

**LOPHOZOZYMUS ERINNYES, A NEW SPECIES OF POISONOUS  
CRAB FROM AUSTRALIA, WITH NOTES ON *L. PICTOR*  
(FABRICIUS, 1798), *L. INCISUS* (H. MILNE EDWARDS, 1834)  
AND *L. EDWARDSI* (ODHNER, 1925)  
(CRUSTACEA: DECAPODA: BRACHYURA: XANTHIDAE)**

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**ABSTRACT.** - The taxonomy of the highly poisonous Indo-West Pacific xanthid crab, *Lophozozymus pictor* (Fabricius, 1798) is treated. Specimens from northeastern and eastern Australia are here recognised as a new species, *L. erinnyes*. The two species differ not only in colouration but also in the form of the sutures between male abdominal segments 3 to 5, structure of the anterolateral lobes and male first pleopod. Taxonomic notes on *L. incisus* (H. Milne Edwards, 1834) and *L. edwardsi* (Odhner, 1925) are also provided.

**KEY WORDS.** - Xanthidae, poisonous crab, new species, Australia, taxonomy.

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**INTRODUCTION**

There has been recent interest in toxicological studies of the poisonous xanthid crab *Lophozozymus pictor* (Fabricius, 1798) (Yasumoto et al. 1986; Llewellyn & Endean, 1989; Lau et al., 1991; Chia et al., 1993). This supposedly widespread species has been reported from various parts of Southeast Asia to the South China Sea, China, Japan, Australia and the islands of the eastern Pacific (Serène, 1968, 1984; Guinot, 1977, 1979; Dai et al., 1986; Dai & Yang, 1991).

The first author, however, has noticed for some years now, that the species seems to exhibit two very distinct colour patterns. One colour morph has a mosaic-patterned carapace of white and red patches (Southeast and East Asia), while the other has a red carapace with numerous small, scattered white spots (northeastern Australia).

Toxicological studies at the National University of Singapore on *Lophozozymus pictor* and comparison of the results of previous toxicological studies done on this species in Singapore, Australia and Japan (Teh & Gardiner, 1970, 1974; Yasumoto et al., 1986;

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Llewellyn & Endean, 1989; Lau et al., 1991; Chia et al., 1993), however, necessitated confirmation that the two colour morphs were conspecific.

A detailed study of large numbers of specimens from various parts of the known range of *L. pictor* showed that the two colour morphs should in fact be referred to two separate taxa, *L. pictor* s. str. and an undescribed species, here named *L. erinnyes*, new species. Other than their different carapace colour patterns, the two species also differ in the carapace sculpture, armature of the anterolateral teeth, shape of the male first pleopod and depth of sutures of the male third to fifth abdominal segments.

The present paper describes the new species, as well as provide comparisons with *L. pictor*. The taxonomy of *L. pictor* is clarified. Specimens from Upolu (Samoa) attributed to *L. pictor* by Buitendijk (1960) were examined and proved to be *L. edwardsi* (Odhner, 1925) instead. Notes on the nomenclature of *Lophozozymus incisus* (H. Milne Edwards, 1834) are also provided.

The abbreviations G1 and G2 are used for the male first and second pleopods respectively. Measurements of the carapace, in millimetres, are of the width and length respectively. Specimens examined are deposited in the Nationaal Natuurhistorisch Museum (previously known as the Rijksmuseum van Natuurlijke Historie [RMNH]), Leiden, The Netherlands; Muséum National d'Histoire naturelle (MNHN), Paris, France; Zoological Museum, Copenhagen University (ZMUC), Denmark; Queensland Museum (QM), Brisbane, Australia; Natural History Museum [formerly the British Museum (Natural History)] (BMNH), London, England; Institute of Zoology, Academia Sinica (AS), Beijing, China; Museum Zoologicum Bogoriense (MZB), Bogor, Java, Indonesia; Sarawak Museum (SM), Sarawak, Malaysia; and the Zoological Reference Collection (ZRC), School of Biological Sciences, National University of Singapore.

## TAXONOMY

### Genus *Lophozozymus* A. Milne Edwards, 1863

**Type species.** - *Xantho octodentatus* H. Milne Edwards, 1834, designated by A. Milne Edwards (1873).

**Remarks.** - Although the type species of *Lophozozymus* A. Milne Edwards, 1863, is generally acknowledged as *Xantho incisus* H. Milne Edwards, 1834, following the designation by Ward (1932) (see Guinot, 1977, 1979; Serène, 1984), this is in fact, not the case. Alphonse Milne Edwards (1873: 203), when discussing *Lophozozymus* had stated "... chez le *Xantho incisus* (M. Edwards) et chez le *X. octodentatus* (M. Edwards), que je considère comme réalisant la forme typique de cette petite division ...". The fact that A. Milne Edwards gave the singular "la forme typique" and not the plural "la formes typiques" shows that with the "typical form" (i.e. type species), he meant *X. octodentatus* only. As *X. octodentatus* was one of the species originally included in *Lophozozymus* by A. Milne Edwards (1863) when he established the genus, his 1873 type species designation for *Lophozozymus* is valid, and antedates Ward's (1942) type species designation of *X. incisus*. The type species of *Lophozozymus* A. Milne Edwards, 1834, is thus *Xantho octodentatus* H. Milne Edwards, 1834 (= *Lophozozymus pictor* (Fabricius, 1798)) by subsequent designation by A. Milne Edwards (1873).

***Lophozoymus incisus* (H. Milne Edwards, 1834)**

*Xantho incisus* H. Milne Edwards, 1834: 394 (secondary homonym of *Xantho incisa* (Leach, 1814)).  
*Lophozoymus incisus*, A. Milne Edwards, 1863: 397.

**Material examined.** - Holotype, female, 36.7 by 24.8 mm (MNHN-B2896), Australia, no other data.

Others. - 1 female (ZRC 1969.12.20.16), gift from R. Serène (Colombo Museum), no other data. — 1 juvenile (RMNH 4740), Kera, Timor, Indonesia, coll. Snellius Expedition, 11-13 Oct. 1929. — 1 female (RMNH 1866), Timor, Indonesia, coll. E.W.A. Ludeking, 1866. — 1 male (BMNH 1934.1.16.70), Gulf of Manaar, coll. W.A. Herdman. — 1 female (MNHN-B9321), Bali, Indonesia, coll. Galathea Expedition, 12 Sep. 1951.

**Remarks.** - The specific name of this species has a rather complex nomenclatural history, but surprisingly, has not been dealt with before. It involves three names, viz. *Xantho incisus* H. Milne Edwards, 1834, *Cancer incisus* Leach, 1814, and *Xantho incisa* Leach, 1814.

Leach (1814: 391) described *Cancer incisus*. Later on, in the same part of the same volume, in an addendum to the article, he established the genus *Xantho* with only one species, *Xantho incisa* (see Leach, 1814: 430), and after the description of this species, he added “*Cancer incisus* of this article. See p. 391”. Although the text of pages 390 and 430 of Leach’s 1914 article were written at different times, they were published simultaneously. While there is no doubt that *Xantho incisa* Leach, 1814, is a senior homonym of *Xantho incisus* H. Milne Edwards, 1834, the question arises if these two names are primary or secondary homonyms. If they are primary homonyms, the name *Xantho incisus* H. Milne Edwards, 1834, has to be replaced. But if the homonymy is secondary and the name *Xantho incisus* H. Milne Edwards, 1834, has not been replaced before 1961, it can still be used by authors who assign the two species to different genera (ICZN Article 59c). Whether the homonymy is primary or secondary is thus dependent on whether *Cancer incisus* Leach, 1814, or *Xantho incisa* Leach, 1814, should be regarded as the original combination of the name. Both names were validly published in the same article, and as such, under the current code of zoological nomenclature, the Principle of the First Reviser must apply (ICZN Article 24a). The problem here of course is that the name *incisus* Leach was forgotten almost as soon as it was published. Leach himself (1815) synonymised *Xantho incisa* Leach, 1814, with *Cancer floridus* Montagu, 1808, and the name *Xantho floridus* (Montagu, 1808) was then used consistently for the species until 1954. Holthuis (1954) was the first to point out that *floridus* Montagu is not an available specific name as Montagu (1808) had incorrectly identified the species with the tropical Indo-West Pacific *Cancer floridus* Linnaeus, 1758 (= *Atergatis floridus* (Linnaeus, 1758)) (see Ng & Holthuis, 1993). The name *Xantho incisus* Leach, 1814, was thus, generally accepted only after Holthuis’s (1954) revelation. In his treatment of the species, Holthuis (1954) commented that “The first valid name given to MONTAGU’S species is that of *Cancer incisus* Leach (1814), and therefore it should be known under the name *Xantho incisus* (Leach, 1814)” (Holthuis, 1954: 103). As such, Holthuis (1954) effectively acted as the first reviser in choosing between *Cancer incisus* Leach, 1814, and *Xantho incisa* Leach, 1814, as he mentioned both names (*Cancer incisus* and *Xantho incisus*) and chose *Cancer incisus* as the senior of the two, citing the author of *Xantho incisa* (Leach, 1814) in parenthesis. In addition, on the ICZN Official List of Specific Names in Zoology, the combination *Cancer incisus* Leach, 1814, is used as the original combination.

The result of all this of course, is that *Cancer incisus* Leach, 1814, and *Xantho incisus* H. Milne Edwards, 1834, are secondary homonyms. As these two species have been assigned

to two different genera (*Xantho* Leach, 1814, and *Lophozozymus* A. Milne Edwards, 1863), there is no need to replace *Xantho incisus* H. Milne Edwards, 1834, with *Lophozozymus incisus* (H. Milne Edwards, 1834) being a valid name.

***Lophozozymus pictor* (Fabricius, 1798)**

(Figs. 1-4; 8A, B; 9A, B; 10A, B)

- Cancer Saxatalis* Rumphius, 1705, 1711, 1739, 1740, 1741: 9, pl. 5 fig M.  
*Cancer Aeneus* Rumphius, 1705, 1740, 1741: 18; Rumphius, 1705, 1711, 1739, 1740, 1741: pl. 11 fig. 4; Petiver, 1713: pl. 21 fig. 3.  
?Cattam Catappan, Rumphius, 1705, 1740, 1741: 18.  
*Cancer pictor* Fabricius, 1798: 335.  
*Cancer saxatalis*, Henschel, 1833: 203.  
*Cancer aeneus*, Henschel, 1833: 204.  
*Xantho octodentatus* H. Milne Edwards, 1834: 398; Lucas, 1853: 23, pl. 23, pl. 9 fig 1; Nauck, 1880: 51.  
*Lophozozymus octodentatus*, A. Milne Edwards, 1863: 276; A. Milne Edwards, 1867: 272; Miers, 1884: 114; Alcock, 1898: 106; De Man, 1902: 102, 104; Balss, 1938: 40; André, 1931: 648; Holthuis, 1959: 69, 114.  
*Lophozozymus epheliticus*, Miers, 1880: 231 (partim); Miers, 1884: 182, 207; Miers, 1886: 115 (partim); Walker, 1887: 109; De Man, 1895: 518; Lanchester, 1900: 736; Shen, 1940: 224 (nec *Cancer epheliticus* Linnaeus, 1763).  
*Lophozozymus pictor*, Rathbun, 1924: 15 (partim); Gruvel, 1925: 105; Sakai, 1939: 452 (partim); Buitendijk, 1960: 297 fig. 7C (partim); Guinot, 1967: 91; Serène 1968: 74; Sakai, 1976: 407, fig. 3; Carumbana et al., 1976: 266, Fig. 1B; Guinot, 1977: xxvi (partim); Garth & Alcalá, 1977: 648 (partim); Guinot, 1979: 64 (partim); Yang, 1979: 20 (partim); Naiyanetr, 1980: 35; Miyake, 1983: 224; Serène, 1984: 168, 170 (partim); Dai et al., 1986: 260 text fig. 149 pl. 35(7); Ng et al., 1990: 104 fig. 1-3; Dai & Yang, 1991: 280, text fig. 149, pl. 35(7); Ng et al., 1992: 6.

**Material examined.** - Lectotype, male, 40.0 by 25.0 mm (ZMUC 109-1), no other data.

Others. - **INDONESIA** - 1 carapace only (108.0 by 65.0 mm) (RMNH-D-44654), Java, coll. H. Kuhl & J.C. van Hasselt, 1820-23. — 1 male, 66.8 by 41.5 mm, (RMNH 1347), Amboina, near Sulawesi, coll. Schorel, 1879. — 1 female (RMNH 1508), Amboina, coll. E.W.A. Ludeking, 1864. — 1 male (RMNH 41352), Ambon, Moluccas, Hitu, Ambon Bay, inner Bay, Martafons, coll. Rumphius Biohistorical Expedition 1990, 4 Dec.1990. — 1 male (BMNH 30.6), Java, coll. E. Gerrard, no date. — 1 female (MZB), Pulau Rambut, coll. F. Sabar, 20 Jul.1975. **SINGAPORE** - 2 males, 3 females (BMNH 1900.10.22.84.88), coll. F. P. Bedford & W. F. Lanchester, 1899/1900. — 1 male (BMNH 86.54), coll. Rowell Expedition. — 1 female (SM), gift from Raffles Museum, 21 Sep.1900. — 1 female (ZRC 1993.194), coll. P.K.L. Ng, no date. — 1 male (ZRC 1993.195), coll. P.K.L. Ng, no date. — 1 male (ZRC 1981.8.14.153), no other data. — 1 female (ZRC 1985.1215), south of Singapore, B59, 25-30 fms, clean bottom, coll. Singapore Fishery Research Station. — 1 male (69.9 by 45.1 mm) (ZRC 1984.6406), coll. Lee, from trawler, 3 Aug.1983. — 1 female (ZRC 1985.1214), Outer Shoal, B25, 65 fms, mud shell and stone substratum, coll. Singapore Fishery Research Station. — 1 male (77.3 by 51.3 mm) (ZRC 1987.505), Tuas, coll. P.K.L. Ng, from trawler, 1983. — 1 male, 1 female (ZRC 1981.7.24.30-31), Tuas, coll. H.K. Voris, from fishermen, 2 Mar.1981. — 1 male (ZRC 1985.1216), Tanjong Teritip, coll. D.S. Johnson, 21 Oct.1963. — 1 female (ZRC 1965.11.5.43), Siglap, Jan.1932, no other data. — 1 female (ZRC 1993.193), Labrador beach, coll. P.K.L. Ng, Jan.1987. — 2 males, 2 females (ZRC 1965.11.5.57-60), Pulau Blakang Mati (= Sentosa), 14 Mar.1934. — 1 female (ZRC 1984.5620), Siloso Beach, Sentosa, 25 May 1982, no other data. — 1 male (ZRC 1989.2971), Siloso Beach, Sentosa, coll. P.K.L. Ng, 1988. — 2 males, 1 female (ZRC 1993.181-183), Sentosa, coll. D.G.B. Chia & D. Vandenspiegel, 21 Jan.1991. — 1 male, 1 female (ZRC 1993.184-185), Sentosa, coll. D.G.B. Chia, 26 Sep.1991. — 1 male, 2 females (ZRC 1993.186-188), Sentosa, coll. D.G.B. Chia, May 1992. — 1 female (ZRC 1993.191), Sentosa, coll. P.K.L. Ng, 17 Feb.1991. — 1 male (ZRC 1993.192), Sentosa, coll. P.K.L. Ng, 26 Feb.1991. 1 male (MNHN), Sentosa, coll. D.G.B. Chia, 26 Sep.1991. — 1 female (ZRC 1988.2242), Sultan Shoal, coll. G.S.Y. Lim, 1988. — 1 male, 1 female (ZRC 1993.189-190), Pulau Semakau, coll. P.K.L. Ng, 27 Oct.1992. — 3 females (ZRC

1965.11.5.44-47), Sultan Shoal, coll. A. Monteiro, 12 Apr.1933. 1 female (ZRC 1965.11.5.48), Alligator Island (= Pulau Pawai), coll. M.W.F.Tweedie, May.1933. — 1 male, 3 females (ZRC 1965.11.5.50.53), Pulau Pawai, Oct.1933, no other data. — 1 male (ZRC 1965.11.5.49), Pulau Sakra, May 1933, no other data. — 2 males, 2 females (ZRC 1965.11.5.39-42), Pulau Senang, Jan.1938. — 1 male (ZRC 1993.196), Pulau Pusing, coll. D.Vandenspiegel & E. Koh, from dredge, 22 Jan.1992. — 3 males, 1 female (ZRC 1965.11.5.24-28), Pulau Pisang, coll. M.W.F. Tweedie, Jan.1934. — 2 males, 1 female (ZRC 1965.11.5.54-56), Pulau Pisang, Jan.1934. — 1 female (ZRC 1969.12.20.15), Pulau Pisang, coll. M.W.F. Tweedie, Jan.1934. — 1 male (58.7 by 39.0 mm) (ZRC 1984.4052), Pulau Sakra, coll. P.K.L. Ng, 18 May.1983. — 3 males, 2 females (ZRC 1984.7966-7970), Sister Islands, Raffles Lighthouse and Pulau Sudong, coll. lighthouse crew, 15 Oct.1954, 16 Jul.1954 and 21 May 1953. — 1 female (ZRC 1985.1217), Raffles Lighthouse, 2 Dec.1959. — 1 male (75.5 by 47.9 mm), 1 female (58.2 by 37.6 mm, mature with juvenile coloration) (ZRC 1984.6407-6408), South China Sea, coll. Hee Huat, from trawler, 10 Sep.1983. **THAILAND** - 1 female (RMNH 37627), Gulf of Thailand, Sattahip, Rayong Province, ca. 180km southeast of Bangkok, Naklua, 10-40 m depth, trawled by fisherman, coll. A.C.J. Burgers & L.B. Holthuis, 16 Dec.1988. — 1 female (RMNH 37978), Bay of Bangkok, between Si Racha & Pattaya, ca. 150 km southeast of Bangkok, 10-40 m depth, trawled by fisherman, coll. A.C.J. Burgers & L.B. Holthuis, 24 Dec.1989. — 1 male (RMNH 36640), Gulf of Thailand, ca. 10 km, southeast of Bangkok, between Naklua & Si Racha, Chonburi Province, trawled by fisherman, coll. A.C.J. Burgers & L.B. Holthuis, 25 May 1986. — 1 female (RMNH 37323), Gulf of Thailand, ca. 150 km southeast of Bangkok, between Naklua & Si Racha, Chonburi Province, trawled by fisherman, coll. A.C.J. Burgers & L.B. Holthuis, 28-30 Dec.1987. **PHILIPPINES** - 1 male (RMNH 587), coll. C. G. Semper, 1880. — 1 male (MNHN-B9332), Cebu, 3 Apr.1976, no other data. **VIETNAM** - 1 male, 96.1 by 67.2 mm, (RMNH Cat. C), Condore, Indochina, no other data. — 1 female (MNHN-B12483), Pulau Condore, coll. L. R. Germain, no other data. — 1 male (MNHN-B2638), Pulau Condore, coll. L. R. Germain, no other data. — 2 males (MNHN-B2635), Pulau Condore, coll. L. R. Germain, no other data. — 2 females (MNHN-B2634), Pulau Condore, coll. L. R. Germain, no other data. — 1 juvenile (MNHN-B9323), Pulau Condore, coll. Harmand. — 3 males, 2 females (MNHN-B9336), Cape St. Jacques, coll. Campagne du "Lanessan", 1930. — 1 male (MNHN-B9284), coll. R. Serène, no other data. **TAIWAN** - 1 male, 1 female (ZRC), northeastern Taiwan, from traps in coral reefs, coll. P. H. Ho, 1992. **CHINA** - 1 male, 1 female (AS 1334), Xisha (= Paracel) Islands, 24 Dec.1955. — 1 male, 1 female (AS 3311), Hainan Island, 22 Dec.1955.

**Diagnosis.** - Carapace and ambulatory legs with distinct pattern of white and red mosaic blotches and spots, with white spots never evenly sized or uniformly distributed. Dorsal surface of carapace feebly lobate, relatively smooth, glabrous. Surface of anterior thoracic sternum glabrous, smooth. Pterygostomial and sub-branchial regions usually with dense pubescence. First anterolateral tooth separated from external orbital tooth by distinct cleft or gap. Anterolateral teeth well developed, teeth separated by deep clefts; first tooth with rounded to subtruncate margin, not extending anteriorly beyond external orbital tooth; subsequent teeth distinctly triangular, with last one smallest and possessing distinct median crest. Dorsal margin of palm of cheliped distinctly cristate throughout length; outer surface of palm smooth. Merus and propodus of ambulatory legs with well developed dorsal crest; length of last merus about 1.5 times maximum width; dense pubescence usually present on margins of dactylus. Sutures separating male abdominal segments 3-5 shallow, faint, with segments appearing almost completely fused. G1 slender, sinuous; distinctly twisted at base, distal part usually elongate, sharply tapering, tip directed inwards.

**Remarks.** - Fabricius (1798: 335) characterised *Cancer pictor* briefly - "C. thorace laeviusculo utrinque quadridentato, fronte fissa [...] Affinis praecedenti at paullo minor et distinctus. Frons majis rotundata, apice fissa. Orbita oculorum elevata, inermis. Thorax breviusculus, utrinque quadridentatus. Chelae breves. Carpi subbidentati. Manus breves margine elevato. Digiti breves, sulci. Pedes breves, compressi margine dorsali carinato".

The number of specimens Fabricius had examined was not specified. The locality from which his specimen(s) originated was not known. Zimsen (1964) noted that there was one



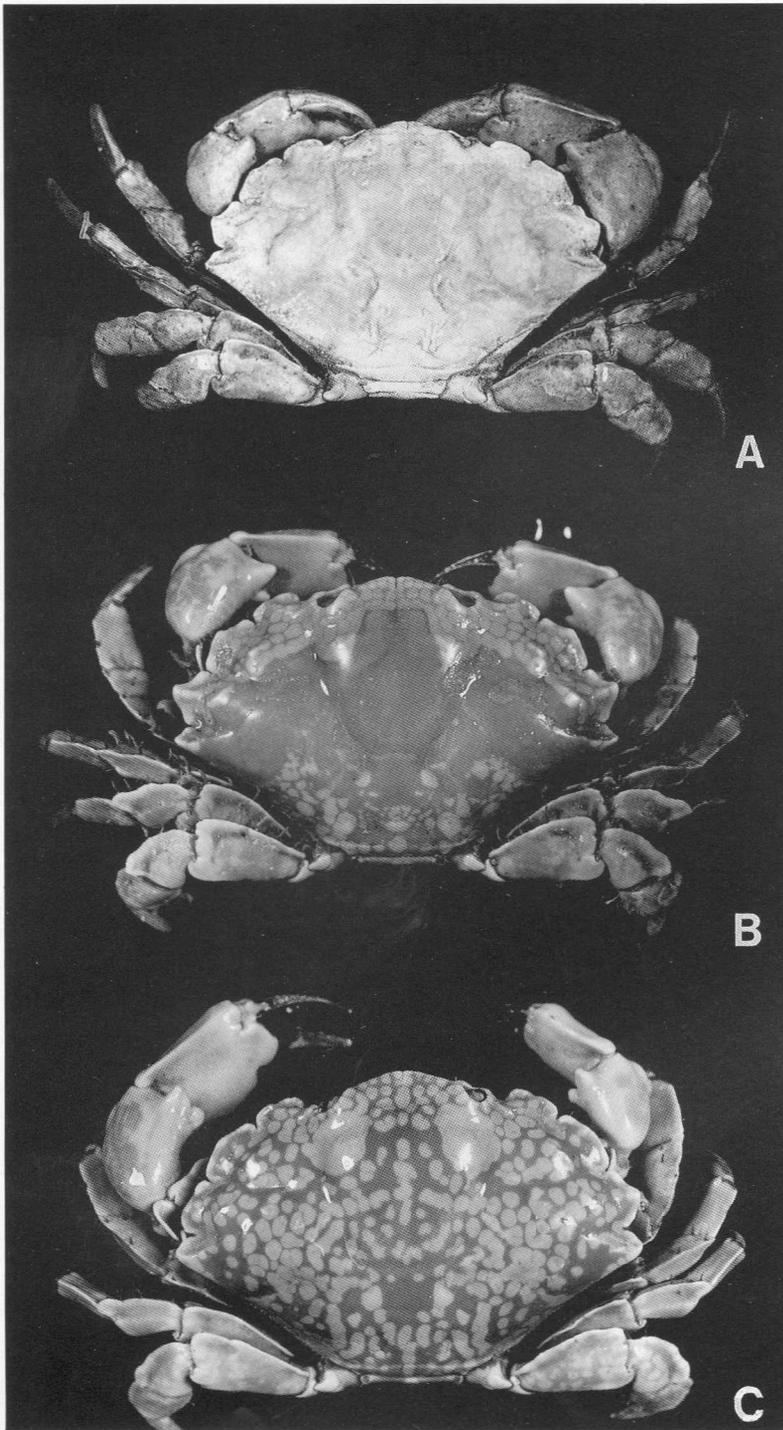


Fig. 2. *Lophozozymus pictor*. A, male, 96.1 by 67.2 mm, RMNH Cat. C, Pulau Condore; B, male, 66.8 by 41.5 mm, mature but with juvenile coloration; RMNH 1347, Ambon; C, male, 77.3 by 51.3 mm, ZRC 1987.505, Singapore.



Fig. 3. *Lophozozymus pictor*. A, mature female, 58.2 by 37.6 mm, with juvenile coloration, ZRC 1984.6408, Singapore; B, male, 58.7 by 39.0 mm, ZRC 1984.4052, Singapore; C, male, 69.9 by 45.1 mm, ZRC 1984.6406, Singapore.

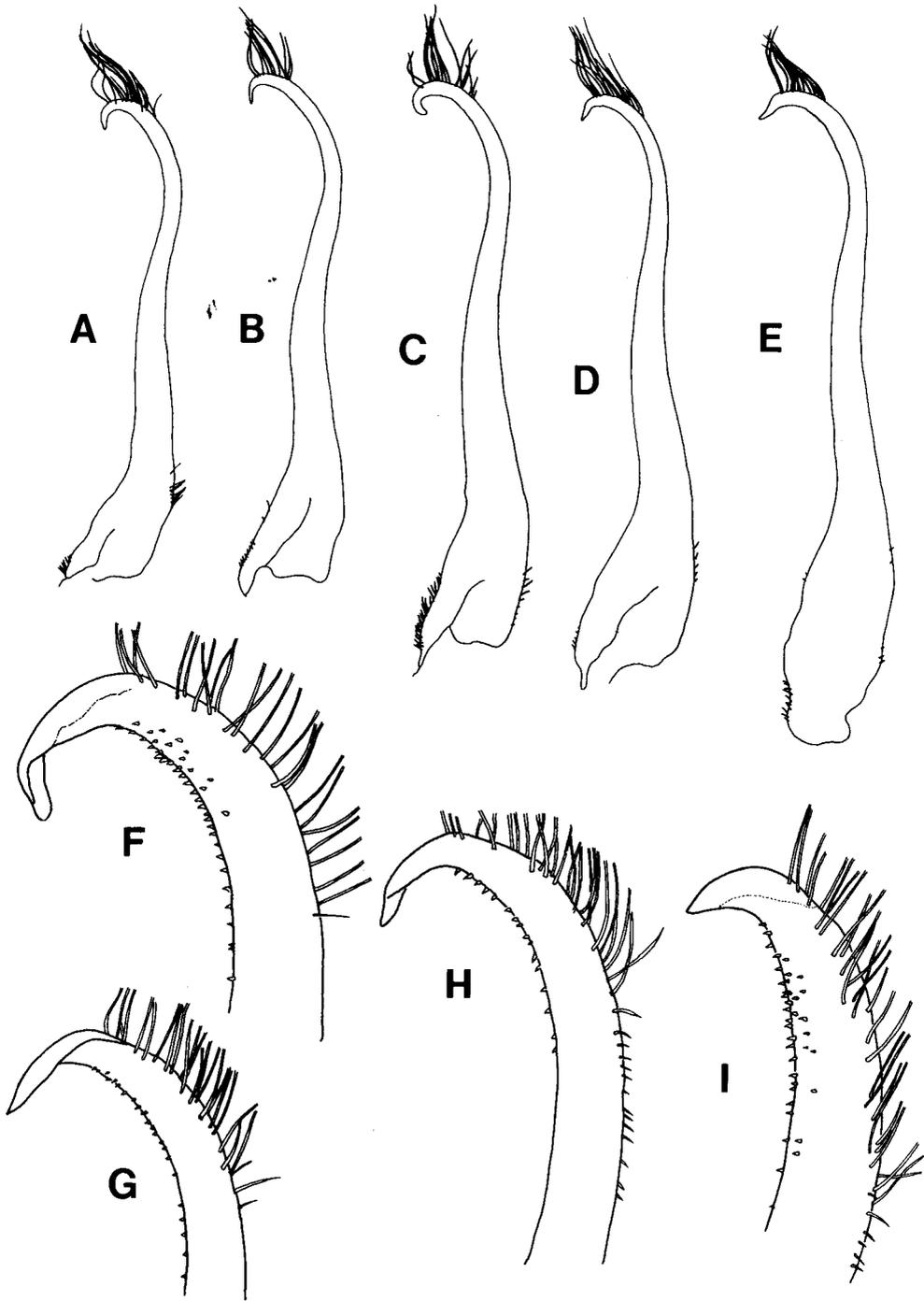


Fig. 4. *Lophozozymus pictor*. Left G1s. A, H, 48.6 by 38.6 mm, ZRC 1984.4052, Singapore; B, G, 66.8 by 41.5 mm, RMNH 1347, Ambon; C, F, 69.7 by 45.2 mm, ZRC 1984.6406, Singapore; D, I, 77.2 by 51.1 mm, ZRC 1987.505, Singapore; E, 75.8 by 47.7 mm, ZRC 1984.6407, Horsburgh Lighthouse (South China Sea);

specimen, originally from Kiel, in the ZMUC. In the ZMUC, however, are two specimens which carry the name *Cancer pictor* (J. Lützen and T. Wolff, in litt.). One specimen, a male, from Kiel, carries the number 109-1. No other data are associated with it. The other specimen, also a male (No. 109-2), also has label which says "America" and another name - "*Panopeus pictus*".

It is, however, obvious from Fabricius' brief description of *Cancer pictor* that the Kiel specimen is the actual type, especially with regards to the distinctly cristate ambulatory legs. It is uncertain, however, how many specimens Fabricius had available. As such, it is best to designate the Kiel male specimen (ZMUC 109-1) as the lectotype of *Cancer pictor* Fabricius, 1798.

Rumphius (1703: 9, pl. 5 fig M) described a crab from Ambon which he called "*Cancer saxatilis*" and regarded as poisonous to man, and provided a figure of it. The original painting of Rumphius (pl. 5) is in colour and at present in the library of the Koninklijk voor Tropen (= Royal Institute for the Tropics) in Amsterdam, of which Prof. L. B. Holthuis was kind enough to show us a photograph of. The notes with this painting (reproduced here as Fig. 1) are as follows: "Cancer saxatilis Amboinensis est admodum virulentus. 25 April 1699. Dit is de seer curieuse roo crabbe, die in de rivieren gevangen wort, hij is seer venijnigh, en moet niet gegeten werden" [Cancer saxatilis is very poisonous. 25 April 1699. This is the very peculiar Roo Crab, which is caught in the rivers. It is very poisonous, and should not be eaten] (p. 50 of the collection of illustrations of Crustacea of Henricus d'Acquet, former burgomaster of Delft). When the publisher received Rumphius' manuscript, he wanted more illustrations than Rumphius had sent. Therefore, the editor, Simon Schijnvoet, had numerous new illustrations made after specimens from Dutch collections, and he also used illustrations owned by several collectors like d'Acquet. Many of the figures chosen by Schijnvoet, unfortunately, did not show the species that Rumphius had actually described. Fortunately, Schijnvoet always made it clear in the text when he used figures from other collections, or if he had made figures after specimens from such collections. Rumphius' *Cancer saxatilis*, the description of which shows it to be the portunid *Scylla serrata*, was not illustrated under Rumphius' supervision, and the figure (pl. 5 fig. M) that Schijnvoet added, came (as clearly stated in its explanation) from the d'Acquet collection, which shows *Lophozozymus pictor* instead (L. B. Holthuis, pers. comm.).

The morphological differences between *L. pictor* and *L. erinnyes* are discussed under the next species. The habitat of *L. pictor* is mainly restricted to coral reefs of the Indo-Pacific region. They are found under coral rocks and in pools of water during ebb tide (Tan & Ng, 1988; Ng et al., 1992; Lim et al., 1994). *Lophozozymus pictor*, as far as is known, is omnivorous. The toxins in the crabs are lost when kept in aquaria for extended periods and the source of the toxin is believed to be exogenous (see Chia et al., 1993).

It is important to discuss the variation in the colour patterns within *L. pictor* s. str. (Figs. 2, 3, 8A, B). Although *L. pictor* displays considerable variation in color patterns, none resemble those of *L. erinnyes*. The main variation is limited to the meta- and meso- gastric region whereby the blotches of white found here which are sometimes missing. More importantly, the white is more speckled than dotted as compared to the *L. erinnyes*. Although the white specks vary in sizes and shape, in *L. pictor* the basic color is a mosaic of red and white. In *L. erinnyes*, the background colour is red, with white dots. The color pattern of juveniles is somewhat different compared to the adult (Figs. 2B, 3A, 8A). The known variation in the colour and patterns of adult *L. pictor*, however, does not overlap with those of *L. erinnyes*.

The taxonomy and nomenclature of *Cancer epheliticus* Linnaeus, 1763 (which has sometimes been confused with *L. pictor*), has been discussed in some detail by Ng & Holthuis (1993), and the name is now applied for the American calappid crab, *Hepatus epheliticus* (Linnaeus, 1763).

**Distribution.** - In addition to published records, we have also seen records, photographs or specimens clearly belonging to *L. pictor* from northwestern Australia facing the Indian Ocean, Philippines and Japan (not listed in above material). *Lophozozymus pictor* thus has a wide distribution, occurring throughout Southeast Asia to Ambon and reaching northwards until Japan. It also reaches Western Australia, but it is not yet known to be sympatric with *L. erinnyes*.

***Lophozozymus erinnyes*, new species**  
(Figs. 5-7; 8C, D; 9C, D; 10C, D)

*Lophozozymus octodentatus*, Haswell, 1882: 58; Calman, 1900: 6 (nec *Xantho octodentatus* H. Milne Edwards, 1834).

*Lophozozymus epheliticus*, Miers, 1880: 231 (partim); Miers, 1884: 182, 207 (partim); Miers, 1886: 115 (list only) (partim) (nec *Cancer epheliticus* Linnaeus, 1763).

*Lophozozymus pictor*, Rathbun, 1924: 15 (partim); Ward, 1928: pl. 28 top right hand corner; Ward, 1932: 243; Buitendijk, 1960: 297 (partim); Forest & Guinot, 1961: 55, fig. 40; McNeill, 1968: 68, pls. 1-2; Campbell & Stephenson, 1970: 277; Guinot, 1977: 648, fig. 4 (partim); Guinot, 1979: 64 pl. 7 fig. 4 (partim); Yang, 1979: 20 (partim); Serène, 1984: 168, 170 (partim) (key); Llewellyn & Davie, 1987: 131, 2 figs. (nec Fabricius, 1798).

**Material examined.** - Holotype - male, 72.2 by 51.7 mm (RMNH 10315), Heron Island, Queensland, Australia, coll. B. Dew, Apr.1955.

Paratypes - AUSTRALIA - 1 male (101.6 by 69.9 mm) (QM-W 16665), Swain Reefs, Queensland, coll. D. K. McCaw, 7 Aug.1990. — 1 male (87.2 by 55.5 mm) (ZRC 1965.11.5.35-38), Linderman Island, coll. M.W.F. Tweedie, May 1934. 1 female (71.0 by 50.8 mm) (QM-W 16665), Swain Reefs, Queensland, coll. D.K. McCaw, 7 Aug.1990. — 1 female (93.7 by 60.1 mm) (QM-W 11516, Queensland Museum), Moreton Bay, Queensland, coll. D. Adsett, 11 May 1984. -3 males (largest 73.3 by 47.2 mm) (ZRC 1965.11.5.36-38), Linderman Island, coll. M.W.F. Tweedie, May 1934. — 1 female (BMNH 1937.9.21.67), Great Barrier Reef, coll. Great Barrier Expedition, 1928-29. — 1 male, 1 female (BMNH 1931.5.15.5), Australia, coll. B. Grey. — 1 male (BMNH 1937.9.21.66), Great Barrier Reef, coll. Great Barrier Reef Expedition, 1928-29. — 1 male (BMNH 1931.4.14.18), Hamilton Island, Whitsunday Passage, Queensland, coll. M Ward. — 1 female (BMNH 69.35), Nicol Bay, northwest coast of Australia, coll. du Boulay. — 1 female (BMNH), Cape Greenville, York Peninsula, Queensland, coll. Wilkins Australia Island Expedition. — 1 male, 3 females (BMNH 69.38), Nicol Bay, northwest coast of Australia, coll. du Boulay. — 1 male, 1 female (BMNH 77.5), New South Wales, coll. G. Krelft. — 1 male (MNHN-B9317), Thursday Island, coll. Sep.1890. — 1 female (MNHN-B9334), Moreton Bay, Nov.1966, no other data. — 2 males, 1 female (MNHN-B9320), Hayman Island, Queensland, coll. M. Ward, 1928.

**Diagnosis.** - Carapace and ambulatory legs with distinct pattern of numerous small white spots on a uniform red background. Dorsal surface of carapace feebly lobate, relatively smooth, glabrous. Surface of anterior thoracic sternum glabrous, smooth. Pterygostomial and sub-branchial regions usually with very dense pubescence. First anterolateral tooth separated from external orbital tooth by distinct cleft or gap. Anterolateral teeth distinct, teeth separated by relatively shallower clefts; first tooth with gently rounded margin, not extending anteriorly beyond external orbital tooth; subsequent teeth distinctly triangular, with last one smallest and possessing distinct median crest. Dorsal margin of palm of cheliped distinctly cristate throughout length; outer surface of palm smooth. Merus and propodus of

ambulatory legs with well developed dorsal crest; length of last merus about 1.5 times maximum width; very dense pubescence usually present on margins of dactylus. Sutures separating male abdominal segments 3-5 deep, sutures pronounced with segments appearing almost separate. G1 slender, sinuous; not distinctly twisted at base, distal part not distinctly elongated but tapering, tip directed outwards.

**Etymology.** - The species name "*Erinnyes*" is derived from the name of the infernal deities in Greek Mythology, who punished those who violated their oaths, alluding to the toxicity of the crab. The name is used as a noun in apposition.

**Remarks.** - *Lophozozymus erinnyes*, new species, differs from *L. pictor* s. str. most obviously in having a carapace patterning composed of white dots on a red background (Fig. 5A); the incision separating the anterolateral lobes being more shallow (Fig. 5A); the black pigmentation on the pollex usually does not extend onto the palm in specimens less than ca. 60 mm carapace width; the denser pubescence on the more distinctly hooked ambulatory dactylus; the sutures on the male abdominal segments 3-5 being deep and distinct (Fig. 10C, D); and the G1 is less twisted on the lower half (lateral views), the distal part is proportionately longer, with the folds on the distal part often forming a slight "hump" on the dorsal part (Fig. 7) (see also Table 1). *Lophozozymus erinnyes* also grows to a larger size than *L. pictor* s. str.

Table 1: Differences between *Lophozozymus pictor* and *L. erinnyes*.

	<i>L. pictor</i>	<i>L. erinnyes</i>
Colour pattern on dorsal surface of carapace	white and red mosaic	numerous small white spots on a uniform red background
Depth of sutures separating male abdominal segments 3-5	shallow, sutures appear faint	deep, sutures pronounced
G1	distinctly twisted at base, distal part usually elongate, tip directed inwards	not distinctly twisted at base, distal part not elongated, tip directed outwards
Anterolateral lobes	pronounced, separated by deep clefts	not as distinctly separated, clefts shallower
Pubescence on pterygostomial and sub-branchial regions, and margins of ambulatory dactylus	dense	very dense

NB. pigmentation on the pollex reaches the palm in older specimens for both species.

The most striking difference between *L. pictor* and *L. erinnyes*, new species, is certainly the colour pattern of the carapace. None of the specimens of *L. pictor* we have examined possess the kind of pattern present in *L. erinnyes*. Although the holotype of *L. erinnyes* from Heron Island (RMNH 10315) has a higher density of white dots which are positioned closer together, the overall patterning still does not form a mosaic pattern as observed in *L. pictor*.

The G1 of *L. erinnyes* is consistently less twisted at the lower half for all the male specimens examined. This character is most obvious when the G1 is viewed laterally. The longer proportional length of the G1 distal segment is constant for smaller specimens, but in the largest specimen (QM-W 16665), this is not obvious (Fig. 7A). The hump-like structure on the dorsal subdistal part of the G1 is usually distinct, being less prominent in the largest

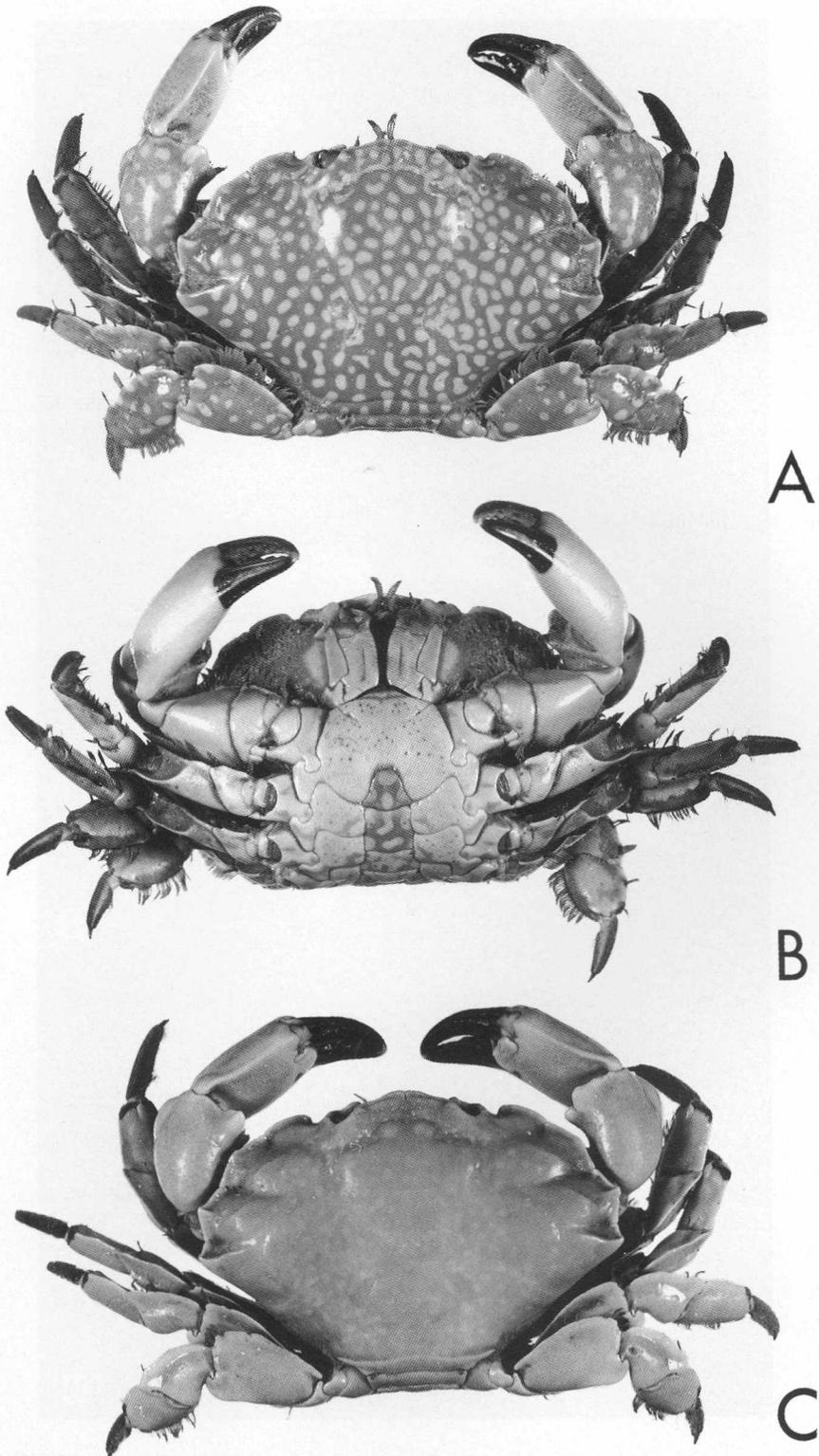


Fig. 5. *Lophozozymus erinnyes*, new species. A, B, holotype male, 72.2 by 51.7 mm, RMNH 10315, Heron Island; C, paratype male, 73.3 by 47.2 mm, ZRC 1965.11.5.36, Linderman Island.

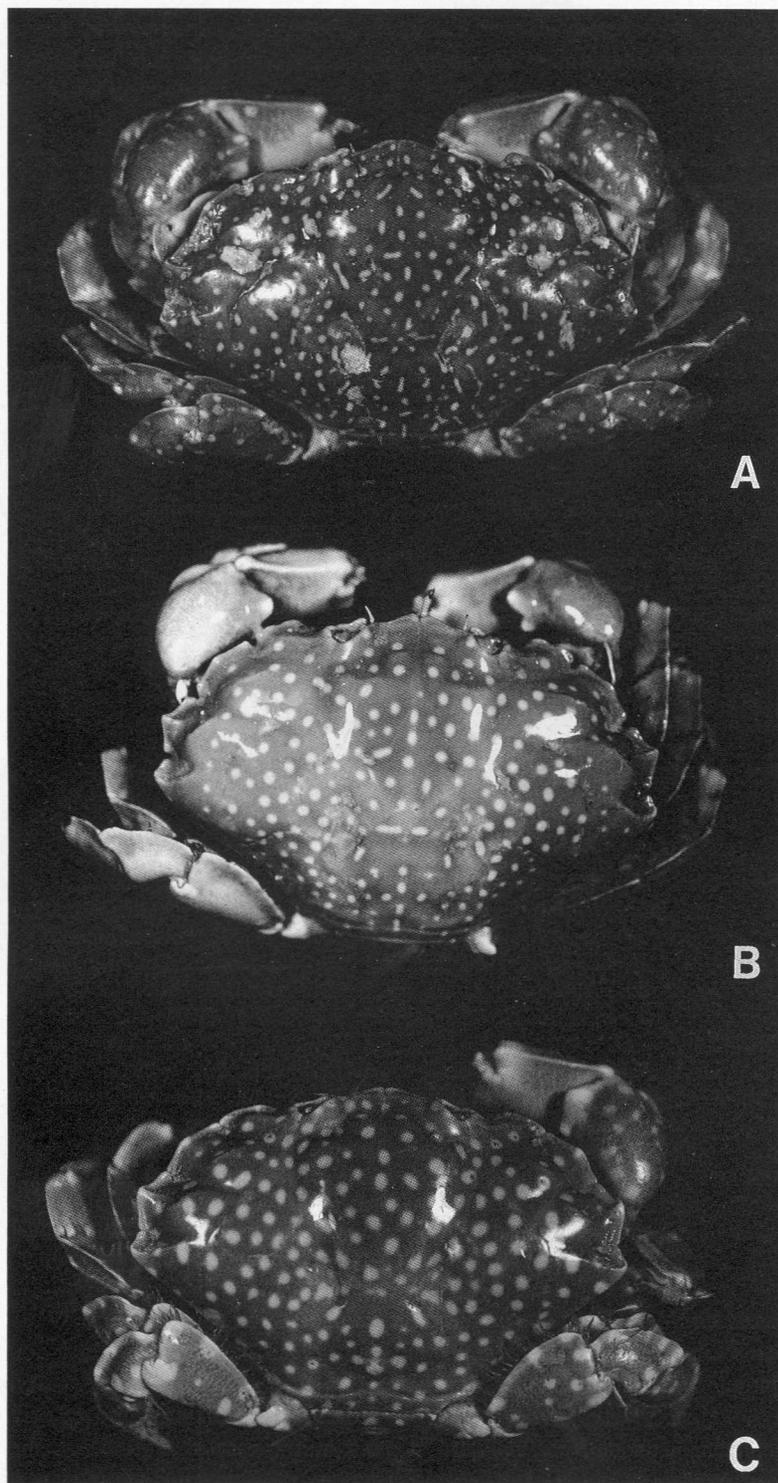


Fig. 6. *Lophozozymus erinnyes*, new species. A, paratype male, 101.6 by 69.9 mm, QM W 16665, Swain Reef; B, paratype female, 93.7 by 60.1 mm, QM W 11516, Moreton bay; C, female, 71.0 by 50.8 mm, QM W 16665, Swain Reef.

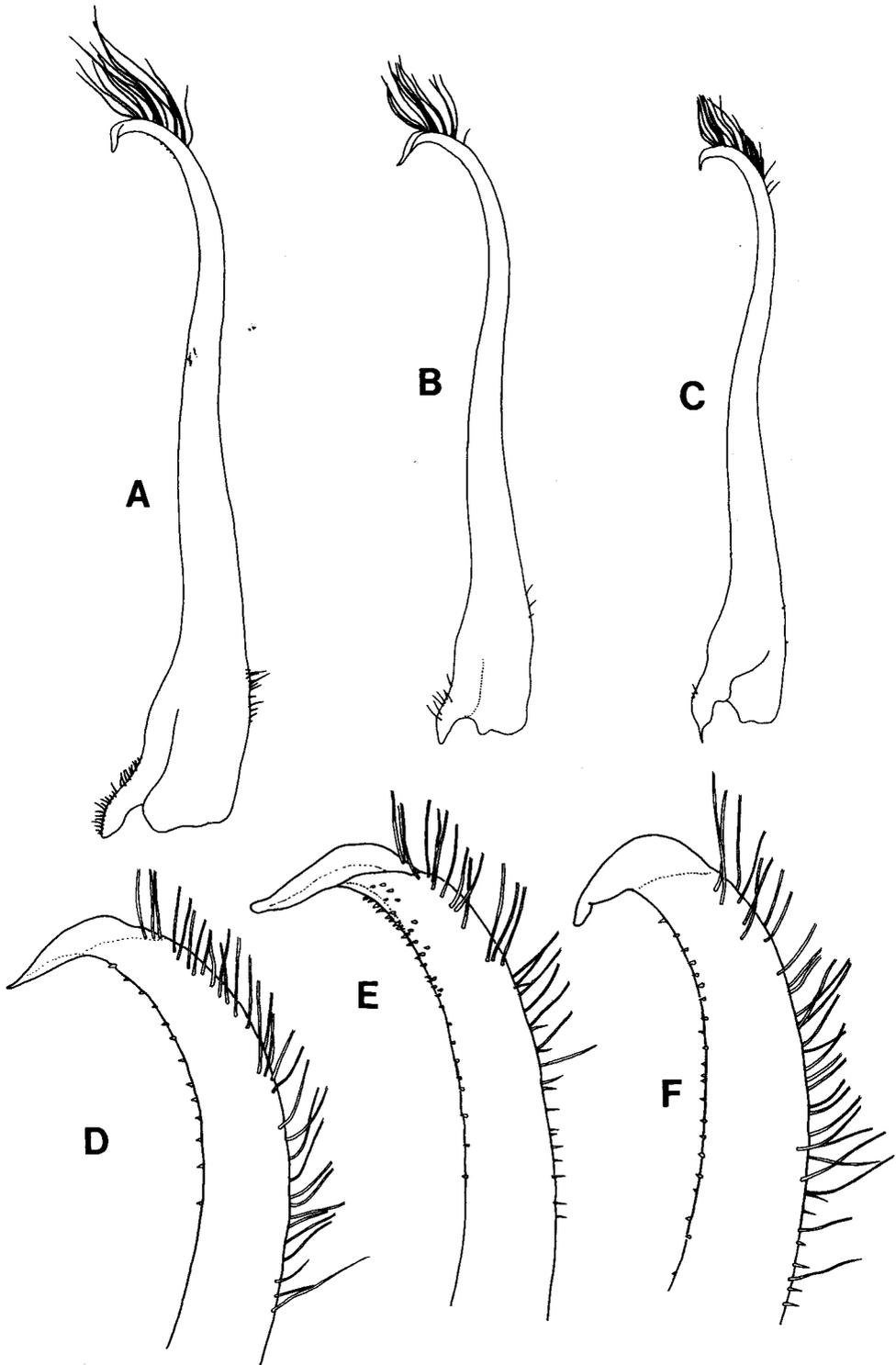


Fig. 7. *Lophozozymus erinnyes*, new species. Left G1s. A, F, paratype, 101.6 by 69.9 mm, QM W 16665, Swain Reef; B, E, holotype, 72.4 by 45.8 mm, RMNH 10315, Heron Island; C, paratype, 73.4 by 47.1 mm, ZRC 1965.11.5.35, Linderman Island; D, paratype, 101.7 by 65.3 mm, QM W 16665, Linderman Island.

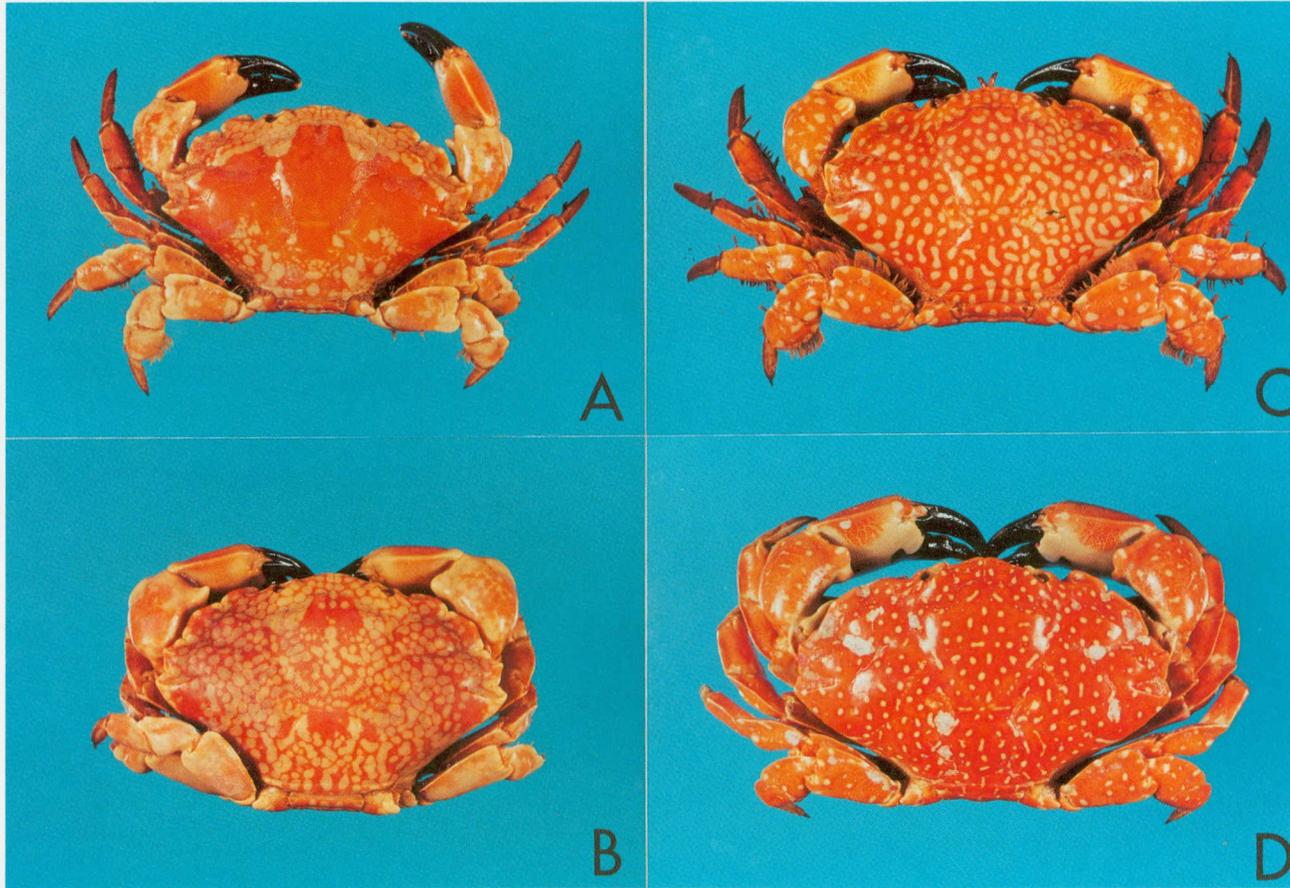


Fig. 8. Fresh coloration. A, B, *Lophozozymus pictor*; C, D, *L. erimyes*, new species. A, male, 66.8 by 41.5 mm, mature but with juvenile coloration; RMNH 1347, Ambon; B, male, 69.9 by 45.1 mm, ZRC 1984.6406, Singapore; C, holotype male, 72.2 by 51.7 mm, RMNH 10315, Heron Island; D, paratype male, 101.6 by 69.9 mm, QM W 16665, Swain Reef.

specimen (QM-W 16665) (Fig. 7F). The tip of the G2 distal segment of *L. erinnyes* is proportionately shorter compared to *L. pictor*. The sutures on the male abdominal segments 3-5 of *L. erinnyes* are deeper and the incision at the anterolateral margin is less deep (Fig. 5) compared to *L. pictor* where the incision is deeper and the lobes are more widely separated (Fig. 3). *Lophozozymus erinnyes* is also usually more setose on the pterygostomial regions and ambulatory legs.

The black pigmentation on the pollex in both species varies according to the size of the specimen. In the larger specimens, the black pigmentation on the pollex reaches the palm whereas in the smaller specimens this is absent (see Fig. 8C, D). This suggests that these markings are associated with age.

Specimens of *L. erinnyes* the size of average adult *L. pictor* (ca. 35-45 mm carapace width) do not possess the extent of the black pigmentation on the pollex and has deeper sutures on male abdominal segments 3 to 5. In *L. pictor*, the sutures on the male abdominal segments 3-5 are deeper in small specimens (ca. 20-30 mm carapace width), becoming very shallow in larger specimens. These sutures, however, are deep in almost all the specimens of *L. erinnyes* examined. The differences observed here suggest that *L. pictor* matures at a smaller size. Specimens of *L. pictor* ca. 50 mm in carapace width are already mature (G1 well chitinised, distal part and setae well developed) whereas a similarly-sized specimen of *L. erinnyes* is still clearly juvenile. Although the above-mentioned differences appear to be size-correlated, specimens of *L. pictor* and *L. erinnyes* of comparable sizes, can nevertheless be easily separated from each other. Very young specimens of *L. erinnyes* from Moreton Bay do not have the adult colour pattern on the carapace, and somewhat resembles that on *L. pictor* (P. Davie, pers. comm.)

*Lophozozymus erinnyes* is now known for certain only from northeastern and eastern Australia.

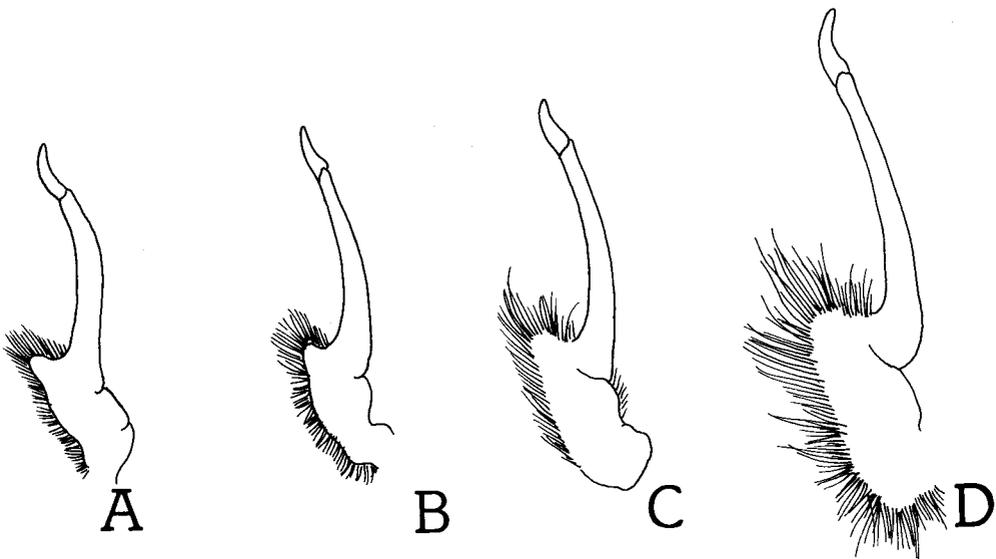


Fig. 9. Left G2s. A, B, *Lophozozymus pictor*; C, D, *L. erinnyes*, new species. A, male, 77.2 by 51.1 mm, ZRC 1987.505, Singapore; B, 66.8 by 41.5 mm, RMNH 1347, Ambon; C, paratype, 101.6 by 69.9 mm, QM W 16665, Swain Reef; D, paratype, 73.4 by 47.1 mm, ZRC 1965.11.5.35, Linderman Island.

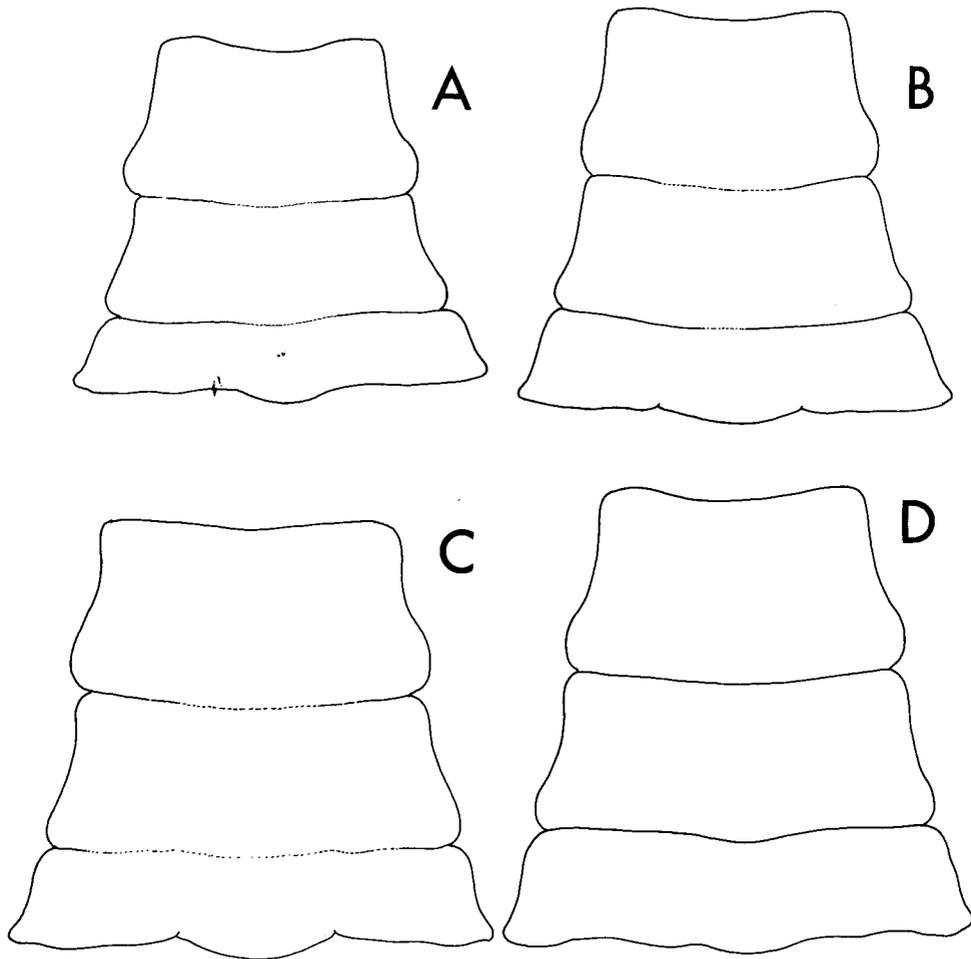


Fig. 10. Male abdominal segments 3-5. A, B, *Lophozozymus pictor*; C, D, *L. erinnyes*, new species. A, male, 66.8 by 41.5 mm, RMNH 1347, Ambon; B, male, 69.9 by 45.1 mm, ZRC 1984.6406, Singapore; C, paratype male, 73.4 by 47.1 mm, ZRC 1965.11.5.35, Linderman Island; D, holotype male, 72.4 by 45.8 mm, RMNH 10315, Heron Island.

*Lophozozymus edwardsi* (Odhner, 1925)

(Fig. 11)

*Lophozozymus pictor* - Buitendijk, 1960: 297 (partim) (nec *Cancer pictor* Fabricius, 1798).

**Material examined.** - 2 males, 1 female (RMNH 1325), Upolu, Samoa Islands, coll. Museum Godeffroy, 1887.

**Remarks.** - Two of the specimens which had been identified as *L. pictor* by Buitendijk (1960) are in fact *L. edwardsi* (cf. Guinot, 1977, 1979). These specimens were from Upolu. The hook-shaped black pigmentation pattern on the cheliped dactylus region is identical to specimens figured in Guinot's (1977, 1979) plates. Both specimens are relatively glabrous and the anterolateral margin is distinctly cristate. The fact that both specimens are collected from the same region, Upolu, helps affirm the identity of the specimen as *L. edwardsi*. *Lophozozymus edwardsi* differs from *L. pictor* and *L. erinnyes* being more flattened

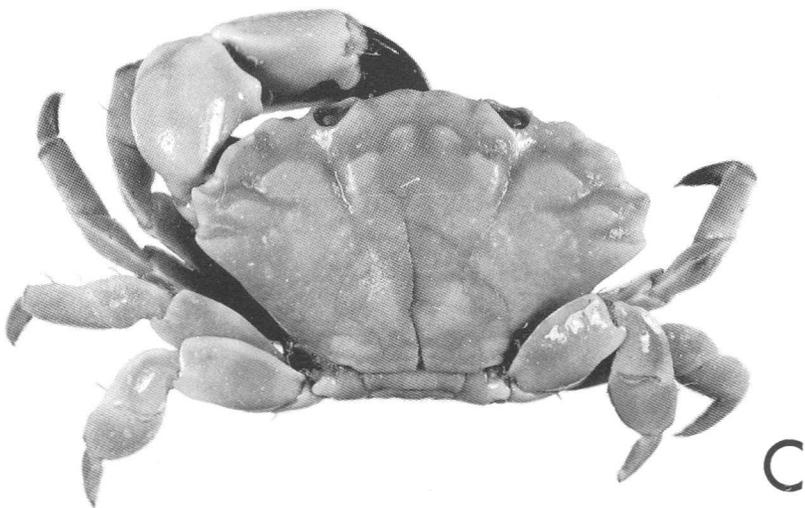
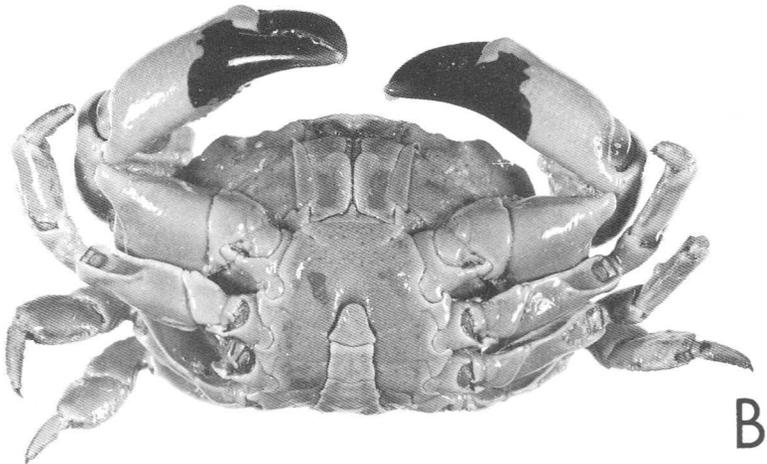


Fig. 11. *Lophozozymus edwardsi*. A, B, male, 45.0 by 27.0 mm, RMNH 1325, New Caledonia; C, male, 28.6 by 17.2 mm, RMNH 1325, New Caledonia.

anterolaterally and bearing small orange punctations all throughout the ventral surface. Also, *L. edwardsi* matures at a smaller size, the male specimen, had fully developed gonopods and the female specimen, which was ovigerous at a size whereby if they were *L. pictor*, they would be juveniles. The G1 of the male specimen of *L. edwardsi* is filiform with an elongated tip.

A note on the collector of these specimens is perhaps useful. The Museum Godeffroy was the private museum of Johann Cesar VI Godeffroy, owner of the shipping company J. C. Godeffroy & Sons of Hamburg. The captains of Godeffroy's ships, which traded mostly in the Pacific and South America, made collections for the museum, and several private persons were also sent out as collectors. Duplicate specimens were sold. Numerous Godeffroy specimens are thus found in several European museums in Leiden, Strasbourg etc. which bought them from the Godeffroy Museum. When the Godeffroy company went bankrupt in 1878, most of the collections went to the Hamburg Zoological Museum (L. B. Holthuis, pers. comm.).

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#### LITERATURE CITED

- Alcock, A., 1898. Materials for a Carcinological Fauna of India. No. 3. The Brachyura Cyclometopa. Part I. The family Xanthidae. *J. Asiat. Soc. Bengal, Calcutta*, 67(2), No. 1: 67-233.
- André, M., 1931. Crustacés Décapodes provenant de l'Institut Océanographique de Nha-Trang (Annam). *Bull. Mus. natn. Hist. nat.*, Paris, (2)3(7): 638-650.
- Balss, H., 1938. Die Dekapoden Brachyura von Dr. Sixten Bocks Pazifik-Expedition 1917-1918. *Göteborgs K. Vetensk.-o. Vitterh-samh. Handl.*, (B)5(7): 1-85, pls. 1-2.
- Buitendijk, A. M., 1960. Biological results of the Snellius Expedition. xxi. Brachyura of the families Atelecyclidae and Xanthidae. *Temminckia*, 10: 252-338.
- Calman, W. T., 1900. On a collection of Brachyura from Torres Straits. *Trans. Linn. Soc. London*, (2) (Zool.) 8(1): 1-50, pls. 1-3.
- Campbell, B. M. & W. Stephenson, 1970. The sublittoral Brachyura (Crustacea: Decapoda) of Moreton Bay. *Mem. Qld. Mus.*, 15(4): 235-301, pl. 22.
- Carumbana, E. E., A. C. Alcalá & E. P. Ortega, 1976. Toxic marine crabs in Southern Negros, Philippines. *Silliman J.*, 23(4): 265-278.

- Chia, D. G. B., C. O. Lau, P. K. L. Ng & C. H. Tan, 1993. Localisation of toxins in the poisonous mosaic crab, *Lophozozymus pictor* (Fabricius, 1798) (Brachyura, Xanthidae). *Toxicon*, **31**(7): 901-904.
- Dai, A.-Y., S.-L. Yang, Y. Song & G. Chen, 1986. [*Crabs of Chinese Seas*]. Pp. 17+642, figs. 1-295, pls. 1-74. China Ocean Press, Beijing. [In Chinese]
- Dai, A.-Y. & S.-L. Yang, 1991. *Crabs of the China Seas*. Springer-Verlag, 608 pp., 74 pls.
- Fabricius, J. C., 1798. *Supplementum Entomologiae Systematicae*. Hafniae, 572 pp.
- Forest, J. & D. Guinot, 1961. Crustacés Décapodes Brachyours de Tahiti et des Tuamotu. *Expedition Française sur les Récifs Coralliens de la Nouvelle-Calédonie*, Vol. Prél., pp. 1-195, pls. 1-18.
- Garth, J. S. & A. C. Alcalá, 1977. Poisonous crabs of the Indo-West Pacific coral reefs, with special reference to the genus *Demania*. *Proc. Third Intern. Coral Reef Symp.*, Miami, pp. 645-651.
- Gruvel, A., 1925. *L'Indo-Chine, ses richesses marines et fluviales, exploitation actuelle, avenir*. Pp. 1-319, pls. 1-24.
- Guinot, D., 1967. *Les crabes comestibles de l'Indo-Pacifique*. Editions de la Fondation Singer-Polignac, 1966, 145 pp., 10 pls.
- Guinot, D., 1977. *Données nouvelles sur la morphologie, la phylogénèse et la taxonomie des Crustacés Décapodes Brachyours*. Thèse de Doctorat d'Etat es Sciences, soutenue le 21 Juin 1977 à l'Université Pierre-et-Marie-Curie. 2 vols., in folio, pp. I-XV, 1-486, XVI-XXIV; 56 feuilles n.n., 78 figs., 31 pls., 14 tabs.
- Guinot, D., 1979. Données nouvelles sur la morphologie, la phylogénèse et la taxonomie des Crustacés Décapodes Brachyours. *Mém. Mus. natn. Hist. Nat.*, Paris, (A) Zool., **112**: 1-354, Pls. 1-27.
- Haswell, W. A., 1882. *Catalogue of the Australian Stalk- and Sessile-eyed Crustacea*. Australian Mus., Sydney, pp. iii-xxiv, 1-324.
- Henschel, A. G. E. T., 1833. *Vita G. E. Rumphii, Plinii Indici. Accedunt Specimen Materiae Rumphianae Medicae Clavisque Herbarii et Thesauri Amboinensis*. Pp. i-xiv, 1-25, 1 pl.
- Herbst, J. F. W., 1782-1804. *Versuch einer Naturgeschichte der Krabben und Krebse, nebst einer systematischen Beschreibung ihrer verschiedenen Arten*. Volumes 1-3, 515 pp., 62 pls.
- Holthuis, L. B., 1954. The names of the European species of the genus *Xantho* Leach 1814 (Crustacea Decapoda Brachyura). *Koninkl. Nederl. Akad. Wetensch. Amsterdam*, (C)**57**(1): 103-107.
- Holthuis, L. B., 1959. Notes on pre-Linnaean carcinology (including the study of Xiphosura) of the Malay Archipelago. In: H. C. D. De Wit (ed.), *Rumphius Mem. Vol., Uitgeverij en Drukkerij Hollandia N. V.*, Baarn, pp. 63-125.
- International Commission of Zoological Nomenclature (ICZN), 1985. *International Code of Zoological Nomenclature*. Third Edition. Adopted by the XX General Assembly of the International Union of Biological Sciences. International Trust for Zoological Nomenclature, in association with the British Museum (Natural History), London, 338 pp.
- Lanchester, W. F., 1900. On a collection of crustacea made at Singapore and Malacca.-Part I. Crustacea Brachyura. *Proc. Zool. Soc. Lond.*, **1900**: 719-770, pls. 44-47.
- Lau, C. O., S. Y. Chng, D. G. B. Chia, R. Yuen, H. E. Khoo, P. K. L. Ng & C. H. Tan, 1991. A preliminary survey of local marine crabs for toxicity. *Abstr. "10th World Congr. Animal, Plant Microb. Toxins"*, Natn. Univ. Singapore & Intern. Soc. Toxinol., Singapore, Ed. P. Gopalakrishnakone & C. K. Tan, p. 254.

- Leach, W. E., 1814. Crustaceology. In: D. Brewster, *The Edinburgh Encyclopaedia*, 7: 383-437, pl. 221.
- Leach, W. E., 1815. A Tabular View of the External Characters of Four Classes of Animals, which Linné Arranged under Insecta, with the Distribution of the Genera Composing Three of These Classes into Orders, and Descriptions of Several New Genera and Species. *Trans. Linn. Soc. Lond.*, 11: 306-400.
- Lim, S. S. L., P. K. L. Ng, L. W. H. Tan & Y. C. Wee, 1994. *Rhythm of the Sea. Life and Times of Labrador Beach*. Natn. Inst. Educ. & Natn. Univ. Singapore, 160 pp.
- Linnaeus, C., 1758. *Systema Naturae per Regna Tria Naturae, Secundum Classes, Ordines, Genera, Species, cum Characteribus, Differentiis, Synonymis, Locis*. 10th edition, 1: i-iii, 1-824 pp.
- Linnaeus, C., 1763. *Amoenitates Academicae; seu dissertationes variae, physicae, medicae, botanicae, Antehac seorsim editae, nunc collectae & auctae*. 6: 384-415.
- Llewellyn, L. E. & P. J. F. Davie, 1987. Crabs and other crustaceans. In: Covacevich, J., P. Davie & J. Pearn (eds.). *Toxic Plants and Animals. A Guide for Australia*. Brisbane, Pp. 126-135.
- Llewellyn, L. E. & R. Endean, 1989. Toxicity and paralytic shellfish toxin profiles of the xanthid crabs, *Lophozozymus pictor* and *Zosimus aeneus*, collected from some Australian coral reefs. *Toxicon*, 27(5): 596-600.
- Lucas, M., 1853. Crustacés. In: Jacquinot, H. & M. Lucas (eds.). *Voyage au Pôle Sud et dans l'Océanie sur les Corvettes l'Astrolabe et la Zélée; exécuté par ordre du roi pendant les années 1837-1838-1839-1840 sous le commandement de M. J. Dumont d'Urville*. Gide et Baudry, Paris, Atlas, 1852: 9 pls., Zool., 3(3), 1853: 1-107.
- Man, J. G. De, 1895. Bericht über die von Herrn Sciffscapitän Storm zur Atjeh, an den westlichen Küsten von Malakka, Borneo und Celebes sowie in der Java-See gesammelten Decapoden und Stomatopoden. *Zool. Jahrb., Syst.*, 8: 485-609, pls. 12-14.
- Man, J. G. De, 1902. Die von Herrn Professor Kükenthal im Indischen Archipel gesammelten Dekapoden und Stomatopoden. In: W. Kükenthal (ed.). *Ergebnisse einer zoologischen Forschungsreise in den Molukken und Borneo. Abh. Senckenberg. Naturforsch. Gesell.*, 25: 467-929, pls. 19-27.
- Man, J. G., De, 1902. Over de Crustacea ("Wecke Schaalvisschen") in Rumphius' Rariteitkamer. *Rumphius Gedenkboek*, Leiden. Pp. 98-104.
- McNeill, F., 1968. Crustacea. Decapoda and Stomatopoda. *Sci. Rep. Gr. Barrier Reef Exped.*, 7(1): 1-98, pls. 1, 2.
- Miers, E. J., 1880. On a collection of Crustacea from the Malaysian Region. Part I. Crustacea Oxyrhyncha and Cyclometopa, except Telphusidea. *Ann. Mag. Nat. Hist.*, (5)5: 226-239, pl. 13.
- Miers, E. J., 1884. Crustacea. *Report on the Zoological Collections in the Indo-Pacific Ocean during the voyage of H.M.S. "Alert" 1881-1882*. London, pp. 178-322, 513-575, pls. 18-34.
- Miers, E. J., 1886. Report on the Brachyura collected by H.M.S. 'Challenger' during the years 1873-1876. In: *Report Sci. Res. Expl. Voy. H.M.S. 'Challenger'*, Zool., Part 49, 17: 1-362, 29 pls.
- Milne Edwards, A., 1863. Monographie des Crustacés fossiles de la famille des Cancériens, Suite. *Ann. Sci. Nat., Zool.*, (4)20: 273-324, pls. 5-12.
- Milne Edwards, A., 1867. Descriptions de quelques espèces nouvelles de Crustacés Brachyures. *Ann. Soc. Entom. France.*, (4)7: 263-288.
- Milne Edwards, A., 1873. Recherches sur la faune carcinologique de la Nouvelle-Calédonie, Deuxième. *Nouv. Mus. Hist. nat.*, Paris, 9: 155-332, pls. 4-18.

Milne Edwards, H., 1834. *Histoire naturelle des Crustacés, comprenant l'anatomie, la physiologie et, la classification de ces animaux*. 1, 1834, pp. i-xxxv, 1-468; 2, 1837, pp. 1-532, atlas.

Miyake, S., 1983. *Japanese crustacean decapods and stomatopods in color. Vol. I. Macrura, Anomura and Stomatopoda*. Hoikusha Publishing Co., Osaka, 261 pp., 56 colour pls.

Montagu, G., 1808. Description of several Marine Animals found on the South Coast of Devonshire. *Trans. Linn. Soc. Lond.*, 9: 81-114, pls. 2-8.

Naiyanetr, P., 1980. *Crustacea Fauna of Thailand (Decapoda and Stomatopoda)*. Dept. Biol., Fac. Sci., Chulalongkorn Univ., Bangkok, 73 pp. (mimeographed).

Nauck, E., 1880. Das Kaugerüst der Brachyuren. *Z. wiss. Zool.*, 34: 1-69, pl. 1.

Ng, P. K. L., D. G. B. Chia, E. G. L. Koh & L. W. H. Tan, 1992. Poisonous Malaysian crabs. *Nature Malaysiana*, 17(1): 4-9.

Ng, P. K. L. & L. B. Holthuis, 1993. The identity of *Cancer epheliticus* Linnaeus, 1763 (Crustacea: Decapoda: Brachyura). *Crustaceana*, 64(1): 87-90.

Ng, P. K. L., L. W. H. Tan, C. S. Ng & P. Gopalakrishnakone, 1988. *Poisonous Crabs*. Venom and Toxin Research Group, National University of Singapore, Publication No. 7 [poster].

Ng, P. K. L., L. W. H. Tan, C. S. Ng & P. Gopalakrishnakone, 1990. Poisonous Crabs. In: Gopalakrishnakone, P. (ed.). *A Colour Guide to Dangerous Animals*. Ridge Books, Singapore Univ. Press. Pp. 101-116.

Odhner, T., 1925. Monographierte Gattungen der Krabbenfamilie Xanthidae I. *Göteborg. Kungl. Vetensk. Vitt. samh. Handl. (Tidsf.)*, (4)29(1): 1-29, figs, pls. 1-5.

Petiver, J., 1713. *Aquatilium Animalium Abboinae, & c. Icones & Nomina. Containing near 400 Figures, engraven on Copper Plates of Aquatick Crustaceous and testaceous Animals; as Lobsters, Crawfish, Prawns, Shrimps, Sea-Urchins, Eggs, Buttons, Stars, Couries, Concks, Perywinkles, Whelks, Oysters, Muscles, Cockles, Frills, Purrs, Scallops, with divers other Sort of Sea and River Shell-fish; all found about Amboina, and the Neighbouring Indian Shores, with their latin, English, Dutch and Native Names*. London. Printed for Mr. Christopher Bateman in Paternoster Row, MDCCXIII, pp. 1-4, i, pls. 1-22.

Rathbun, M. J., 1924. Results of Dr. E. Mjöberg's Swedish Scientific Expeditions to Australia 1910-1913. 37. Brachyura, Albuneidae and Porcellanidae. *Ark. Zool.*, 16(23): 1-33, pls. 1-2.

Rumphius, G. E., 1705. *D'Amboinsche Rariteikamer, Behelzende eene Beschryvinge van allerhande zoo weeke als harde Schaalvisssen, te weeten raare Krabben, Kreeften, en diergelyke Zeedieren, als mede allerhande Hoortjes en Schulpen, die men in d'Amboinsche Zee vindt: Daar beneven zommige Mineraalen, Gesteenten, en soorten van Aarde, die in d'Amboinsche, en zommige omleggende Eilanden gevonden worden. Verdeelt in drie Boeken, En met nodige Printverbeeldingen, alle naar't leven getekent, voorzien. T. Amsterdam, Gedrukt by Francois Halma, Boekverkoper in Konstantijn den Grooten*. 28 pp. pp. 1-340, 43 pp., frontispiece, pls. 1-60. (First edition)

Rumphius, G. E., 1711. *Thesaurus Imaginum Piscium Testaceorum; Quales sunt Cancrini, Echini, Echinometra, Stellae Marinae, &c. Ut & Cochlearum; Inter quas numerantur Lunares; Laciniatae; Trochi, Valvatae; sive Semilunares; Valvatae Striatae, Cassides tuberosae, verrucosae, laeves & Murices; Globosae; Buccina; Strombi; Volutae; Alatae; Porcellanae majores & minores; Cylindri, &c. Quibus accedunt Conchylia, ut Nautilus, Cornu Ammonis, &c. Conchae univalviae & bivalviae; Quarum species sunt Solenes univalvii, Chamae asperae, Chamae laeves, Pectines, Pectunculi, Tellinae, Solenes bivalvii, Musculi, Pinnae, Ostrea, &c. Denique Mineralia; Uti Metalla, Lapides & Argillae, variis in locis reperta Quorum omnium maximam partem Georgius Everhardius Rumphius M. D. Et Academiae Caesariae Naturae Curiosorum Collega, dictus Plinius Indicus, collegit; Jam vero Naturae Amator & Curiosus quidam in hunc ordinem digessit, & nitidissimè aeri incidi curavit. Lugduni Batavorum, Apud Petrum vander Aa, Bibliopolam*. MDCCXI, 8 pp., pls. 1-60. (First edition)

Rumphius, G. E., 1739. *Thesaurus Imaginum Piscium Testaceorum; Quales sunt Cancrini, Echini, Echinometra, Stellae Marinae, & c. UT ET Cochlearum; Inter quas numerantur Lunares; Laciniatae; Trochi, Valvatae; sive Semilunares; Valvatae Striatae, Cassides tuberosae, verrucosae, laeves & Murices; Globosae; Buccina; Strombi; Volutae; Alatae; Porcellanae majores & minores; Cylindri, & c. Quibus accedunt Conchylia, UT Nautilus, Cornu Ammonis, & c. Conchae univalviae & bivalviae; Quarum species sunt Solenes univalvii, Chamae asperae, Chamae laeves, Pectines, Pectunculi, Tellinae, Solenes bivalvii, Musculi, Pinnae, Ostrea, & c. Denique Mineralia; Uti Metalla, Lapidés & Argillae, variis in locis reperta Quorum omnium maximam partem Georgius Everhardius Rumphius, M. D. Et Academiae Caesareae Naturae Curiosorum Collega, dictus Plinius Indicus, collegit; Jam vero Naturae Amator & Curiosus quidam in hunc ordinem digessit, & nitidissimè aeri incidi curavit. Lugduni Batavorum, Apud Petrum vander Aa, Bibliopolam. MDCCXI, 8 pp., pls. 1-60. (Second edition)*

Rumphius, G. E., 1740. *D'Amboinsche Rariteikamer, Behelzende eene Beschryvinge van allerhande zoo weeke als harde Schaalvisschen, te weete raare Krabben, Kreeften, en diergelyke Zeedieren, als mede allerhande Hoorntjes en Schulpen, die men in d'Amboinsche Zee vindt: Daar benevens zommige Mineraalen, Gesteenten, en soorten van Aarde, die in d'Amboinsche, en zommige omleggende Eilanden gevonden worden. Verdeelt in drie Boeken, En met nodige Printverbeeldingen, alle naar't leven getekent, voorzien. T. Amsterdam, Gedrukt by Francois Halma, Boekverkoper in Konstantijn den Grooten. 28 pp. pp. 1-340, 43 pp., frontispiece, pls. 1-60. (Second edition)*

Rumphius, G. E., 1741. *D'Amboinsche Rariteikamer, Behelzende eene Beschryvinge van allerhande zoo weeke als harde Schaalvisschen, te weeten raare Krabben, Kreeften, en diergelyke Zeedieren, als mede allerhande Hoorntjes en Schulpen, die men in d'Amboinsche Zee vindt: Daar benevens zommige Mineraalen, Gesteenten, en soorten van Aarde, die in d'Amboinsche, en zommige omleggende Eilanden gevonden worden. Verdeelt in drie Boeken, En met nodige Printverbeeldingen, alle naar't leven getekent, voorzien. T. Amsterdam, Gedrukt by Francois Halma, Boekverkoper in Konstantijn den Grooten. 28 pp. pp. 1-340, 43 pp., frontispiece, pls. 1-60. (Third edition)*

Sakai, T., 1939. *Studies on the crabs of Japan. IV. Brachygnatha, Brachyrhyncha*. Tokyo, pp. 365-741, Pls. 42-111.

Sakai, T., 1976. *Crabs of Japan and the Adjacent Seas*. In three volumes; English Text, pp. xxix + 773pp., Japanese Text, pp. 1-461, Plates Volume, pp. 1-16, Pls. 1-251. Kodansha Ltd., Tokyo.

Serène, R., 1968. The Brachyura of the Indo-West Pacific Region. In: *Prodromus for a Check List of the non-planctonic marine fauna of South East Asia. UNESCO, Singapore, Special Publ. No. 1, Fauna III Cc3: 33-112.*

Serène, R., 1984. Crustacés Décapodes Brachyours de l'Océan Indien occidental et de la Mer Rouge. Xanthoidea: Xanthidae et Trapeziidae. Addendum Carpiliidae et Menippidae - A. Crosnier. *Faune Tropicale (ORSTOM) 24: 1-400, Pls. 1-48.*

Shen, C. J., 1940. The Brachyura Fauna of Hong Kong. *J. Hong Kong Fish. Res. Stn.*, **1**(2): 211-242.

Tan, L. W. H. & P. K. L. Ng, 1988. *A Guide to Seashore Life*. (Second edition 1992. Singapore Science Centre, Singapore, 160 pp.

Teh, Y. F. & J. E. Gardiner, 1970. Toxin from the coral reef crab, *Lophozozymus pictor*. *Pharmacol. Res. Comm.*, **2**: 251.

Teh, Y. F. & J. E. Gardiner, 1974. Partial purification of *Lophozozymus pictor* toxin. *Toxicon*, **12**: 603-610.

Walker, A. O., 1887. Notes on a collection of Crustacea from Singapore. *J. Linn. Soc., Zool.*, **20**: 107-117, pls. 6-9.

Ward, M., 1928. The Crustacea of the Capricorn and Bunker Groups, Queensland. *Aust. Zool.*, **5**(3): 241-246, pls. 27-29.

Ward, M., 1932. The true crabs of the Capricorn Group, Queensland (Class Crustacea, Order Decapoda Brachyura). *Aust. Zool.*, 7(3): 237-255

Yang, C. M., 1979. *A list of Brachyura in the Zoological Reference Collection of the Department of Zoology*. Dept. Zool., Univ. Singapore, 60 p. (mimeographed).

Yasumoto, T., D. Yasumura, Y. Ohizumi, M. Takahashi, A. Alcala & A. L. Alcala, 1986. Palytoxin in two species of xanthid crab from the Philippines. *Agric. Biol. Chem.*, 50(1): 163-167.

Zimsen, E., 1964. *The type material of I. C. Fabricius*. Pp. 1-656, 1 text-fig., 2 pls.

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