Memoirs of the National Museum of Victoria 12 April 1971

Port Phillip Bay Survey 2

https://doi.org/10.24199/j.mmv.1971.32.05

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BRACHYURA (CRUSTACEA, DECAPODA)

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Abstract

The Survey collected 1023 specimens of Brachyura belonging to 29 species and 10 families. Seven species were taken by the Portland Pier Survey in 1963, five of which are also represented in the Port Phillip Survey collection. Only four of the 38 species known from Western Port are represented in the collection. The majid *Paratymolus latipes* and the xanthid *Pilumnus acer* are recorded from Victoria for the first time; previous records of the graspid *Cyclograpsus audouinii* from Victoria are doubtful. Seventeen species known from Port Phillip are not represented in the collection. All are typically cool temperate species well known from SE. Australia. Four species of *Pilumnus* were represented in the collections and these are compared in detail with other SE. Australian *Pilumnus* species. Most abundant in Port Phillip are *Halicarcinus ovatus* and *H. rostratus* (Hymenosomatidae), *Notomithrax minor* (Majidae), *Ebalia* (*Phylyxia*) *intermedia* (Leucosiidae), *Litocheira bispinosa* (Goneplacidae), *Pilumnus tomentosus* and *P. monilifer* (Xanthidae), *Nectocarcinus integrifrons* and *Carcinus maenas* (Portunidae) and *Pinnotheres pisum* (Pinnotheridae). The majority of the species are found on the sandy areas around the edge of the Bay, particularly in the W. areas; no species was taken in the central deeper parts of the Bay. Ovigerous females of most species were collected in late summer. Parasitism by sacculinas was small and confined to two species of *Pilumnus*.

Introduction

The Survey was carried out over a period of six years (1957-63) and 317 stations were worked during this period (Macpherson and Lynch 1966). More than 1000 specimens of crabs were collected during the Survey and these form the subject of this report. A superficial collection of the fauna of Portland Harbour, on the Victorian coast near the S. Australian border, was made at the Ocean Pier on 9-10 June 1963 (Jeanette E. Watson, pers. comm.). One pile below the pier was taken as an average and a swathe was cut from top to bottom (32 ft). The material was scaled immediately in plastic bags. Bryozoa colonies were broken up for enclosed fauna, ascidians were closely examined and crustaceans removed. The specimens from the Portland Survey and a small collection from Western Port are treated together with the specimens from the Port Phillip Survey.

In a checklist of the Brachyura of Victoria published near the beginning of this century, Fulton and Grant (1906b) listed 37 species from Port Phillip and 38 species from Western Port; 24 of these species were listed as occurring in both areas. The following species listed by them are at present known by specific names other than those used in their list (current name in brackets): *Gonatorhynchus tunidus (Paramithrax barbicornis), Halimus truncatipes (Naxia spinosa), Leptomithrax australiensis (L. gaimardii), Pilumnus lanatus (P. etheridgei), Pilumnus pilosa (Heteropilumnus fimbriatus), Lioxantho haswelli (Megametope rotundifrons), Ovalipes trimaculatus (O. australiensis), Cyclograpsus punctatus (C. granulosus).* A number of other species is now placed in genera other than those used by Fulton and Grant. Sayce (1902) earlier gave a list of dredged Brachyura from Port Phillip; the species were identified by F. E. Grant. Several are not included in the list given by Fulton and Grant (1906b) and therefore we consider that Grant thought those earlier identifications to be in error.

Ward (1929), in a popular article on the

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crabs of Port Phillip, dealt with 21 species. All but four were ones listed by Fulton and Grant: *Paramithrax minor* (currently placed in *Notomithrax*), *Nectocarcinus tuberculosus, Paragrapsus quadridentatus* (listed by Fulton and Grant as *Casmagnathus* (sic) *quadridentatus* from Bass Strait and Victorian coast) and *Petalomera lamellata* (*P. lateralis* in caption to figure) were the additional species. Several species were discussed under different names from those used by Fulton and Grant.

The present report deals with 31 species—29 from Port Phillip, eight species from the Portland area and four from Western Port. References are given for each species, one to the original description, one to the most recent treatment of the species and one or more to any other which discusses the species in detail or provides an adequate illustration. The total number of males and females (including ovigerous females), the size range (in mm) and the size of the smallest ovigerous female are given. The size given is the greatest width across the carapace (abbreviated as c.w.) or the greatest length of the carapace (c.l.) and is exclusive of spines except in the majids and hymenosomatids where the length of the rostrum is included and in the portunids where the lateral 'teeth' are included. Measurements were made to the nearest 0·1 mm with dial calipers. The localities from which specimens were taken by the Survey are listed by area number (with station number in brackets); each station number is followed by the number of specimens. Special attention is paid to those species which proved difficult to identify, where the Port Phillip collection permitted clarification of interspecific differences, especially *Nectocarcinus* and *Pilumnus* species. The months during which ovigerous females were taken are listed for each species. Data on infestation by sacculinas are also included.

Family DROMIIDAE

Petalomera lateralis (Gray)

Dromia lateralis Gray, 1831: 40.
Petalomera lateralis; Rathbun, 1923: 153. Hale, 1927: 111-112, Figs. 108-109. Griffin, in press.

MATERIAL: 1 ♂, 1 ♀, c.w. 6·5, 11·3 mm. Survey areas 26 (301) 1 (number of specimens), 58 (293) 1.

REMARKS: The ridges on the ambulatory legs in this species are low and rounded, the carapace bears a close pubescence and the anterolateral teeth of the carapace are low and broad. These feaures are among those distinguishing *P. lateralis* from *P. lamellata* (Ortmann). See Griffin in press.

DISTRIBUTION: E., S., W. Australia from Low Isles, off Port Douglas, Qld., through N.S.W., Vict., Tasm., S. Aust. to Nickol Bay, a little N. of N.W. Cape, W. Aust. Intertidal to a depth recorded as '80-120 fm'. Unconfirmed records from Japan and the Philippine Islands.

Petalomera wilsoni (Fulton and Grant)

Cryptodromia wilsoni Fulton and Grant, 1902b: 61, Pl. 9 (*Dromia wilsoni* in caption).
Petalomera wilsoni; Rathbun, 1923: 154-156, Pl. 42, fig. 1. Hale, 1927: 113-114, Fig. 111. Dell, 1968: 14-17, Figs. 5-7, Pl. 2 (pleopods 1-2).

MATERIAL: 1 ♂, 1 ♀, c.w. 34·6, 41·2 mm. Survey area 58 (150-154) 1. Portland Pier Survey: from several small bryozoans under fisherman's pier, 9 June 63, 1 specimen.

REMARKS: These two specimens agree well with the previous description of this species. The pits and ridges formed by the tomentum on the carapace are characteristic.

DISTRIBUTION: SE. Australia from Port Stephens, N.S.W., through Vict. and Tasm. to a little W. of Kingston, SE. South Australia. Intertidal to 470 fm. N. and central New Zealand; central and S. Japan; Natal to Algoa Bay, S. Africa.

Dromidiopsis excavata (Stimpson)

Dromidia excavata Stimpson, 1858: 239; 1901: 172.
Dromidiopsis excavata; Rathbun, 1923: 146-147, Pl. 38. Hale, 1927: 110, Fig. 106.

MATERIAL: 1 ♂, 4 ♀ ♀ (2 ovig.), c.w. 18·8-42·4 mm, smallest ovig. ♀ 41·8 mm. Survey areas 10 (13-15) 1, 31 (10) 1 in red sponge, 59 (23) 2, 68 (220) 1.

REMARKS: These specimens agree with the brief description given by Rathbun. The transverse fringe of long hairs just behind the front of the carapace is very distinctive.

The ovigerous females were taken in September.

DISTRIBUTION: SE. and S. Australia from Port Stephens, N.S.W., through Vict. and Tasm.

to Nuyts Archipelago, Great Australian Bight, S. Aust. Intertidal to a depth recorded as '70-100 fm'.

Family LEUCOSIIDAE

Ebalia (Phlyxia) intermedia Miers

Ebalia (Phlyxia) intermedia Miers, 1886: 308. Pl. 25, fig. 2-2c. Tyndale-Biscoe and George, 1962: 74, Fig. 4.4 (pleopod 1).
Phlyxia intermedia; Hale, 1927: 198-199, Fig. 199.

MATERIAL: 43 ♂ ♂, 48 ♀ ♀ (5 ovig.), c.l. 6·2-13·3 mm, smallest ovig ♀, 9·8 mm. Survey areas 3 (202) 25, 6 (66-67) 2, 7 (208) 10, 9 (178, 180) and 19 (179-181) 9, 11 (195) 11, 13 (92, 94) 4, 16 (283) 8, 18 (308) 3, 22 (119) 1, 27 (284) 1, 31 (10) 2, 42 (38) 1, (288) 3, (289) 1, 43 (303) 1, 55 (256) 3, 68 (155) 2, (157) 3. Additional Material: Area 42, Indented Head shore coll., J.H.M., 16 Jan. 64, 1 specimen.

REMARKS: The specimens vary in the shape of the intestinal lobe and length of the intestinal spine. The margin of the lobe is sometimes weakly convex with the lateral angles obtuse and sometimes the lateral angles are acute and the posterior margin straight or very weakly concave. The intestinal spine is usually rather short and blunt but is sometmies quite sharp.

The ovigerous females were taken during March.

DISTRIBUTION: S. and W. Australia from Western Port, Vict., through Tasm. and S. Australia to Cottesloe, just N. of Fremantle, W. Australia. Intertidal to 33 fm.

Philyra laevis Bell

Philyra laevis Bell, 1855: 300, Pl. 32, fig. 7. Hale, 1927: 194-195, Fig. 195. Tyndale-Biscoe and George, 1962: 75, Fig. 4.7 (pleopod 1).

MATERIAL: 10 ♂ ♂, 7 ♀ ♀, c.l. 6·5-22·0 mm. Survey areas 6 (118) 1, 27 (Point Wilson shore coll., 28 April 1962) 3, 42 (Indented Head shore coll., 1 Mar. 1959) 1, 49 (236) 1, 58 (89) 8, 59 (36) 1. Addition material: French Is., Western Port Bay, 20 Jan. 1963, 2 specimens.

REMARKS: The small specimens (up to about 10 mm c.l) have the carapace sparsely granular, the lateral margins possess a few small tubercules or granules between the anterior two of the three usual subacute lobes and the merus of the chelipeds is finely granular, particularly on the outer face where some granules are larger than others. In larger specimens (c.l. 15 mm) only the the anterior part of the carapace is obviously granular.

DISTRIBUTION: S. Australia from Western Port, Vict., through Tasm. and S. Aust. to Albany area, SW. Western Australia. Intertidal to 6 fm.

Philyra undecimspinosa (Kinahan)

Bellidilia undecimspinosa Kinahan, 1856: 128, Pl. 3, fig. 2.
Ebalia (Phlyxia) undecimspinosa; Whitelegge, 1900: 162.
Philyra murrayensis Rathbun, 1923: 136-137, Pl. 34. Hale, 1927: 195-196, Fig. 196.
Philyra undecimspinosa; Griffin, in press.

MATERIAL: 5 ♂ ♂, 10 ♀ ♀ (5 ovig.), c.l. 9.1-30.7 mm, smallest ovig. ♀ 14·2 mm. Survey areas 3 (202) 6, 6 (63-67) 1, 7 (205) 3, 13 (82-83) 1, (94) 2, 43 (251) 2.

REMARKS: These specimens agree well with Kinahan's original description and with Rathbun's description of *Philyra murrayensis*. See Griffin, in press.

The ovigerous females were taken during March.

DISTRIBUTION: SE. and S. Australia from off Newcastle, N.S.W., through Vict. to S. Aust. waters (no detailed localities). Intertidal to 40 fm.

Family HYMENOSOMATIDAE

Halicarcinus ovatus Stimpson

Halicarcinus ovatus Stimpson, 1858: 109; 1907: 146. Stebbing, 1900: 523, Pl. 36A. Hale, 1927: 117, Fig. 113.

MATERIAL: 152 ♂ ♂, 138 ♀ ♀ (46 ovig.), c.l. 2·1-9·2 mm, smallest ovig. ♀ 4·4 mm. Survey areas 3 (202) 13, 5 (51) 3, (165-169) 6, 6 (66) 2, (118) 9, (136) 28, 7 (206) 14, (208) 1, 9 (84) 4, 9 (178, 180) and 19 (179-181) 7, 10 (13) 5, (Point Cook shore coll. 12 July 1960 2 specimens. 11 (190) 7, 13 (83) 1, (92) 8, 14 (4) 2, (95) 2, 16 (142) 7, 17 (173) 1, 18 (61) 3, 22 (119) 1, 27 (41) 8, (138-139) 2, (284) 3, 28 (140) 2, 30 (278) 2, 31 (10) 7, (275) 1, 39 (43) 1, 40 (101) 1, 42 Indented Head shore coll. 1 Mar. 59) 1, (109) 14, (281) 3, 50 (228) 5, (233) 3, (238) 1, 51 (250) 1, (271) 8,

55 (35) 7, (39) 10, 58 (80-81) 2, (88) 12, (150-154) 2, 59 (25) 3, (36) 4 visits, 14 specimens, (224) 2, 60 (235) 1, 61 (239) 2, (242) 1, 62 (96) 1, 64 (163) 6, 67 (216-217) 2, 68 (155) 12, 69 (221) 1. Portland Pier Survey: From Bryoza 10-15 ft, J.E.W. 10 June 63, 2 specimens; in ascidian, just below low water mark 10 June 63, 1 specimen; in aseidian and sponge 30 ft, J.E.W. 10 June 63, 4 specimens; in fold in ascidian 20 ft, J.E.W. 9 June 63, 1 specimen; with encrusting aseidian (*Ascidia sydneiensis* Stimpson) 24 ft, J.E.W., 10 June 63, 1 specimen; in ascidian 9 ft, J.E.W., 9 June 63, 2 specimens; in aseidians, J.E.W., 9 June 63, 1 specimen; with ascidians (*Ascidia sydneiensis* Stimpson) 10 ft, J.E.W., 7 June 63, 1 specimen; with aseidians *Cystodites dellechiajei* (Della Valle) 10 ft, J.E.W., 9 June 63, 2 specimens; with aseidians *Herdmania momus* (Savigny) 15-30 ft, J.E.W., 9 June 63, 3 specimens; with aseidians *Sycozoa cerebritiformis* Quoy and Gaimard 24 ft, J.E.W., 9 June 63, 2 specimens; from Bryozoa under fisherman's pier, J.E.W., 7 June 63, 3 specimens.

Remarks: Of the wide variation shown by this species, that involving the rostrum, the pubescence of the carapace and legs, and the development of the proximal tooth on the dactyl of the cheliped in the male, is particularly obvious in the series examined here. The three rostral lobes are usually distinctly separated from each other throughout their length, subequal in length and more or less parallel. In most of the specimens from Portland Pier, however, the lateral rostral lobes are distinctly outwardly directed and are slightly more widely separated from the medial lobe than in most of the specimens from Port Phillip. In one specimen (ovig. ♀, c.l. 6·5 mm from Area 5) the medial lobe is a little longer than the laterals. In a large ♂ (c.l. 9·2 mm from Areas 9 and 19) the three lobes are adpressed throughout their length, the laterals curving inwards to meet the medial lobe from the base to the tip. The carapace is usually naked but several specimens have the dorsum of the carapace covered by hairs. The proximal, apically truncate, tooth on the inner edge of the dactyl in the male is present, although very small, in males from a carapace length of about 4 mm and is prominent in large males (about 6 mm and above). In a few cases there is no marked proximal gape between the dactyl and fixed finger. In two males (c.l. 5·2 from Area 16, and c.l. 6·2 mm from Area 18) there is no trace of a proximal tooth and the fingers are adjacent throughout their length. Males as small as 2·5 mm possess well-developed pleopods.

Ovigerous females were taken in all months except July, November and December when no samples of this species were collected.

Distribution: SE., S, and W. Australia from Sydney, N.S.W., through Viet., Tasm. and S. Aust. to Woodman's Point, just S. of Fremantle, W. Aust. Intertidal to 33 fm.

Halicarcinus rostratus (Haswell)

Hymenosoma rostratus Haswell, 1882: 550.
Halicarcinus rostratus; Kemp, 1917: 247. Hale, 1927: 117-118, Fig. 114.

Material: 17 ♂ ♂, 25 ♀ ♀ (17 ovig.), c.l. 2·1-9·2 mm, smallest ovig. ♀ 4.4 mm. Survey areas 11 (190) 5, 12 (196) 3, 14 (175) 1, 18 (308) 1, 19 (305) 1, 20 (124) 3, 36 (74, 76-77) 3, 39 (43) 1, 42 (109) 1, 43 (263) 1, 53 (253) 1, 55 (149) 4, 61 (241) 8, 62 (96) 2, (243-244) 2, 63 (21) 1, (162) 2, 68 (155) 2.

Remarks: In males of this species less than about 6 mm c.l. the fingers of the chelae are adjacent throughout their length and lack the distinctive tooth pattern found in larger specimens.

Ovigerous females are present in samples taken during December, February, March, April, June and July.

Distribution: S. Australia from Western Port, Viet., to Kangaroo Island and S. Aust. waters (no detailed localities). Intertidal to 11 fm.

Family Majidae

Paratymolus latipes Haswell

Paratymolus latipes Haswell, 1880: 303, Pl. 16, figs. 3-5.
Paratymolus latipes var. *quadridentatus* Baker, 1906: 107, Pl. 1, fig. 2. Hale, 1927: 123, Fig. 119.

Material: 1 ♀, c.l. 6·4 mm. Portland Pier Survey: From small Bryozoa under fisherman's pier, 9 June 63, 1 specimen.

REMARKS: This specimen for the most part agrees with previous descriptions under the name *P. latipes* and *P. latipes* var. *quadridentatus*. The three anterolateral spines on each side have one tubercle midway between each at a slightly higher level. The merus of the cheliped bears one spine midway along the dorsal edge, and there are four similar spines along the ventrolateral edge. The palm of the chela is short and distally high and the dorsal edge bears two short, distally-directed spines.

DISTRIBUTION: E., S. and SW. Australia from Port Denison, Bowen, Qd., through N.S.W., Vict. and S. Aust. to Cockburn Sound, near Fremantle, W. Aust. Subtidal to 27 fm. Unconfirmed record from Ponape, Micronesia. This species has not been recorded previously from Victoria.

Naxia deflexifrons (Haswell)

Microhalimus deflexifrons Haswell; 1880: 435, Pl. 25, fig. 2.
Naxia (Microhalimus) deflexifrons; McCulloch, 1913: 330, Pl. 10, figs. 1-4.

MATERIAL: 4 ♂♂, 1 ♀, c.l. 6·3-15·0 mm. Survey areas 58 (88) 2, (150-154) 2, 59 (36) 1.

REMARKS: The five small specimens agree in all features with the descriptions and figures given by Haswell and McCulloch. The prominent lobe medial to the supraorbital eave is not obvious in small specimens, and the anterolateral spine of the basal antennal article is usually directed slightly laterally rather than forwards as shown by McCulloch.

DISTRIBUTION: SE. Australia from Port Jackson, N.S.W., through Bass Strait to Port Phillip, Vict. Intertidal to 37 fm.

Naxia aurita (Latreille)

Pisa aurita Latreille, 1825: 140.
Naxia aurita; Hale, 1927: 129, Fig. 127. Balss, 1935: 120 (synon.).

MATERIAL: 9 ♂♂, 9 ♀♀, c.l. 15·0-41·5 mm. Survey areas 26 (300) 2, 40 (Clifton Springs intertidal coll., 1 Mar. 59) 1, (101) 1; 42 (Indented Head intertidal coll. 1 Mar. 59) 3, (108) 1, 50 (233) 2, 59 (214) 1, (224) 2, 60 (235) 2, 67 (216) 1. Additional material: Area 42, Indented Head shore coll., 16 Jan. 64, 2 specimens.

REMARKS: This reasonably large series, comprising mostly small specimens, indicates that the best single features distinguishing small specimens of this species from small specimens of *N. aries* (Guérin) (see Hale 1927: 127, Fig. 128) is the straight, stout rostral spines. In small specimens of the present species the marginal spines of the carapace are relatively long as in *N. aries*.

DISTRIBUTION: S. and SW. Australia from D'Entrecasteaux Channel, Tasm., and Port Phillip, Vict., through S. Aust. to Abrolhos Islands, W. Aust. Intertidal to 8 fm.

Naxia tumida (Dana)

Halimus tumidus Dana, 1852: 115, Pl. 4, fig. 2a-g.
Naxia tumida; Hale, 1927: 128, Fig. 126. Balss, 1935: 121 (synon.).

MATERIAL: 2 ♂♂, 4 ♀♀ (1 ovig.), c.l. 9·1-15·8 mm, ovig. ♀, 15·8 mm. Survey areas 58 (150-154) 2, (290) 1, 59 (79) 1, (87) 2.

REMARKS: The anterior part of the lateral margin of the basal antennal article bears one or a few short spines in all specimens, a feature characteristic of this relatively small species of *Naxia*.

The ovigerous female was collected in May.

DISTRIBUTION: E. and S. Aust. from Moreton Bay, Qd., through N.S.W. and Vict. to Kangaroo Is. and St. Vincent's Gulf, S. Aust. Intertidal to 7 fm.

Notomithrax minor (Filhol)

Paramithrax minor Filhol, 1885: 3; 1886: 356, Pl. 40, figs. 4-5, 7.
Notomithrax minor; Griffin, 1966: 53-57, Figs. 10, 21-3, 4.

MATERIAL: 70 ♂♂, 85 ♀♀ (42 ovig.), c.l. 5·2-37·0 mm, smallest ovig. ♀ 11·3 mm. Survey areas 3 (202) 5, 5 (51) 2, (166, 168) 3, 6 (66) 8, (118) 1, (137) 9, 7 (123) 1, (204) 7, (207) 1, (208) 16, 9 (178, 180) and 19 (179, 181) 2, 10 (103) 10, 11 (125) 1, (190) 13, 12 (196) 1, 13 (82-83) 5, (92, 94) 14, (209) 2, 16 (143) 2, 17 (170) 1, 18 (308) 1, 19 (305) 1, 21 (115) 1, 23 (2) 4, (68, 70) 4, (71) 1, 26 (301) 1, 27 (41) 1, 28 (141) 1, 29 (107) 1, (287) 1, 30 (278) 1, 35 (121) 2, 36 (77) 1, 37 (40) 3, 42 (Indented Head intertidal coll., 31 Mar. 59) 1, (108-109) 1, 50 (233) 1, 55 (35) 3, (Half Moon Bay intertidal coll., 14 Jan. 58) 1, (39) 3, (149)

1, (256) 1, 61 (239) 2, (242) 1, 62 (243-244) 1, 63 (20) 4, (159) 2, (245) 4, 68 (158) 1, (220) 1.

REMARKS: The very large series agrees in all features with material from New Zealand previously reported on by Griffin (1966) and from Australia recorded by Rathbun (1918) and by Haswell, Whitelegge, Fulton and Grant and Grant and McCulloch as *Paramithrax peronii* (for synonymy see Griffin 1966). There are low spines in the midline of the carapace, the protogastric regions are smooth and the marginal spines are alternately large and small. Small specimens (less than about 15 mm c.l.) have the anterolateral lobe of the basal antennal article spinulate or crenulate laterally and in many cases very small specimens have secondary spinules on the marginal spines.

Ovigerous females were taken in January, March, April, May, July, October, November and December.

DISTRIBUTION: E. and SE. Australia from Port Curtis, Gladstone, Qd., through N.S.W. to Port Phillip, Vict., and Tasm. Subtidal to a depth recorded as '22-60 fm'. N. and S. New Zealand to 70 fm.

Leptomithrax gaimardii (H. Milne Edwards)

Paramithrax gaimardii H. Milne Edwards, 1834: 325.
Leptomithrax autraliensis; Hale, 1927: 135-136, Fig. 135.
Leptomithrax gaimardii; Griffin, 1963: 133-137, Figs. 1-6, Pls. 6-7.

MATERIAL: 9 ♂♂, 7 ♀♀, c.l. 7·0-147·0 mm. Survey areas 18 (307-308) 1, 20 (309) 1, 27 (49) 1, 42 (108-109) 1, 43 (303) 1, 50 (228) 1, 51 (271) 1, 58 (150-154) 1, 59 (227) 1, 68 (220) 1, 69 (100) 1, (221) 1. Portland Pier Survey: on bottom and lower piles 10 June 63, 2 specimens; from bottom below piles 10 June 63, 1 specimen; J.E.W. (no date), 1 specimen.

REMARKS: Almost all the specimens have the carapace and chelipeds spinous rather than tuberculate. In all important features they agree with specimens previously reported on by various authors (see references Griffin 1963). This species is easily recognized by the orange, transversely oval, naked area at the junction of the ischium and merus of the third maxilliped endopod.

The figures given by Griffin (1963), drawn from photographs of the holotype, do not accurately show the spinules around the orbit; the eave bears a number of spinules close to the margin, the intercalated spine bears several short, sharp spinules anteriorly and posteriorly near its base and the postorbital lobe bears a short stout spine on the anterior upper border about 0·3 of its length from the base.

DISTRIBUTION: SE. and S. Aust. from Shoalhaven Bight, off Nowra, N.S.W., through Vict., Tasm. and S. Aust. to Oyster Harbour, Albany, SW. Western Australia. Intertidal to a depth recorded as '250-450 fm'.

Family PORTUNIDAE

Carcinus maenas (Linnaeus)

Cancer maenas Linnaeus, 1758: 627.
Carcinus maenas; Stephenson and Campbell, 1960: 80-82, Figs. 1A, 2A; Pl. 1, fig. 1; Pl. 5A.

MATERIAL: 5 ♂♂, 16 ♀♀, c.w. 13·7-36'·9 mm. Survey areas 5 (Altona intertidal coll.) 1 specimen, 9 (84) 14, 42 (38) 2, 58 (89) 4.

REMARKS: The 21 specimens have a granular carapace and the dactyl of the fifth leg (swimming paddle) is extremely narrow as is typical of this species.

DISTRIBUTION: SE. Aust. from Mallacoota Inlet, Vict. (near N.S.W. border) to Port Phillip, Vict. Intertidal. N. Atlantic; unconfirmed records from Red Sea and Hawaii.

Nectocarcinus integrifrons (Latreille)

Portunus integrifrons Latreille, 1825: 192.
Nectocarcinus integrifrons; A. Milne Edwards, 1861: 406-407, Pl. 38. Hale, 1927: 152-153, Fig. 153. Stephenson and Campbell, 1960: 83-84, Fig. 2B; Pl. 1, fig. 2; Pls. 5B, 6A.

MATERIAL: 18 ♂♂, 19 ♀♀ (2 ovig.), c.w. 5·3-73·6 mm, smaller ovig. ♀ 28·4 mm. Survey areas 3 (203) 1, 5 (51) 1, (168) 2, 7 (123) 2, 9 (178, 180) and 19 (179-181) 4, 10 (14) 2, 11 (190-192) 2, 14 (95) 1, 17 (173) 2, 18 (60-61) 3, 27 (41) 1, 39 (45) 1, 40 (101-102) 2, 42 (108-109) 4, 50 (228) 1, 51 (250) 1, (271) 1, 55 (39) 3, 59 (224) 1, 63 (21) 1. Additional material: Area 42 (Indented Head intertidal coll., 16 Jan. 64) 3 specimens. Portland Pier Survey: from bottom under pier 32 ft, 9 June 63, 1 specimen.

REMARKS: The following features, typical of this species, are present in the material from

Port Phillip. The frontal margin is smoothly but weakly convex, sometimes with a minute medial notch in very small specimens (c.w. less than 20 mm), or a shallow medial emargination in larger specimens; in one specimen (52 mm ♂ from Portland Pier) the medial frontal notch is prominent and narrow. In moderately large specimens the front is bordered in dorsal view by a single row of numerous small rounded tubercles with similar tubercles, fewer in number, behind them; a second, ventral, row of tubercles separated from the first by a fringe of hairs, is visible only in frontal view. Above the antenna, the frontal margin is very shallowly concave and the junction with the orbital margin is usually smoothly rounded. The anterolateral teeth of the carapace are sharp spines; in medium sized specimens these bear tubercules around their bases and along the lateral surfaces. The protogastric regions each possess a low elevation bearing small tubercles, and in front of these are more tubercles on a weak elevation. Usually the larger, posterior pair of elevations are weakly convex posteriorly and declivous anteriorly. In two specimens (males, 28·0, 31·2 mm, Area 10) the posterior elevations are uniformly convex, the anterior ones weakly declivous. The inner margin of the carpus of the cheliped bears several small tubercles in a row from the tip of the main spine to the articulation with the chela; in very small specimens there is usually no trace of spines or tubercles. In a few specimens between 20 mm and 30 mm c.w. these tubercles are sharp and enlarged. The surface of the carapace is pubescent in most of the specimens and beneath this the carapace is weakly tuberculate.

The ovigerous females were collected in March and October.

DISTRIBUTION: SE., S. and SW. Aust. from Port Stephens, N.S.W., through Viet., Tasm., S. Aust. to Cockburn Sound, a little S. of Fremantle, W. Aust. Intertidal to 8 fm.

Ovalipes australiensis Stephenson and Rees

Ovalipes bipustulatus; Hale, 1927: 147-148, Fig. 148. (Not *Platyonichus bipustulatus* H. Milne Edwards, 1834.)

Ovalipes australiensis Stephenson and Rees, 1968: 227-232, Figs. 1-4; Pls. 35, 39, 41-42.

MATERIAL: 2 ♀ ♀, c.w. 24·3-57·1 mm. Survey areas 59 (36) 1, 63 (Safety Beach intertidal coll., 22 Sept 63) 1 specimen.

REMARKS: Both specimens have the carapace anteriorly granulate dorsally and a pair of orange (in alcohol) spots posteriorly; both features are characteristic of this species.

DISTRIBUTION: E., S. and SW. Aust. from Wide Bay, just S. of Fraser Is., Qd., through N.S.W., Vict., Tasm. and S. Aust. to Rottnest Is. and Cottesloe, just N. of Fremantle, W. Aust. (Presumably 'Shark Bay' in Stephenson and Rees 1968: 231 is a *lapsus* for Geographe Bay.) Subtidal to about 33 fm (60 m). Lord Howe Is., Tasman Sea.

Family XANTHIDAE

Actaea peronii (H. Milne Edwards)

Xantho peronii H. Milne Edawrds, 1834: 392.

Xantho spinosus Hess, 1865: 132, Pl. 6, fig. 3 (leg only).

Actaea peronii; Rathbun, 1923: 107, Pl. 21, figs. 4-5. Hale, 1927: 159, Fig. 159.

MATERIAL: 4 ♂ ♂, 6 ♀ ♀, c.w. 5·1-15·9 mm. Survey area 59 (Portsea Pier intertidal coll., 22 Mar. 1960) 1 specimen. Portland Pier Survey: from several small Bryozoa, 9 June 63, 7 specimens; in Bryozoa 15 ft, J.E.W., 9-10 June 63, 4 specimens.

REMARKS: All specimens possess the very long spines on the dorsal surface of the ambulatory carpi and propodi typical of this species. The tubercles on the lateral parts of the carapace are very large and rounded and the tubercles on the central areas are much lower and more discrete in small specimens with a tendency to become separated by transverse grooves anteriorly so that the carapace has the appearance of bearing numerous short transverse grooves centrally.

DISTRIBUTION: SE. and S. Aust. from Port Stephens, N.S.W., through Vict. and Tasm. to Spencer Gulf, S. Aust. Subtidal to a depth recorded as '70-80 fm'. Unconfirmed record from Samoa.

Two so-called subspecies of *A. peronii* have been recorded from Australia—*A. p. squamosa* Henderson from Torres Strait by Calman (1900) and *A. p. occidentalis* Odhner from SW. Australia (Odhner 1925: 58); the present

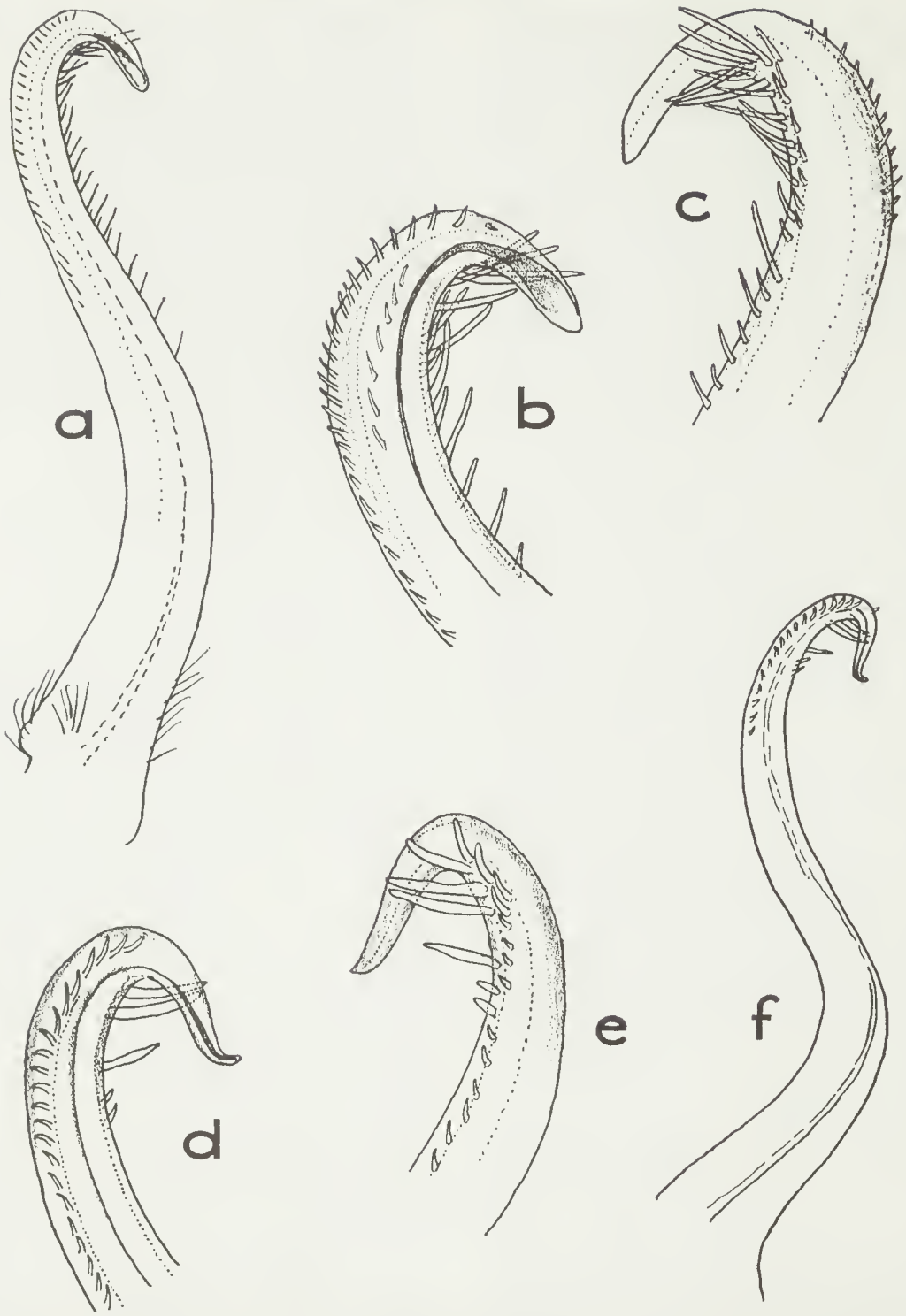

Fig. 1—Left first pleopods of males of *Pilumnus acer* (a-c), HOLOTYPE, c.w. 20·4 mm, 60-80 mi W. of Eucla, Great Australian Bight (AM E.3178) and *P. etheridgei* (d-f), HOLOTYPE, c.w. 15·6 mm, 10 mi N. of Circular Head, Tasm. (AM E.6490). a, f, whole pleopod, abdominal aspect; b, d, tip, abdominal aspect; c, e. tip, sternal aspect.

series from Victoria appears to belong to the typical form of *P. peronii*.

Pilumnus acer Rathbun (Fig. 1a-c)

Pilumnus acer Rathbun, 1923: 124-125, Pl. 29. Hale, 1927: 165-166, Fig. 166.

MATERIAL: 13 ♂ ♂, 4 ♀ ♀ (1 ovig.), c.w. 5·1-21·0 mm, ovig. ♀ 21·0 mm. Survey areas 5 (58) 1, 27 (41) 3, 58 (89) 1, 59 (intertidal coll., 20 Mar. 60) 4, (36) 3, 61 (37) 1, 66 (292) 1. Portland Pier Survey: from small Bryozoa under fisherman's pier, J.E.W., 9 June 63, 1 specimen; in Bryozoa 15 ft, J.E.W., 10 June 63, 1 specimen; from Bryozoa 15 ft, J.E.W., 9 June 63, 1 specimen.

REMARKS: The very long, simple hairs forming a sparse but obvious fringe just behind the front, together with the long, simple, curved anterolateral spines, smooth carapace and the presence of sharp spines on the ambulatory meri and carpi, but not propodi, distinguish this species from its southern temperate congeners (see Table 1). Very small specimens (up to about 8 mm c.w.) have tufts of long thick hairs on the dorsal surface of the carapace.

The ovigerous female was taken in December. The preserved eggs are large (1·3 to 1·5 mm in diameter) suggesting that abbreviated or direct development may take place in this species as has been recorded for the Australian *Pilumnus vestitus* and the two New Zealand species of *Pilumnus, P. novaezealandiae* and *P. lumpinus* (see Wear 1967).

DISTRIBUTION: S. Australia from Port Phillip, Vict., through S. Aust. to a little W. of Eucla, Greath Australian Bight, W. Aust. Subtidal to a depth recorded as '80-120 fm'. This species has not been previously recorded from Victoria.

Pilumnus etheridgei Rathbun (Fig 1d-f)

Pilumnus lanatus; Fulton and Grant, 1906b: 18. (Not *Pilumnus lanatus* Latreille, 1825.)
Pilumnus etheridgei Rathbun, 1923: 117-119, Pl. 26. Balss, 1933: 27.

MATERIAL: 3 ♂ ♂, 3 ♀ ♀, c.w. 5·6-13·3 mm. Survey areas 58 (88) 3, (154) 1, 59 (36) 1, 66 (292) 1.

REMARKS: The characteristic features of this species are the sparse, moderately long, simple hairs which generally occur on the anterior half to two-thirds of the carapace dorsally and on the chelipeds and ambulatories (the ventral half or slightly more of the outer surface of the palm of the major chela is naked or bears some very slender hairs), the presence of sharp spines on the ambulatory carpi and propodi dorsally and the apically very strongly recurved first pleopod in the male. Accessory spinules are seldom present on the anterolateral spines.

Even small male specimens (about 8 mm c.w.) can be distinguished from the similar *P. acer* by the shape of the first pleopod, which is apically rather weakly curved in the latter species, and by the absence of a fringe of long hairs close to the front of the carapace.

DISTRIBUTION: S. and SW. Aust. from Oyster Bay, E. Tasm., through Vict. and presumably S. Aust. (but no records available) to off Fremantle, W. Aust. Subtidal to 26 fm.

Pilumnus monilifer Haswell (Fig. 2d-f)

Pilumnus monilifera (sic) Haswell, 1881: 543-544; 1882: 65, Pl. 1, fig. 3.
Pilumnus monilifer; Hale, 1927: 163, Fig. 163.

MATERIAL: 37 ♂ ♂, 38 ♀ ♀ (3 ovig.), c.w. 4·1-21·7 mm, smallest ovigerous ♀ 9·1 mm. Survey areas 5 (51) 3, (Point Cook intertidal coll. 12 July 60) 6 specimens; 6 (137) 4, 10 (14) 1, 11 (190) 1, 14 (95) 1, 26 (301) 4, 27 (41) 10, (138) 1, 28 (141) 3, 30 (278) 1, (279) 2, 31 (131-134) 3, 37 (40) 1, 39 (43) 1, 42 (281) 1, 55 (149) 1, 58 (80) 3, 59 (36) 3, 61 (37) 1, (239) 2, 62 (96) 1, 68 (155) 1, 69 (221) 1, (222) 1. Portland Pier Survey: in sponges 10 ft, J.E.W., 10 June 63, 1 specimen; from Bryozoa 10-15 ft, J.E.W., 10 June 63, 2 specimens; from Bryozoa 15 ft, J.E.W., 9 June 63, 2 specimens; from small Bryozoa under fisherman's pier, J.E.W., 4 June 63, 13 specimens.

REMARKS: Large specimens (greater than about 12 mm c.w.) of the present series agree with the type material of Haswell's species (in Australian Museum—see Griffin, in press) particularly in the following features: there are tubercles on the anterolateral subspiniform lobes; an elevated group of about six tubercles is situated close to the anterolateral margin; the chelipeds and legs are mostly covered by a very dense mass of very short, 'clubbed' hairs

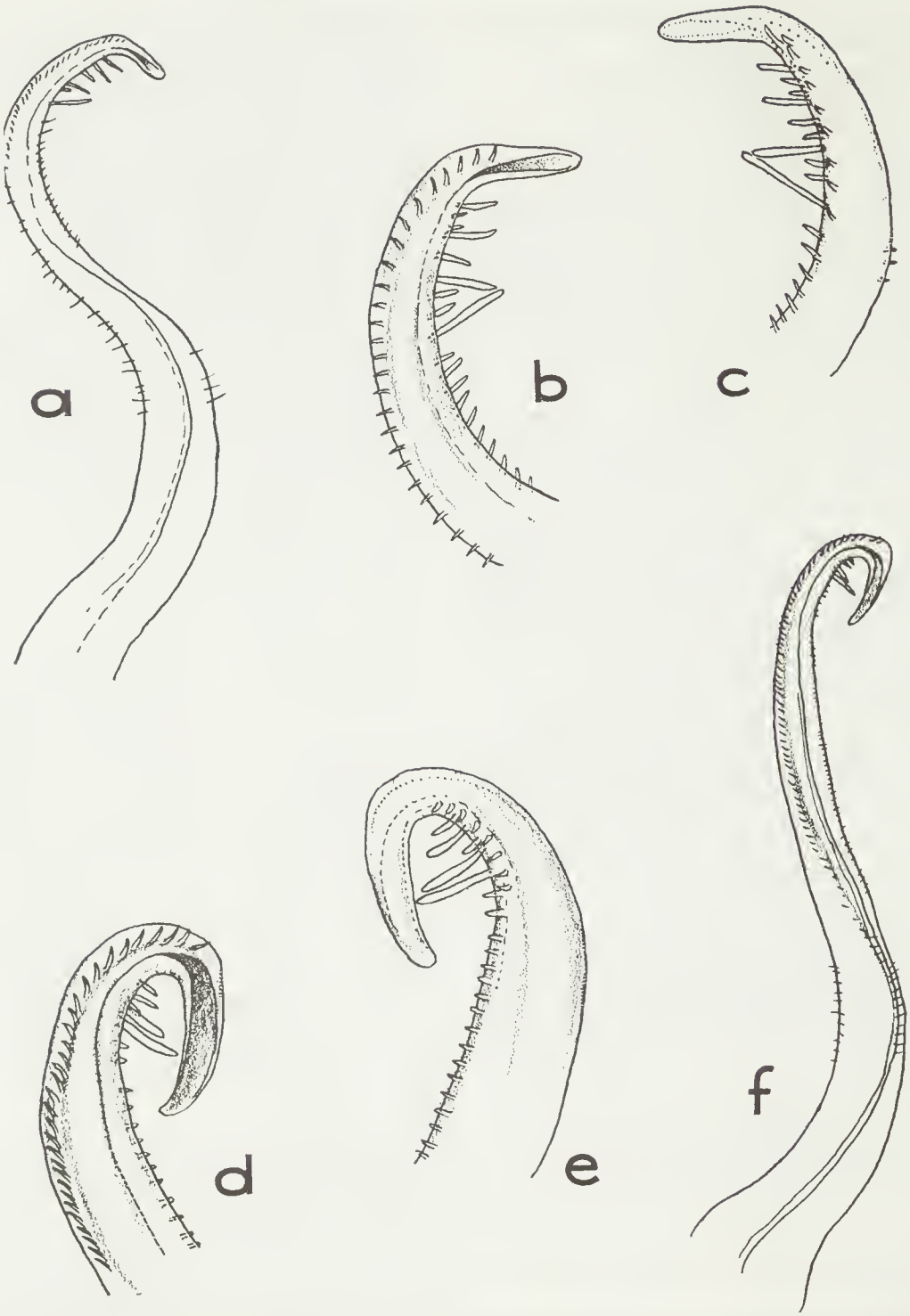

Fig. 2—Left first pleopods of males of *Pilumnus rufopunctatus* (a-c), c.w. 20·6 mm, Cabbage Tree Bay, N.S.W. (AM P.860) and *P. monilifer* (d-f), c.w. 21·0 mm, rocky shore below low tide mark, Beaumaris, Port Phillip, Vict. (AM P.9231). a, f, whole pleopod, abdominal aspect; b, d, tip, abdominal aspect; c, e, tip, sternal aspect.

with expanded setose tops; the outer surface of the palm of the major chela is covered by tubercles for slightly more than the dorsal half, and the ambulatory carpi and propodi possess several tubercles more or less in a double row dorsally. The tubercles on the carapace, chelipeds, and legs in most cases have retained a red colour and barely show through the mat of short hairs. The tubercles on the outer surface of the palm of the major chela tend to cover more of the surface in females than in males. In addition, the first pleopod of the male is apically strongly recurved with short hairs along the medial and lateral surfaces in the distal third to one half and a group of very long hairs on the lateral surface of the apical curve. In most specimens the carapace bears several tufts of very stout, long hairs.

In the key to Australian *Pilumnus* species given by Rathbun (1923: 108-110), *P. monilifer* is placed in that group of species having the carapace covered only by short hairs mixed with long hairs, and is distinguished from others in that group (particularly *P. rufopunctatus* Stimpson) in having the anterolateral lobes 'capped by a cluster of granules'. Hale (1927: 162-163), in a key to S. Australian species based on Rathbun's key, states that *P. monilifer* differs from *P. rufopunctatus* in lacking bead-like granules showing through the pubescence. Thus, in both Rathbun's and Hale's keys, large specimens from the present series come out only with difficulty.

Initially, many of the small specimens (less than about 12 mm c.w.) in the present series (now assigned to *P. monilifer*) were separated as a distinct species on the basis of the absence of obvious tubercles from the carapace and ambulatories, the simple spiniform nature of the anterolateral lobes and the less strongly apically curved first pleopod in the males. In those specimens from areas where silt and clay make up the dominant fraction of the substrate, the carapace, chelipeds and ambulatories possess many tufts of long thick hairs. However, these small specimens were identified as *P. monilifer* when it was found, from examination of large series of other species of *Pilumnus*, that in general smaller specimens in this genus tend to be less tuberculate and spinous than adults and that in small males the first pleopod is less strongly curved apically. It must be stressed that some specimens of *P. monilifer* as small as 9 mm c.w. have supplementary tubercles on the slopes of the anterolateral lobes and that most specimens above this size possess at least three tubercles in a group near the anterolateral border.

Two other species of south-eastern Australian *Pilumnus* possess the close pubescence of the 'clubbed' type found on *P. monilifer*—*P. rufopunctatus* and *P. fissifrons* Stimpson (see Table 1). These also agree in the general arrangement of hairs and tubercles on the outer surface of the palm of the major chela and the dorsal surfaces of the ambulatories, but differ in the tuberculation of the carapace in adults. However, *P. rufopunctatus* never possesses tufts of long thick hairs and in *P. fissifrons* the first pleopod in males lacks long hairs laterally near the apical curve. It is by these features that *P. monilifer* can be distinguished from its congeners, not really by the characters selected by Rathbun and incorrectly modified by Hale.

The ovigerous females were taken in June and September.

One specimen, a female, c.w. 8·8 mm, is infested with a *Sacculina*.

DISTRIBUTION: Southern Australia from Victorian, Tasmanian and S. Australian waters (no detailed range limits available). Intertidal to 10 fm.

Pilumnus tomentosus Latreille (Fig. 3a-c)

Pilumnus tomentosus Latreille, 1825: 125. Rathbun, 1923: 119-122, Pl. 27, figs. 1-2. Hale, 1927: 166. Fig. 167. Balss, 1933: 23 (part: not Pl. 3, figs. 14-15).

MATERIAL: 16 ♂ ♂, 34 ♀ ♀, c.w. 5·6-39·6 mm. Survey areas 5 (51) 1, (166) 1, 6 (66) 1, (137) 1, 7 (123) 2, 10 (13) 4, 11 (190) 3, 13 (94) 4, 14 (4) 2, 16 (142) 1, 17 (172) 1, 18 (308) 1, 26 (301) 3, 28 (286) 2, 35 (121) 3, 36 (77) 1, 39 (43) 1, 40 (101) 1, 47 (29) 1, 51 (250) 2, 62 (96) 3, 63 (20) 2, 64 (164) 3, 69 (100) 1, (222) 1. Additional Material: Areas 63 (1 mile 1·6 km, off Dromana on sandy bottom, dredged 3 fm 22 Sept. 62), 2 specimens; 68 (1·5 miles, 2·4 km, off Rye Pier 7 fm, T. Crawford 16 Mar. 63), 2 specimens.

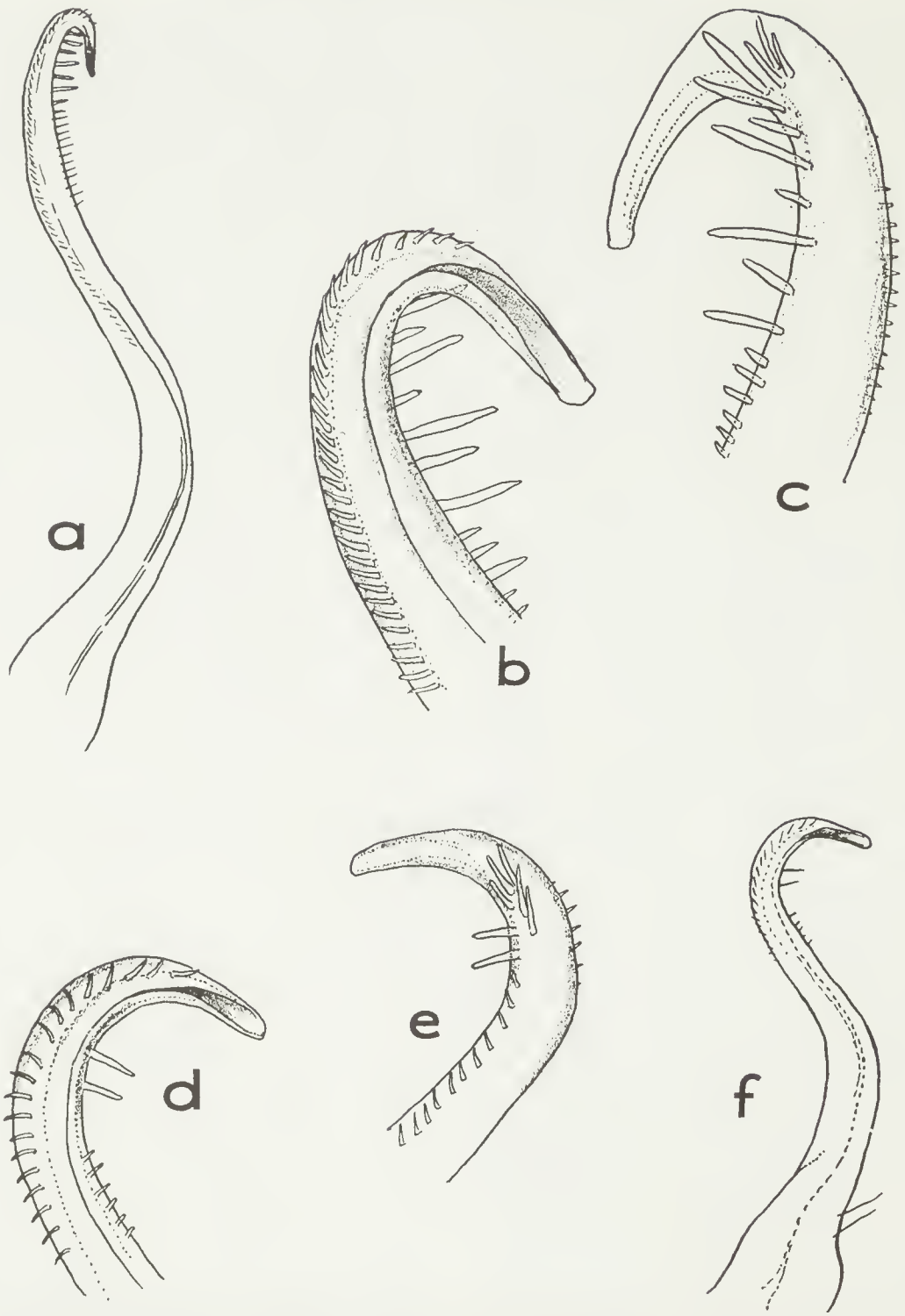

Fig. 3—Left first pleopods of males of *Pilumnus tomentosus* (a-c), c.w. 31·7 mm, 80-120 fm, 60-80 mi W. from Eucla, Great Australian Bight (AM P.3562) and *P. australis* (d-f), c.w. 10·6 mm, from intestine of Nannygai (fish) caught at Shellharbour, N.S.W. (AM P.8442). a, f, whole pleopod, abdominal aspect; b, d, tip, abdominal aspect; c, e, tip, sternal aspect.

REMARKS: This species is characterized mainly by the presence of long, simple hairs rather densely covering the carapace, chelipeds and legs, the presence of tubercles over all of the outer surface of the palm of the major chela—these tubercles tend to be pointed and longer, but sparser, dorsally—and by the lack of spines or tubercles on the carpi and propodi of the ambulatory legs. Larger specimens (above about 25 mm c.w.) usually have one to three spinules or tubercles on the posterior slopes of the anterolateral spines and about three spines on the dorsal surface of the carapace near the anterolateral border. Small specimens (less than 15 mm c.w.) often possess tufts or long thick hairs on the dorsal surface of the carapace and along the dorsal and ventral edges of the ambulatory legs and usually lack spines on the dorsal surface of the carapace and lack spinules on the anterolateral lobes.

Nine specimens ranging in size from 8·5-12·5 mm c.w., are infested with sacculinas.

DISTRIBUTION: SE. and S. Australia from off Newcastle, N.S.W., through Vict., Tasm. and S. Aust. to Albany in SW. Western Australia. From 3 fm to a depth recorded as '200-300 fm'. Extra-Australian records of *P. tomentosus* are now considered as referring to other species of this genus (see Griffin, 1970).

General remarks on SE. Australian *Pilumnus* species

Nine species of *Pilumnus* occur in SE. Australia. (Balss 1933: 11-13, has transferred the deep water *P. spongiosus* Nobili *to Planopilumnus*; *P. terraereginae* Haswell is described and figured elsewhere (Griffin, 1970)). Table 1 compares seven of these with respect to a number of characters. Four have been collected in the Port Phillip Survey and two others have

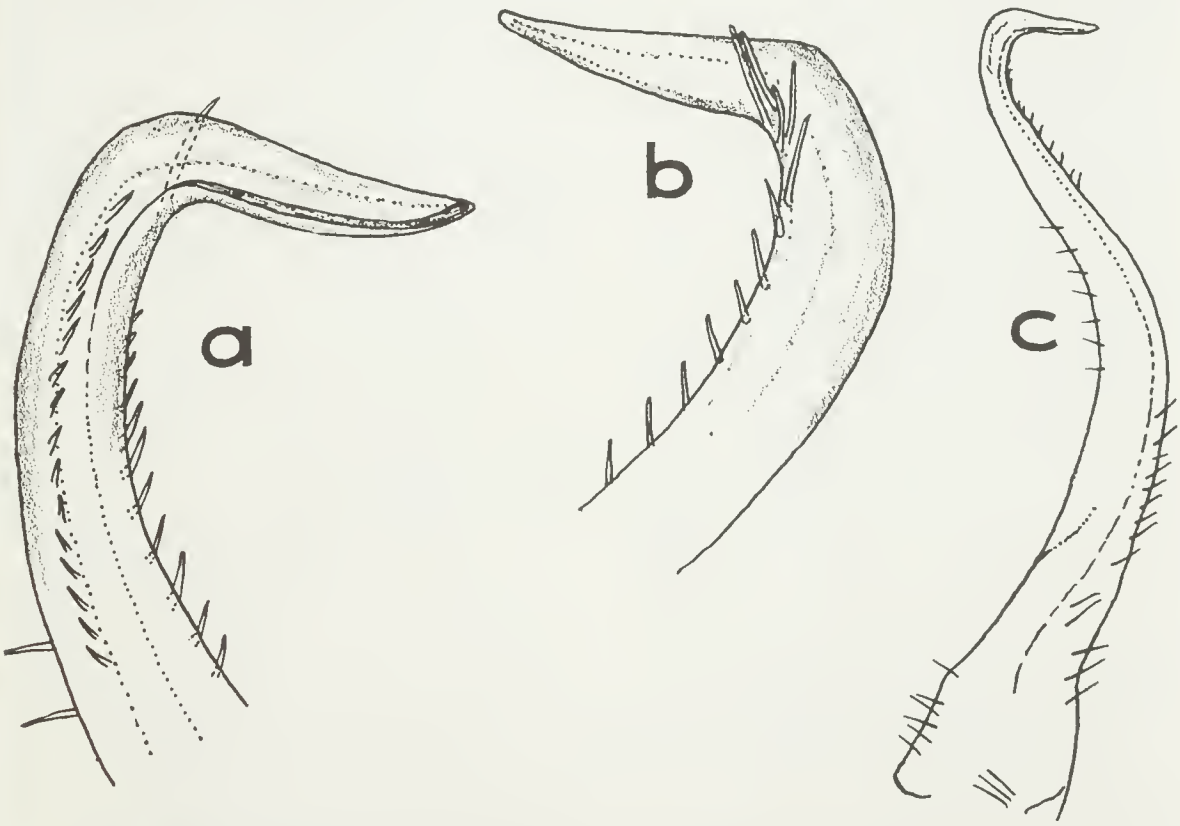

Fig. 4—Left first pleopod of male of *Pilumnus fissifrons*, c.w. 13·7 mm, among growth on hull of H.M.A.S. *Penguin* in dock, Cockatoo Island, Port Jackson, N.S.W. (AM P.8563). a, tip, abdominal aspect; b, tip, sternal aspect; c, whole pleopod, abdominal aspect.

been discussed in relation to *P. monilifer*. The seven species can be divided into two groups which are fairly easy to separate from each other: *P. monilifer, P. rufopunctatus* Stimpson (see Rathbun 1923: Pl. 24, figs. 3-4, and Takeda and Miyake 1968: 12-15, Fig. 3a-c, Pl. 1D) and *P. fissifrons* Stimpson (see Hale 1927: Fig. 164, Takeda and Miyake 1968: 15-17, Fig. 3d-f, Pl. 1A), share features of hairyness and ornamentation of the carapace, chelipeds and ambulatory legs and differ in these features from *P. tomentosus, P. acer, P. australis* Whitelegge (see Whitelegge 1900: Pl. 35, figs. 1-4) and *P. etheridgei*, which, however, differ from each other in ornamentation of the ambulatories. Within these groups separation can be difficult, especially with small specimens.

The only other south-eastern Australian *Pilumnus* is *P. semilanatus* Miers (see Rathbun 1923: Pl. 24, figs. 1-2, Takeda and Miyake 1968: 7-9, Fig. 1a-c, Pl. 1B) which occurs in S. Queensland and S. Australia. This differs from the other six in almost all of the features dealt with in the table: the first anterolateral lobe is rounded and the last two are blunt, all these lobes are covered by numerous small tubercles, the hairs on the carapace are in rows anteriorly, the tubercles on the carapace occur mainly near the front in the midline, where a prominent group covers a pair of postfrontal elevations, the subhepatic region is smooth, the hairs on the outer surface of the palm of the major chela are confined to a small proximal area and do not occur over the dorsal surface, on the minor chela the hairs form a dense mass on the outer surface but both the dorsal and ventral surfaces are smooth and the hairs on the ambulatories form a dense mass on the posterior surface of the propodi as well as along dorsal and ventral edges of all segments.

Heteropilumnus fimbriatus (H. Milne Edwards)

Pilumnus fimbriatus H. Milne Edwards, 1834: 416.
Heteropilumnus fimbriatus; De Man, 1895: 533, 536. Hale, 1927: 168, Fig. 170. (Not *Pilumnus fimbriatus* Haswell, 1882 (= *Cryptocoeloma haswelli* Rathbun, 1923; see Balss 1933: 43).)
Pilumnus pilosus Fulton and Grant, 1906a: 7, Pl. 4, figs. 1-4.

MATERIAL: 5 ♂ ♂, c.w. 5·5-14·6 mm. Survey areas 7 (123) 1, 14 (95) 1, 22 (119) 1, 25 (299) 1, 42 (281) 1.

REMARKS: All specimens possess the very dense fringe of long silky hairs around the front and anterolateral borders, the four low lobes on the anterolateral margin and the smooth carapace typical of this species. In all specimens the outer faces of both chelae are covered by close-set small tubercles. On the minor chela these tubercles usually cover almost the whole of the outer surface of the palm leaving bare only a small area near the articulation of the dactyl. The major chela in most specimens is also densely tuberculate, the tubercles covering at least the proximal half of the outer surface of the palm. In one specimen (♂, c.w. 12·1 mm from Area 42), however, the tubercles on the major chela are restricted to a small proximal area near the articulation with the carpus, the remainder of the outer surface being smooth and bare; the minor chela in this specimen possesses tubercles ventrally and dorsally and the proximal tubercles extend on to the outer face to leave a larger area smooth and naked than in other specimens. Fulton and Grant's type material of *Pilumnus pilosus* (one 'co-type' in Australian Museum, a dry ♂, c.w. 11·3 mm, mounted on glass with printed label 'Cryptocoeloma pilosus Fult. & Grant' and registered as G.5907) resembles the Port Phillip Survey material fairly closely in the granulation of the chelae although the original description does not make this clear.

DISTRIBUTION: S. Australia from Western Port, Vict., through Tasm. to St. Vincent Gulf, S. Aust. Intertidal to 11 fm. Records under this name from tropical Australia and other Indo-pacific localities presumably refer to *Cryptocoeloma haswelli* Rathbun.

Pilumnopeus serratifrons (Kinahan)

Ozius (?) *serratifrons* Kinahan, 1856: 118, Pl. 4, fig. 1.
Heteropanope australiensis Stimpson, 1858: 87; 1907: 64, Pl. 7, fig. 7.
Pilumnopeus crassimanus A. Milne Edwards, 1867: 228.
Pilumnopeus serratifrons; Haswell, 1882: 70, Pl. 2, figs. 1a-b. Balss, 1933: 34 (synon.). Dell, 1968: 19-20, Figs. 1-4 (pleopod 1), Pl. 3.
Heteropanope serratifrons; Hale, 1927: 161, Fig. 162.

MATERIAL: 5 ♂ ♂, 1 ♀ (ovig.), c.w. 16·9-26·9 mm, ovig. ♀ 16·9 mm. Survey areas 27 (Point Wilson intertidal coll. 28 Apr. 62) 1 specimen, 42 (38) 2. Additional material:

Table 1. Comparison of south-eastern Australian species of *Pilumnus*

Structure	Character	*P. monilifer*	*P. rufopunctatus*	*P. fissifrons*	*P. tomentosus*	*P. acer*	*P. etheridgei*	*P.* [illegible]
Antero-lateral lobes	form	short, subspiniform	short, stout, curved spines	short, stout, spiniform	moderately long, stout spines; external orbital angle short	long spines, external orbital angle short	moderately long, sharp spines	very long, sharp spines, no spine on external orbital angle
		external orbital angle blunt						
	ornamentation	1-3 tubercles on medial or posterior slopes	1 or 2 tubercles on posterior slopes	none	1-3 spinules on posterior slopes	none	1-3 spinules sometimes in front or behind first two	none
Carapace	hairs	dense mat of short 'clubbed' hairs, especially anteriorly, mixed with tufts of long, stout hairs	dense mat of short 'clubbed' hairs unmixed with long hairs	dense mat of 'clubbed' hairs and several tufts of long stout hairs.	moderately long, simple, stout, longer and more numerous anteriorly	very long, simple, covering whole of surface, forming a fringe just behind front	moderately long, simple, not especially dense, sparse posteriorly	simple hairs of various lengths, sparse posteriorly, longer and more dense anteriorly. Some short 'clubbed' hairs posteriorly
	ornamentation	one main group of 6-13 tubercles in curved row near antero-lateral border, other tubercles near last antero-lateral lobe and anteriorly submedially	several groups of a few tubercles near antero-lateral border, next to last antero-lateral lobe and on gastric regions medially	a few tubercles or spinules near antero-lateral border and submedially anteriorly	a group of 1-3 spines near antero-lateral border and sometimes one or more behind orbits submedially	none, carapace smooth	none, carapace smooth	none, carapace smooth
Front	ornamentation	closely-spaced, small tubercles		closely-spaced tubercles	small tubercles	sometimes with small tubercles	closely-spaced tubercles	about 4 slender spinules on each side, lateral one widely separated from others
Orbits	ornamentation	closely-spaced, blunt tubercles	closely-spaced, pointed tubercles	a few tubercles dorsally near external angle, closely-spaced tubercles ventrally	blunt to pointed tubercles dorsally and ventrally	smooth dorsally, spinules ventrally	stout spinules dorsally and ventrally	unarmed dorsally, ventrally with minute, widely spaced tubercles and one long spine medially
Subhepatic region	ornamentation	a few small tubercles, one or more enlarged		1 or 2 tubercles	a few small spinules	several tubercles and 1-4 spines	several tubercles and spinules	minute spinules and tubercles
Major chela palm - outer surface	hairs	dense mat of short 'clubbed' hairs, ventral ½ or more naked	dense mat of short 'clubbed' hairs mixed with some longer simple hairs dorsally, ventral ½ or more naked	scattered long, simple hairs and dense mat of short 'clubbed' hairs, ventral ½ or more naked	moderately long, simple, stout, more dense dorsally, ventral ½ or less naked	very long, simple, ventral ½ or more naked	moderately long, simple, not especially dense, leaving just more than ventral ½ naked	very long, simple hairs, ventral 2/3 or more naked
	ornamentation	closely-spaced, round, blunt tubercles, ventral ½ or more smooth	closely-spaced, round, blunt tubercles, pointed dorsally, ventral ½ or less smooth	closely-spaced round, blunt tubercles, ventral ½ or more smooth	stout tubercles covering whole surface, blunt ventrally, sharper, longer and less dense dorsally	large, pointed tubercles, dorsal ones sometimes longer and curved, ventral ½ or more smooth	small, closely spaced, stout spines covering almost all of surface, longer and sharper dorsally	closely spaced, stout spines on dorsal ½-2/3, small and blunt towards ventral edge, longer, sharper dorsally
Minor chela palm - outer surface	hairs	dense mat of short 'clubbed' hairs, ventral ½ or more naked	dense mat of short 'clubbed' hairs mixed with some short simple hairs, ventral 1/3 or less naked	scattered long, simple hairs and dense mat of short 'clubbed' hairs, ventral ½ or more naked	moderately long, simple, covering whole of surface, more dense dorsally	sparse, simple, very long dorsally, shorter ventrally, covering whole of surface	moderately long, simple, not especially dense, leaving ventral ½-2/3 naked	very long, simple hairs covering all of surface, generally sparse but more dense dorsally
	ornamentation	closely-spaced, round blunt tubercles, ventral ½ or more smooth	tubercles covering whole of outer surface, pointed dorsally	small blunt tubercles, ventral ½ or less smooth	stout, pointed tubercles more or less in rows, over whole surface, less dense dorsally	tubercles ventrally and spines dorsally more or less in rows, longer and curved dorsally	small, closely spaced, stout spines covering almost all of surface, longer and sharper dorsally	stout spines covering all of surface, longest dorsally
Ambulatory legs	hairs	dense mat of short 'clubbed' hairs dorsally, longer simple hairs dorsally and ventrally	dense mat of short 'clubbed' hairs dorsally, longer simple hairs dorsally and ventrally	dense mat of short 'clubbed' hairs on dorsal and posterior surfaces, long, stout and slender hairs dorsally and ventrally	simple, long, dense dorsally, shorter on posterior and anterior surfaces	very long, simple, straight, longer and more dense dorsally	long, simple, rather sparse	simple hairs on all surfaces of all segments, dorsally longer and more dense
Ambulatory merus	ornamentation	dorsal edge smooth or with a few very low tubercles	dorsal edge with a few curved spinules	smooth or with a few tubercles	sometimes a few spinules dorsally	up to 5 short, curved spines on dorsal edge	a few tubercles dorsally	4 or more spines dorsally, longer distally, some short spinules ventrally
Ambulatory carpus	ornamentation	several blunt tubercles more or less in a double row	several blunt to spiniform tubercles dorsally more or less in double row	small, blunt tubercles dorsally more or less in double row	lacking spines or tubercles	about 3 long, straight or weakly curved spines dorsally	up to 8 long spines dorsally	3 long spines dorsally
Ambulatory propodus	ornamentation					lacking spines or tubercles	about 6 long spines more or less in double row	none

French Is., Western Port, 20 Jan. 63, 3 specimens.

Remarks: These specimens agree with previously described material in all important features. There are short hairs in clumps around the lateral borders and the sides of the carapace, and also in clumps along the epibranchial and hepatic elevations and in several transverse rows on the protogastric regions near the front. There are a few granules on the carapace in front of the epibranchial elevation and in a curved band parallel to the anterolateral borders and sometimes on the anterolateral lobes and on the posterolateral parts of the carapce. The chelae are minutely granulate dorsally with slightly larger tubercles mid-dorsally along the proximal three-quarters. There are dense fringes of stout hairs along the dorsal and ventral borders of the ambulatory legs.

Dell (1968: 18-19) has reviewed the status of the genus *Pilumnopeus*.

The ovigerous female was taken in January.

Distribution: E. and S. Australia from Brisbane River, Qd., through N.S.W. and Vict. to S. Aust. waters (no detailed localities). Intertidal and subtidal. N. New Zealand.

Family Goneplacidae

Litocheira bispinosa Kinahan

Litocheira bispinosa Kinahan, 1856: 121, Pl. 3, fig. 1. McCulloch, 1913: 323-325, Fig. 42. Hale, 1927: 170-171, Fig. 172.

Material: 88 ♂ ♂, 76 ♀ ♀ (9 ovig.), c.w. 2·9-15·9 mm, smallest ovig. ♀ 8·2 mm. Survey areas 5 (51) 2, 6 (67) 1, (137) 1, 7 (123) 1, 9 (178, 180) and 19 (179-180) 14 specimens, 10 (13-15) 6, 11 (190-192) 12, 13 (82-83) 1, (94) 8, 14 (4) 1, 16 (142) 1, (282-283) 6, 17 (170) 1, 18 (307-308) 6, 19 (304) 2, 22 (119) 2, 25 (129) 2, (299) 1, 26 (126) 14, (300-301) 8, (Limeburners Bay intertidal coll. 5 June 63) 1 specimen, 27 (41) 3, 28 (140) 1, (285) 3, (315) 1, 30 (278) 3, 35 (73) 1, 37 (40) 8, (296) 5, 39 (43, 45-46) 9, (314) 16, 40 (101) 6, 42 (108-109) 8, (288) 1, 49 (237) 1, 50 (228) 1, 55 (147) 1, 59 (214) 1, 63 (245) 1, 67 (216) 1, 68 (155) 3, 69 (221) 2. Additional material: Area 42 (Indented Head intertidal coll. 16 Jan. 64) 1 specimen.

Remarks: Specimens of carapace width about 12 mm or larger have a pair of distinct, transverse, rounded elevations on the anterior part of the branchial regions. There is considerable variation in the shape of the external orbital angle (though usually blunt it is sometimes spinous), the shape of the anterolateral spine (usually acute but sometimes rounded and blunt) and the size of the proximal tooth on the dactyl of the major chela. There is a reasonable amount of long scattered hair along the dorsolateral part of the carapace and on the chelipeds and ambulatories in all medium-sized (c. 9 mm c.w.) and larger specimens.

Hale (1927: 170-171) states, 'During life the carapace of this . . . species is mottled with purplish brown, and the walking legs are irregularly banded with the same colour'. The present series of specimens show this colour pattern very clearly.

This species is easily distinguished from *L. glabra* Baker, from S. Australia, apparently known only from the holotype, a female, by the double-ridged, or grooved, frontal margin, presence of an anterolateral spine on the carapace and differences in shape of the suborbital border, third maxillipeds and chela.

Ovigerous females were collected in March, June, August and November.

Distribution: S. Australia from Hobart, Tasm. and Western Port, Vict., through S. Aust. to Albany area, SW. Western Australia. Subtidal to 15 fm. Unconfirmed records from Port Curtis, Qd., Torres Strait and Fiji.

Family Pinnotheridae

Pinnotheres pisum (Pennant)

Cancer pisum Pennant, 1777: 1, Pl. 1, fig. 1.
Pinnotheres pisum; Bouvier, 1940: 301-302, Fig. 187. Scott, 1961: 303-309, Figs. 2-3, 5.

Material: 6 ♂ ♂, 25 ♀ ♀ (2 ovig.), c.w. 4·3-12·0 mm, smaller ovig. ♀ 8·8 mm. Survey areas 5 (58) 3, (165-166, 168-169) 2 specimens, 6 (64) 4, 7 (208) 1, 13 (82) 1, 14 (95) 11, 42 (108) 2, 63 (159-162) 1. All specimens were from *Mytilus planulatus*. Additional material: Areas 63-70, Dromana, in cast up *Eumarcia fumigata*, June 1962, 1 specimen; Port Phillip, from *Mytilus planulatus*, 7 fm,

I. D. Hiscock, 1967 (A.M. P.15608) 5 specimens.

Remarks: All the adult (soft shelled) females in this series possess a dactyl on the third maxilliped which arises from the proximal part of the propodus, the fused ischiomerus bears hairs along the distal part but sometimes along the whole of the lateral margin, the palm of the chela is longer than high, stoutest distally, the dactyl of the chela bears a strong proximal tooth on the inner margin and the fixed finger bears a low, broad, acute tooth about midway along the inner edge, the ambulatory legs are slender and the last bears a thick fringe of plumose hairs on the dorsal edge of the merus and scattered short hairs on the ventral edge of the merus and on both dorsal and ventral edges of the carpus and propodus. The mandible of one specimen was examined and this possesses an uneven medial edge with about three lobes or teeth close to the incisor process. This material is therefore clearly referable to *P. Pisum* and agrees well with the figures given by Bouvier 1940 and to a lesser extent with the figures and remarks provided by Scott 1961. Our material differs from that discussed by Scott in that the chela is slightly stouter, the lateral margin of the ischiomerus is often fringed with hairs along its entire length (these are not especially dense) and a thick fringe of plumose hairs occurs only on the dorsal edge of the merus of the last leg, not on both edges of merus, carpus and propodus as stated by Scott (1961: 305).

Our material also agrees in essential features with specimens studied by the late F. E. Grant (in ms notes) and compared with specimens of *P. pisum* in the British Museum (Nat. Hist.). According to the late A. R. McCulloch (in ms notes), however, Grant's material agreed with specimens from the type series of *Pinnotheres subglobosa* Baker. We have compared these two series (Grant's material and 'co-types' of *P. subglobosa*, both in Australian Museum) and find that Baker's specimens differ from *P. pisum* in lacking a dactyl on the third maxilliped and in the shape of the palm of the chela and in the ornamentation of the fingers—the palm is very much longer than high and of almost even height throughout, the tooth on the dactyl is slender and acute and the fixed finger bears two broad triangular teeth which closely flank the tooth on the dactyl when the fingers are closed.

Rathbun (1923: 98) identified one female specimen from Bass Strait as *Pinnotheres novaezelandiae*. Re-examination of this specimen enables us to confirm that the orbits do extend laterally beyond the eyes for a distance equal to the length of the eyestalks as a shallow groove whereas in our specimens of *P. pisum* the orbits extend only a very short distance beyond the eyestalks; in Rathbun's specimen the dactyls of the ambulatories are fringed with hairs. The specimen is not referable to *P. pisum* and Scott (1961: 308) considered that it was probably not *P. novaezelandiae*.

The ovigerous females were taken in March.

Distribution: SE. Australia, from Victorian waters, free-living or commensal in bivalve molluscs of the genera *Mytilus, Modiolus* and *Eumarcia*. Intertidal to 10 fm. NE. Atlantic and Mediterranean.

Family Grapsidae

Leptograpsus variegatus (Fabricius)

Cancer variegatus Fabricius, 1793: 450.
Leptograpsus variegatus; Rathbun, 1918: 234-235, Pl. 56. Hale, 1927: 180-181, Fig. 181. Bennett, 1964: 80.

Material: 1 ♂, c.w. 60·0 mm. Portland Pier Survey: Portland rock platform, J. E. Watson, 25 June 63, 1 specimen.

Remarks: This large male constitutes one of the few records of this species from the Victorian coast.

Distribution: E., S. and W. Australia from Rockhampton, Qd., through N.S.W., Viet., Tasm. and S. Aust. to Shark Bay, W. Aust. Intertidal to a depth recorded as '3-4 fm'. Middleton Reef, Norfolk and Lord Howe Islands, Tasman Sea; Kermadec Islands; N. and central New Zealand; Easter Is. and Juan Fernandez, SE. Pacific; Peru and Chile, W. South America.

Cyclograpsus audouinii H. Milne Edwards

Cyclograpsus Audouinii H. Milne Edwards, 1837: 78.
Cyclograpsus audouinii; Hale, 1927: 176-177, Fig. 176. Campbell and Griffin, 1966: 150-152, Figs. 3A, 6A; Pl. 21, figs. 1-2; Pl. 23, figs. 5-6.

MATERIAL: 1 ♀, c.w. 14·5 mm. Survey area 14 (Beaumaris shore coll. 3-6 ft, 11 Jan. 61) 1 specimen.

REMARKS: In the extensive felting of the ambulatories, particularly on the first and last legs, the uniformly convex lateral margins and bilobate front, this specimen clearly agrees with the large series of specimens of *C. audouinii* examined by Campbell and Griffin (1966). The related *C. granulosus* is the species usually found in Victoria.

DISTRIBUTION: E., S. and W. Aust. from Elliott River mouth, just S. of Bundaberg, Qd., through N.S.W., Vict. (this is the first definite record from Victoria) and S. Aust. to Shark Bay, W. Aust. Supralittoral and intertidal to a depth recorded as '3-4' fm'. Unconfirmed record from New Guinea.

Paragrapsus quadridentatus (H. Milne Edwards)

Cyclograpsus quadridentatus H. Milne Edwards, 1837: 79.
Paragrapsus quadridentatus; Campbell and Griffin, 1966: 160-161, Figs. 8A, 10A; Pl. 22, fig. 1; Pl. 23, fig. 9.

MATERIAL: 10 ♂♂, 7 ♀♀, c.w. 4·4-22·3 mm. Survey areas 6 (118) 1, 10 (103) 1, 17 (170) 5, 40 (101) 2, 55 (35) 1, (39) 1, (off Schnapper Point intertidal coll. under stones 12 Mar. 62) 6 specimens.

REMARKS: These specimens, mostly small, are clearly conspecific with those examined by Campbell and Griffin (1966). In all specimens the reddish spots on the carapace are distinct and more numerous anteriorly.

DISTRIBUTION: SE. Australia, from Wilsons Promontory to Lady Bay, Warrnambool (Vict.), and Tasm. Intertidal to 5 fm.

Paragrapsus gaimardii (H. Milne Edwards)

Cyclograpsus gaimardii H. Milne Edwards, 1837: 79.
Paragrapsus gaimardii; Hale, 1927: 179-180, Fig. 180. Campbell and Griffin, 1966: 164-165, Figs. 9A, 10B; Pl. 22, fig. 3; Pl. 23, fig. 11.

MATERIAL: 6♂♂, 4♀♀ (1 ovig.), c.w. 4·9-25·2 mm, ovig. ♀ 25·2 mm. Survey areas 9 (84) 1, 25 (129) 4, 37 (40) 2, 58 (89) 2. Additional material: French Is., Western Port, 20 Jan. 1963, 1 specimen.

REMARKS: All the specimens are pale in colour with the felting on the ambulatories agreeing with that typical for the species (see Campbell and Griffin 1966); further, in the males the penultimate segment of the abdomen is very broad and the first sternite is at a different level from the second.

The ovigerous female was collected in August.

DISTRIBUTION: SE. and S. Australia from Wilsons Promontory, Vict., through Tasm. to Kangaroo Is. and the Coorong Channel, Murray River mouth, S. Aust. Supralittoral and intertidal to 6 fm.

Family MICTYRIDAE

Mictyris platycheles H. Milne Edwards

Mictyris platycheles H. Milne Edwards, 1852: 154. McNeill, 1926: 123-128, Fig. 4; Pl. 10, figs. 3-4.

MATERIAL: 5 ♂♂, c.l. 14·7-16·7 mm. Survey area 5 (Altona on muddy sandbanks at low tide 19 June 62), 2 specimens. Additional material: French Is., Western Port, 20 Jan. 63, 3 specimens.

REMARKS: The five males are clearly referable to this species by their possession of large whitish tubercles on the central parts of the carapace, branchial regions and third maxillipeds and of a large tooth on the inner edge of the dactyl of the chela.

DISTRIBUTION: E. and SE. Australia from Moreton Bay, Qd., through N.S.W. to Port Phillip, Vict., and Tasm. Intertidal.

Discussion

Zoogeographic Relationships. All but two of the 31 species discussed in this report have been previously recorded from Victoria, although *Leptograpsus variegatus* was generally known from islands off the coast rather than from the mainland (see Bennett and Pope 1953) and previous records of *Cyclograpsus audouinii* from Victoria are doubtful (Campbell and Griffin 1966). The following two species have not previously been recorded from Victoria: *Pilumnus acer* (taken by the Port Phillip Survey) and *Paratymolus latipes* (from the Portland Pier Survey). The following three species, not listed by Fulton and Grant as occurring in Port Phillip, have been taken by the Survey: *Naxia aurita, Notomithrax minor* and *Paragrapsus quadridentatus. N. aurita* was recorded by

Kinahan (1856) from Port Phillip and this record was repeated by McCulloch (1913: 327) and by Balss (1935). *N. minor* was recorded (as *Paramithrax peronii*) by Fulton and Grant (1906) and by Kershaw (1906) from Wilsons Promontory and was stated by Ward (as *P. minor*) to occur in Port Phillip. *P. quadridentatus* was listed by Fulton and Grant as occurring on the Victorian coast and Bass Strait islands and by Ward as occurring in Port Phillip.

The following 14 species from Port Phillip recorded by Fulton and Gray were not represented in the collections available to us for the purpose of this report (current names given only): *Merocryptus lambriformis, Halicarcinus australis, Naxia spinosa, Paramithrax barbicornis, Huenia bifurcata, Leptomithrax sternocostulatus, Micippa tuberculosa, Tumulosternum longimanus, Pseudocarcinus gigas, Macropipus corrugatus, Helograpsus haswellianus, Paragrapsus laevis, Brachynotus spinosus, Cyclograpsus granulosus* and *Macrophthalmus latifrons*. The following three species, not listed by Fulton and Grant as occurring at Port Phillip, but discussed by Ward (1929), were not taken by the Port Phillip Survey: *Petalomera lamellata, Nectocarcinus tuberculosus* and *Heloecius cordiformis*.

All the species taken by the Survey are thus well known, cool temperate species recorded from other areas in SE. Australia and in a few cases from central E. or SW. Australia.

Ecological Distribution. Of the 1120 specimens which make up the collection 10 species account for 955 specimens. These are as follows (number of specimens in brackets): *Halicarcinus ovatus* (279), *Litocheira bispinosa* (90), *Pilumnus monilifer* (77), *Pilumnus tomentosus* (50), *Halicarcinus rostratus* (42), *Nectocarcinus integrifrons* (37), *Carcinus maenas* (31) and *Pinnotheres pisum* (31). No other species is represented by more than 20 specimens.

Almost all species occur in the shallower parts around the edge of the Bay, especially in the W. part, although not all extend into the Geelong Harbour-Corio Bay area. *Notomithrax minor, Halicarcinus ovatus, Pilumnus tomentosus* and *Litocheira bispinosa* are widespread species in the Bay, distributed around the shallower areas where sand makes up the dominant fraction of the bottom sediment (Beasley 1966). *N. minor, P. tomentosus* and *P. monilifer* were frequently taken in areas where silt is common and *Caulerpa* and *Zostera* occur (Willis 1966); *H. rostratus* occurs in deeper water than *H. ovatus* and where clay is sometimes mixed with the other fractions. *L. bispinosa* also occurs in areas where silt and clay from a significant proportion of the substrate. *Ebalia* (*Phlyxia*) *intermedia, Philyra laevis, Naxia aurita, Leptomithrax gaimardii, Nectocarcinus integrifrons* and *Carcinus maenas* appear to occur more frequently in areas where *Caulerpa* and *Zostera* cover the bottom. A small group of species, *Naxia deflexifrons, Naxia tumida, Pilumnus acer* and *P. etheridgei* occur mainly near the Port Phillip Heads region where the majority of algal species occur (Womersley 1966). No species is found in the centre of the Bay where clay and silty clay occur at depths exceeding 10 fm. The reason does not lie solely with the type of substrate since several species are found in the Geelong Harbour area where silty clay forms the dominant fraction.

The Portland Pier Survey took seven species of crabs: *Petalomera wilsoni, Halicarcinus ovatus, Paratymolus latipes, Leptomithrax gaimardii, Nectocarcinus integrifrons, Pilumnus acer* and *Actaea peronii*. The larger specimens of *L. gaimardii* represent part of a very large swarm of this species, the formation of which is possibly related to breeding or moulting (see Lynch 1961). Of these seven, five species (*P. wilsoni, P. latipes, N. integrifrons, P. acer* and *A. peronii*) were associated only with Bryozoa; *H. ovatus* was associated with ascidians and in greater numbers (18 specimens) than with Bryozoa (3). One specimen of *Leptograpsus variegatus* was taken on a rock platform at Portland. Only four species (*Philyra laevis, Pilumnopeus serratifrons, Paragrapsus gaimardii* and *Mictyris platycheles* were collected at Western Port.

Breeding. The available information suggests that in *Halicarcinus ovatus* ovigerous females occur in greater numbers in summer, although breeding appears to take place throughout the year (see Table 2). A similar pattern appears

to exist in *Notomithrax minor*. Ovigerous females of *Dromidiopsis excavata* (Sept.), *Ebalia (Phlyxia) intermedia* (Mar.), *Philyra undecimspinosa* (Mar.), *Halicarcinus rostratus* (Dec., Feb. through Apr., June, July), *Naxia tumida* (May), *Pinnotheres pisum* (Mar.), *Nectocarcinus integrifrons* (Mar., Oct.), *Litocheira bispinosa* (Mar., June, Aug., Nov.), *Paragrapsus gaimardii* (Aug.), *P. monilifer* (June, Sept.), *P. acer* (Dec.), and *Pilumnopeus serratifrons* (Jan.) were also collected but the data are inadequate for the purpose of any useful generalization about temporal patterns in breeding.

TABLE 2

Frequency of occurrence (expressed as percentage of total number of females) of ovigerous females of two species of crabs taken by Port Phillip Survey 1959-63.

	Halicarcinus ovatus		*Notomithrax minor*	
Month	% ovig.	Total females	% ovig.	Total females
Jan.	47·8	23	33.3	6
Feb.	40·0	5	0	1
Mar.	41.6	24	65·3	26
Apr.	16·6	4	55·5	18
May	8·3	12	42·8	7
June	12·5	24	—	—
July	—	—	60.0	5
Aug.	63·6	11	0	1
Sept.	66·6	3	—	—
Oct.	100	6	62·5	8
Nov.	100	1	100	1
Dec.	—	—	50·0	2

Parasitism. In two species of *Pilumnus*—*P. tomentosus* and *P. monilifera*—a small number of specimens were infested with sacculinas.

Acknowledgements

We are grateful to the Director, National Musuem of Victoria, for making this collection available and to Mrs Hope Black for invaluable assistance with locality information. We thank the late Mr F. A. McNeill, formerly Curator of Crustacea at the Australian Museum and Professor W. Stephenson, University of Queensland for help with indentification of some of the material.

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