

ON THE TAXONOMIC STATUS OF
CERATOCARCINUS LONGIMANUS WHITE, 1847
(CRUSTACEA: DECAPODA: BRACHYURA: EUMEDONIDAE),
A CRAB SYMBIOTIC WITH COMATULID CRINOIDS

Peter Castro, Diana G. B. Chia and Peter K. L. Ng

ABSTRACT. - Re-examination of the extant type specimens and extensive preserved and live materials has shown that three poorly-known species of *Ceratocarcinus* White, 1847, viz. *C. speciosus* Dana, 1851, *C. dilatatus* A. Milne Edwards, 1872, and *C. intermedius* Zehntner, 1894, are junior synonyms of *C. longimanus* White, 1847.

INTRODUCTION

There has been some confusion as to the validity of the described species of *Ceratocarcinus* White, 1847. Six species have been assigned to the genus (see Serène et al., 1958; Števcic et al., 1988): *C. longimanus* White, 1847 (the type species), *C. speciosus* Dana, 1851, *C. dilatatus* A. Milne Edwards, 1872, *C. spinosus* Miers, 1879, *C. intermedius* Zehntner, 1894, and *C. trilobatus* (Sakai, 1938). Most of these species have been collected in association with comatulid crinoids in the Indo-west Pacific region. Confusion among the species have been mainly the result of the scarcity of material. As in the other members of the Eumedonidae, all of which are small and cryptically colored symbionts of echinoderms, they are rarely collected and studied. In the case of *Ceratocarcinus*, further confusion was created by failing to recognise that some morphological differences are not species-specific but the result of variations due to size.

A revision of the Eumedonidae currently in progress has allowed us to examine all of the extant type specimens of the species of *Ceratocarcinus*. We have also studied extensive material, including live specimens, from numerous locations. Three of the species were found to represent size variants of *C. longimanus* while *C. spinosus* has been shown to represent a new genus within the Eumedonidae (unpublished data).

Peter Castro - Biological Sciences Department, California State Polytechnic University, Pomona, CA 91768, U.S.A. Diana G. B. Chia and Peter K. L. Ng - Department of Zoology, National University of Singapore, Kent Ridge, Singapore 0511, Republic of Singapore.

The abbreviations cb and cl are used for the carapace width and length respectively. Geographic names are spelled as used in the original source as well as anglicized following the 1992 edition of 'The Times Atlas of the World' (Times Books, London).

Specimens examined are deposited in the Australian Museum (AM), Sydney; Forschungsinstitut Senckenberg (SMF), Frankfurt-am-Main, Germany; Institut Royal des Sciences Naturelles de Belgique / Koninklijk Belgisch Instituut voor Natuurwetenschappen (RBINS), Brussels, Belgium; Muséum National d'Histoire Naturelle (MNHN), Paris, France; Nationaal Natuurhistorisch Museum (former Rijksmuseum van Natuurlijke Historie, RMNH), Leiden, The Netherlands; National Science Museum (NSMT), Tokyo, Japan; Natural History Museum (former British Museum (Natural History), BMNH), London, United Kingdom; Naturhistorisches Museum (NMW), Vienna, Austria; Naturhistoriska Riksmuseet (NRS), Stockholm, Sweden; Northern Territory Museum of Arts and Sciences (NTM), Darwin, Australia; Queensland Museum (QM), Brisbane, Australia; South Australian Museum (SAM), Adelaide, Australia; United States National Museum of Natural History (USNM), Washington D.C., U.S.A.; Western Australian Museum (WAM), Perth, Australia; Zoological Reference Collection (ZRC), Department of Zoology, National University of Singapore; Zoölogisch Museum (ZMA), University of Amsterdam, Netherlands; and the Zoologisk Museum (ZMUC), University of Copenhagen, Denmark.

***Ceratocarcinus longimanus* White, 1847**

(Fig. 1)

Ceratocarcinus longimanus White, 1847a:125 [nomen nudum] (type locality "Eastern Seas (Balambangan)" = Borneo: Sabah, Malaysia).

Ceratocarcinus longimanus White, 1847b:57 (type locality "north coast of Borneo (Balambangan)" = Borneo: Sabah, Malaysia); White, 1847c:62 (text identical to White, 1847b); Adams & White, 1848-1849:34, pl. 6:figs. 6, 6a [colour plate] (Sabah, Malaysia); Miers, 1886:105 (Aru Islands, Indonesia); Alcock, 1895:288 (Straits of Malacca); Balss, 1922:136 (list only); Flipse, 1930:76, 77, 80, 90 (list only); Roxas, 1930:18 (Mindoro island, Philippines); Gordon, 1934:69, fig. 33a (Borneo, holotype re-examined; Banda Islands, Moluccas = Maluku islands, Indonesia); Estampador, 1937:559 (list only); Serène et al., 1958:175 [in key], 184, 232 [as *G. longimanus*], 233, figs. 4A, 4B, 6, pl. 4:fig. B (on unidentified comatulid crinoid; Nhatrang, Vietnam); Estampador, 1959:121 (list only); Serène & Romimoharto, 1963:5, figs. 1B, 3 [male first pleopod]; pl. 1:fig. C (Nusalenga, Moluccas = Maluku islands, Indonesia); Serène, 1968:63 (list only); Monod & Serène, 1976:27 (on unidentified comatulid crinoids; list only); Serène et al., 1976:16 (Moluccas = Maluku islands, Indonesia); Yang, 1979:11 (Mindoro island, Philippines); Števcic et al. 1988:1308 (on unidentified comatulid crinoid; Townsville, Queensland, Australia); Takeda, 1989:150, fig. 9B (on unidentified comatulid crinoid; Oshima Passage, Amami Islands, Nansei (Ryukyu) Islands, Japan); Fabricius & Dale, 1993:43, 45 (on *Comanthus gisleni* Rowe et al., *C. parvicirrus* (Müller), & *Comatula purpurea* (Müller), central Great Barrier Reef, Queensland, Australia); Mather & Bennett, 1993:114 (Great Barrier Reef, Queensland, Australia).

Ceratocarcinus speciosus Dana, 1851:274 (type locality "Archipelago Vitiensis" = Viti Levu island, Fiji; on unidentified comatulid crinoid); Dana, 1852:139, pl. 6:fig. 8 (no new record); Miers, 1886:105 (list only); Balss, 1922:136 (list only); Flipse, 1930:80, 90 (list only); Balss, 1938:25 (Viti Levu island, Fiji); Serène et al., 1958:175 [in key], 234, fig. 4F (list only); Serène, 1968:63 (list only); Stevcic et al., 1988:1308 (list only).

Ceratocarcinus dilatatus A. Milne Edwards, 1872:256, pl. 14:figs. 2, 2a, 2b (type locality New Caledonia); Miers, 1886:105 (list only); Walker, 1887:109 (Singapore); De Man, 1887-1888:230, 585 (Ambon, Moluccas = Maluku islands, Indonesia); McCulloch, 1913:338 (Murray Island, Torres Strait, Queensland, Australia); Rathbun, 1918:29 (Double Island Point, Queensland, Australia); Hale, 1927:143, fig. 146 (Great Australian Bight, South Australia); Flipse, 1930:71, 76, 77, 80, 90, figs.

5, 6 (Postillon Islands = Sabalana Islands, Indonesia); Balss, 1957:fig. 1189 (list only); Serène et al., 1958:175 [in key], 233, fig. 4C (list only); Griffin & Yaldwyn, 1968:171 (list only); McNeill, 1968:9, 49 (off Lookout Point, Queensland, Australia); Serène, 1968:63 (list only); Števčić et al., 1988:1308 (on *Zygometra* sp., Roebuck Bay, Western Australia).

Ceratocarcinus intermedius Zehntner, 1894:141, pl. 7:figs. 1, 1a, 1b (type locality Ambon, Moluccas = Maluku islands, Indonesia); Balss, 1922:136 (list only); Flipse, 1930:76, 77, 80, 90 (list only); Serène et al., 1958:175 [in key], 233, fig. 4D (list only); Serène, 1968:63 (list only); Števčić et al., 1988:1308 (list only).

Ceratocarcinus sp. - Mather & Bennett, 1978:40 (Queensland, Australia).

Material examined. - Holotype - male (cb 8.0 mm, cl 6.6 mm) (BMNH 1939.9.20.7), Balambangan, Borneo, Sabah, Malaysia. - **India:** 1 male (ZMUC), Nancowry island, Nicobar Islands, Galathea Expedition, coll. T. Reinhardt, Feb.1846. - **Singapore:** 2 females (ZRC), Southern Islands, Singapore, on unidentified comatulid crinoids, coll. D. Vandenspiegel, 1992. - **Malaysia:** 1 female (ZRC), Manukan Islands, off Kota Kinabalu, Borneo, Sabah, coll. D. Lane, Jun.1992. - **Indonesia:** 1 female (ZMA), Lumu-Lumu shoal, Balabalangan Islands, Makassar Strait, 34 m, Siboga Expedition, station 78, 10-11 Jun.1899. - 1 male (MNHN B24771), Amed, northeastern Bali, 18 m, on unidentified comatulid crinoid (Comasteridae), coll. P. Castro, 3 Oct.1992. - 2 males (ZMA), Flores Sea: Sarassa Island, Postillon Islands = Sabalana Islands, 36 m, Siboga Expedition, station 43, 4-5 Apr.1899. - 1 male (SMF), Ambon, Moluccas = Maluku Islands, coll. J. Brock, 7 Sep. 1885. - 1 juvenile, 1 megalopa (RMNH D42520), Leitumur, Ambon, Moluccas = Maluku islands, 3 m, on unidentified comatulid crinoid, Rumphius Biohistorical Expedition, 10 Nov.1990. - 1 female, 1 male (RMNH), Laha, Ambon, 5-10 m, on unidentified comatulid crinoids, Rumphius Biohistorical Expedition, station 18, coll. T. Egmond, 19 Nov.1990. - 1 female (RMNH), Laha, Ambon, 2-3 m, on unidentified comatulid crinoid, Rumphius Biohistorical Expedition, coll. T. Egmond, 24 Nov.1990. - 1 male (NSMT Cr11322), Lehari Beach, Ambon, 8 Dec.1992. - 1 female, 1 male (BMNH 84-15), Banda Islands, Challenger Expedition, 1848. - 1 female (RBINS IG9223), Bandanaira, Banda Islands, 24 Feb.1929. - 1 male (BMNH 84-31), Aru Is., Challenger Expedition, 18 Aug.1848. - **Papua New Guinea:** 1 male (cb 3.4 mm, cl 2.8 mm) (MNHN B24738c), 2 females (cb 12.0 mm, cl 7.8 mm) (MNHN B24738a), (cb 5.4 mm, cl 4.4 mm) (MNHN B24738b), 2 juvenile males (cb 2.5 mm, cl 2.0 mm) (MNHN B24738d), (cb 2.5 mm, cl 2.0 mm) (MNHN B24738e), Motupore Island, Coral Sea, 9°30'S, 147°07'E, 3-6 m, on *Comanthus* sp. (2 females) and *Comatella stelligera* (Carpenter)? (1 male, 2 juveniles), coll. P. Castro, 15-16 Aug.1992. - 1 female (RBINS IG26080), Wongad Island, Madang, coll. J. Pierret. - Undetermined sex (RBINS), Hansa Bay, Madang Province, on *Himerometra robustipinna* (Carpenter). - 1 male (RBINS), Hansa Bay, Madang Province, 25 m, on *Comaster tenella* A.H. Clark?. - 1 male (RBINS), Hansa Bay, Madang Province, 25 m, on *Capillaster multiradiatus* (Linnaeus). - 1 male (RBINS), Hansa Bay, Madang Province, 12 m, on *Comatella nigra* (Carpenter). - 1 male (MNHN B24739), lagoon side of barrier reef, Tab Island, Madang, 5°14'S, 145°45'E, 2-6 m, on *Clarkcomanthus* sp., coll. P. Castro, 18 Aug.1992. - 1 male (ZRC), Awar wreck, Hansa Bay, Madang Province, 10 m, on unidentified comatulid crinoid, coll. D. Vandenspiegel, Aug.1992. - 1 male (ZRC), Madang, on unidentified comatulid crinoid, coll. D. Vandenspiegel, 8 Sep.1992. - **Australia:** 1 male (AM P16029), Broome, Gantheaume Point, 17°59'S, 122°11'E, Western Australia, on unidentified comatulid crinoid, coll. A.A. Livingstone, 1929. - 1 female (AM P16030), Roebuck Bay, 18°06'S, 122°14'E, Western Australia, coll. A.A. Livingstone, 1929. - 1 male (AM P16031), Pearl Shoals, Roebuck Bay, 18°02'S, 122°08'E, Western Australia, coll. A.A. Livingstone, 1929. - 1 female (AM P16032), Roebuck Bay, 18°06'S, 122°14'E, Western Australia, coll. A.A. Livingstone, 1929. - 1 female, 3 males (AM P16033), Broome, Gantheaume Point, 17°59'S, 122°11'E, Western Australia, intertidal, 5 Aug.1929. - 1 female (AM P16034), Broome, Gantheaume Point, 17°59'S, 122°11'E, Western Australia, coll. A.A. Livingstone, 4 Sep.1929. - 3 females, 1 male (WAM), South Passage, Shark Bay, 10 m, coll. R.W. George, 14 May.1960. - 1 female (WAM), West Cape Jaubeir, Western Australia, 42 m, on sponge, coll. R.W. George, 13 Oct.1962. - 1 female (cb 18.6 mm, cl 13.8 mm) (WAM), Central Exmouth Gulf, Western Australia, 9-20 m, F.R.V. *Flinders*, 1 Aug.1975. - 1 female (QM W18655), Northwest shelf, 19°30.8'S, 118°49.3'E, Western Australia, 38-39 m, R.V. *Soela*, 30 Aug.1983. - 1 female (QM W18656), Northwest shelf, 19°29.7'S, 118°52'E, Western Australia, 39 m, R.V. *Soela*, 25 Oct.1983. - 4 juveniles (cb 1.5 mm, cl 1.5 mm) (NTM Cr5348a), (cb 1.5 mm, cl 1.5 mm) (NTM Cr5348b), (cb 2.0 mm, cl 1.8 mm) (NTM Cr5348c), (cb 2.8 mm, cl 2.4 mm) (NTM Cr5348d), 1 male (cb 4.4 mm, cl 3.0 mm) (NTM Cr5348e), Port Essington, Coral Bay, Cobourg Peninsula, 11°09.4'S, 132°04'E, Northern Territory, 5 m. - 1 male (NTM Cr8586), Sandy Islands, Cobourg Peninsula, 11°55'S, 132°17'E, Northern Territory, station CP26, coll. A.J. Bruce. - 1 female (AM P3141), Murray Island, Torres Strait, 9°56'S, 144°04'E, 1907, Queensland, coll. C. Hedley & A.R. McCulloch. - 1 female (AM E6277), 20 mi north east of Double Island Point, 53-55

m, *Endeavour*. - 1 female, 1 male (BMNH 1937 9-21-461-462), off Lookout Point, Great Barrier Reef Expedition, station XVI, 37 m, 9 Mar.1929. - 1 male, 1 juvenile (QM W14729), Watson's Bay, Lizard Island, 14°40'S, 145°28'E, 10-13 m, amongst unidentified comatulid crinoids and sponges, coll. P. Davie & J. Short, 5 Jun.1987. - 1 female (QM W14731), 1 km southeast of North Point, Lizard Island, 14°40'S, 145°28'E, 25-30 m, amongst branching coral, coll. P. Davie & J. Short, 1 Jun.1987. - 1 female (QM W14735), Blue Lagoon, Lizard Island, 14°40'S, 145°28'E, 5-7 m, amongst dead coral, coll. P. Davie & J. Short, 5 Jun.1987. - 1 juvenile (NTM Cr9509), south of Crystal Beach, Lizard Island, 14°40'S, 145°28'E, 5 m, on *Capillaster multiradiatus*, coll. A. Hoggett, 11 Sep.1988. - 1 juvenile (NTM Cr9510), North Point, Lizard Island, 14°40'S, 145°28'E, 10 m, on *Capillaster multiradiatus*, coll. A. Hoggett, 24 Sep.1988. - 1 male (NTM Cr9570), North Point, Lizard Island, 14°40'S, 145°28'E, 6-10 m, on *Clarkcomanthus littoralis* (Carpenter), coll. A. Hoggett, 9 Apr.1988. - 1 male (QM W15969), Davies Reef Lagoon, 18°50'S, 147°39' E, 10 m, on *Comanthus parvicirrus*, coll. K. Fabricius, 26 Oct.1988. - 1 male (AM P21681), Broadhurst Reef, Townsville, Queensland, 19°16'S, 146°49'E, on comatulid crinoid, coll. I. Loch, 14 Sep.1975. - 1 male (AM P21681), Swain Reef, Swain Reef Expedition, station 1, on comatulid crinoid, 1962. - 2 females (SAM TC12518), Great Australian Bight, South Australia, coll. E.W. Howard, 1888. - **New Caledonia**: 1 male (cb 12.0 mm, cl 9.0 mm) (MNHN 644, lectotype of *Ceratocarcinus dilatatus* A. Milne Edwards, here designated), coll. M. Beaudouin. - 1 male (MNHN 644, paralectotype of *C. dilatatus* A. Milne Edwards), coll. M.E. Marie. - 1 male (MNHN 645), 1903. - 2 females, 2 males (MNHN 4601), 1903. - 1 female (MNHN B17816), Nouméa, coll. R. Catala. - 1 female, 1 male (MNHN B24725), Nouméa, coll. R. Catala. - 1 female (MNHN), lagoon, 22°18.3'S, 166°25.05'E, station A1, 15 m, 11 Feb.1985. - 1 female (MNHN), Ile des Pins, 22°32'S, 167°19'E, station 594, 25 m, 18 Jul.1985. - 1 female (MNHN), east lagoon, 21°36'S, 166°21'E, station 0677, coll. B. Richer de Forges, 9 Aug.1986. - 1 female (MNHN), east lagoon, 20°36'S, 164°52'E, station 0875, 21 m, 13 Jan.1987. - 1 female, 1 male (MNHN), Ile Ouen, Baie de Prony, 22°23'S, 166°48'E, station 112, 42 m, coll. B. Richer de Forges. - 2 males (MNHN), Ile Ouen, Baie de Prony, 22°24'S, 166°51'E, station 247, 43 m, coll. B. Richer de Forges. - 1 female (MNHN), Ile Ouen, Baie de Prony, 22°26'S, 166°42'E, station 116, 43 m, coll. B. Richer de Forges. - 2 females (MNHN), Ile Ouen, Baie de Prony, 22°31'S, 166°44'E, station 124, 18 m, coll. B. Richer de Forges. - 1 female, 1 male (MNHN), Ile Ouen, Baie de Prony, 22°25'S, 166°42'E, station 249, 11 m, coll. B. Richer de Forges. - 1 female (MNHN), secteur de Nouméa, 22°22'S, 166°21'E, station 4, 9 m, coll. B. Richer de Forges. - 1 female (MNHN), secteur de Nouméa, 22°17'S, 166°24'E, station 261, 19 m, coll. B. Richer de Forges. - 1 female, 2 males (MNHN) secteur de Nouméa, 22°19'S, 166°25'E, station 251, 20 m, coll. B. Richer de Forges. - 1 male (MNHN), grand récif sud, 22°47'S, 166°44'E, station 309, 31 m, coll. B. Richer de Forges. - 2 males (MNHN), on antipatharian. - 1 male (MNHN), 21°18'S, 165°53'E, Bathus 1, station 1236. - 1 male (MNHN), Touho, 15 m. - 4 females, 4 males, 3 juveniles (MNHN), Ilot Canard, station 136, 22°19'20S, 166°21'70E, 20m, on *Comanthina schlegelii* (Carpenter), and two unidentified comatulid crinoids (Comasteridae), coll. P. Castro, 24 Apr.1995. - 1 juvenile (MNHN), Sèche Croissant, station 140, 22°19'90S, 166°22'30E, 13m, on *Comanthina schlegelii*, coll. P. Castro, 26 Apr.1995. - **Solomon Islands**: 1 male (NMW), 1906. - **Fiji**: 1 male (cb 3.6 mm, cl 3.4 mm) (NRS 14396, neotype of *Ceratocarcinus speciosus* Dana, here designated), Namuka, Viti Levu island, S. Bock, 25 Jun.1917. - **Palau**: 1 female, 1 male (USNM 134387), on green and yellow comatulid crinoid, coll. F.M. Bayer, 22 Jul.1955. - **Philippines**: 3 females, 1 male (SMF 685), Bohol island, coll. C. Semper, 1863-64. - 1 female (ZRC), Puerto Galera, Mindoro island, coll. H.A. Roxas. - **Japan**: 1 female, 1 male (ZRC), Sesoko island, Okinawa, Nansei (Ryukyu) Islands, on *Oxycomanthus bennetti* (Müller). - 1 male (ZRC), Sesoko Island, Okinawa, Nansei (Ryukyu) Islands, on *Comatella stelligera*, 3 Jun.1981. - 1 male (NSMT Cr9684), O-shima Passage, Amami Islands, Nansei (Ryukyu) Islands, 25-40 m, Kagoshima University, 29 Jun.1970.

Diagnosis. - Carapace quadrate, distinctly broader than long in all except juveniles; rostrum short, distinctly deflexed downwards; inner supraorbital teeth well developed, long, produced well beyond edge of frontal margin; regions well defined, proto-, metagastic, branchial and cardiac regions with well-developed tubercles of varying degree, tubercles covered with callosities in large individuals; surfaces of carapace relatively smooth, covered with scattered small granules coarser in larger adults; dorsal surface of carapace usually covered with very thin pubescence, with longer hairs on protogastric tubercles. Antero- and posterolateral margins clearly demarcated; anterolateral margin lamelliform, with four teeth (including external orbital angle), first three teeth (especially the third) truncate, usually well defined, separated by narrow fissures, tightly adjoining each other, sometimes appearing fused, lower part of third

tooth might be laterally directed, fourth tooth especially well developed, long, sharp, laterally directed. Chelipeds elongate; surfaces granular; carpus with sharp spine or low, rounded tubercle on inner distal angle; chelae elongated, length ca. 4 times length of fingers, 4-5 times height; fingers not carinate, pollex not distinctly bent downwards. Dactylus of first ambulatory leg elongated, other segments subcylindrical, not cristate. G1 long, slender.

Colour. - Dorsal surface of carapace of adults red-brown with four thin yellow stripes across. Borders of carapace yellow. Thick brown stripes on ventral surface; thin brown stripe along legs and chelipeds. Juveniles and small adults with light yellow carapace and three or four red-brown horizontal stripes on dorsal surface. Stripes may fuse at tips to form one or two hollow semi-circles.

Remarks. - *Ceratocarcinus longimanus*, the type species of the genus, was described from a relatively small specimen (Fig. 1A-I) collected in Borneo (White, 1847b) and illustrated for the first time in Adams & White (1848-1849: plate 6, figs. 6 and 6a). Although White (1847b) listed the species as "*Ceratocarcinus longimanus*, Adams & White," the correct author of the species should be White (see Ng, 1994).

Our examination of the holotype and a large number of specimens collected from numerous localities and showing a wide variation in size (cb 1.5 mm to 18.6 mm) has allowed us to elucidate the correlation between size and morphology. Failure to recognize this relationship led to the description of three separate species, *C. speciosus* Dana, 1851, *C. dilatatus* A. Milne Edwards, 1872, and *C. intermedius* Zehntner, 1894. *Ceratocarcinus dilatatus* A. Milne Edwards, 1872, was described from two specimens collected in New Caledonia. There is no evidence that the holotype of *C. longimanus* was examined by A. Milne Edwards. It thus appears that the species was described only on the basis of comparisons with the description (White, 1847b) and the only existing illustrations (Adams & White, 1848-1849) of *C. longimanus*. *C. dilatatus* was characterized by a carapace that was wider than that of *C. longimanus* and having anterolateral angles that ended as a more pointed end (A. Milne Edwards, 1872:256). Only two additional differences were given, the presence of granular tubercles on the branchial region of the carapace and in walking legs that were more granular than those of *C. longimanus*. These differences are apparent when the figures of Adams & White (1848-1849: plate 6, figs. 6 and 6a) are compared to those of A. Milne Edwards (1872: plate 14, figs. 2, 2a and 2b).

A. Milne Edwards did not designate a holotype among his two New Caledonia specimens (MNHN B644). The largest individual (a male, cb 12.0 mm, cl 9.0 mm) was the specimen illustrated and we are hereby designating it as the lectotype. A small portion of the lower part of the carapace of the dried specimen is missing, hence the slight difference with the carapace length of 10 mm given by Milne Edwards (1872:258). Only the right third of the carapace of the second specimen (hereby designated as a paralectotype) survives.

Also surviving are A. Milne Edwards' original sketches of the two specimens (unnumbered documents in the Library, Laboratoire de Zoologie, Muséum National d'Histoire Naturelle, Paris). Only the largest specimen, the lectotype, was drawn in its entirety, and the sketch used in the published illustrations (A. Milne Edwards, 1872: plate 14, figs. 2, 2a and 2b). When fig. 2a was redrawn from A. Milne Edwards' sketch, several details were omitted, one being the constriction between the carpus and merus of the third maxilliped (see Rathbun, 1918: 29). The second and smaller individual, the paralectotype, was sketched to show the colour pattern on the carapace. This sketch was unfortunately not published. The paralectotype



Fig.1. *Ceratocarcinus longimanus*. A-I, Holotype male, cb 8.0mm, cl 6.6 mm (BMNH1939.9.20.7): A, dorsal view of carapace (solid circle indicates ex-position of pin); B, postero-dorsal view of right cheliped; C, sternum (solid circle indicates ex-position of pin; dotted line indicates a crack); D, face of carapace; E, last left leg; F, left third maxilliped; G, H, left male first pleopod; I, left male second pleopod. J, female, cb 12.0 mm, cl 7.8 (MNHN B24738a). K, juvenile male, cb 2.5 mm, cl 2.0 mm (MNHN B24738d). L, juvenile male, cb 3.6, cl 3.4 (NRS 14396). Scales for A-G, J-L = 1.0mm; for H-I = 0.1mm.

is practically identical in morphology to the carapace of the *C. longimanus* holotype illustrated (Fig. 1A). The paralectotype also lacks the very same features that A. Milne Edwards used to characterize his new species, viz., wider carapace, more pronounced anterolateral spine, tubercles on the dorsal surface of the carapace that are larger and provided with callosities, and more granular walking legs.

The examination of most of the specimens previously identified as *C. dilatatus*, including A. Milne Edwards's type material as well as additional dried material identified by him (MNHN B645 and MNHN B4601), has demonstrated that the morphological differences specific to *C. dilatatus* are only the result of size. As size increases, the last (fourth) tooth along the anterolateral margin of the carapace becomes more pronounced and is separated from the third by a conspicuous groove-like gap, thus giving the appearance of having a wider carapace as used by A. Milne Edwards in defining *C. dilatatus*. A conspicuous gap is absent only in small individuals. It is absent in the paralectotype of *C. dilatatus* and in the unpublished sketch of A. Milne Edwards. It is present in the holotype of *C. longimanus* but unfortunately missing in the illustration of Adams & White (1848-1849: plate 6, figs. 6 and 6a). The gap makes the carapace look wider but this is only an appearance since the same direct relationship between the width and length of the carapace found in the holotype of *C. longimanus* and other specimens of *C. longimanus* is observed in the lectotype, the New Caledonia material of *C. dilatatus* studied by A. Milne Edwards, as well as in all the specimens of *C. longimanus* and those previously identified as *C. dilatatus* that were examined by us.

Also directly correlated with the size of individuals is the size of the tubercles on the dorsal surface of the carapace. Their relative size is difficult to illustrate and this has created some confusion. Serène et al. (1958: fig. 4), for instance, used the relative size and shape of the tubercles to differentiate among the species of *Ceratocarcinus*, three of which are now found to be synonyms of *C. longimanus*. Although conspicuous in the holotype (Fig. 1A), tubercles barely show in the coloured illustration of Adams & White (1848-1849: plate 6, fig. 6). The larger specimens have very conspicuous tubercles (particularly the protogastric ones) and are covered with thick callosities.

It seems reasonable to believe that some of the specimens of *C. longimanus* were identified as *C. dilatatus* simply because A. Milne Edwards's illustrations were clearer, more complete and accessible than those of Adams & White, despite the fact that both represent different size variants of the same species. None of the subsequent records of *C. dilatatus* (Walker, 1887; De Man, 1887-1888; McCulloch, 1913; Rathbun, 1918; Hale, 1927; Flipse, 1930; McNeill, 1968; Števčić et al., 1988) include comparisons with *C. longimanus*. Miers (1886: 105) had in fact considered *C. dilatatus* to be a "variety" of *C. longimanus*. We now conclude that *C. dilatatus* A. Milne Edwards, 1872, is a junior synonym of *C. longimanus* White, 1847.

Ceratocarcinus speciosus Dana, 1851 was described from a single male collected from an unidentified crinoid in Fiji. The holotype, as with most of Dana's types, was almost certainly destroyed in the 1871 Chicago fire (see Evans, 1967; R.B. Manning, pers. comm.). Dana's specimen was very small, with a carapace length of only 1.5 lines, or 3.3 mm. The species was characterized by having minute spines on the dactylus and merus of the chelipeds. The frontal margin of the carapace between the two inner supraorbital teeth was broad and straight, emarginate at the middle, and minutely crenulate. All of these features are absent in larger individuals of *C. longimanus*. The illustration of the holotype (Dana, 1852: plate 6, fig. 8b) also reveals that the antennal flagellum projected a small distance beyond the apex of the preorbital tooth. In contrast, the flagellum is shorter in larger specimens of *C. longimanus*.

Characteristics identical to Dana's specimen, however, are present in three small individuals of *C. longimanus* collected at Motupore Island (MNHN B24738c-e; Fig. 1K). Two larger specimens, the largest of which clearly shows all the characteristics of *C. longimanus*, were collected from the same hosts and locality (MNHN B24738a, b; Fig. 1J). The four smallest Papua New Guinea individuals, all of which were collected live, also showed variations of the characteristic colour pattern illustrated by Dana (1852: plate 6, fig. 8). The carapace showed four red-brown ("flesh-red" in Dana) transversal lines that formed two hollow semicircles that had their convex sides oriented toward the anterior and posterior edges of the carapace and their flat sides facing each other in the middle of the carapace.

The same characters, except the colour pattern which was lost after preservation, were confirmed in three juveniles and two small males of *C. longimanus* that were collected in one location in northern Australia (NTM Cr5348a-e). The three juveniles were actually smaller than the lost holotype of *C. speciosus*.

A second record from Fiji is the only other known specimen referable to *C. speciosus* (see Balss, 1938). The specimen (NRS 14396; Fig. 1L) is a male slightly larger than the lost holotype. It differs from the holotype in having an antennal flagellum that is slightly shorter than the preorbital tooth as in the other small specimens of *C. longimanus* from Papua New Guinea and northern Australia. The frontal margin of the carapace is slightly concave, while it is slightly convex in Dana's illustration of the holotype; it was nevertheless described as "concave" (Dana, 1852: 141). One of Dana's two illustrations (8a) shows blunt, not pointed, supraorbital teeth, particularly the right one. The second illustration (8b), however, shows a pointed tooth, the shape shown in Balss' specimen as well as in the small specimens from Papua New Guinea and northern Australia.

We thus have little doubt that *C. speciosus* Dana, 1851, is a junior synonym of *C. longimanus* White, 1847. Since the type of *C. speciosus* (from Fiji) is lost, it is best that a neotype be designated for the species to ensure that the taxonomy of the species as discussed here (i.e. as a junior synonym of *C. longimanus*) remains unchanged. The Fiji specimen examined by Balss (1938) (NRS 14396) is here designated as the neotype of *C. speciosus*.

We are also convinced that *Ceratocarcinus intermedius* Zehntner, 1894, described on the basis of one very large (cb 20.5 mm, cl 14.5 mm) female from the Moluccas, is conspecific with *C. longimanus* White, 1847. The status of *C. intermedius* had been questioned by Serène et al. (1958) and Stevcic et al. (1988), who suggested that it was a junior synonym of *C. dilatatus*. The holotype, the only specimen ever recorded of the species, is lost or misplaced (B. Hauser, Muséum d'Histoire Naturelle, Geneva, pers. comm.). Zehntner's illustration (Zehntner, 1894: plate 7, figs. 1, 1a and 1b) differs from *C. longimanus* in that the gap between the two inner supraorbital teeth is triangular and not trapezoidal as in the holotype of *C. longimanus*. This gap, however, varies from wide and almost square in small individuals to narrow and rounded or triangular in larger individuals. More significant is that the shape of the gap depends to a large extent on the angle of inclination of the specimen being drawn.

Zehntner also mentions other differences between his species and *C. dilatatus*, viz., the presence of "two lobes" along the anterolateral margin instead of three truncate teeth, a "bifid" tooth at the anterolateral angle instead of one, sinuous lateroposterior borders, straight posterior borders, and shorter and stouter legs. These differences fall within the degree of variation that has been observed among individuals of *C. longimanus*. Zehntner's very large specimen seems to be merely the extreme expression of the tendency for the outermost anterolateral

spine to separate from the rest of the margin that is observed in large individuals of *C. longimanus*. Zehntner mentions that another difference in *C. intermedius* is that the merus of the third maxilliped is narrower. This is the result of the error in A. Milne Edward's fig. 2a of *C. dilatatus* previously referred to.

Specimens referred to as *C. longimanus* by Roxas (1930), Serène & Romimohtarto (1963), Yang (1979), Števíć et al. (1988), and Fabricius & Dale (1993) were examined and they all agree with the current definition of the species. Roxas' specimen from the Philippines (ZRC) is very large. It shows a narrow but distinct gap between the outermost anterolateral spine and the rest of the anterolateral margin, a character observed in other large specimens of *C. longimanus* and in the holotype of *C. intermedius*.

General biology. - Very little is known about the biology of *C. longimanus*. It appears to be restricted to comatulid crinoids. Crabs are typically found on the oral side of the host's central disk. Practically all of the hosts that have been recorded are comatulids belonging to the family Comasteridae. There is, however, one record each from a zygometrid and a himerometrid crinoid. Two specimens were recorded from an antipatharian coral in New Caledonia, while a few others were recorded from coral and sponges in eastern Australia. It is very possible, however, that the crabs originally inhabited crinoids, with the crabs having being displaced from their hosts during collection.

Ceratocarcinus longimanus has been recorded from the Ryukyu Islands, southern Japan to as far west as the Nicobar Islands in the Andaman Sea and as far east as Fiji. Two specimens presumably from South Australia (Hale, 1927) represent the only eumedonid ever collected from outside the tropical Indo-west Pacific region.

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