in the same horizontal plane, outermost pair not more widely separated from inner pair than these are from median tooth; fronto-orbital width about one-fifth width of carapace. External orbital tooth small, next behind it rounded, succeeding teeth becoming larger and more acute posteriorly, the last tooth in adult specimens being the largest; between the teeth margin of carapace is marked with short, closed fissures. Carpus of chelipeds with a large tooth at the antero-internal angle and a smaller one behind

the upper hinge joint; dark color on dactyls of chelipeds reaching less than one-half the length of the outer margin.

Dimensions.—Type, length hardly 25.4 mm., "but probably attains a greater size" (Randall). A series of twenty-eight mature males and females measured by Weymouth ranged from 24.5 mm. to 173.5 mm. in width.

Color.—The prevailing color of the adult is red, becoming darker and more brownish above, and orange or yellowish below. Among four young ones found under the stones at Monterey, two are chocolate color, with a somewhat darker tint on the elevated parts of the carapace; one is bright yellow, with irregular blotches of red; and the fourth is yellow with narrow red stripes, giving it a zebra-like

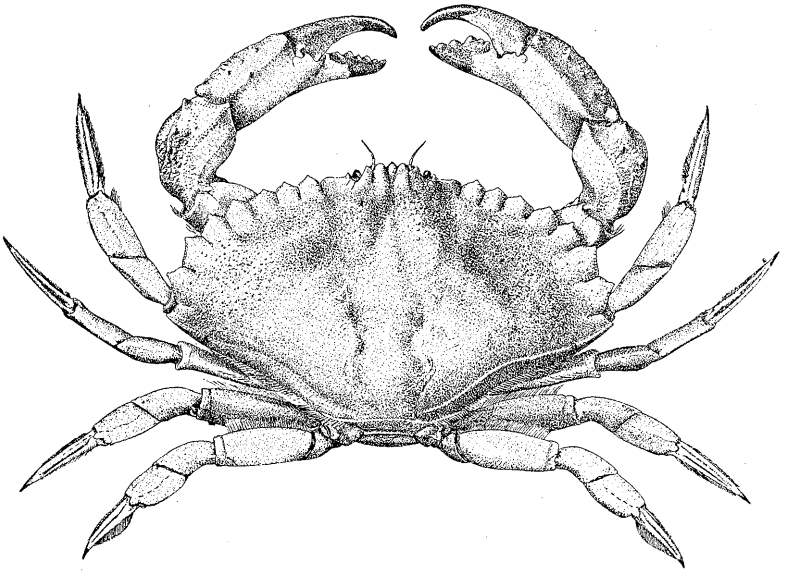


Fig. 136. *Cancer productus,* × about ½ (after R. Rathbun).

appearance. An examination of young and adult specimens only would lead to the belief that they were distinct species, but a full series of specimens, of all sizes and ages, reveals their specific identity (Lockington).

Weymouth describes the coloration as follows:

The adult color of a dark red above, below a dirty white or yellowish white is not invariable, though there are no striking differences; some adults show a light red above due to minute red spots, not so numerous as in the case of the darker color on a yellowish ground. The longitudinal colored lines of the immature specimens as described by Holmes is not the invariable youthful coloration; various mottled patterns are also found and occasionally the red of the adult.

Type Locality.—Western America.

Distribution.—From Kadiak, Alaska, to Magdalena Bay, Lower California.

Remarks.—This species is common in the bay at San Francisco, but I have never found either it or its young beneath the stones on the beach, as is the case at Monterey. In April of this year [1876] half an hour's search under the stones at Preston's Point, Tomales Bay, procured me twelve fine adult specimens, all or most of them females. I did not observe any ova attached to them, and I thought it singular that on a second visit to the spot in July, I could not find a single specimen, though at low-tide mark I secured an overgrown male who had lost too many limbs to retreat with sufficient quickness (Lockington).

Biological Survey of San Francisco Bay.—Cancer productus, the "red crab," like *Cancer antennarius* is quite closely confined to the middle bay and principally that portion lying west of Alcatraz, Angel Island, and the head of Raccoon Strait. Only four of the thirteen middle bay stations at which this species was taken lie east of this line. There is no record of it from either the upper bay or outside and only three (D 5723, 5767, 5802) from the lower bay, near its extreme upper end between Alameda and the Mission Rock (see plate 5).

An analysis of the various bottoms on which this species was taken seems to offer a very striking explanation of its limited distribution within the bay, in view of the fact that *Cancer productus* lacks the so-called "straining apparatus" for removing fine particles of foreign matter from the inhalant respiratory stream of water and consequently is restricted to more or less hard, "rocky or gravelly bottoms." (Weymouth, 1914, p. 124.)

Twenty-four of the total thirty-four specimens taken in connection with the survey, inclusive of two seined at Sausalito, were obtained within the region outlined above. The bottom throughout its extent is more or less hard and is largely sand, gravel, and rock in varying proportions; at one station (D 5763) the bottom for the greater part was overgrown with eel-grass. Practically every *Cancer productus* was a small or juvenile, ranging from 11 to 29 mm. in width, and it is interesting to note that the only large specimen taken was dredged in this sand, gravel, and rock area, in 2 to 3 fathoms, from a rocky bottom consisting of angular stones of various sizes, off Yellow Bluff (D 5773) just south of Sausalito. Three small specimens of the same species were taken with it. Of the remaining four middle bay stations, two (D 5708, 5826) lie in the stretch between Point San Quentin and the Southampton Shoal light, with bottoms of "sandy mud" and "fairly clean sand, with very little mud and many shell fragments" respectively; one small individual was obtained at each station. One of the other two stations lies off the northeast shore of Angel Island (D 5718), where the bottom is "soft grey mud with great quantities of worm tubes and ophiurians"; and the second was dredged in a line (D 5754) across the mud flats, of slightly gritty brown mud, lying between the channel east of Angel Island and the Berkeley shore. From each of these stations but one small specimen was returned.

In the lower bay: six medium sized individuals were obtained in mid-channel off Mission Rock (D 5723) on a bottom of "black sticky mud streaked with brown," covered "with many shells, clinkers, and abundant ophiurians." Another specimen was taken at an adjacent station (D 5802) on a "sandy, shelly, mud" bottom; while still another was dredged on the edge of the "muddy sand" flats off Alameda (D 5767).

The highest temperature at which any particular specimen was taken, was 17.0° C, off Alameda (D 5767), the lowest, 11.0° C, east of Fort Point (D 5779); the greatest salinity was 33.3, off Sausalito (D 5801), the least 21.7, off Point San Quentin (D 5708).

One half of all the dredging records were in less than 9 fathoms; of the remainder only two exceeded 19 fathoms, the deeper of which was made in Golden Gate (D 5808) in 27 to 43 fathoms, at a time when the observed bottom temperature and salinity were 11.1° to 13.4° C and 32.3 to 32.4 respectively. Two specimens were seined at Sausalito in March, 1912.

A complete list of dredging stations at which this species was taken includes: D 5700, 5702, 5708, 5718, 5723, 5754, 5763, 5767, 5773, 5778, 5779, 5795, 5801, 5802, 5808, 5826.

Cancer amphioetus Rathbun

Plate 36, figures 1 and 2

Trichocarcinus dentatus Miers, Proc. Zool. Soc. London, 7, 34, 1879.
Cancer amphioetus Rathbun, Proc. U. S. Nat. Mus., 21, 582, 1898; H. A. E., 10, 175, pl. 6, fig. 3, 1904.

Characters.—Carapace smooth, not pubescent, but strongly areolated; anterolateral margins with nine flat, broadly triangular, not strongly produced, subequal teeth; behind the ninth tooth is usually a small tooth on the posterolateral margin, which is defined by a line of granules; fronto-orbital width nearly one-half the width of the carapace; front five-toothed, the middle one very small, the two outer separated from the rest by a wide interval. Carpus with two spines, one above, at distal end, and a second below this, on inner angle; hand of cheliped with usually two spines on its upper margin and three longitudinal raised ridges on its outer surface; dark color on the fingers of the chelipeds reaching more than one-half the length of the outer margin, movable finger not more than two-thirds colored.

Dimensions.—Type, male: length 22.2 mm., width 25.4 mm.; female: length 27.5 mm., width 38.1 mm.

Type Locality.—Off the Korean coast.

Distribution.—From San Diego Bay, California, to the Gulf of California; Japan; Korea, 11½ and 169 fathoms (Rathbun).

Cancer antennarius Stimpson

Plate 35, figure 3; plate 36, figure 8

Cancer antennarius Stimpson, Proc. Calif. Acad. Sci., **1**, 96, 1856; Jour. Boston Soc. Nat. Hist., **6**, 466, 1857; Rathbun, R., The Fisheries and Fishery Industries of the U. S., sec. 1, p. 771, pl. 263, 1884; Holmes, Occas. Papers Calif. Acad. Sci., **7**, 49, 1900; Rathbun, H. A. E., **10**, 176, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 47, pl. 10, fig. 31, pl. 11, fig. 32, 1910.

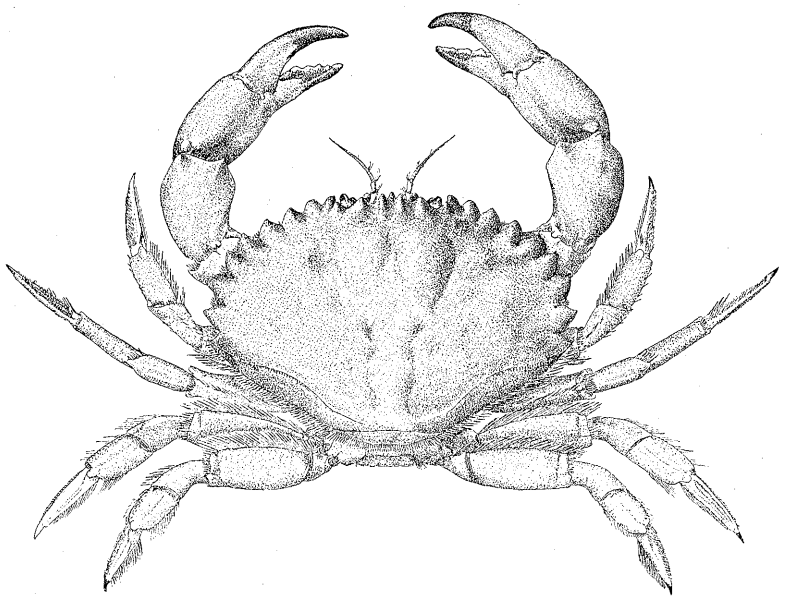


Fig. 137. *Cancer antennarius,* × about ½ (after R. Rathbun).

Characters.—Carapace smooth, widest at eighth anterolateral tooth, eleventh (really the second posterolateral) tooth distinct; fronto-orbital width one-third the width of the carapace; front not produced, the three median teeth separated from the outermost pair, which is the largest, middle tooth smaller and rather below the lateral ones. Merus of outer maxillipeds with distal margin nearly transverse, angles rounded. Carpus of chelipeds with a single spine above, at distal end; outer surface of hand costate, costae well marked in the young, almost obsolete in the adult; dark color on the fingers of the chelipeds, reaching more than one-half the length of the outer margins. Under parts spotted or blotched with reddish. Dactyls of ambulatory legs with eight longitudinal sulci, three superior, three inferior, one anterior, and one posterior.

Dimensions.—Types, male: length of carapace 61.7 mm., width 94 mm.; female: length of carapace 54.1 mm., width 78.2 mm. The Bay specimens ranged from 8 to 57 mm. in width.

Color.—Color of live specimens is fairly uniform and undergoes little change in alcohol. The general shade is a dark red, usually more or less mottled with a

lighter, more yellowish tinge; the under parts are yellowish white spotted with red, a coloration not found in any other species of *Cancer* examined (Weymouth).

Type Locality.—San Francisco Bay.

Distribution.—Queen Charlotte Sound, British Columbia, to Magdalena Bay, Lower California. Shallow water to 7 fathoms (Rathbun).

Remarks.—From Weymouth (1910, p. 47) I have taken the following:

There is considerable variation in this species and apparently a tendency toward two types, the extremes of which might readily be taken as a separate species. By far the greater number—which I would consider typical *C. antennarius*—have a smooth carapace devoid of hair except in the very young, 15 mm. and less in width which exhibit a few coarse hairs. A small number show a tendency toward hairiness and roughness of the hand, the extreme type of which is represented by a young female, measuring 46 by 50 mm. In this the whole carapace is densely pubescent (typical specimens of half the size show a perfectly bare carapace) and on the summits of the areolations, which are more marked than in the typical form, there are bunches of larger and stouter hairs. The granulations on these elevations are coarser than on the rest of the carapace, and in some cases pass into small spines. The anterolateral teeth do not differ markedly from the typical form except in being more thickened and in having the teeth spiny-pointed. The frontal teeth are more acute and thicker than is common in *C. antennarius*, especially those lying on either side of the median tooth, The tips of the basal joint and of the adjoining tooth on the lower orbital margin are more acute than in typical *C. antennarius* of the same size.

The chelipeds and ambulatory legs are pubescent, as is the case with the carapace. The carpus of the chelipeds is marked with several costae bearing low spines and rows of hairs; these costae are generally indicated in the typical form by a line of slightly coarser granulations. There is an acute tubercle above the hinge, a strong spine at the inner angle, and a well marked spine below this. These spines are present in some typical *C. antennarius* of the same size, but the lower spine is more generally lacking and never of as great size. The hand is marked with two superior and five external carinae, all formed of rows of hairs and spines, the spines in the upper carinae being much longer and more pronounced. In typical *C. antennarius* of the same size these carinae are more or less well marked by rows of granulations.

This specimen is, as I have said, the extreme of divergence from the typical form; other smaller individuals show the same pubescence, some have the same extreme type of areolation, notably a larger female from San Diego, the only one not from Monterey Bay here considered. Many young show roughness of the hand, but no other specimen combines as many of these characters.

The total of these variations from the typical form of *C. antennarius* might merit specific distinction were it not for certain other facts. All specimens in which I have noticed these characters in any marked degree are immature females. Though they differ from typical forms of the same size, and therefore presumably of similar age, certain of the characters, chiefly the roughness of the hand and the pubescence of the carapace, vary with age in the typical form, being more apparent in the young, so that these differences though apparently much greater than those due to age cannot be said to be of a dissimilar kind. Again, in the typical adult, the female has a more convex and deeply areolated carapace than the male, which raises the question whether the difference in this character may not be, in part, sexual.

Miss Rathbun has informed me that she has examined very hairy specimens of about the size described, 40 and 50 mm., from La Jolla and San Diego, which she considered as a variety of *C. antennarius*. Sufficient material may establish this variety, but the collection at hand does not seem to warrant it.

See also *Remarks* under *C. gibbosulus*.

Biological Survey of San Francisco Bay.—Cancer antennarius, the "rock crab," is only recorded from the middle bay and particularly from that section lying between Sausalito, Fort Point, and Point Bonita, or in the words of Stimpson (Proc. Calif. Acad. Sci., **1**, 88,

1856), "found on rocky bottoms in two or three fathoms about the mouth of the Bay of San Francisco." Of the ten specimens taken during the survey all but two are small or juvenile specimens. These two are large adult specimens and were both taken at Sausalito, one in the 150-foot seine and the other in a crab-net over the ship's side. Of the smaller specimens, one of about medium size (70 mm. wide) was collected along the Sausalito shore; a very small one (12 mm. wide) was obtained from among the rocks and algae between tide marks at Point Bonita, while another of like size (15 mm. wide) was dredged in a similar environment in 2¼ to 3½ fathoms (D 5778) on the south side of Golden Gate, inside of Fort Point; still two other juvenile specimens were dredged (D 5808, 5845) in 27 to 49 fathoms in the outer central portion of Golden Gate. The three remaining specimens, also juvenile (two averaging 35 mm., and one measuring 8 mm. in width), were taken in two hauls of the tow-net, off California City (H 5135) and Point San Quentin (H 5137), respectively, at a considerable distance from the restricted area in which all the other specimens were taken. These tow-net hauls show a maximum temperature of 18.2° C at the time they were made, which is considerably higher than the one given in the range of temperature of the hydrographic station (H 4967) to which all the other records of this species are referable (see page 354 and accompanying table). The range of temperature for this station is 8.7° to 14.3° C; its range of salinity, 26.6 to 33.3; a range not greatly at variance with the surface salinities (25.4 and 28.9) observed at the above hydrographic stations.

Cancer gibbosulus (De Haan)

Plate 36, figure 7

Corystes (*Trichocera*) *gibbosula* De Haan, Fauna Japonica, p. 45, pl. 2, fig. 4, pl. 13, fig. 3, 1835.

Cancer gibbosulus Rathbun, Proc. U. S. Nat. Mus., 21, 581, 1898; H. A. E., 10, 176, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 43, pl. 10, fig. 29, 1910.

Characters.—Carapace markedly areolated, sparsely pubescent, hairs rather coarse and harsh; anterolateral margin, including outer angle of orbit, with nine strongly produced and forward-curving teeth, all except first two tipped with spines, behind these on posterolateral margin a well marked tooth directed upward and not laterally, and a distinct spine representing the eleventh; fronto-orbital width one-third the width of the carapace; front with five more or less acute teeth (not counting the supraorbital), the three median of which are the smaller and are separated from the tooth at inner angle of eye by a distance greater than

that occupied by the three; supraorbital tooth more or less acute. Merus of outer maxillipeds abruptly truncated, inner angle slightly produced, inner margin with a conspicuous tooth below the articulation of palp. Chelipeds hairy; carpus with two spines, one above, at distal end, and a second below this, at inner angle; upper surface of hand with two rows of three to five spines, outer surface with five costae marked with hair and small spines; upper margin of movable finger spiny, dark color on fingers reaching less than one-half the length of their outer margins. Ambulatory legs hairy; dactyls slightly longer than propodi, straight, tipped with nearly straight, corneous spines.

Dimensions.—Type: length of carapace 21.2 mm., width 17 mm.; large male: 35.5 by 25.5 mm. (Weymouth). The specimens taken in connection with the Bay Survey measured from 11 to 29 mm. in width.

Color.—Whitish tone marked with irregular but symmetrically disposed reddish blotches, tips of fingers of chelipeds black, ambulatory legs light banded with red (Weymouth).

Type Locality.—Japan.

Distribution.—From Granite Cove, Port Althorp, Alaska, to San Geronimo Island, Lower California?, Japan. Shallow water to 40 fathoms.

Remarks.—Miss Rathbun tells me after a recent working over of the juvenile specimens of *Cancer* in the collection of the U. S. National Museum, that the inconspicuous spine sometimes present at the inner angle of the carpus of the cheliped of *C. antennarius* (cf. "key" on page 219) is occasionally so prominent as to lead one to confuse that species with *C. gibbosulus*, but that the character of the granulation of the carapace will serve to distinguish the two: the granules on the carapace of *C. antennarius* are crowded, while in *C. gibbosulus* they are not crowded but in scattered groups.

It also appears that there are no specimens of *C. gibbosulus* in the Museum collections from farther south than Santa Catalina Island.

Biological Survey of San Francisco Bay.—Only three specimens of *Cancer gibbosulus* were taken during the survey, outside, at station D 5790, 33 to 35 fathoms, bottom "very coarse variegated sand, with a small proportion of fine sand, temperature range 9.7° to 11.5° C, salinity 33.9.

Cancer anthonyi Rathbun

Plate 35, figure 1

Cancer anthonyi Rathbun, Proc. Biol. Soc. Wash., **11**, p. 111, 1897; Amer. Nat., **34**, 134, 1900; H. A. E., **10**, 176, pl. 6, fig. 2, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 49, pl. 11, fig. 33, 1910.

Characters.—Carapace widest at ninth anterolateral tooth; anterolateral teeth nine, broader and less projecting than in *C. antennarius*, margins denticulate, second to eighth tooth, inclusive, having the posterior margins about twice as long as the anterior, first to sixth tooth, inclusive, obtuse, last three teeth with short, sharp tips directed forward; tenth tooth (first posterolateral) indistinct, including it posterior margin shows only two very faint emarginations; front narrower than in *C. antennarius*. Merus of outer maxillipeds oblong, anterior margins slightly oblique. Carpus of chelipeds with a single spine above, at distal end; hand smooth

or granulated, without spines; dark color on fingers of chelipeds reaching less than half the length of the outer margins. Under parts uniform light color. Lower surface and legs less hairy than in *C. antennarius*. Dactyls of ambulatory legs with six longitudinal sulci, two superior, two inferior, one anterior, and one posterior.

Dimensions.—A male somewhat larger than the type measures 52.1 mm. long and 77.5 mm. wide (Rathbun).

Color.—Brownish red (Rathbun).

Type Locality.—Long Beach, California.

Distribution.—Long Beach, California, to Playa Maria Bay, Lower California.

Cancer jordani Rathbun

Plate 36, figures 5 and 6

Cancer jordani Rathbun, Amer. Nat., 34, 133, 1900; H. A. E., 10, 176, pl. 6, fig. 4, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 45, pl. 10, fig. 30, 1910.

Characters.—Carapace slightly areolated, hairy; anterolateral teeth separated to their bases, tips spiniform, second, fourth, sixth and eighth smaller than the others (outer orbital tooth being counted as the first); alternation in size of teeth varying with age, most noticeable in young specimens, less so in large ones, ninth tooth scarcely more prominent than eighth, tenth tooth (really posterolateral) indicated in older specimens and less conspicuously in younger ones by a slight gap in the small spines marking the posterolateral margin of the carapace; fronto-orbital width nearly one-half the width of the carapace. Merus of outer maxillipeds obliquely truncated, the inner angle the more advanced, corners rounded. Palms of the chelipeds have two superior and five external carinae, fringed with hair, superior carinae also with several spines; movable finger not spiny; extent of dark color on fingers of chelipeds variable.

Dimensions.—Type, female: length 15.5 mm., width 19.5 mm. (Rathbun). Large male: length 25.4 mm., width 33.4 mm. (Weymouth).

Type Locality.—Monterey Bay, California.

Distribution.—Pillar Point reef, Half Moon Bay, California, to San Geronimo Island, Lower California.

Remarks.—With regard to the relations of this species I have quoted the following from Miss Rathbun's Harriman Alaska Report (1904*a*, p. 177):

This species may have been confounded with the young of better known species. The young of *C. magister* has a nearly naked carapace, the ninth tooth of the lateral margin is produced sideways, the antennae are less than twice as wide as front, the merus of the maxillipeds is no broader than long, the carinae of the upper and outer surfaces of the hand are 6 instead of 7.

The carapace of young *C. antennarius* is also nearly naked (Dr. Holmes may have had in his hand *C. gibbosulus* when he described the carapace of young *C. antennarius* as thickly covered with hair); the teeth are all much thickened, the orbital teeth prominent, the two underneath being rounded, not sharp; the maxillipeds reach only to the base of the antennal segment, the merus not broader than long; the dark color on the fingers is more extensive than in *C. jordani*.

Cancer gibbosulus has a much more uneven carapace, strongly marked and rounded orbital teeth, a postero-lateral tooth, ninth tooth more prominent than eighth. Carapace hairy, as in *C. jordani*.

In *C. anthonyi* the antero-lateral teeth are low and broad, not alternately large and small, the first six having blunt angles; the inner supraorbital tooth is well developed.

Cancer magister Dana

Cancer magister Dana, Proc. Acad. Nat. Sci. Phila., **6**, 73, 1852; Crust. U. S. Expl. Exped., **1**, 151, 1852, pl. 7, fig. 1, 1855; Rathbun, R., The Fisheries of the U. S., sec. 1, 770, pl. 261, 1884; Holmes, Occas. Papers Calif. Acad. Sci., 7, 50, 1900; Rathbun, H. A. E., **10**, 177, 1904; Weymouth, Stanford Univ. Publ., Univ. Ser., no. 4, 42, pl. 9, fig. 25, 1910; Rept. British Columbia Comm. of Fisheries, 1914, 123–129, figs. 1–8; Calif. Fish and Game, **2**, no. 1, pp. 22–27, fig. 3, 1916.

Characters.—Carapace widest at tenth anterolateral tooth; posterolateral margin behind it entire, without teeth; anterolateral teeth with more or less prominent serrations anteriorly; front not produced, the three median teeth small, the middle one being slightly larger than the others and projecting farther forward; outermost pair larger than the others, not reaching so far forward, and separated from them by a considerable interval. Carpus of chelipeds with a single spine above, at distal end; fingers of chelipeds without dark color. Dactyls of ambulatory legs, especially those of last pair, much flattened.

Dimensions.—Type: length of carapace 120.7 mm., greatest width 177.8 mm.

Color.—Light reddish brown, darkest anteriorly, often light orange below; inner sides of the anterior feet and hands crimson (Stimpson).

Type Locality.—San Francisco Bay.

Distribution.—Unalaska to Magdalena Bay, Lower California. Low water to 50 fathoms (Rathbun).

Biological Survey of San Francisco Bay.—Cancer magister is quite universally distributed throughout the bay, upper, middle and lower, from Carquinez Strait to Point San Mateo (see plate 10), as well as outside. On the whole, so far as our survey records would seem to indicate, little discrimination is displayed by this species between the various kinds of bottom. In the upper bay where the bottom is predominantly muddy it was dredged at twelve (54%) of the stations. In the middle bay slightly more than half, eighteen (53%) of a total of thirty-four stations were in the eastern or muddy portion, the balance, sixteen (47%), being in the Raccoon Strait-Alcatraz-Golden Gate section with its sand, gravel and rock bottom. In the lower bay, however, where the bottom is possibly even more pronouncedly muddy than in the upper bay, only five (13%) of the hauls returned specimens, quite an evident falling off in the number of productive stations as compared with the other two divisions of the bay. Outside *Cancer magister* was obtained from six (35%) of the stations, all of which were made on a sandy bottom. Weymouth in his "Contributions to the Life-History of the Pacific Coast Edible Crab" (1914, p. 124) says:

Cancer magister shows a distinct preference for sandy bottoms. Occasionally it is found in the fine sand or mud of bays, but such are always recognizable by their discoloured appearance. It is found at times on gravel, but never, as far