

CRABS OF THE GENUS *MACROPHTHALMUS* OF PHUKET, THAILAND (CRUSTACEA: DECAPODA: OCYPODIDAE)

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ABSTRACT

Collections of the crabs of the genus *Macrophthalmus* Latreille, 1829, made in Phuket, Thailand, during ecological studies of ocypodid crabs in 1987 and 1990 contain 12 species: *M. boscii* Audouin, 1826, *M. brevis* (Herbst, 1804), *M. convexus* Stimpson, 1858, *M. definitus* White, 1848, *M. laevimanus* H. Milne Edwards, 1852, *M. milloti* Crosnier, 1965, *M. pacificus* Dana, 1851, *M. parvimanus* Guérin-Méneville, 1834, *M. quadratus* A. Milne Edwards, 1873, *M. serenei* Takeda and Komai, 1991, *M. teschi* Kemp, 1919, and *M. tomentosus* Souleyet, 1841. For each species, a description and figures of the females and the males, notes on the coloration of living animals and their habitats, are provided. One new subgenus, *Paramareotis*, is proposed to accommodate *M. quadratus* (type-species), *M. boteltobagoe* Sakai, 1939, and *M. erato* De Man, 1888, species which had been assigned to the subgenus *Mareotis* Barnes, 1967. Accordingly, the diagnosis of *Mareotis* is emended. It is suggested that the morphologies of the chela and the shape of the female genital organs, and the shape of the telson are reliable characters for the identification of the females in this genus. A provisional key to the species, based on female characters, is proposed on the basis of the available materials.

This report deals with collections of crabs of the genus *Macrophthalmus* Latreille, 1829, made in Phuket, Thailand, in 1990 during an ecological research on ocypodid crabs planned by us. A small collection made by one of us (SG) also in Phuket in 1987 is included. The taxonomic literature on the genus (Tesch, 1915; Kemp, 1919; Tweedie, 1937; Barnes, 1967; Serène, 1973), shows the following 16 species have been recorded from the Andaman Sea including the Malacca Straits: *M. abbreviatus* Manning and Holthuis, 1981, *M. boscii* Audouin, 1826, *M. brevis* (Herbst, 1804), *M. convexus* Stimpson, 1858, *M. crassipes* H. Milne Edwards, 1852, *M. crinitus* Rathbun, 1913, *M. depressus* Rüppell, 1830, *M. erato* De Man, 1888b, *M. laevimanus* H. Milne Edwards, 1852, *M. latreillei* (Desmarest, 1822), *M. milloti* Crosnier, 1965, *M. pacificus* Dana, 1851, *M. teschi* Kemp, 1919, *M. tomentosus* Souleyet, 1841, *M. transversus* (Latreille, 1817), and *M. serenei* Takeda and Komai, 1991 (as *M. telescopicus* (Owen, 1839) or *M. verreauxi* H. Milne Edwards, 1848). Lundoer (1974) listed from Phuket the following 10 species including two not previously known from the west coast of Peninsular Malaysia: *M. boscii*, *M. brevis*, *M. convexus*, *M. definitus* White, 1848, *M. laevimanus*, *M. pacificus*, *M. parvimanus* Guérin-Méneville, 1834, *M. serenei* (as *M. verreauxi*), *M. transversus*, and *M. tomentosus*. We could verify the occurrence of these except *M. transversus*. Recently, Kosuge and Wada (1992) added *M. quadratus* A. Milne Edwards, 1873a, to the Phuket brachyuran fauna. Further, we add herein *M. milloti* and *M. teschi* to the Phuket brachyuran fauna.

As noted by Takeda (1981), identification of the female of the species in the genus *Macrophthalmus* has remained difficult in spite of studies of Barnes (1966a, 1966b, 1967, 1970, 1971, 1973, 1976, 1977). Although Barnes substantially clarified the systematics of the genus and gave a key to all species regarded then as valid, he, as well as previous authors who dealt with the taxonomy of the genus, paid little attention to female characters, and detailed morphology of the male first and second pleopods. Previously, adult males were needed for exact identification of species in the genus. Therefore, we studied primarily the female specimens

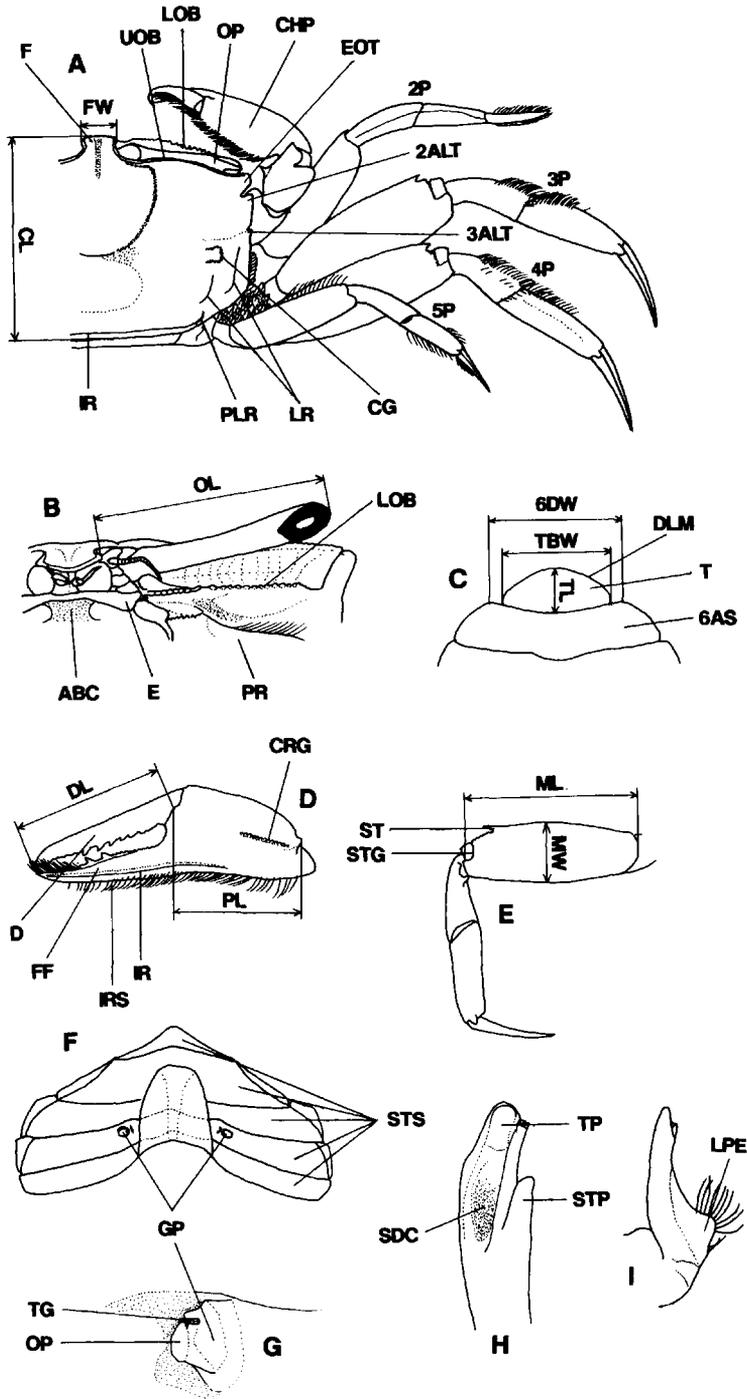


Figure 1. Diagrammatic selected parts of *Macrophthalmus*, indicating terminology used for morphological features and measurements. A, right half of animal in dorsal aspect: CG = clumps of granules on branchial region; CHP = cheliped (first pereopod); CL = carapace length; EOT = external orbital tooth (first anterolateral tooth); F = front; IR = intestinal ridge; LOB = lower orbital border; LR =

associated with males in the field. Among species from which female specimens were not collected in Phuket, specimens from other areas were used. Our primary intent is to provide descriptions of females and of several characters of males to which little attention had been paid by previous authors. We also gathered information for the identification of female specimens in our material. Further, we propose a new subgenus to better organize the grouping of the species of this genus.

MATERIALS AND METHODS

The present collection was represented by intertidal species, captured by hand. The specimens were preserved in 60% isopropyl alcohol, and are deposited at the Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University (HUMZ). For comparison, the following species from other collections of HUMZ and National Science Museum, Tokyo (NSMT) were also examined.

Macrophthalmus (Macrophthalmus) abbreviatus: HUMZ-C 1545, 5 females (7.4–15.2 mm CL, 13.8–29.2 mm CW), 2 males (10.0, 12.5 mm CL, 17.0, 22.2 mm CW), Amakusa-Matsushima, Kumamoto Pref., Kyushu, Japan, mud-flat, 30 March 1990, coll. T. Yamaguchi.

M. (M.) telescopicus: NSMT-Cr 5548, 1 female (9 mm CL, 14.1 mm CW), 1 female (6.5 mm CL, 10.0 mm CW), Ogasawara Island, 42 m, dredge, 14 June 1976, coll. M. Takeda and M. Imajima.

M. (Mareotis) depressus: NSMT-Cr 4567, 1 male (12.8 mm CL, 19.4 mm CW), Dohr, Kuwait, 20 March 1972, coll. H. Motoh.

M. (Paramareotis) boteltobogoe Sakai, 1939: HUMZ-C 1574, 1 female (5.8 mm CL, 7.6 mm CW) and 3 males (3.6–4.9 mm CL, 5.3–7.0 mm), Horikawa, Okinawa-jima, April 1992, coll. T. Kosuge; HUMZ-C 1575, 2 female (4.5, 5.9 mm CL, 6.3, 8.4 mm CW), Horikawa, Okinawa-jima, July 1989, coll. T. Kosuge.

Macrophthalmus (P.) erato: NSMT-Cr 1157, 1 female (8.8 mm CL, 12.0 mm CW), Hong Kong, date unknown, coll. T. Habe.

In the systematic account, subgenera and species are arranged alphabetically. Synonymies list the literature published since 1966, when the first of Barnes's series of work dealing with the systematics of this genus appeared. In keys, non-dichotomous characters are inserted with brackets. The measurements and terminology used in this study are indicated in Figure 1. The carapace width (CW) is measured across the widest portion.

Carapace length (CL) and carapace width (CW) are used as the standard measurements. The abbreviation PMBC stands for Phuket Marine Biological Center.

SYSTEMATIC ACCOUNT

Family Ocypodidae Subfamily Macrophthalminae Genus *Macrophthalmus* Latreille, 1829

Type Species.—*Goneplax transversus* Latreille, 1817.

←

longitudinal ridges on branchial region; OP = ocular peduncle; PLR = posterolateral ridge; UOB = upper orbital border; 2, 3ALT = second and third anterolateral teeth; 2–5P = second to fifth pereopods. B, left half of anterior region of carapace and cephalic appendages: ABC = anterior buccal cavity; E, epistome; LOB = lower orbital border; OL = ocular peduncle length; PR = pterygostomian region. C, distal two segments of abdomen: DLM = distolateral margin; T = telson; TBW = telson basal width; TL, telson length; 6AS = sixth abdominal somite; 6DW = sixth abdominal somite distal width. D, chela of female cheliped: CRG = central row of granules; D = dactylus; DL = dactylus length; FF = fixed finger; IR = inferior ridge; IRS = inferior row of setae; PL = palm length. E, fourth pereopod: ML = merus length; MW = merus width; ST = subdistal tooth; STG = subdistal transverse groove. F, female thoracic sternites: GP = genital papillae; STS = sternites of third to seventh thoracic somites. G, genital papillae: OP = operculum; TG = transverse groove. H, distal part of male first pleopod: SDC = subdistal concavity; STP = subdistal process; TP = terminal process. I, male second pleopod: LPE = lateral proximal expansion.

Diagnosis.—Carapace rectangular or trapezoid, always wider than long; front narrow, deflexed, usually with median groove; orbits long, occupying whole of anterior border of carapace between front and external orbital angles, lower orbital border fringed with granules or tubercles; external orbital angle forming first anterolateral tooth; lateral margins parallel or convergent posteriorly; regions usually well demarcated. Epistome long and narrow. Ocular peduncle long, cornea reaching or overreaching external orbital tooth. Antennule without distinctive character. Antenna with moderately long flagellum. Male abdomen seven-segmented, triangular, third somite with lateral margins strongly expanded; female abdomen very wide, subcircular. Chelipeds showing sexual dimorphism; in males, palm large and elongate, fixed finger with longitudinal ridge on outer surface often extending into palm, cutting edges usually with large differentiated tooth; in females, cheliped poorly developed, cutting edges of fingers without distinctly differentiated tooth. Third and fourth pereopods large and subequal, second and fifth pairs small (fifth pair smallest); meri long, with subdistal tooth on upper margins, often concealed by setae. Male first pleopod long, straight or slightly curved, never recurved, usually with subdistal process; second pleopod tiny, proximally with thin expansion fringed with pulmose setae proximally, terminal part cleft. Female vulvae showing as small papillae (termed as genital papillae in this study) (Fig. 1F, G), with an operculum, situated very near to suture between sternites of fifth and sixth thoracic somites.

Remarks.—The genus *Macrophthalmus* now contains 39 recent and three extinct species (Barnes, 1977; Wada and Sakai, 1989). Barnes (1967) divided *Macrophthalmus* into six subgenera, and most subsequent authors (e.g., Serène, 1973; Sakai, 1976; Dai and Yang, 1991) have accepted his classification. In this study, a new subgenus, *Paramareotis*, is proposed. These seven subgenera are separated by the following key.

KEY TO SUBGENERA OF *MACROPHTHALMUS*

- | | |
|--|-----------------------------------|
| 1a. Posteromedian margin of epistome protuberant | 2 |
| 1b. Posteromedian margin of epistome nearly straight to broadly concave | 3 |
| 2a. Carapace about 1.5 times as wide as long; branchial regions with two longitudinal ridges on each posterior half, without clumps of granules; front relatively wide, more than 0.15 times as wide as carapace; ocular peduncles moderately stout, about 0.5 times as long as carapace | <i>Tasmanoplax</i> Barnes, 1967 |
| 2b. Carapace more than 1.5 times as wide as long; branchial regions with three clumps of granules on each posterior half, without longitudinal ridges; front narrow, less than 0.15 times as wide as carapace; ocular peduncles thin, more than 0.5 times as long as carapace | <i>Macrophthalmus</i> s. s. |
| 3a. Front wide, about 0.2 times as wide as carapace, not or slightly constricted at bases of ocular peduncles; third maxilliped with merus subequal to ischium; ocular peduncles stout | 4 |
| 3b. Front narrow, less than 0.15 times as wide as carapace, strongly constricted at bases of ocular peduncles; third maxilliped with merus distinctly longer than ischium; ocular peduncles moderately stout to relatively thin | 6 |
| 4a. Carapace subquadrate, less than 1.3 times as wide as long; no distinct ridges on branchial regions | 5 |
| 4b. Carapace oblong, about 1.5 times as wide as long; transverse and oblique ridges on each branchial region; [posterior margin of epistome straight] | <i>Hemiplax</i> Heller, 1865 |
| 5a. Epistome with posterior margin broadly concave, without support of ridges of anterior buccal cavity; lower orbital border with small granules in both sexes; merus of cheliped without stridulating crest on inner margin in male | <i>Mopsocarcinus</i> Barnes, 1967 |
| 5b. Epistome with posterior margin somewhat convex, supported by sharp median ridge of anterior buccal cavity; lower orbital border with some lobules on lateral part in male; merus of cheliped with stridulating crest on inner margin in male | <i>Paramareotis</i> subgen. nov. |
| 6a. Carapace more than 1.3 times as wide as long; branchial regions with well defined longitudinal | |

- ridges or longitudinal row of setae on each posterior half; epistome with posterior margin usually concave *Mareotis* Barnes, 1967
- 6b. Carapace less than 1.3 times as wide as long; branchial regions without distinct longitudinal ridges, but sometimes with poorly defined longitudinal row of granules; epistome with posterior margin straight or slightly concave *Venitus* Barnes, 1967

Subgenus *Macrophthalmus* sensu stricto

Type-Species.—*Goneplax transversus* Latreille, 1817.

Diagnosis.—Carapace wide, more than 1.6 times as wide as long; front narrow, distinctly constricted at base; lower orbital border fringed with small tuberculate granules almost over entire length; anterolateral teeth relatively narrow based, triangular; branchial regions usually with two clumps of granules on each posterior half; intestinal ridge sometimes present. Posterior margin of epistome protuberant, but without support of median ridge of anterior buccal cavity. Sixth abdominal somite of males with lateral margins somewhat expanded proximally; telson of females more than 2.6 times as wide as long. Ocular peduncle more than 0.7 times as long as carapace, narrow, cornea sometimes extending beyond external orbital tooth. Third maxilliped with merus distinctly shorter than ischium, both segments barely sculptured. In males, inferior ridge of palm usually weak; fingers stout, fixed finger hardly to strongly deflexed, armed usually with differentiated tooth on cutting edge; merus lacking stridulating crest. In females, palm of chela relatively deep; inferior ridge marginal, strongly raised, extending to level of articular knob of palm; inferior row of setae absent. Second to fifth pereopods not thickly setose; merus of third and fourth pereopods armed with subdistal tooth somewhat proximal to subdistal groove which is abruptly delimited.

Remarks.—The females of this subgenus are characterized by having a relatively deep palm with an inferior ridge that is marginal and strongly raised.

Macrophthalmus (Macrophthalmus) brevis (Herbst, 1804)

Figure 2

Cancer brevis Herbst, 1804: 9, pl. 60, fig. 4 [type-locality: East India].

Macrophthalmus carinimanus H. Milne Edwards, 1837: 65; 1852: 156.—De Man, 1880: 69; 1902: 492.

Macrophthalmus dilatatus carens Lanchester, 1900a: 759.

Macrophthalmus crassipes: Lanchester, 1900a: 759 (not H. Milne Edwards, 1852).

Macrophthalmus brevis: Tesch, 1915: 169, pl. 6, fig. 5.—Kemp, 1919: 388.—Tweedie, 1937: 164.—Barnes, 1977: 276 (key).

Macrophthalmus simdentatus Shen, 1936: 70, text-figs. 2–3.—Starobogatov, 1972: 345.

Macrophthalmus cf. *crassipes*: Tweedie, 1937: 164.

Macrophthalmus tranvancorensis Pillai, 1951: 30, text-fig. 5.

Macrophthalmus (Macrophthalmus) brevis: Barnes, 1970: 207; 1971: 4, fig. 1.—Lundoer, 1974: 8 (list).—Dai, Yang, Song, and Chen, 1986: 432, pl. 60(1), fig. 240(2); Dai and Yang, 1991: 473, pl. 60(1), fig. 240(2).

not *Macrophthalmus brevis*: Hilgendorf, 1869: 86, 87.—Nobili, 1906a: 318. (= *M. grandidieri* A. Milne Edwards, 1867).

not *Macrophthalmus carinimanus*: Hilgendorf, 1879: 806 (= *M. grandidieri*).—Haswell, 1882: 88 (= *M. crassipes* H. Milne Edwards, 1852).—Lanchester, 1900b: (= *M. sulcatus* H. Milne Edwards, 1852).—McNeill, 1962: 41, pl. 2, fig. 2 (= *M. crassipes*).

Material Examined.—HUMZ-C 1186, 5 males (8.1–10.8 mm CL, 15.5–21.7 mm CW), 1 ovigerous female (7.6 mm CL, 14.2 mm CW), Ao Tang Khen, mudflat, 5 Oct. 1990, coll. T. Komai; HUMZ-C 1189, 1 male (10.0 mm CL, 20.1 mm CW), Ao Nam Bor, mudflat, 7 Oct. 1990, coll. T. Komai.

Description of Female.—Carapace (Fig. 2A) wide, greatest width across second anterolateral teeth, 1.94 times as wide as long. Front with shallow median groove.

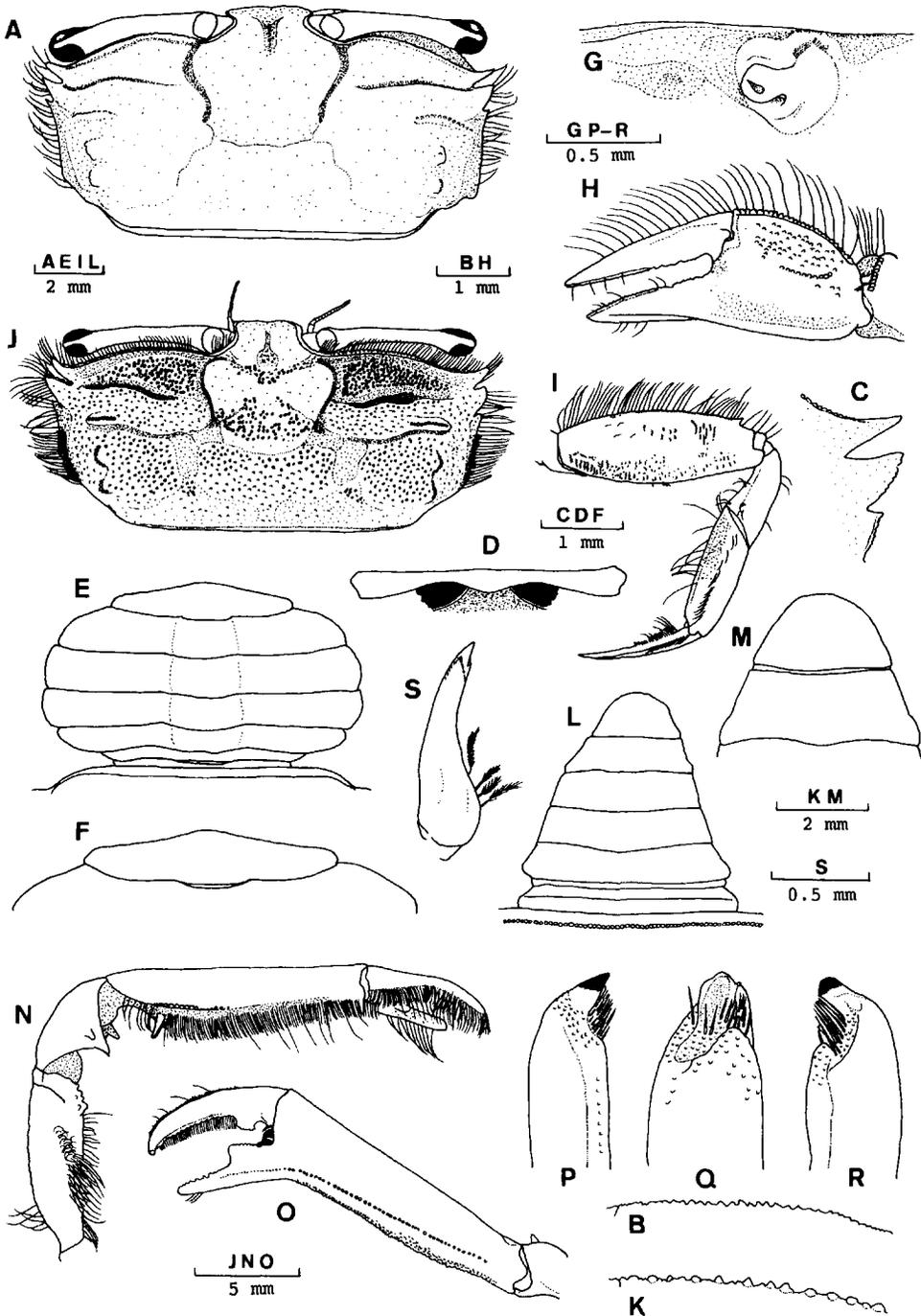


Figure 2. *Macrophthalmus (Macrophthalmus) brevis* (Herbst, 1804), HUMZ-C 1186, female (A–I) and male (J–S). A, J, carapace, dorsal; B, K, left lower orbital border, ventral; C, right anterolateral margin; D, epistome and anterior buccal cavity; E, L, abdomen, sternal; F, telson, sternal; G, left genital papilla; H, left chela, anterior; I, right fourth pereopod, dorsal; M, sixth abdominal somite and telson, sternal; N, left cheliped, dorsal; O, chela, anterior; P, Q, R, distal part of left first pleopod, ventral, lateral, and dorsal; S, left second pleopod.

Upper orbital border slightly oblique, minutely granulate; lower orbital border (Fig. 2B) fringed with series of small granules almost over entire length. Lateral margins with general profile convergent posteriorly, armed with three anterolateral teeth including external orbital tooth (Fig. 2C); external orbital tooth narrow, triangular, not reaching second anterolateral tooth, separated from latter by narrow, deep V-shaped incision, posterolateral margin almost straight; second anterolateral tooth triangular, somewhat wider than preceding tooth, lateral margin strongly convergent posteriorly; third anterolateral tooth small but distinct, separated from preceding tooth by shallow U-shaped incision. Carapace surface mostly smooth, naked, lateral areas covered with small granules; branchial region with transverse row of granules slightly posterior to level of third anterolateral tooth, two weak clumps of granules on posterior half, and short, obscure posterolateral ridge. Intestinal ridge absent.

Posteromedian margin of epistome protuberant (Fig. 2D); anterior buccal cavity slightly elevated medially.

Abdomen (Fig. 2E) very wide; telson (Fig. 2F) unusually wide proportionately, about 4.7 times as wide as long, distolateral margins weakly concave except proximal lateral angle strongly convex, basal margin somewhat convex, as wide as distal margin of sixth somite.

Genital papillae (Fig. 2G) situated slightly posterior to suture between sternites of fifth and sixth thoracic somites; operculum suboval, directed ventromesially, abruptly delimited posteriorly; transverse groove absent; shallow depression present on sternite of sixth thoracic somite somewhat mesial to genital papilla.

Ocular peduncle (Fig. 2A) long, narrow, about 0.8 times as long as carapace, reaching base of external orbital tooth.

Palm of chela (Fig. 2H) with central row of granules on proximal half of outer surface; superior surface of palm beaded with two rows of granules; fingers bearing small, tuberculate teeth on proximal half of cutting edge; dactylus somewhat longer than palm.

Second to fifth pereopods moderately stout. Fourth pereopod (Fig. 2I) with dactylus equal to propodus, with patch of setae on flexor surface and thick lateral fringes of setae.

Description of Male.—The male specimens differ from the female specimen in the condition of dorsal surface of the carapace, the size of granules of both orbital borders besides the structure of cheliped and gonopods.

Greatest width of carapace across external orbital or second anterolateral tooth, 1.91–2.12 times as wide as long (Fig. 2J). Upper orbital border more strongly granulate than in female; lower orbital border (Fig. 2K) fringed with large, tuberculated granules. Dorsal surface more strongly sculptured and granulated than in female; submarginal ridge along posterior margin strongly granulated.

Abdomen (Fig. 2L) very wide; sixth somite with lateral margins somewhat expanded proximally; telson (Fig. 2M) almost as long as sixth somite, 1.9 times as wide as long, lateral margins straight or slightly convex.

Cheliped (Fig. 2N, O) as figured.

First pleopod (Fig. 2P–R) moderately compressed, setae covering distal part not thick; terminal process short, entire, directed distolaterally; subdistal process thick, closely appressed. Second pleopod (Fig. 2S) sharply pointed distally, lateral proximal expansion narrow.

Coloration.—Entire animal sandy gray in dorsal aspect. Branchiostegal region dark brown; in male, sternite and abdomen pale gray; in female, abdomen also pale gray. Outer surface of palm of male cheliped mostly white except fingers which are pinkish.

Habitat.—The present specimens were collected in open mudflats where the substrates were relatively hard. Each made a burrow.

Remarks.—The specific status of *Macrophthalmus brevis* was seriously confused until the publication of Barnes's (1971) paper (see synonymy). The present male specimens agree well with his description of *Macrophthalmus brevis*. According to him, *M. brevis* is distinguished from the closely related species, *M. abbreviatus* (as *M. dilatatus* in Barnes's paper), *M. crassipes*, and *M. sulcatus* H. Milne Edwards, 1852, chiefly by the morphology of male cheliped. Direct comparison of the specimens of both sexes with *M. abbreviatus* (HUMZ-C 1545) revealed that *M. brevis* also differs from *M. abbreviatus* in having the ocular peduncle somewhat stouter (5.9–6.3 times as long as width of cornea vs. 6.7–8.0 times as long) and the upper orbital border being less oblique. These differences are apparent even when comparing small specimens. Judging from the previous reports (Barnes, 1967, 1970), *M. crassipes* and *M. sulcatus* seem to be very similar to *M. abbreviatus* in the proportion of ocular peduncle and the degree of slope of the upper orbital border. Further, the female specimen of *M. brevis* examined here differs from those of *M. abbreviatus* in having a central row of granules on the outer surface of the palm and the proportionately wider telson (4.7 vs. 3.7–4.2, 4.2–4.3 in matured specimens). No significant difference was found in the morphology of the female genital opening between *M. brevis* and *M. abbreviatus*. In fresh material, *M. brevis* may be easily distinguishable from *M. abbreviatus* by the coloration of the abdomen: in *M. brevis* the abdomen is pale gray instead of reddish brown in *M. abbreviatus*.

M. convexus and *M. parvimanus* occurred sympatrically with *M. brevis*.

Distribution.—East India (Herbst, 1804); Mauritius and Pondicherry (H. Milne Edwards, 1852); Celebes (De Man, 1880); Halmahera (De Man, 1902); Mergui Archipelago (Kemp, 1919); Hainan Island (Shen, 1936); Singapore and Malacca (Barnes, 1970).

Macrophthalmus (Macrophthalmus) convexus Stimpson, 1858

Figures 3, 4

Macrophthalmus convexus Stimpson, 1858: 97 [type-locality: Loo-Choo Islands (Ryukyu Islands), Japan].—De Man, 1888a: 354, pl. 15, fig. 4.—De Man, 1902: 493, pl. 19, fig. 6, 6a.—Stimpson, 1907: 97, pl. 13, fig. 2.—Rathbun, 1910a: 323, pl. 2, fig. 3.—Tesch, 1915: 175 (in part), pl. 7, fig. 8.—Kemp, 1919: 389, pl. 24, fig. 2.—Boone, 1934: 201, pls. 104–106.—Sakai, 1939: 625, fig. 97.—Barnes, 1977: 277 (key).

Macrophthalmus inermis A. Milne Edwards, 1867: 286 [type locality: Sandwich Island, New Hebrides, Vanuatu]; 1873a: 277, pl. 12, fig. 5.—Rathbun, 1906: 834.

Macrophthalmus (Macrophthalmus) convexus: Barnes, 1967: 211, fig. 3, pl. 1(c).—Lundoer, 1974: 8 (list).—Sakai, 1976: 613, text-fig. 336.—Tai and Song, 1984: 81 (key).—Miyake, 1983: 167, pl. 56, fig. 4.—Dai, Yang, Song and Chen, 1986: 431, pl. 59(8), fig. 240(1).—Dai and Yang, 1991: 472, pl. 59(8), fig. 240(1).—Huang, Yu and Takeda, 1992: 147, fig. 6, pl. 1F.

not *Macrophthalmus convexus*: Tesch, 1915: 175 (in part).—Guinot, 1967: 282. (= *M. graeffei* A. Milne Edwards, 1873b).

Material Examined.—HUMZ-C 1185, 5 males (11.3–15.2 mm CL, 19.3–28.5 mm CW), Ao Tang Khen, mudflat, 5 Oct. 1990, coll. T. Komai; HUMZ-C 1191, 3 males (9.1–11.6 mm CL, 15.3–22.0 mm CW), Ao Nam Bor, mudflat, 7 Oct. 1991, coll. T. Komai.

Supplementary Material.—HUMZ-C 1474, 2 males (11.0, 11.4 mm CL, 11.4, 20.5 mm CW), 3 females (10.7–11.2 mm CL, 18.0–20.2 mm CW), Kin, Okinawa-jima, Ryukyu Islands, mudflat, 29 July 1985, coll. S. Goshima.—HUMZ-C 1532, 2 females (13.0, 14.1 mm CL, 24.2, 26.2 mm CW), Guam, mudflat, June 1986, 4 males (12.4–14.7 mm CL, 22.1–28.0 mm CW), coll. M. Murai.

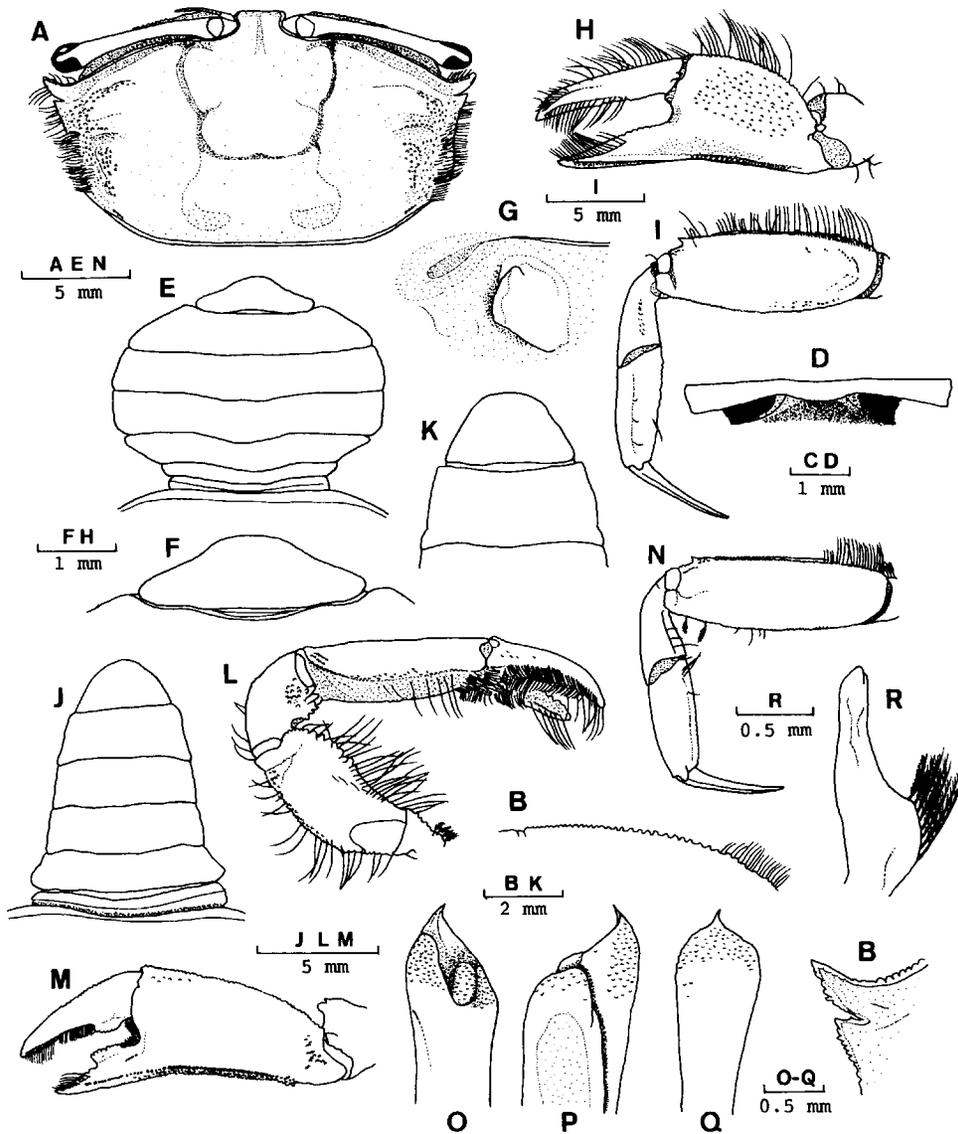


Figure 3. *Macrophthalmus (Macrophthalmus) convexus* Stimpson, 1858. HUMZ-C 1474, female (A–I) and HUMZ-C 1184, male (J–R). A, carapace, dorsal; B, left lower orbital border, ventral; C, left anterolateral margin; D, epistome and anterior buccal cavity; E, J, abdomen, sternal; F, telson, sternal; G, left genital papilla; H, left chela, anterior; I, N, left fourth pereopod, dorsal; K, sixth abdominal somite and telson, sternal; L, left cheliped, dorsal; M, chela, anterior; O, P, Q, distal part of left first pleopod, ventral, lateral, and dorsal; R, left second pleopod.

Description of Female.—Carapace wide (Fig. 2A), greatest width always across external orbital teeth, 1.65–1.76 times as wide as long. Front with shallow median groove. Upper orbital border oblique, minutely granulate; lower orbital border (Fig. 2B) fringed with series of small granules almost over entire length. Lateral margin with general profile convergent posteriorly, armed with two anterolateral teeth including external orbital tooth (Fig. 2C); external orbital tooth narrow,

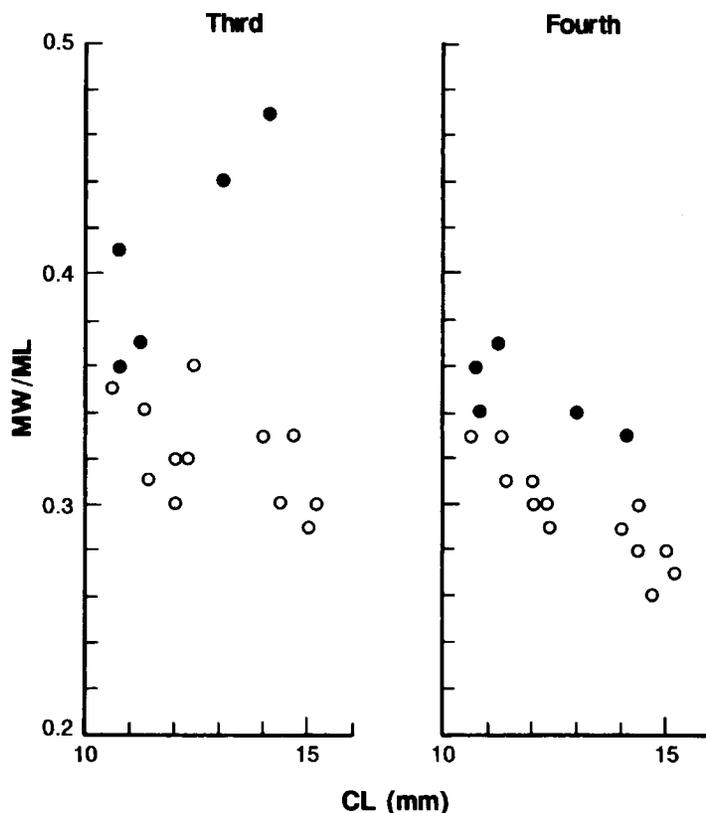


Figure 4. *Macrophthalmus (Macrophthalmus) convexus* Stimpson, 1858. Sexual differences of proportionate width of meri of third and fourth pereopods (MW/ML), ● = female (N = 5), ○ = male (N = 13).

triangular, considerably projecting beyond second anterolateral tooth, separated from latter by narrow V-shaped incision, posterolateral margin somewhat convex; second anterolateral tooth as wide as preceding tooth, triangular. Carapace surface mostly naked except lateral areas covered with thick setae; branchial region covered with small granules, having two weak clumps of granules; posterolateral ridge appearing as row of granules. Intestinal ridge absent.

Posteromedian margin of epistome protuberant (Fig. 2D); central region of anterior buccal cavity slightly elevated medially.

Abdomen (Fig. 2E) wide; telson (Fig. 2F) 2.6–3.7 times as wide as long, distolateral margins distinctly sinuous, basal margin weakly convex, as wide as distal margin of sixth somite.

Genital papillae (Fig. 2G) situated slightly proximal to suture between sternites of fifth and sixth thoracic somites, without transverse groove; operculum faintly suboval, directed mesially; deep depression present on sternite mesial to operculum.

Ocular peduncle (Fig. 2A) long and narrow, about 0.8 times as long as carapace, slightly falling short of tip of external orbital tooth.

Palm of chela (Fig. 2H) without central row of granules on outer surface; superior surface of palm with two granulate ridges, outer ridge strongly granulate;

fingers bearing small tuberculate teeth on proximal half of cutting edges; dactylus 0.90–0.99 times as long as palm.

Pereopods stout. Third pereopod with merus 0.36–0.41 (Fig. 4) times as wide as long. Fourth pereopod (Fig. 3I) with merus 0.31–0.36 times as wide as long (Fig. 4); dactylus slightly shorter than propodus, lateral fringes of setae sparse, flexor surface lacking patch of setae.

Description of Male.—In non-sexual characters, males differ from females in the proportionately narrower meri of the third and fourth pereopods.

Carapace 1.74–1.94 times as wide as long.

Abdomen moderately narrow (Fig. 2J); sixth somite with lateral margins weakly expanded proximally. Telson (Fig. 2K) slightly shorter than sixth somite, 1.9 times as wide as long, lateral margins straight or weakly convex.

Cheliped (Fig. 2L, M) as figured.

Second and third pereopods (Fig. 2N) with meri proportionately narrower than in female, 0.29–0.36 times as wide as long and 0.23–0.33 times as long respectively.

First pleopod (Fig. 2O–Q) strongly compressed, distal part obliquely truncated, obscured by long setae; terminal process rather short, tapering to small, acute tooth distally, distal concavity filled with spiniform setae; subdistal process broad, closely appressed. Second pleopod (Fig. 2R) cleft distally, with lateral proximal expansion moderately broad.

Coloration.—Entire animal sandy gray in dorsal aspect. Sternum and abdomen reddish brown; pterygostomian region dark brown. Third maxilliped white. Inner surface of whole cheliped and outer surface of fingers, and ventral surfaces of remaining pereopods reddish brown.

Habitat.—Lives on flat areas, usually at the lowest high tidal level, seems to prefer rather hard, sandy substrates.

Remarks.—Since no female specimen of *Macrophthalmus convexus* from Phuket of definite identity is available, we examined the collections of *M. convexus* from the Ryukyus, Japan (HUMZ-C 1474) and Guam (HUMZ-C 1532). The description of the female here is based on this material. The affinity with *M. parvimanus* will be discussed under the account of *M. parvimanus*. *M. crassipes* is also similar to *M. convexus* in general appearance of the carapace, including the length of ocular peduncles. According to Barnes (1967), *M. convexus* differs from *M. crassipes* primarily in the external orbital tooth distinctly protruding beyond the second anterolateral tooth, and absence of a backwardly directed tubercle on the inner surface of the palm in males. Structure of the anterolateral teeth is useful to distinguish females of the two species.

In *M. convexus*, the sexual difference of the meri of the second and third pereopods is apparent (Fig. 4). Clayton (1990) noted that in *Cleistostoma kuwaitense* Jones and Clayton, 1983, and *Uca* species, pereopods of females are usually shorter and the meri wider and more arched than those of males of the same species. Salmon (1987) suggested that meral enlargements strengthened the legs of females and enabled them to defend their burrows more effectively.

Distribution.—Existing records suggest that this species is widely distributed in the Indo-West Pacific region, ranging from the Red Sea eastward to New Caledonia, and then northward to the Ryukyu Islands, Japan, and southward to Queensland, Australia.

Macrophthalmus (Macrophthalmus) laevimanus
H. Milne Edwards, 1852
Figure 5

Macrophthalmus laevimanus H. Milne Edwards, 1852 [type-locality: Pondicherry, India].—Barnes, 1977: 277 (key).

Macrophthalmus (Macrophthalmus) laevimanus: Barnes, 1970: 220, fig. 5.—Lundoer, 1974: 8 (list).

Macrophthalmus malayensis Tweedie, 1937: 165, fig. 8 [type-locality: Morib, Selangor].

Macrophthalmus (Macrophthalmus) malayensis: Barnes, 1967: 203 (list).

Material.—HUMZ-C 1192, Ao Nam Bor, mudflat, 7 Oct. 1990, 7 males (9.0–12.2 mm CL, 17.6–26.1 mm CW), 1 female (8.7 mm CL, 15.7 mm CW), coll. T. Komai; HUMZ-C 1193, Ban Pa Khlok, mudflat, 27 Oct. 1990, 3 males (4.5–9.2 mm CL, 7.8–17.8 mm CW), 1 female (7.7 mm CL, 14.2 mm CW), coll. T. Komai.

Description of Female.—Carapace (Fig. 5A) wide, greatest width across second anterolateral teeth, 1.8 times as wide as long. Front with shallow median groove. Upper orbital border nearly transverse, minutely granulate; lower orbital border (Fig. 5B) fringed with series of tuberculate granules. Lateral margin with general profile convergent posteriorly, armed with three anterolateral teeth including external orbital tooth (Fig. 5C); external orbital tooth rather widely based, triangular in dorsal aspect, slightly falling short of second anterolateral tooth, separated from latter by V-shaped incision; second anterolateral tooth wider than preceding tooth, with lateral margin convex; third anterolateral tooth small, separated by narrow V-shaped incision; lateral margin behind third anterolateral tooth converging posteriorly. Carapace surface naked except lateral areas; branchial region covered with small granules, having a transverse granular ridge at level of third anterolateral tooth, and two well-developed clumps of granules on posterior half of carapace. Intestinal ridge present.

Posteromedian margin of epistome protuberant (Fig. 5D); central region of anterior buccal cavity slightly elevated medially.

Abdomen (Fig. 5E) very wide, with third somite weakly ridged transversely; telson (Fig. 5F) very wide, 4.2 times as wide as long, distolateral margins broadly concave, basal margin weakly convex, as wide as distal margin of sixth somite.

Genital papillae (Fig. 5G) situated slightly posterior to suture between sternites of fifth and sixth thoracic somites, with transverse groove just anterior to operculum; operculum suboval, directed ventromesially; shallow extended depression on sternite posteromesial to operculum.

Ocular peduncle (Fig. 5A) narrow, long, 0.7–0.8 times as long as carapace, reaching base of external orbital tooth.

Palm of chela (Fig. 5H) without central row of granules on outer surface; superior surface having granulate ridge along over entire length; cutting edges of fingers bearing small tuberculate tooth on central part; dactylus equal to palm.

Pereopods relatively narrow. Third pereopod (Fig. 5I) with dactylus equal to propodus, with thick lateral fringes of setae, lacking patch of setae on flexor surface.

Description of Adult Male.—Other than the sexual feature, males differ from females in the tuberculated upper and lower orbital borders.

Carapace (Fig. 5J) 1.93–2.30 times as wide as long. Upper orbital border fringed with series of tubercular granules. Lower orbital border (Fig. 5K) fringed with large tubercles.

Abdomen (Fig. 5L) relatively wide; sixth somite with lateral margins distinctly expanded slightly posterior to midlength; telson (Fig. 5M) as long as or slightly longer than sixth somite, 1.7–1.8 times as wide as long, lateral margins convex.

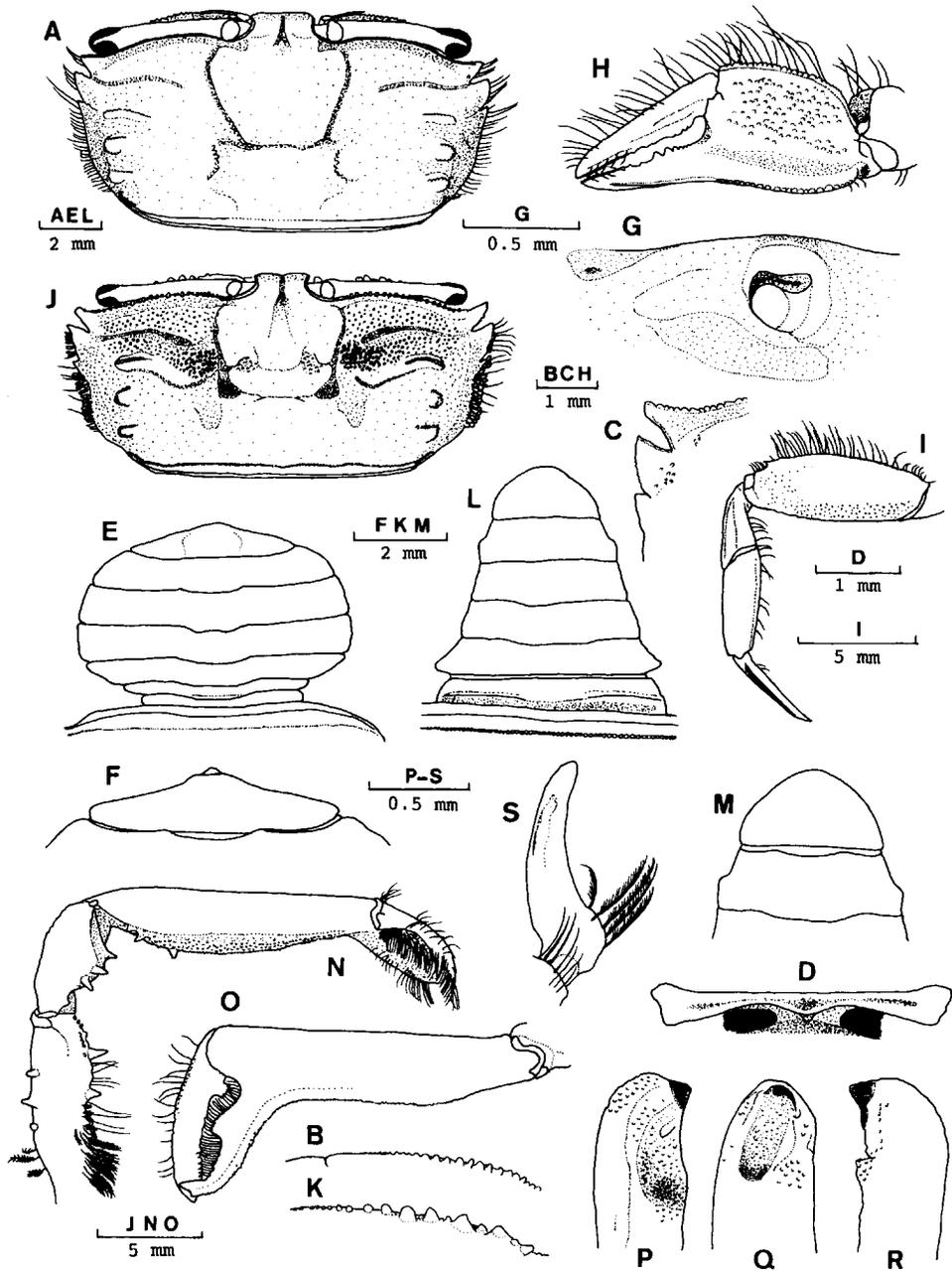


Figure 5. *Macrophthalmus (Macrophthalmus) laevimanus* (H. Milne Edwards, 1852. HUMZ-C 1193, female (A-I) and HUMZ-C 1192, male (J-S). A, J, carapace, dorsal; B, K, left lower orbital border, ventral; C, left anterolateral margin; D, epistome and anterior buccal cavity; E, L, abdomen, sternal; F, telson, sternal; G, left genital papilla; H, left chela, anterior; I, left fourth pereopod, dorsal; M, sixth abdominal somite and telson, sternal; N, left cheliped, dorsal; O, chela, anterior; P, Q, R, distal part of left first pleopod, ventral, lateral, and dorsal; S, left second pleopod.

Cheliped (Fig. 5N, O) as figured.

First pleopod (Fig. 5P–R) moderately compressed, distal part broadly rounded in ventral aspect; terminal process situated dorsodistally, very short, rounded distally; distolateral concavity filled with short setae; subdistal process obsolescent. Second pleopod (Fig. 5S) with apical margin entire; lateral proximal expansion rather narrow.

Description of Young Male.—Carapace proportionately narrower than in adult, 1.58–1.72 times as wide as long; anterior submarginal ridge on posterior region obscure in central part.

Chela apparently female-like, but dactylus armed with low differentiated tooth on cutting edge.

Coloration.—Entire animal brownish or sandy gray from dorsal aspect; from ventral aspect generally pale gray except for grayish brown first thoracic sternite and dark brown pterygostomian region.

Habitat.—This species was found on mudflats at a considerable distance from the mangrove swamp where the substrates were very soft.

Remarks.—The male specimens of the present series agree well with the description of the holotype of *Macrophthalmus malayensis* given by Barnes (1970), a species which he synonymized with *M. laevimanus* after comparing the former species with a photograph of the holotype of the latter species. Examination of the specimens of both sexes proved that this species is unique among the species examined here in having the distinct intestinal ridge connecting with the posterolateral ridges. Barnes (1970: 221) cited this character in the description, but he did not seem to have appreciated the significance of this character. As far as the known literature indicates, only *M. grandidieri* A. Milne Edwards, 1867, possesses the intestinal ridge (cf. Barnard, 1950: 100, fig. 20c; Crosnier, 1965: 128, fig. 230). Referring to Barnes (1970), *M. grandidieri* is easily distinguishable from *M. laevimanus* in having the vestigial external orbital tooth and the upper orbital border more strongly curved as well as in the morphology of the male cheliped. The carapace features are reliable in distinguishing females of the two species.

Distribution.—Pondicherry, India (H. Milne Edwards, 1852); Selangor (Tweedie, 1937); Phuket (Lundoer, 1974).

Macrophthalmus (Macrophthalmus) milloti Crosnier, 1965

Figure 6

Macrophthalmus podophthalmus: Lanchester, 1900a: 760 (not Souleyet, 1841 (= *M. telescopicus*)).

Macrophthalmus telescopicus: Kemp, 1919: 387 (in part), pl. 24, fig. 11.

Macrophthalmus cf. *telescopicus*: Tweedie, 1937: 164; 1950: 128 (in part).

Macrophthalmus milloti Crosnier, 1965: 124, figs. 217–220, 222, 223, pl. 11, fig. 4 [type-locality: Madagascar]; 1975: 737.—Barnes, 1977: 276 (key).—Takeda and Komai, 1991: 166, fig. 1.

Macrophthalmus (Macrophthalmus) milloti: Barnes, 1967: 203 (list); 1976: 135, fig. 3.—Serène, 1973: 112, pl. 4, figs. A–C.—Hartnoll, 1975: 309 (list).

Macrophthalmus (Macrophthalmus) telescopicus: Barnes, 1967: 205, pl. 1, fig. a (in part).

Material Examined.—HUMZ-C 1183, 1 male (12.2 mm CL, 20.6 mm CW), Ao Tang Khen, rocky area, 5 Oct. 1990, coll. T. Komai; HUMZ-C 1481, 1 female (8.7 mm CL, 15.1 mm CW), Ao Tang Khen, rocky area, 2 Dec. 1990, coll. T. Koga and T. Kosuge.

Description of Female.—Carapace (Fig. 6A) wide, greatest width across external orbital teeth, 1.74 times as wide as long. Front with moderately deep median groove. Upper orbital border oblique, minutely granulate; lower orbital border (Fig. 6B) fringed with series of small granules. Lateral margins with general

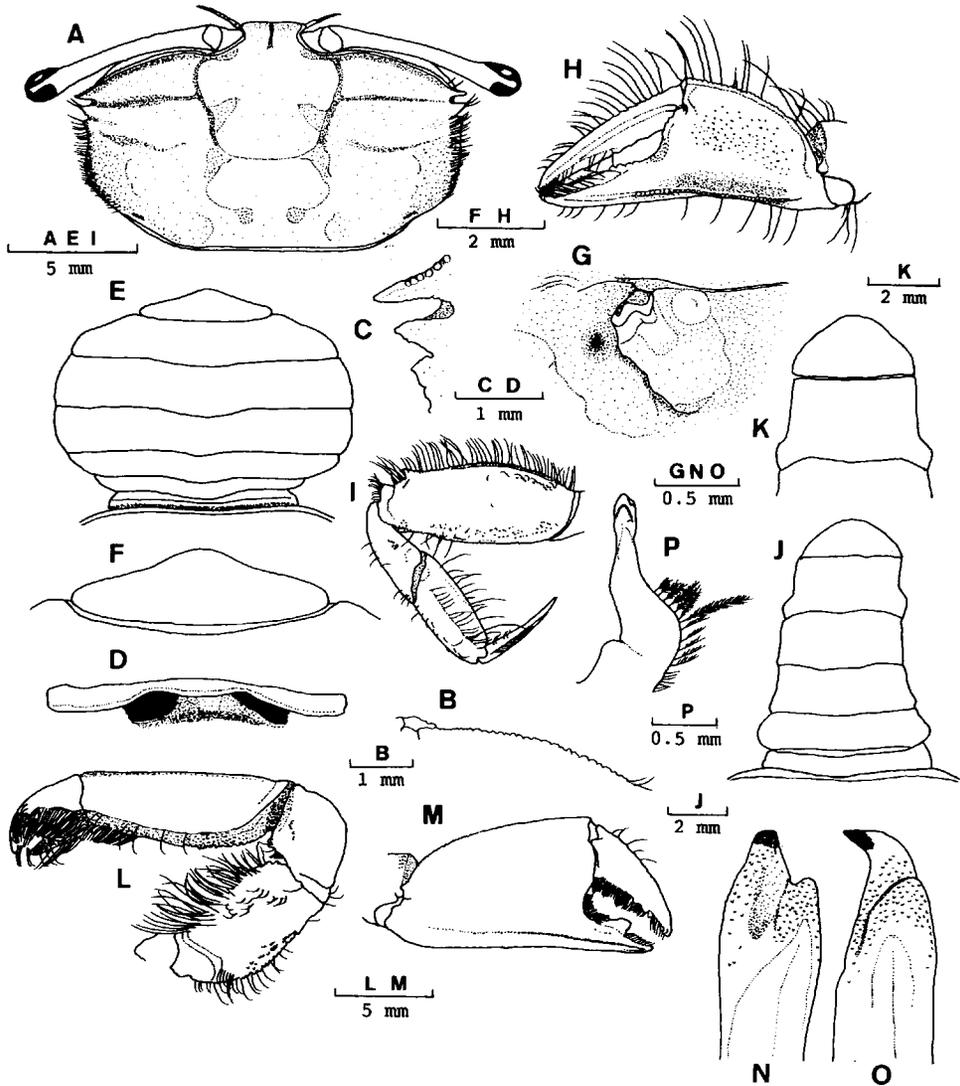


Figure 6. *Macrophthalmus (Macrophthalmus) milloti* Crosnier, 1965. HUMZ-C 1481, female (A-I) and HUMZ-C 1183, male (J-P). A, carapace, dorsal; B, left lower orbital border, ventral; C, left anterolateral margin; D, epistome and anterior buccal cavity; E, J, abdomen, sternal; F, telson, sternal; G, left genital papilla; H, left chela, anterior; I, left fourth pereopod, dorsal; K, sixth abdominal somite and telson, sternal; L, right cheliped, dorsal; M, chela, anterior; N, O, distal part of left first pleopod, lateral and dorsal; P, left second pleopod.

profile convergent posteriorly, armed with three anterolateral teeth including external orbital tooth (Fig. 6C); external orbital tooth very narrow, acute, exceeding second tooth, separated from latter by narrow V-shaped incision; second anterolateral tooth wider than external orbital tooth, acute; third anterolateral tooth small, defined by wide V-shaped incision. Carapace surface naked; branchial regions covered with medium-sized granules on lateral half, lacking distinct ridge or clumps of granules except for short posterolateral ridges. Intestinal ridge absent.

Posteromedian margin of epistome broadly convex (Fig. 6D); central region of anterior buccal cavity slightly elevated medially.

Abdomen (Fig. 6E) wide; telson (Fig. 6F) 3.5 times as wide as long, distolateral margins slightly concave, basal margin somewhat convex, as wide as distal margin of sixth abdominal somite.

Genital papillae (Fig. 6G) attached anteriorly to suture between sternites of fifth and sixth thoracic somite, bearing prominent ovate elevation lateral to operculum; operculum faintly W-shaped, directed anteromesially; deep depression on sternite of sixth thoracic somite just mesial to genital papilla.

Ocular peduncle (Fig. 6A) narrow, very long, 1.0 times as long as carapace, projecting beyond external orbital tooth by length of cornea.

Palm of chela (Fig. 6H) without central row of granules; superior surface beaded with two rows of granules; cutting edges of fingers armed with small tuberculate teeth on proximal part; dactylus almost equal to palm.

Second to fifth pereopods relatively stout. Fourth pereopod (Fig. 5I) with dactylus slightly shorter than propodus, bearing rather sparse lateral fringe of setae, lacking patch of setae on flexor surface.

Description of Male.—Male is similar to female besides the structure of the cheliped and the copulatory organs.

Abdomen (Fig. 6J) relatively narrow; sixth somite with lateral margins distinctly expanded near base; telson (Fig. 6K) distinctly shorter than sixth somite, 2.0 times as wide as long, distolateral margins weakly convex.

Cheliped (Fig. 6L, M) as figured.

First pleopod (Fig. 6N, O) moderately compressed, distal part obscured by relatively long setae; terminal process elongate, strongly curved outward; distal concavity situated laterally, not filled with setae; subdistal process separated. Second pleopod (Fig. 6P) with apical margin slightly cleft; lateral proximal expansion moderately broad.

Coloration.—Not recorded.

Habitat.—The present specimens of *M. milloti* were collected on dead coral reef platforms in the intertidal zone. Serène (1973) noted that this species also inhabits soft muddy bottoms in the intertidal zone of estuaries.

Remarks.—The present specimens belong to the *Macrophthalmus telescopicus* complex (Barnes, 1976), and were identified as *M. milloti* because of the relatively short ocular peduncle (1.0 times as long as carapace) and the external orbital tooth distinctly projecting beyond the subsequent two anterolateral teeth. The opercula of the genital papillae of the present female specimen is curiously W-shaped, but we can not decide whether this is aberrant or not as only one female specimen was available. If this shape of the operculum is normal for the species, this character can be used to distinguish *M. milloti* from the other two species of the *M. telescopicus* complex, *M. serenei*, and *M. telescopicus*, in which the operculum is subovate and directed mesially.

There is little doubt that *Macrophthalmus podophthalmus* reported by Lanchester (1900a) from Singapore is identical with *M. milloti* because of the relative shortness of the ocular peduncle (0.97 times as long as carapace). Specimens of *M. serenei* recorded by Dai et al. (1986) and Dai and Yang (1991) (as *M. verreauxi*) from the Chinese waters may be referable to *M. milloti* at least in part, since the shape of the terminal part of the male first pleopod figured by them agrees well with that of *M. milloti* rather than *M. serenei*.

Distribution.—Widely distributed in tropical Indo-West Pacific from the African coast (Madagascar to Red Sea) to eastern coast of Australia (Serène, 1973), and northward to Ishigaki-jima Island, Japan (Takeda and Komai, 1991).

Macrophthalmus (Macrophthalmus) parvimanus

Guérin-Méneville, 1834

Figures 7, 8

Macrophthalmus parvimanus Guérin-Méneville, 1834: 7, pl. 4, fig. 1 [type-locality: Seychelles].—H. Milne Edwards, 1837: 65.—Richters, 1880: 155.—Miers, 1884: 542.—Balss, 1934: 523.—Barnes, 1977: 277 (key).—Crosnier, 1975: 739.

Macrophthalmus convexus: Kemp, 1919: 389, pl. 24, fig. 2 (in part).

Macrophthalmus convexus kemp Gravely, 1927: 150 [type-locality: Gulf of Manaar].

? *Macrophthalmus consobrinus* Nobili, 1906b: 265 [type-locality: Rikitea, Tuamotu Archipelago].—Crosnier, 1965: 129, figs. 232–234, 237, 238.

Macrophthalmus (Macrophthalmus) parvimanus: Barnes, 1970: 211, fig. 2.—Lundoe, 1974: 8 (list).—Hartnoll, 1975: 309 (list).—Vannini and Valmori, 1981: 216, figs. 9B, 10A.

Material Examined.—HUMZ-C 1184, 1 male (12.0 mm CL, 21.0 mm CW), Ao Tang Khen, mudflat, 5 Oct. 1990, coll. T. Komai; HUMZ-C 1190, 2 males (10.0, 11.0 mm CL, 16.1, 19.0 mm CW), 1 female (11.8 mm CL, 22.0 mm CW), Ao Nam Bor, mudflat, 7 Oct. 1990, coll. T. Komai; HUMZ-C 1194, 1 male (12.0 mm CL, 21.0 mm CW), 1 female (11.1 mm CL, 19.3 mm CW), Ban Pa Khlok, mudflat, 27 Oct. 1990, coll. T. Komai; HUMZ-C 1475, 2 males (9.6, 12.0 mm CL, 17.0, 21.6 mm CW), 1 female (damaged, 15.0 mm CW), Ko Sirei, 30 Oct. 1987, coll. S. Goshima; HUMZ-C 1476, 1 male (14.7 mm CL, 27.1 mm CW), 1 female (13.0 mm CL, 23.1 mm CW), Ban Dan Yit, 2 Nov. 1987, coll. S. Goshima; HUMZ-C 1478, 3 males (11.7–16.2 mm CL, 20.3–31.3 mm CW) Beach in PMBC, 4 Nov. 1987, coll. S. Goshima.

Description of Female.—Carapace (Fig. 7A) with greatest width across external orbital teeth, 1.74–1.86 times as wide as long. Front narrow, with shallow median groove. Upper orbital border somewhat oblique, minutely granulate; lower orbital border (Fig. 7B) fringed with series of medium sized granules. Lateral margins with general profile convergent posteriorly from dorsal aspect, armed with two or three anterolateral teeth including external orbital tooth, with third tooth, if present, poorly defined (Fig. 7C); external orbital tooth narrowly triangular from dorsal aspect, distinctly overreaching second tooth, separated from latter by V-shaped narrow incision, posterolateral margin regularly concave; second anterolateral tooth almost as wide as preceding tooth, triangular from dorsal aspect. Carapace surface mostly smooth and naked, lateral areas covered with small granules; branchial region with a short transverse row of granules at level of mid-length, two well-developed clumps of granules, and well-defined posterolateral ridge. Intestinal ridge absent.

Posteromedian margin of epistome protuberant (Fig. 7D); central region of anterior buccal cavity slightly elevated medially.

Abdomen (Fig. 7E) wide; telson (Fig. 7F) 3.4–3.5 times as wide as long, distolateral margins markedly sinuous, basal margin weakly convex, as wide as distal margin of sixth abdominal somite.

Genital papillae (Fig. 7G) situated slightly posterior to suture between sternites of fifth and sixth thoracic somite, abruptly eliminated anteromesially, without transverse groove; operculum subovate, depressed centrally, directed anteromesially; transverse groove absent; rather deep depression just anterior to operculum.

Ocular peduncle (Fig. 7A) long, narrow, 0.8–0.9 times as long as carapace, reaching base of external orbital tooth.

Palm of chela (Fig. 7H) without central row of granules; superior surface with two rows of granules; cutting edges armed with small tuberculate teeth on proximal half; dactylus 0.85–0.88 times as long as palm.

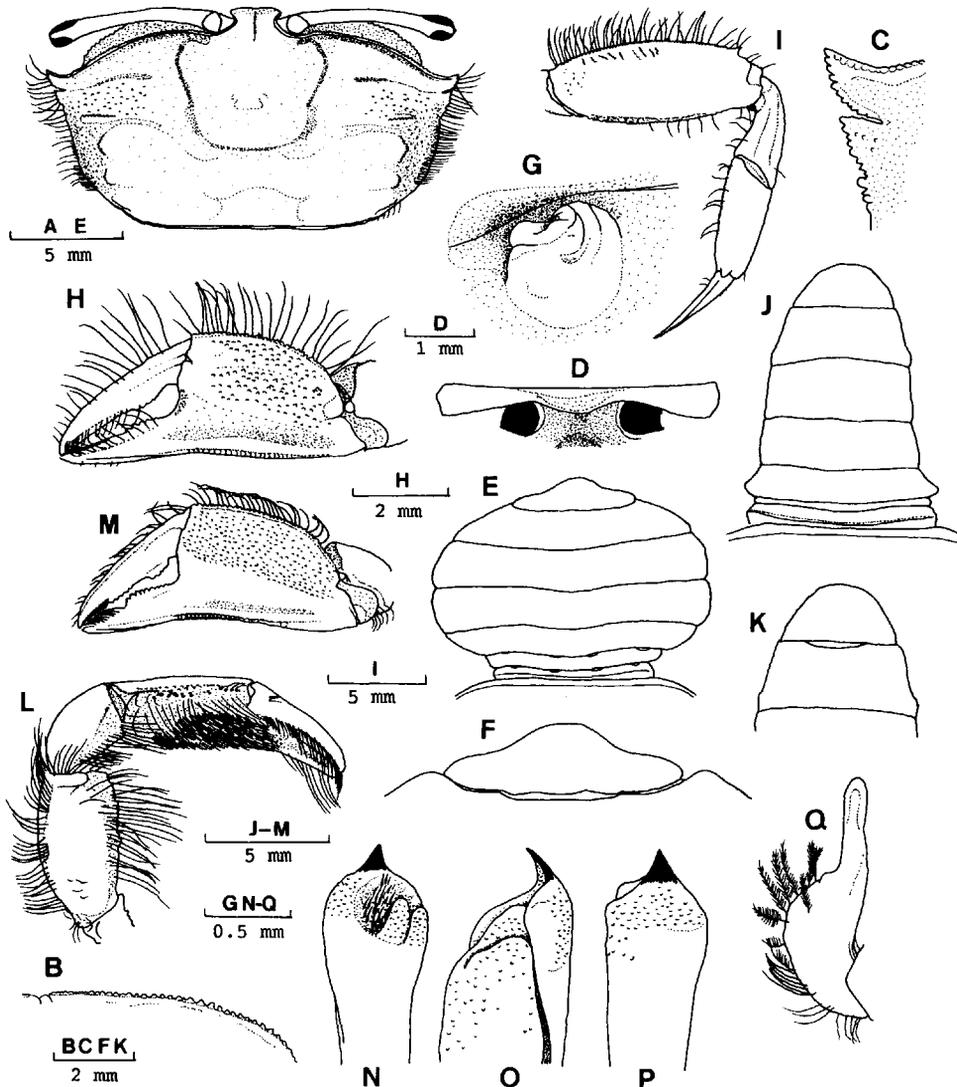


Figure 7. *Macrophthalmus (Macrophthalmus) parvimanus* Guérin-Méneville, 1834. HUMZ-C 1190, female (A-I) and HUMZ-C 1190, male (J-R). A, carapace, dorsal; B, left lower orbital border, ventral; C, left anterolateral margin; D, epistome and anterior buccal cavity; E, J, abdomen, sternal; F, telson, sternal; G, left genital papilla; H, left chela, anterior; I, left fourth pereopod, dorsal; K, sixth abdominal somite and telson, sternal; L, right cheliped, dorsal; M, chela, anterior; N-P, distal part of left first pereopod, ventral, lateral, and dorsal; Q, left second pleopod.

Second to fifth pereopods stout. Third pereopod with merus 0.36–0.44 times as wide as long. Fourth pereopod (Fig. 7I) with merus 0.34–0.36 times as wide as long respectively; dactylus slightly shorter than propodus, lateral fringes of setae sparse, lacking patch of setae on flexor surface.

Description of Male.—Male and female non sexual characters are similar.

Carapace 1.61–1.95 times as wide as long.

Abdomen (Fig. 7J) moderately narrow; sixth somite with lateral margins slight-

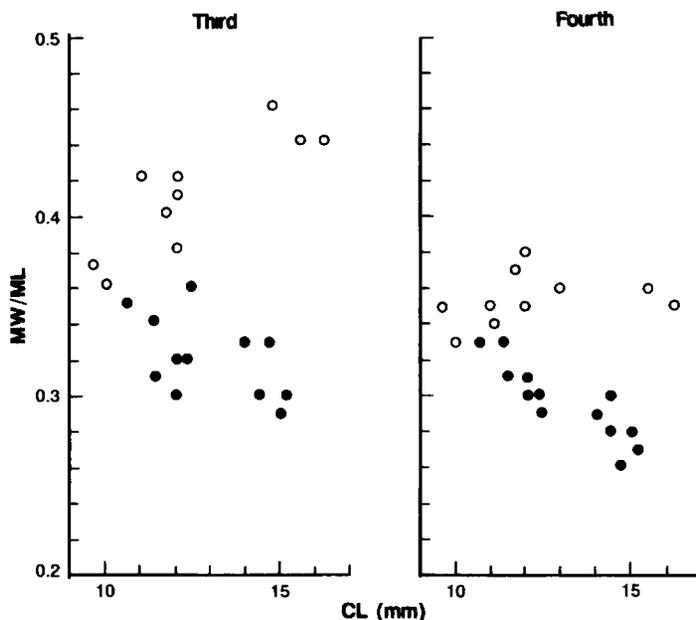


Figure 8. Comparison of proportionate width of meri of third and fourth pereopods (MW/ML) in males between *M. parvimanus* (●: N = 10) and *M. convexus* (○: N = 12).

ly expanded proximally; telson (Fig. 7K) slightly shorter than sixth somite, 2.0–2.1 times as wide as long, distolateral margins weakly convex.

Cheliped (Fig. 7L, M) as figured.

First pleopod (Fig. 7N–P) strongly compressed, distal part obliquely truncate, with tuft of long setae mesially; terminal process tapering to strong tooth curved ventrally, distal concavity filled with spiniform setae; subdistal process very broad, closely appressed. Second pleopod (Fig. 7O) with apical margin entire; lateral proximal expansion broad.

Coloration.—Similar to the coloration of *Macrophthalmus convexus*.

Habitat.—Similar to the habitat of *Macrophthalmus convexus*.

Remarks.—Barnes (1977: 273) noted as follows: “*M. parvimanus* is in a sense defined in a somewhat negative manner: it is, in a sense, a *M. convexus* which has retained juvenile chelae into adult male stage, . . .” Actually, Barnes (1970) did not manage to find other specific differences between the form with juvenile-like chelipeds and that with normally developed chelipeds. Crosnier (1965: 129) enumerated the following three features to separate *M. parvimanus* (under the name of *M. consobrinus*; Barnes (1970) showed that Crosnier’s *M. consobrinus* is conspecific with *M. parvimanus*) from *M. convexus*: “les bords latéraux de la carapace moins convergents; la côtelé la face externe du propode des chélopèdes moins marquée; la carapace proportionnellement un peu moins large (rapport largeur/longueur légèrement inférieur à 2.” The present examination proves that these differences, except for the structure of the chela, are not reliable for distinguishing these two species. However, our studies showed that *M. parvimanus* differs from *M. convexus* in some small but significant features other than the cheliped morphology of the male. In males, the meri of the third and fourth

pereopods in *M. parvimanus* are significantly wider than in *M. convexus* (the ratio 0.36–0.44 vs. 0.29–0.36 and 0.33–0.38 vs. 0.26–0.33) (Fig. 8). The proportionate widths of the meri of these pereopods do not differ sexually in *M. parvimanus*, contrary to what is known for *M. convexus* (see “Remarks” under account of the latter). The apical tooth of the male first pleopod of *M. parvimanus* is somewhat stronger than that of *M. convexus*. The female specimens were compared with those of *M. convexus* collected from the Ryukyus and Guam, since females of the latter species from Phuket of ascertainable identity were not available to us. We found two differences between these two species. The dactylus of the chela in *M. parvimanus* is proportionately shorter than in *M. convexus* (0.83–0.88 vs. 0.93–0.99). The opercula of genital papillae of *M. parvimanus* is directed anteromesially rather than mesially in *M. convexus* (compare Figs. 2G and 7G).

Although Barnes (1977) tentatively synonymized *M. consobrinus* Nobili, 1906b, with *M. parvimanus*, he suggested that a few minor differences were apparent between the holotype of the former and *M. parvimanus* examined by him. Further, the locality of Nobili's species is Tuamotu Archipelago in the Central Pacific. On the other hand, the known geographical range of *M. parvimanus* is restricted to the Indian Ocean. The widely separated distributions of these two nominal species may suggest that *M. consobrinus* is possibly distinct from *M. parvimanus*. The question about the identity of the Tuamotu population with *M. parvimanus* can only be resolved satisfactorily when additional material from Tuamotu becomes available for comparison.

Distribution.—The previous records of *M. parvimanus* is restricted to the Indian Ocean except for the type locality of *M. consobrinus* Nobili: Seychelles (Miers, 1884); Mauritius (H. Milne Edwards, 1837; Richters, 1880); Gulf of Manaar (Kemp, 1919; Gravely, 1927); Madagascar (Balss, 1934; Crosnier, 1965); Mahe, Aldabra (Barnes, 1970); Phuket (Lundoer, 1974).

Macrophthalmus (Macrophthalmus) serenei

Takeda and Komai, 1991

Figure 9

Macrophthalmus verreauxi: ? De Man, 1880: 184.—? Alcock, 1900: 237.—? Borradaile, 1903: 433.—Nobili, 1906a: 317.—Rathbun, 1910a: 332, fig. 6.—Laurie, 1915: 472, fig. 5.—Yamaguchi et al., 1987: 38, pl. 18, fig. 5. (not H. Milne Edwards, 1848 (= *M. telescopicus*)).

Macrophthalmus telescopicus: Tesch, 1915: 161, pl. 5, fig. 2 (in part); 1918: 58 (in part).—Kemp, 1919, 387 (in part), pl. 24, fig. 10.—Crosnier, 1965: 126 (in part), fig. 227.

Macrophthalmus cf. *telescopicus*: Tweedie, 1950: 128.

Macrophthalmus (Macrophthalmus) telescopicus: Barnes, 1967: 205 (in part), fig. 1 (? in part).—Barnes, 1970: 219.

Macrophthalmus (Macrophthalmus) verreauxi: Serène, 1973: 107, text-figs. 2a, d, pl. 3, figs. C, D.—Lundoer, 1974: 8 (list).—Barnes, 1976: 135, fig. 2.—Vannini and Valmori, 1981: 217, fig. 9C.—Takeda, 1981: 70.—Dai et al., 1986: 433, pl. 60(3), fig. 242(1) (? in part)—Dai and Yang, 1991: 475, pl. 60(3), fig. 242(1) (? in part).

Macrophthalmus (Macrophthalmus) verreauxi: Hartnoll, 1975: 309 (list).

Macrophthalmus kempi Serène, 1981: 1140 (not Gravely, 1927) [type-locality: Red Sea].

Macrophthalmus serenei Takeda and Komai, 1991: 168, fig. 3 [replacement name for *M. kempi* Serène, 1981].

Material Examined.—HUMZ-C 1198, 1 female (6.1 mm CL, 9.7 mm CW), Ban Dan Yit, mudflat, 13 Oct. 1990, coll. T. Komai; HUMZ-C 1199, 1 female (7.4 mm CL, 12.4 mm CW), beach in PMBC, sandy area, 18 Oct. 1990, coll. T. Komai; HUMZ-C 1482, 2 males (7.3 mm, 8.5 mm CL, 11.8, 13.2 mm CW), Ao Tang Khen, 2 Dec. 1990, coll. T. Koga & T. Kosuge; HUMZ-C 1483, 2 males (5.7, 6.2 mm CL, 9.7, 9.9 mm CL), 3 females (6.3–6.9 mm CL, 10.4–11.5 mm CL), Ao Tang Khen, 3 March 1991, coll. T. Koga and T. Kosuge.

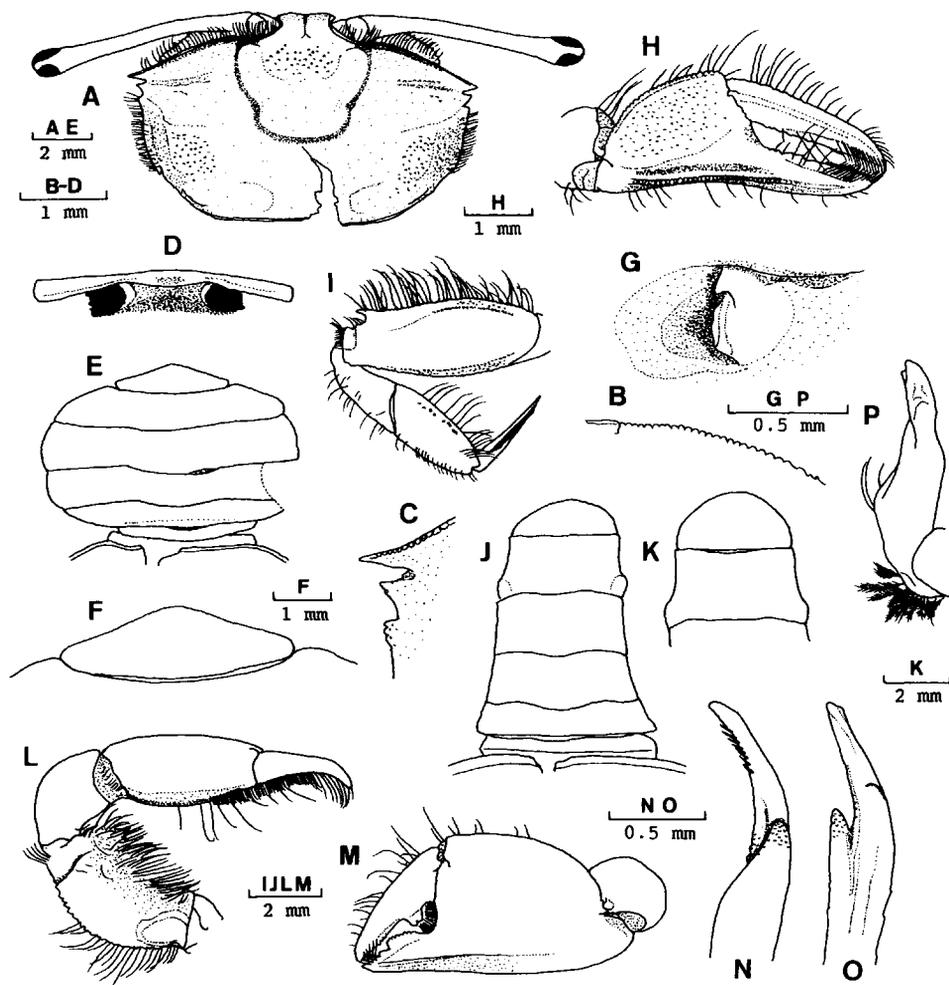


Figure 9. *Macrophthalmus (Macrophthalmus) serenei* Takeda and Komai, 1991. HUMZ-C 1199, female (A-I) and HUMZ-C 1482, male (J-P). A, carapace, dorsal, posterior margin damaged; B, left lower orbital border, ventral; C, left anterolateral margin; D, epistome and anterior buccal cavity; E, J, abdomen, sternal, left margin of second and third somite damaged; F, telson, sternal; G, left genital papilla; H, left chela, anterior; I, left fourth pereopod, dorsal; K, sixth abdominal somite and telson, sternal; L, right cheliped, dorsal; M, chela, anterior; N, O, distal part of left first pleopod, dorsal and mesial; P, left second pleopod.

Description of Female.—Carapace (Fig. 9A) with greatest width across external orbital teeth, 1.60–1.66 times as wide as long. Front with moderately deep median groove. Upper orbital border oblique, minutely granulate; lower orbital (Fig. 9B) border fringed with series of small granules. Lateral margins with general profile converging posteriorly, armed with three anterolateral teeth including external orbital tooth (Fig. 9C); external orbital tooth very narrow, triangular, overreaching second anterolateral tooth, separated from latter by narrow V-shaped incision; second tooth wider than external orbital tooth, triangular; third anterolateral tooth small, blunt, defined by wide V-shaped incision. Carapace surface naked; bran-

chial region covered with small granules on lateral half, lacking distinct ridge or clumps of granules except for short posterolateral ridge. Intestinal ridge absent.

Posteromedian margin of epistome convex (Fig. 9D); central region of anterior buccal cavity slightly elevated medially.

Abdomen (Fig. 9E) wide; telson (Fig. 9F) 3.3 times as wide as long, distolateral margins slightly concave, basal margin somewhat convex, as wide as distal margin of sixth abdominal somite.

Genital papillae (Fig. 9G) less elevated, attached anteriorly to suture between sternites of fifth and sixth thoracic somites, without distinct transverse groove; operculum subovate, shallow, directed mesially; deep depression on sternite just mesial to genital papillae.

Ocular peduncle (Fig. 9A) narrow, very long, about 1.08–1.22 times as long as carapace, projecting beyond external orbital tooth by length of distal $\frac{1}{3}$ to $\frac{2}{5}$.

Palm of chela (Fig. 9H) without central row of granules on outer surface; superior surface beaded with a row of granules over entire length; cutting edges of fingers bearing small, tuberculate teeth on proximal half; dactylus slightly shorter than palm.

Pereopods stout. Third pereopod (Fig. 9I) with dactylus slightly shorter than propodus, lacking patch of setae on flexor surface, lateral fringes of setae rather sparse.

Description of Male.—Male and female non-sexual characters are similar.

Abdomen (Fig. 9J) moderately narrow; sixth somite with lateral margins distinctly expanded near base; telson (Fig. 9K) distinctly shorter than sixth abdominal somite, 2.0–2.1 times as wide as long, with distolateral margins convex.

Cheliped (Fig. 9L, M) as figured.

First pleopod (Fig. 9N, O) moderately compressed, distal part surrounded by long setae; terminal process strongly elongate, curved outward, with a row of spinules laterally; subdistal process rather thin, clearly separated. Second pleopod (Fig. 9K) cleft terminally; lateral proximal expansion narrow.

Coloration.—Not known.

Habitat.—A specimen from Ban Dan Yit was collected on soft muddy bottoms in the intertidal zone of the estuarine area. The other specimens were collected from small pools on the dead coral reef platform or from rocky shores with little freshwater influence.

Remarks.—Serène (1981), who examined the holotype, concluded that *Macrophthalmus verreauxi* was synonymous with *M. telescopicus*, and he applied a new name, *M. kemp*i, to another allied species distinct from true *M. verreauxi*. However, Takeda and Komai (1991) renamed this species as *M. serenei*, because the name *M. kemp*i was a junior homonym of *M. convexus kemp*i Gravely, 1927, which has been regarded as a synonym of *M. parvimanus*.

This species belongs to the *M. telescopicus* complex of Barnes (1976), including *M. telescopicus* and *M. milloti*. The present specimens agree well with the species defined by Barnes (1976) as *M. verreauxi* (= *M. serenei*). As regards the female, the combination of relative length of the ocular peduncle and structure of the external orbital tooth is usable to differentiate the three species. Fortunately we could examine a female specimen of *M. telescopicus* from Ogasawara Island, Japan (NSMT-Cr 5548). We could not find significant differences in the morphology of the genital papillae between it and *M. serenei*.

There is little doubt that *M. verreauxi* reported by Sakai (1976) from several

localities around Japan is referable to *M. telescopicus*, judging from the figure (Sakai, 1976: 611, text-fig. 334) and the habitat.

Distribution.—Widely distributed in tropical Indo-West Pacific from African coast (Madagascar to Red Sea) to eastern coast of Australia (Serène, 1973), and northward to Kyushu, Japan (Yamaguchi et al., 1987).

Subgenus *Mareotis* Barnes, 1967

Type-Species.—*Ocypode japonica* De Haan, 1835.

Emended Diagnosis.—Carapace moderately wide; front moderately to strongly narrow, more or less constricted basally; lower orbital border fringed with medium-sized granules (except male of *M. tomentosus*, in which lower orbital border bears lobulate tubercles); anterolateral teeth broad based, rectangular; branchial region with conspicuous longitudinal ridges or line represented by row of setae, without clumps of granules. Posteromedian margin of epistome usually concave, anterior buccal cavity deeply depressed below or slightly elevated medially. Ocular peduncles more than half of carapace length in adult, narrow, cornea reaching base of external orbital tooth. Carapace without intestinal ridge. Male abdomen with sixth somite usually not expanded proximally; female telson moderately wide, distolateral margins variable, basal margin considerably convex. Third maxilliped with merus distinctly shorter than ischium, both well sculptured. In males, inferior ridge on outer surface of palm poorly developed; fingers moderately short, fixed finger more or less deflexed; merus lacking stridulating crest on anterior margin. In females, palm of chela relatively shallow, without longitudinal granular row on outer surface; inferior ridge weak, submarginal; inferior row of setae usually present. Second to fifth pereopods moderately stout; merus of second and third pereopods armed with subdistal tooth proximal to abruptly delimited subdistal groove.

Remarks.—The concept of this subgenus here is somewhat different from that conceived by Barnes (1967) because of the establishment of a new subgenus, *Paramareotis*, to accommodate three species that previously have been assigned to *Mareotis*. The features of the female are added here on the basis of material available to us. The species belonging to *Mareotis* may be divided into two groups. Group A is characterized by the relatively wide front slightly constricted proximally, the relatively short, stout ocular peduncle (less than 0.5 times as long as the carapace), and the presence of two longitudinal rows of setae on each posterior branchial region. The following two species are assigned to this group: *M. crinitus* and *M. darwinensis* Barnes, 1971. Group B is characterized by the narrow front distinctly constricted proximally, the relatively long, narrow ocular peduncle (more than 0.5 times as long as the carapace), and the presence of two longitudinal ridges on each of the posterior branchial region. The following eight species are referable to this group: *M. abercrombiei* Barnes, 1966a, *M. banzai* Wada and Sakai, 1989, *M. definitus*, *M. depressus*, *M. japonicus*, *M. pacificus*, *M. setosus* H. Milne Edwards, 1852, and *M. tomentosus*.

Macrophthalmus (Mareotis) definitus White, 1848

Figure 10

Macrophthalmus definitus White, in Adams and White, 1848: 51 [type-locality: Philippines].—Ortmann, 1897: 342.—Rathbun, 1910b: 307, pl. 2, fig. 1.—Tesch, 1915: 198; 1918: 59.—Barnes, 1966a: 46; 1977: 278 (key).—Starobogatov, 1972: 346.
Macrophthalmus depressus: Ortmann, 1894: 745 (not Rüppell, 1830).

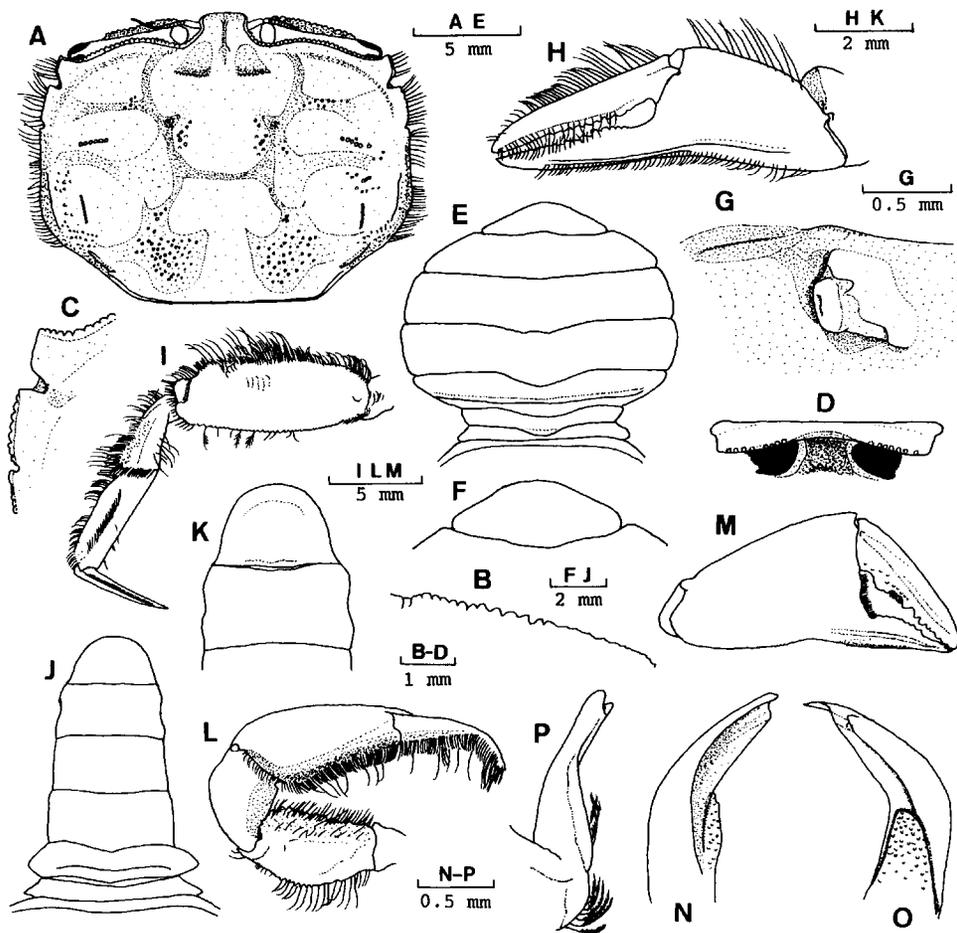


Figure 10. *Macrophthalmus (Mareotis) definitus* White, 1848. HUMZ-C 1197, female (A-I) and HUMZ-C 1183, male (J-P). A, carapace, dorsal; B, left lower orbital border, ventral; C, left anterolateral margin; D, epistome and anterior buccal cavity; E, J, abdomen, sternal; F, telson, sternal; G, left genital papilla; H, left chela, anterior; I, left fourth pereopod, dorsal; K, sixth abdominal somite and telson, sternal; L, right cheliped, dorsal; M, chela, anterior; N, O, distal part of left first pleopod, ventral and dorsal; P, left second pleopod.

Macrophthalmus (Mareotis) definitus: Barnes, 1967: 214, fig. 4, pl. 1d; 1970: 232; Barnes, 1971: 17.—Lundoer, 1974: 8 (list).—Takeda, 1981: 73, fig. 2.—Tai and Song, 1984: 82 (key).—Dai, Yang, Song and Chen, 1986: 436, pl. 60(7), fig. 243(2).—Dai and Yang, 1991: 478, pl. 60(7), fig. 243(2).

Macrophthalmus teschi: Gordon, 1931: 549 (not Kemp, 1919).

Material Examined.—HUMZ-C 1197, 4 males (10.5–14.2 mm CL, 13.0–18.8 mm CW), 2 ovigerous females (10.7, 13.0 mm CL, 13.0, 16.3 mm CW), Ban Pa Khlok, mudflat below mangrove swamp, 13 Oct. 1990, coll. T. Komai.

Description of Female.—Carapace (Fig. 10A) moderately wide, greatest width across level of anterior to insertion of third pereopod, 1.21–1.25 times as wide as long. Front narrow, somewhat constricted at bases of ocular peduncles, with deep median groove. Upper orbital border weakly oblique, distinctly granulate; lower orbital border (Fig. 10B) fringed with series of relatively large granules. Lateral margins with general profile very slightly convex, armed with three anterolateral

teeth including external orbital tooth (Fig. 10C); external orbital tooth widely based, square, falling short of second anterolateral tooth, separated from latter by U-shaped incision, lateral margin slightly divergent posteriorly; second anterolateral tooth wider than preceding tooth, with lateral margin divergent posteriorly; third anterolateral tooth small, defined by wide V-shaped incision; lateral margins behind third anterolateral teeth almost parallel to median line. Carapace surface granulate except gastric, cardiac, and intestinal regions smooth, shiny; protogastric region with paired transverse rows of granules; branchial region with two short longitudinal granular ridge on posterior part; posterolateral ridge rather long, heavily granulate.

Posteromedian margin of epistome concave (Fig. 10D); central region of anterior buccal cavity depressed below.

Abdomen (Fig. 10E) wide, with third somite having strong transverse ridge; telson (Fig. 10F) moderately wide, approximately 2.7 times as wide as long, distolateral margins nearly straight, basal margin broadly convex, as wide as distal margin of sixth abdominal somite.

Genital papillae (Fig. 10G) situated slightly posterior to suture between sternites of fifth and sixth thoracic somites, abruptly delimited mesially, without definite transverse groove; operculum faintly suboval, directed mesially; shallow depression on sternite just anteromesial to operculum.

Ocular peduncle (Fig. 10A) moderately long and narrow, about 0.5 times as long as carapace, falling short of tip of external orbital tooth.

Palm of chela (Fig. 10H) with inferior ridge weak, falling short of level of articular knob of palm; inferior row of setae present along inferior to inferior ridge; superior surface rounded; cutting edges of fingers bearing small tuberculate teeth on proximal $\frac{2}{3}$; dactylus longer than palm.

Second to fifth pereopods relatively stout. Extensor surface of merus of fourth pereopod (Fig. 10I) concealed by thick setae, subdistal tooth situated somewhat proximal to subdistal transverse groove; carpus and propodus also thickly setose on extensor surface; dactylus distinctly shorter than propodus, bearing thick lateral fringe of setae.

Description of Male.—Male specimens are similar to the females in all non-sexual characters.

Abdomen narrow (Fig. 10J); third somite with distinct transverse ridge, lateral expansion strong; sixth somite with lateral margins slightly sinuous at midlength; telson (Fig. 10K) almost as long as sixth somite, 1.5–1.6 times as wide as long, with lateral margins slightly concave proximally.

Cheliped (Fig. 10L, M) as figured.

First pleopod (Fig. 10N, O) moderately compressed, distal part obscured by setae ventrally; terminal process elongate, strongly curved outward; subdistal process moderately broad, closely appressed. Second pleopod (Fig. 10P) distinctly twisted, lateral margin forming thin plate almost over entire length, terminal part deeply cleft.

Coloration.—Sandy or muddy gray in dorsal aspect, carapace scattered with brownish patches. Lower orbital border yellowish brown, anterior part of pterygostomian region dark brown. Thoracic sternite and abdomen brownish gray in male. Third maxilliped pale gray or white. Outer surface of palm of chela gray, fingers brownish.

Habitat.—The present material was collected from burrows on mudflats near a mangrove swamp where the substrates are very soft. *M. teschi* was found sympatrically.

Remarks.—The present specimens agree well with the description given by Barnes (1967). The male first pleopod resembles the figure given by Dai et al. (1986: fig. 243-2) and Dai and Yang (1991: fig. 243-2) except for the subdistal process that is closely appressed rather than clearly separated.

Macrophthalmus definitus is easily distinguished from all species of group B by having a proportionately narrower carapace, possession of a pair of transverse row of granules on the protogastric region, and a distinct transverse ridge on the third abdominal somite in both sexes.

Distribution.—The previous records of *M. definitus* are restricted to the Western Pacific Ocean, other than the list of Lundoer (1974) from Phuket: Philippines (Adams and White, 1848; Rathbun, 1910b); Solomon Islands (Barnes, 1967); Hong Kong, Canton (Gordon, 1931; Barnes, 1970); Soela Islands (Barnes, 1971); Queensland, Australia (Zucker, 1988); Iriomote-jima Island, Ryukyu Islands (Takeda, 1981).

Macrophthalmus (Mareotis) pacificus Dana, 1851

Figure 11

Macrophthalmus pacificus Dana, 1851: 248 [type-locality: Samoa].—1852: 314, pl. 19, fig. 4.—Stimpson, 1858: 97.—De Man, 1895: 579.—Tesch, 1915: 190, pl. 8, fig. 11.—Kemp, 1919: 391.—Sakai, 1939: 628.—Tweedie, 1950: 359.—Chhapgar, 1957: 514, pl. 15.—Starobogatov, 1972: 345.—Barnes, 1977: 278 (key).

Macrophthalmus (Mareotis) pacificus: Barnes, 1967: 218, pl. 2b, fig. 6.—Lundoer, 1974: 8 (list).—Sakai, 1976: 614, text-fig. 337.—Dai et al., 1986: 435, pl. 60(5), fig. 242(3-4).—Dai and Yang, 1991: 476, pl. 60(5), fig. 242(3-4).

? *Macrophthalmus bicarinatus* Heller, 1865: 36, pl. 4, figs. 2, 3 [type-locality: Nicobars].

Macrophthalmus depressus: Lanchester, 1900b: 259 (not Rüppell, 1830).

not *Macrophthalmus pacificus*: Rathbun, 1910b: 307, pl. 1, fig. 3 (= *Macrophthalmus crinitus* Rathbun, 1913).

Material Examined.—HUMZ-C 1895, 2 males (14.3, 15.0 mm CW), Ban Pa Khlok, mudflat near mangrove swamp, 13 Oct. 1990, coll. T. Komai and T. Kosuge.

Supplementary Material.—NSMT-Cr uncat., 1 female (16.7 mm CL, 23.5 mm CW), Philippines, July 1974, coll. H. Motoh.

Description of Male.—Carapace (Fig. 11A) moderately wide, greatest width across third anterolateral tooth, 1.30 times as wide as long. Front narrow, slightly constricted at bases of ocular peduncles, with deep median groove. Upper orbital border nearly transverse, minutely granulate; lower orbital border (Fig. 11B) fringed with series of relatively large granules. Lateral margins with general profile very slightly convex, armed with three anterolateral teeth including external orbital tooth (Fig. 11C); external orbital tooth widely based, square, falling short of second anterolateral tooth, separated from latter by U-shaped incision, lateral margin strongly divergent posteriorly; second anterolateral tooth wider than preceding tooth, with lateral margin divergent posteriorly; third anterolateral tooth small but distinct, defined by V-shaped incision; lateral margins behind third anterolateral teeth somewhat convergent posteriorly. Carapace surface smooth, shiny; protogastric region without paired transverse row of granules; branchial region with two short longitudinal granular ridges on posterior part; posterolateral ridge rather well defined, strongly convex.

Posteromedian margin of epistome weakly concave or straight (Fig. 11D); central region of anterior buccal cavity elevated somewhat medially.

Ocular peduncle (Fig. 11A) moderately narrow, about 0.5 times as long as carapace, slightly falling short of tip of external orbital tooth.

Abdomen narrow (Fig. 11E); third somite lacking transverse ridge, with lateral

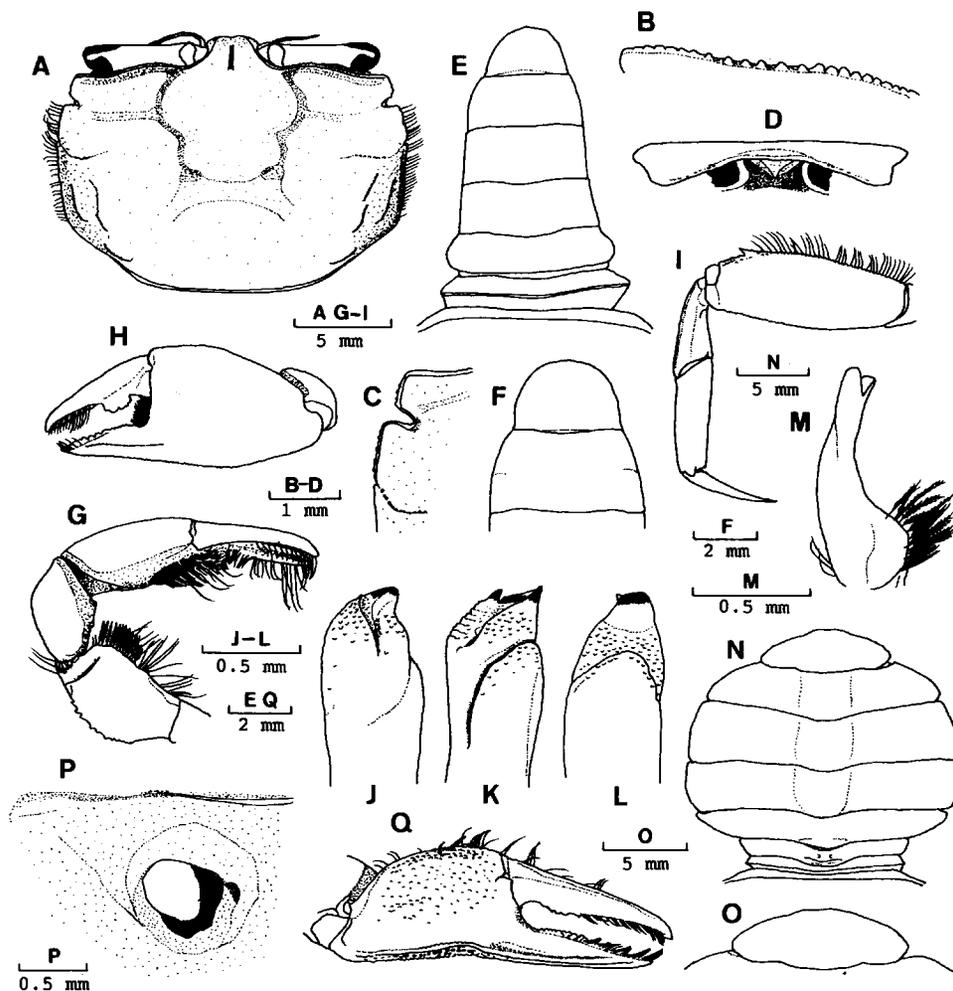


Figure 11. *Macroptalmus (Mareotis) pacificus* Dana, 1851. HUMZ-C 1195, male (A-M) and NSMT-Cr uncat., female (N-Q). A, carapace, dorsal; B, left lower orbital border, ventral; C, left anterolateral margin; D, epistome and anterior buccal cavity; E, N, abdomen, sternal; F, sixth abdominal somite and telson, sternal; G, left cheliped, dorsal; H, chela, anterior; I, left fourth pereopod, dorsal; J-L, distal part of left first pleopod, ventral, lateral, and dorsal; M, left second pleopod; P, left genital papilla; Q, right chela, anterior.

expansion moderate; sixth somite with lateral margins slightly convex; telson (Fig. 11F) slightly shorter than sixth abdominal somite, 1.65 times as wide as long, with distolateral margins very slightly concave proximally.

Cheliped (Fig. 11G, H) as figured.

Second to fifth pereopods moderately stout, each extensor surface only with row of setae. Extensor surface of merus of fourth pereopod (Fig. 11I) only with row of long setae, subdistal tooth situated considerably proximal to subdistal transverse groove; carpus and propodus naked; dactylus distinctly shorter than propodus, bearing sparse fringe of setae.

First pleopod (Fig. 11J-L) moderately compressed; terminal margin aimed with acute corneous spine on ventral side; terminal process short, truncate, directed

distomesially; subdistal process very wide, closely appressed. Second pleopod (Fig. 11M) barely twisted, apically cleft; lateral proximal expansion broad.

Description of Female.—The female specimen is similar to the males in most non-sexual characters.

Carapace 1.4 times as wide as long.

Abdomen (Fig. 11N) wide, with third somite lacking transverse ridge; telson (Fig. 11O) moderately wide, 3.1 times as wide as long, distolateral margins very slightly convex, basal margin broadly convex, as wide as distal margin of sixth abdominal somite.

Genital papillae (Fig. 11P) situated somewhat posterior to suture between sternites of fifth and sixth thoracic somites, gradually sloping round about, without transverse groove; operculum faintly suboval, directed ventrally; no marked depression on sternite of sixth thoracic somite.

Palm of chela (Fig. 11Q) with inferior ridge distinct, extending proximally to level of articulate knob of palm; inferior row of setae absent; superior surface rounded; cutting edges of fingers with small, tuberculate teeth; dactylus equaling palm in length.

Coloration.—From dorsal aspect, entire animal sandy gray except posterior margin of carapace which is colored with white. Pterygostomian region with two deep brown bands along lateral margin of buccal frame and outer half of lower orbital border to anterior anterolateral margin on white background. Thoracic sternite and abdomen pale gray except sternal plate of first pereopod which has tinge of brown. Carpus, and merus of first pereopod yellowish, outer surface of palm bluish gray.

Habitat.—The present material was collected on mudflats very near a mangrove swamp where the substrates were very soft.

Remarks.—The two male specimens from Phuket agree in general with the descriptions of *M. pacificus* given by Barnes (1967). The terminal part of the male first pleopod seems to differ from the figure given by Dai et al. [1986: fig. 242(3–4)] and Dai and Yang [1991: fig. 242(3–4)] in having the mesial terminal spine much shorter. We consider that the difference is due to the immaturity of our specimens.

Since no female specimen of this species from Phuket was available, we examined a specimen from the Philippines through the kind cooperation of Dr. M. Takeda of the NSMT. *Macrophthalmus pacificus* is distinguishable from all members of group B other than for the male first pleopod structure, in having the carapace almost naked without granules, the external orbital tooth with lateral margin strongly divergent posteriorly, a relatively stout, short ocular peduncle, and sparsely hairy pereopods. Furthermore, the female of this species is peculiar among the *Mareotis* species examined here in lacking the inferior row of setae on the palm and having the genital papilla not accompanied with marked depression on the sternite.

Distribution.—Samoa (Dana, 1852); Malaya (De Man, 1895); Australia (Boone, 1934); Ishigaki-jima and Iriomote-jima Islands (Sakai, 1939); Borneo (Tweedie, 1950); India (Chhappgar, 1957); New Guinea, Solomon Islands (Barnes, 1967).

Macrophthalmus (Mareotis) teschi Kemp, 1919
Figure 12

Macrophthalmus depressus: De Man, 1888b: 124; De Man, 1895: 578.—Alcock, 1900: 380 (in part).

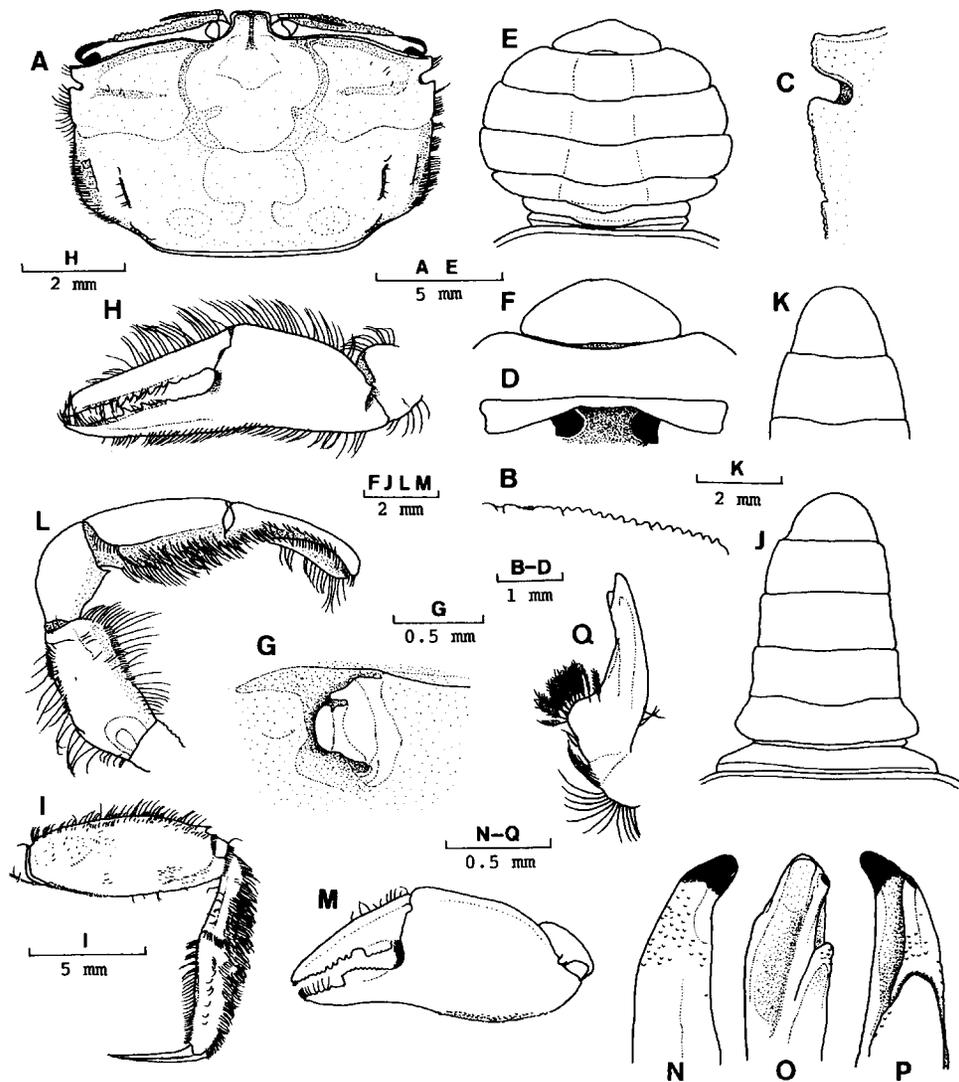


Figure 12. *Macrophthalmus (Mareotis) teschi* Kemp, 1919. HUMZ-C 1196, female (A-I) and male (J-Q). A, carapace, dorsal; B, left lower orbital border, ventral; C, left anterolateral margin; D, epistome and anterior buccal cavity; E, J, abdomen, sternal; F, telson, sternal; G, left genital papillae; H, left chela, anterior; I, right fourth pereopod, dorsal; K, sixth abdominal somite and telson, sternal; L, right cheliped, dorsal; M, chela, anterior; N-P, distal part of left first pleopod, ventral, lateral, and dorsal; Q, left second pleopod.

Macrophthalmus teschi Kemp, 1919: 393, pl. 24, figs. 8, 9 [type-locality: Port Canning; Aracan Coast; Mergui].

Macrophthalmus (Mareotis) teschi: Barnes, 1971: 26, fig. 6. not *Macrophthalmus teschi*: Gordon, 1931: 549 (= *M. definitus* White, 1848).

Material Examined.—HUMZ-C 1196, 4 males (7.9–9.1 mm CL, 11.4–13.3 mm CW), 8 females (6 ovigerous) (6.4–10.5 mm CL, 9.0–15.0 mm CW), Ban Pa Khlok, mudflat, 28 Oct. 1990, coll. T. Komai.

Description of Females.—Carapace (Fig. 12A) moderately wide, greatest width across external orbital teeth or second anterolateral teeth, 1.38–1.51 times as wide

as long. Front narrow, constricted at bases of ocular peduncles, with deep median groove. Upper orbital border weakly oblique, minutely granulate; lower orbital border (Fig. 12B) fringed with series of medium-sized granules. Lateral margins with general profile parallel or very slightly convergent posteriorly, armed with three anterolateral teeth including external orbital tooth (Fig. 12C); external orbital tooth comparatively narrow, square, projecting as far as or slightly falling short of second anterolateral tooth, separated from latter by wide U-shaped incision, lateral margin very slightly convergent posteriorly; second anterolateral tooth much wider than preceding tooth, with lateral margin slightly convergent posteriorly; third anterolateral tooth poorly defined; lateral margin behind third anterolateral tooth almost parallel to median line. Carapace surface devoid of granules, but covered entirely with short, soft pubescence; epi- and protogastric region lacking transverse row of granules; posterior part of branchial region having two short longitudinal granular ridges with several stout setae, and transverse row of stout setae slightly posterior to level of third anterolateral tooth; posterolateral ridge weak, bearing several stout setae.

Posteromedian margin of epistome variable from straight to weakly convex (Fig. 12D); central region of anterior buccal cavity flat or slightly elevated.

Abdomen (Fig. 12E) wide, with third somite lacking transverse ridge; telson (Fig. 12F) moderately wide, 2.3–2.6 times as wide as long, distolateral margins straight except for proximal part which is rounded, basal margin broadly convex, distinctly narrower than distal margin of sixth abdominal somite.

Genital papillae (Fig. 12G) situated slightly posterior to suture between sternites of fifth and sixth thoracic somite, abruptly delimited mesially, with deep transverse groove just anterior to operculum; operculum suboval, directed mesially; shallow depression on sternite just mesial to genital papillae.

Ocular peduncle (Fig. 12A) narrow, about 0.6–0.7 times as long as carapace, slightly falling short of tip of external orbital tooth.

Palm of chela (Fig. 12H) with inferior ridge obscure; inferior row of setae present; superior surface poorly ridged; cutting edges of fingers with several large, sharply pointed teeth as well as small tuberculate teeth; dactylus slightly longer than palm.

Second to fifth pereopods relatively stout. Extensor surface of merus of fourth pereopod (Fig. 12I) obscured by moderately long and short, soft setae, subdistal tooth situated somewhat proximal to subdistal transverse groove; extensor surface of carpus and propodus concealed by thick setae; dactylus distinctly shorter than propodus, with thick fringe of setae.

Description of Male.—Males and females are similar in most non-sexual features.

Abdomen (Fig. 12L) narrow; third somite without distinct transverse ridge, lateral expansion moderate; sixth somite with lateral margins nearly straight; telson (Fig. 12K) 1.6 times as wide as long, with distolateral margins regularly convex.

Cheliped (Fig. 12L, M) as figured.

First pleopod (Fig. 12N–P) moderately compressed, distal part obscured by long setae ventrally; terminal process somewhat elongate, curved outward, apical margin rounded; distolateral concavity not filed with setae; subdistal process moderately broad, separated. Second pleopod (Fig. 12Q) slightly twisted, lateral proximal expansion very broad, terminal part deeply cleft; lateral proximal expansion broad.

Coloration.—Entire animal muddy gray in dorsal aspect. Branchiostegal region along lower orbital border fine yellow, and remainder dark brown; sternite of male gray. Sternal surface of third maxilliped white. Outer surface of palm of cheliped gray, fingers, carpus, and merus brownish.

Habitat.—The present specimens were collected from muddy grounds some distances from the mangrove swamp, where the substrate is very soft and deep.

Remarks.—The present male specimens agree well with the original description of *Macrophthalmus teschi* given by Kemp (1919) except for the less deflexed fixed finger of the male chela which is probably due to the immaturity of the specimens. On the other hand, they differ, apparently, from the description given by Barnes (1971), based on material from east Java, in the general outline of carapace. According to Barnes's figure (Barnes, 1971: 21, fig. 6), the external orbital tooth falls short of the tip of the second anterolateral tooth, and thus the general outline of the anterolateral margin of the carapace is convergent anteriorly. On the other hand, in the original description and the present material, the external orbital tooth projects as far as the second anterolateral tooth and the anterolateral margin of carapace is slightly divergent anteriorly. Unfortunately, Barnes did not comment on the significance of this difference. Furthermore, he described the posteromedian margin of the epistome having a rounded protuberance in his material, but it varies individually from straight to slightly convex in our material. This suggests that shape of the epistome is not always reliable for identifying *M. teschi*, at least using the key proposed by Barnes (1977).

M. teschi belongs to group B, and is most closely related to *M. depressus*, as pointed out by Kemp (1919). *M. teschi* differs essentially from *M. depressus* in having a large differentiated tooth on the fixed finger of the male chela. However, differences between females of these two species remain unknown, since we could not examine female *M. depressus*. The female of *M. teschi* is readily distinguishable from those of other *Mareotis* species examined here in having a narrow based telson, and acute, relatively large teeth on cutting edges of the fingers.

Distribution.—Bay of Bengal (De Man, 1888b; Kemp, 1919); Soelabaja, E. Java (Barnes, 1971).

Macrophthalmus (Mareotis) tomentosus Souleyet, 1841
Figure 13

Macrophthalmus tomentosus Souleyet, 1841: 243, pl. 3, fig. 8 [type locality: Manila, Philippines].—A. Milne Edwards, 1873a: 279.—De Man, 1888b: 122.—Alcock, 1900: 382.—Tesch, 1915: 193, pl. 9, fig. 12.—Kemp, 1919: 392.—Balss, 1922: 146.—Shen, 1940: 93.—Starobogatov, 1972: 345.—Barnes, 1977: 275 (key).

Macrophthalmus (Mareotis) tomentosus: Barnes, 1967: 203 (list); 1970: 229, fig. 8.—Lundoer, 1974: 8 (list).—Tai and Song, 1984: 82 (key).—Dai, Yang, Song and Chen, 1986: 435, pl. 60(6), fig. 243(1).—Dai and Yang, 1991: 477, pl. 60(6), fig. 243(1).

Macrophthalmus quadratus: Boone, 1934: 204, pls. 107–109 (not A. Milne Edwards, 1873a).

Material Examined.—HUMZ-C 1485, 1 aberrant female (8.8 mm CL, 12.3 mm CW), Ban Pa Khlok, mudflat, 28 Oct. 1990, 1 male (10.0 mm CL, 13.6 mm CW), T. Komai.

Supplementary Material.—HUMZ-C 1097, 1 female (19.5 mm CL, 26.8 mm CW), Jeram, Malaysia, 14 Dec. 1989, coll. S. Goshima.

Description of Male.—Carapace (Fig. 13A) moderately wide, greatest width across level of insertion of third pereopods, 1.36 times as wide as long. Front narrow, slightly constricted at bases of ocular peduncles, with deep median groove. Upper orbital border almost transverse, minutely granulate; lower orbital

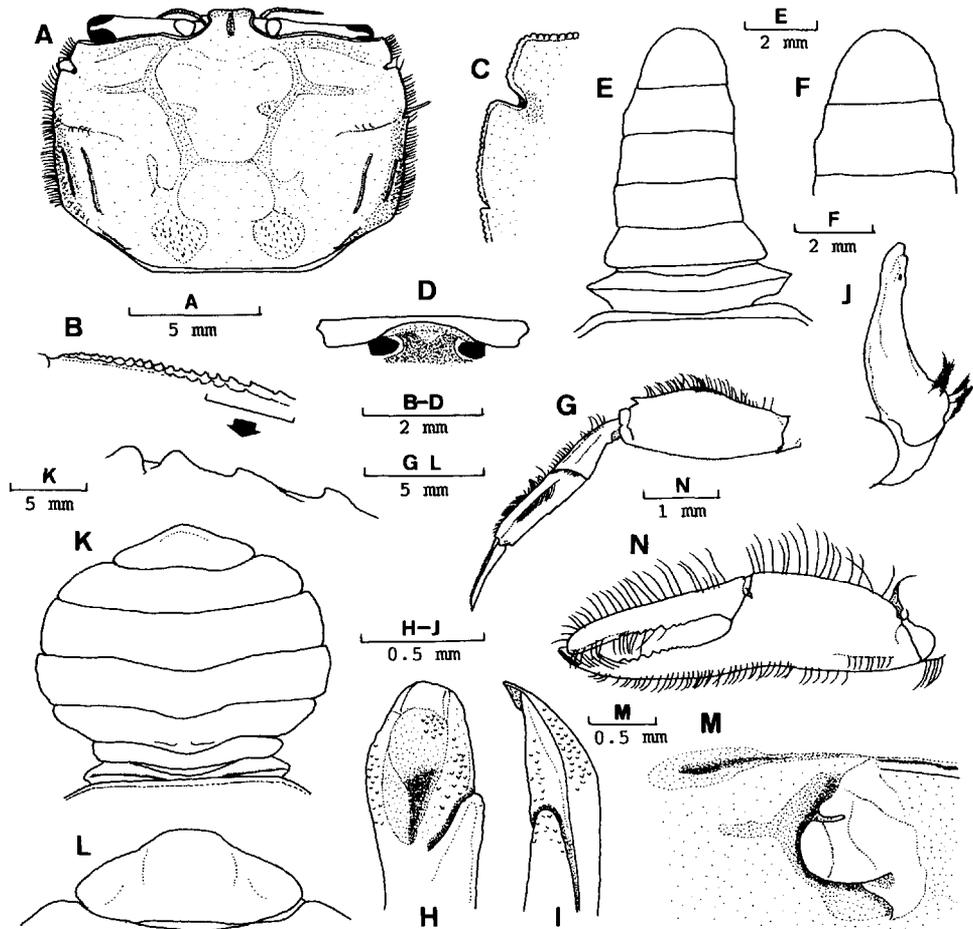


Figure 13. *Macrophthalmus (Mareotis) tomentosus* Souleyet, 1841. HUMZ-C 1485, male (A-J) and HUMZ-C 1097, female (K-N). A, carapace, dorsal; B, left lower orbital border, ventral; C, left anterolateral margin; D, epistome and anterior buccal cavity; E, K, abdomen, sternal; F, sixth abdominal somite and telson, sternal; G, left fourth pereopod, dorsal; H, I, distal part of left first pleopod, lateral and dorsal; J, left second pleopod; L, telson, sternal; M, left genital papilla; N, left chela, anterior.

border (Fig. 13B) fringed with series of medium-sized granules on inner $\frac{3}{4}$ and three wide tubercles on outer $\frac{1}{4}$. Lateral margins armed with three anterolateral teeth including external orbital tooth (Fig. 13C), with general profile convergent anterior to level of third anterolateral tooth; external orbital tooth wide, square, considerably falling short of second anterolateral tooth, separated from latter by wide U-shaped incision, lateral margin strongly divergent posteriorly; second anterolateral tooth much wider than preceding tooth, with lateral margin somewhat divergent posteriorly; third anterolateral tooth very small, defined by V-shaped incision; lateral margin behind third anterolateral tooth slightly convergent posteriorly. Carapace surface devoid of granules except posterolateral cardiac depressions, but covered entirely with short, soft pubescence; epi- and protogastric regions lacking row of granules; branchial region having two long, distinct longitudinal granular ridges, but lacking transverse row of granules; posterolateral ridge strong.

Posteromedian margin of epistome concave (Fig. 13D); central region of anterior buccal cavity depressed below.

Abdomen (Fig. 13E) narrow; third somite without distinct transverse ridge, lateral expansion moderate, sixth somite with slightly convexity at about mid-length of lateral margin; telson (Fig. 13F) 1.5 times as wide as long, with distolateral margins regularly convex.

Ocular peduncle (Fig. 13A) narrow, rather short proportionately, 0.5 times as long as carapace, falling short of tip of external orbital tooth.

Chela poorly developed.

Second to fifth pereopods moderately stout, not thickly setose. Extensor surface of merus of fourth pereopod (Fig. 13G) bearing patch of thick short setae on central portion besides row of long setae, subdistal tooth somewhat proximal to subdistal transverse groove; dactylus distinctly shorter than propodus, with thick lateral fringe of setae.

First pleopod (Fig. 13H, I) moderately slender, distal part somewhat flattened, curved outward, obscured by moderately long setae ventrally; terminal process short, rounded; distolateral concavity not filled with setae; subdistal process rather thin, closely appressed. Second pleopod (Fig. 13J) slightly twisted, distal part deeply cleft; lateral proximal expansion moderately broad.

Description of Female.—Female specimen differs from the male specimen described above in granulation of lower orbital border besides the copulatory organ.

Carapace 1.34 times as wide as long. Lower orbital border fringed with granules almost over entire length.

Abdomen (Fig. 13K) wide, with third somite lacking transverse ridge; telson (Fig. 13L) moderately wide, 2.45 times as wide as long, distolateral margins broadly concave, basal margin convex, as wide as distal margin of sixth abdominal somite.

Genital papillae (Fig. 13M) situated slightly posterior to suture between sternites of fifth and sixth thoracic somites, abruptly delimited mesially, with deep transverse groove just anterior to operculum; operculum suboval, directed mesially; shallow depression on sternite just mesial to genital papilla.

Palm of chela (Fig. 13N) with short row of setae parallel to inferior margin on proximal part; inferior ridge absent; inferior row of setae present; superior surface rounded; cutting edges of fingers with small tuberculate teeth on proximal $\frac{2}{3}$; dactylus slightly longer than palm.

Coloration.—Not recorded.

Remarks.—Although the present two specimens are subadult and one of them is sexually aberrant (see below), there is little doubt that they belong to the group B of *Mareotis*. The carapace distinctly narrowed anteriorly and covered with short pubescence, relative shortness of the ocular peduncle (0.5 times as long as the carapace), the narrow front constricted proximally, and the absence of transverse ridge on the third abdominal somite leads us to suggest that the present specimens are conspecific with *M. tomentosus*. Our identification is supported by the presence of lobulate tubercles on lateral side of lower orbital border in the male specimen. *M. tomentosus* is unique among members of the subgenus *Mareotis* in possessing the stridulatory apparatus in adult males (Barnes, 1977). The large ovigerous specimen from Jeram, Malaysia, was identified as *M. tomentosus* on the basis of the carapace features and relative shortness of the ocular peduncles. *M. tomentosus* differs from the closely related *M. pacificus* in having a pubescent body, in form of the male chela, in structure of the female genital papillae and

in the proportionately narrower telson (2.45 times as wide as long vs. 3.1 times as wide).

We suggest that the *M. quadratus* reported by Boone (1934), which was regarded as identical with *M. pacificus* by Barnes (1967), is very likely referable to *M. tomentosus* instead, at least judging from Boone's photographs (Boone, 1934: pls. 107–109).

The smaller specimen, which was infested by a bopyrid isopod, is sexually aberrant: the abdomen is apparently male-like, but has four pairs of biramous pleopods; the third thoracic sternite bears a pair of genital elevations showing as rudimentary tubercles.

Distribution.—Philippines (Souleyet, 1841); New Caledonia (A. Milne Edwards, 1873a); Mergui Archipelago (De Man, 1888b); south of China (Shen, 1940; Starobogatov, 1972; Dai and Yang, 1991).

Subgenus *Mopsocarcinus* Barnes, 1967

Type Species.—*Macrophthalmus boscii* Audouin, 1826.

Diagnosis.—Carapace subrectangular; front wide, more than 2.0 times as wide as carapace, very slightly constricted at bases of ocular peduncle; lower orbital border with small granules almost over entire length; anterolateral teeth broad based, rectangular; branchial region devoid of conspicuous longitudinal ridges or clumps of granules; intestinal ridge absent. Posteromedian margin of epistome broadly concave; anterior buccal cavity flat. Ocular peduncles short and stout, less than 0.5 times as long as carapace, cornea reaching base of external orbital tooth. Female telson very wide (more than 4 times as wide as long); distolateral margins nearly straight, basal margin slightly convex. Third maxilliped with merus and ischium well sculptured, merus somewhat shorter than ischium. In males, palm of chela with weak inferior ridge on outer surface; fingers moderately short, armed with a differentiated tooth on cutting edges, fixed finger not or slightly deflexed; merus without stridulating crest on proximal part of anterior margin. In females, palm of chela bearing distinct inferior ridge, but lacking inferior row of setae. Second to fifth pereopods relatively stout; merus of third and fourth pereopod armed with subdistal tooth overhanging abruptly delimited subdistal groove.

Remarks.—Only two species, *M. boscii* and *M. puncturatus* Miers, 1884, belong to the subgenus *Mopsocarcinus* (Barnes, 1967).

Macrophthalmus (Mopsocarcinus) boscii Audouin, 1826

Figure 14

Macrophthalmus Boscii Audouin, 1826: 258 [type-locality: Red Sea].

Euplax Bosci (sic): H. Milne Edwards, 1852: 160.—Heller, 1861: 17.

Cleistostoma boscii: Dana, 1852: 313, pl. 19, fig. 3.

Euplax Boscii: De Man, 1888a: 357.

Chaenostoma orientale Stimpson, 1858: 97.—Stimpson, 1907: 98.

Chaenostoma crassimanus Stimpson, 1858: 97.—Stimpson, 1907: 98.

Euplax (Chaenostoma) Boscii: A. Milne Edwards, 1873a: 281.—Miers, 1884: 542.—1886: 252.

Euplax (Chaenostoma) Bosci (sic): Nobili, 1906a: 319.

Euplax boscii: Tesch, 1918: 60.—Sakai, 1939, 630, fig. 100.

Macrophthalmus bosci (sic): Kemp, 1919: 383, pl. 24, fig. 6.—Barnes, 1977: 277 (key), 279 (list).

Macrophthalmus Franchettii Maccagnoo, 1936: 177.—Guinot, 1967: 283 (list).

Macrophthalmus boscii: Barnard, 1950: 103, fig. 20.—Holthuis, 1958: 53.—Crosnier, 1965: 134, figs. 244–8; Barnes, 1966b: 371.

Macrophthalmus (Euplax) bosci (sic): Guinot, 1967: 282.

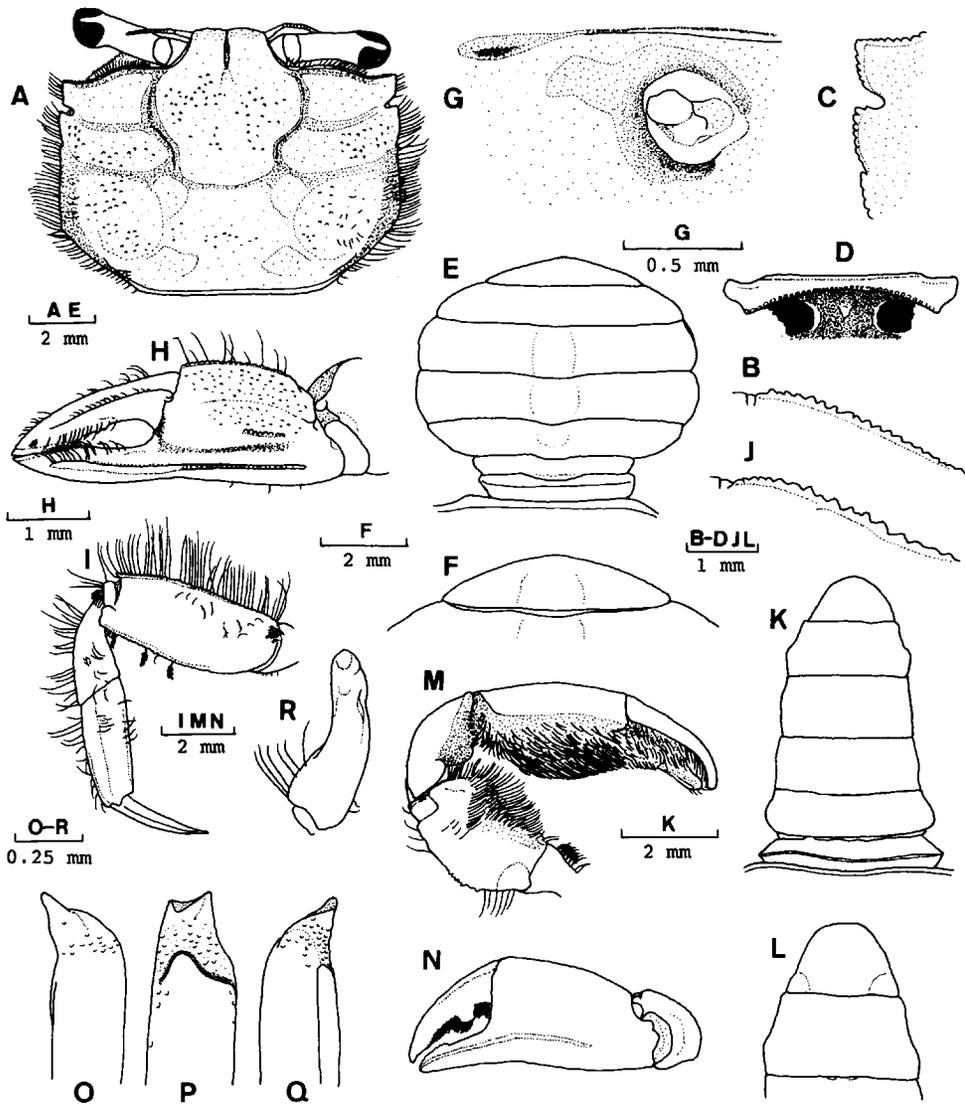


Figure 14. *Macroptalmus (Mopsocarcinus) boscii* Audouin, 1826. HUMZ-C 1187, female (A-I) and HUMZ-C 1181, male (J-R). A, carapace, dorsal; B, J, left lower orbital border, ventral; C, left anterolateral margin; D, epistome and anterior buccal cavity; E, K, abdomen, sternal; F, telson, sternal; G, left genital papilla; H, left chela, anterior; I, right fourth pereopod, dorsal; L, sixth abdominal somite and telson, sternal; M, left cheliped, dorsal; N, chela, anterior; O-Q, distal part of left first pleopod, ventral, lateral, and dorsal; R, right second pleopod.

Macroptalmus franchettii: Guinot, 1967: 283 (list).—Frogliia, 1978: 222, fig. 1 (synonymized with *M. boscii*).

Macroptalmus (Mopsocarcinus) boscii: Barnes, 1967: 227, pl. 3, fig. 9.—Lundoer, 1974: 9 (list).—Sakai, 1976: 615 (English text), pl. 211, fig. 1.—Lewinsohn, 1977: 76.—Chen, 1980: 136, fig. 19.—Vannini and Valmori, 1981: 221, figs. 9E-F, 10B.—Takeda, 1981: 74.—Miyake, 1983: 168, pl. 56, fig. 2.—Dai, Yang, Song, and Chen, 1986: 437, pl. 61(1), fig. 244.—Dai and Yang, 1991: 479, pl. 61(1), fig. 244.

Macroptalmus (Mopsocarcinus) franchettii: Barnes, 1967: 203 (list).

Macroptalmus quadratus: McNeill, 1968: 84, pl. 2, figs. 2-4 (not A. Milne Edwards, 1873a).

Macrophthalmus (Mopsocarcinus) bosci (sic): Barnes, 1970: 242.—Hartnoll, 1975: 309 (list).—Huang, Yu and Takeda, 1992: 149, fig. 9, plate 1H.

Macrophthalmus (Mareotis) quadratus: Takeda and Nunomura, 1977: 82 (not A. Milne Edwards, 1837a).

Material Examined.—HUMZ-C 1181, 1 male (7.8 mm CL, 10.2 mm CW), 4 females (4.9–7.1 mm CL, 6.6–8.9 mm CW), Ao Tang Khen, rocky area, 4 Oct. 1990, coll. T. Komai; HUMZ-C 1187, 2 males (6.3, 6.7 mm CL, 8.4, 8.9 mm CW), 6 females (6.6–8.1 mm CL, 9.1–10.8 mm CW), PMBC, rocky area, 9 Oct. 1990, coll. T. Komai.

Description of Female.—Carapace (Fig. 14A) subrectangular, greatest width across external orbital or second anterolateral teeth, 1.25–1.35 times as wide as long. Front broad, not constricted at bases of ocular peduncles, with shallow median groove. Upper orbital border nearly transverse, minutely granulate; lower orbital border (Fig. 14B) fringed with series of small granules almost over entire length. Lateral margins with general profile almost parallel, armed with three anterolateral teeth including external orbital tooth (Fig. 14C); external orbital tooth wide, square, projecting almost as far as second anterolateral tooth, separated from latter by wide U-shaped incision, lateral margin almost parallel or slightly convergent posteriorly; second anterolateral tooth wider than external orbital tooth, with lateral margin slightly divergent; third anterolateral tooth very small, defined by small notch. Carapace surface granular almost entirely, grooves filled with short setae; epi- and protogastric regions lacking transverse ridge or row of granules; branchial region lacking marked ridges except for short posterolateral ridge.

Posteromedian margin of epistome straight or slightly concave (Fig. 14D); central region of anterior buccal cavity not elevated.

Abdomen (Fig. 14E) wide, with third somite lacking transverse ridge; telson (Fig. 14F) about 4.3 times as wide as long, distolateral margins straight, basal margin nearly straight, as wide as distal margin of sixth somite.

Genital papillae (Fig. 14G) situated somewhat posterior to suture between sternites of fifth and sixth thoracic sternites, gradually sloping round about, without transverse groove; operculum subovate, directed ventromesially; shallow depression on sternite mesial to operculum.

Ocular peduncle (Fig. 14A) stout, less than 0.5 times as long as carapace, reaching base of external orbital tooth.

Palm of chela (Fig. 14H) moderately deep, with central row of granules on proximal half of outer surface; inferior ridge running submarginally, extending proximally to level of articular knob of palm; inferior row of setae absent; superior surface with two granulate ridges extending over entire length, outer ridge more strongly granulate; fingers bearing small, tuberculate teeth; dactylus equal to palm.

Second to fifth pereopods relatively stout, not thickly setose. Extensor surface of merus of fourth pereopod (Fig. 14I) with row of long setae, subdistal tooth overhanging subdistal transverse groove; carpus and propodus also with row of setae; dactylus distinctly shorter than propodus, lacking lateral fringe of setae.

Description of Male.—Males differ from females in the tuberculation of the lower orbital border, other than in the structure of the cheliped and the copulatory organs.

Lower orbital border (Fig. 14J) fringed with granules somewhat larger and fewer than in female.

Abdomen (Fig. 14K) narrow; third somite without transverse ridge, lateral expansion moderate, sixth somite with lateral margins slightly expanded proximally; telson (Fig. 14L) 1.6 times as wide as long, lateral margins not sinuous.

Cheliped (Fig. 14M, N) as figured.

First pleopod (Fig. 14O–Q) moderately compressed, ventrodistal part obscured

by long setae; ventrodistal margin of terminal process notched, outer part overreaching inner part; subdistal process broad, closely appressed. Second pleopod (Fig. 14R) with apical margin entire; lateral proximal expansion poorly developed.

Coloration.—Dorsal surface of body and appendages muddy or sandy gray. Male sternum and abdomen white. Outer surface of palm of male chela white.

Habitat.—All of the present specimens were collected in rocky areas at a relatively high tide level. They were found under stones or in clefts of rocks, and do not make burrows themselves. *M. quadratus* sometimes occurred in the same area.

Remarks.—The present male specimens agree in general with the description given by Barnes (1967) except for shape of the abdomen. Differences in the abdomen between the present specimens and Barnes's figure 9c (p. 228) are noted as follows: lateral margins of the abdomen are slightly uneven (vs. considerably uneven); anterior margin of the sixth somite is straight (vs. broadly concave); and lateral margins of the telson are not sinuous (vs. distinctly sinuous). However, we can not comment further on the significance of these differences. If Barnes's figure is correct, the male abdomen of *M. boscii* must show great variability in morphology. Further, Barnes (1967) indicated that the proportionate width of the front to the carapace tends to increase with growth, but in the present series, this character is independent of growth, ranging from 0.20 to 0.24 times. The terminal part of the male first pleopod agrees well with the figure given by Dai et al. (1986: fig. 244) and Dai and Yang (1991: fig. 244), especially in the notched terminal margin.

According to Barnes (1967; 1977), *M. boscii* differs from *M. punctulatus* Miers, 1884, the other member of the subgenus *Mopsocarcinus*, in the dorsal surface of carapace being granulated (smooth in *M. punctulatus*) and in morphology of the male cheliped. The condition of the dorsal surface of the carapace is reliable for distinguishing the females of these two species. Since the female of *M. punctulatus* has not been described in detail, we cannot comment on other differences between the two species. On the other hand, the present examination revealed that females of *M. boscii* are easily distinguished from the members of *Paramareotis*, which have superficially similar carapaces and proportions for the ocular peduncles, by the anterior buccal cavity being depressed below, presence of a median row of granules on the outer surface of the palm, less hairy pereopods, and orientation of opercula of the genital papillae.

The original spelling of the specific name is *boscii*, though several authors incorrectly used *bosci* (see synonymy). We follow Lewinsohn (1977) for the year of publication of Audouin's work as 1826, and not 1825. Our examination of the specimens identified as *M. quadratus* by Takeda and Nunomura (1977) from New Caledonia shows that their material belongs to *M. boscii* instead. The New Caledonian material agrees very well with the Phuket specimens.

Distribution.—Widely distributed throughout the Indo-Pacific region, ranging from east coast of Africa down to Cape Natal to New Caledonia (Tesch, 1918); southern Japan (Sakai, 1939); Queensland, New Guinea, Solomon Islands, Santa Cruz Islands (Barnes, 1967).

Subgenus *Paramareotis*, new subgenus

Type-Species.—*Macrophthalmus quadratus* A. Milne Edwards, 1873a.

Diagnosis.—Carapace subquadrate; front wide, more than 0.2 times as wide as carapace, very slightly constricted at bases of ocular peduncles; lower orbital border bearing some lobules on lateral part in males; anterolateral teeth broad

based, rectangular; branchial region devoid of conspicuous longitudinal ridges or clumps of granules; intestinal ridge absent. Posteromedian margin of epistome more or less convex, supported by sharp median ridge of anterior buccal cavity. Ocular peduncles short and stout, cornea reaching base of external orbital tooth. Females with telson relatively wide (3–4 times as wide as long); distolateral margins straight, basal margin slightly convex. Third maxilliped with merus somewhat shorter than ischium, both merus and ischium well sculptured. In males, palms of chelae bearing inferior ridge on outer surface; fingers moderately short, fixed finger not or very slightly deflexed, armed with differentiated tooth on cutting edge; merus armed with stridulating crest on proximal part of anterior margin. In females, palms of chelae bearing distinct inferior ridge, but lacking inferior row of setae. Pereopod relatively stout; merus of third and fourth pereopod armed with subdistal tooth overhanging gradually delimited subdistal groove.

Members.—Other than the type species *Macrophthalmus quadratus*, the following two species, which have been referred to *Mareotis*, are here assigned to the new subgenus: *M. erato* and *M. boteltobagoae*. Males of *M. erato* were not available for examination.

Etymology.—From para and *Mareotis*, which is the subgenus proposed by Barnes (1967); gender is masculine.

Remarks.—Barnes (1970) transferred *M. quadratus* from *Mopsocarcinus* to *Mareotis*, but he stated that *M. quadratus* is in many respects an intermediate species between these two subgenera. Further, he implied a polyphyletic origin of *Mareotis*. The three species assigned here to the new subgenus are distinct from *Mareotis* in having the epistome with a convex posteromedian margin supported by the sharp median ridge of the anterior buccal cavity, possession of a stridulatory apparatus in the males, a considerably wider female telson with the basal margin nearly straight, and the subdistal tooth on the meri of the second and third pereopods overhanging the subdistal groove. All of the previous authors seemed to have overlooked the presence of a sharp median ridge of anterior buccal cavity in these three species. Although Barnes (1971) noted that the posterior margin of epistome is straight in *M. quadratus* and *M. erato*, we found that in all specimens of *M. quadratus* and *M. erato* available for our study, it is more or less convex. From *Mopsocarcinus*, the three species are distinct also in having the stridulatory apparatus in addition to the structures of epistome and anterior buccal cavity. Following the current view of character evolution within the genus *Macrophthalmus* (Barnes, 1967, 1973), the presence of a stridulatory apparatus in the males is assumed to be apomorphic. The presence of a median ridge in the anterior buccal cavity appears to be rare within the genus *Macrophthalmus*, but it is frequently found in other ocypodid taxa (unpubl. data). Therefore, the presence of this ridge cannot always be regarded as an apomorphy in spite of its rarity within the genus. *M. (Mareotis) tomentosus* also has a stridulatory apparatus similar to that in three species (Barnes, 1977), but it possesses typical *Mareotis* features, such as longitudinal ridges on the branchial regions. Thus we propose a new subgenus *Paramareotis* to receive the three species. From the viewpoint of modern systematics (Hennig, 1966; Wiley, 1981, etc.), we suggest the necessity of a strict phylogenetic analysis in order to present a highly corroborated hypothesis on the genealogical relationships of the subgenera. This should be based at least on the morphological characters that have been used to classify this group, since no definite apomorphy has been established for most subgenera of *Macrophthalmus*, and even for *Macrophthalmus* itself.

Macrophthalmus (Paramareotis) quadratus new combination

A. Milne Edwards, 1873

Figure 15

Macrophthalmus quadratus A. Milne Edwards, 1873a: 280, pl. 12, fig. 6 [type-locality: New Caledonia].—Tesch, 1915: 185, pl. 8, fig. 10.—Kosuge and Wada, 1992: 61, fig. 2.

Macrophthalmus (Mopsocarcinus) quadratus: Barnes, 1967: 203 (list).

Macrophthalmus (Mareotis) quadratus: Barnes, 1971: 17, fig. 4. not *Macrophthalmus quadratus*: Boone, 1934: 204, pls. 107–109 (=possibly *M. tomentosus* Souleyet, 1841).—McNeill, 1968: 84, pl. 2, figs. 2–4.—Takeda and Nunomura, 1977: 82 (= *Macrophthalmus boscii* Audouin, 1826).

Material Examined.—HUMZ-C 1182, Ao Tang Khen, rocky area, 5 and 6 Oct. 1990, 4 males (4.3–7.5 mm CL, 5.7–7.5 mm CW), 1 female (9.9 mm CL, 12.9 mm CW), coll. T. Komai; HUMZ-C 1188, beach in PMBC, rocky area, 9 Oct. 1990, 4 males (4.1–9.0 mm CL, 5.4–12.5 mm CL), coll. T. Komai.

Description of Female.—Carapace (Fig. 15A) comparatively narrow, greatest width across external or second anterolateral teeth, 1.3 times as wide as long. Upper orbital border almost transverse, distinctly granulate; lower orbital border (Fig. 15B) fringed with series of medium-sized granules over entire length. Lateral margins with general profile parallel to median line, armed with two anterolateral teeth including external orbital tooth (Fig. 15C); external orbital tooth subrectangular, projecting as far as second anterolateral tooth, separated from latter by wide U-shaped incision, with lateral margins convergent posteriorly; second anterolateral tooth not defined posteriorly. Carapace surface granular except median area, covered with darkly pigmented stiff setae, densest in lateral areas; epigastric region with paired transverse ridges; branchial region lacking row or clumps of granules, posterolateral ridge granulate, fringed with stout setae.

Posteromedian margin of epistome convex (Fig. 15D); central region of anterior buccal cavity sharply ridged medially.

Abdomen (Fig. 15E) wide, with third somite lacking transverse ridge; telson (Fig. 15F) 4.1 times as wide as long, distolateral margins almost straight, basal margin nearly straight, as wide as distal margin of sixth somite.

Genital papillae (Fig. 15G) less elevated, somewhat posterior to suture between sternites of fifth and sixth thoracic somite, without transverse groove; operculum subovate, directed posteromesially; shallow depression extending along mesial side of genital papilla.

Ocular peduncle (Fig. 15A) moderately long, stout, 0.5 times as long as carapace at most, reaching base of external orbital tooth.

Palm of chela (Fig. 15H) moderately deep, lacking central row of granules on outer surface; inferior ridge running submarginally, strongly granulate proximally, extending posteriorly to level of articular knob of palm; inferior row of setae absent; superior surface having two rows of granules over entire length; cutting edges of fingers armed with small tuberculate teeth on proximal central part; dactylus equal to palm.

Second to fifth pereopods stout, thickly setose from dorsal aspect. Fourth pereopod (Fig. 15I) with merus comparatively wide, dorsal surface partly covered with thick setae, extensor surface concealed by thick setae, subdistal tooth overhanging subdistal groove gradually delimited; dactylus distinctly shorter than propodus, bearing thick lateral fringe of short setae.

Description of Male.—Other than non-sexual characters, the present male specimens differ from the female in shape of the lateral margin of the carapace, and structure of the lower orbital border.

Greatest width of carapace across external orbital teeth, 1.3–1.4 times as wide

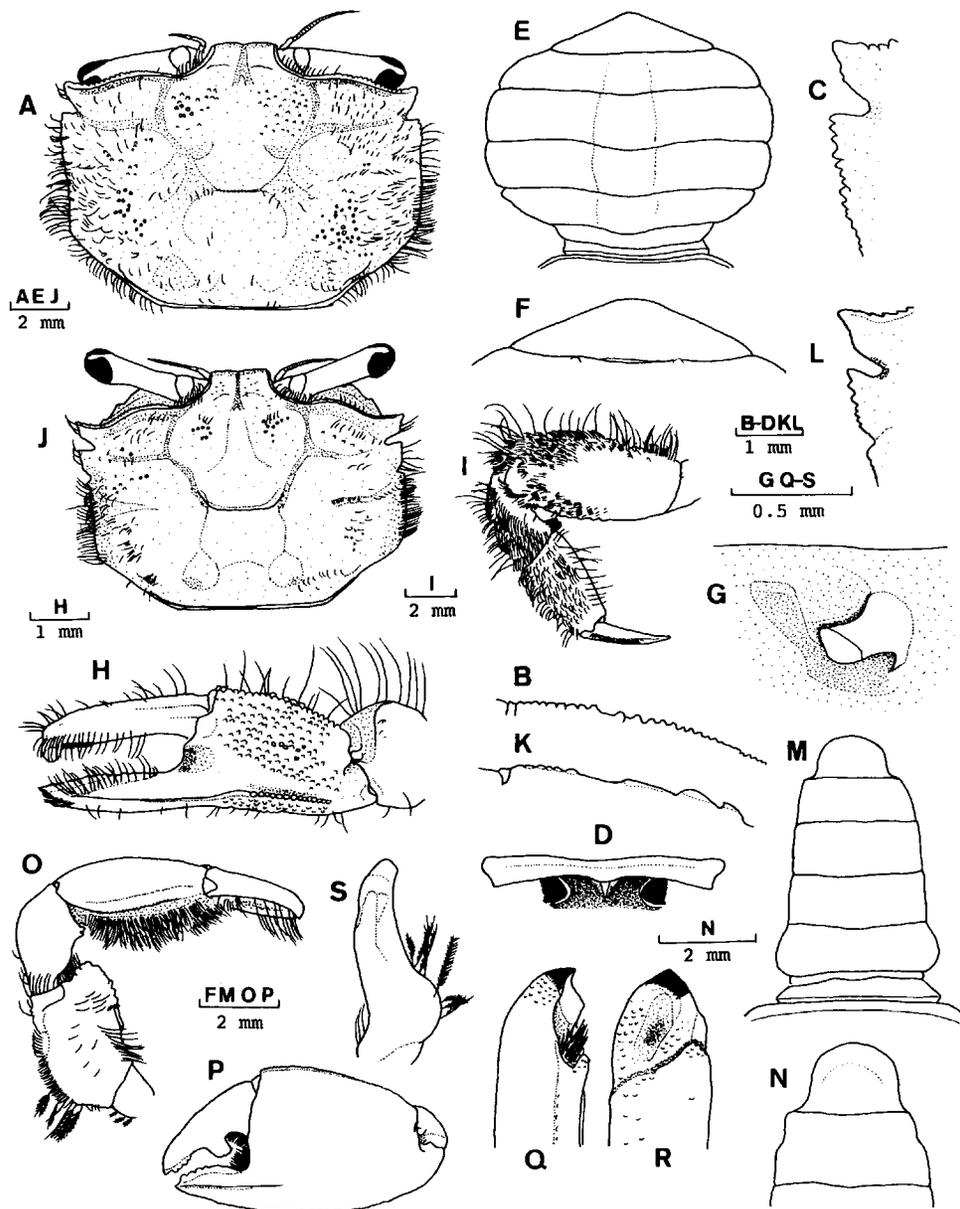


Figure 15. *Macrophthalmus (Paramareotis) quadratus* A. Milne Edwards, 1873. HUMZ-C 1182, female (A-I) and HUMZ-C 1188, male (J-S). A, J, carapace, dorsal; B, K, left lower orbital border, ventral; C, L, left anterolateral margin; D, epistome and anterior buccal cavity; E, M, abdomen, sternal; F, telson, sternal; G, left genital papilla; H, left chela, anterior; I, left fourth pereopod, dorsal; N, sixth abdominal somite and telson, sternal; O, left cheliped, dorsal; P, chela, anterior; Q, R, distal part of first pleopod, ventral and lateral; S, left second pleopod.

as long (Fig. 15J). Lateral margins armed with three anterolateral teeth (Fig. 15L); external orbital tooth slightly overreaching second anterolateral tooth, lateral margin strongly convergent posteriorly; second anterolateral tooth almost as wide as preceding tooth, with lateral margin distinctly convergent posteriorly; third an-

terolateral tooth small, separated from preceding tooth by wide V-shaped incision; lateral margins posterior to level of third anterolateral tooth parallel or concave, slightly divergent posteriorly. Lower orbital border with three to five broad lobules on lateral half.

Abdomen (Fig. 15M) moderately narrow; third somite lacking transverse ridge, lateral expansion moderate; lateral margins of sixth somite slightly sinuous at about midlength; telson (Fig. 15N) 1.6–1.7 times as wide as long, with distolateral margins distinctly sinuous near base.

Cheliped (Fig. 15O, P) as figured.

First pleopod (Fig. 15Q, R) moderately compressed, distal part obscured by moderately long setae, rounded distally from ventral aspect; terminal process short, directed dorsally, apical margin entire; distal concavity without setae; subdistal process broad based, small, closely appressed. Second pleopod (Fig. 15S) with apical margin cleft; lateral proximal expansion moderately broad.

Coloration.—Dorsal surface of body and appendages muddy or sandy gray. Male abdomen and thoracic sternum brownish orange.

Habitat.—The present specimens were collected on rocky shores in the intertidal zone together with *M. boscii*. Each was found in burrows on pebbly substrates under large stones or in the rocky clefts. Kosuge and Wada (1992) showed that *M. quadratus* inhabits burrows on pebbly substrates, mangrove pneumatophores or driftwood.

Remarks.—The present male specimens agree well with the description given by Barnes (1971), except for absence of a granular row across the anterior branchial region and the posteromedian margin of epistome being convex as against straight. We believe that shape of the posteromedian margin of epistome may be variable individually.

Barnes (1977) separated the three species assigned here to a new subgenus on the basis of morphology of the male cheliped. However, there has been no study to show differences between females of these three species. Comparing the present female specimen of *M. quadratus* with the female *M. erato* from Hong Kong (NSMT-Cr 1157), a few minor differences were detected as follows: the carapace is more hairy in *M. quadratus* than in *M. erato*; the transverse row of granules on the epigastric region is less distinct in *M. quadratus* than in *M. erato*; and the telson is proportionately wider in *M. quadratus* than in *M. erato* (4.3 times as wide as long vs. 3.3 times as wide). Since the available specimens are few, we can not assess the taxonomic value of these differences. However, proportions of the telson may be reliable to distinguish these two species. We also examined three female specimens of *M. boteltobagoe* from Okinawa Island and found the following differences between this species and *M. quadratus*: the carapace and pereopods are more hairy in *M. quadratus*; the telson is proportionately wider in *M. quadratus* (4.3 times as wide as long vs. 2.5–3.3 times as wide); the opercula of the genital papillae are directed posteromesially in *M. quadratus* rather than anteromesially as in *M. boteltobagoe*.

Our study also shows that the specimens recorded from New Caledonia by Takeda and Nunomura (1977) as *M. quadratus* belong to *M. boscii* (see remarks of *M. boscii*).

Distribution.—The previous records of this species are scattered widely in the tropical Western Pacific, including Phuket (Kosuge and Wada, 1992).

CONCLUDING REMARKS

Species of *Macrophthalmus* have been the subjects of several ethological studies recently because of their well-developed social behavior (Wada, 1978, 1984; Zucker, 1988). Barnes, in his revision of the genus *Macrophthalmus*, relied mainly on male morphology (e.g., the male cheliped) to distinguish the related species, but identification of females of the genus remained difficult, since females of almost all the species were unknown or not properly described. In this work, we have attempted to show the diversity of the female morphology, although the material available to us is limited to only about one third of the total number of valid species known in the genus. As a summary of our study, a key to females of the species examined by us is provided here. Non dichotomous characters are inserted with brackets.

KEY TO SPECIES OF ADULT FEMALE *MACROPHTHALMUS*

- | | |
|---|------------------------|
| 1a. Ocular peduncle extending beyond external orbital tooth at least by length of cornea [inferior ridge on palm marginal, strongly raised; inferior row of setae absent from palm] | 2 |
| 1b. Ocular peduncle never extending beyond external orbital tooth | 4 |
| 2a. External orbital tooth projecting beyond succeeding anterolateral teeth | 3 |
| 2b. External orbital tooth projecting as far as or falling short of succeeding anterolateral teeth [ocular peduncle 1.2–1.6 times as long as carapace] | <i>M. telescopicus</i> |
| 3a. Ocular peduncle 0.8–1.0 times as long as carapace | <i>M. milloti</i> |
| 3b. Ocular peduncle 1.1–1.4 times as long as carapace | <i>M. serenei</i> |
| 4a. Carapace more than 1.6 times as wide as long; inferior ridge on palm marginal, strongly raised [inferior row of setae absent from palm; posteromedian margin of epistome protuberant] | 5 |
| 4b. Carapace less than 1.6 times as wide as long; inferior ridge on palm submarginal, not raised | 9 |
| 5a. Telson more than 4.0 times as wide as long | 6 |
| 5b. Telson less than 3.5 times as wide as long | 8 |
| 6a. Carapace with intestinal ridge | <i>M. laevimanus</i> |
| 6b. Carapace without intestinal ridge | 7 |
| 7a. Upper orbital border weakly oblique; ocular peduncle 5.9 times as long as width of cornea; palm with central row of granules on outer surface; in life, abdomen white | <i>M. brevis</i> |
| 7b. Upper orbital border distinctly oblique; ocular peduncle 6.7–8.0 times as long as width of cornea; palm without central row of granules on outer surface; in life, abdomen reddish brown | <i>M. abbreviatus</i> |
| 8a. Dactylus of chela 0.90–0.99 times as long as palm; opercula of genital papillae directed mesially | <i>M. convexus</i> |
| 8b. Dactylus of chela 0.85–0.88 times as long as palm; opercula of genital papillae directed anteromesially | <i>M. parvimanus</i> |
| 9a. Front less than 0.15 times as wide as carapace, distinctly constricted; two longitudinal granular ridges on posterior branchial region; telson less than 3 times as wide as long, with basal margin broadly convex; palm with inferior row of setae (except <i>M. pacificus</i>) | 10 |
| 9b. Front more than 0.20 times as wide as carapace, barely constricted; no longitudinal ridge on posterior branchial region; telson more than 4 times as wide as long, with basal margin almost straight; palm without inferior row of setae | 14 |
| 10a. Carapace with transverse granular ridge on protogastric region; third abdominal somite with strong transverse ridge | <i>M. definitus</i> |
| 10b. Carapace without transverse granular ridge on protogastric region; third abdominal somite without transverse ridge | 11 |
| 11a. Carapace more than 1.4 times as wide as long, anterolateral margin subparallel to median line; ocular peduncle 0.6–0.7 times as long as carapace | 12 |
| 11b. Carapace less than 1.4 times as wide as long, anterolateral margin strongly convergent anteriorly; ocular peduncle 0.5 times as long as carapace [fingers of chela armed with small, rounded, tuberculate teeth] | 13 |
| 12a. Telson with lateral margins broadly concave, basal margin subequal to morphologically posterior margin of sixth abdominal somite; superior surface of palm sharply ridged; fingers with rounded, tuberculate teeth | <i>M. japonicus</i> |

- 12b. Telson with lateral margins straight, basal margin distinctly shorter than morphologically posterior margin of sixth abdominal somite; superior surface of palm rounded; fingers with small, acute teeth *M. teschi*
- 13a. Carapace naked, shiny; palm without inferior row of setae; extensor surface of meri of pereopods only with row of long setae *M. pacificus*
- 13b. Carapace covered with short, soft pubescence; extensor surface of meri of pereopods partly obscured by soft pubescence *M. tomentosus*
- 14a. Posteromedian margin of epistome straight or concave; anterior buccal cavity without median ridge; palm with central row of granules; opercula of genital papillae directed ventrally *M. boscii*
- 14b. Posteromedian margin of epistome straight or convex; anterior buccal cavity with sharp median ridge; palm without central row of granules; opercula of genital papillae not directed ventrally 15
- 15a. Telson more than 4.0 times as wide as long [operculum of genital organ directed posteromesially] *M. quadratus*
- 15b. Telson less than 3.5 times as wide as long 16
- 16a. Operculum of genital papillae directed posteromesially *M. boteltobagoe*
- 16b. Operculum of genital papillae directed anteromesially *M. erato*

ACKNOWLEDGMENTS

We all appreciate the kindness and cooperation of the Director of PMBC, Mr. K. Charoenpanich, in making the Center's facilities available. We thank Mr. S. Poovachiranon of PMBC for general assistance during our stay in Phuket. We express our gratitude to Drs. P. K. L. Ng of Department of Biology, National University of Singapore, and M. Takeda of NSMT for their invaluable advice and suggestions on drafts of the manuscript; Dr. Takeda also made available the *Macrophthalmus* specimens deposited in the NSMT, and provided working space on several occasions; to Dr. T. Yamaguchi of Aitsu Marine Biological Station, Kumamoto University, for providing several live specimens of *Macrophthalmus abbreviatus*; to Mr. T. Kosuge of Kyushu University, for making available specimens of *M. boteltobagoe*; to Dr. K. Wada of the Department of Biology, Nara Women's University for supplying important literature; and to Prof. K. Amaoka of Faculty of Fisheries, Hokkaido University, for help in preparing the manuscript. This study was supported by Grant-in-Aid 01041069 for International Scientific Research from the Japanese Ministry of Education, Science and Culture.

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DATE ACCEPTED: May 27, 1993.

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