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Hawaiian Grapsidae

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INTRODUCTION

This report on the crabs of the family Grapsidae of the Hawaiian area follows the plan and purpose of my account of the Hawaiian Por-tunidae [B. P. Bishop Mus., Occ. Papers 21 (12): 217-274, 1953] in that it presents a condensed, systematic record of a specific group of marine fauna known to occur in, or to be accredited to, the Hawaiian region.

Keys are included, supplemented by sufficient descriptive matter and figures, I believe, to enable one to determine without much difficulty any representative of the family which might be discovered in local waters. The systematic work of Mary J. Rathbun (15)¹ remains a valued basis for consideration of brachyuran crabs of the central Pacific area. In this paper I have added to her records of 50 years ago material from the work of many additional authorities and information based on specimens in Bishop Museum and a number of California institutions, including the California Academy of Sciences, Hopkins Marine Station, and the Allan Hancock Foundation.

Although most crabs of the Grapsidae family are typically inhabitants of the rocky shores and shallow water of the sea, considerable variation in habits and habitats is found among members of the group. Intertidal forms are usually very tolerant of fresh water and some Grapsidae have quite fully adapted themselves to that medium. Certain species may be found under stones at, or even above, high water mark. Others are habitually semiterrestrial and often wander far from the sea shore, concealing themselves under logs or in hollow tree trunks. Survival of such forms is made possible during more or less lengthy periods by special mechanisms for keeping the gills moist. Representatives of certain genera of the family have become adapted to a truly

¹ Numbers in parentheses refer to Bibliography, page 201.

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pelagic existence. These are occasionally observed in the open sea clinging to drifting sea weeds, logs, or other flotsam. Even marine turtles may serve as transportation or at least temporary resting places for these ocean-going crabs. Pelagic forms of the genera *Pachygrapsus* and *Planes* have frequently been found clinging to beached drift logs or other timbers on the windward shores of Oahu.

How species of crabs typical of rocky shores have become so widely dispersed as certain Grapsidae can be answered only by conjecture. However, the hulls of ships offer one accessible means of long-distance transportation. Crabs with clinging facilities should have little difficulty in holding on for long periods among the assortment of marine organisms which constitute the fouling on the bottoms of ocean-going craft. Observations in local drylocks indicate that many exotic forms of marine life may be introduced into new environs in this manner. How many of them become established under altered conditions it is impossible to say, but there is evidence that some of them do.

Twenty-four species of Grapsidae were listed by Rathbun (15) among the brachyuran fauna of Hawaii collected by the Albatross Expedition of 1902 or previously reported by various investigators. Many of these species are now well known about the local shores, whereas others accredited to the islands nearly a century ago have not been observed locally since that time, which leads to a probability that this locality cited by some early authors may be erroneous. However, as failure to observe certain species does not entirely rule out their occurrence in local waters, the following account includes a few forms the presence of which in Hawaii cannot, at the present time, be substantiated by tangible evidence. No new species of Grapsidae is here recorded, although two forms not previously recognized among Hawaiian fauna are included.

As in representatives of a number of other families of the Brachyura, certain species of the Grapsidae are provided with special structures by which they are believed capable of creating and receiving sounds which serve as means of communication between individuals of the same species. If structures supposed to be sound-producing are confined to the males, which is usual, it is believed that sounds produced by one male may serve as a warning call to another male or possibly as a mating call to a member of the opposite sex. Sound-producing organs, however, would obviously imply the presence of sound receptors of some nature.

In certain Grapsidae a crest of the inner border of the merus of the cheliped is rubbed against a specialized suborbital ridge. Species of *Hemigrapsus* recorded from Hawaii have stridulating organs of this kind, as do species of other genera not represented among Hawaiian fauna. In many species of *Sesarma* the males are characterized by a longitudinal row of tubercles on the dorsal border of the dactyli of the chelipeds. These tubercles have the general appearance of being part of a stridulating mechanism.

Tweedie (27) describes the stridulating activity of *Sesarma cumolpe* de Man which he was fortunate enough to observe. By a twisting of the chelipeds the tuberculated upper border of one dactylus was brought into contact with and rubbed against the corresponding border of the opposite dactylus. Although no sound was detected by the human ear, the observation doubtless established the function of the dactylar tubercles in *Sesarma*.

Also in many species of *Sesarma*, especially in the males, the upper border of the palm of the cheliped bears a series of parallel rows of obliquely placed pectinated ridges, believed by some investigators to be sound receptors. However, inasmuch as these pectinated ridges are absent or poorly developed in the females, they may be provided with sound detectors not yet recognized by observers if the stridulating sounds produced by the males serve as mating calls. Species of *Sesarma* recorded from Hawaii lack both dactylar tubercles and the pectinated ridges of the chelipeds, as well as any other observed means of producing or receiving stridulating sounds.

In Hawaii the Grapsidae crabs play little or no part in the economy of the human population. As human food the Grapsidae in Hawaii are virtually a negative factor, and crabs sold on the market are almost exclusively of the Portunidae family. The larger Grapsidae which surpass in size some of the edible portunids are scarce in comparison and, even though they were equally acceptable as food, could supply but a fraction of the demand.

There is evidence that in earlier times native Hawaiians recognized the large rock crab *Grapsus grapsus tenuicrustatus* as a food and made free use of it. It is also said that in the pursuance of religious rites this crab was often offered as a sacrifice to the gods that requests might be granted.

Reports from oriental countries where species of the grapsoid genera of *Eriocheir* and *Sesarma* are plentiful indicate that they are ex-

tensively used as food by the human population, regardless of the danger to health from parasites with which the crabs are usually infested. Referring to the large rock crab *Grapsus grapsus tenuicrustatus* at Cocos-Keeling Islands, Tweedie (26) quotes an observer to the effect that the species is plentiful at North Keeling, where it is considered very good eating fried in coconut oil or roasted over a slow fire of coconut husks.

In some parts of the Orient fresh-water Grapsidae damage rice crops by the actual destruction of growing stalks of grain, as well as by the burrowing habits of the crabs which result in the drainage of water from rice paddies. A similar situation has arisen in Hawaii, where taro patches are dehydrated, not by grapsoid crabs, but by introduced crayfish.

FAMILY GRAPSIDAE

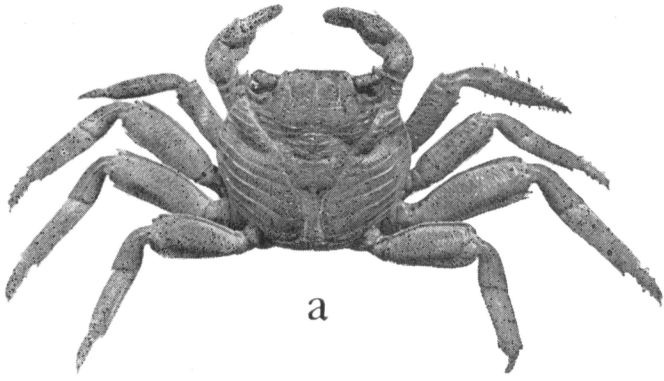
Carapace usually quadrate, flattened or moderately convex with lateral borders straight or slightly arched, frequently with teeth. External maxillipeds usually separated by a gap of considerable size, their exognaths with or without a flagellum; interantennular septum broad.

Key to subfamilies of Grapsidae

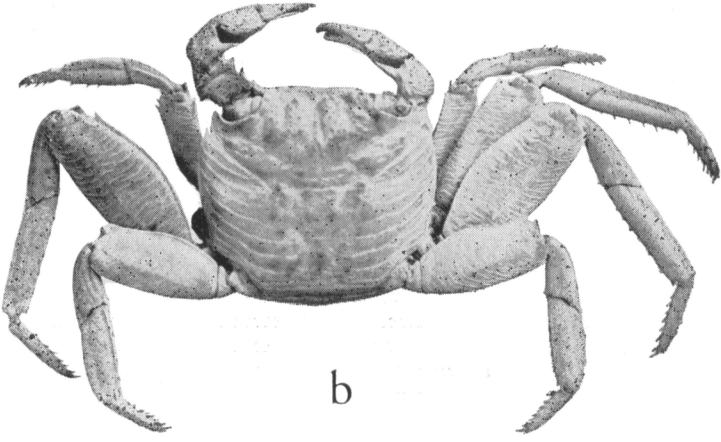
- Front not cut into lobes or teeth; antennules folding transversely.
 No hairy crest traversing external maxillipeds.
 Antennal flagellum very short; exognath of external maxilliped narrow **Grapsinae.**
 Antennal flagellum usually of good length; exognath of external maxilliped usually broad..... **Varuninae.**
 A hairy crest obliquely traversing the external maxillipeds..... **Sesarminae.**
 Front cut into lobes or teeth; antennules folding longitudinally..... **Plagusinae.**

Key to genera of Grapsinae

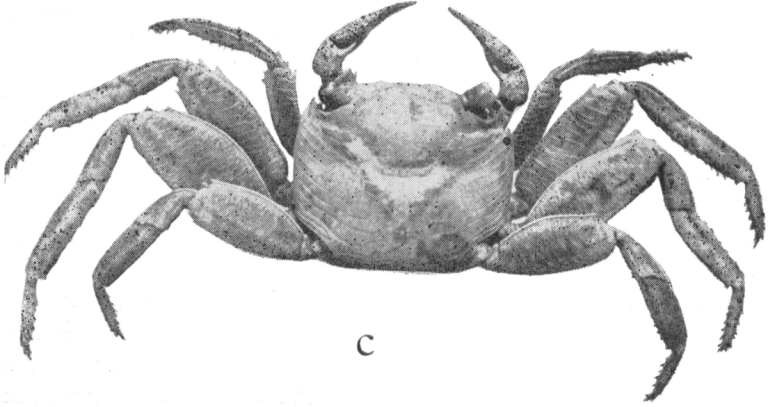
- Front less than half the greatest breadth of carapace; merus of external maxilliped longer than broad.
 Fingers of cheliped spooned; exognath of external maxilliped with flagellum **Grapsus.**
 Fingers of cheliped not spooned; exognath of external maxilliped without flagellum..... **Geograpsus.**
 Front more than half the greatest breadth of carapace; merus of external maxilliped broader than long.
 Antenna usually excluded from the orbit..... **Metopograpsus.**
 Antenna in the orbital hiatus..... **Pachygrapsus.**



a



b



c

FIGURE 1.—a, *Grapsus grapsus tenuicrustatus*; b, *G. strigosus*; c, *G. longitarsis*.

Key to Hawaiian species of *Grapsus*

- Carapace with lateral borders markedly arched.
 Carapace with front vertical, depth about one-half the width between orbits; strong oblique ridges mark branchial areas with surface between rough.....**G. grapsus tenuicrustatus.**
 Carapace with front vertical, depth much less than one-half width between orbits; low, oblique lines mark branchial areas with surface between smooth.....**G. strigosus.**
 Carapace with lateral borders nearly straight, slightly divergent behind**G. longitarsis.**

Grapsus grapsus tenuicrustatus (Herbst) (= *Grapsus maculatus tenuicrustatus* of some authors).—Rathbun, U. S. Fish Comm., Bull. 23 (3): 838, 1903 (1906).—Sakai, Studies on crabs of Japan IV . . ., 649, pl. 106, fig. 4, 1939.

Grapsus maculatus tenuicrustatus Tesch, Siboga-Exp., Monogr. 39c: 72, 1918.—Stephensen, Danish sci. invest. in Iran (4): 194, fig. 59, a-d, 1945.

Carapace slightly convex, lateral borders strongly arched with one tooth close behind the external orbital angle. Upper surface of carapace marked by salient transverse and oblique ridges with intervening areas roughened by similar ridges directed longitudinally. Postfrontal ridges strongly developed, covered by tubercles which extend posteriorly over the gastric area. Front vertically deflexed, its depth one-half its breadth. Chelipeds (male) stout but little longer than length of carapace, surface roughened by ridges, tubercles, and teeth. A row of teeth on inner margin of ischium and merus and on outer margin of merus near distal extremity. Outer border of merus marked by transverse lines, and outer border of carpus ornamented by tubercles and short ridges, its inner angle bearing a strong tooth. Outer border of palm traversed longitudinally by two lines of small tubercles. Tubercles on upper border of palm and dactylus larger, a sharp tooth-like one at distal extremity of palm. Lower border of palm marked by oblique ridges. Fingers spooned at the tip, and provided with strong teeth. Walking legs long with flattened joints, the first leg the shortest and the penultimate one about twice the length of the carapace. (See figure 1, a.)

Authors have long differed as to the proper terminology to be applied to this large rock crab. A number of writers prefer *Grapsus maculatus* (Catesby, 1743) to *G. grapsus* (Linnaeus, 1758). Rathbun, who preferred *G. grapsus*, separated the species into two forms. The typical one, *G. grapsus*, which ranges the tropical and subtropical shores of America and those of the eastern Atlantic, is characterized by the lobe of the inner angle of the carpus of the cheliped being very broad and ending in a short point. Whereas in the subspecies, *G. grapsus tenuicrustatus*, typical of the oriental area and the islands of the central and western Pacific, the carpal lobe is narrower, terminating in a longer spine. (See figure 2, a.)

Specimens of *G. grapsus* from the Galapagos Islands among collections of the California Academy of Sciences presents a marked distinction from the subspecies *tenuicrustatus* of Hawaii in the very broad carpal lobe of the cheliped ending in a short, acute tip (fig. 3, *a*). Also, the first pleopods of the male in the two forms, although indicating a relationship, clearly show morphological differences. In *G. grapsus tenuicrustatus* the first pleopods are tipped at the distal extremity by a bifurcated chitinous blade (fig. 2, *c*), whereas in the typical *G. grapsus* the corresponding appendages are tipped by a broad chitinous blade

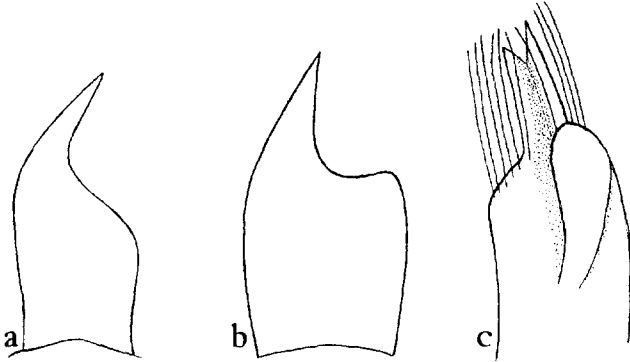


FIGURE 2.—*Grapsus grapsus tenuicrustatus*: a, carpal lobe of cheliped (Hawaii); b, carpal lobe of cheliped (Chichi Jima); c, first pleopod, male, distal extremity.

having a slight notch on one side (fig. 3, *b*). It may be noted that in the first pleopods of the male *G. maculatus*, as figured by Stephensen (22), the chitinous blade is wanting.

Sakai (20) cites another distinction between *G. grapsus* and its subspecies *tenuicrustatus*, pointing out that in the subspecies the last walking legs are longer than the first ones, whereas they are subequal in the typical species. He also notes that the merus segments of the walking legs are longer and narrower in the subspecies than in *G. grapsus*.

According to Ward (28) *G. tenuicrustatus* (Herbst) may be distinguished from *G. grapsus* (Linnaeus) by the more irregular surface of the carapace, by the greater development of raised lines on the gastric area, and by the broader propodi of the walking legs, which are

one-third as broad as long, whereas in *G. grapsus* they are but one-fourth as broad as long.

However, either some investigators have failed to recognize distinctions between the typical *G. grapsus* and the subspecies *tenuicrustatus* or there appears to be an overlapping of distribution in the western Pacific. Various authors, such as Balss (1), and Miyake (11), have recorded *G. grapsus* (Linnaeus) from widely separated areas, including the Gilbert, Marshall, Caroline, and Palau Islands, which localities should normally be within the range of the subspecies. A male specimen in Bishop Museum from Chichi Jima definitely represents the subspecies *tenuicrustatus*, as is indicated by the carpal lobe of the cheliped (fig. 2, *b*) and the first pleopod, which is like figure 2, *c*.

This colorful rock crab is the largest of the Grapsidae common in Hawaiian and central Pacific waters. Specimens with a breadth of carapace slightly exceeding 75 mm. are in Bishop Museum. This wary crab is not easily captured in its native haunts, which are usually rocky ledges or piles of stones at the water's edge. It clammers over or among the rocks with great rapidity when pursued, retreating into the crevices for safety and concealment. If this crab can be induced to leave the rocky retreat and take to the shallow water, it becomes less shy and may be procured with greater ease.

Grapsus strigosus (Herbst) Alcock, Asiatic Soc. Bengal, Jour. **69** (2) : 393, 1900.—Rathbun, U. S. Fish Comm., Bull. **23** (3) : 838, 1903 (1906).—Tesch, Siboga-Expd., Monogr. **39c** : 71, 1918.—Sakai, Studies on crabs of Japan IV . . . , 650, pl. 106, fig. 3, 1939.

Carapace with front obliquely deflexed but much less deep than in *G. grapsus tenuicrustatus*; lateral borders arched as in that species. Ridges of carapace, both transverse and oblique, low and smooth, and surface between oblique ridges also smooth. Tooth at inner angle of orbit subacute, sharper than in *G. g. tenuicrustatus*. Lobe at inner angle of carpus of cheliped narrow, nearly straight, not talon-like; fingers not so broad or blunt as in *G. g. tenuicrustatus*. First and fourth walking legs subequal in length, and length of merus joints about twice their breadth. (See figures 1, *b*; 3, *c, d*.)

The general distribution of the species is very wide, ranging from the Red Sea and the east coast of Africa through the Indian and Pacific Oceans to Australia, Japan, and Hawaii. It is much less common, at least in Hawaii, and is a smaller species than *G. g. tenuicrustatus*; but it can be distinguished from that form by the smoother general surface of the carapace, the lesser depth of the front and the narrower and straighter lobe at the inner angle of the carpus of the cheliped. Bishop

Museum has only two or three specimens of this species from Oahu, one from Johnston Island, and a juvenile from Fiji tentatively assigned to the species. One of the larger specimens is 32 mm. in breadth of carapace.

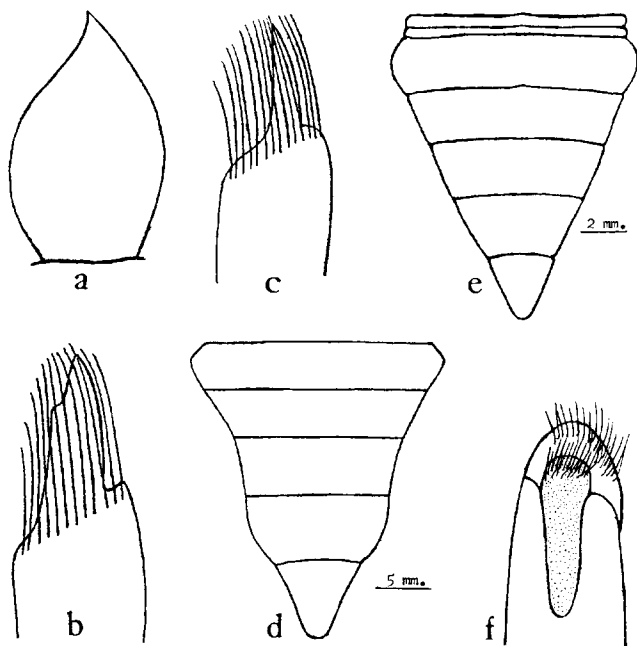


FIGURE 3.—a, b, *Grapsus grapsus*: a, carpal lobe of cheliped (Galapagos Islands); b, first pleopod, male, distal extremity (Galapagos). c, d, *G. strigosus*: c, first pleopod, male, distal extremity; d, abdomen, male. e, f, *G. longitarsis*: e, abdomen, male; f, first pleopod, male, distal extremity.

Grapsus longitarsis Dana, U. S. Exploring Exped., Crustacea 13: 339, 1852 (pl. 21, 1855).—Rathbun (as subspecies of *Grapsus strigosus*), U. S. Fish Comm., Bull. 23 (3): 838, pl. 8, fig. 4, 1903 (1906).—Tesch, Siboga-Exped., Monogr. 39c: 72, 1918.—Sakai, Studies on crabs of Japan IV . . . , 650, pl. 106, fig. 1, 1939.

A smaller species than *G. strigosus*; front of carapace less deflexed, not so deep but relatively wider than in that species. Lateral borders of carapace not arched as in *G. strigosus* but almost straight, slightly divergent posteriorly. Anterior half of carapace more tubercular and middle region more depressed than in *G. strigosus*. Inner suborbital tooth subacute, keeled. Lobe at inner angle of carpus of cheliped narrow and straight; fingers gaping in basal half, narrow at

tips but somewhat hollowed out. Walking legs long and slender, first and fourth subequal; combined length of carpus and propodus greater than that of merus. Abdomen of female very broad, of male triangular. (See figures 1, *c*; 3, *e, f*.)

This species is very close to and may rather easily be confused with *G. strigosus*, of which it was at one time considered by Miss Rathbun to be a subspecies. Its chief characters of distinction, however, are the straighter lateral borders of the carapace and the relatively wider front and longer walking legs.

There are records of the species from Hong Kong, from localities about Japan, the Ryukyu Islands, the Tuamotus, and Hawaii. Bishop Museum records include the islands of Oahu, Molokai, Maui, and Hawaii and also Wake and Palmyra. One of the larger specimens from Oahu is 28 mm. in breadth of carapace.

Key to Hawaiian species of *Geograpsus*

- Carapace flat, widening posteriorly; surface marked by transverse striae, short and broken on gastric, cardiac, and intestinal regions. Sub-orbital area lateral of buccal cavity densely haired.....*G. crinipes*.
 Carapace flat, slightly divergent posteriorly; surface marked by transverse striae, obsolescent on gastric area and absent on cardiac region. Suborbital area lateral of buccal cavity sparsely haired.....*G. lividus*.

Geograpsus crinipes (Dana) Alcock, Asiatic Soc. Bengal, Jour. **69** (2): 396, 1900.—Rathbun, U. S. Fish Comm., Bull. **23** (3): 839, 1903 (1906).—Sakai, Studies on crabs of Japan IV . . . 652, pl. 107, fig. 2, 1939.

Carapace depressed, flat, surface marked by transverse nearly straight striae, of which those on gastric, cardiac, and intestinal areas are short and broken. Lateral borders thin, slightly divergent posteriorly. Free edge of front straight. Infraorbital border serrated, with a large notch near outer end; palate and epistome separated by a granular ridge. Chelipeds subequal in male, unequal in female; squamous markings on merus, carpus, and lower border of palm; upper border of palm and dactylus granular; fingers pointed. Merus of first three walking legs denticulate on lower distal border; this border in fourth walking leg entire. (See figures 4, *a*; 5, *a*.)

The range of this species is very wide, from the Red Sea through the Indian and Pacific Oceans to Japan, Samoa, and Hawaii. There are numerous specimens in Bishop Museum from Hawaii and the Line Islands. Large specimens may exceed 40 mm. in breadth of carapace.

Geograpsus lividus (Milne Edwards) Dana (as *Grapsus lividus*), U. S. Exploring Exped., Crustacea **13**: 340, 1852 (pl. 21, fig. 5, 1855).—Kingsley (as *Orthograpsus hillii*), Acad. Nat. Sci. Phila-

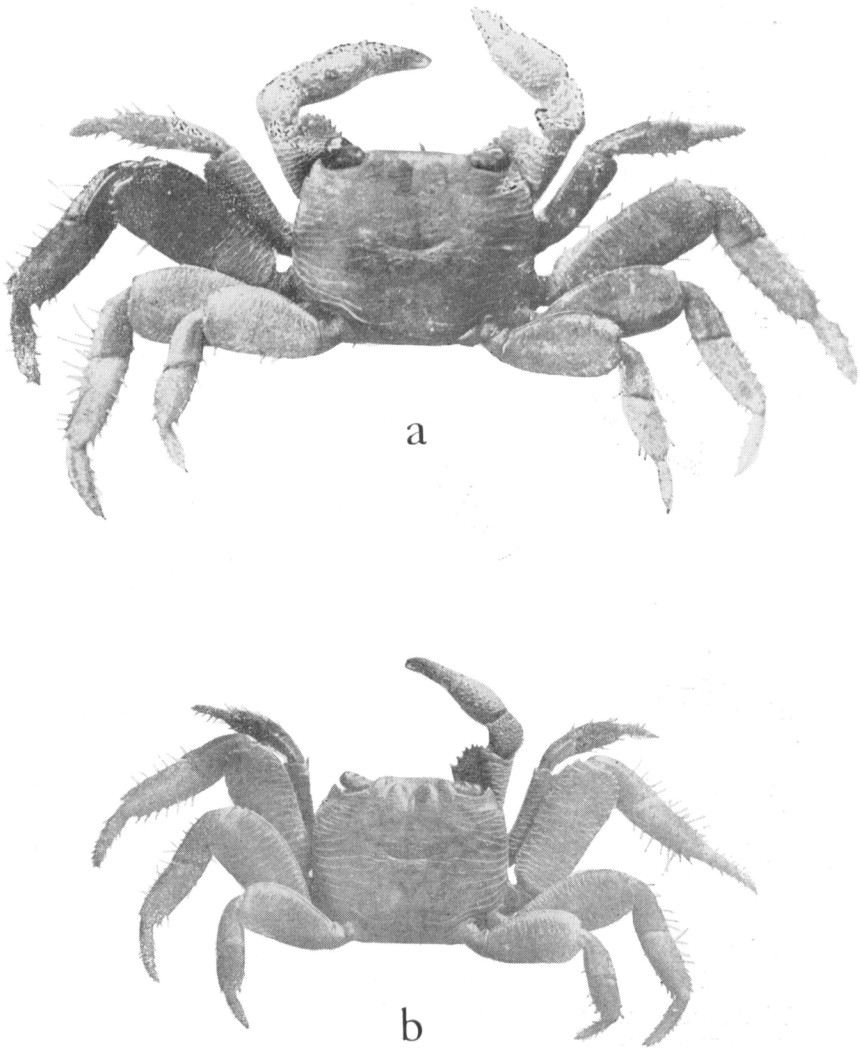


FIGURE 4.—a, *Geograpsus crinipes*; b, *G. lividus* (specimen from Cupica Bay, Colombia; Allan Hancock Foundation).

delphia, Proc. 1880:194, 1881.— Rathbun, U. S. Fish Comm., Bull. 23 (3):839, 1903 (1906); U. S. Nat. Mus., Bull. 97:232, pl. 55, 1918.

Carapace subquadrate, upper surface slightly convex, marked by fine transverse lines which fade away on gastric region and are absent on cardiac area. Free edge of front nearly straight. Suborbital border with a deep notch near outer end. Lateral borders of carapace well defined, almost straight, a small tooth close behind external orbital angle. Chelipeds somewhat unequal; merus marked by transverse lines; carpus, palm, and dactylus tuberculate above. Inner border of merus sharp, expanded, and toothed; a small tooth at inner angle of carpus. First walking leg shorter than fourth; second longest. Breadth of merus of walking legs approximately one-half its length. Segments of walking legs, carpus to dactylus, bearing long bristles. Tufts of hairs borne on basal segments of walking legs 2 and 3, and male abdomen triangular with sides of segments 4 to 7 almost straight, as in *G. crinipes*. (See figures 4, b; 5, b.)

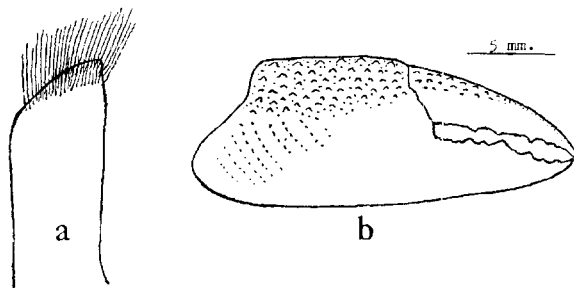


FIGURE 5.—a, *Geograpsus crinipes*, first pleopod, male, distal extremity; b, *G. lividus*, chela, male (Cupica Bay, Colombia; Allan Hancock Foundation).

In general appearance *Geograpsus lividus* closely resembles *G. crinipes* but differs from that species in the lateral borders of the carapace being slightly less divergent. Also, in *G. lividus* a sharp line extends from the buccal cavity toward, and almost to, the posterolateral border of the carapace. In *G. crinipes* this line is less pronounced and the entire suborbital area lateral of the buccal cavity is densely covered with short hairs, but scantily so in *G. lividus*.

I have examined specimens of *G. lividus* among the collections of the Allan Hancock Foundation taken from Cupica Bay, Colombia. An alcoholized specimen (male) with a carapace 26 mm. long and 30 mm. broad has the upper surface of the carapace covered with rather broad, reddish lines, forming a scroll-like pattern on a pale, yellowish background. Authorities have recorded living specimens as red or yellowish red in color.

The normal range of this species appears to be the east and west coasts of America, according to Rathbun, from the Florida keys to Sao Paulo, Brazil; the Bermudas; the Cape Verde Islands; and Lower California to Chile. It is also known from the Galapagos Islands, and was recorded from Hawaii by Kingsley in 1880. Two specimens accredited to Hawaii by A. Garrett are reported to be in the Museum of Comparative Zoölogy, Harvard University.

There are no records of the species having been observed in Hawaii in recent years, and there are no specimens in Bishop Museum.

A subspecies, *G. lividus stormi* de Man, is reported by Sakai (20) to differ from *Geograpsus lividus* in that the carapace is more depressed and flattened and the surface smoother, having fewer transverse striae. Tesch (25) states that in the subspecies the sharp keel extending from the anterolateral angle of the buccal cavity is convex, whereas in the typical species it is straight or sigmoid. The subspecies has been recognized from the Flores Sea, Atjeh, Japan, and the Marquesas Islands. If the early Hawaiian records of the species are accurate, there would seem to be some geographic overlapping in the distribution of the two forms, at least in the eastern half of the Pacific.

Key to Hawaiian species of *Metopograpsus*

- Carapace broader than long, lateral borders converging posteriorly, surface marked by fine striae on postfrontal and lateral branchial regions; inner infraorbital lobe in contact with frontal lobe.....**M. messor.**
 Carapace and other features quite similar to *M. messor*, except inner infraorbital lobe, which is not in contact with frontal lobe.....**M. thukuhar.**

Metopograpsus messor (Forskål) Alcock, Asiatic Soc. Bengal, Jour. 69 (2): 397, 1900.—Rathbun, U. S. Fish Comm., Bull. 23 (3): 839, 1903 (1906).—Tesch, Siboga-Exped., Monogr. 39c: 79, 1918.—Sakai, Studies on crabs of Japan IV . . ., 654, pl. 107, fig. 3, 1939.—Stephensen, Danish sci. invest. in Iran (4): 195, fig. 59, 1945.

Carapace quadrate, a little broader than long, lateral borders converging posteriorly; surface convex and quite smooth, fine oblique striae traverse lateral branchial areas, and short transverse striae mark postfrontal region. Front broad, its free margin beaded, thin and slightly sinuose. Inner infraorbital lobe sharp and crested at apex, its inner margin in contact with frontal lobe. Chelipeds unequal, inner distal border of merus expanded and dentate; carpus wrinkled and granulate, two or three small spinules at inner angle; upper border of hand marked by oblique striae and granules, a longitudinal ridge traversing lower outer border; fingers with blunt tips. First walking leg smallest. Merus of walking legs with a subdistal spine on anterior border and three spinules on posterior distal border. (See figures 6, a; 7, a, b.)

This species is widely dispersed from the Red Sea and east African coast through the Indian Ocean and Indo-Pacific area to Japan and Hawaii. There are many specimens in Bishop Museum from central Pacific regions. In Hawaii it is a common species under stones, on muddy flats, and at the mouths of small streams where they enter the sea. Frequently the carapace and legs of living specimens are well coated with the common rock barnacle, which association may be of some mutual advantage to the organisms concerned. Large specimens of the crab may exceed 30 mm. in breadth of carapace.

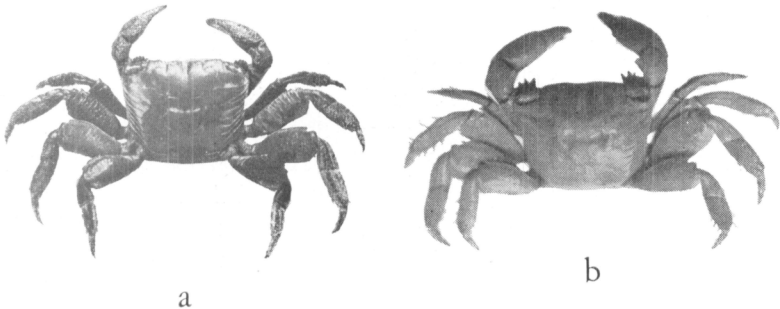


FIGURE 6.—a, *Metopograpsus messor*; b, *M. thukuhar*.

Metopograpsus thukuhar (Owen) (as *Grapsus thukuhar*), Zool. Beechey's Voy., Crustacea, 80, pl. 24, fig. 3, 1839.—A. Milne Edwards, Nouv. Arch. Mus. d'Hist. Nat. Paris 9: 290, 1873.—de Man, Archiv für Naturgesch. 53 (1): 362, pl. 15, fig. 5, 1888.—Tesch, Siboga-Expd., Monogr. 39c: 80, 1918.—Sakai, Studies on crabs of Japan IV . . . , 654, pl. 107, fig. 4, 1939.

Lateral borders of carapace less convergent posteriorly; front narrower resulting in somewhat larger orbits; inner infraorbital lobe not in close contact with frontal lobe (fig. 7, c); more spines on antero-distal border of merus of cheliped; propodi of walking legs relatively longer; penultimate segment (sixth) of male abdomen longer than fifth segment; irregular yellow patches of color on palm and dactylus of cheliped. (See figure 6, b.)

The above-described characteristics distinguishing this species from *M. messor* are adapted from de Man (6). Although convinced that *M. thukuhar* represented a distinct species, de Man recognized that some of the distinguishing characters cited were very slight. Most authors consider the separation of the infraorbital and frontal lobes in *M. thukuhar* to be the chief distinction between the two. This space between

the two lobes permits a portion of the flagellum of the antenna to project into the orbit, which is not the case in *M. messor*. As de Man remarks, this position of the antenna in *M. thukuhar* gives the species an appearance of a *Pachygrapsus*.

In Owen's account of *Grapsus thukuhar*, from a specimen taken at Oahu, characters are set forth which might well be applicable to *Metopograpsus messor*. The color of *Grapsus thukuhar*, however, is described by Owen as "dull yellow, sprinkled closely all over with minute brown spots."

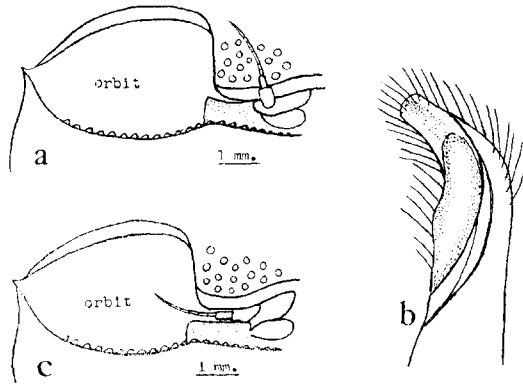


FIGURE 7.—a, b, *Metopograpsus messor*: a, orbital view, with position of antenna; b, first pleopod, male, distal extremity. c, *M. thukuhar*, orbital view, with position of antenna.

Sakai (20), on examining a male specimen from the Bonin Islands which he considered to be *Metopograpsus thukuhar*, states that, in addition to the non-contiguous frontal and orbital lobes, the spinules and striae on the upper surface of the palm of the cheliped are rather coarser and sharper than in *M. messor* and that otherwise the two species are quite alike.

On the reexamination of many specimens in Bishop Museum taken from Hawaiian waters and recorded as *M. messor*, I have observed numerous individuals in which the infraorbital and frontal lobes are sufficiently separated to permit the distal half of the flagellum of the antenna to rest in the orbit. These specimens, without doubt, represent *M. thukuhar*. In one lot of a dozen specimens taken on Waikiki reef, Oahu, nearly 50 years ago, 10 clearly present characteristic features of *M. thukuhar*. Even in color of carapace these specimens, after pres-

ervation in alcohol for many years, are identical with that described by Owen. Although *M. messor* appears to be the dominant species of the genus among the Hawaiian fauna, I am convinced that the form recognized as *M. thukuhar* is also present.

Many investigators have recorded *M. thukuhar* from widely separated Indo-Pacific areas, its best-known range. However, the Pacific is where it is associated with the typical *M. messor*. Tweedie's report (26) of *M. thukuhar* from the Cocos-Keeling Islands was the first record of the species outside the Pacific Ocean.

Key to Hawaiian species of *Pachygrapsus*

- Lateral borders of carapace arched, at least anteriorly; a tooth behind external orbital angle.
 - Front of carapace with a small lobe at either extremity; a large non-pelagic species.....**P. crassipes.**
 - Front of carapace without a lobe at either extremity; a small pelagic species.....**P. marinus.**
- Lateral borders of carapace not arched; no tooth behind external orbital angle.
 - Lateral borders of carapace strongly convergent posteriorly; surface marked by smooth, transverse striae.....**P. minutus.**
 - Lateral borders of carapace slightly convergent posteriorly; surface marked by transverse plications or faint striae.
 - Lateral borders of carapace not concave; surface marked by strong plications with stiff hairs.....**P. plicatus.**
 - Lateral borders of carapace concave; surface partially marked by faint striae without hairs.....**P. planifrons.**

Pachygrapsus crassipes Randall, Acad. Nat. Sci. Philadelphia, Jour. 8 (1) : 147, 1839 (1840).—de Man, Leyden Mus., Notes 12 : 86, pl. 5, fig. 11, 1890.—Rathbun, U. S. Fish Comm., Bull. 23 (3) : 840, 1903 (1906); U. S. Nat. Mus., Bull. 97 : 241, pl. 59, 1918.—Schmitt, Univ. California Pub., Zool. 23 : 270, fig. 159, 1921.—Sakai, Studies on crabs of Japan IV . . . , 655, pl. 74, fig. 2, 1939.—Hiatt, Pacific Sci. 2 (3) : 135, figs., 1948.

Carapace quadrate, a little broader than long; lateral margins convex anteriorly, converging posteriorly; surface marked by transverse and oblique lines except cardiac and intestinal regions. Front broad, free edge nearly straight, a slight lobe at each end. One tooth behind external orbital angle. Chelipeds subequal, large, and stout; palm quite smooth, upper border with raised margin, lower outer surface marked by oblique line; fingers sharp. Second walking legs longest, the fourth shortest; anterior border of merus joints bearing a subterminal spine, distal extremity of lower border dentate except in last leg, which is entire. General color of living specimens dark red, sometimes spotted with pale white or brown. (See figures 8, a; 9, a.)

This shore crab is a very common one on the American west coast ranging from Oregon to the Gulf of California. It is also known from the Galapagos Islands and the coast of Chile. On the western side of the Pacific, it is reported from Korea; and, according to Sakai (20), it is the most common rock crab along the entire main coast of Japan. The species is introduced here by reason of the report by Randall (13) in which the Hawaiian Islands are cited as the type locality. Rathbun (15), however, has considered this record locality probably erroneous.

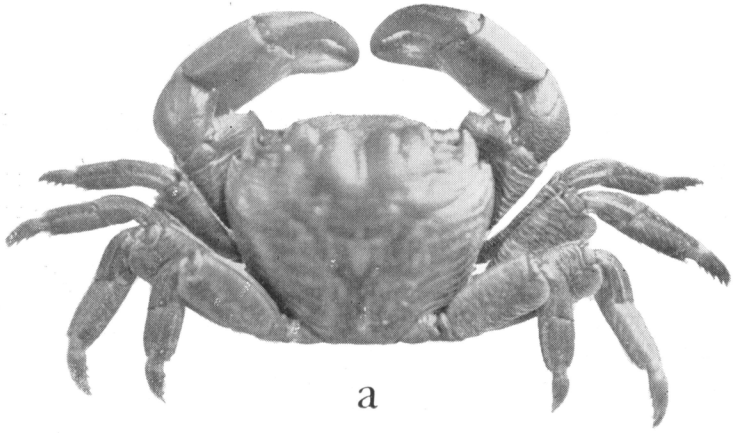
The size of the crab (carapace may exceed 40 mm. in breadth) and its known habits should render its detection rather easy. As there are no reports of the species having been taken or observed in Hawaii in recent years, we are led to conclude that it does not exist here. Neither do we have any record of its presence about any central Pacific island. Figure 8, *a* represents a specimen from Monterey Bay, California, presented to Bishop Museum through the courtesy of Hopkins Marine Station.

Pachygrapsus marinus (Rathbun) (as *Planes marinus*), U. S. Nat. Mus., Proc. 47: 120, pl. 3, 1915; U. S. Nat. Mus., Bull. 97: 258, pl. 64, 1918.—Chace, U. S. Nat. Mus., Proc. 101: 65-103, figs., 1951.

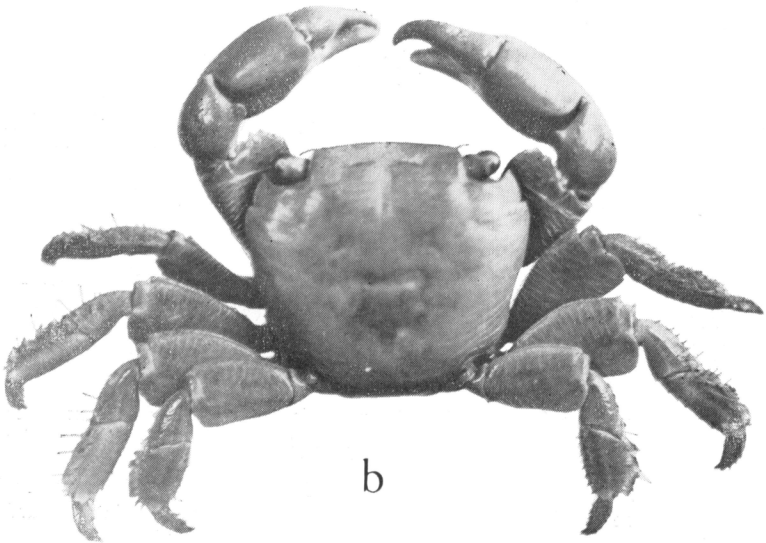
Carapace a little broader than long, surface moderately convex; lateral borders arcuate anteriorly, nearly straight and converging posteriorly, one blunt tooth behind external orbital angle. Free edge of front slightly arcuate, granular. Postfrontal lobes low but distinct. Surface of carapace marked anteriorly by transverse striae and by diagonal ones on branchial areas. Gastric and cardiac regions without striae but microscopically punctate. Chelipeds equal, massive; merus transversely marked by short broken striae, antero-distal border expanded and dentate; carpus faintly striated, a blunt tooth at inner angle; palm swollen, quite smooth, outer surface faintly punctate, upper border marked by very fine oblique striae; fingers dentate. Walking legs short, flattened, merus broad, transversely striate; anterior border of propodus densely haired; dactylus bearing spines and stiff bristles. (See figures 8, *b*; 9, *b*.)

On describing this grapsoid crab as a representative of the genus *Planes*, Dr. Rathbun (17), recognized its close resemblance to *Pachygrapsus*. However, during the more than 30 years which followed, as no more specimens were discovered to serve for further investigations, the name remained *Planes marinus*.

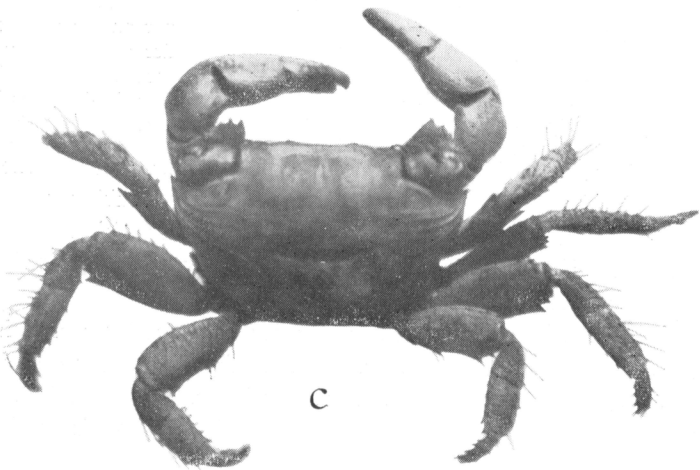
The discovery of additional examples of the pelagic crab in 1947 prompted Fenner A. Chace, Jr. to reexamine the status of this form and other possible species of the genus *Planes*. The result of this survey by Dr. Chace (2) was the removal of Miss Rathbun's species from



a



b



c

FIGURE 8.—a, *Pachygrapsus crassipes* (specimen from Monterey Bay; Hopkins Marine Station); b, *P. marinus*; c, *P. minutus*.

Planes to *Pachygrapsus* and the drawing of a clear distinction between two species of *Planes* which now make up the complement of that genus. Chace's researches also resulted in the reexamination of the brachyuran crabs in Bishop Museum long under the label *Planes*. Among the collections were six lots of *Pachygrapsus marinus* specimens taken at different times from the windward shores of Oahu. In most instances the crab has been observed associated with other pelagic crabs of the genus *Planes*. In one lot of 38 crabs taken from a drift log, 26 proved to be *Pachygrapsus marinus* and 12 were *Planes cyanus* Dana.

Apparently specimens of *Pachygrapsus marinus* have been seen in three general localities in the Pacific, with the type locality the open sea west of Lower California. According to Chace four specimens were recovered from fouling on a Japanese mine which drifted ashore at Lincoln Beach, Oregon, in 1947; and numerous specimens have been taken from flotsam on the windward shore of Oahu. The largest specimen I have seen, a male, has a carapace 30 mm. broad and 28 mm. long.

Pachygrapsus minutus A. Milne Edwards, Nouv. Arch. Mus. d'Hist. Nat. Paris 9: 292, pl. 14, fig. 2, 1873.—Rathbun, U. S. Fish Comm., Bull. 23 (3): 840, 1903 (1906).—Tesch, Siboga-Exped., Monogr. 39c: 77, 1918.—Sakai, Studies on crabs of Japan IV . . . , 656, text fig. 112, 1939.

Carapace broader than long, lateral borders strongly convergent posteriorly, no tooth behind external orbital angle. Surface of carapace somewhat convex, marked by transverse and diagonal striae which are more conspicuous on the branchial areas. Outer surface of merus of chelipeds transversely striated, inner margin expanded at distal extremity, dentate. Carpus and palm quite smooth; fingers spooned at tips. Merus joints of walking legs one-half as broad as long, lower distal margin dentate. Posterior border of merus of last walking leg marked by a tubercle on proximal half bearing a long seta. Propodus and dactylus of walking legs provided with stiff spines and bristles. (See figures 8, *c*; 9, *d*, *e*.)

This species is one of the smaller forms of Grapsidae. The largest specimen in Bishop Museum is 8 mm. in breadth of carapace. Specimens in Bishop Museum are from the Hawaiian area, the Line Islands, Samoa, and Fiji. The species is well known through the Indo-Pacific region to Japan and eastward. New Caledonia is the type locality.

Pachygrapsus plicatus (H. M. Edwards), Rathbun, U. S. Fish Comm., Bull. 23 (3): 839, 1903 (1906).—Tesch, Siboga-Exped., Monogr. 39c: 77, 1918.—Sakai, Studies on crabs of Japan IV . . . , 657, pl. 108, 1939.

Carapace broader than long, moderately convex, the entire dorsal surface strongly marked by transverse and oblique, setose plications. Lateral borders of carapace converging posteriorly, no tooth behind external orbital angle. Front broad, free edge concave in middle. Antenna resting in orbital hiatus. Chelipeds stout, merus marked externally by transverse setose plications, as in carapace, inner distal angle expanded, dentate; carpus with upper and outer surface granular, inner angle produced into a stout tooth. Palm granular above, outer surface smooth, traversed by four longitudinal ridges; fingers hollowed at tips, dactylus with granulated ridges on upper base. Merus joints of walking legs diagonally striated, lower distal borders dentate. (See figures 9, c; 10, a.)

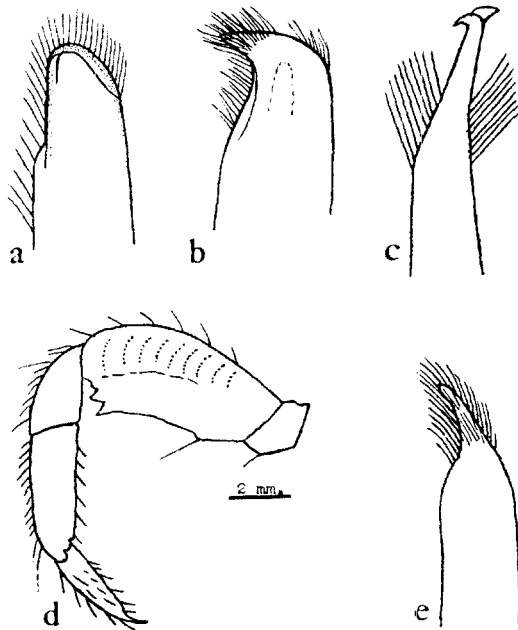


FIGURE 9.—a, *Pachygrapsus crassipes*, first pleopod, male, distal extremity (Monterey Bay; Hopkins Marine Station); b, *P. marinus*, first pleopod, male, distal extremity; c, *P. plicatus*, first pleopod, male, distal extremity. d, e, *P. minutus*: d, fourth walking leg; e, first pleopod, male, distal extremity.

This well-known species has a very wide distribution in the Indian and Pacific Oceans. Most of the records, however, are from the Pacific. It is not uncommon in the Hawaiian area, which is the type locality, where it may be found under stones in shallow water. There are many specimens in Bishop Museum from Hawaii and other central Pacific localities. One of the larger specimens in the collections is 23 mm. in breadth of carapace.

An allied species, *Pachygrapsus transversus* (Gibbes) is widely distributed in the Atlantic Ocean, on the west American coasts, has been taken at the Galapagos Islands as well as in oriental areas, but has not been reported from the central Pacific area. In this species the transverse and oblique striae of the carapace are without setae, and there is a tooth on the lateral border behind the external orbital angle.

Pachygrapsus planifrons de Man, Archiv für Naturgesch. 53 (1): 368, pl. 16, fig. 2, 1888.—Rathbun (as *Pachygrapsus longipes*), U. S. Nat. Mus., Proc. 16: 247, 1893; U. S. Fish Comm., Bull. 23 (3): 840, pl. 8, fig. 7, 1903 (1906).—de Man, Indian Mus., Rec. 2 (3): 218, 1908.—Tesch, Siboga-Exped., Monogr. 39c: 77, 1918.—Ward, Raffles Mus., Bull. 9: 25, 1934.

Carapace quite flat, a little broader than long; front obliquely deflexed, breadth slightly more than one-half distance between external orbital angles, free edge faintly sinuose. Upper surface of carapace marked by transverse and diagonal lines, except gastric and cardiac regions. Postfrontal lobes low and broad, lateral ones merging with superior orbital border. Lateral borders of carapace concave, without a tooth behind external orbital angles. Infraorbital margin microscopically dentate, a tooth and notch near outer end. Ischium of external maxilliped concave on inner margin; merus subcircular with inner border pointed.

Chelipeds equal, stouter in male than in female; upper and outer borders of merus and carpus traversed by diagonal lines. Inner border of ischium bearing a short, sharp tooth; a variable number of teeth (usually three to five) on expanded inner margin of merus and a sharp tooth at inner angle of carpus. Palm appears quite smooth but inner and outer borders, especially lower portion, marked by very fine diagonal lines, microscopically granular; a longitudinal line traverses immovable finger and extends partially across outer border of palm. Fingers longer in female than in male, provided with tufts of stiff hairs at tips; immovable finger more strongly toothed than dactylus.

Walking legs long, slender beyond merus joints; merus rather broad, outer border marked by diagonal lines or weak plications, anterior margin bearing a row of very short spines and subdistal tooth; two teeth of unequal size near distal end of posterior margin. Carpus, propodus, and dactylus bearing numerous long bristles and short spinelets. Abdomen of male (segments 3 to 7) broadly triangular. Length of carapace (male) 9 mm., breadth between external orbital angles 11 mm., breadth of front 6 mm. (See figures 10, *b*; 11, *a-e*.)

The foregoing description based upon a specimen from Johnston Island conforms in principal features with the observation of the type specimen by de Man (6). The front, however, does not appear to be so sharply deflexed as de Man indicates by the "almost vertical" characterization. Also, the anterior margins of the merus joints of the walking legs of the Johnston Island specimen lack the stiff hairs mentioned by de Man. Instead they have very short movable spinelets, and near

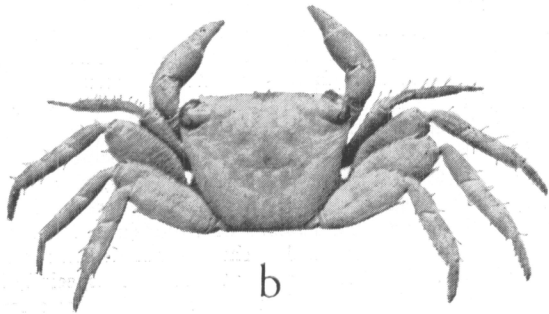
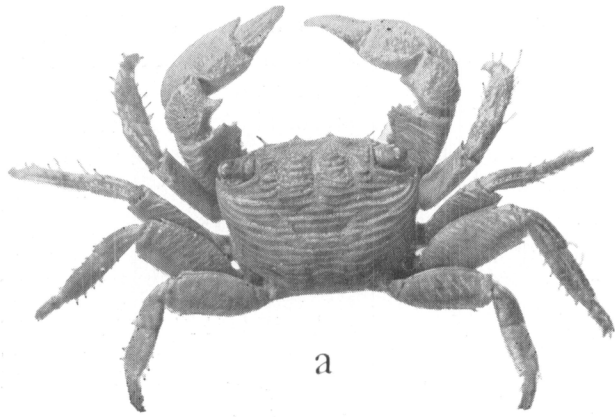


FIGURE 10.—a, *Pachygrapsus plicatus*; b, *P. planifrons*; c, *Planes cyaneus*.

the distal extremity of the posterior margin of this segment are two sharp teeth of unequal size in all the walking legs, instead of the one de Man depicts for the last two legs. Although the specimen I have described does not coincide with the type in every respect, the chief characters agree and I am convinced that it represents *Pachygrapsus planifrons*. Tesch (25) examined a female specimen of *P. planifrons* from Lombok Island, East Indies, which differed from de Man's description of the type to a greater degree than does the Johnston Island specimen. Ward (28) cites the distinctive features of the species as the flat character of the carapace, the sinuous outline of the front, the concave lateral borders, and the hairs at the tips of the fingers, together with the small size of the crab.

In Bishop Museum are specimens identical with the Johnston Island form, except for size, from Oahu, Midway Island, Guam, from numerous Line Island localities and also Canton and Penrhyn Islands. The largest specimens in Bishop Museum are from Johnston Island. Those from other localities have a maximum breadth of carapace of about 8 mm. *P. planifrons* is known from widely separated areas in the Indian Ocean, Indonesian seas, and the Pacific Ocean. The type locality is Noordwachter Island. It appears to be a rather common species about the equatorial islands of the central Pacific Ocean.

In 1893 Rathbun (14) described a small grapsoid crab from Hawaii under the name of *P. longipes* which de Man (9), in 1908, noted was very similar to his *P. planifrons* described in 1888. In considering *P. longipes*, Rathbun compared it with *P. plicatus* but made no mention of de Man's species, which omission was probably due to an oversight in literature. More recently Tesch (25), on the strength of de Man's observation, placed *P. longipes* in synonymy under *P. planifrons*, with reservations. On the opinion of Dr. Chace (letter of July 6, 1955), of the United States National Museum, where specimens of *P. longipes* Rathbun are on deposit, the species should be considered, without question, a synonym of *P. planifrons* de Man. From minor but rather constant differences in structural features noted by investigators it appears that the species may be represented by geographical variants.

Key to Hawaiian genera of Varuninac

- Lateral border of carapace with one tooth behind external orbital angle;
 merus of external maxilliped broader than long..... **Planes**.
- Lateral border of carapace with two teeth behind external orbital angle;
 merus of external maxilliped as long as, or longer than, broad.....
 **Hemigrapsus**.

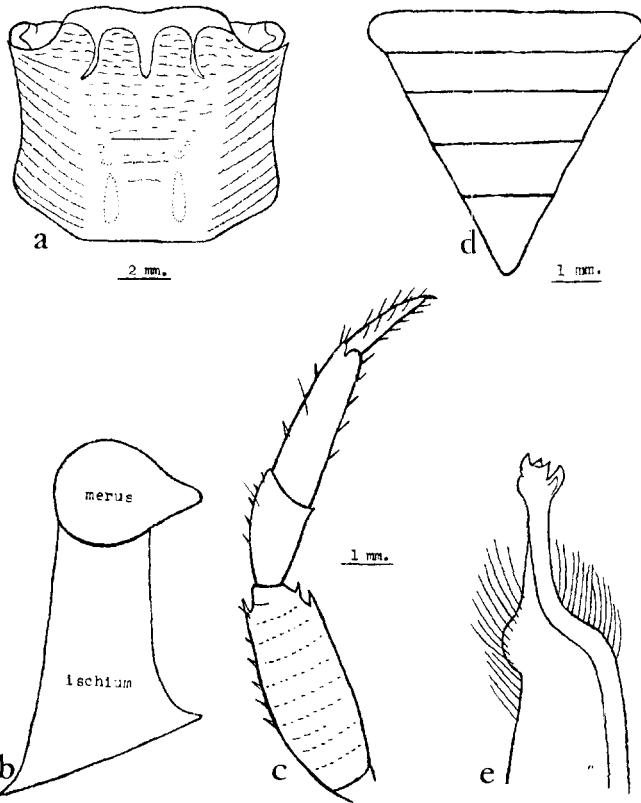


FIGURE 11.—*Pachygrapsus planifrons*: a, carapace (after de Man); b, outer maxilliped (ischium-merus); c, fourth walking leg; d, abdomen, male, segments 3-7; e, first pleopod, male, distal extremity.

Key to known species of *Planes*

- Carapace with lateral sides evenly convex; fourth segment of male abdomen abruptly narrower than third, terminal segment with convex sides.....***P. cyaneus***.
- Carapace with lateral sides convex in older specimens; fourth segment of male abdomen not abruptly narrower than third, terminal segment with straight sides.....***P. minutus***.

Planes cyaneus Dana, Acad. Nat. Sci. Philadelphia, Proc. 5: 250, 1852; U. S. Exploring Exped., Crustacea 13: 347, 1852 (pl. 22, fig. 1, 1855).—Rathbun (as *Planes minutus*), U. S. Fish Comm., Bull.

23 (3): 840, 1903 (1906).—Ward, Am. Mus., Nov. 1049: 14, 1839.—Chace, U. S. Nat. Mus., Proc. 101: 65-103, figs., 1951.—Garth, Lunds Univ. Årsskrift 53 (7): 96, 1957.

Carapace slightly longer than broad, upper surface convex, appearing quite smooth but microscopically punctate and marked by faint transverse lines mostly short and broken but longer and diagonal on the branchial areas. Front bilobed, broadly concave in middle; lateral borders convex, a slight notch behind external orbital angle. Chelipeds equal, massive, especially in male, quite smooth; merus transversely striated on outer border, inner margin sharp, finely serrate with low teeth on distal border. Carpus faintly marked by broken lines on outer and upper borders, a blunt tooth at inner angle; palm marked by microscopic punctae on outer border and irregular, diagonal lines above; lower inner border marked by fine transverse lines which become low ridges on lower border. Fingers stout, pointed at tips; cutting edge of immovable finger angled downward from near middle and more strongly toothed than dactylus. Walking legs short, flattened, merus broad; front border of carpus and propodus fringed with hair; dactylus short, broad, and stubby, bearing numerous spines and bristles. (See figures 10, c; 12, a, b.)

For nearly 100 years prior to 1951 Dana's *Planes cyaneus* was generally neglected, the species being assigned to another genus or brought within the scope of *P. minutus* (Linnaeus, 1758), which name became an all inclusive one for these pelagic crabs known the world around within tropical and temperate latitudes. Ward (29), however, recognized the validity of Dana's species; and the critical study by Chace (2) reestablished its authenticity, pointing out characters which clearly distinguish it from *P. minutus*. Furthermore, it was concluded, on the basis of specimens available to Chace, that two species of *Planes* exist, the typical form of the Atlantic Ocean being *P. minutus*, whereas *P. cyaneus* ranges widely through the Pacific Ocean. It was revealed that specimens from localities along the American west coasts and in the central Pacific area, once determined as *P. minutus*, are in reality *P. cyaneus*. A reexamination of specimens in the western Pacific, the Indian Ocean, the Mediterranean Sea, and elsewhere is desirable to confirm present records or correct errors and to fix regions of overlapping distribution of the two species, if two exist.

In a survey of specimens of *Planes* in Bishop Museum, 17 lots were each labeled *P. minutus*. Most of the specimens were taken from windward Oahu, but other localities include Midway Island, Laysan, Lord Howe Island, and Okinawa. I have also examined a specimen recovered in mid-ocean, latitude 6° 13' N., longitude 158° 53' W., which was clinging to fishing gear of the SS. *Hugh M. Smith*, survey ship of the Fish and Wildlife Service. All specimens examined proved to be

examples of *P. cyaneus*, as did those taken in the Hawaiian area by the *Albatross* which are now in the United States National Museum, Washington, recorded as *P. minutus* by Rathbun (15). The length of carapace of the largest specimen of *P. cyaneus* in Bishop Museum is 28 mm., breadth 26 mm.

Chace (2) indicates the following characters by which the distinction between *P. minutus* and *P. cyaneus* may be recognized:

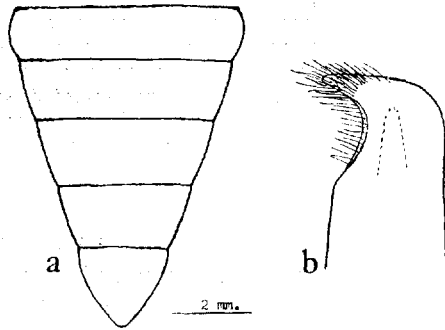


FIGURE 12.—*Planes cyaneus*: a, abdomen, male, segments 3-7; b, first pleopod, male, distal extremity.

Carapace in *P. minutus* is subquadrate in very young specimens, trapezoidal when medium size (6-12 mm.), and laterally convex in older specimens, whereas the carapace of *P. cyaneus* is laterally convex at all sizes.

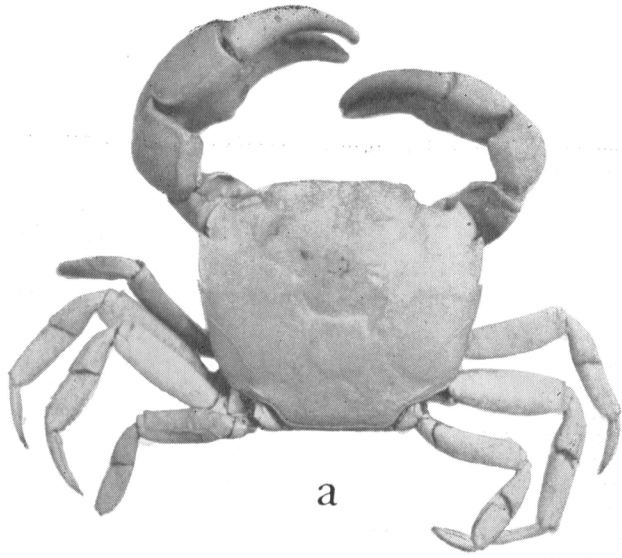
Male abdomen in *P. minutus* is rather broadly triangular (third to seventh segments); terminal segment triangular with straight sides, whereas in *P. cyaneus* the abdomen is triangular (fourth to seventh segments), fourth segment abruptly narrower than third; terminal segment shorter than broad with convex sides.

Walking legs relatively longer in *P. minutus* than in *P. cyaneus*, and old specimens are usually a little smaller than those of *P. cyaneus*.

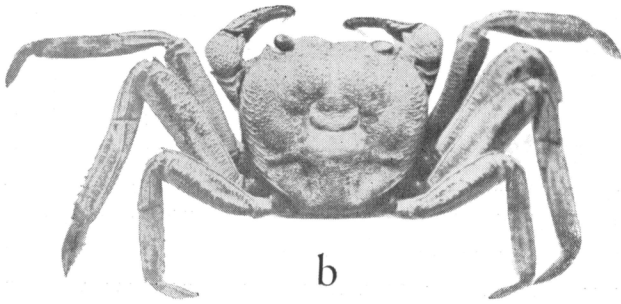
Apparently there is no authenticated record of the occurrence of *P. minutus* about the Hawaiian Islands or in the central Pacific area. A recent report by Garth (4) lists known records of *P. cyaneus* on the west coast of South America.

Key to Hawaiian species of Hemigrapsus

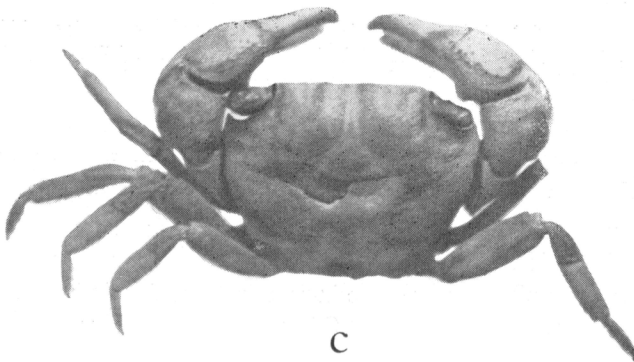
Tufts of hairs on outer and inner surfaces at base of fingers of chelipeds in adult males; suborbital stridulating ridge consisting of coarse granules (inner portion) and two lobes of unequal length and a single tubercle (outer portion)..... **H. penicillatus.**



a



b



c

FIGURE 13.—a, *Hemigrapsus penicillatus*; b, *Sesarma rotundata* (after Rathbun); c, *S. obtusifrons*.

No tufts of hairs on either surface at base of fingers of chelipeds; sub-orbital stridulating ridge consisting of granules (inner portion) and separate tubercles (outer portion).....**H. crassimanus.**

Hemigrapsus penicillatus (de Haan) Stimpson (as *Heterograpsus penicillatus*), Acad. Nat. Sci. Philadelphia, Proc. **1858**: 104, 1859.—de Man, Leyden Mus., Notes **1**: 71, 1879.—Kingsley, Acad. Nat. Sci. Philadelphia, Proc. **1880**: 209, 1881.—Tesch (as *Brachynotus penicillatus*), Siboga-Expd., Monogr. **39c**: 104 (key), 1918.—Shen, Zool. Sinica A, **9**: 163, pl. 7, text figs., 1932.—Edmondson, B. P. Bishop Mus., Occ. Papers **20** (13): 236, fig. 36, 1951.

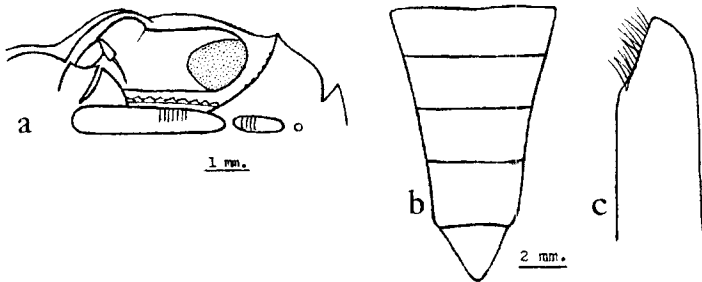


FIGURE 14.—*Hemigrapsus penicillatus*: a, suborbital stridulating organ; b, abdomen, male, segments 3-7; c, first pleopod, male, distal extremity.

Carapace a little broader than long, upper surface convex, quite smooth, punctate and granulate anteriorly. An oblique ridge extending from behind last tooth of lateral border backward to cardiac area. Front broader than one-half breadth of carapace, margin granular, slightly sinuose. Lateral border of carapace with three teeth including external orbital angle, last tooth smallest. Suborbital stridulating ridge of six to eight coarse granules on inner portion, outer portion consisting of three divisions, innermost longest, outer a single tubercle. (See figure 14, a.)

Chelipeds of male unequal, stout, surface smooth, a blunt tooth at inner angle of carpus. Palm swollen, fingers curved inward, provided with numerous rounded teeth. A tuft of hair on both inner and outer borders at base of fingers in adult male. Walking legs slender, dactylus sharp, nearly as long as propodus. (See figures 13, a; 14, a-c.)

Six specimens of the species collected at Laysan Island by W. A. Bryan in 1903 are now in Bishop Museum. The largest, a male, is 23 mm. in breadth of carapace. There is no recent record of the species having been seen in the central Pacific area. The type locality is Japan, where it is a common littoral crab in certain localities. It is also known from Formosa, from the coasts of China, and from Korea.

The tufts of hair on either side of the palm at the base of the fingers appear to be an age feature as well as a sexual feature, as they are observed only in adult males. The abdomen of the male is rather narrow with the lateral margins of segments 3 to 6 concave. (See figure 14, *b*.)

Hemigrapsus crassimanus Dana, U. S. Exploring Exped., Crustacea 13: 349, 1852 (pl. 22, fig. 4, 1855).—Rathbun, U. S. Fish Comm., Bull. 23 (3): 839, 1903 (1906); Lingnan Sci. Jour. 8: 87-88, 1929.

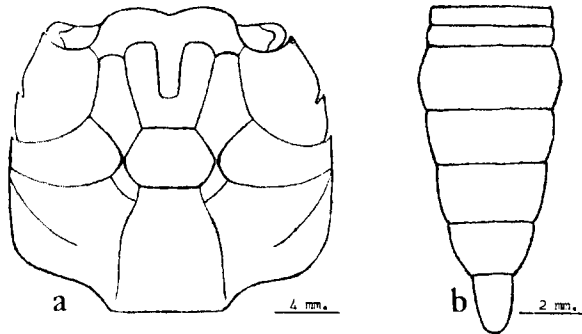


FIGURE 15.—*Hemigrapsus crassimanus*: a, carapace; b, abdomen, male. (After Dana.)

Carapace quadrate, very little broader than long, upper surface finely granular; front consisting of two convex lobes. Lateral borders of carapace slightly arcuate, cut into three teeth including external orbital angles, last tooth the smallest. Chelipeds of male stout and smooth; carpus indented on upper surface; palm swollen, somewhat flattened on upper border. Walking legs slender; merus hairy on lower border; carpus, propodus, and dactylus pubescent, propodus sulcate on upper border. Abdomen of male narrow, terminal segment elongate. (See figure 15, *a, b*.)

Opinions have differed regarding the status of the genera *Brachynotus* de Haan, 1835; *Heterograpsus* Lucas, 1849; and *Hemigrapsus* Dana, 1851. Tesch (25), on reviewing the conclusions of numerous investigators, was convinced that not only *Heterograpsus* and *Hemigrapsus* are identical but that both should be placed in synonymy under *Brachynotus*. The logical result of this view would be to place *Hemigrapsus crassimanus* Dana in synonymy under *Brachynotus sanguineus* (de Haan). Not all systematists, however, have accepted this position

for Dana's species. Rathbun (19) pointed out differences between *Brachynotus* and *Hemigrapsus* substantial enough, it would seem, to warrant their continued separation. Furthermore, Rathbun called attention to specific distinctions between *Hemigrapsus crassimanus* Dana and *H. sanguineus* (de Haan), including, especially, the suborbital stridulating ridge which, in the female *H. crassimanus*, is formed of granules in the inner three-fifths and in the outer remaining portion is composed of separate tubercles. In *H. sanguineus* the stridulating ridge in both male and female is an entire ridge, growing smaller toward its outer extremity and transversely striated throughout its length. In view of these generic and specific differences pointed out

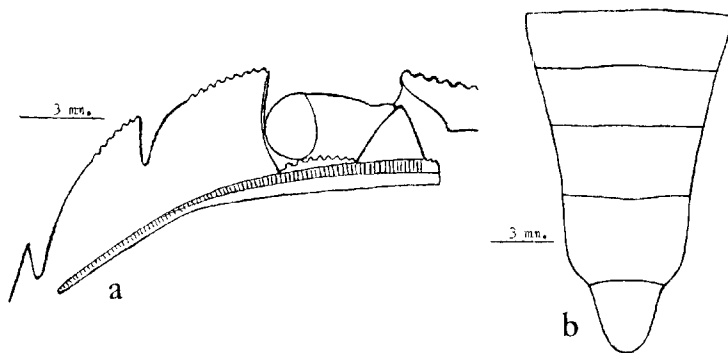


FIGURE 16.—*Hemigrapsus sanguineus*: **a**, showing suborbital stridulating organ; **b**, abdomen, male, segments 3-7. (From Fiji.)

by Rathbun, I believe there is justification in maintaining a separate status for *H. crassimanus* Dana.

I have examined a specimen of *H. sanguineus* (de Haan) from Fiji in which there are apparent differences from Dana's *H. crassimanus* in the carapace, the character of the suborbital stridulating ridge, and the male abdomen (fig. 16, *a, b*). In the specimen described by Dana the carapace had a breadth of about 18 mm.

Although Hawaii was recorded as the type locality of *H. crassimanus* by Dana more than 100 years ago, no specimens have been observed in local waters since that time, and no other report of the species is known.

Key to Hawaiian genera of Sesarminae

- Antenna resting in orbital hiatus.
- Front strongly deflexed, bordered by a prominent postfrontal ridge. A sieve-like reticulation well developed on pterygostomian and subhepatic areas. Lateral borders of carapace usually straight, entire, or dentate, upper surface often bearing tufts of hairs.....**Sesarma**.
- Front obliquely deflexed, not bordered by a postfrontal ridge. No reticulation on pterygostomian or subhepatic areas. Lateral borders of carapace more or less arched, entire or feebly toothed.....**Cyclograpsus**.
- Antenna excluded from the orbit. Front deflexed, bordered by a postfrontal ridge, lobes of which are close together. Lateral borders of carapace entire.....**Metasesarma**.

Key to Hawaiian species of *Sesarma*

- Carapace granular, with or without tufts of hair; free margin of front deeply emarginated or sinuose; lateral borders with one or two distinct teeth behind external orbital angle.
- Carapace with tufts of hair; free margin of front deeply emarginated; lateral borders slightly concave, with one tooth behind external orbital angle.....**S. (*Sesarma*) angustifrons**.
- Carapace without tufts of hair; free margin of front sinuose; lateral borders strongly arched, with two teeth behind external orbital angle.....**S. (*Sesarma*) rotundata**.
- Carapace granular, without tufts of hair; free margin of front slightly emarginate or convex; lateral borders entire or with but a trace of a tooth behind external orbital angle.....**S. (*Holometopus*) obtusifrons**.

Sesarma (Sesarma) angustifrons A. Milne Edwards, Nouv. Arch. Mus. d'Hist. Paris, Bull. **5**: 26, 1869.—de Man, Zool. Jahrb. **4**: 432, pl. 10, fig. 10, 1889; Leyden Mus., Notes **21**: 134, pl. 12, fig. 17, 1899.—Rathbun, U. S. Fish Comm., Bull. **23** (3): 840, 1903 (1906).

Description of Hawaiian specimen by A. Milne Edwards (3):

Carapace narrow, broader behind than in front, upper surface moderately convex, bearing small tufts of hairs toward the front and along the sides. Front concave in the middle. One very small tooth on the lateral border of the carapace behind the external orbital angle. Chelipeds slender, palm marked on inner surface by a short, diagonal, spinous crest. Walking legs long and slender.

Description of Tahitian specimens from de Man (7):

Length of carapace equals its width between external orbital angles; posteriorly, carapace is wider than in front. Areas of surface of carapace well defined by shallow furrows; tufts of short hairs borne on the postfrontal region and along the lateral borders. Front turned down nearly vertically, its free margin deeply emarginated in the middle. Median postfrontal lobes about twice the breadth of lateral ones. Lateral borders of carapace slightly concave, bearing a small, acute tooth behind the external orbital angle. Chelipeds of male fairly

small, the left one slightly the stouter. Merus generally smooth with one small spine on anterior border; carpus spinous above and bearing a blunt tooth at inner angle. Outer border of palm convex, bearing some sharp tubercles, upper border without pectinate ridges, inner border bearing a short oblique ridge with 5 or 6 spines. Fingers longer than palm. Walking legs very slender; merus nearly three times as long as broad, a sharp spine on its antero-distal border; propodus narrow, about four times as long as broad; dactylus slightly hooked, about as long as propodus. (See figure 17, *a*.)

The type locality of *S. angustifrons* is Hawaii, but there is no certain record of the species from this area since the report by Edwards. Rathbun (15) records one specimen in the Peabody Museum, Yale University, collected by W. H. Pease probably in the Hawaiian Islands. However, inquiries at the Peabody Museum, Yale University; the United States National Museum, Washington; the Museum of Comparative Zoölogy, Harvard University; and the Peabody Museum, Salem, Massachusetts fail to reveal the presence of such a specimen. The few specimens of the species known to have been collected in the Pacific apparently are in European museums. De Man's description of *S. angustifrons* was based on a male specimen from Tahiti having a carapace 15 mm. in length and 18 mm. in breadth.

Sesarma (Sesarma) rotundata Hess, *Archiv für Naturgesch.* 31: 149, pl. 6, fig. 9, 1865.—Rathbun (as *Sarmatium faxoni*), *U. S. Fish Comm., Bull.* 23 (3): 841, pl. 7, fig. 5, 1903 (1906).—Tesch, *Zool. Meded.* 3: 193, 1917.—Sakai, *Studies on crabs of Japan IV* . . . , 687, pl. 110, fig. 4, 1939.

Carapace a little broader than long, anterior third inclined; front portion (nearly one-half) of upper surface granular, posterior portion grooved and pitted, with some marginal oblique striae. Front vertical, free margin sinuose, postfrontal ridge bilobate. Lateral borders of carapace strongly arched and bearing three teeth, including the external orbital angle which is the largest and the last the smallest. Merus of cheliped with external surface marked by transverse granular striae and a row of sharpish tubercles below. Outer surface of carpus rough, inner angle produced into a blunt tooth. Outer and inner borders of palm granular, also upper border of dactylus and lower border of pollex. Walking legs long, rather narrow and flat; merus broadening distally, bearing a subterminal spine above. Abdomen of female very broad, the last segment set deeply into preceding one. Abdomen of male with sides of segments 3 to 5 slightly concave, of sixth segment convex; terminal segment with free end broadly rounded. (See figures 13, *b*; 17, *b*.)

Rathbun (15) described specimens under the name, *Sarmatium faxoni*, new species, but later (16) recognized the true position to be under the present species. The species ranges widely through the Indo-Pacific area to Australia and Japan and east to Fiji, Samoa, and the

Hawaiian Islands. A specimen was collected near Oahu nearly 100 years ago but, in so far as we know, there are no recent records from this locality. Large specimens may exceed 40 mm. in breadth of carapace. There are no specimens in Bishop Museum.

Sesarma (Holometopus) obtusifrons Dana, U. S. Exploring Exped., Crustacea 13: 355, 1852 (pl. 22, fig. 9, 1855).—de Man, Zool. Jahrb. 9 (2): 161, 1895; op. cit. 10: pl. 29, fig. 31, 1898.—Rathbun, U. S. Fish Comm., Bull. 23 (3): 840, 1903 (1906); Mus. Comp. Zool., Mem. 35 (2): 35, 1907.

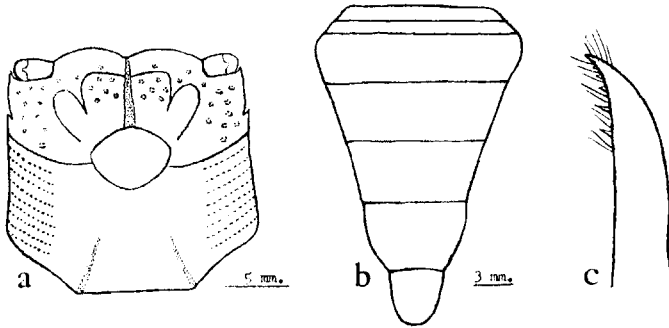


FIGURE 17.—a, *Sesarma angustifrons*, carapace (after de Man); b, *S. rotundata*, abdomen, male (after Rathbun); c, *S. obtusifrons*, first pleopod, male, distal extremity.

Carapace broader than long, surface somewhat irregular, with areas well defined, granulose. Front vertical, fairly deep, free margin slightly emarginate in male, convex in female. Lateral borders of carapace slightly concave between hepatic and branchial areas then becoming a little convex as they converge toward posterior border. No diagonal lines mark surface. Chelipeds of male subequal; upper border of merus unarmed but with a sharp angle at distal end; upper border of carpus granulose, inner angle fairly sharp. Palm of hand granular on upper and inner borders and part of outer surface. Lower border of immovable finger forms a straight line with lower border of hand. Inner surface of palm bears a slightly enlarged ridge carrying 10 or 11 granules.

Length of merus of walking legs more than two times its breadth, with no sharp spine on antero-distal border, lower distal margin also unarmed. Segments of walking legs following merus have a short compact form; propodus haired on anterior border and dactylus, which is shorter than propodus, also haired. (See figures 13, c; 17, c.)

This is a small species, the larger specimens ranging from 15 to 20 mm. in breadth of carapace. It is usually found under stones between tides or even above high water mark. Specimens in Bishop Museum

are mostly from Oahu, and it is also known from other Hawaiian islands. The range of the species is extensive, having been reported from Atjeh by de Man (8) and from Niue by Rathbun (16). There is a specimen in Bishop Museum from Guam.

Metasesarma trapezium (Dana) (as *Sesarma trapezium*), U. S. Exploring Exped., Crustacea 13: 354, 1852 (pl. 22, fig. 8, 1855).—Stimpson, Acad. Nat. Sci. Philadelphia, Proc. 1861: 373, 1862.—Rathbun [as *Sesarma (Holometopus) trapezium*], U. S. Fish Comm., Bull. 23 (3): 841, 1903 (1906).—Tesch, Zool. Meded. 3: 213, 1917.

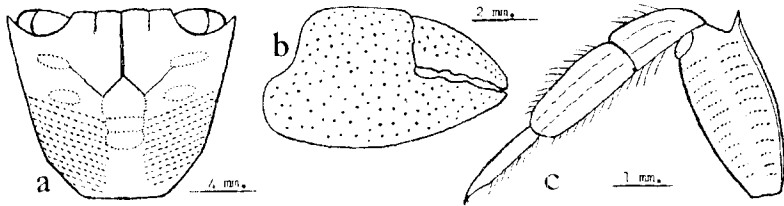


FIGURE 18.—*Metasesarma trapezium*: a, carapace; b, right chela; c, walking leg. (After Dana.)

Carapace quadrate, surface somewhat uneven, anterior portion bearing minute granules, posterior half marked by raised, diagonal lines. Front broad, abruptly bent down, postfrontal border faintly four-lobed. Lateral borders of carapace entire, sharply converging posteriorly. Chelipeds granulate; hand short, quite smooth except for minute sharpish granules. Movable finger with a dense hairy spot near base. Walking legs compressed, merus rather broad; carpus, propodus, and dactylus hairy on margins. Abdomen of male narrow. (See figure 18, a-c.)

This minute form (length of carapace 11 mm.) is known only from Dana's description and figures (here adapted); and the Hawaiian locality, as cited, has remained unverified through the past 100 years. Stimpson (23), within 10 years after Dana's report, recognized the species as a member of the genus *Metasesarma* instead of *Sesarma*. Although Rathbun (15) did not accept this generic change, some more recent authors, including Tesch (24), have done so.

Key to Hawaiian species of *Cyclograpsus*

Lateral borders of carapace convex, surface smooth except for granules near antero-lateral angles. Abdomen of male broad, sides subparallel

..... **C. cinereus.**

Lateral borders of carapace subparallel except close behind external orbital angles. Abdomen of male narrowing distally, sides more or less concave.

Surface of carapace densely granular (punctate) on nearly anterior half. Sides of abdomen of male slightly concave. Cutting edges of fingers not dentate.....**C. granulatus.**

Surface of carapace punctate on frontal and antero-lateral areas only. Sides of abdomen of male distinctly concave. Cutting edges of fingers dentate.....**C. henshawi.**

Cyclograpsus cinereus Dana, U. S. Exploring Exped., Crustacea 13: 360, 1852 (pl. 23, fig. 3, 1855).—Rathbun, U. S. Fish Comm., Bull. 23 (3): 840, 1903 (1906); U. S. Nat. Mus., Bull. 97: 327, pl. 98, 1917.—Tesch, Siboga-Exped., Monogr. 39c: 126, 1918.

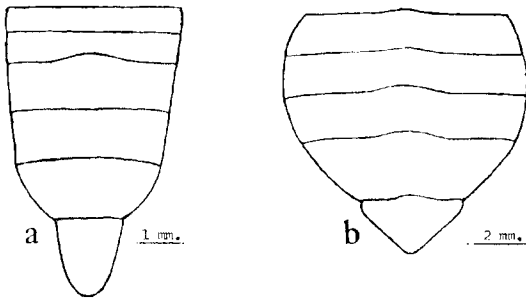


FIGURE 19.—*Cyclograpsus cinereus*: **a**, abdomen male, segments 2-7; **b**, abdomen, female, segments 3-7. (Specimens from Peru; Allan Hancock Foundation.)

Carapace broader than long, smooth for greater part of upper surface; below a deep furrow extends backward from orbit. Merus of outer maxilliped as long as, or longer than, ischium, its crest extending back toward posterior outer angle of ischium. Chelipeds large and stout, especially in male, subequal, quite smooth; fingers pointed, denticulate. Merus of walking legs smooth, unarmed; propodus and dactylus hairy. Abdomen of male characterized by nearly straight, subparallel sides of segments 2-5. Terminal segment of abdomen (male) narrow, elongate; (female) broadly triangular. (See figure 19, *a, b.*)

This species should be recognized easily by the convexity of the lateral borders of the carapace and by the male abdomen with its nearly parallel sides. However, the chances of finding it in the Hawaiian area are small. The only record of the species for Hawaii is that of Dana, and Rathbun (15) observes that this locality may be erroneous. The established range of *C. cinereus* is from Panama to Chile on the west