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(CRUSTACEA, DECAPODA, ANOMURA)**

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A REVIEW OF THE AUSTRALIAN CRABS OF FAMILY HIPPIDAE
(CRUSTACEA, DECAPODA, ANOMURA)

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ABSTRACT

Five species of Hippidae are recorded from Australian waters. Keys, diagnoses, and illustrations are given for their identification, and the Australian literature of the family is reviewed. *Mastigochirus quadrilobatus*, *Hippa adactyla*, *H. pacifica*, and *H. celaeno* are tropical species and widely distributed in the Indo-West Pacific; *Hippa australis* is a warm-temperate Australian endemic.

The Hippidae are a small family of anomuran crustaceans of worldwide distribution, adapted for burrowing in sand. Because of this habit they are known in some areas as mole crabs or sand crabs, but in Australia no common name has been applied to the family as a whole. Hale (1927, p. 97) used the name 'southern mole-crab' for *Hippa australis*, and McNeill (1958, p. 491) referred to the tropical species collectively, under the name *H. adactyla*, as 'turtle crab'.

Hippa, the largest of the three genera comprising the Hippidae, is represented in the tropical Indo-West Pacific by at least ten species, most of which were the subject of an excellent revision by De Man (1896). The literature on the genus is in considerable confusion, however, because many identifications were based on an earlier revision by Miers (1878). Miers considered most of the nominal species of *Hippa* to be synonyms of a single, variable species, *Remipes testudinarius* (*adactyla* of some authors). Another source of confusion is the fact that the species-complex to which Miers applied the name *testudinarius* does not include the species to which that name properly belongs. For a discussion and partial solution of this problem, see Haig (1970).

Records in the literature give the impression that three species of Hippidae occur in Australia: *Mastigochirus quadrilobatus* Miers, from northern Queensland; *Hippa australis* Hale, confined to temperate waters; and *H. adactyla* Fabricius, widespread in the Australian tropics. Griffin and Yaldwyn (1968, p. 171) included *H. adactyla* among examples of decapod Crustacea that are widely distributed in Australia. This picture, however, proves to be somewhat inaccurate and misleading. The present study, in which I have used De Man's revision for the first time for the identification of Australian *Hippa*, has shown that there are at least three tropical species of that genus in Australia and that *H. pacifica* (Dana) is the common and widely distributed one, while *H. adactyla* appears to be relatively rare in the area.

Measurements mentioned in the text refer to carapace length (cl.), and were taken in the midline with a dial caliper.

In order to clarify the status of the Hippidae in Australia it was necessary to examine some material on which earlier records were based; I also examined unrecorded specimens from several sources. Museums in which material is deposited are abbreviated in the text as follows:

A.M.	Australian Museum, Sydney
B.M.N.H.	British Museum (Natural History), London
M.U.Q.	Museum of the Department of Zoology, University of Queensland, Brisbane
N.M.V.	National Museum of Victoria, Melbourne
Q.M.	Queensland Museum, Brisbane
S.A.M.	South Australian Museum, Adelaide
W.A.M.	Western Australian Museum, Perth
Z.M.H.	Zoologisches Museum, Hamburg

FAMILY HIPPIDAE

DIAGNOSIS: Carapace oval, strongly convex, with lateral extensions which cover all but the first pereopods. Telson of abdomen elongate, lanceolate. Mandibles reduced, non-functional as feeding organs. Third maxillipeds without an exopodite; merus broadened. First pereopods non-chelate. Dactyl of pereopods 2-4 curved and flattened.

KEY TO THE GENERA OF HIPPIDAE

1. Antennal flagella very long; dactyl of first pereopods oval and lamellate *Emerita*
(Nine species, including three from the Indo-West Pacific; not reported from Australia)
- Antennal flagella short; dactyl of first pereopods not oval and lamellate .. 2
- 2 (1). Dactyl of first pereopods greatly elongated and multiarticulate *Mastigochirus*
Dactyl of first pereopods styliform, not multiarticulate *Hippa*

Mastigochirus Miers, 1878

Mastigopus Stimpson, 1858, p. 230. Type-species: *Mastigopus gracilis* Stimpson, 1858, by original designation.
Mastigochirus Miers, 1878, p. 321. New name for *Mastigopus* Stimpson, 1858, preoccupied by *Mastigopus* Leuckart, 1853; *ipso facto* the same type-species: *Mastigopus gracilis* Stimpson, 1858.

Mastigochirus quadrilobatus Miers, 1878 (Figure 1)

Mastigochirus quadrilobatus Miers, 1878, p. 322, pl. 5 fig. 8 (type-locality: Guimaras, Philippine Is.); 1884, p. 280 (Prince of Wales Channel). Henderson, 1888, p. 39 (off Booby I., Flinders Passage).
Remipes adactylus: Grant and McCulloch, 1906, p. 33 (Port Curtis). Not *Hippa adactyla* Fabricius.
[?] *Emerita analoga*: Stephenson, Endean, and Bennett, 1958, p. 269 (Low Is.). Not *E. analoga* (Stimpson).
MATERIAL: Western Australia: Three specimens, Roebuck Bay, Mrs B. Grey, B.M.N.H. 1932.11.30.61 62.

Female, Broome, sand bar opposite jetty, R. W. George on 'Dorothea', 16.x.1962, W.A.M. 8-68.

Queensland: Male, two females, Albatross Bay near Weipa, Gulf of Carpentaria, H. Foley, vi.1962 to iii.1963, A.M. P14138. Three females, mouth of Embly R., Weipa, 200 yds offshore, 15 ft on sand, high tide, E. Gamberg, 29.i.1962, W.A.M. 311-62. Three females, Port Curtis, presented ii.1907 by Mrs F. E. Grant, A.M. G5759 (with label '*Remipes testudinaria*'). Female, 1 mile SE of Skirmish Pt, Moreton Bay, 2 fm on sand ripple, Dep. Zool. Univ. Qd, 14.viii.1967, Q.M. W2988.

DIAGNOSIS: Carapace covered with wavy, transverse lines. Frontal margin with four teeth; outer pair narrow, triangular, and projecting well beyond inner pair; latter close-set, rounded or triangular. No teeth on lateral margins. A row of about 20-24 shallow, setiferous pits near each lateral margin. First pair of legs longer than carapace plus dorsally visible portion of abdomen; dactyl heavily clothed with long hairs, and composed of about 20 articles.

MEASUREMENTS: Male 9.1 mm, non-ovigerous females 6.2 to 11.6 mm, ovigerous females 9.5 to 12.8 mm.

REVIEW OF AUSTRALIAN LITERATURE: *Mastigochirus quadrilobatus* was collected off Queensland by the 'Alert' (Miers, 1884) and the 'Challenger' (Henderson, 1888). Grant and McCulloch (1906) reported three specimens of *Remipes adactylus*, dredged at Port Curtis in 7 fm. The collections of the Australian Museum contain no *Hippa* that match these data; however, the three female *Mastigochirus* from Port Curtis, A.M. G5759, are almost certainly the basis of Grant and McCulloch's record.

The record by Stephenson *et al.* (1958) of *Emerita analoga* is undoubtedly erroneous; *E. analoga* (Stimpson) is a western American species, and none of three Indo-West Pacific members of the genus has been found in Australian waters. The collections from the 1954 Low Isles survey are housed in the Department of Zoology, University of Queensland, but the material on which this record was based cannot be located (Dr W. Stephenson, pers. comm.). It was probably *Mastigochirus quadrilobatus*, the only Australian hippid with a superficial resemblance to *Emerita*.

REMARKS: This species has one congener, which also inhabits the Indo-West Pacific. *Mastigochirus gracilis* (Stimpson) is distinguished from *M. quadrilobatus* by the presence of three teeth instead of four on the frontal margin of the carapace, and several teeth on the lateral margins.

DISTRIBUTION: Waltair coast, India; Guimaras, Philippine Is.; and Australia from Roebuck Bay, W.A., around the northern coast and southward to Moreton Bay, Qd. To depth of about 8 fm.

Hippa J. C. Fabricius, 1787

Hippa J. C. Fabricius, 1787, p. 329. Type-species: *Hippa adactyla* Fabricius, 1787, by subsequent designation of Rathbun, 1900, p. 301.

Remipes Latreille, 1804, p. 126. Type-species: *Remipes testudinarius* Latreille, 1806, by subsequent monotypy.

REMARKS: Most of the Indo-West Pacific members of this genus were treated by De Man (1896, 1898). Since it is highly probable that additional species of *Hippa* may yet be encountered in Australian waters, his revision should be consulted for the identification of any material that does not agree with the illustrations and diagnoses given in the present paper.

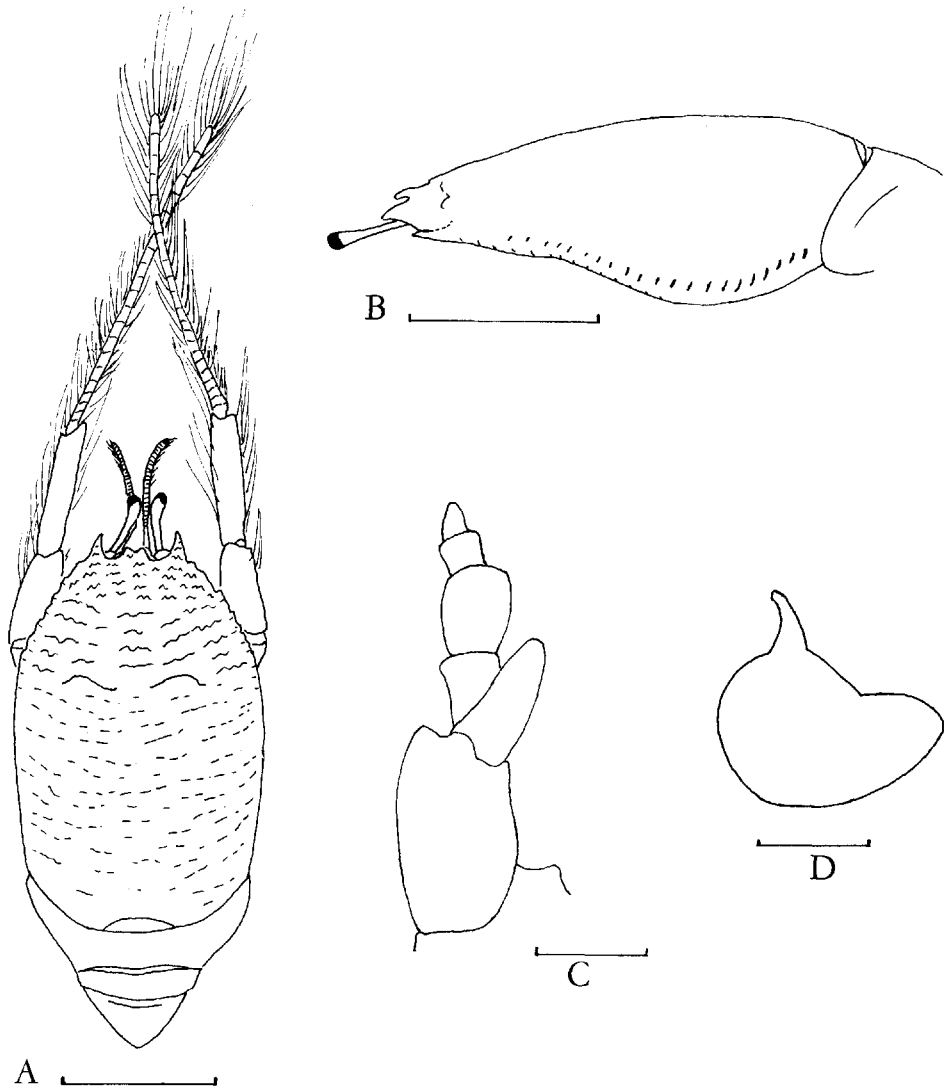


FIG. 1: *Mastigochirus quadrilobatus* (Stimpson). A, animal in dorsal view; B, carapace, lateral view; C, left antenna; D, dactyl of right second pereiopod. Scales A, B = 5 mm; C = 0.5 mm; D = 1 mm.

KEY TO HIPPA KNOWN FROM AUSTRALIA

1. Frontal margin of carapace with two (occasionally three) median and two lateral lobes or teeth; each lateral margin of carapace with a submarginal row of shallow, setiferous pits 2
 Frontal margin of carapace with a broad median lobe, lateral lobes scarcely developed; no row of setiferous pits paralleling lateral margins *H. australis*
- 2 (1). All frontal lobes about equally projecting; concave margin of dactyl of legs 2 and 3 cut into an obtuse angle 3
 Lateral lobes of frontal margin much more strongly projecting than median pair; concave margin of dactyl of legs 2 and 3 cut into a right angle *H. adactyla*
- 3 (2). Submarginal row with about 30–40 setiferous pits; antennal flagellum normally with two articles *H. pacifica*
 Submarginal row with about 23–28 setiferous pits; antennal flagellum normally with a single article *H. celaeno*

Hippa adactyla J. C. Fabricius, 1787
(Figure 2; Plate 6)

Hippa adactyla J. C. Fabricius, 1787, p. 329 (type-locality: 'in Oceano australi'). Haig, 1970, p. 293 (Coff's Harbour; neotype designated).

Remipes testudinarius Latreille, 1806, p. 45 (type-locality: 'in Oceano Australasiae.'). 1819, p. 141 ('Nouvelle-Hollande'). Desmarest, 1823, p. 285 ('Nouvelle-Hollande'); 1825, p. 175 ('Nouvelle-Hollande'). Guérin, 1825, p. 281 ('nouvelle Hollande'). H. Milne Edwards, 1837a, p. 114, footnote, pl. 42 figs. 1, 1a–j ('Nouvelle-Hollande'); 1837b, p. 206, pl. 21 figs. 14–20 ('Nouvelle-Hollande'). Haswell, 1882, p. 151 (no new records). De Man, 1896, pp. 461, 463; 1898, pl. 33 figs. 50, 50a–c.

Remipes [testudinarius]: Latreille, 1817, p. 28 (type-locality restricted to 'Nouvelle-Hollande').

Remipède tortue: Latreille, 1817, pl. 2 fig. 2.

Remipes denticulatifrons White, 1847, p. 57 (nomen nudum; type-locality: Phillipine Is.).

Remipes testudinarius var. *denticulatifrons* Miers, 1878, p. 318 (in part), pl. 5 fig. 2.

Hippa testudinarius var. *denticulifrons*: Thomassin, 1969, pp. 150, 161, 164, 172, figs. 6, 7a, 8a, pl. 5.

[non] *Remipes testudinarius*: White, 1847, p. 57. Miers, 1878, p. 316, pl. 5 fig. 1. Ortmann, 1892, p. 537.

[non] *Remipes adactylus*: Grant and McCulloch, 1906, p. 33.

[non] *Hippa adactyla*: Stephenson, Endean, and Bennett, 1958, pp. 269, 274. McNeill, 1968, p. 39.

MATERIAL: Large dry specimen lacking most of carapace, Dunk I., Qd, presented by E. J. Banfield and registered ii.1920, A.M. P4660. Female, neotype, 25.1 mm cl., McCauley's Beach, Coff's Harbour jetty, N.S.W., low tide, C. Bowden, A.M. P17384. Female, 26.5 mm cl., and soft-shelled juvenile, 7.5 mm cl., same data as neotype, A.M. P15825 and P15826. Male and female, Australia, Z.M.H. K5053. Soft-shelled specimen, Australia, Lidth de Jeude, 1866, N.M.V. Male, old collection, Q.M. W381.

DIAGNOSIS: Carapace densely covered with sharply serrate, transverse lines. Frontal margin five-toothed; outer pair narrow, triangular, and sharp-pointed, and in adults projecting well beyond inner ones; inner pair rounded; between them a small median denticle, broadly triangular and scarcely produced. A row of 50–55 shallow, setiferous, slightly elongate pits near each lateral margin, forming a narrow band. Antennal flagellum with 3–6 articles, the number increasing with age. Dactyl of second and third legs deeply falcate, distal and proximal portions of the concave margin meeting at a right angle.

REVIEW OF AUSTRALIAN LITERATURE: *Remipes testudinarius* was described by Latreille (1806) from material collected by Péron and Lesueur at an unspecified Australian locality. This record was subsequently repeated several times (Latreille, 1817, 1819; Desmarest, 1823, 1825; Guérin, 1825). H. Milne Edwards' diagnoses and illustrations (1837a, 1837b) may have been based on other than type-material. Haswell (1882) recorded *Remipes testudinarius* in his catalogue of Australian Crustacea, but had no material and merely translated H. Milne Edwards' (1937b) diagnosis.

Haig (1970) selected as the neotype of *Hippa adactyla* a specimen of *Remipes testudinarius* from New South Wales, thereby reducing the latter name to synonymy.

REMARKS: This species is easily distinguished from all other members of the genus by the shape of the dactyl of the second and third pairs of legs. In the form of the frontal margin of the carapace it resembles *Hippa admirabilis* (Thallwitz), which is recorded from southern New Guinea and should be looked for in suitable habitats along the northern Australian coast.

DISTRIBUTION: From the west coast of Madagascar eastward through the East Indian Archipelago, north to Japan and east to the Marquesas Is. (for confirmed records see Haig, 1970, p. 294). In Australia the only precise localities on record are Dunk I. and Coff's Harbour on the east coast.

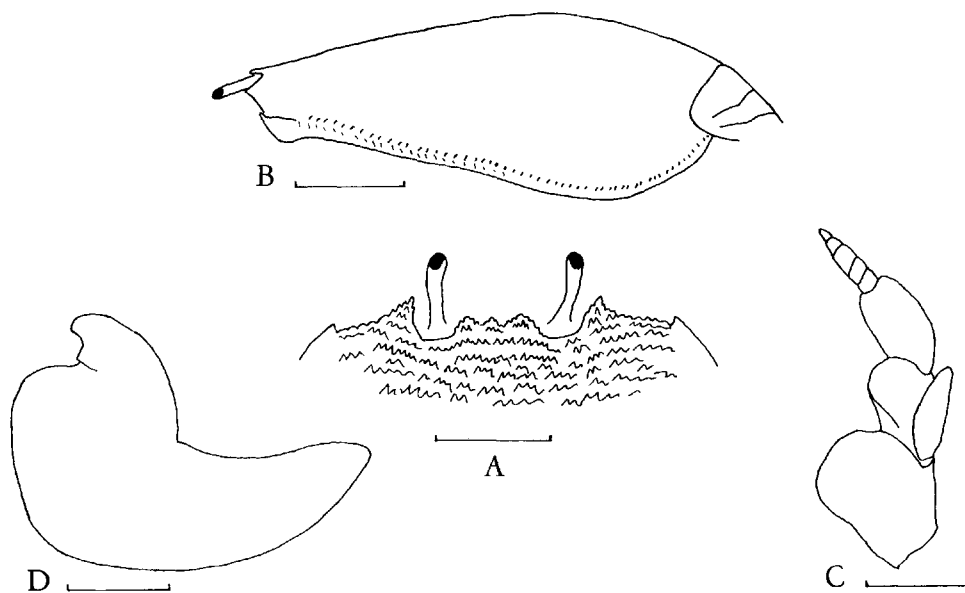


FIG. 2: *Hippa adactyla* Fabricius. A, frontal part of carapace; B, carapace, lateral view; C, left antenna; D, dactyl of right second pereiopod. Scale A = 4 mm; B = 6 mm; C, D = 2 mm.

***Hippa pacifica* (Dana, 1852)**
(Figure 3)

[?] *Remipes testudinarius*: White, 1847, p. 57 (Australia). Ortmann, 1892, p. 537 (E. Australia). Not *R. testudinarius* Latreille = *Hippa adactyla* Fabricius.

[?] *Remipes marmoratus* Jacquinot in Jacquinot and Lucas, 18[?], pl. 8 figs. 22-26; 1853, p. 97 (type-locality: Raffles Bay, Australia).

Remipes pacificus Dana, 1852, p. 407 (type-localities: Fiji and Sandwich = Hawaiian Is.); 1855, pl. 25 figs. 7a-g. Miers, 1877, p. 74 (Australia, at least in part). De Man, 1896, pp. 462, 476; 1898, pl. 33 figs. 53, 53a-c.

Remipes testudinarius: Miers, 1878, p. 316 (in part: Australia), [?] pl. 5 fig. 1. Not *R. testudinarius* Latreille = *Hippa adactyla* Fabricius.

Hippa adactyla: McNeill, 1968, p. 39 (Murray I., Torres Str., in part). Not *H. adactyla* Fabricius.

Hippa pacificus: Thomassin, 1969, pp. 157, 161, 164, 172, figs. 7c, 8c, 10, pl. 7.

MATERIAL: Western Australia: Ten males, seven females, Pt Vlamingh, Rottnest I., in coarse sand at water's edge, W.A.M. 24/9-36 and 30/44-36. Three specimens, Cape Vlamingh, Rottnest I., in coarse sand at edge of water, low tide, B.M.N.H. 1938.2.24.1-3. One specimen, Rottnest I., Hymnus, ii.1920, W.A.M. 9612. Female, Pt Quobba near Carnarvon, P. Barrett Lennard, x.1959, W.A.M. 117-68. Female, Pt Cloates, W.A.M. 282-52. Six males, four females, near Yardie Creek Homestead, North West Cape, on beach, Alf Sneed, v.1959, W.A.M. 67-62. Male and female, between Cape Dupuy and Cape Malouet, Barrow I., intertidal rock flat, W. A. Mus-U. S. Nat. Mus. Barrow I. Exped., 13.ix.1966, W.A.M. 96-68. Female, Yampi Sound, in beach sand, G. H. Robinson, x.1959, W.A.M. 60-62.

Queensland: Sixteen males, forty-seven females, Murray I., Torres Str., C. Hedley and A. R. McCulloch, viii-x.1907, A.M. P2937. Male and female, Hope I. near Cooktown, A. R. McCulloch, viii.1906, A.M. P17395.

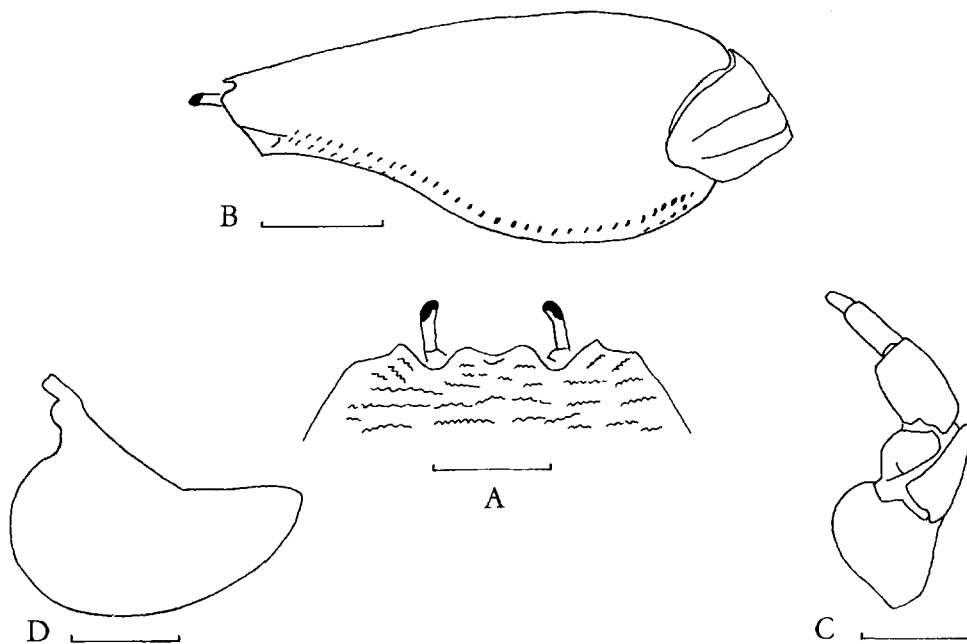


FIG. 3: *Hippa pacifica* (Dana). A, frontal part of carapace; B, carapace, lateral view; C, left antenna; D, dactyl of right second pereopod. Scale A = 4 mm; B = 6 mm; C, D = 2 mm.

Female, Michaelmas Cay off Cairns, presented xi.1926 by C. Hedley, A.M. P8743. Male, Orpheus I., A. A. Cameron, 3.vii.1940, Q.M. W1109. Female, Townsville, found in surf, A. Collins, 8.ix.1923, Q.M. W109. Female, Wistari Reef near Heron I., Capricorn Grp. under the sand, A. A. Cameron, x.1939, A.M. P11164. Female, Caloundra, C. Y. Ross, 29.iv.1946, Q.M. W1677. Female, Redcliffe, F. Stott, 16.vi.1949, Q.M. W1706.

New South Wales: Female, Corindi Beach, 30 miles S. of Grafton, intertidal sandy beach, J. Knight, 20.ii.1964, A.M. P15801. Female, McCauley's Beach, Coff's Harbour, low tide, presented by C. Bowden and registered 26.ix.1957, A.M. P12973.

Lord Howe I.: Female, old collection, no data, A.M. P15806. Female, W. S. Thomson, collected before 1902, A.M. G4072. Female, presented xi.1923 by R. Baxter, A.M. P6764.

DIAGNOSIS: Carapace covered with wavy, transverse lines. Frontal margin with four rounded lobes, outer pair slightly more projecting than inner; lobes of inner pair separated by a shallow concavity; rarely a small median denticle. A row of about 30–40 shallow, setiferous, slightly elongate pits near each lateral margin. Antennal flagellum normally with two articles. Dactyl of second and third legs with a concave margin, distal and proximal portions of this margin meeting at an obtuse angle.

MEASUREMENTS: Males 9.0 to 17.7 mm, non-ovigerous females 11.3 to 24.9 mm, ovigerous females 14.5 to 27.5 mm.

REVIEW OF AUSTRALIAN LITERATURE: White (1847) listed six Australian specimens of *Remipes testudinarius* in the collections of the British Museum, and Miers (1877) noted that there were specimens of *Remipes pacificus* in the collections of that institution. Miers' Australian material, which would have included that listed by White, was probably based at least in part on *Hippa pacifica*; but until these specimens can be re-examined their status must remain uncertain. Miers (1878) published a revision of the Hippidea in which he combined most of the nominal Indo-West Pacific species of *Hippa*, including *H. pacifica*, under the name *Remipes testudinarius*. The record from E. Australia by Ortmann (1892), who followed Miers's broad interpretation of *R. testudinarius*, may have been based on *Hippa pacifica*.

McNeill (1968) referred to notes made in 1907 by A. R. McCulloch on *Hippa adactyla* from Murray I., Torres Str. Eighty-one specimens collected by C. Hedley and A. R. McCulloch on that occasion are in the collections of the Australian Museum; 63 of them proved to belong to *H. pacifica* and the rest to *H. celaeno*.

Jacquinet (in Jacquinet and Lucas, 1853) described a new species, *Remipes marmoratus*, with Raffles Bay as the type-locality. Miers (1876, p. 59) included it in his catalogue of the Crustacea of New Zealand, citing the Raffles Bay locality; but Thomson (1899, p. 169) pointed out that Raffles Bay is on the northern coast of Australia, and deleted *R. marmoratus* from the New Zealand faunal list.

De Man (1896) did not include Jacquinet's species in his revision of Indo-West Pacific *Remipes*, and its status has remained unknown. During a visit several years ago to the Paris Museum I examined the type-material, consisting of four soft-shelled specimens; although I did not compare them critically with material of *Hippa pacifica*, I noted that they agree with that species in the number of setiferous pits near the lateral margin of the carapace and in having a two-segmented antennal flagellum. The illustration of *R. marmoratus* was published before the description and probably earlier than 1852, since Dana

(1852, p. 408) mentioned the species in connection with his original description of *R. pacificus*. Should careful comparison of the two species prove them to be synonymous, the unused name *marmoratus* might have to be suppressed to insure the stability of *pacificus*.

REMARKS: From the study of *Remipes testudinarius* (probably = *Hippa pacifica*, at least in part) from the Philippine Is., Estampador (1939, p. 355) concluded that these animals are either predators or scavengers. *H. pacifica* was later reported feeding on *Physalia* on Hawaiian beaches (Bonnet, 1946, as *Emerita pacifica*). Matthews (1955, p. 382) also observed *H. pacifica* preying on *Physalia* in the Hawaiian Is., and discussed the mechanics of selective feeding in this species. No observations have been published on feeding of *Hippa* in Australian waters; but the label with ten specimens of *H. pacifica* from North West Cape, W.A., listed above, indicates that the animals were "attracted by fish."

Hippa pacifica is most closely related to *H. ovalis* (A. Milne-Edwards), which differs chiefly in the form of the frontal lobes, and in having a three-segmented flagellum and about 45-55 setiferous pits near the lateral margins of the carapace (see De Man, 1896 and Thomassin, 1969).

DISTRIBUTION: *Hippa pacifica* is more widely distributed than are any of its congeners. It is apparently absent from the Red Sea, where all verified records refer to either *H. picta* (Heller) or *H. celsa* (De Man) (Lewinsohn, 1969, pp. 172, 173). Most records from the E. and S. coasts of Africa under the names of *testudinarius* and *adactyla* probably refer to *H. ovalis* (A. Milne-Edwards), but I have seen material of *H. pacifica* from Tanzania. There are confirmed records throughout the tropical Indo-West Pacific as far east as the Hawaiian and Gambier Is. The species has also reached the west coast of the Americas where it occurs in the tropics from Mexico to at least as far south as Panama, and on various outlying islands (Clipperton, Revillagigedo, Cocos, Galapagos); Efford (1972) showed that all W. American records under the names *adactyla*, *denticulatifrons*, and *testudinarius* are based on material of *H. pacifica*.

In Australian waters the species is now shown to range from Rottneest I., W.A., around the northern coast and southward to Coff's Harbour, N.S.W.

***Hippa celsa* (De Man, 1896)**

(Figure 4)

Remipes celsa De Man, 1896, pp. 462, 483 (type-localities: Makassar and Amboina); 1898, pl. 33 figs. 55, 55a-e.

Hippa adactyla: Stephenson, Endean, and Bennett, 1958, pp. 269, 274 (Low Is.). McNeill, 1968, p. 39 (off Low Is.). McNeill, 1968, p. 39 (off Low Is.; Murray I., Torres Str., in part). Not *H. adactyla* Fabricius.

MATERIAL: Queensland: Two males, sixteen females, Murray I., Torres Str., C. Hedley and A. R. McCulloch, viii-x.1907, A.M. P7552 and P14455. Male and female, Hope I. near Cooktown, A. R. McCulloch, viii.1906, A.M. P15863. Two females, off Low Is., Great Barrier Reef Exped. 1928-29, B.M.N.H. 1937.9.21.367-368. Dry specimen, Low Is., wet beach sand just above reef flat, 1954 Low Is. Survey, 14.viii.1954, M.U.Q. Male, three females, Horseshoe Bay near Bowen, Dep. Zool. Univ. Qd, 20.v.1966, W.A.M. 6-68. Female, Heron I., Capricorn Grp, Dep. Zool. Univ. Sydney, viii.1960, A.M. P15800.

DIAGNOSIS: Carapace covered with short, somewhat wavy, transverse lines. Frontal margin with four rounded or rounded-triangular lobes, all about equally projecting, outer

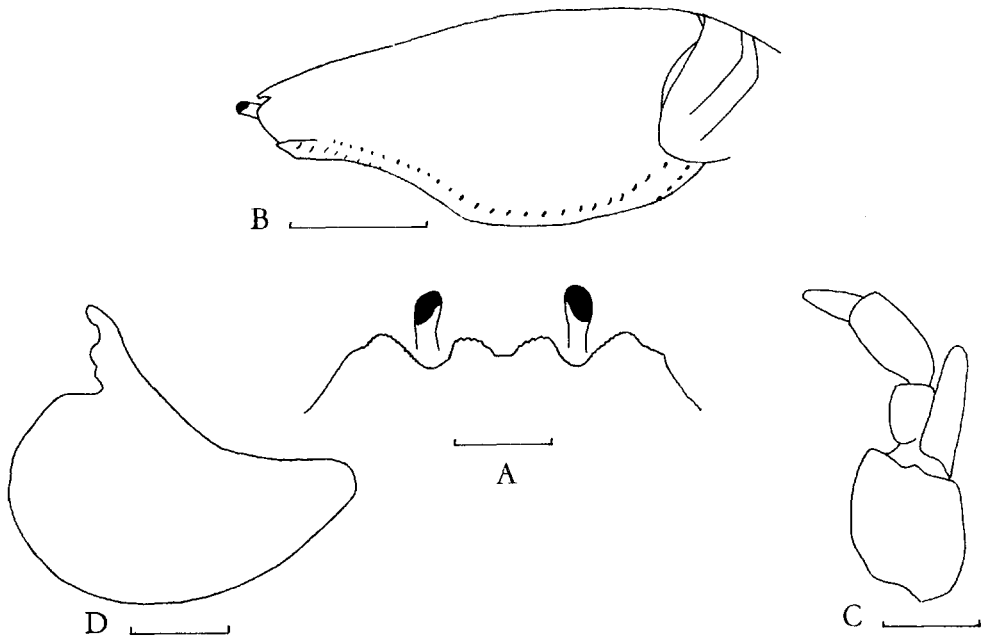


FIG. 4: *Hippa celaeno* (De Man). A, frontal part of carapace; B, carapace, lateral view; C, left antenna; D, dactyl of right second pereiopod. Scale A = 2 mm; B = 5 mm; C, D = 1 mm.

pair somewhat broader than inner ones. Anterior part of lateral margins rather markedly and evenly concave. A row of about 23–28 shallow, setiferous, slightly elongate pits near each lateral margin; this row sharply diverging from margin posteriorly. Antennal flagellum normally with a single article. Dactyl of second and third legs with a concave margin, distal and proximal portions of this margin meeting at an obtuse angle.

MEASUREMENTS: Males 6.0 to 9.1 mm, non-ovigerous females 7.8 to 16.0 mm, ovigerous females 11.0 to 16.9 mm.

REVIEW OF AUSTRALIAN LITERATURE: This species was not reported previously from Australian waters. The specimens collected at Low Is. during the Great Barrier Reef Expedition of 1928–29, and one from the 1954 Low Is. Survey, all of which had been reported as *Hippa adactyla*, were re-examined and found to be *H. celaeno*. As I have noted under the account of *H. pacifica*, McNeill's (1968) record of *H. adactyla* from Murray I. was based on both *H. pacifica* and *H. celaeno* which were collected together at that locality by C. Hedley and A. R. McCulloch.

REMARKS: *Hippa celaeno* may be easily recognized by the abrupt concavity of the anterior portion of the lateral carapace margin, and by the strong divergence from that margin of the last few setiferous pits. Only one other species, *H. picta* (Heller), has both a one-segmented antennal flagellum and fewer than 30 pits in the submarginal row.

DISTRIBUTION: Red Sea, East Indian Archipelago, Bismarck Archipelago, New Caledonia, and now reported from the east coast of Australia from Torres Str. to Capricorn Grp, Qd.

***Hippa australis* Hale, 1927**
(Figure 5 A-F)

Hippa australe Hale, 1927, p. 97, fig. 94 (type-locality: Corney Pt at mouth of Spencer Gulf, Australia); 1928, p. 97 (Cottesloe).

MATERIAL: South Australia: Cast exoskeleton, holotype, Corney Pt, Yorke Peninsula, mouth of Spencer Gulf, Mrs Isabella Klem, 1.x.1923, S.A.M. C994.

Western Australia: Female, beach near Forest Grove, close to Black Rock, W.A.M. 540-31. Female, Bob's Hollow, Calgardup, W.A.M. 151-40. Female, beach near Margaret R., 1954, W.A.M. 4-68. Female, Gnoocardup, W.A.M. 37-44. Female, Bunker Bay, in fine beach sand at tide level, R.W. George, 5.iii.1959, W.A.M. 68-62. Eleven males, four females, beach W. of Harvey, W.A.M. 4/18-36. Two females, beach near Harvey, W.A.M. 213/4-35. Three males, twenty-four females, Harvey, received from Snell, W.A.M. 3-68. Female, Cockburn Sd, D. McCorkill, iii.1958, W.A.M. 64-62. Female, Naval Base, Cockburn Sd, W.A.M. 326-33. Female, Port Beach, Fremantle, G. Riley, 24.xi.1963, W.A.M. 2-68. Male, Leighton Beach, W.A.M. 33-45. Twenty-one males, twenty females, Cottesloe, W.A.M. 10174/93. Female, City Beach, W.A.M. 288-45. Female, Scarborough Beach, presented 27.xi.1963 by R. G. Mason, W.A.M. 5-68. Female, Triggs I., C. Tillbrook, iii.1959, W.A.M. 65-62.

DIAGNOSIS: Carapace covered with shallow, setiferous pits, nearly absent anteriorly, elsewhere arranged in more or less even, transverse rows; anterolaterally these close-set, forming a series of oblique lines near lateral margins. Front with a low, broad, obtusely triangular rostrum; orbits shallowly concave, outer orbital lobes rounded, obscure. Longer flagellum of antennule with about 32-40 articles, shorter with 5-7 (usually 6) in males, 7-12 (usually 8) in females. Antennal flagellum with two articles, the proximal one elongate. Concave margin of dactyl of second and third legs curved, distal and proximal portions not meeting at a sharp angle.

MEASUREMENTS: Males 5.7 to 10.2 mm, non-ovigerous females 6.4 to 18.2 mm, ovigerous females 8.5 to 17.1 mm.

REMARKS: Hale (1928, p. 98) suggested that *Hippa australis* might be identical with *H. truncatifrons* (Miers), a species known from China and Japan. Several years ago, at my request, Dr Isabella Gordon compared specimens of the Australian species with the female holotype of *H. truncatifrons* (B.M.N.H. 1936.8.25.1) and pointed out several differences. Later I was able to verify these by examination of four Japanese specimens of *H. truncatifrons* sent by Dr Sadayoshi Miyake. Although closely related, the two species may be distinguished by the following characters:

1. In *Hippa australis* the low, triangular lobe is flanked on either side, to the inside of the eye, by a weakly developed, rounded lobe (Fig. 5A). There is no trace of such lobes on the rostral area in *H. truncatifrons* (Fig. 5G).

2. In *Hippa australis* the longer flagellum of the antennule is elongate and more or less gradually tapering toward the tip (Fig. 5C), while in *H. truncatifrons* it is much shorter and less tapering (Fig. 5H). The shorter antennular flagellum may be consistently longer in *H. australis* than in *H. truncatifrons*, but the articles have been

counted in a very small sample of the latter species. In females (figured) the usual number of articles in *H. australis* is 8, in *H. truncatifrons* 6. In male *H. australis* there are usually 6 articles in the shorter flagellum; there are only 4 in the single male *H. truncatifrons* that I have examined.

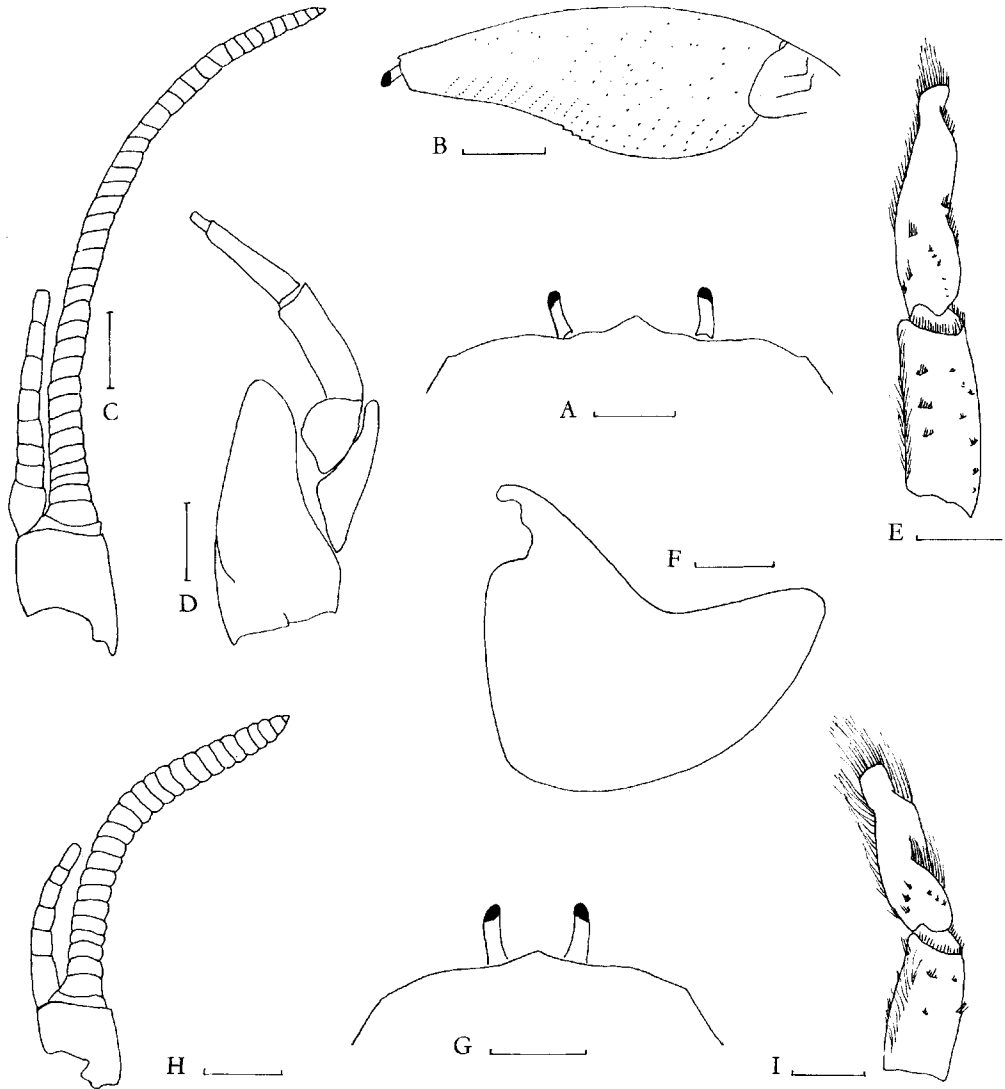


FIG. 5: A-F. *Hippa australis* Hale. A, frontal part of carapace; B, carapace, lateral view; C, left antennule; D, left antenna; E, F, dactyl of right first and second pereiopods, respectively.

G-I. *Hippa truncatifrons* (Miers) from Tosa Bay, Shikoku, Japan. G, frontal part of carapace; H, left antennule; I, dactyl of right first pereiopod.

Scales A, E, G, I = 2 mm; B = 4 mm; C, D, F, H = 1 mm.

3. The propodus and dactyl of the first pereopods are more slender in *Hippa australis* (Fig. 5E) than in *H. truncatifrons* (Fig. 5I).

Hippa was placed on the Official List of Generic Names in Zoology and designated as feminine (International Commission on Zoological Nomenclature, 1963, p. 18). Therefore, the original spelling *australe* is changed to *australis* in this paper to agree in gender with *Hippa*.

DISTRIBUTION: The holotype of *Hippa australis* is a cast exoskeleton, which was picked up on the beach in South Australian waters. All subsequent records for the species are from temperate Western Australia.

DISCUSSION

Mastigochirus quadrilobatus, *Hippa adactyla*, *H. pacifica*, and *H. celaeno* are members of the tropical Indo-West Pacific fauna, and are widely distributed in the Indian and western Pacific oceans. The ranges of *H. adactyla* and *H. pacifica* extend to eastern Polynesia, and the latter species has crossed the Pacific faunal barrier to become established on the west coast of the Americas. With the exception of *H. pacifica*, the group of about eight species of *Hippa* to which the tropical Australian forms belong—all having two or three median frontal lobes or teeth, and a row of setiferous pits paralleling each lateral margin—has no representatives outside the Indo-West Pacific region. *Mastigochirus*, with two species in the Indian and western Pacific oceans, is an endemic Indo-West Pacific genus.

The fifth species treated in this paper, *Hippa australis*, is an Australian endemic and is confined to warm-temperate waters in the south and southwest part of the continent. It belongs to a second group of *Hippa* species, characterized by the presence of a single median frontal lobe and the lack of a submarginal row of setiferous pits. Its closest relative is *H. truncatifrons*, a subtropical Indo-West Pacific species that is apparently restricted to southern Japan and adjacent parts of the Chinese mainland. The other three members of this group are tropical with one representative each in the eastern Pacific, central and western Atlantic, and eastern Atlantic.

The division of the Australian hippid fauna into a southern temperate and a northern tropical component is consistent with the distribution of Australian marine decapods in general (Griffin and Yaldwyn, 1968, p. 168). Of the tropical species, *Mastigochirus quadrilobatus* and *Hippa pacifica* occur in suitable sandy habitats on both west and east sides of the continent and to the north, while *H. adactyla* and *H. celaeno* appear to be restricted to the east side. However, the distribution of these latter species may prove to be much wider when more collecting has been done.

Thomassin (1969, p. 172), in a study made on the west coast of Madagascar, found that the distributions of Hippidae in that area are influenced by wave action, salinity, and texture of the substrate. *Hippa adactyla* tolerates water of reduced salinity and lives in coarse sediments in the infralittoral zone; *H. pacifica* tends to be distributed according to age, with young postlarval stages (to 5 mm cl.) usually found in fine sands on the outer slope of the reefs, while adults live in coarser sediments, always in the region of breaking waves. The ecological requirements of the other Australian species have not been investigated.

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PLATE 6

Hippa adactyla Fabricius, neotype. McCauley's Beach, Coff's Harbour, N.S.W. (AM P17384).

Scale in millimetres.

