

A REVIEW OF THE INDO-WEST PACIFIC SPECIES OF GENUS *PACHYCHELES* (PORCELLANIDAE, ANOMURA)*

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ABSTRACT

Pachycheles is a well-defined genus in the Porcellanidae, occurring world-wide and with approximately 40 species. To date the Indo-West Pacific members of the genus have not been reviewed as a whole. In this area there is a total of 11 species: of these, two have recently been described and two more have not previously been recognized as members of genus *Pachycheles*.

INTRODUCTION

PACHYCHELES Stimpson, 1858, is a well-defined genus in the Porcellanidae, occurring world-wide in tropical, warm-temperate, and cold-temperate regions and with approximately 40 species. Most of them live intertidally or in shallow water, although occasional individuals of a few species have been dredged in depths of 100 meters or more. Like most porcellanids they conceal themselves under stones, in the cavities of sponges, or among algae; in tropical regions they frequently live in corals.

Pachycheles belongs to that group of genera in which the basal antennal segment is short, not excluding the movable segments from the orbit. The carapace is usually about as broad as long in males and somewhat broader than long in females. The outer orbital angle is produced into a spine in some species but, except for spiniform tubercles which may be developed along the lateral margins (a condition occurring only in *P. spinipes*), there are no other spines on the carapace. The front is trilobate, but the anterior part of the frontal region is usually sharply deflexed so that the lobes are not visible in dorsal view. The lateral walls of the carapace (epimera) are incomplete, with the posterior (sub-branchial) portion consisting of one or more pieces separated by membranous interspaces from the anterior portion—a character shared by none of the other porcellanid genera which are represented in the Indo-West Pacific. The chelipeds are robust, and in males one is distinctly larger than the other; in females the difference between the two chelipeds is not always great. A strong lobe is developed on the anterior margin of the merus. The walking legs are usually hairy and the dactyl terminates in a single claw. There are either seven or five plates in the telson of the abdomen; five are present in all Indo-West Pacific species (the number of plates is unknown in *P. pectinirarpus*).

Certain characters, constant within a given species, are most useful in distinguishing members of genus *Pachycheles*. These include (1) presence or absence of a tuft of hair on the frontal region of the carapace; (2) structure of the hairs (whether plumose or not) on the carapace, chelipeds and walking legs; and (3) presence or absence of a pair of pleopods in males.

The present study grew out of routine attempts to identify specimens from various parts of the Indian and Pacific Oceans and to determine where each species might be expected to occur, during which it soon became apparent that a review of the Indo-West Pacific members of the genus was

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needed. In general, only the first of the three characters enumerated above has been mentioned in published discussions of the species, while too much reliance has been placed on certain other characters, such as the degree of tuberculation of the chelipeds, which are extremely variable within some forms. As a result there has been much confusion regarding the status of several species and their distribution.

Two recent studies (Haig, 1964; and 1965) dealt in part with *Pachycheles sculptus* and several species which have been confused with it. In the present paper, eleven Indo-West Pacific species of *Pachycheles* are recognized. Only published locality records which could be verified, or which seem reasonably certain, are cited. Locality records which have not appeared in the literature are marked with an asterisk (*).

KEY TO THE INDO-WEST PACIFIC SPECIES

1. Carapace devoid of hairs.....2
Carapace distinctly hairy.....7
2. Males with a pair of pleopods.....3
No pleopods in males.....4
3. Front narrow, rounded-triangular; walking legs with non-plumose hairs.....*natalensis*
Front broad, transverse, with a small median notch; walking legs thickly covered with plumose hairs.....*garciaensis*
4. Anterior portion of carapace covered with strong rugae and squamae; chelipeds and walking legs with strongly projecting, thorn-shaped tubercles.....*spinipes*
No strong rugae or squamae across anterior portion of carapace; no thorn-shaped tubercles on chelipeds and walking legs.....5
5. Carpus and chela with longitudinal rows of well-separated tubercles, latter covered with short hairs.....*granti*
Chelipeds devoid of hairs.....6
6. Anterior regions of carapace smooth; chelae smooth, tuberculate, or with four longitudinal ridges.....*sculptus*
Anterior regions of carapace roughened by grooves; chelae with large, scalloped-edged tubercles.....*johnsoni*
7. Front without a distinct tuft of hairs; surface of carapace posterior to frontal region with scattered hairs.....*pisoides*
Front with a distinct tuft of hairs; carapace otherwise hairless or nearly so.....8
8. Carpus and chela minutely hairy or devoid of hairs.....9
Carpus and chela thickly covered with hairs.....10
9. Carpus of chelipeds sulcate, and with about three broad teeth on anterior margin...*stevensii*
Carpus of chelipeds not sulcate, and with about eight small teeth on anterior margin...*pectinincarpus*
10. Frontal tuft composed of plumose hairs only; carpus and chela covered with plumose hairs.....*balssi*
Frontal tuft composed of short plumose hairs and long, scattered, non-plumose setae; carpus and chelae covered with short plumose hairs and long, scattered, non-plumose setae.....*tomentosus*

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Pachycheles sculptus (H. Milne Edwards)

Porcellana sculpta H. Milne Edwards, 1837, p. 253 (type locality: Java; holotype in Paris Museum).

Porcellana pisum H. Milne Edwards, 1837, p. 254 (type locality: China; type not extant?).

Porcellana pulchella Haswell, 1882, p. 758 (type localities: Holborn Island and Port Molle, Australia; types in Australian Museum).

Pachycheles sculptus Ortmann, 1894, p. 29. Haig, 1964, p. 368.

Pachycheles sculptus var. *tuberculatus* Borradaile, 1900, p. 423 (type locality: Lifu, Loyalty Islands; types in Cambridge Museum).

Diagnosis.—Carapace devoid of hairs. Surface smooth except for faint rugosities on frontal region and series of grooves crossing posterolateral areas; carapace of some specimens very smooth, shining, strongly convex. Front in dorsal view broad, transverse.

Chelipeds devoid of hairs; extremely variable in ornamentation. Anterior margin of carpus with three or four broad teeth; dorsal surface entirely smooth, or with low, somewhat overlapping tubercles, or with irregular rows of strong, squamate tubercles, some of them transversely elongate. Chela entirely smooth, or with incipient smooth, longitudinal ridges, or with surface somewhat pitted, or with four smooth, narrow, longitudinal ridges, latter often crossed by slightly oblique grooves to form rows of close-set tubercles; the wide interspaces between these rows smooth, pitted, or with small, wide-set tubercles. Chelae similar in ornamentation, or minor more strongly ridged and tuberculate than major.

Walking legs completely hairless, or anterior margins with long, non-plumose setae.

No pleopods in males.

Distribution.—Indian Ocean: Mergui Archipelago and Western Australia. Pacific Ocean: Ryukyu Islands south to East Indian Archipelago and Queensland, Australia; *Caroline, *Gilbert, Loyalty, and *Tuamotu Islands. In the littoral, under stones and in coral head; dredged to about 1,800 metres.

Pachycheles johnsoni Haig

Pisosoma sculptum, Miyake, 1942, p. 374, text-figs. 33–35.

Pachycheles johnsoni Haig, 1966, p. 192, text-fig. 1 (type locality: Shark Bay, Western Australia; holotype in Western Australian Museum).

Diagnosis.—Carapace devoid of hairs. Surface smooth in median portion and with a series of transverse grooves along lateral margins, and distinctly roughened by grooves in anterolateral region. Front in dorsal view broad, transverse.

Chelipeds devoid of hairs. Anterior margin of carpus with three to five broad, strongly projecting teeth, their edges sometimes entire and sometimes scalloped or dentate; dorsal surface completely covered with large, close-set tubercles, either strongly convex or forming a smooth flat paving, and with their edges scalloped and sometimes free all the way around to form mushroom-shaped structures. Manus covered with tubercles of same size and structure as those of carpus, but generally arranged in more or less even longitudinal rows, spaces between the rows filled with smaller, less projecting tubercles.

Walking legs covered with long, stiff, non-plumose hairs,

No pleopods in males,

Distribution.—Indian Ocean: Western Australia. Pacific Ocean: Caroline Islands; Marshall Islands; Northern Territory, Australia. In the littoral, under stones and in coral heads; dredged to about 29 metres.

Pachycheles spinipes (A. Milne Edwards), n. comb.

Porcellana spinipes A. Milne Edwards, 1873, p. 262 (type locality: Upalu, Samoa; holotype in Hamburg Museum).

Porcellana sollasi Whitelegge, 1897, p. 144, pl. 7, figs. 3, 3 a (type locality: Funafuti Atoll, Ellice Islands; syntype in Australian Museum). Borradaile, 1900, p. 397.

Pachycheles sculptus, Calman, 1909, p. 706.

Diagnosis.—Carapace devoid of hairs. Frontal region with rounded tubercles, gastric, hepatic, and epibranchial regions with transversely elongate squamae, and hepatic and epibranchial margins with large spines or tubercles; this ornamentation is generally very strongly marked, but occasionally obsolescent. Cardiac and intestinal regions nearly smooth, meso- and post-branchial regions covered with series of strong, transverse ridges. Front in dorsal view transverse, with a deep median groove and sometimes appearing medially notched.

Chelipeds devoid of hairs or with faint setation, visible under magnification. Dorsal surface of carpus and chela covered with very strongly projecting, thorn-shaped tubercles, distally curved and pointed or truncate at their tips (in some specimens these tubercles more squamiform than thorn-shaped). Anterior margin of carpus with two or three narrow, pointed, strongly projecting, serrate-edged teeth.

Walking legs hairless or with a few fine, scattered setae; anterior margins of carpus and propodus with strong, thorn-shaped tubercles.

No pleopods in males.

Distribution.—Indian Ocean: Christmas Island. Pacific Ocean: *Caroline Islands; Loyalty Islands; Ellice Islands; Samoa. On coral reefs.

Pachycheles garciaensis (Ward)

Pisisma garciaensis Ward, 1942, p. 64 (type locality: Diego Garcia, Chagos Archipelago; types in private collection of M. Ward).

Pachycheles graciaensis, Haig, 1966, p. 42.

Diagnosis.—Carapace devoid of hairs. Surface more or less smooth except for grooves crossing posterolateral areas and faint rugosities on frontal region. Front in dorsal view broad, transverse, and with a very small median notch.

Chelipeds devoid of hairs. Anterior margin of carpus with three large teeth proximally and one or two smaller ones distally, the largest teeth sometimes with serrate edges; dorsal surface covered with series of large, flattened, close-set tubercles, these usually taking the form of oblique rugae on anterior half of segment. Manus smooth or obliquely rugose; a longitudinal crest on outer margin and another near it on dorsal surface, these crests separated by a deep groove; a third, shorter crest sometimes present about midway on dorsal surface.

Anterior margins of carpus and propodus of walking legs thickly covered with long plumose hairs.

Males with a pair of pleopods,

Distribution.—Indian Ocean: Madagascar; Chagos Archipelago. Pacific Ocean: *Ryukyu Islands; Marianas Islands. On coral reefs and from coral heads.

Pachycheles granti Haig

Pachycheles sculptus, Grant and McCulloch, 1906, p. 40, pl. 2, fig. 1. McNeill and Ward, 1930, p. 364.

Pachycheles granti Haig, 1965, p. 104 (type locality: Yamba, New South Wales, Australia; holotype in Australian Museum).

Diagnosis.—Carapace devoid of hairs. Surface more or less smooth except on frontal region and near anterolateral margins, where it is roughened by grooves and flattened granules; a series of transverse grooves on posterolateral area. Front in dorsal view broad, transverse.

Carpus of chelipeds with three broad, strongly projecting teeth on anterior margin, these teeth smooth and with entire or minutely crenulate edges; dorsal surface (exclusive or marginal teeth) covered with five longitudinal rows of well-separated, strongly projecting tubercles, irregularly rounded or somewhat elongate, and covered except at their apices with very short, close-set hairs. Chela with five rows of tubercles similar in size, arrangement, and setation to those of carpus.

Carpus and propodus of walking legs with long, stiff, non-plumose setae.

No pleopods in males.

Distribution.—Pacific Ocean: Queensland and New South Wales, Australia. In the littoral, under stones and in sponges.

Pachycheles natalensis (Krauss)

Porcellana natalensis Krauss, 1843, p. 58, pl. 4, figs. 1, 1 *a-c* (type locality: coast of Natal, South Africa; location of type not known).

Pachycheles natalensis, Stimpson, 1858, p. 228. Barnard, 1950, p. 472, text-fig. 87. Haig, 1964, p. 371.

Pisosoma natalensis, Paulson, 1875 *a*, pl. 1, fig. 12; 1875 *b*, p. 88, pl. 11, fig. 5; 1961, p. 94, pl. 11, fig. 5.

Pachycheles sculptus, Ortmann, 1894, p. 29. Nobili, 1906 *a*, p. 67; 1906 *b*, p. 136. Riddell, 1911, p. 263. Balss, 1916, p. 8.

Pisosoma sculpta, Gravely, 1927, p. 140, pl. 20, fig. 8.

Diagnosis.—Carapace devoid of hairs. Surface with light transverse grooves along lateral margins and on frontal region. Front in dorsal view narrow, rounded-triangular.

Dorsal surface of chelipeds devoid of hairs. Anterior margin of carpus with a strong crest, cut into a large, truncate tooth at proximal end and two smaller teeth distally, these teeth often with serrate edges; dorsal surface with punctae, short, oblique rugosities, or small, flattened granules, and usually with two longitudinal grooves near posterior margin. Manus covered with granulations, more distinct than those on carpus; outer margin with a crest defined by a deep, broad groove, and surface with two broad crests, these not always well-defined. A long, thick tuft of fine plumose hairs sometimes present on ventral surface of major chela at base of fingers; in some specimens this tuft completely absent.

Walking legs densely or sparsely covered with long, non-plumose hairs.

Males with a pair of pleopods,

Distribution.—Indian Ocean: East African coast, Dar-es-Salaam to Natal; Red Sea; Gulf of Iran; Southern India. In the littoral and dredged to about 9 metres.

***Pachycheles pisoides* (Heller)**

Porcellana pisoides Heller, 1865, p. 73, pl. 6, fig. 3 (type locality: Nicobar Islands; syntypes in Vienna Museum).

Pachycheles lifuensis Borradaile, 1900, p. 424 (type locality: Lifu, Loyalty Islands; syntypes in Cambridge Museum).

Pachycheles pisoides, Edmondson, 1925, p. 19. Haig, 1964, p. 371.

Pachycheles fronto Melin, 1939, p. 114, text-figs. 69–71 (type locality: Bonin Islands; syntypes in Stockholm Museum).

Diagnosis.—Carapace covered with scattered, non-plumose hairs, these more close-set on frontal region but very short and not forming a tuft. Surface more or less smooth except for grooves crossing postero-lateral area. Front in dorsal view broad, transverse.

Chelipeds covered with short and long non-plumose setae. Carpus with three or four strong, narrow teeth on anterior margin, most proximal one largest; posterior half of dorsal surface with elongate tubercles arranged in two more or less even, longitudinal rows, and a third row along posterior margin. Dorsal surface of manus covered with small, rounded, wide-set tubercles.

Walking legs with long, non-plumose setae.

Males with a pair of pleopods.

Distribution.—Indian Ocean: Seychelles; Nicobar Islands; Western Australia. Pacific Ocean: Ryukyu Islands; Bonin (Ogasawara) Islands; *Marianas Islands; *Carolina Islands; Loyalty Islands; Norfolk Island; Kermadec Islands; Hawaiian Islands; *Tuamotu Islands. On coral reefs and from coral heads.

***Pachycheles stevensii* Stimpson**

Pachycheles stevensii Stimpson, 1858, pp. 228, 242 (type locality: Jesso, Japan; type not extant); 1907; p. 187, pl. 23, fig. 6. Makarov, 1938, pp. 111, 299, text-fig. 40; 1962, p. 107, text-fig. 40. Miyake, 1943, p. 103, text-figs. 32–33. Kobjakova, 1955, p. 152, pl. 38, fig. 1.

Diagnosis.—Carapace devoid of hairs except on frontal region, which bears a tuft of very short plumose hairs. Surface smooth or punctate, and with a series of transverse grooves in postero-lateral area. Front in dorsal view narrow, rounded-triangular.

Anterior margin of carpus of chelipeds with two or three large, irregularly shaped teeth on anterior margin, their edges serrate; dorsal surface, including teeth, covered with large, coarse granules or tubercles, their distal side fringed with hairs which are visible only under magnification; surface with three indistinct longitudinal crests defined by shallow sulci. Chelae covered with granules and minute hairs as in carpus; surface of manus with three broad, indistinct longitudinal crests, the median one somewhat produced distally to form a protuberance at base of pollex. On major chela, a thick tuft of plumose hairs on ventral surface at base of fingers.

All segments of walking legs with a thick fringe of plumose hairs along anterior margins; dorsal surface of carpus and propodus hairy.

Males with a pair of pleopods.

Distribution.—Pacific Ocean; Sea of Japan, south to Petra Velikogo Bay in U.S.S.R. and Hokkaido to Nagasaki in Japan; east coast of Japan south to Tokyo Bay. In the littoral, under stones.

Pachycheles pectinicaarpus Stimpson

Pachycheles pectinicaarpus Stimpson, 1858, pp. 228, 242 (type locality: Hong Kong: type not extant); 1907, p. 186, pl. 23, fig. 5.

Diagnosis.—Carapace hairless except for a tuft on frontal region. Surface smooth but postero-lateral area crossed by grooves. Front in dorsal view narrow, rounded, not prominent.

Chelipeds (apparently) not hairy. Anterior margin of carpus convex, armed with about eight small, subequal, spiniform teeth; dorsal surface covered with small granules, some of them a little larger and arranged in longitudinal rows. Chela covered with wide-set granules or small tubercles. Gape of fingers of major chela pubescent.

Remarks.—This species is known only from a single specimen (probably a female, to judge from the width of the carapace as shown in Stimpson's illustration). The brief description does not mention setation, except for its presence on the frontal region; and it is not known whether or not there are pleopods in the male.

Distribution.—"Found under stones on rocky ground in the third subregion of the littoral zone, on the shore of Ly-i-moon passage, near Hong Kong, China" (Stimpson, 1907).

Pachycheles balssi Miyake

Pachycheles pubescens, Balss, 1913, p. 32.

Pachycheles hertwigi Balss, 1913, p. 33, text-figs. 22, 23 a-b, 24 (corrected to *P. pubescens* Holmes in Balss, 1914, p. 98).

Pachycheles balssi Miyake, 1943, p. 106, text-figs. 34-36 (type locality: Okinosima Island, Japan; holotype in Zoological Laboratory, Kyushu University).

Diagnosis.—Carapace with a few very small, scattered hairs on anterior half, and with a tuft of short, plumose hairs on frontal region. Surface smooth or punctate, postero-lateral area crossed by grooves. Front in dorsal view narrow, rounded-triangular.

Chelipeds densely covered with long, plumose hairs. Proximal two-thirds of anterior margin of carpus occupied by two strongly projecting, serrate-edged teeth, distal third of margin unarmed or crenulate; dorsal surface with three widely separated longitudinal rows of small, pearly tubercles. Dorsal surface of manus completely covered with small, wide-set, rounded tubercles, which are rather strongly projecting but completely concealed by dense covering of hair. Pollex and distal third of dactyl paved with large, close-set, flattened tubercles; proximal two-thirds of dactyl with large tubercles in two longitudinal rows, area between these rows filled with hair which is otherwise nearly absent from dorsal surface of fingers. Lower surface of major chela with tuft of hair at base of fingers.

Anterior margin of walking legs, and dorsal surface of carpus and propodus, densely covered with plumose hairs.

Males with a pair of pleopods.

Distribution.—Pacific Ocean: east coast of Japan, from Tokyo Bay to Okinosima Island. In the littoral, under stones.

Pachycheles tomentosus Henderson

Pachycheles tomentosus Henderson, 1893, p. 428, pl. 39, figs. 16-18 (type locality: Karachi, Pakistan; syntypes in British Museum).

Diagnosis.—Carapace devoid of hairs except on frontal region, which bears a tuft of short plumose hairs and long, stiff, non-plumose setae. Surface nearly smooth except for grooves crossing posterolateral area. Front in dorsal view narrow, rounded-triangular.

Chelipeds densely covered with tufts of short plumose hairs; interspersed with these are long, stiff, scattered non-plumose setae. Carpus with two or three broad, shallow teeth on anterior margin; dorsal surface with three widely separated, longitudinal rows of small, pearly tubercles. Dorsal surface of chela with rows of tubercles like those on carpus. A short tuft of plumose hairs in gape of fingers of major chela.

Anterior margins of walking legs densely covered with plumose hairs.

Males with a pair of pleopods.

Distribution.—Known only from Karachi, Pakistan.

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ERRATA

- p. 285, footnote. For Contribution No. 000 read Contribution No. 281.
- " 287, line 29. For Haig, 1966, p. 192 read Haig, 1965, p. 102.
- " 288, " 28. For types in private collection of M. Ward read
syntype in Mauritius Institute.
- " 288, " 29. For graciaensis read graciaensis.
- " 289, " 2. For Marianas Islands read *Marianas Islands.
- " 289, " 12. For or marginal teeth read of marginal teeth.
- " 290, " 21. For *Carolina Islands read *Caroline Islands.
- " 293, " 26. For Anomuran read Anomura.
- " 293, " 27. For 3950 read 39-50.
- " 293, " 36. For Verbeitung read Verbreitung.
- " 294, " 10. For Denscher. read Denkschr.