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Systematics and Distribution of *Callianassa* (Crustacea, Decapoda, Macrura) from Port Phillip Bay, Australia, with Descriptions of Two New Species[1]

GARY C. B. POORE[2]

ABSTRACT: Two new species of *Callianassa* are described from Port Phillip Bay subtidal sediments. Their systematic position and their status within the genus are briefly discussed. The distribution of the four species known from Port Phillip Bay correlates with that of sediment type and depth. *C. arenosa* n. sp. was distributed on silty sand sediments and was most dense between 13–19 m depth. *C. limosa* n. sp. was most dense (over 1,000 individuals per m²) on silty clay sediments below 15 m. *C. ceramica* Fulton & Grant occurred at low densities on sandy sediments less than 10 m depth and has previously been reported from intertidal muddy flats along with *C. australiensis* (Dana).

Two SPECIES of thalassinidean shrimp of the genus *Callianassa* Leach, *C. australiensis* (Dana), and *C. ceramica* Fulton & Grant, have previously been reported from intertidal muddy flats in Port Phillip Bay (Fulton and Grant 1906).

During the course of a large-scale survey of the soft-bottom benthic fauna of Port Phillip Bay, Victoria, *C. ceramica* and two new species were found to be common in deep water. The survey yielded distribution data derived from five 0.1-m² Smith-McIntyre grab samples taken from each of 86 stations on a triangular grid across the bay. The stations are numbered 901 to 986 from west to east in latitudinal rows from north to south and prefixed PPBES for the Port Phillip Bay Environmental Study. Poore and Rainer (1974) detailed the methods used in the benthic survey section of the study while discussing the distribution of the mollusks found. Material of the new species was also available from nearby Western Port.

All illustrations are of left limbs unless otherwise indicated and, except those of pleopods and pereiopod 3, omit setae. Terminology follows Biffar (1971*a*). Type material has been placed in the National Museum of Victoria, Melbourne, and paratype series in the Australian Museum, Sydney.

Many thanks are extended to Dr. D. J. G. Griffin, the Australian Museum, Sydney, for his comments on the manuscript, and to my laboratory assistants who helped sort the many thousands of specimens handled. This work was undertaken as part of the Port Phillip Bay Environmental Study, a joint Melbourne and Metropolitan Board of Works and Fisheries and Wildlife Division project.

SYSTEMATICS

FAMILY CALLIANASSIDAE

Genus *Callianassa* Leach, 1814

See Biffar (1971*a*) for recent diagnosis of the genus.

Callianassa arenosa, new species

Figures 1, 2

Description

Dorsal oval 0.8–0.85 length of dorsal carapace. Rostrum broad and short, sometimes pointed, about one-third length of eyestalks; lateral projections obsolete. Eyestalks extending almost to end of first antenna 1 article, with short mesiodistal lobe or papilla; pigmented area covered by a large, thinly pig-

[1] Manuscript received 30 May 1974.
[2] Fisheries and Wildlife Division, Marine Pollution Studies Group, Melbourne, Australia.

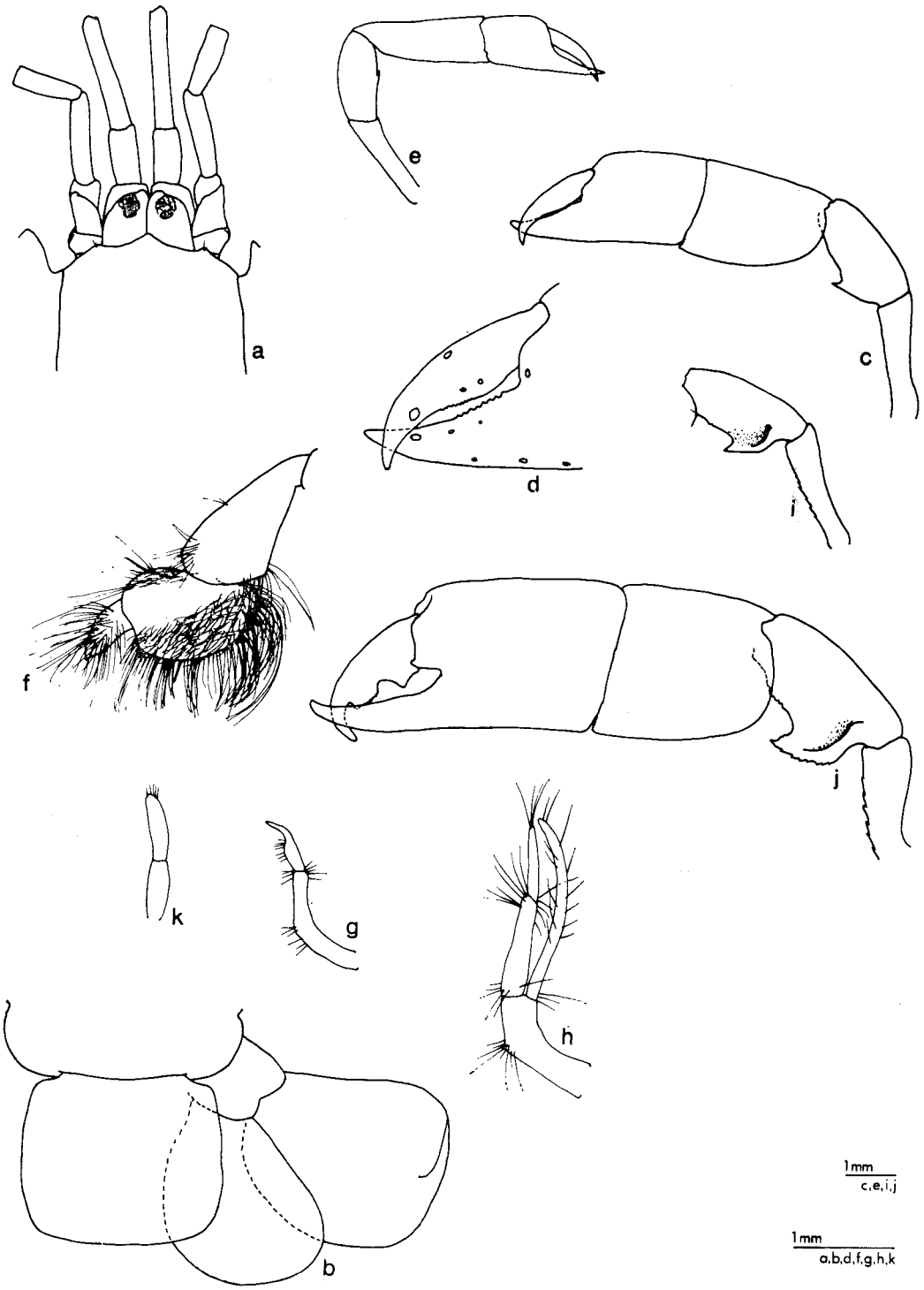

FIGURE 1. *Callianassa arenosa*, new species. Holotype (female): *a*, front; *b*, tail fan; *c*, *d*, large cheliped (left); *e*, small cheliped (right); *f*, pereiopod 3; *g*, *h*, pleopods 1, 2. Female, 20 mm, station 982: *i*, large cheliped ischium and merus. Allotype (male): *j*, large cheliped (left); *k*, pleopod 1.

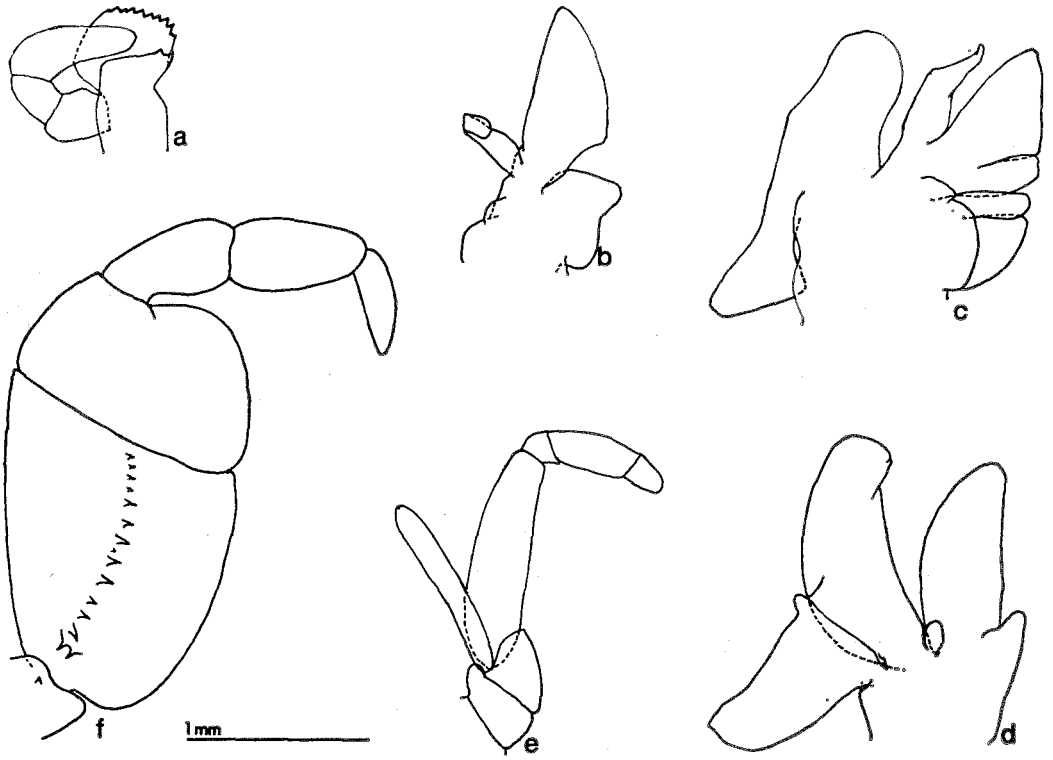

FIGURE 2. *Callianassa arenosa*, new species. Holotype: *a*, mandible; *b*, *c*, maxillae 1, 2; *d*, *e*, *f*, maxillipeds 1, 2, 3.

mented, circular dome. Maxilliped 3 merus width 0.6 length of ischium and merus together (broader in very large specimens), merus about 0.6 as long as ischium; ischium with curved mesial row of 17–20 fine teeth; carpus articulating on distolateral corner of merus, not medially lobed; propod widest proximally, half as wide as long; dactyl narrow, half as wide as propod. Large cheliped (female) ischium usually finely serrate ventrally; merus with a short broadly based acute hook on ventral margin and usually a few small denticles distal to this; carpus 0.7–0.8 as wide as long; propod fixed finger broad basally, tapering to slightly upcurved end; ratio of dorsal lengths—merus : carpus : propod—1 : 1.0–1.2 : 1; dactyl equal to fixed finger, curved, denticulate midventrally. Large cheliped (male) merus with strong ventral serrate hook and distal to this, a denticulate blade; carpus about as wide as long; propod fixed finger evenly curved, a deep notch at the base of the gape defined by a minute denticle laterally; ratio of dorsal lengths—merus : carpus : propod—1 : 1.0–1.1 : 1.0–1.3; dactyl stout, cutting edge with basal and medial truncate or denticulate teeth, strongly hooked tip. Small cheliped ischium smooth ventrally, merus with single fine spine, carpus and propod widest distally, dactyl curved. Pereiopod 3 propod with slight dorsal lobe and wide ventral lobe; ventral lobe with curved margin produced proximally. Pleopod 1 (female) uniramous, 2-articulate, second article lobed medially and curved distally. Pleopod 2 (female) biramous, exopod fine, curved, longer than 2-articulate endopod. Pleopod 1 (male) uniramous, 2-articulate, second article with rounded setose end. Pleopod 2 (male) absent. Telson subquadrate, as long as wide, posterior corners evenly rounded. Uropod endopod with straight anterior margin and evenly curved distoposterior margin, longer than telson; exopod length equal to greatest width, broadly truncate distally.

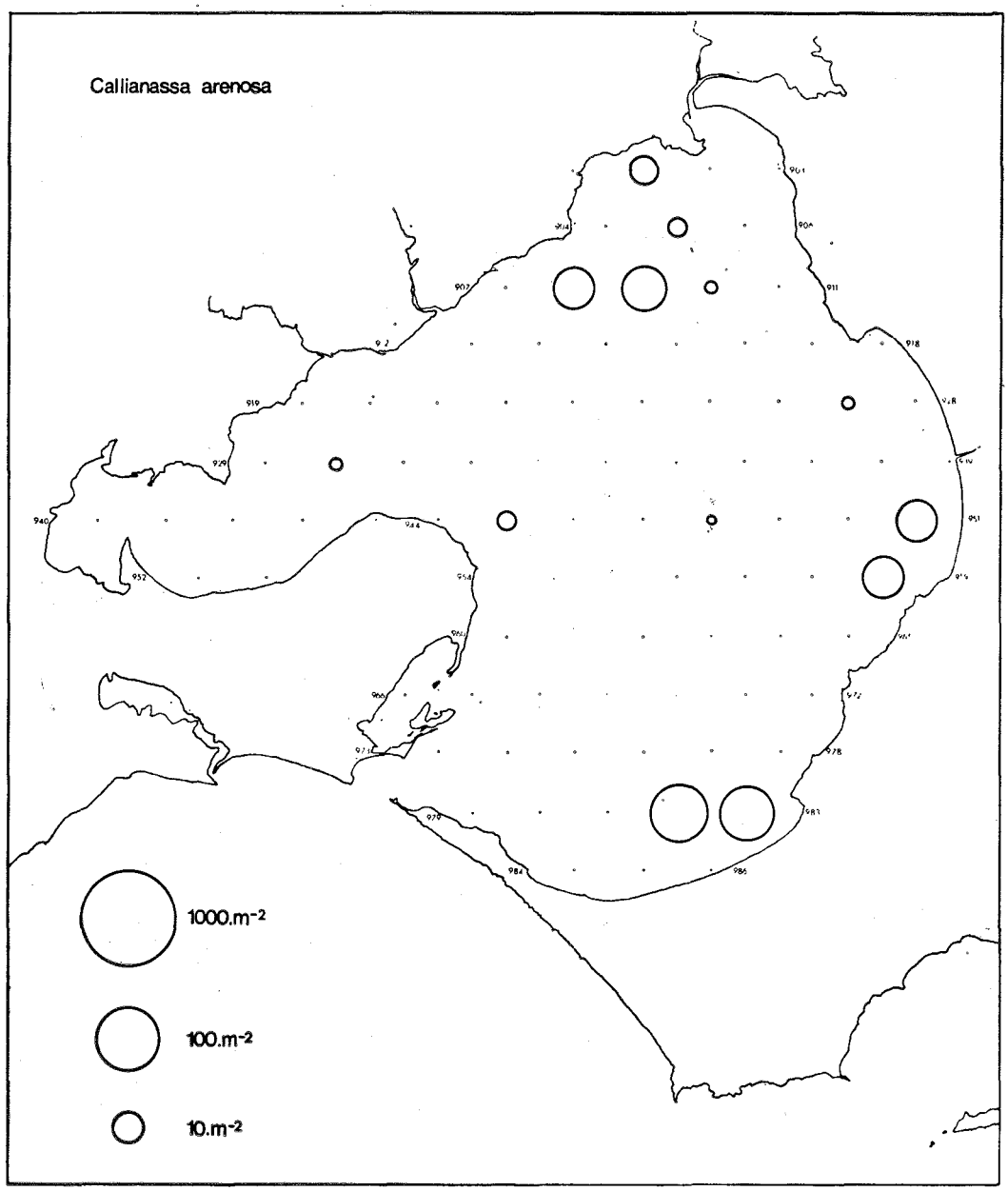

FIGURE 3. Distribution of *Callianassa arenosa* (derived from a total of 109 individuals). Diameters of the circles centered on each station are proportional to the log of density in numbers of individuals per square meter.

Color

Pale yellow to white with patches of red on maxilliped 3, anterior of carapace, posterior of pleon and pleopods, tail fan.

Types

National Museum of Victoria. Holotype: no. J.271, female, length 24 mm. Allotype: no. J.272, male, length 22 mm. Paratype series: no. J.273, 10 specimens.

Type Locality

Port Phillip Bay, 3.5 km off Seaford, PPBES station 951, 13 m, sandy sediment, 8 September 1971.

Material Examined

Port Phillip Bay: more than 100 specimens from marginal areas (see Figure 3). Western Port: near Crib Point, Benthic Survey stations 03N (two specimens), 12N(1), 12S(1); intertidal zone, Crib Point, G. Parry collection (six specimens); near Sandy Point, French I., M. Ahsanullah collection (two specimens). Size range, about 6 mm to 38 mm.

Distribution

Port Phillip Bay and Western Port, Victoria; fine sand sediments.

Remarks

Callianassa arenosa is most closely related to those species of the genus having a well-developed ventral hook on the merus of the large cheliped. Of these, it shows greatest similarity to *C. japonica* Ortmann (= *C. harmandi* Bouvier, *C. californiensis* var. *japonica* Bouvier and others, see Sakai [1969]). These two species are similar in the general form of the large and small chelipeds of both sexes, the relative lengths of the peduncles of antennae 1 and 2, in having a nonlobed maxilliped 3 propod, and in the form of pleopods 1, 2 in both sexes. They differ in the rostrum, the shape of the telson and uropods, and in the detail of the dentition of the dactyl of the male cheliped. The large cheliped of *C. arenosa* is also similar to that of a second Japanese species, *C. petalura* Stimpson (Sakai 1969). *Callianassa biformis* Biffar, 1971 and *C. fragilis* Biffar, 1970 (and 1971*a*) also share with *C. arenosa* a hooked merus on the large cheliped and similar pleopods 1, 2, but differ from it in the form of the dactyl and other characters. See also remarks below for *C. limosa*.

Callianassa limosa, new species

Figures 4, 5

Description

Dorsal oval 0.8–0.85 length of dorsal carapace. Rostrum a broad triangle, sometimes quite sharp, about one-third length of eyestalks; lateral projections obsolete. Eyestalks extending to end of first antenna 1 article, with minute mesiodistal spine, often sharp; pigmented area central, small and irregular. Maxilliped 3 merus width 0.45–0.5 length of ischium and merus together, merus half as long as ischium; ischium with curved mesial row of 8–10 fine teeth; carpus articulating on distolateral corner of merus, medially lobed; propod medially lobed, width 0.8 of length; dactyl width 0.3 that of propod, tapering. Large cheliped (female) ischium serrate ventrally; merus with strong proximoventral serrate hook and serrate ridge on dorsal margin; carpus 0.8–0.95 as wide as long; propod finely crenulate ventrally, finger tapering to upturned end; ratio of dorsal lengths—merus:carpus:propod—1:0.85–0.95:0.9; dactyl longer than fixed finger, tapering to curved end, both setose especially on cutting edges. Large cheliped (male) carpus 1.1–1.2 times as wide as long; propod fixed finger stout, upturned terminally, separated from the base of dactylus by a notch at the base of the gape and a minute lateral denticle; ratio of dorsal lengths—merus:carpus:propod—1:0.7–0.8:1.0–1.1; dactyl stout, setose, little longer than setose fixed finger, with a truncate tooth basally (often bearing a distolateral denticle), a blunt subterminal tooth and a strongly curved tip. Small cheliped ischium with small denticles, merus usually with a minute ventral spine, carpus and propod elongate, dactyl curved, fixed finger straight, subequal. Pereiopod 3 propod lobed dorsally and ventrally; ventral lobe narrow, produced distally and proximally, ventral margin sinuous. Pleopod 1 (female) uniramous, 2-articulate, second article medially lobed, distal portion laminar and curved posteriorly. Pleopod 2 (female) biramous, exopod curved, subequal to 2-articulate endopod. Pleopod 1 (male) uniramous, 2-articulate, distal article tapering. Pleopod 2 (male) a minute

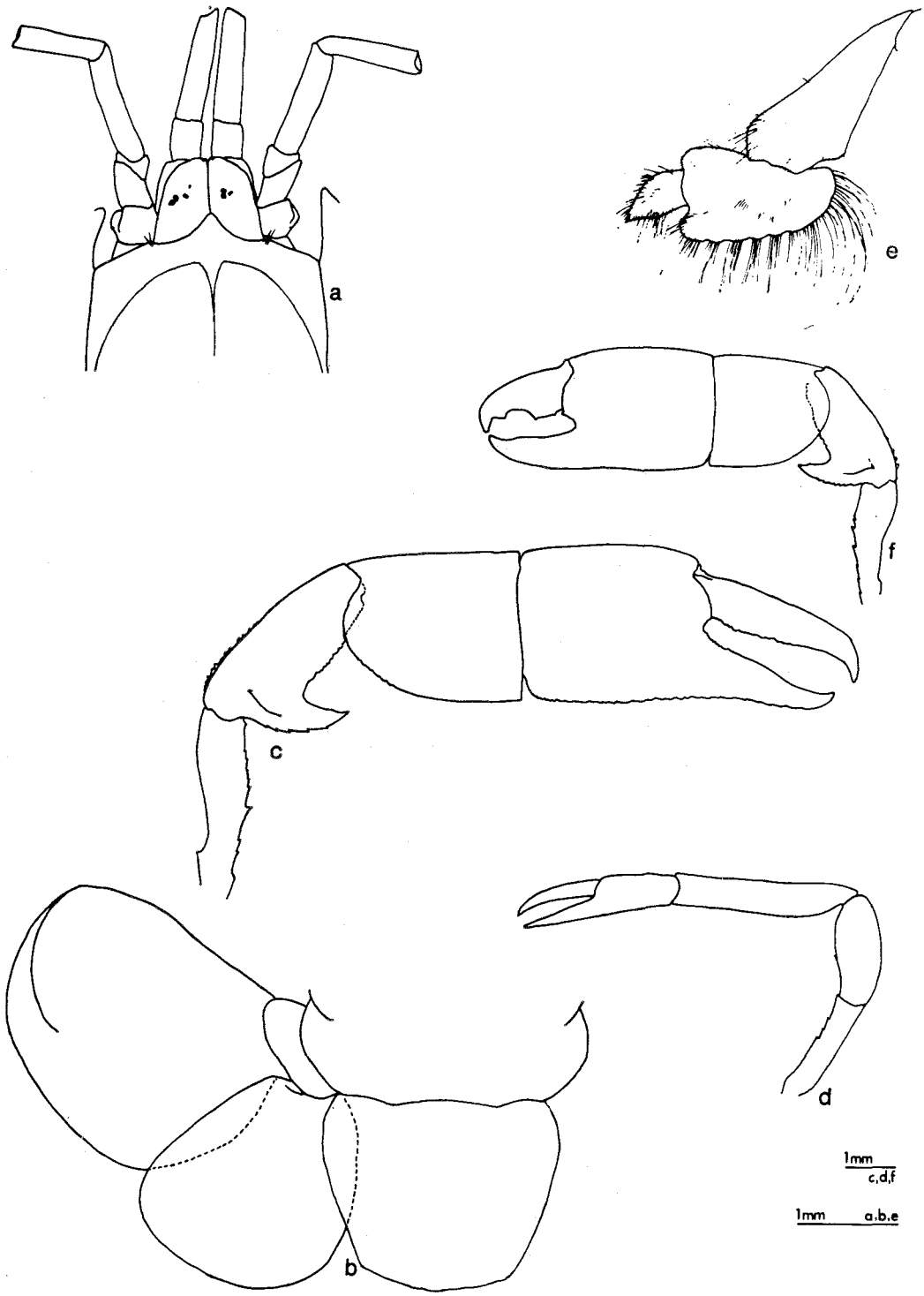

FIGURE 4. *Callianassa limosa*, new species. Holotype (female): *a*, front; *b*, tail fan; *c*, large cheliped (right); *d*, small cheliped (left); *e*, pereiopod 3. Allotype (male): *f*, large cheliped (left).

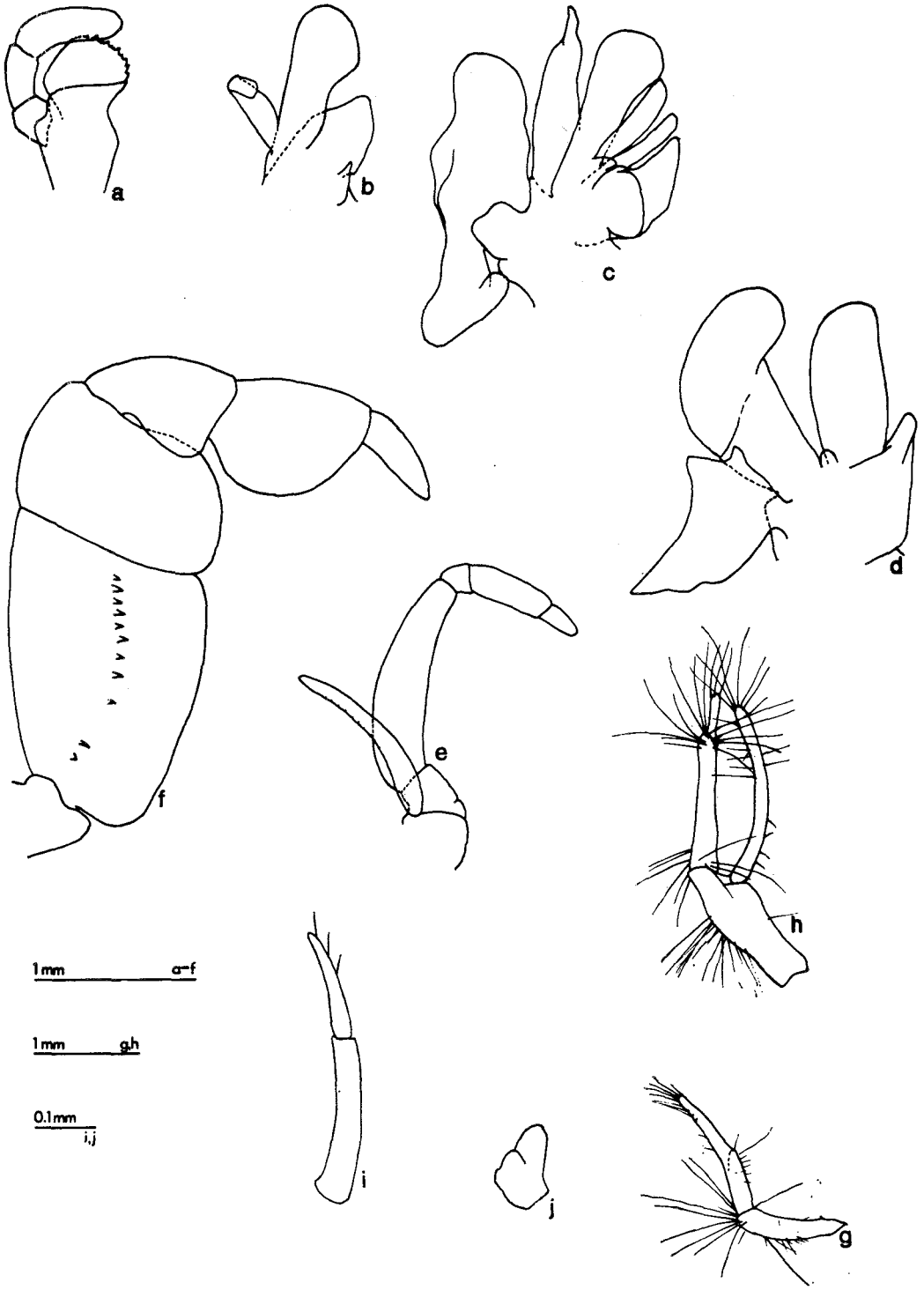

FIGURE 5. *Callianassa limosa*, new species. Holotype (female): *a*, mandible; *b*, *c*, maxillae 1, 2; *d*, *e*, *f*, maxillipeds 1, 2, 3; *g*, *h*, pleopods 1, 2. Allotype (male): *i*, *j*, pleopods 1, 2.

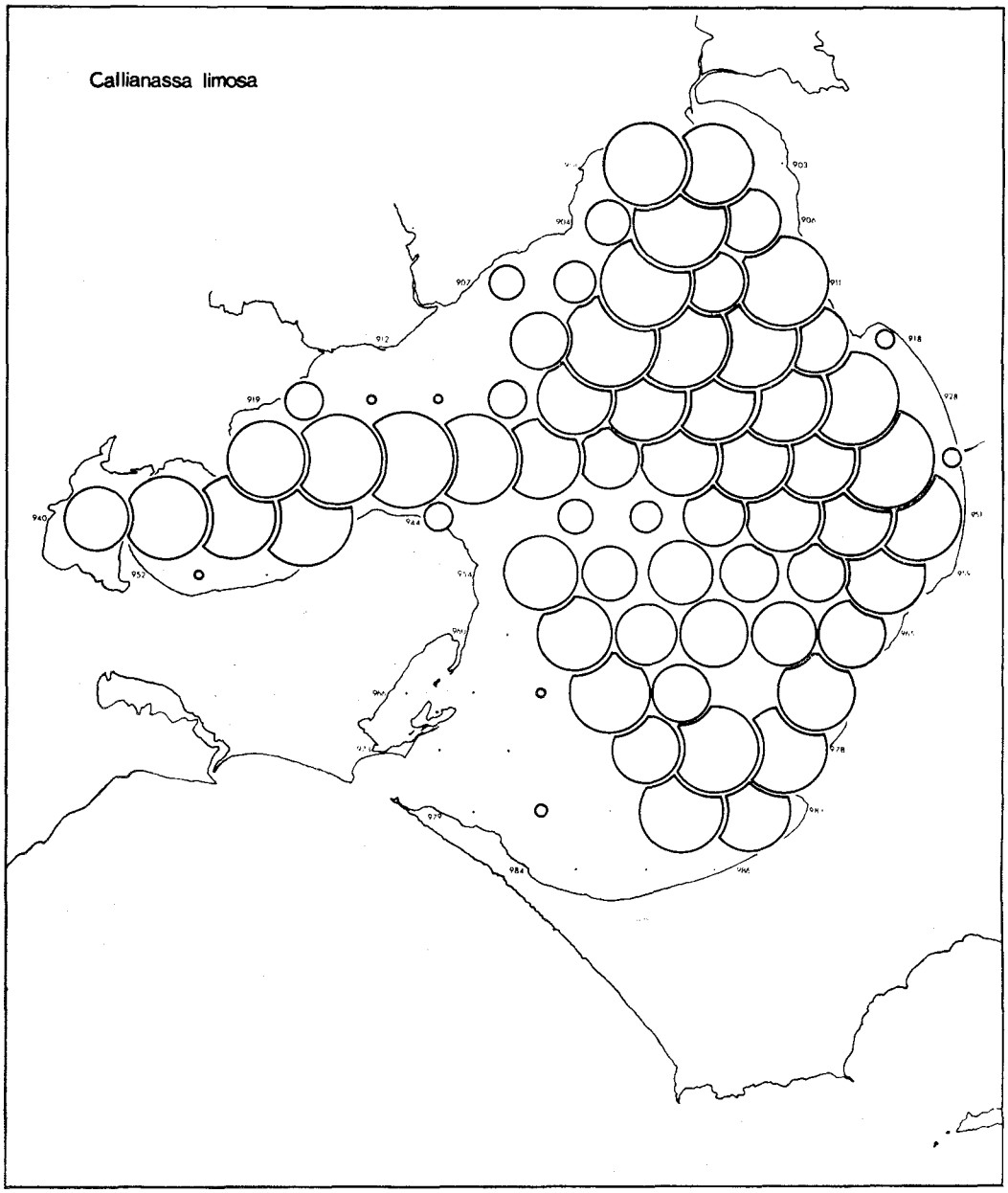

FIGURE 6. Distribution of *Callianassa limosa* (derived from a total of 10,379 individuals). Diameters of the circles centered on each station are proportional to the log of density in numbers of individuals per square meter. See Figure 3 for scale.

medially lobed tapered papilla. Telson tapering, posterior margin curved, about as long as greatest width. Uropod endopod subtriangular, greatest width in distal third, little longer than wide, longer than telson; exopod longer than endopod, length 1.3 width, greatest width proximally.

Color

Yellowish with broad orange dorsal stripe, prominent on pleon.

Types

National Museum of Victoria. Holotype: no. J.274, female, length 23 mm. Allotype: no. J.275, male, length 14 mm. Paratype series: no. J.276, 10 specimens.

Type Locality

Port Phillip Bay, about 8 km off Dromana, PPBES station 977, 22 m, clay sediment, 28 February 1973.

Material Examined

Port Phillip Bay: More than 10,000 specimens from many parts of the Bay (see Figure 6). Western Port: near Crib Point, Benthic Survey station 31N (four specimens); near Sandy Pt, French I., M. Ahsanullah collection (nine specimens). Size range, 5 mm to 30 mm.

Distribution

Port Phillip Bay and Western Port, Victoria; fine sand to clay sediments.

Remarks

Like the previous species, *Callianassa limosa* belongs in the group of species possessing a strong hook on the merus of the large cheliped. It differs from all others most obviously in the presence of a vestigial male pleopod 2 and in a strongly lobed propod on maxilliped 3.

Callianassa ceramica Fulton & Grant, 1906

Remarks

A redescription of this species will appear in a review of the Australian Thalassinidea currently being prepared. All of the specimens available were incomplete and most were small juveniles, less than 20 mm total length. None possessed the characteristic large cheliped of this species and the specific identification was made by comparison with material in the Australian Museum and the National Museum of Victoria.

GENERAL SYSTEMATIC DISCUSSION

The two new species described here, *Callianassa arenosa* and *C. limosa*, have sexually dimorphic, large chelipeds, the male possessing a toothed dactyl on this limb. But in both species exceptions were found—males (as determined from the structure of the pleopods 1 and 2 and position of the gonopore) with large chelipeds of the female form. *C. biformis* Biffar is similar insofar as the male possesses two forms of cheliped, one being a female type, but differs in that the female does not possess a large cheliped (Biffar 1971*b*). *C. japonica* Ortmann and *C. petalura* Stimpson males have large chelipeds of many forms, some approaching that of the female (Sakai 1969). The forms of the chelipeds of all these species suggest they form a related group within the genus (see "Remarks" sections above).

Following the failure of Borradaile's (1903) subgenera of *Callianassa*, used by de Man (1928) but later discredited by Gurney (1944) and most subsequent workers, the genus has recently been divided into eight genera, five of which were new (de Saint Laurent 1973). Borradaile's subgenera were distinguished on the form of the propod of pereiopod 3, maxilliped 3, telson and uropods in an arrangement which proved unworkable for many species. De Saint Laurent's scheme also uses maxilliped 3 but, in addition, relies on the epipod of maxilliped 1, the exopod of the uropod among other characters.

The two new Australian species can be excluded from all of the eight genera, except *Callianassa sensu stricto*, on the form of maxilliped 1 or 3. *Callianassa arenosa* can be accommodated in this genus on all characters, but *C. limosa* is excluded by having a very broad propod of maxilliped 3. The division of the genus *Callianassa sensu lato* along the lines proposed by de Saint Laurent is therefore of no value for this species.

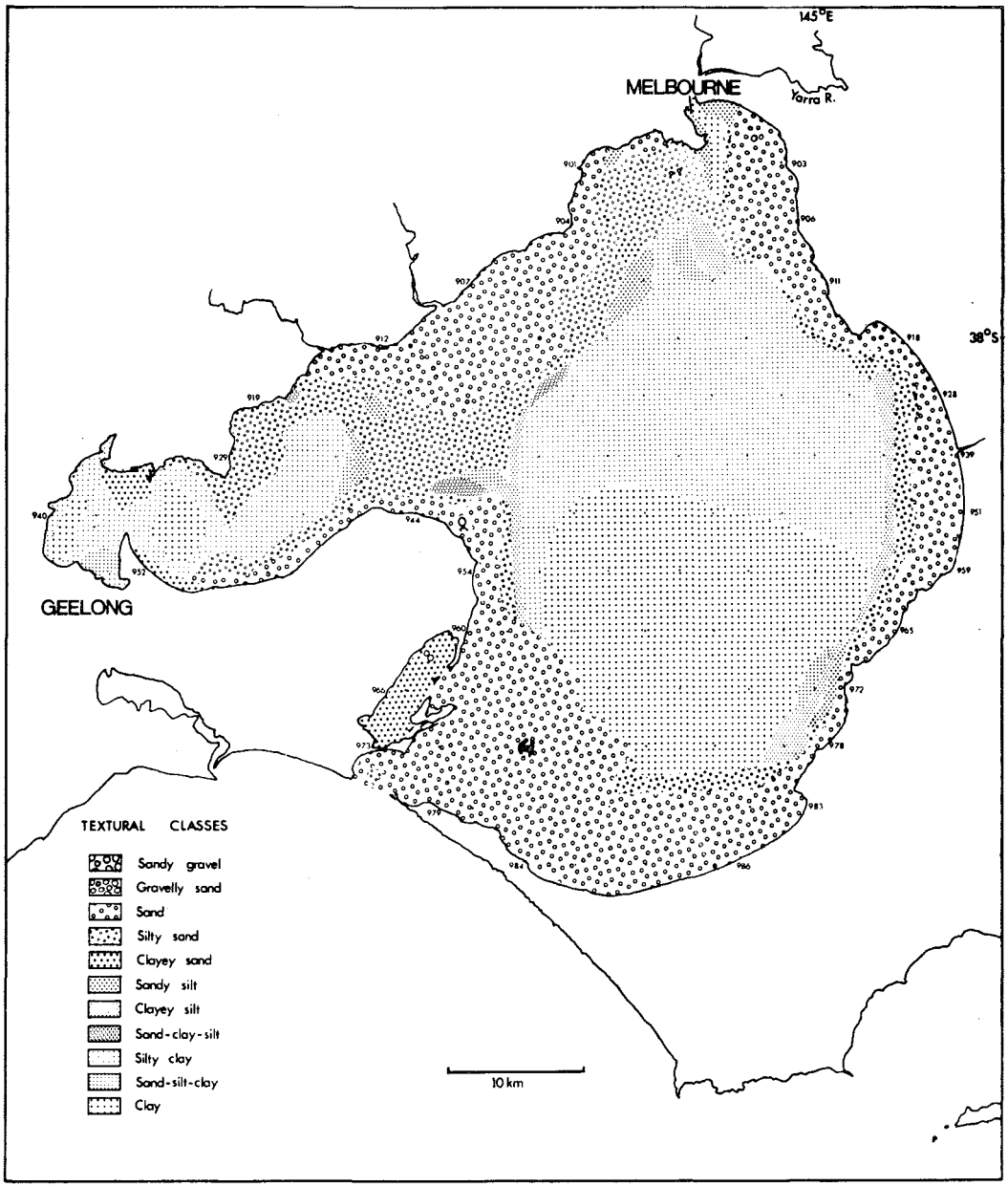

FIGURE 7. Distribution of sediments in Port Phillip Bay by textural class, redrawn from Beasley (1966: figure 1). Numbers on shore refer to the end stations in each latitudinal row.

DISTRIBUTION

Port Phillip Bay Hydrology and Sediments

A previous survey of Port Phillip Bay provides valuable information on history, geology, hydrology, and biology (Memoirs of the National Museum of Victoria 27, 32 [1966, 1971]) and the Phase One report of the Port Phillip Bay Environmental Study (Melbourne . . . 1973) deals particularly with hydrology, chemistry, and biology. Port Phillip Bay is a largely enclosed, marine bay of 1,900 km² on

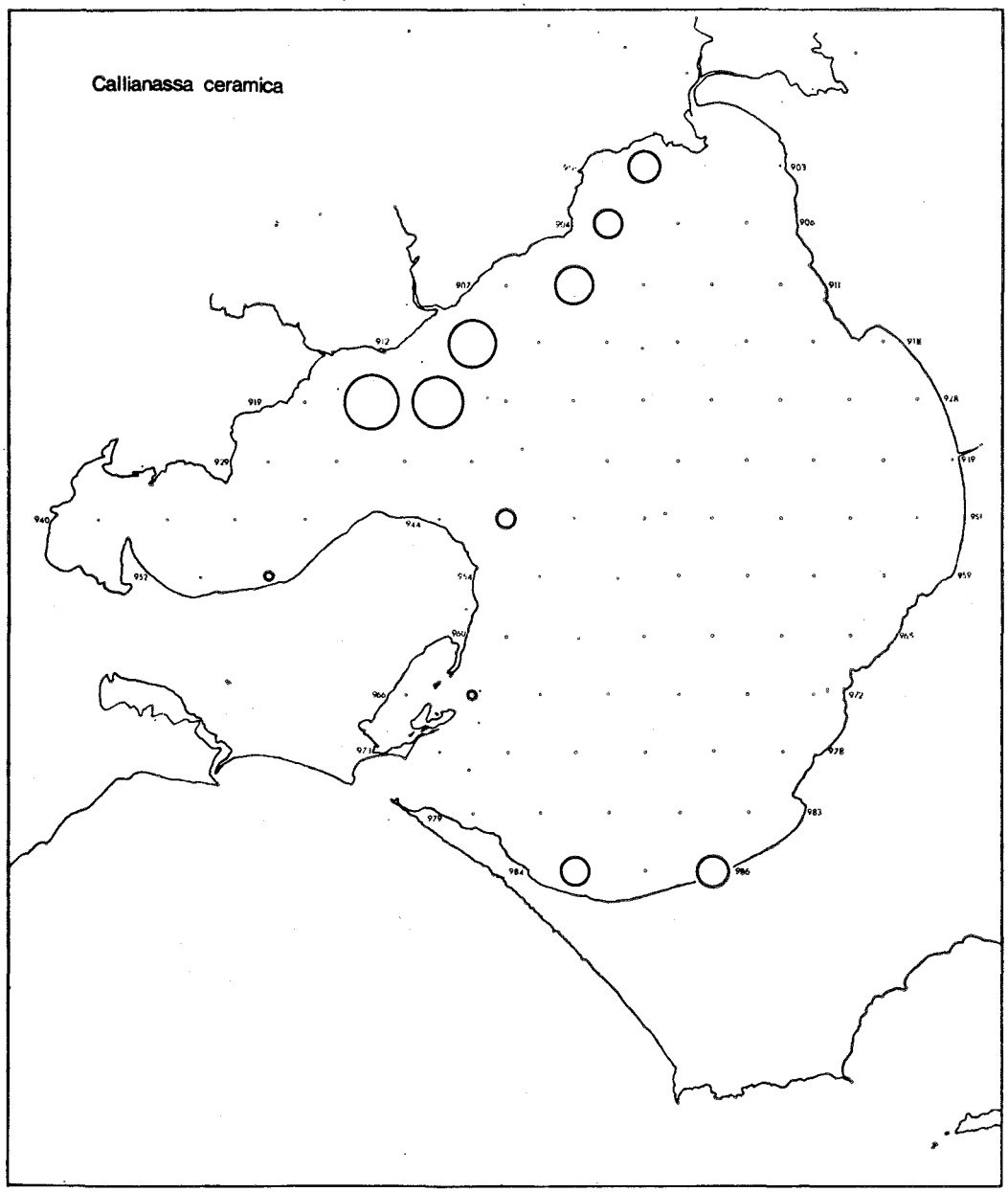

FIGURE 8. Distribution of *Callianassa ceramica* (derived from a total of 90 individuals). Diameters of the circles centered on each station are proportional to the log of density in numbers of individuals per square meter. See Figure 3 for scale.

the south coast of Victoria, Australia. Its average depth is 13.7 m. Apart from a few small reefs, the bottom is of soft sediment sloping quickly away from the east coast and more gradually from the west (Figure 7). The only major source of freshwater, the Yarra River entering in the north, passes through the city of Melbourne situated entirely in the Bay's catchment. A 3-km-wide opening links Port Phillip Bay with Bass Strait, but exchange of

water is damped by an extensive sand bank and channel system in the southern part of the Bay.

The greatest area of the Bay is a central basin of fine sediments, clay in the south and silty clay in the north, at depths greater than about 15 m. (Figure 7; also Beasley 1966). Similar sediments occur in the shallower Geelong arm. A narrow band of coarser sediments predominantly of silt and sand surrounds the basin, extending most particularly towards the west coast, and sediments predominantly of sand are found marginally. The sand near the Bay entrance especially in the channels is better sorted than that along other coasts. Macrophytic algae are found in shallow areas of the Bay, in particular on the compacted, poorly sorted sandy sediments along the west coast. But even here the percentage of algal cover is rarely greater than 20 percent and usually much less.

Results and Discussion

The distribution of the three species of *Callianassa* is highly correlated with that of sediments.

C. arenosa (Figure 3) was found at low densities (maximum of 60 individuals/m^2) at a few widely separated stations. It showed a preference for sediments and depths of an intermediate nature, silty sand between about 13 and 19 m depth. *C. limosa* (Figure 6) occurred at most stations in the Bay but was notably absent from the well-sorted sands near the Bay entrance. Highest densities were in the fine sediments of the central basin deeper than 15 m (1,152 individuals/m^2 at station 938) and in the Geelong arm. The average density in the northern part of the basin where the substrate contained an appreciable proportion of silt and around its edges was somewhat higher than that in clay sediments in the southern deeper part of the basin. *C. ceramica* (Figure 8) is confined to shallow water less than 10 m where the sediments are predominantly sand. These occurred on the shelf along the southern coast and at nearshore stations along the western coast. Density was always low, maximum recorded being 46 individuals/m^2. No adults of this species were taken in the survey. Being large, they may burrow beyond the penetration of the grab—about 10 cm. Fulton and Grant (1906) recorded the species from "muddy flats in both Port Phillip and Western Port," presumably an intertidal habitat. *C. australiensis* (Dana) was also reported from this habitat.

The four species of *Callianassa* known from Port Phillip Bay show a clear division of the soft-bottom habitat and, in fact, rarely coexist except at a few stations of intermediate sediment type. No obvious anatomical features explain this differentiation and nothing is known of their behavior or burrowing characteristics that might correlate with the separation.

The sediment-dependent distribution patterns of *Callianassa* in Port Phillip Bay follow closely those of the soft-bottom mollusks of the Bay (Poore and Rainer, 1974). The marginal sandy areas are dominated by suspension-feeding bivalves and the central fine sediments by surface deposit feeders. In the central basin of the Bay *C. limosa* was one of the two dominant invertebrate species in a rather impoverished macrofauna, the other being small tellinid bivalve *Theora fragilis* (A. Adams, 1855). This species, therefore, must play an important part in the material and energy turnover of this extremely soft substrate.

Most species of *Callianassa* are inhabitants of intertidal to shallow sublittoral regions of sandy beaches or mud flats. The ecology of a few species in these habitats has been studied. For example, Frankenberg, Coles, and Johannes (1967) discussed the potential trophic importance of fecal pellets of *C. major*; Devine (1966) examined distribution and feeding in *C. filholi*; and Hailstone and Stephenson (1961) studied many aspects of the biology of *C. australiensis*. Distribution patterns in these species were correlated with tidal level. Nothing is known of the ecology of other deep-water species of *Callianassa*. De Man (1928) reported several species from depths between 30 and 800 m, but never more than a few specimens from each station.

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