Memoirs of the Museum of Victoria 47(1): 1-57 (1986) ISSN 0814-1827

FRESHWATER CRAYFISH OF THE GENUS *EUASTACUS* CLARK (DECAPODA, PARASTACIDAE) FROM VICTORIA

By Gary J. Morgan

Department of Zoology, Monash University, Wellington Road, Clayton, Victoria 3168, Australia
(Present address: Department of Crustacea, Western Australian Museum, Francis Street, Perth, Western Australia 6000, Australia)

Abstract

Morgan, G.J., 1986. Freshwater crayfish of the genus *Euastacus* (Decapoda: Parastacidae) from Victoria. *Mem. Mus. Vict.* 47: 1-57.

Six Victorian species of *Euastacus, E. diversus, E. neodiversus, E. kershawi, E. yarraensis, E. bispinosus* and *E. armatus* are redescribed. Two new species, *E. woiwuru* from high country east of Melbourne and *E. bidawalus* from far eastern Victoria are described. External morphological characters, measurement ratios and gastric mill ossicles are employed in the revision. A key to the Victorian species is presented. The condition of the male cuticle partition and spination of the chela, thorax and abdomen are the most useful characters for distinguishing species.

Contents

Introduction

The Australian freshwater crayfish genus *Euastacus* Clark has been taxonomically and phylogenetically examined in several papers, often in association with other genera of the Parastacidae (Clark, 1936, 1941; Riek, 1951, 1956, 1969, 1972; Patak and Baldwin, 1984). Some additional papers described single species of *Euastacus* (Watson 1935, 1936; Monroe, 1977). Francois (1962) and Kane (1964) reviewed the genus in unpublished theses.

The systematics of the Parastacidae have been subject to some controversy in recent years due to errors and omissions in formal descriptions and keys. The genera of parastacids were keyed by Riek (1969). Prior to this study, the systematics of *Euastacus* were summarised by Riek (1969) and one species added by Monroe (1977). The present paper is the first in a series revising the taxonomy of *Euastacus*. Species are divided by Australian states according to their respective type localities and this paper comprises descriptions of eight species occuring in Victoria. The type locality of *E. armatus* is the Murray River and the species is arbitrarily included in the Victorian descriptions. Two species (*E. crassus* and a new species) that overlap slightly into Victoria from New South Wales will be included in the New South Wales paper (Morgan, in prep. b).

Materials and methods

Field.

The known range of *Euastacus* in eastern Australia, from Cooktown in north Queensland to the South Australian-Victorian border, was sampled in 1981-2 to augment the patchy existing collections in Australian museums and other institutions. Inland New South Wales was not sampled extensively due to the large area involved and because *E. armatus* is reasonably well represented in museum collections.

Natural or semi-natural bushland was sampled preferentially, especially in state forests and national parks. Crayfish were collected by baited traps, drop nets and hand held baited strings. Many specimens were obtained by turning rocks in streams and scooping up escaping crayfish by hand net. Digging of specimens from burrows was attempted only where the substrate was suitable and burrows shallow. Observations were made at each site of vegetation and hydrology and brief mention of habitat is made for each species.

Colours of live specimens were recorded before emersion in a solution of 10% formalin and 5% glycerol for fixation. Specimens were transferred subsequently to a 70% ethanol/5% glycerol solution.

Laboratory.

One hundred and twenty external characters and fifteen measurements were recorded for all specimens. Four gastric mill attributes were recorded for selected specimens. Specimens were examined under dissecting microscope and measured with vernier calipers. Characters were derived in part from those used by Clark (1936, 1941), Riek (1951, 1956, 1969) and Francois (1962), though many previously used characters were discarded as of little taxonomic value. Characters are illustrated in Figures 1-2 and selected character states in Figures 3-5.

The term "spine" is used in this study for most cuticular protuberances, even if blunt, since homologous spines on different species may be very sharp or very blunt and may vary in sharpness with growth. The expression "general tubercles" denotes the small protrusions on the lateral branchiostegites (Figs. 1 and 4b). The term "bumps" is used occasionally to describe several small, close, irregular protrusions of the cuticle (e.g., dorsal bumps on propodus).

In some species the dorsal thoracic spines are small, irregularly distributed and difficult to count. The spines are referred to as "just discernible".

The term "medium" is employed to describe sizes (e.g., of spines) between large and small. The term "moderate" usually describes intermediacy in sharpness or shape of spines or other structures.

Postorbital ridge spines (Fig. 1a, c) sometimes are described as an "edge" or "small edge" (Fig. 3m). While no distinct spine is present in the "edge" condition, the character is termed a postorbital spine for uniformity since

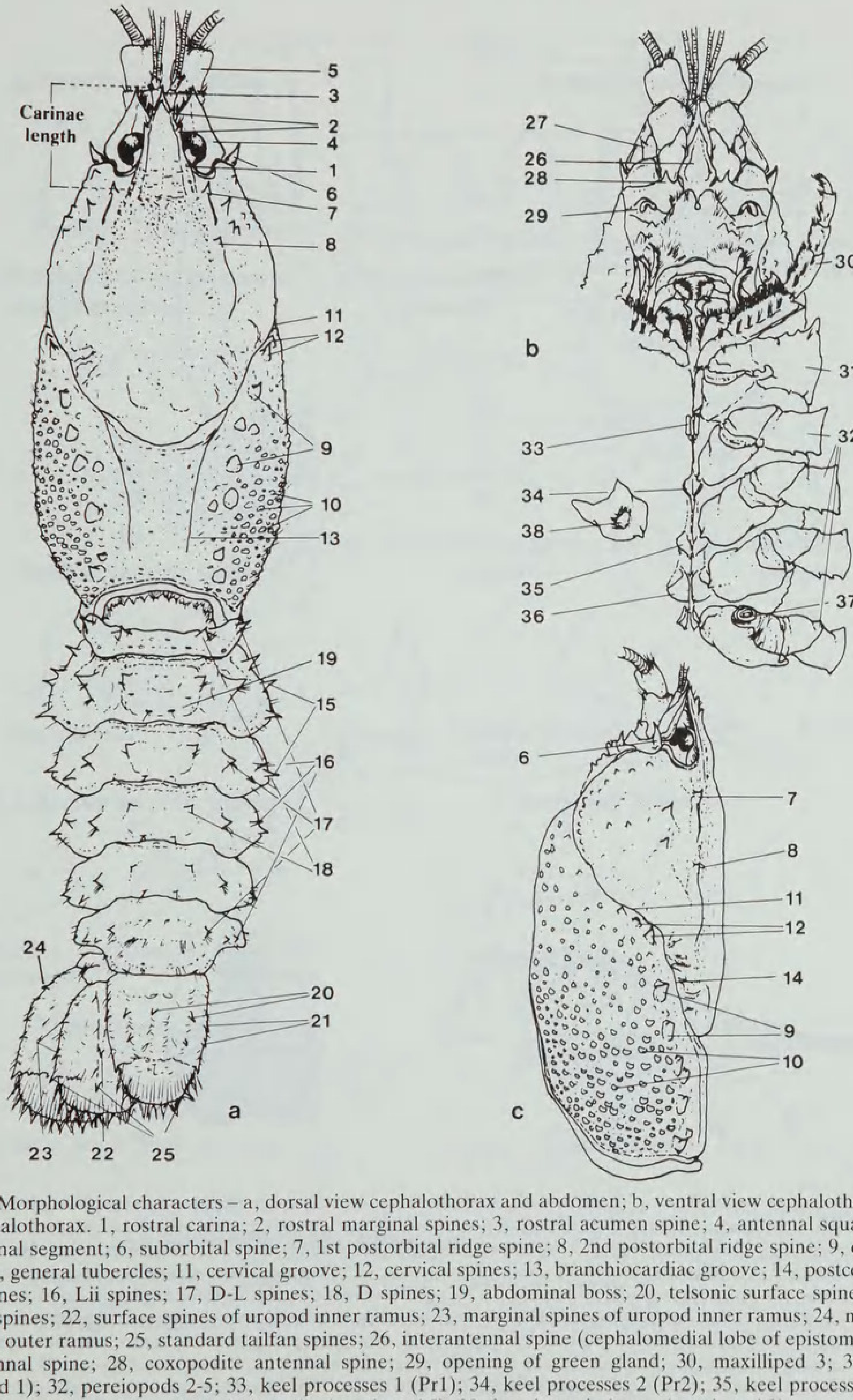

Figure 1. Morphological characters – a, dorsal view cephalothorax and abdomen; b, ventral view cephalothorax; c, lateral view cephalothorax. 1, rostral carina; 2, rostral marginal spines; 3, rostral acumen spine; 4, antennal squame (scale); 5, 3rd antennal segment; 6, suborbital spine; 7, 1st postorbital ridge spine; 8, 2nd postorbital ridge spine; 9, dorsal thoracic spines; 10, general tubercles; 11, cervical groove; 12, cervical spines; 13, branchiocardiac groove; 14, postcervical groove; 15, Li spines; 16, Lii spines; 17, D-L spines; 18, D spines; 19, abdominal boss; 20, telsonic surface spines; 21, telsonic marginal spines; 22, surface spines of uropod inner ramus; 23, marginal spines of uropod inner ramus; 24, marginal spines of uropod outer ramus; 25, standard tailfan spines; 26, interantennal spine (cephalomedial lobe of epistome); 27, basipodite antennal spine; 28, coxopodite antennal spine; 29, opening of green gland; 30, maxilliped 3; 31, great chela (pereiopod 1); 32, pereiopods 2-5; 33, keel processes 1 (Pr1); 34, keel processes 2 (Pr2); 35, keel processes 3 (Pr3); 36, keel processes 4 (Pr4); 37, male genital papilla (pereiopod 5); 38, female genital pore (pereiopod 3).

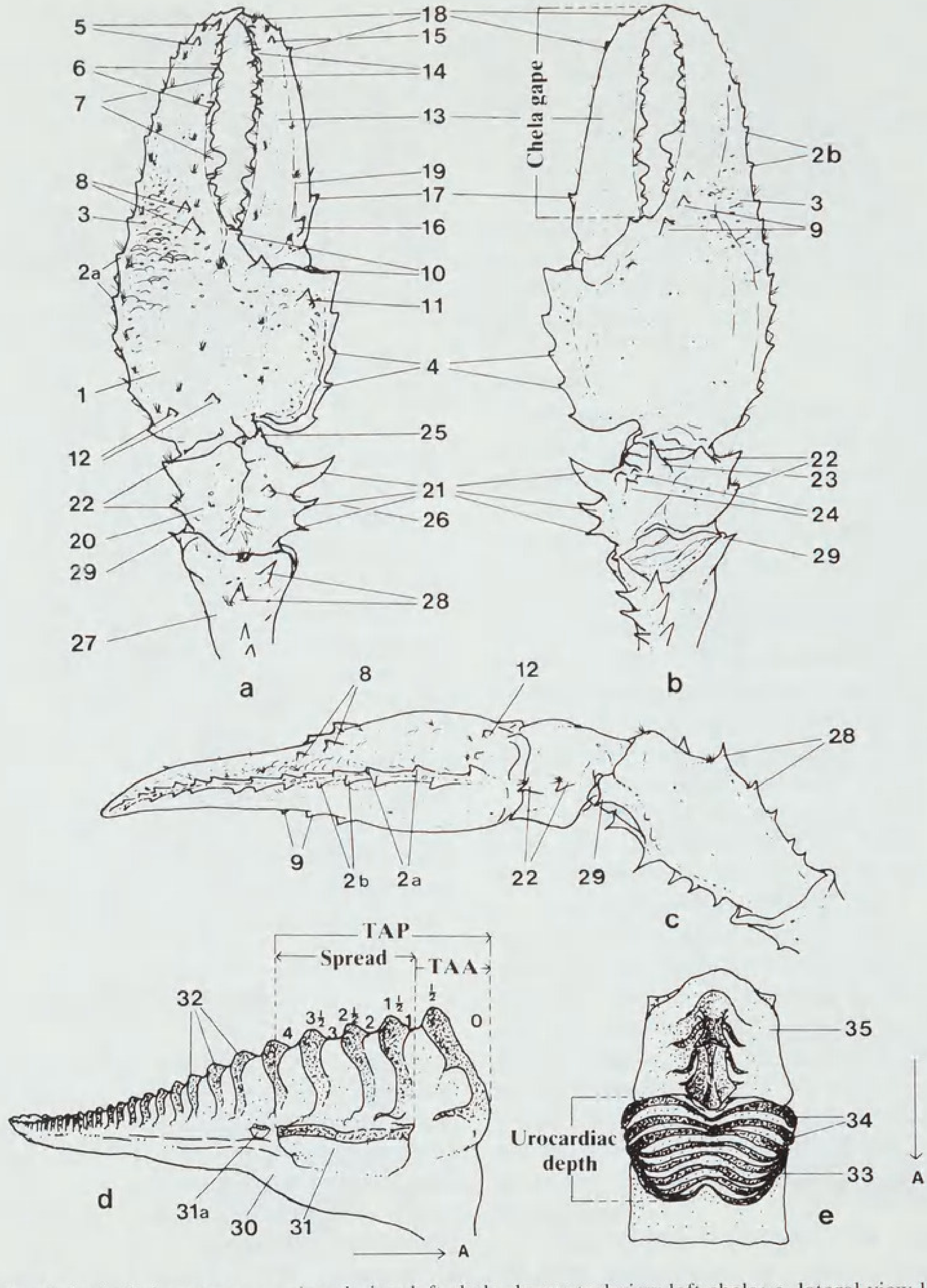

Figure 2. Morphological characters – a, dorsal view left chela; b, ventral view left chela; c, lateral view left chela; d, e, gastric mill ossicles. 1, propodus; 2, lateral propodal spine rows: a dorsal, b ventral; 3, lateral spine ridge; 4, mesal propodal spines; 5, dorsal apical propodal spines; 6, spines above propodal cutting edge; 7, cutting teeth; 8, spines lateral to dactylar base dorsally; 9, spines lateral to dactylar base ventrally; 10, spines at dactylar articulation; 11, spine posterior to dactylar articulation; 12, precarpal spines; 13, dactylus; 14, spines above dactylar cutting edge; 15, extra dorsal apical dactylar spine; 16, dorsal mesal dactylar basal spine; 17, marginal mesal dactylar basal spine; 18, apical mesal dactylar spines; 19, dactylar groove; 20, carpus; 21, mesal carpal spines; 22, lateral carpal spines; 23, ventral carpal spine; 24, ventromesal carpal spines; 25, articulation spine; 26, dorsal carpal spine; 27, merus; 28, dorsal meral spines; 29, outer (distolateral) meral spine. 30, lateral view zygocardiac ossicle; 31, ventral ear; 31a, secondary ear; 32, zygocardiac teeth; 33, ventral view urocardiac ossicle; 34, urocardiac ridges; 35, prepyloric ossicle. A anterior.

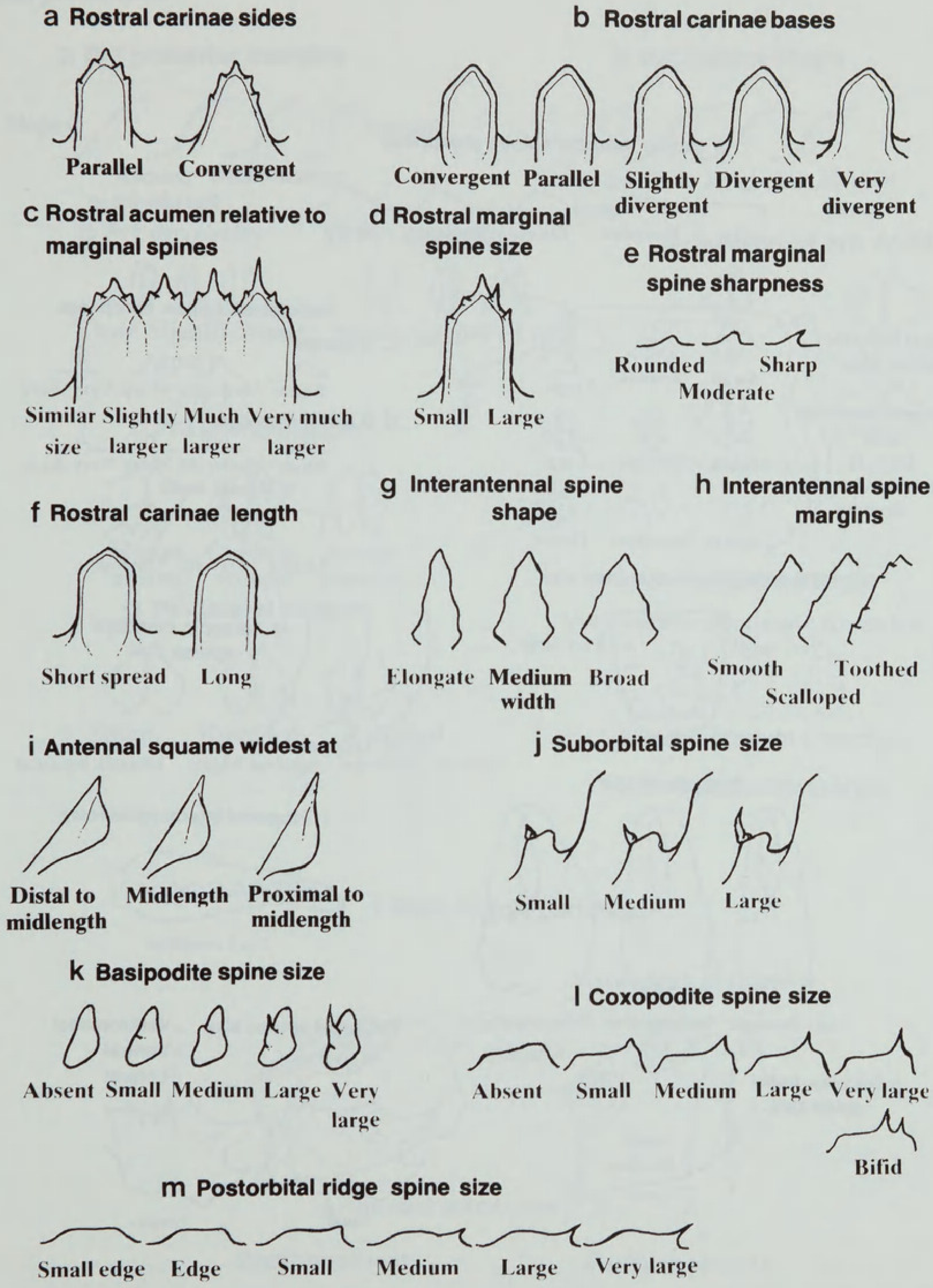

Figure 3. Selected character states.

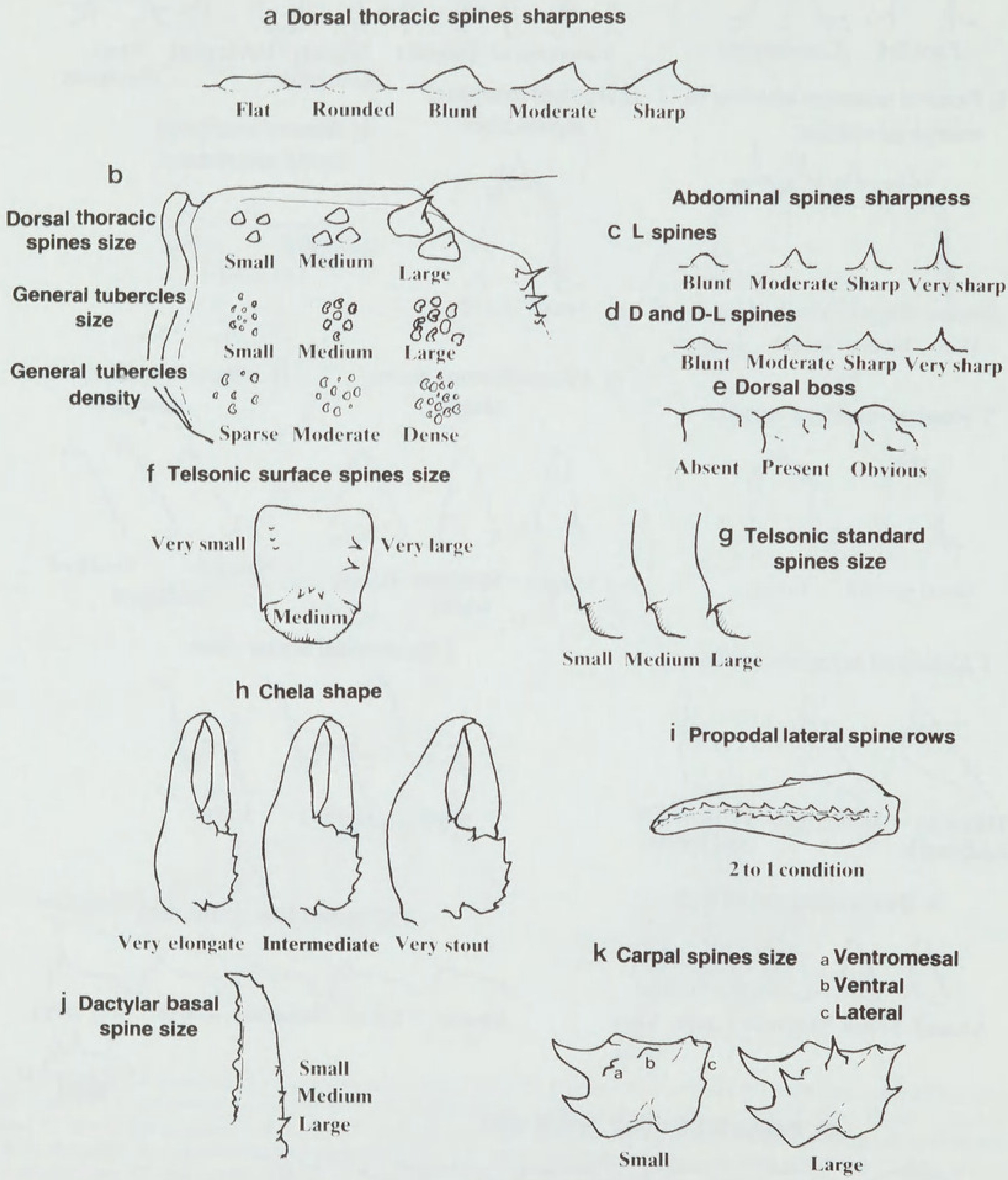

Figure 4. Selected character states (continued).

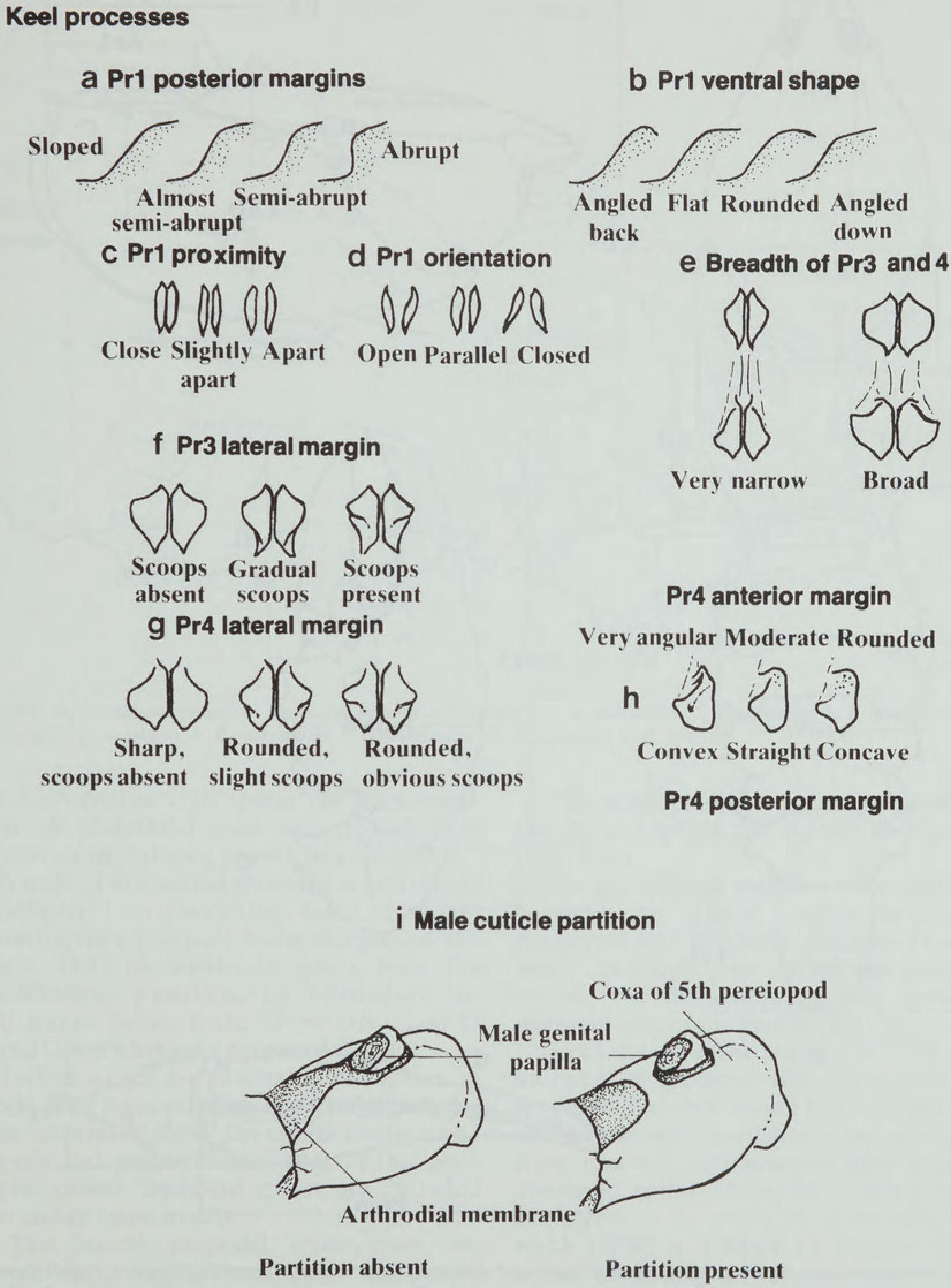

Figure 5. Selected character states (continued).

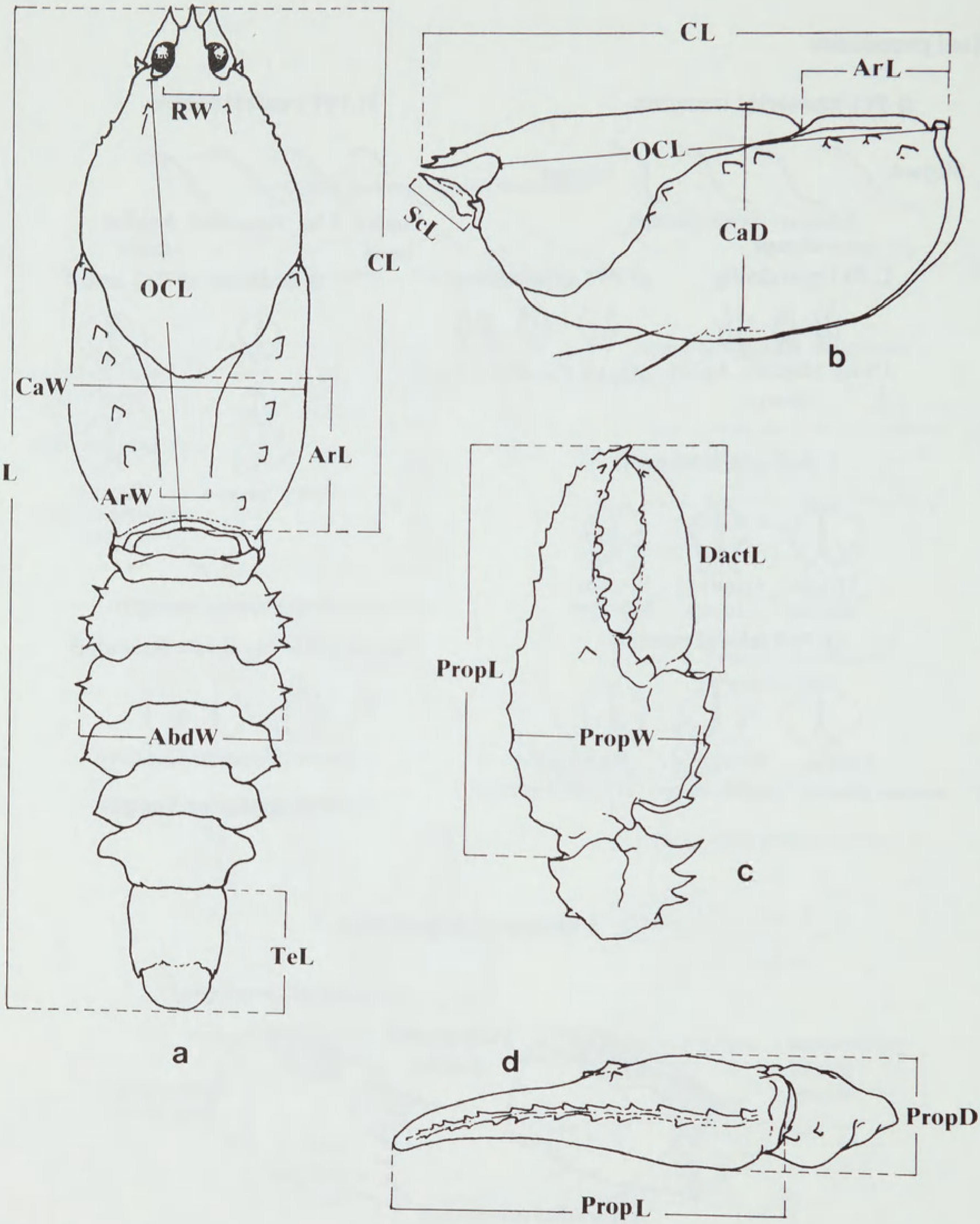

Figure 6. Measurements – a, dorsal view cephalothorax and abdomen; b, lateral view cephalothorax; c, dorsal view left chela; d, lateral view left chela. OCL - occipital carapace length; CL - carapace length; L - total body length; CaW - carapace width; CaD - carapace depth; ArL - areola length; ArW - areola width; RW - rostral width; AbdW - abdominal width; TeL - telsonic length; ScL - scale (squame) length; PropL - propodal length; PropW - propodal width; PropD - propodal depth; DactL - dactylar length.

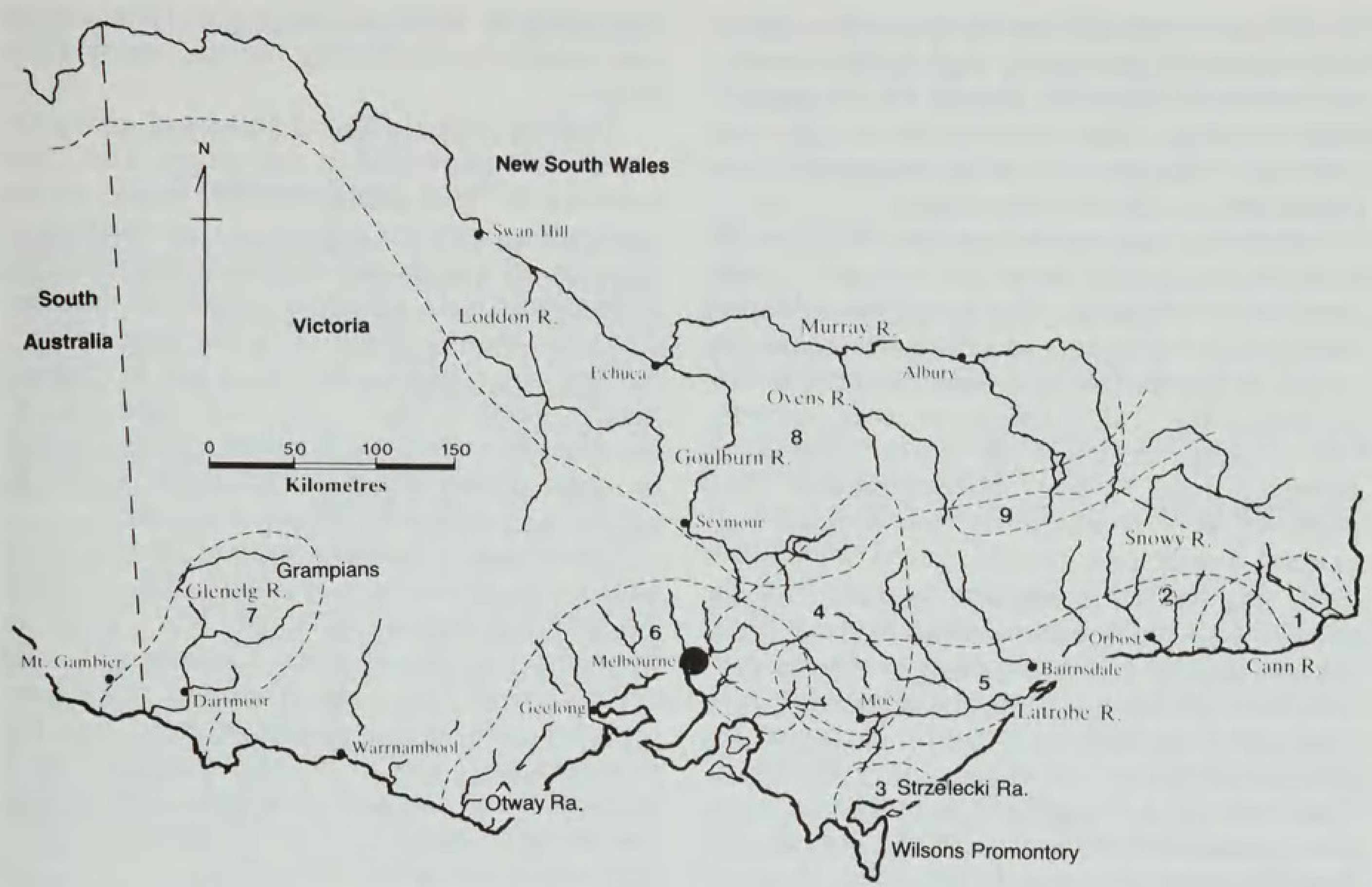

Figure 7. Approximate ranges of *Euastacus* species in Victoria – 1, *E. bidawalus*; 2, *E. diversus*; 3, *E. neodiversus*; 4, *E. woiwuru*; 5, *E. kershawi*; 6, *E. yarraensis*; 7, *E. bispinosus*; 8, *E. armatus*; 9, *E. crassus*.

it is homologous with spines on other specimens. A postorbital spine may decline from large to an edge during growth of a specimen.

A code of abdominal spination is introduced to facilitate descriptions (Fig. 1a): Li (primary lateral) spines protrude from margins of the pleura, D-L (dorsolateral) spines from the pleura/tergum junctions, Lii (secondary lateral) spines between the above rows and D (dorsal) spines from the tergum dorsally.

Tailfan spines are illustrated in Figures 1a and 4f. The standard spines protrude from the posterolateral edges of the calcified telson and uropods and posteromedial edge of the inner uropod ramus. Standard spines are excluded from tailfan spine counts.

The lateral propodal spine rows are regarded as extending from the proximal base of the propodus and hence the 2-to-1 row condition (Fig. 4i) describes the ventral row ending subapically.

The term "scoops" refers to infoldings of the distal edge of the sternal keel processes (Fig. 5f, g).

The male cuticle partition is a strip of cuticle between the genital papilla on the fifth pereiopod and the arthrodial membrane between coxa and basis. When the partition is absent, the membrane extends around the chitinous ring of the papilla (Fig. 5i).

Occipital carapace length (OCL) is used as an index of specimen size. Fitzpatrick (1977) proposed carapace length (CL) to be a preferable measure of crayfish size but specimens of *Euastacus* not infrequently have broken or deformed rostra. Propodal length (PropL) is employed as an index of chela size. Rostral width (RW) is difficult to measure and was taken arbitrarily at approximately halfway through the posterior occipital curve. Propodal width (PropW) was measured at approximately halfway between the proximal and distal edges of the mesal margin of the propodus. Since dactyli may be broken or slightly deformed, a "theoretical" dactylar length was measured from the base of the dactylus to its apex if it coincided with the apex of the propodus. Measurements are illustrated in Figure 6.

Fourteen ratios were derived from the fifteen measurements and are included in the species' descriptions. The range in values of measured specimens is recorded and allometric trends indicated by "i": ratio increases with growth, "d": ratio decreases with growth, "id": ratio increases in early growth to decrease later, "di": ratio decreases then increases later. These postscripts indicate only general ontogenetic trends and do not imply a neat progression from one extreme to the other. Most ratios are self-evident though two involve inverse relationships of measurements. The ratio OCL/CL is used as a measure of relative rostral length; as the ratio increases the rostrum decreases in length relative to OCL. The ratio OCL/L similarly is employed as an inverse index of relative abdominal length. The measurements CL and L are used above as denominators to avoid ratio values in excess of unity.

Allometric and some geographic variation are incorporated in the descriptions.

Sexual maturity in females is estimated from the state of the gonopores: light setation around closed pores indicates approaching maturity, heavy setae and open pores indicate sexual maturity. Turvey (1980) also employed gonopore setae in determining female maturity. Sexual maturity in males is difficult to estimate from external characters.

Gastric mills were dissected from selected specimens using a fine pair of forceps inserted via the mouth, as described by Francois (1962). Teeth anterior to the posterior margin of the zygocardiac ossicle ear were counted as the TAP; teeth anterior to the anterior margin of the ear were counted as the TAA; subtracting the TAA from TAP gives the tooth spread. The number of urocardiac ridges was counted, excluding the first anterior ridge which is an extension of a more posterior ridge. The mill characters are similar to those described by Francois (1962) with the exception that the first anterior tooth of the zygocardiac ossicle was counted consistently for this study (Fig. 2d, e).

Francois (1962: 24) defined a mill character usually not employed in this study. The "first extra tooth" (not projecting into rugae on the zygocardiac ossicle) appears to be variable in virtually all species and is seldom diagnostic on a specific level. Francois admitted that the character is of "limited taxonomic value", though suggesting it may be of use in "infraspecific relationships". In the case of *E. armatus*, however, the first extra tooth appears to occur invariably between teeth 5 and 6, unlike the positions of all other species.

Numerical techniques were employed as an adjunct to classical taxonomy. The CSIRO TAXON program package was used in polythetic agglomerative classification and ordination of data. The computer results are complex and not reproduced here but the descriptions represent conclusions based upon numerical and classical techniques. The author can be contacted for information on the programs employed and the printouts.

Species descriptions are extensive and adhere to a standard format that will be maintained in papers on *Euastacus* species from other states. For new species, paratypes are designated to "show the range of variation within the species" (Schenk and McMasters, 1956). Holotypes and paratypes are figured preferentially also to a standard format. Descriptions incorporate specimens of all sizes but diagnoses include only specimens larger than 20 mm OCL (> 20 OCL) since diagnostic characters rarely are developed on smaller animals.

Abbreviations.

Sizes of specimens in descriptions are given in millimetres of occipital carapace length and the unit is omitted (e.g., 50 OCL, 30-40 OCL). The scales in figures are in millimetres.

Australian museums are abbreviated: Australian Museum, Sydney (AM), Museum of Victoria, Melbourne (NMV). The following collectors are designated by initials except in citing type localities: E.F. Riek (EFR), J.R.

Kane (JRK), S.J. Harders (SJH), G.J. Morgan (GJM).

PARASTACIDAE Huxley, 1878

Euastacus Clark, 1936

Diagnosis. Carapace with spines or tubercles other than rostral and postorbital, and varying degree of setation; enlarged branchiostegite spines dorsal when present. Anterolateral extension of branchiocardiac groove fused with cervical groove rather high on carapace. Abdomen usually bearing spines (up to 4 rows) but these may be reduced to low bumps. Pleuron of first abdominal somite distinct and partially overlapped by second somite. Telson frequently with dorsal spines, divided laterally by transverse suture, posterior portion membranous. Third maxilliped with ventral surface of ischium bearing single row of stiff setae and prominently produced distolaterally; exopodite reduced, basal segment not reaching apex of ischium. Propodus of chela (1st pereiopod) with ventrolateral margin bearing one or two rows of spines; plane of movement of chela propodus and dactylus oblique; chela dactylus usually with several basal and/or apical mesal spines (at least one apical mesal spine); chela carpus with 2-4 (rarely 5) mesal spines and 1 to several ventral or ventromesal spines, carpus with deeply incised dorsal longitudinal groove. Male genitalia on ventral coxa, consisting of short papilla with calcified ring, not distinctly tubular. Branchial formula 21 +epr; stem of podobranchiae, except on fourth pereiopod, produced laterally in wing-like expansion. [Modified from Riek (1969), Hobbs (1974).]

Type species Cancer serratus Shaw, 1794 (non *Cancer serratus* Forskål, 1775).

Astacoides spinifer Heller, 1865 (by original designation).

Remarks. Clark (1936) established the genus *Euastacus*, designating *Cancer serratus* Shaw as type species. Later (1941), she realised that her initial concept of *Euastacus serratus* included several species and gave *Euastacus elongatus* Clark as type species. This move was invalid and the original designation must stand. *Cancer serratus* Shaw is a junior homonym and its name has been replaced by the next available synonym, *Astacoides spinifer* Heller.

Key to Victorian species of *Euastacus*

Euastacus species are determined by character combinations and hence combinations are required to key species adequately. Specimens <20 mm OCL have been excluded from the key since diagnostic characters rarely are developed. Attention must be paid to grammatical punctuation. Characters in couplets are separated by full stops. There are frequently alternatives within each level of a couplet. The following illustrates use of the full stop, colon and comma –

Spine A present, or if spine absent: B spine present, C spine large and X spines extending beyond half gape of chela. Y spine on dactylus. Z spines absent.

The alternative is that spine A may be present or absent. If the spine is absent, the colon indicates that the subsequent characters apply regarding spines B, C and X, separated by commas. The full stop identifies the end of the alternative; following characters regarding spines Y and Z are applicable regardless of the first alternative (i.e., whether or not spine A is present).

Secondary characters are included in square brackets. These characters are not exclusive to that level but are constant and hence useful in corroborating the primary, diagnostic characters. Chela characters apply to non-regenerate appendages, therefore if chelae differ distinctly in size, the larger should be employed for the key.

1. 1 or more telsonic surface spines present, or if rarely absent: thoracic spines medium sized or large (may be flattened), usually 2 mesal carpal spines and rostral carinae of medium length or long 2

– Telsonic surface spines absent. Thoracic spines absent or just discernible, or if thoracic spines distinct: 3 or more mesal carpal spines and rostral carinae usually short and spread 5

2. Male cuticle partition present. [D abdominal spines absent and distinct abdominal boss present on specimens >60 mm OCL. Usually large spine lateral to dactylar base dorsally. Posterior margins of Pr1 usually sloped] . . . . *E. kershawi*

– Male cuticle partition absent. [D abdominal spines present, or if absent: rarely a small or medium sized spine lateral to dactylar base dorsally and posterior margins of Pr1 usually abrupt] 3

3. Thoracic spines usually large but flat or rounded (rarely sharp posteriorly). D abdominal spines absent, or small if present and only on anterior somites, often on one side only. Abdominal boss pronounced on specimens >60 mm OCL. [Pr1 abrupt. Usually 2 Li spines per side on somite 2] . . . . *E. bispinosus*

– Thoracic spines sharp or blunt, rarely rounded. D abdominal spines present, often sharp. Abdominal boss not very pronounced (obscured by broad D spines) 4

4. D abdominal spines usually curved towards anterior on specimens >50 mm OCL. Rostral base usually parallel. General tubercles moderately distributed or sparse. Telsonic spines medium sized or small (sometimes absent). Dorsal mesal dactylar basal spines usually absent. Usually 2 Li spines per side on somite 2. PropW/PropL usually 0.38-0.42. PropD/PropL usually 0.23-0.27. 1st extra zygocardiac tooth between teeth 5 and 6 . . . . *E. armatus*

– D abdominal spines not strongly curved to anterior. Rostral base usually divergent or very divergent. General tubercles often dense. Telsonic spines usually large. Usually 1-3 dorsal mesal dactylar basal spines. Usually >2 Li spines per side on somite 2. PropW/PropL usually 0.43-0.46. PropD/PropL usually 0.27-0.29. 1st extra zygocardiac tooth usually between teeth 6 and 7 (not 5 and 6) . . . . *E. yarraensis*

5. Male cuticle partition absent . . . . *E. crassus*

– Male cuticle partition present 6

6. 2-5 dorsal mesal dactylar basal spines usually reaching distal to midlength of dactylus. Marginal mesal dactylar basal spine usually absent 3-5 (rarely 2) apical mesal dactylar spines, usually reaching mesal basal spines 7

– 1 (rarely 2) dorsal mesal dactylar basal spine(s). 1-2 marginal mesal dactylar basal spines. 2 apical mesal dactylar spines (mesal dactylar basal spines not reaching apical dactylar spines 8

7. Spines above propodal and dactylar cutting edges reaching midlength, proximal to midlength or to full gape. Thoracic spines usually small or absent . . . . *E. woiwuru*

– Spines above propodal and dactylar cutting edges apical. Thoracic spines medium sized with some small . . . . *E. neodiversus*

8. Marginal squamal spine(s) present. Dorsal thoracic spines absent . . . . *E. diversus*
– Marginal squamal spines absent. Dorsal thoracic spines medium-sized . . . . *E. bidawalus*

Euastacus armatus (von Martens)

Figures 8, 9

Astacus armatus von Martens, 1866: 359-60.
Astacoides serratus.–McCoy, 1867: 189.–1878: 17, pl. 15 (in part, Murray R. locality).
Astacus serratus.–von Martens, 1868: 615 (in part, Murray R. locality, fide Francois, 1962).
Astacopsis armatus (von Martens).–Huxley, 1880: 308, fig. 76.
Astacopsis serratus.–Haswell, 1882: 174 (in part, Murray R. locality).–McCoy, 1888: 225-6.–Ortmann, 1902: 292 (in part, Murray R. locality).–Smith, 1912: 145-7, 149, 157-160, pl. 16 (in part, Murray R. locality).–McCulloch, 1917: 237-8 (in part, Murray R. locality).–Hale, 1927: 75-6 (in part, Murray R. locality).
Astacopsis spinifer.–Spence-Bate, 1888: 195, 205 (in part, Murray R. locality).
Astacopsis spinifera (misspelling).–Faxon, 1898: 670, 675 (in part, Murray R. locality).–1914: 402 (in part).
Euastacus serratus.–Clark, 1936: 12-13, pl. 2, fig. 12(?) (in part, Murray R. locality).–1937a: 35.–1937b: 186.
Euastacus yarraensis.–Clark, 1936: 14-15 (in part, Yea R. locality).–1941: 15-16 (in part, tributaries of Murray R. localities).
Euastacus nobilis.–Clark, 1941: 20-2 (in part, tributaries of Murray R. localities).
Euastacus elongatus Clark, 1941: 12-13, pl. 1.–Riek, 1951: 378, 384-5.
Euastacus armatus (von Martens).–Clark, 1941: 13-15, pl. 2.–Clark & Burnet, 1942: 90-2.–Riek, 1951: 384-5.–Francois, 1960: 217-18.–Riek, 1969: 894.

Material examined. Vic. Alexandra, 6 miles upstream of Seymour (Goulburn R.), 19 Sep 1963, JRK, NMV J6199, 1♂, 1♀; Goulburn R. near Tongala, 30 Sep 1962, JRK, 1♂; Trawool Bridge, Goulburn R., 19 Sep 1963, Rawlinson, NMV J6198, J6208, J6209, 3♀♀; Goulburn R. near Trawool Bridge, 17 Apr 1980, GJM, 1♂, 2♀♀; Goulburn R., Dec 1935, 2♂♂, 4♀♀; Goulburn R. near Jamieson, Jan 1980, 3♂♂, 2♀♀; Yea R. near Devlins Bridge, 16 Apr 1980, GJM, 2♂♂, 2♀♀; Murrundindi R. just east of Murrundindi, 16 Apr 1980, GJM, 2♀♀; King Parrot Ck, tributary of Goulburn R. near Strath Creek, 13-14 Apr 1980, GJM, 2♂♂, 1♀; Jamieson R., Dec 1935, Hordern, NMV J6200, 2♂♂, 2♀♀; Howqua R., 1980, R. England, 1♀; Mitta Mitta R., Dartmouth, NMV J6206, 1♀; Mitta Mitta R., 7 Dec 1977, G. Bennison, NMV J6197, 1♂; Kerang area (Murray R.), Oct 1969, A. Pescott, NMV J6217, 1♀; (2 labels), Yea R., Oct 1935, or Murray R., 1907, 1♀.

NSW and ACT. Murray R., Mar 1910(?), AM P2364, 1♂; Murray R., 21 Jun 1914, 1♂; Murray R. at Echuca, Oct 1935, Harris, NMV J6201, J6216, 1♂, 1♀; Murray R. 14 miles below Albury, K. Frankenburg, NMV J6210, 1♀; Murrumbidgee area, 1970-1972, J. Lake, AM P21832-3, 14♂♂, 14♀♀; Murrumbidgee R., May 1920, Amateur Fishermens Association, AM P4692, 1♀; Murrumbidgee R., Jun 1920, D.G. Stead, AM P4720, 1♀; Murrumbidgee R., Oct 1954, A. Racek, AM P13378-9, 2♂♂; Murrumbidgee R., May 1936(?), AM P10748, 1♀; Murrumbidgee R., Jun 1968, AM P16165, 1♂; Yanco, south-west N.S.W., 9 Feb 1960, J. Buggei, AM P13459-60, 2♀♀; Narrandera, Aug 1902(?), P. Mowbray, AM G3971, 1♀; Cotter R. near Canberra, A.C.T., 14 Dec 1946, EFR, AM P11943-4, 6♂♂, 3♀♀; Cotter R., A.C.T., at stilling pool, Nov 1949, EFR, 3♂♂, 1♀; Creek east of Kandos near Rylstone, west side of Dividing Range, tributary of Macquarie R., R. D. Gauthier, AM P15522-4, 2♂♂, 1♀; Goodridigby R., Jan 1951, EFR, AM P13036, 1♂.

SA. Blanchetown No. 1 Lock, Murray R., 14 Aug 1935, 1♂; Murray R., 1905, 1♀; Murray R., 30 Nov 192?, SAM C691, 1♂.

No locality. NMV, 3♂♂, 3♀♀. 1♀ with label "Skipton, Vic" NMV J6205, must be sited erroneously.

Diagnosis. Male cuticle partition absent. Rostral spines reaching proximal to midlength of carinae (rarely only to midlength). Rostral base usually parallel, carinae medium length to long. Antennal squame widest proximal or very proximal to midlength. Marginal squamal spines absent. Suborbital spine medium sized or large. Large thoracic spines distributed in irregular rows. General tubercles large or medium sized on large animals, moderately distributed or sparse. Usually 2 Li spines on abdominal somite 2, spines medium sized to very large. D abdominal spines large and sharp (>60 OCL), curving towards anterior. Abdominal boss present (>60 OCL) but not obvious. 1-9 telsonic surface spines (rarely absent). Often marginal spines on outer ramus of uropod. Lateral propodal spines in 2 to 1 row condition. 1-3 dorsal apical propodal spines (most >40 OCL). Spines above propodal and dactylar cutting edges apical, rarely to midlength of gape. 5 (rarely 4, 6) mesal prop-

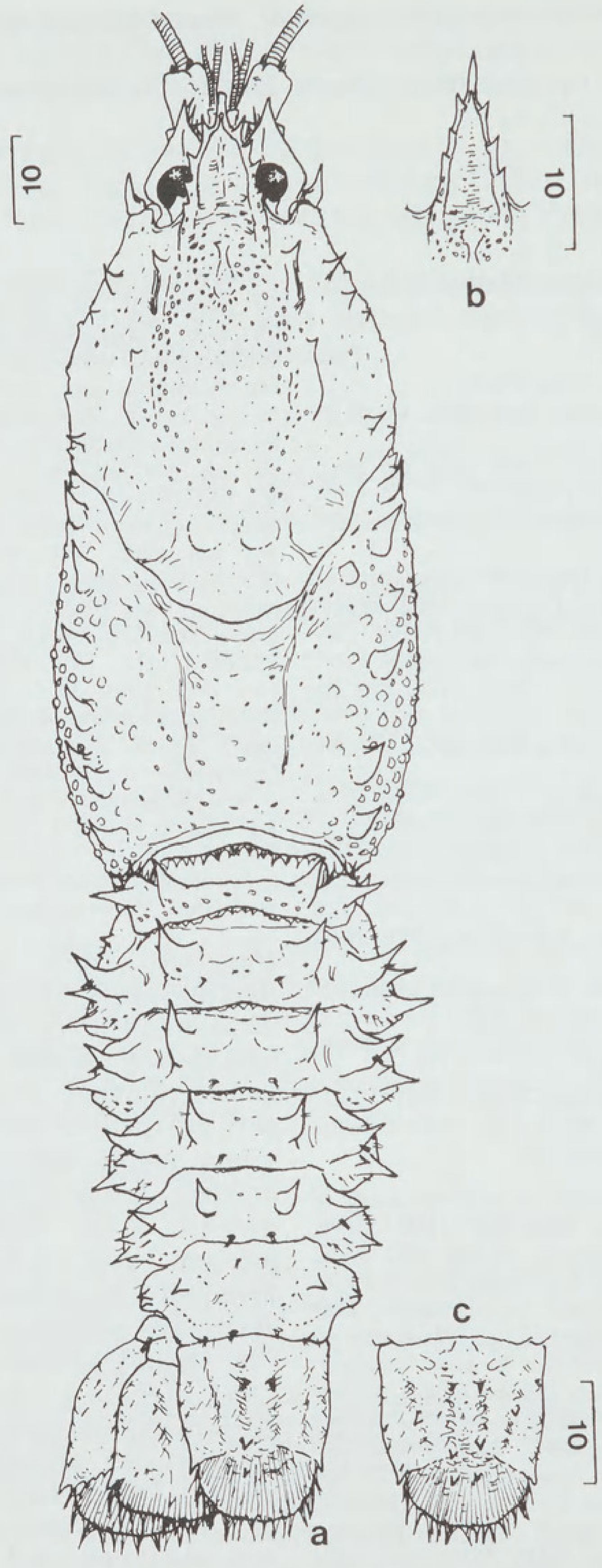

Figure 8. *Euastacus armatus* – (Type not available for illustration) a, dorsal view, ♂, Alexandra, Vic., NMV J6199; b, rostrum, more elongate (allometry), ♀, Kandos, NSW, AM P15523; c, telson, more numerous surface spines (6), ♂, Kandos, NSW, AM P15522.

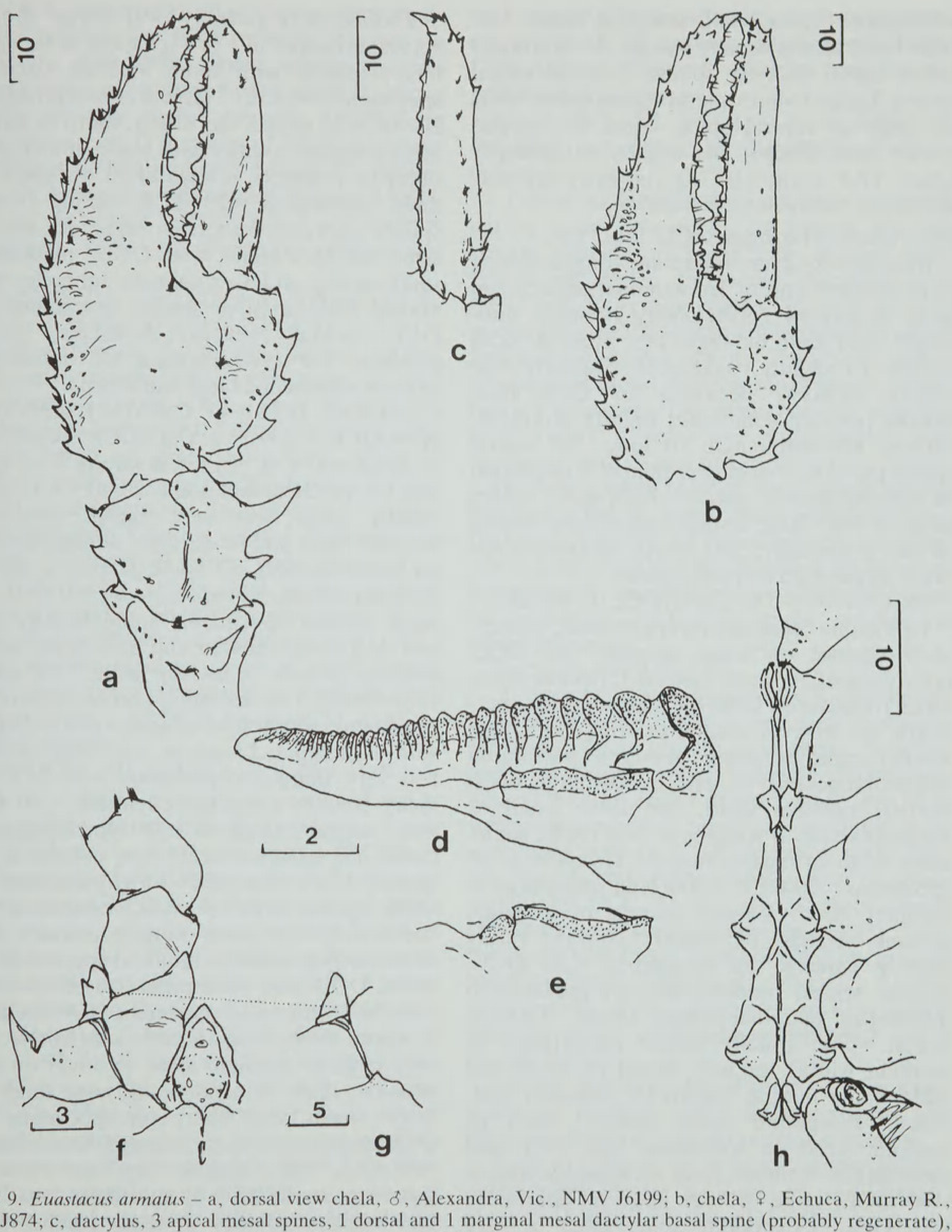

Figure 9. *Euastacus armatus* – a, dorsal view chela, ♂, Alexandra, Vic., NMV J6199; b, chela, ♀, Echuca, Murray R., NMV J874; c, dactylus, 3 apical mesal spines, 1 dorsal and 1 marginal mesal dactylar basal spine (probably regenerate), ♂, Kandos, NSW, AM P15522; d, zygocardiac ossicle, ♀, Echuca, Murray R., NMV J874, type of E. elongatus, Francois collection; e, zygocardiac ossicle, small 2 ear posterior to main ear, ♀, Euston, Murray R., Francois collection; f, ventral view cephalon, ♂, Alexandra, Vic., NMV J6199; g, cephalon, ♀, Echuca, Vic., NMV J874; h, sternal keel, ♂, Kandos, NSW, AM P15522.

odal spines. Dorsal and marginal mesal dactylar basal spines usually absent. 2-3 (rarely 1) apical mesal dactylar spines. 2 mesal carpal spines. Largest ventromesal carpal spine rarely as large as ventral spine. Keel Pr1 sloped (rarely semi-abrupt) and slightly or distinctly apart. TAP count 5.0- 7.0. [1st extra zygocardiac tooth between teeth 5 and 6].

Description. Maximum OCL: 146.2 mm.

Rostrum. Rostrum broad and long, reaching to or distal to end of 3rd antennal segment on most specimens (occasionally between midlength and end of segment). Rostral sides parallel or slightly convergent, distinctly convergent on some specimens <60 OCL. Base usually parallel, sometimes slightly divergent; carinae medium length to long. 3-5 rostral spines per side, reaching proximal to midlength of carinae (rarely only to midlength); spines large or very large distally, usually decreasing in size proximally, and sharp. Acumen spine much larger than marginal spines.

OCL/CL 0.73-0.84 i. RW/OCL 0.14-0.23 d.

Cephalon. Spinose or very spinose, moderately spinose on some animals <60 OCL, poorly spined on some <20 OCL (spines sometimes rounded on large specimens due to abrasion); 1-4 large or medium sized spines, with smaller spines or bumps, ventral to postorbital ridges. 1st postorbital spine usually large, occasionally medium sized; 2nd spine small or medium sized on specimens >60 OCL, sometimes large on smaller animals, always large on specimens <20 OCL. Suborbital spine large to medium sized. Lateral margin of antennal squame straight or slightly convex, rarely slightly concave on specimens <20 OCL; squame widest proximal or very proximal to midlength; marginal spines absent. Interantennal spine usually broad (sometimes of medium width), or very broad on small animals; spine margin slightly or distinctly scalloped. Basipodite spine absent, small or medium sized on specimens >60 OCL and most smaller animals, large on some specimens <60 OCL, large or very large on specimens <20 OCL. Coxopodite spine small or very small, sometimes absent; spine weakly unimodal or serrated.

ScL/OCL 0.14-0.36 d.

Thorax. 3-12 (usually 5-9) dorsal thoracic spines, arranged in 1 or 2 irregular rows; spines large, usually with some medium sized, on specimens >40 OCL, large to small on animals 20-40 OCL; spines very sharp, sharp or moderately pointed, usually with some dorsal spines blunt or rounded, always blunt on small animals. Specimens <20 OCL lacking thoracic spines. General tubercles large to medium sized on specimens >60 OCL, medium to small or tiny on lesser animals; tubercles moderately distributed or sparse. Specimens <20 OCL lacking general tubercles, merely punctate. 1-4 cervical spines; 1st (dorsalmost) and sometimes 2nd large and sharp.

ArL/OCL 0.34-0.40. CaW/OCL 0.55-0.64 i. ArW/OCL 0.15-0.23 d. CaD/OCL 0.49-0.56 d.

Abdomen. D-L spine on somite 1 of specimens >40 OCL and some 20-40 OCL; spine usually large and very sharp, sometimes medium sized and moderately pointed or blunt on small animals. D spine (rarely 2 on one side) on somite 1 of specimens >40 OCL and some smaller specimens; spine usually large and very sharp, smaller and blunter on smaller animals. Somite 2 usually with 2 Li spines, occasionally 3 on one side (4 on one side of one specimen); somites 3-5 of specimens >20 OCL with 1 Li spine; Li spines very large or large and very sharp on specimens >60 OCL and many smaller animals, specimens <40 OCL with medium sized to tiny spines, sharp to blunt. Lii spines absent from somite 2, frequently 1 or 2 on somites 3-6 of specimens >40 OCL; spines large to small, sometimes tiny, and usually very sharp on large animals, often moderately pointed to blunt on specimens <60 OCL. D-L spine on somites 2-6 of specimens >60 OCL and many specimens 20-60 OCL; D-L spines decreasing in size posteriorly, from very large to medium sized or small on large animals, large or small to tiny on small animals; spines very sharp on specimens >60 OCL and some smaller animals; some animals <60 OCL with blunt or very blunt spines. D spine on somites 2-5 of specimens >40 OCL and anterior somites of some smaller specimens; D spines diminishing posteriorly from very large to large on large animals, large or medium sized to small or tiny on specimens

<60 OCL; spines very sharp (sometimes moderately pointed) on large animals, blunter on specimens <60 OCL. Some specimens with tiny D spine on somite 6. D-L and D spines usually strongly curved towards anterior on large specimens; D-L spines of large specimens sometimes developing two points. Specimens <20 OCL lacking abdominal spines. Dorsal boss on specimens >60 OCL but not strongly developed, vague or absent on smaller animals.

AbdW/OCL: ♂ 0.42-0.54 d; ♀ 0.44-0.57 di. OCL/L ♂: 0.35-0.47 i; ♀ 0.35-0.45 i.

Tailfan. Usually 1-9 telsonic surface spines, occasionally absent; spines very large or large on specimens >100 OCL, large to medium sized on specimens 60-100 OCL, medium sized to very small on lesser individuals. Small or medium sized telsonic marginal spine on one side of some specimens. Inner ramus of uropod sometimes with 1 medial surface spine and frequently 1-3 marginal spines; outer ramus often with 1-3 (rarely 4) marginal spines; uropod spines sometimes absent on specimens of all sizes, always absent on specimens <40 OCL; spines usually medium sized or small, rarely large. Standard spines small or medium sized on specimens >80 OCL, medium to large on smaller animals.

TeL/OCL: ♂ 0.27-0.42 d; ♀ 0.28-0.41 di.

Chelae. Chelae elongate to intermediate in shape, often dorsoventrally flattened. Teeth well developed on most specimens >80 OCL.

Propodus: Lateral spine rows in 2 to 1 condition; spines large and sharp. Lateral spine ridge present, usually large or very large on specimens >20 OCL, smaller animals with only a small or vague ridge. Usually 5 mesal spines, occasionally 4 or 6 (7 on some regenerate chelae). 1-3 dorsal apical spines on specimens >80 OCL and on most 40-80 OCL, absent on some specimens <80 OCL and most <40 OCL. Usually 1-3 (rarely 4) spines above propodal cutting edge, spines occasionally absent especially on animals <40 OCL; spines apical (occasionally to midlength of gape) and medium sized or small. Spines usually absent lateral to dactylar base dorsally, sometimes 1 small spine (2 on one specimen) (spines most common on Cotter R. specimens); ventrally, O or 1 (rarely 2) spines lateral to dactylar base, usually small or medium sized, rarely large. Low ridge posterior to dactylar articulation; precarpal spines absent.

PropL/OCL: ♂ 0.91-1.09 i; ♀ 0.85-1.05. PropW/PropL 0.34-0.45. PropD/PropL 0.19-0.28 d.

Dactylus: Usually 1 spine above dactylar cutting edge, sometimes 2-4 (rarely 5), high counts usually on regenerate chelae; some regenerate chelae and some specimens <40 OCL lacking spines; spines apical (rarely to midlength of gape) and medium sized to small. Extra dorsal spines absent. Usually no dorsal or marginal mesal dactylar basal spines, sometimes 1 spine on either chela (usually regenerate), rarely a spine on both chelae (one specimen with 3 marginal spines on a regenerate chela); when present, basal spines usually medium sized or large, frequently somewhat flattened. Usually 2-3 apical spines, occasionally 1 (one small specimen with 4 on a regenerate chela). Dactylar groove absent or vague on specimens >40 OCL, more definite on lesser specimens.

DactL/PropL 0.50-0.60.

Carpus: 2 mesal carpal spines, frequently with small bump distal or proximal to spines; 1st (distal) spine usually much larger than 2nd and only slightly offset ventrally. 2(occasionally 1) lateral carpal spines, large on large specimens, medium sized or small on most specimens <40 OCL. Articulation spine usually absent, sometimes small or tiny on specimens <40 OCL. Dorsal carpal spines absent (low bumps on some regenerate chelae). Ventral spine very large, medium sized or small on some specimens close to or <20 OCL. Largest ventromesal spine large to small, usually medium sized; additional ventromesal spines merely bumps.

Merus: 5-8 large dorsal spines. Outer spine small or medium sized on specimens >80 OCL, medium or large on smaller specimens.

Keel: Pr1: Posterior margins usually sloped, occasionally almost semi-abrupt, rarely semi-abrupt (Kandos specimens with processes more abrupt than most other populations); ventral edges angled down (rarely rounded on small specimens); processes slightly or distinctly apart and parallel or slightly open. Keel after Pr1 usually pronounced anteriorly near bases of processes; distinct spine absent. Pr2: Open or very open. Keel after Pr2 lacking spines, sometimes weakly saddle-shaped. Pr3: Scoops usually distinct on large specimens, sometimes slight or gradual, absent on some specimens <20 OCL; processes usually rounded, sometimes moderately sharp. Keel after Pr3 low, often rather blunt, spines absent. Pr4: Scoops usually distinct, occasionally slight; posterior edges rounded to moderate curved and slightly convex, approximately straight or, most commonly, irregular; anterior edges angular or very angular. Processes 3 and 4 broad or very broad.

Setation: Light.

Punctation: Usually dense or very dense on cephalon, moderate to dense on thorax.

Gastric Mill: TAP count 5.0-7.0 (often variation between two zygocardiac ossicles of one animal; when TAP counts low, frequently a tiny secondary ear immediately posterior to main ear, effectively extending ear by one tooth); TAA count 1.0-1.5; spread 4.0-6.0. Urocardiac ridges 9-10.

Coloration: Body dorsally dark or medium green or brown, sometimes slightly tinged blue. Thoracic spines usually pale at tips, sometimes all white; general tubercles cream or pale brown. Abdominal somites laterally slightly tinged blue/green; abdominal spines pale orange, cream or white. Carpus of cheliped cream or white, medial groove often green on small specimens, mesal edge often tinged green or blue. Propodus cream or white, often with green or blue mottling on specimens <40 OCL. Fingers white or cream, tips often slightly tinged blue.

Body ventrally orange, brown, green and cream. Carpus of cheliped cream or white, often tinged blue mesally. Propodus like carpus, sometimes orange tinge mesally.

Chelae mottled green and yellow on small crayfish.

Sexes: Males lack a cuticle partition. Females <40 OCL have unopen gonopores. Some females in the 40-100 OCL range are open, the percentage increasing with increasing size. One female >100 OCL has pores with feint setae developing, but unopen. It appears that female maturity occurs from OCLs of 40 to 100 mm (or more) and very large specimens can be immature.

Distribution and biology. The species occurs in the Murray River throughout most of its length and major tributaries in Victoria (including the Goulburn, Yea, Murrundindi, Jamieson, Howqua, Ovens and Mitta Mitta Rivers) and New South Wales (including the Murrumbidgee, Cotter and Macquarie Rivers) (Fig. 7). The range extends over 800 km east-west. The most northerly known site of the species is near Kandos 160 km west of Newcastle, NSW. Presumably the creek flows into the Cudgegong and thence Macquarie and Darling Rivers. This site indicates a north-south range of approximately 450 km. *Euastacus armatus* inhabits large and small streams in a variety of habitats including cleared pasture and dry and wet sclerophyll forests (vegetation usually densest along upper reaches of streams) at altitudes from close to sea level to over 700 m a.s.l. Low elevations may be depopulated with possible extinction of the species in South Australia (Kaires, 1980; Zeidler, 1982). *Euastacus armatus* is sympatric with *Cherax destructor* for much of its range. Females are berried in winter, with hatching in spring and summer (Johnson, 1974).

Remarks. While by no means constant in characters *E. armatus* is remarkably invariable considering the size of its range, the largest for any species of *Euastacus*. Without further information, it seems valid to suggest the continuity of the Murray River drainage as responsible for comparatively free gene flow in *E. armatus*. The species is morphologically similar to *E. yarraensis* but the two can be distinguished by the characters listed in the key to species and in the diagnosis of *E. yarraensis*.

The collections of *E. armatus* are patchy with several of the large museum specimens unlabelled, but it is possible that maturation size varies with habitat. All mature females in the 40-80 mm OCL range were collected from relatively small streams, the Cotter and Howqua Rivers. No mature females smaller than 80 mm OCL have been collected from large watercourses, including the Murray, Murrumbidgee and Goulburn Rivers. Additionally, a sponge infection of the thorax observed on some Murrumbidgee specimens (AM P21833) appears to have retarded female maturation.

Euastacus armatus has a long taxonomic history as evidenced by the synonymy. The holotype is lodged in the Zoologisches Museum, Berlin. Its type locality is the Murray River.

Euastacus bidawalus sp. nov.

Figures 10, 11

Material examined. Holotype: ♂, OCL 48.0 mm, NMV J4526. Vic., Chandlers Ck, near junction with Cann R., 27 km north of Cann River, (37°20'S., 149°13'E.), 9 Nov 1981, G.J. Morgan and S.J. Harders.

Paratypes: Vic., Mt Drummer, Alfred National Park, 4 Dec 1956, EFR, AM P15313, 2♂♂, 6♀♀.

Other specimens: Vic. Upper Cann R., above Chandlers Ck, 23 March 1968, J.C. Yaldwyn and F.J. Beeman, AM P16191, 3♂♂, 1♀; Gibbs Ck, south of Cann River, 1982, P. Horwitz, 1♀; Dingo Ck, Lind National Park, 4 Jan 1982, P. Horwitz, 1♀; Type locality, GJM and SJH, NMV J5931, 1♀; Karlo Ck tributary, Alfred National Park, (37°32'S., 149°22'E.), 9 Nov 1981, GJM and SJH, NMV J5929, 2♂♂, 2♀♀; Beehive Ck, east of Chandlers Ck, (37°20'S., 149°15'E.), 9 Nov 1981, GJM and SJH, NMV J5928, 1♂; Euchre Ck, Lind National Park, (37°34'S., 148°57'E.), 9 Nov 1981, GJM and SJH, NMV J5932, 2♀♀. NSW. Imlay Ck tributary, south-west of Eden, (37°14'S., 149°44'E.), 8 Nov 1981, GJM and SJH, 2♂♂.

Diagnosis. Male cuticle partition present. Rostral spines rarely proximal to midlength of carinae. Rostral base divergent or very divergent, carinae spread. Antennal squame widest at approximately midlength, marginal spines absent. Suborbital spine small or medium sized. Thoracic spines usually medium sized, distributed in row or thin zone. General tubercles medium sized, moderately distributed or dense. 4-7 Li spines on abdominal somite 2 (>30 OCL), spines usually medium sized to large, sometimes small. D abdominal spines very small and blunt. Abdominal boss absent. Tailfan spines absent. Lateral propodal spines in 2 to 1 or 2 row condition. 1 dorsal apical propodal spine (>30 OCL). Spines above propodal cutting edge apical or to midlength of gape. 5 (rarely 6) mesal propodal spines. Spines above dactylar cutting edge reaching midlength or proximal to midlength of gape. 1 (rarely 2) dorsal mesal dactylar basal spine(s). 1-2 marginal mesal dactylar basal spines. 2 apical mesal dactylar spines. 3 (rarely 4) mesal carpal spines. Largest ventromesal carpal spine rarely as large as ventral carpal spine. Keel Pr1 sloped or almost semi-abrupt and close. TAP count 7.0-9.0.

Description. Maximum OCL: 48.0 mm.

Rostrum: Rostrum short, at most reaching midlength of 3rd antennal segment and frequently not reaching base of segment. Rostral sides slightly convergent, almost parallel on several specimens; base divergent to very divergent and carinae moderately spread or spread. 1(+1)-4 rostral spines per side, higher numbers usually on large specimens; spines usually not reaching midlength of carinae, sometimes to or slightly proximal to midlength; spines medium sized to small and moderately pointed to rounded, sometimes sharp on small specimens. Acumen spine similar to or slightly larger than marginal spines.

OCL/CL 0.80-0.87 i. RW/OCL 0.15-0.20 d.

Cephalon: Spination moderate or poor (very poor on some crayfish <20 OCL) with 1-3(4) medium sized or small spines and tiny bumps ventral to postorbital ridges. 1st postorbital spine small on specimens >30 OCL, medium sized, rarely large, on smaller crayfish; 2nd spine small or edge (one small specimen lacking 2nd spine). Suborbital spine small to medium sized, large on some specimens <20 OCL. Lateral margin of squame straight to slightly convex; squame widest at midlength or slightly proximal or distal to midlength; marginal spines absent. Interantennal spine medium width to broad, very broad on some crayfish <20 OCL; spine margin scalloped, sometimes almost toothed. Basipodite spine small to medium sized on specimens >20 OCL (large on one specimen, absent on another), medium or large on smaller specimens. Coxopodite spine medium/large to small; spine unimodal, bifid or serrated.

ScL/OCL 0.13-0.24 d.

Thorax: Usually 5-8 thoracic spines per side on large animals, in a row or thin zone; spines medium-large to medium-small (often with

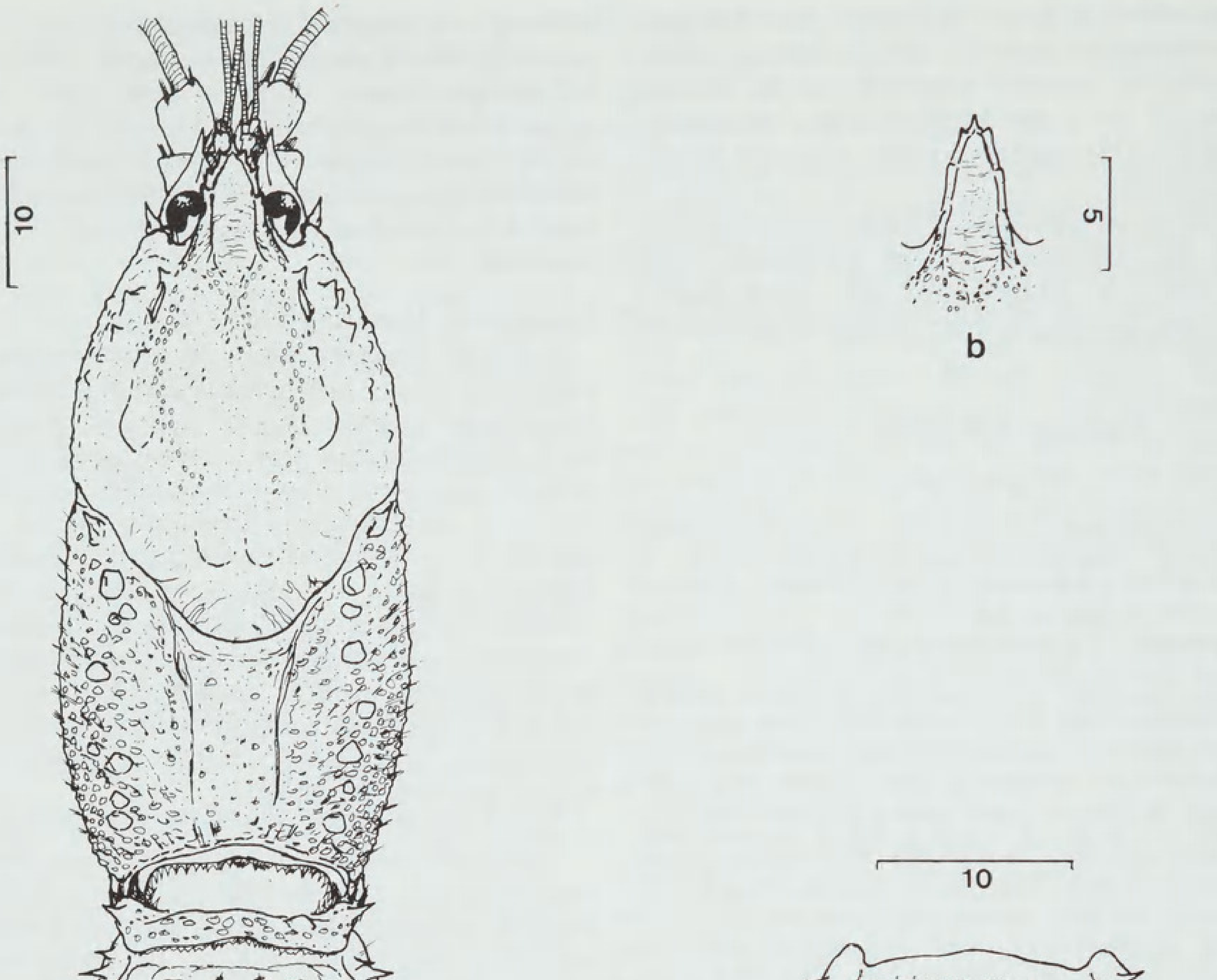

Figure 10. *Euastacus bidawalus* – a, dorsal view holotype ♂, Chandlers Ck, NMV J4526; b, rostrum (allometry), ♀, Chandlers Ck; c, somite 2, fewer spines, F, Gibbs Ck; d, zygocardiac ossicle, holotype ♂.

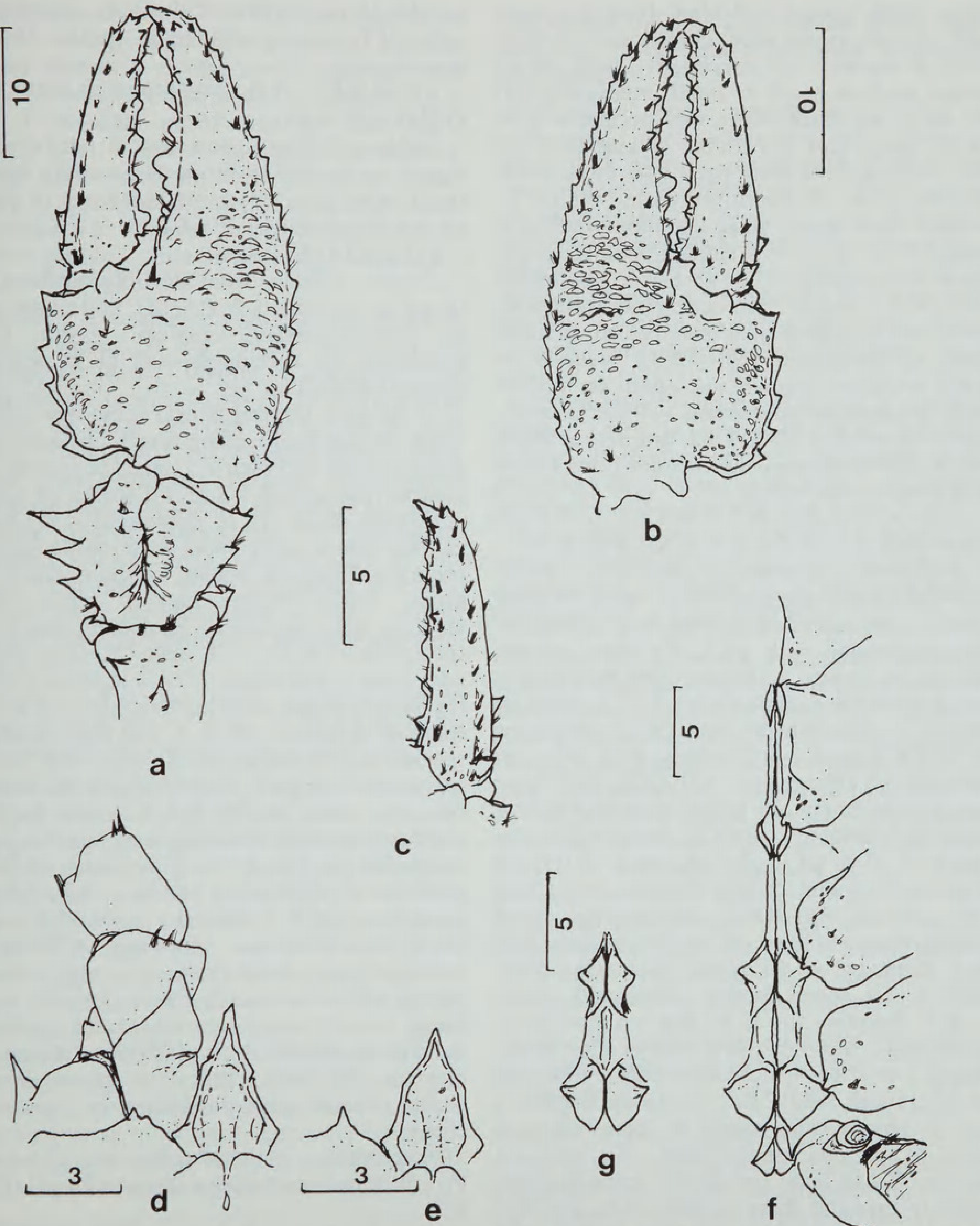

Figure 11. *Euastacus bidawalus* – a, dorsal view chela, holotype ♂; b, chela, more elongate, more numerous spines above cutting edges, small spine lateral to dactylar base, ♂, Karlo Ck, NMV J5929; c, dactylus, 2 marginal mesal basal spines, ♀, Euchre Ck, NMV J5932; d, ventral view cephalon, holotype ♂; e, ventral view cephalon, ♀, Chandlers Ck; f, sternal keel, holotype ♀; g, sternal keel, narrower Pr3 and 4, ♀, Gibbs Ck.

some small spines) and blunt (one specimen with dorsal spines only immediately behind cervical spines); on specimens 20-30 OCL, spines medium-small to small, numbering 2-6 or only just discernible; on specimens <20 OCL, spines just discernible or absent. General tubercles medium sized and moderately distributed to dense on crayfish >30 OCL, usually small or very small and moderately distributed to sparse on smaller animals; very small and very sparse or absent on specimens <20 OCL. Usually 2 cervical spines, occasionally 1 or 3; spines medium/large to medium sized on specimens >30 OCL, medium to small on lesser animals and sharp or moderately pointed on specimens >30 OCL, moderate on crayfish 20-30 OCL and rather blunt on smaller specimens; dorsal spine often larger and sharper than others.

ArL/OCL 0.33-0.38. CaW/OCL 0.57-0.63. ArW/OCL 0.12-0.19 d. CaD/OCL 0.48-0.56.

Abdomen: D-L spine on somite 1 of crayfish >30 OCL and some 20-30 OCL; spine medium sized to tiny and sharp to blunt, size and sharpness increasing with OCL. D spine usually absent on somite 1 (largest specimen with a small blunt spine on one side). 4-7 Li spines on somite 2 of specimens >30 OCL; specimens 20-30 OCL with 2-3(5) spines. 1 Li spine on somites 3-5 of animals >30 OCL and some smaller specimens. Li spines large to medium sized on specimen >40 OCL, medium/large to small on 30-40 OCL crayfish, small or tiny on smaller specimens; spines sharp or very sharp on crayfish >30 OCL, moderately sharp (rarely sharp) to blunt on smaller crayfish. Size and sharpness of Li spines decreasing posteriorly. Lii spines poorly developed, small (rarely medium sized) to tiny on specimens >30 OCL, tiny or absent on smaller specimens; 2 or 3 Lii spines on somites 2 and 3 of most crayfish >30 OCL, rarely on somites 4 and 5, absent from somite 6; spines medium sized to tiny and usually blunt. D-L spine on somites 2-4 of large specimens, spine medium sized to tiny and sharp to blunt. Small or tiny D spine on somites 2-4 of largest animal, only on somite 2 of some 30-40 OCL crayfish; D spines blunt or very blunt (and slightly darker in colour). D and D-L spines poorly developed or absent on crayfish <30 OCL. Specimens <20 OCL lacking abdominal spines. Dorsal boss absent.

AbdW/OCL: ♂ 0.47-0.55 d; ♀ 0.47-0.57 d. OCL/L 0.37-0.43 i.

Tailfan: Tailfan spines absent; slight setal bumps on margins of uropods. Standard spines small to medium sized, medium/large or large on some specimens <30 OCL.

TeL/OCL 0.32-0.42 d.

Chelae: Chelae stout to intermediate in shape on specimens >30 OCL, more elongate on some smaller crayfish. Teeth well developed on specimens >40 OCL and on some 30-40 OCL.

Propodus: Ventral lateral spine row sometimes closely approaching finger tip (almost 2 rows), or gap and then 1-3 spines near apex, or ventral row ending 1/3 or 1/2 length of propodus from distal tip; on specimens <30 OCL, ventral row usually short near midlength of propodus. Lateral spines medium sized to small, rather sharp. Lateral spine ridge medium sized on largest specimen, small on specimens <40 OCL. Usually 5 mesal propodal spines, sometimes 6 on one chela (some regenerate chelae with 4 spines). Dorsal apical spine on animals >30 OCL and many smaller specimens, absent on crayfish <20 OCL. Most specimens >20 OCL with 2-3 spines above cutting edge, some 20- 30 OCL with only 1 spine and one specimen lacking spines; spines apical or reaching midlength of gape (rarely slightly proximal to midlength) and large to medium sized on crayfish >30 OCL, medium to small on lesser specimens. Crayfish <20 OCL lacking spines above the cutting edge. Many bumps lateral to dactylar base dorsally, very rarely a small spine; ventrally, 1-3(4) medium sized or small spines, often vague or absent on crayfish <30 OCL. Precarpal spines usually absent, a small spine sometimes on regenerate chelae.

PropL/OCL: ♂ 0.77-0.88; ♀ 0.73-0.84. PropW/PropL 0.42-0.48 i. PropD/PropL 0.26-0.31

Dactylus: 2-6 medium to small spines above dactylar cutting edge of specimens >30 OCL, reaching to or proximal to midlength of gape; on smaller specimens, 1-6 spines, sometimes apical; specimens <20 OCL lacking spines above cutting edge. Extra dorsal dactylar spines absent. 1 dorsal mesal dactylar basal spine (2 on one chela of one specimen). Usually 1 marginal mesal dactylar basal spine (rarely 2 or 3 spines on regenerate chelae). Basal spines medium sized to large, rather sharp. 2 apical mesal dactylar spines (one small specimen with 3 spines on one chela). Dactylar groove present, often light on large specimens.

DactL/PropL 0.54-0.62.

Carpus: 3 mesal carpal spines (one specimen with 4 spines on one chela), spines evenly spaced, 1st (distal) slightly or distinctly offset ventrally to others. 2 (rarely 3) lateral carpal spines, medium to large on specimens >30 OCL, often smaller on lesser crayfish. Articulation spine absent or very small, medium sized on some small specimens. Dorsal carpal spines usually absent (sometimes on regenerate chelae). Ventral spine medium/large to very large. Usually 2 or 3 ventromesal spines; largest spine medium/small to large, usually smaller than ventral spine, occasionally similarly sized.

Merus: 5-9 dorsal spines, medium sized to large. Outer spine small to medium sized, occasionally large on specimens <20 OCL.

Keel: Pr1: Posterior margins sloped or almost semi-abrupt; ventral edges usually angled down; processes close (slightly apart on some specimens <20 OCL) and parallel. Keel after Pr1 low, without spines. Pr2: Open. Keel after Pr2 low, sometimes a slight bump immediately posterior to processes. Pr3: Scoops slight or gradual, bases quite rounded, often distinctly concave. Keel after Pr3 low or slightly pronounced, pronounced on some specimens <30 OCL. Pr4: Scoops absent or very slight; posterior edges moderate to sharp and slightly convex to straight; anterior edges angular (rarely moderately curved). Processes 3 and 4 narrow or just broad on specimens >30 OCL, broad on some smaller crayfish.

Setation: Light.

Punctation: Dense or very dense.

Gastric Mill: TAP count 7.0-9.0 (high counts usually on large specimens); TAA count 0.5-1.0; spread 6.0-8.5. Zygocardiac teeth small and close. Urocardiac ridges 8-10, increasing with growth.

Coloration: Body dorsally green/brown or red/brown, paler ventrolaterally. Thoracic spines dark blue or green; general tubercles pale yellow. Rostral carinae dark green. Abdominal somites blue or green laterally; abdominal spines dark with either yellow (Li, D-L) or blue (D) tips when sharp. Carpus of cheliped orange or brown with green or blue mottling, mesal spines green. Propodus similar to carpus, lateral spines cream. Fingers blue/green.

Body ventrally cream and orange. Carpus of cheliped mesally green or blue, laterally orange. Propodus orange, sometimes with green mottling, lateral edge pale, mesal edge green or blue. Fingers with blue tips.

Sexes: Male cuticle partition present. All females examined have unopen gonopores. It must be assumed that onset of female maturity usually occurs at sizes >40 OCL.

Distribution and biology. The species has been collected at elevations between 150 m and 400 m above sea level from easterly and southerly flowing streams from near Mt Imlay south of Eden (New South Wales) to Lind National Park, 20 km west of Cann River (Victoria), a distance of about 90 km. Dry sclerophyll forest and heath vegetated ridges above streams with tree ferns and vines frequently along valleys. *Euastacus bidawalus* is present in cleared areas if a border of vegetation persists along creeks. In the north of its range in New South Wales, the species is sympatric with another new species of *Euastacus* (Morgan, in prep. b).

Etymology. Named after Bidhawal, the major aboriginal language of the species' range (Eades, 1976).

Remarks. The species has been collected from only a small range and does not display marked geographical variation, though specimens from the southern and western parts of the known range commonly have a second marginal mesal dactylar basal spine.

Euastacus bidawalus is similar morphologically to *E. diversus*.

Euastacus bispinosus Clark

Figures 12, 13

Euastacus nobilis kershawi.–Clark, 1936: 16-17 (in part, Glenelg R. locality).–1937a: 35 (in part, inclusive distribution).–1937b: 186.

Euastacus bispinosus Clark, 1941: 22-4, pl. 7.–Clark & Burnet, 1942: 90-2.–Riek, 1969: 895.

Material examined. Holotype: ♀, OCL 119.5 mm, NMV J875. Vic., Glenelg R., H. Pritchard (fide Clark, 1941).

Paratype: Vic., type locality, NMV J873, ♀.

Other specimens: Vic. Glenelg R., Lake Moora Moora, 12 Nov 1963, JRK, NMV J6174, J6176, J6221, J6222, 7♂♂, 11♀♀; Headwaters of Glenelg R., 16 Dec 1966, 1♀; Little Moleside Ck, tributary of Glenelg R. near Dartmoor, 9-11 Nov 1970, 1♂, 3♀♀; Wannon R., Grampians, 23 Nov 1969, EFR, 1♀; 2♂♂, Glenaulin Ck, tributary of Crawford R., (37°59'S., 141°23'E.), 26 Mar 1982, GJM and SJH, 2♂♂; Crawford R., (38°56'S., 141°27'E.), 26 Mar 1982, GJM and SJH, NMV J5934, 1♂, 3♀♀; Rose Ck above Burrong Falls, Grampians, (37°08'S., 142°21'E.), 27 Mar 1982, GJM and SJH, NMV J5933, 6♂♂, 2♀♀; Wannon R., Grampians (37°21'S., 142°30'E.), 28 Mar 1982, GJM and SJH, NMV J5935, 1♂, 3♀♀.

SA. Ewens Ponds, Mt Gambier, 6 Sep 1975, N. Coleman, AM P25029, 1♂, 1♀.

No locality. AM P13219, 2♀♀; NMV, 7♀♀.

Diagnosis: Male cuticle partition absent. Rostral spines apical, rarely to midlength of carinae. Rostral base divergent, rarely parallel; carinae medium length to long. Antennal squame widest slightly proximal to midlength. Marginal squamal spines absent. Suborbital spine small or medium sized (>60 OCL). Thoracic spines large or medium sized and rounded or flat, in irregular row. General tubercles large or medium sized (>60 OCL), moderately distributed or sparse. Usually 2 (rarely 1 or 3) Li spines on abdominal somite 2, spines large and sharp. D abdominal spines usually absent, occasionally small spines anteriorly. Abdominal boss well developed (>40 OCL), boss not distinctly U-shaped. 3-8 telsonic surface spines. Uropod outer ramus usually with 2-6 marginal spines. Lateral propodal spine rows in 2 to 1 condition. 1-2 dorsal apical propodal spines. Spines above propodal and dactylar cutting edges reaching or proximal to midlength of gape (rarely apical). 5 (rarely 4) mesal propodal spines. 1-3 (rarely 4) dorsal mesal dactylar basal spines. Marginal mesal dactylar basal spines usually absent. 2-4 apical mesal dactylar spines. 2 (occasionally 3) mesal carpal spines. Largest ventromesal carpal spine smaller than ventral spine. Keel Pr1 abrupt and close or apart. TAP count 5.5-8.0.

Description: Maximum OCL: 130.3 mm.

Rostrum: Rostrum short of, to slightly overeaching, midlength of 3rd antennal segment on specimens >40 OCL; to midlength or end of segment on most specimens 20-40 OCL and distal to segment on some specimens close to or <20 OCL. Rostral sides usually slightly convergent, sometimes convergent or parallel. Bases usually divergent or very divergent, occasionally parallel; carinae medium length or long. 2-4 rostral spines per side, usually apical or distal to midlength of carinae, occasionally reaching or exceeding midlength; spines small on specimens >80 OCL, small to medium sized on most smaller specimens (rarely large on very small crayfish); spines rounded to sharp. Acumen spine slightly or distinctly larger than marginal spines on specimens > 80 OCL, much larger on lesser individuals.

OCL/CL 0.74-0.91 i. RW/OCL 0.13-0.24 d.

Cephalon: Spination poor or moderate with 1 or 2 spines (frequently rather blunt) and some bumps ventral to postorbital ridges. 1st postorbital spine an edge or small on specimens >60 OCL, often medium sized on smaller animals and large on specimens close to or <20 OCL; 2nd spine a small edge or edge (occasionally absent on specimens >60 OCL), sometimes small on lesser crayfish and medium sized or large on some specimens <40 OCL. Suborbital spine small to medium sized on specimens >60 OCL, larger on smaller specimens. Lateral margin of antennal squame usually distinctly or slightly convex, occasionally straight especially on specimens <20 OCL; squame widest at slightly proximal to midlength on large specimens, distinctly proximal on small crayfish; marginal spines absent (one large specimen with spine on one squame). Interantennal spine elongate to medium width on specimens >60 OCL, usually medium to broad (or very broad) on smaller animals; spine margin toothed or very scalloped; centre often with small spine. Basipodite spine absent or small (rarely medium sized) on specimens >40 OCL, small to large on smaller animals (sometimes very large on specimens <20 OCL). Coxopodite spine small to medium sized on specimens >60 OCL, medium to large or very large on lesser individuals and usually bifid or serrated, sometimes unimodal.

ScL/OCL 0.12-0.31 d.

Thorax: 2-8 (usually 3-5) dorsal thoracic spines per side; spines large or medium sized on specimens >20 OCL and small on lesser crayfish; spines usually rounded or flat, rarely blunt or sharp posteriorly, and usually distributed in 1 irregular row. General tubercles large to medium sized on specimens >60 OCL, medium to small on specimens 20-60 OCL, very small or absent on smaller crayfish; tubercles moderately distributed to sparse. 1-4 cervical spines per side, usually medium sized or small and moderately pointed or blunt, though dorsal spine sometimes large and sharp.

ArL/OCl 0.33-0.38. CaW/OCL 0.57-0.63. ArW/OCL 0.12-0.19 d. CaD/OCL 0.48-0.56.

Abdomen: Usually D-L spine on somite 1, large and sharp on most specimens >60 OCL, often medium sized or small on smaller animals; specimens <20 OCL lacking spine. D spine absent from somite 1. Somite 2 with 1-3 Li spines, except on specimens <20 OCL; somites 3-5 with 1 Li spine; Li spines very large or large and very sharp on specimens >60 OCL, large to medium sized on specimens 40-60 OCL and medium to tiny, sharp to moderately pointed on lesser individuals. 1-2 Lii spines usually on somites 3-6 of specimens >60 OCL and some small crayfish; Lii spines diminishing in size posteriorly from large or medium sized to small on large specimens, medium or small to tiny on small animals; spines very sharp on specimens >60 OCL, sharp to blunt on lesser individuals. 1 D-L spine on somites 2-6 of most specimens >20 OCL, declining in size to posterior from very large or large to small or tiny on specimens >40 OCL, usually medium sized to tiny on smaller crayfish; spine very sharp on specimens >40 OCL, usually sharp to blunt on smaller animals. D spines frequently absent, but dorsal boss obvious on specimens >40 OCL, especially on somites 2-4; boss not distinctly U-shaped. Some specimens, especially from northern areas (eg. Grampians), with small or tiny (rarely medium sized), usually sharp or moderately pointed D spines on boss of somite 2 and rarely somites 3 and 4; D spine often on one side only. Specimens <20 OCL lacking abdominal spines.

AbdW/OCL: ♂ 0.47-0.57 d; ♀ 0.50-0.59 di. OCL/L 0.35-0.45 i.

Tailfan: 3-8 (usually 4-6) telsonic surface spines on specimens >20 OCL; spines very large to medium sized on specimens >80 OCL, large to small on lesser individuals. Specimens <20 OCL and some slightly larger animals lacking spines. Marginal telsonic spines usually absent, sometimes 1 spine on large specimens. Inner ramus of uropod usually with 1-2 (rarely 3) large or medium sized surface spines, sometimes absent; usually 1-4 large to small marginal spines on inner ramus, occasionally absent especially on small specimens. Outer ramus of specimens >80 OCL usually with 2-6 large marginal spines; smaller specimens with 1-3 spines, or spines absent. Standard spines very small to medium sized on specimens >60 OCL, medium to large on specimens 20-60 OCL, large or very large on smaller animals.

TeL/OCL: ♂ 0.31-0.43 d; ♀ 0.32-0.41 d.

Chelae: Chelae stout to elongate (intermediate in shape or elongate on large animals). Teeth well developed on specimens >60 OCL.

Propodus: Lateral spine rows in 2 to 1 condition, ventral row sometimes almost reaching apex (nearly 2 rows), but usually poorly developed on specimens <20 OCL; lateral spines medium sized to large. Lateral spine ridge present, ranging from vague to obvious. Usually 5, rarely 4, mesal propodal spines. 1-2 (3 on one specimen) dorsal apical spines on specimens >40 OCL and some smaller animals. 2-5 spines above propodal cutting edge on specimens >40 OCL, 1-4 on most specimens 20-40 OCL; spines sometimes apical but usually distributed to or proximal to midlength of gape, sometimes full gape; spines large or medium sized on specimens >60 OCL, medium to small on lesser crayfish. Specimens <20 OCL lacking spines above cutting edge. Usually no spines lateral to dactylar base dor-

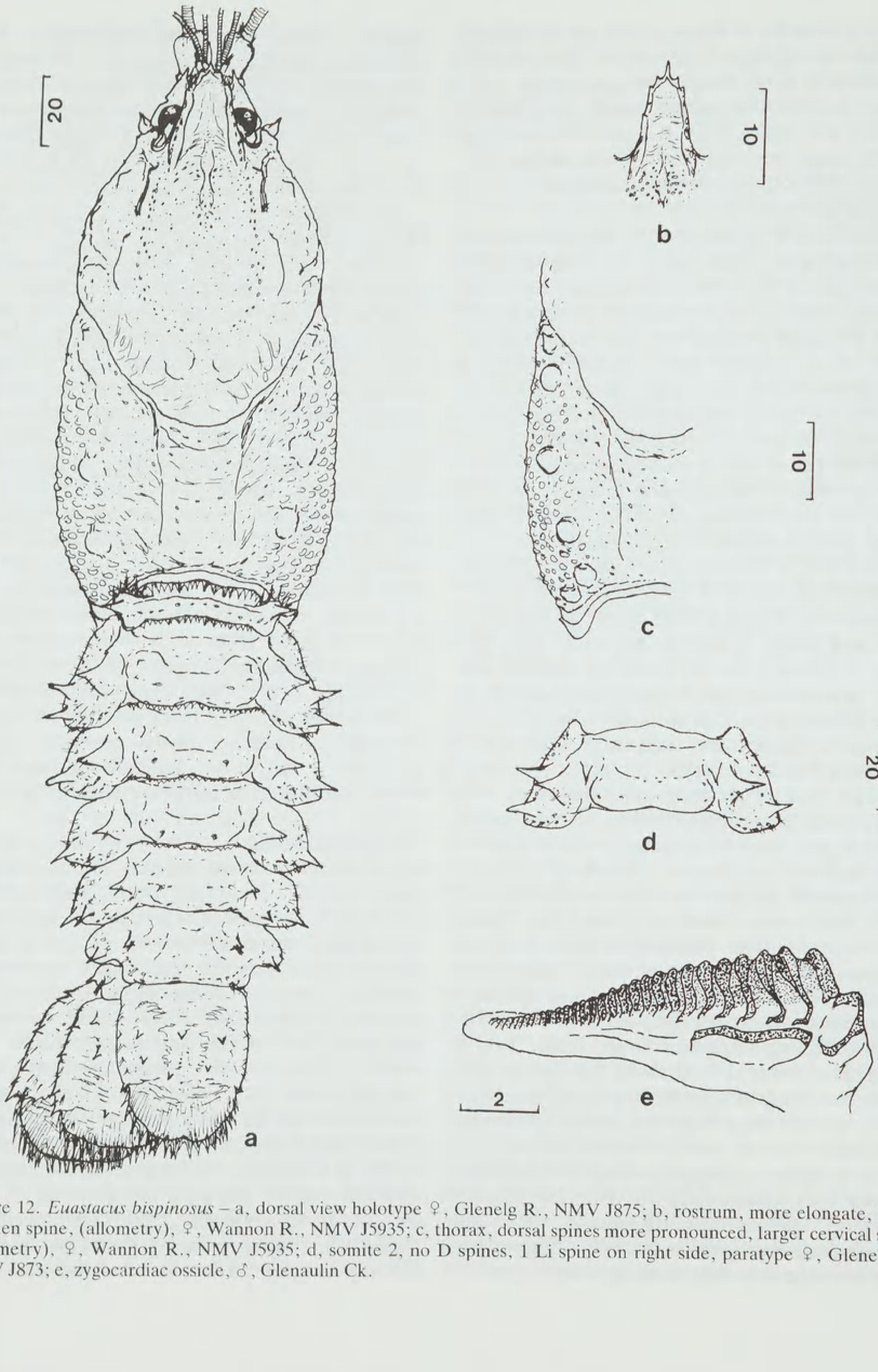

Figure 12. *Euastacus bispinosus* – a, dorsal view holotype ♀, Glenelg R., NMV J875; b, rostrum, more elongate, larger acumen spine, (allometry), ♀, Wannon R., NMV J5935; c, thorax, dorsal spines more pronounced, larger cervical spine, (allometry), ♀, Wannon R., NMV J5935; d, somite 2, no D spines, 1 Li spine on right side, paratype ♀, Glenelg R., NMV J873; e, zygocardiac ossicle, ♂, Glenaulin Ck.

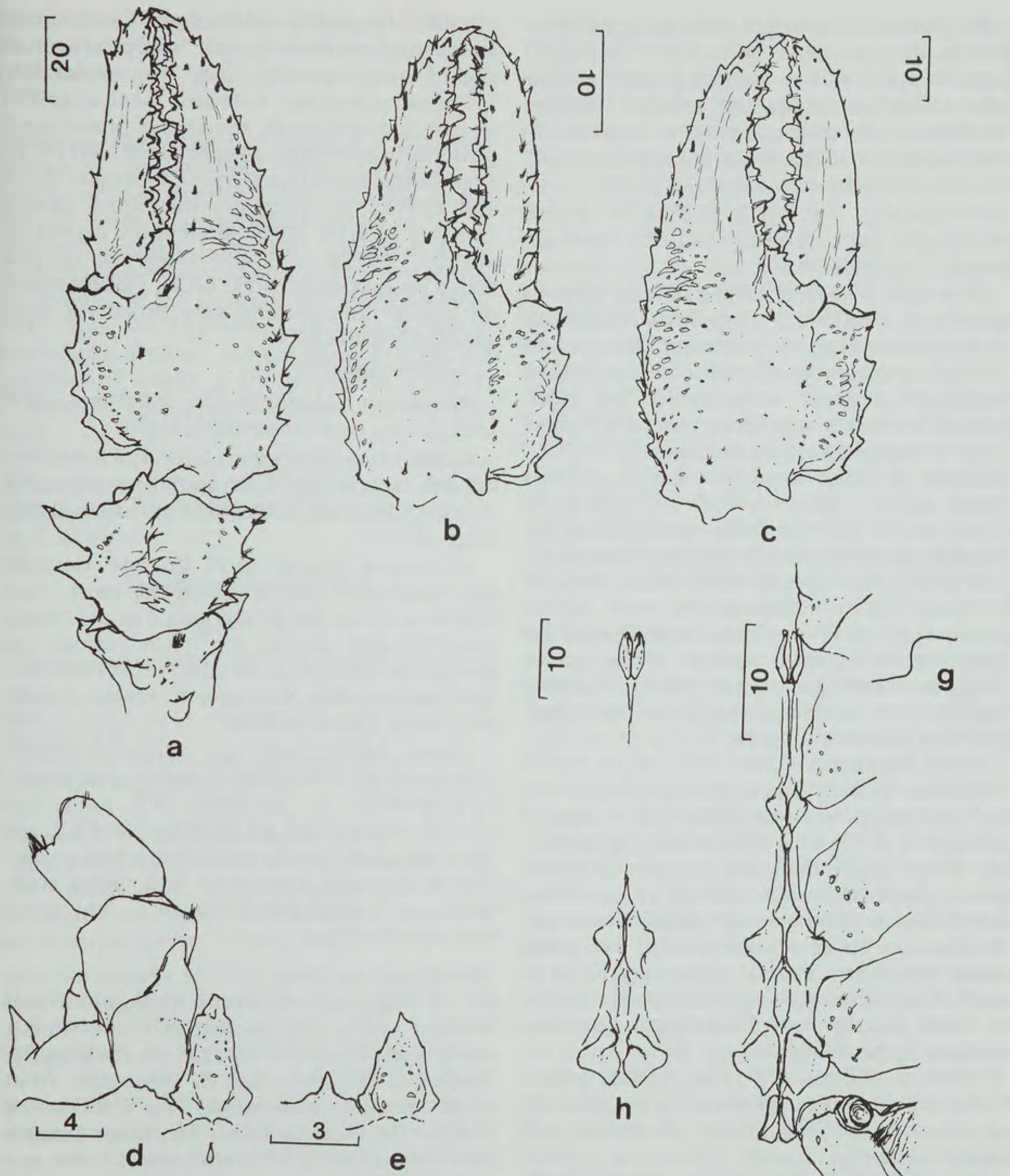

Figure 13. *Euastacus bispinosus* – a, dorsal view chela, holotype ♀; b, chela, 2 dorsal apical propodal spines, more numerous spines above cutting edges, small spine lateral to dactylar base, 3 dorsal mesal dactylar basal spines, ♀, Wannon R., NMV J5935; c, chela, stouter, 1 dorsal mesal dactylar basal spine, ♂, L. Moora Moora; d, ventral view cephalon, holotype ♀; e, ventral view cephalon, ♀, Wannon R., NMV J5935; f, sternal keel, ♂, L. Moora Moora; g, profile Pr1; h, sternal keel, Pr1 closer, Pr3 and 4 narrower, holotype ♀.

sally, sometimes medium sized or small spine usually on one chela only; ventrally, 1-2(3) large to small spines. Proximal spine at dactylar articulation frequently inflated on large specimens. Low ridge sometimes proximal to dactylar articulation. Precarpal spines usually absent, except on some small specimens.

PropL/OCL: ♂ (0.80)0.85-0.99 i; ♀ (0.83)0.85-0.96 i. PropW/PropL 0.37-0.48 id; PropD/PropL 0.22-0.30.

Dactylus: 3-7 spines above cutting edge of specimens >40 OCL, 1-6 on most specimens 20-40 OCL, absent on specimens close to and <20 OCL; spines distributed to or proximal to midlength of gape, sometimes to full gape, (apical on some regenerate chelae); spines large to medium sized on specimens >60 OCL, medium to small on lesser animals. Extra dorsal dactylar spines absent. 1-3 (rarely 4) dorsal mesal dactylar basal spines; marginal mesal basal spines usually absent, occasionally 1 or 2 (rarely 3) spines; basal spines large or medium sized on specimens >60 OCL, medium to small on lesser individuals. 2-4 apical mesal dactylar spines. Basal spines sometimes reaching apical spines, forming irregular row of mesal dactylar spines. Dactylar groove absent or light.

DactL/PropL 0.52-0.60.

Carpus: Usually 2 mesal carpal spines, often with proximal (and sometimes distal) bumps, sometimes 2(+1) or 3 spines; distal spine usually much larger than 2nd. Usually 2 lateral spines, large to medium sized on specimens >40 OCL, medium to small on lesser animals. Articulation spine absent, except on some small specimens. Ventral spine very large or large. Largest ventromesal spine medium/large to small; usually 2 or 3 additional tiny ventromesal spines/bumps.

Merus: 4-7 usually large dorsal spines. Outer meral spine medium sized or small on specimens >40 OCL, large or medium on smaller animals.

Keel: Pr1: Posterior margins abrupt (rarely semi-abrupt); ventral edges flat, rounded or angled back; processes close or apart and usually parallel or open. Keel after Pr1 sometimes with a slight anterior bump. Pr2: Usually open, or very open on specimens <60 OCL. Keel after Pr2 frequently saddle-shaped, sometimes small spine posteriorly. Pr3: Scoops absent or slight; bases usually sharp or moderately rounded, sometimes rounded. Keel after Pr3 usually saddle-shaped, sometimes pronounced posteriorly especially on specimens <60 OCL. Pr4: Scoops absent; posterior edges quite sharp and convex or irregular, sometimes almost straight; anterior edges moderately curved or angular. Processes 3 and 4 narrow or just broad on specimens >100 OCL, usually broad on smaller animals and very broad on most specimens <40 OCL.

Setation: Light.

Punctation: Moderate on specimens >60 OCL, dense on most smaller animals.

Gastric Mill: TAP count 5.5-8.0; TAA count 0.5-1.0; spread 4.5-7.5. Variation primarily due to differences in length of ear. Urocardiac ridges 8-11.

Coloration: Similar to *E. kershawi* dorsally but abdominal spines sometimes more blue tinged or cream and D abdominal spines (when present) dark brown or black; spines on cheliped usually paler, mottling often more distinct on propodus. Similar to *E. kershawi* ventrally, often cream on keel.

Sexes: Males lack a cuticle partition. Females <40 OCL have unopen gonopores. One specimen in the 40-60 OCL range has open gonopores and all females >60 OCL are open, frequently with eggs or attached young. Female maturity appears to occur most commonly at approximately 60 OCL, but some variation is evident.

Distribution and biology. The species inhabits the Glenelg River and its tributaries of western Victoria and is also present in Ewens Ponds south of Mt Gambier, South Australia (Fig. 7). Zeidler (1982) recorded *E. bispinosus* from small coastal streams east of Port MacDonnell (SA) to the Glenelg River. The range extends from close to sea level to altitudes of 320 m and probably slightly greater elevations in areas of the Grampians. Vegetation at low sites includes *Eucalyptus* and *Leptospermum* species, bracken (*Pteridium*), with wet sclerophyll forest and pine plantations in areas. In the Grampians, sites are bordered by heath, with vines and ferns in some sheltered valleys. Berried females have been collected in November and in "early spring" (Clark, 1937b).

Remarks. *Euastacus bispinosus* is a relatively invariable species and most variation is allometric. Geographic differences are minor but are evident in the development of the D abdominal spine. On most southern specimens, D spines are absent though a dorsal boss is obvious. In the north of the range, particularly from the Grampians area, many specimens bear a small, usually sharp D spine on the boss of somite 2, rarely somites 3 and 4. Frequently the spine is present on one side only.

Euastacus bispinosus most closely resembles *E. kershawi* of Gippsland. The species can be distinguished by characters noted in *Remarks* of *E. kershawi*.

Euastacus diversus Riek

Figures 14, 15

Euastacus diversus Riek, 1969: 908, fig. 20E.

Material examined. *Holotype*: ♂, OCL 28.2 mm, AM P15711. Vic., 30 miles (48 kilometres) north of Orbost, 6 Dec 1956, E.F. Riek.

Allotype: ♀, OCL 29.9 mm, type locality, AM P15712.

Paratypes: Type locality, AM P15713, 3♂♂, 7♀♀.

Diagnosis. As for *E. bidawalus* except:

1-2 marginal squamal spines, sometimes on one squame only. Thoracic spines absent. 2-4 Li spines on abdominal somite 2. 3(+1)-4 mesal carpal spines. TAP count 8.0-9.0.

Description: Maximum OCL: 32.2 mm.

Rostrum: Rostrum rather short, never longer than midlength of 3rd antennal segment, often only to base of segment on large specimens. Rostral sides slightly convergent or almost parallel, base divergent or very divergent and carinae short and slightly spread. 1-2(+1) rostral spines per side, apical or short of midlength of carinae; spines small (medium/small on some specimens <20 OCL), usually rounded, sometimes moderately pointed on very small specimens. Acumen spine similar to or slightly larger than marginal spines.

OCL/CL 0.81-0.86 i. RW/OCL 0.15-0.23 d.

Cephalon: Spination moderate to poor, 1-3 medium or small spines and some tiny bumps ventral to postorbital ridges. 1st postorbital spine small on specimen >30 OCL, small to large on specimens 20-30 OCL, large on specimens <20 OCL; 2nd spine usually absent (one animal with edge). Suborbital spine medium sized to medium/large. Lateral margin of antennal squame concave or straight; squame widest at midlength or slightly distal to midlength; 1-2 large marginal spines, sometimes on only one squame (one very small animal lacking spines). Interantennal spine medium width to broad; spine margins scalloped. Basipodite spine small to medium sized on crayfish >20 OCL, large or very large on small animals. Coxopodite spine small to medium sized and usually bifid.

ScL/OCL 0.16-0.29 d.

Thorax: Dorsal spines absent (one specimen with bump immediately posterior to cervical spines). General tubercles medium sized to medium/large on specimens >20 OCL, small on smaller crayfish; tubercles gradually increasing in size dorsally on branchiostegites. Tubercles dense on specimens close to or >30 OCL, moderate to sparse on smaller animals, absent on one very small specimen. 1st (dorsal) cervical spine usually distinctly larger and sharper than other 4-5 small, blunt spines.

ArL/OCL 0.34-0.37. CaW/OCL 0.55-0.58. ArW/OCL 0.15-0.17 d. CaD/OCL 0.47-0.54 d.

Abdomen: Small or tiny, moderately pointed or blunt D-L spine on somite 1 of most specimens >20 OCL, absent on smaller specimens. D spine absent from somite 1 and subsequent somites (vague bump on somite 1 of largest specimen implying development of small D spine on larger animals). 2-4 Li spines on somite 2, 1 Li spine on somites 3-5 of crayfish >20 OCL; Li spines large and sharp to small or tiny, decreasing posteriorly; smaller specimens lacking, or with tiny blunt Li spines. Lii spines small or tiny and blunt, numbering 1-4 per segment, or absent; large specimens with 2-3 tiny Lii spines or bumps on somite 6. Tiny blunt D-L spine sometimes on somites 2-4. Dorsal boss absent.

AbdW/OCL 0.51-0.54. OCL/L 0.35-0.41 i.

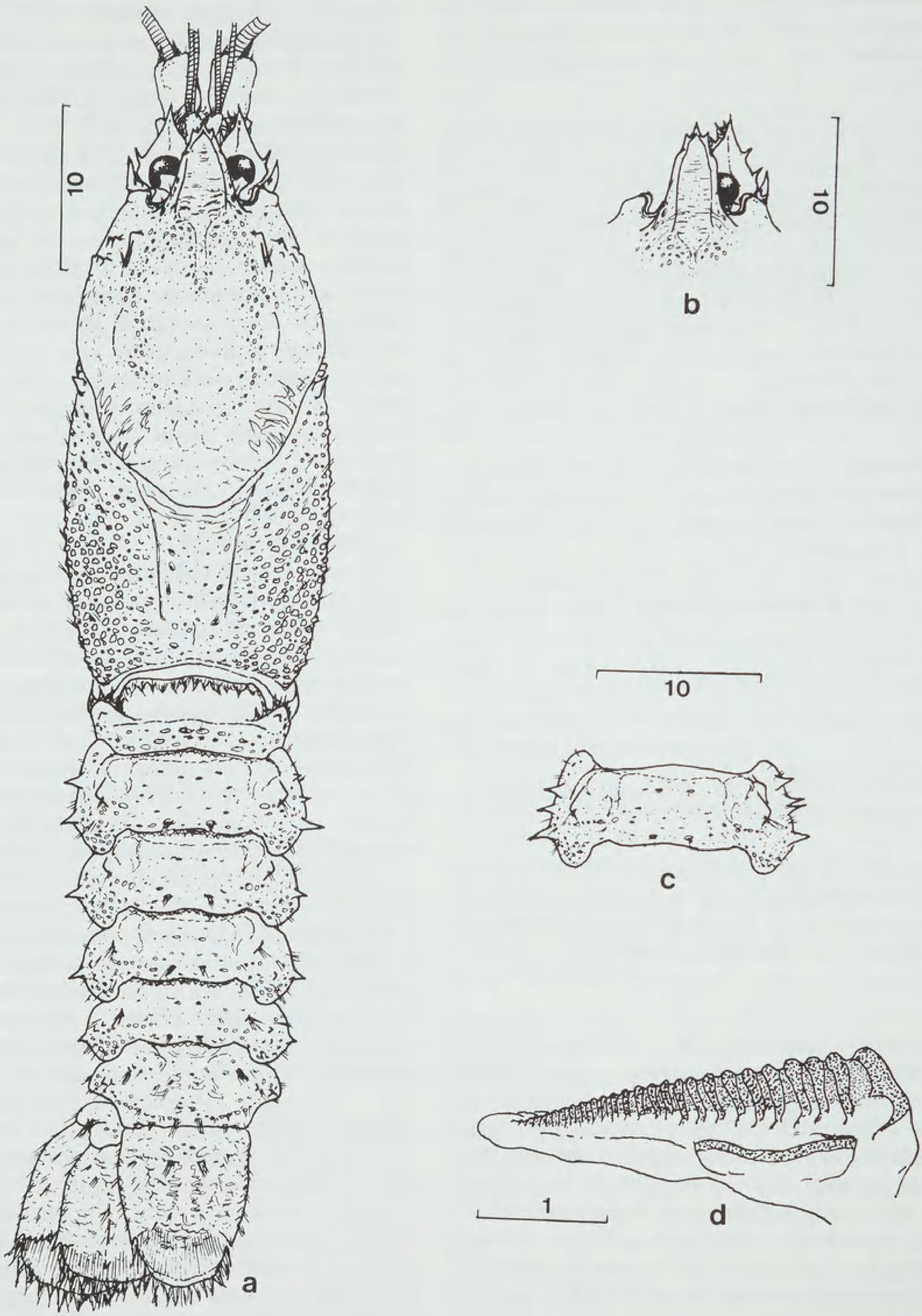

Figure 14. *Euastacus diversus* – a, dorsal view holotype ♂, north of Orbost, AM P15711; b, more elongate rostrum and 2 marginal squamal spines, allotype ♀, AM P15712; c, somite 2, more numerous Li spines, allotype ♀; d, zygocardiac ossicle, holotype ♂.

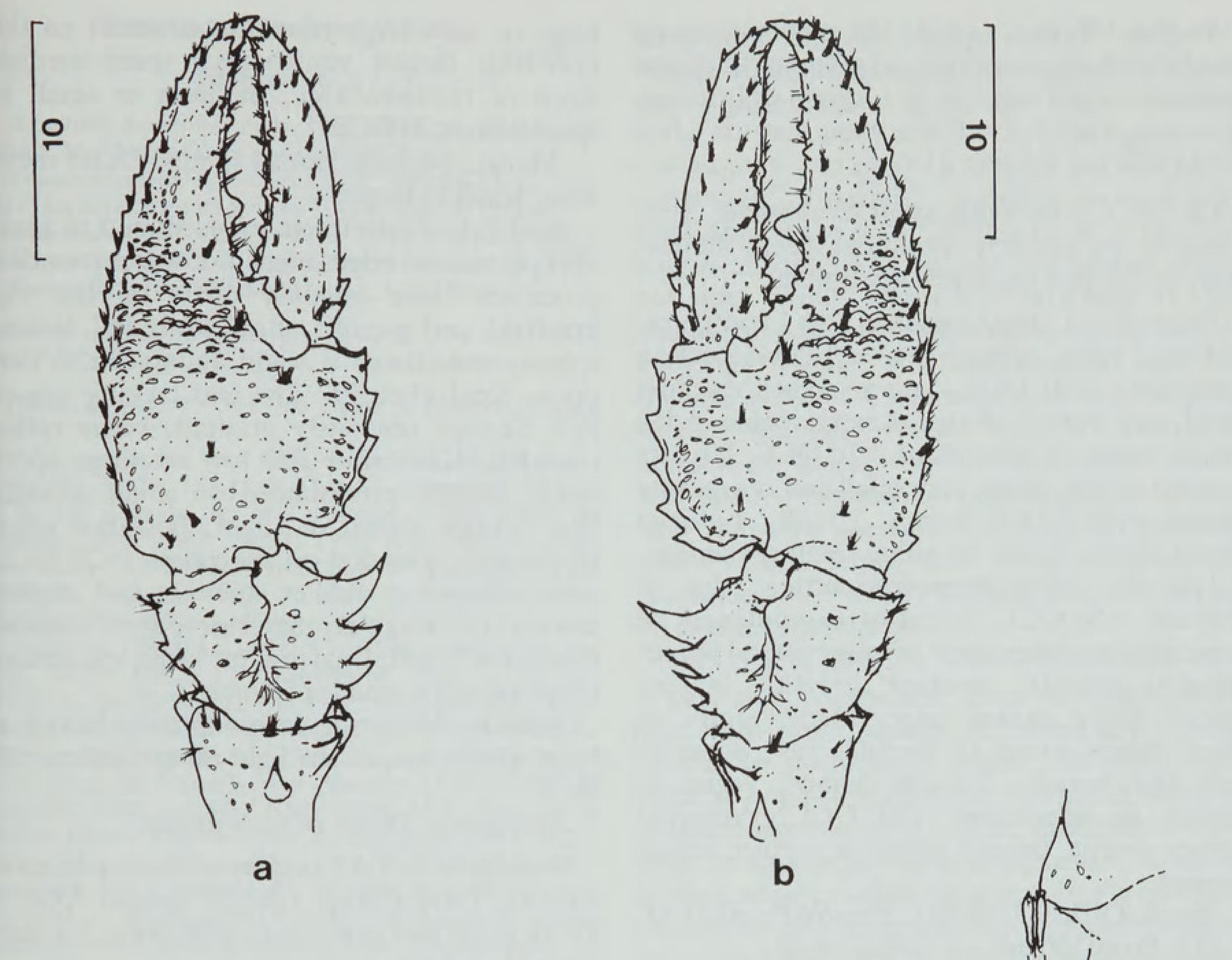

Figure 15. *Euastacus diversus* – a, dorsal view chela, holotype ♂; b, chela, 2 marginal mesal dactylar basal spines, 4th mesal carpal spine larger, paratype ♀, AM P15713; c, ventral view cephalon, holotype ♂; d, interantennal spine, paratype ♀; e, sternal keel, holotype ♂.

Tailfan: Tailfan spines absent; feint setal bumps on margins of uropods. Standard spines medium sized to large, decreasing with increasing OCL.

TeL/OCL 0.35-0.45 d.

Chelae: Chelae fairly stout to elongate, very elongate on smallest specimen. Teeth moderately developed on largest specimens.

Propodus: Lateral spines in 2 to 1 configuration or 2 rows, ventral row well developed on specimens >20 OCL; lateral spines medium sized and rather sharp. Lateral spine ridge small, vague on specimens <20 OCL. Usually 5 mesal spines, some very small and regenerate chelae with 4 or 6 spines. Usually 1 dorsal apical spine, absent on some small specimens. 1-3 spines above propodal cutting edge of crayfish >20 OCL, apical or to midlength of gape and medium sized to large (mesal spines usually largest); smallest crayfish lacking spines above cutting edge. Many bumps or small spines lateral to dactylar base dorsally; ventrally, usually 2-6 low bumps, vague or absent on specimens <20 OCL. Precarpal spines absent, though propodal surface rather bumpy.

PropL/OCL 0.77-0.90 i. PropW/PropL 0.43-0.47 i. PropD/PropL (0.22)0.25-0.30.

Dactylus: 2-5 spines above dactylar cutting edge, reaching proximal to midlength of gape on most specimens >20 OCL; 1 apical spine on some animals close to 20 OCL, absent on specimens <20 OCL; spines medium sized or medium/large, often largest mesally. Extra dorsal dactylar spines absent. 1 dorsal mesal dactylar basal spine (absent on some regenerate chelae); 1-2 marginal mesal basal spines; basal spines medium sized to large and usually sharp. Usually 2 apical mesal spines; 1 spine on small specimens and regenerate chelae. Dactylar spines absent on very small specimen. Dactylar groove present, sometimes deep.

DactL/PropL 0.52-0.60.

Carpus: Usually 3(+1) or 4 mesal carpal spines, sometimes only 3 spines followed proximally by 1 or 2 bumps. 2 medium sized lateral carpal spines. Articulation spine absent, or tiny on small crayfish. Dorsal carpal spines absent, except on one regenerate chela. Ventral spine large or very large (medium or small on tiny crayfish); largest ventromesal spine medium sized or medium/large, medium or small on specimens <20 OCL.

Merus: 5-8 large dorsal spines. Outer meral spine small to large.

Keel:Pr1: Posterior margins sloped to semi-abrupt; ventral edges angled down or rounded; processes close (slightly apart on the tiny crayfish) and parallel. Keel after Pr1 lacking spines, sometimes a slight bump. Pr2: Very open. Keel after Pr2 low and lacking spines. Pr3: Scoops obviously gradual, bases rather rounded. Keel after Pr3 low on large specimens, slightly pronounced on small animals. Pr4: Scoops absent or slight; posterior edges moderately rounded on specimens >20 OCL, quite sharp on smaller animals and slightly convex or irregular; anterior edges angular. Processes 3 and 4 narrow on large specimens, broad on some small specimens.

Setation: Moderate to moderately heavy on large specimens, rather light on specimens <20 OCL.

Punctation: Dense or very dense.

Gastric Mill: TAP counts of four specimens 8.0-9.0; TAA counts 1.0-1.5; spread 7.0-8.5. Teeth small and close, ear rather long. Urocardiac ridges 7-8.

Coloration: No live specimens of *E. diversus* were examined in this study and Riek (1969) did not record the colours of the animals he collected.

Sexes: Males possess a cuticle partition. All females examined have unopen gonopores. Female maturity probably occurs at sizes >40 OCL and the species possibly grows to a size similar to that of *E. bidawalus*.

Distribution and biology. The species is known only from the type locality north of Orbost (Fig. 7), inadequately recorded by Riek (1969). Habitat was not noted. No specimens could be found on recent sampling excursions.

Remarks. The species is represented by only 13 specimens from the type locality and no geographical variation is evident. The squamal spine number is more variable than recorded by Riek (1969).

Euastacus kershawi (Smith)

Figures 16, 17

Astacopsis kershawi Smith, 1912: 160-1, pl. 19 (Moe R. locality for "Large Gippsland Crayfish").

Euastacus nobilis kershawi.–Clark, 1936: 16-17, pl. 3 fig. 16(?) (in part, several species).–1937a: 35.–1937b: 186.

Euastacus nobilis.–Clark, 1936: 15-17 (?in part, Gippsland localities).–1941: 20-2, pl. 6 (in part, several species).

Euastacus kershawi (Smith).–Riek, 1969: 894.

Material examined. *Lectotype*: ♂, OCL 91.2 mm, NMV J869. Vic., Moe R., Gippsland, Dec 1886, W. Kershaw.

Paralectotypes: ♀, OCL 106.2 mm, ♀ (dissected); type locality, NMV J11922.

Other specimens: Vic. Moe, Gippsland, W. Kershaw, NMV No. 52516, 1♀; Little Moe R., Gippsland, 20 Dec 1878, 1♂; Latrobe R. near Noojee, 5 Nov 1967, A. Neboiss, NMV J6169, J6223, 2♀♀; Near Noojee, 1980, 1♂; Shady Ck, 10 miles north-east of Warragul, 5 Nov 1967, A. Neboiss, NMV J6167, 1♂; Tarago R. near Drouin, 5 Nov 1967, A. Neboiss, NMV J6168, 1♀; Tarago R. tributary, (38°00'S., 145°55'E.), 21 Apr 1982, GJM and SJH, NMV J5837, 1♂; Latrobe R. west of Noojee, (37°53'S., 145°53'E.), 21 Apr 1982, GJM and SJH, NMV J5938, 1♂; Narracan Falls, Narracan, 5 Nov 1969, A. Neboiss, NMV J6226, 1♂; Little Yarra R., NMV J6165, 2♂♂, 1♀; Little Yarra R. near Gilderoy, (3750, 14540), 22 Apr 1982, GJM and SJH, NMV J5936, 3♀♀; Tanjil R. at Willow Grove, Oct-Nov 1980, G. Bennison, NMV J6224, J6225, 3♂♂, 1♀; Western Tyers R., Christmas Ck Road, 3 Feb 1981, 1♀; Caledonia R., 30 miles north of Licola, 3 Jan 1973, L. Windsor, NMV J6166, 1♀; Bemm R., bridge north of Bemm River at junction with Combienbar R., 11 Dec 1978, M. Treasure, NMV J6175, 1♂; Martins Ck in Martins Ck Scenic Reserve, north of Orbost, (37°28'S., 148°34'E.), 10 Nov 1981, GJM and SJH, NMV J5939, 1♀; Gippsland Lakes(?), AM P13220, 1♂.

No locality: NMV, 2♂♂.

Diagnosis. Male cuticle partition present. Otherwise similar to *E. bispinosus*, except:

Rostral spines to or proximal to midlength of carinae. Rostral base convergent or parallel. Suborbital spine medium sized or large. 2-4 Li spines on abdominal somite 2. Abdominal boss U-shaped. Marginal spines on outer ramus of uropod rare. Usually 2 lateral propodal spine rows. 1-3 dorsal apical propodal spines. Spines above propodal and dactylar cutting edges often apical. Keel Pr1 sloped or almost semi-abrupt. TAP count 7.0-9.5.

Description. Maximum OCL: 159.5 mm.

Rostrum: Broad rostrum reaching base or to midlength of 3rd antennal segment on specimens >40 OCL (sometimes not reaching base on specimens >100 OCL), to or distal to midlength of segment on specimens 20-40 OCL, to end or distal to end of segment on smaller animals. Rostral sides usually slightly or distinctly convergent, occasionally almost parallel; base convergent or parallel, divergent on some very small specimens <20 OCL; carinae of medium length or long. 2-5 (usually 3-4) rostral spines per side, usually distributed proximal to midlength or to full carinae length, rarely only to midlength; spines small or medium sized on specimens >40 OCL, medium to very large on smaller animals; spines usually moderately pointed or sharp, sometimes rounded (probably due to abrasion) on very large animals and very sharp on specimens <20 OCL. Acumen spine slightly larger than marginal spines on specimens >80 OCL, slightly to much larger on smaller specimens.

OCL/CL 0.72-0.89 i. RW/OCL 0.14-0.24 d.

Cephalon: Spination poor or moderately poor with 1 or 2 spines and some low bumps ventral to postorbital ridges. 1st postorbital spine an edge on specimens >60 OCL, small or medium sized at 40-60 OCL, medium to very large on smaller animals. 2nd postorbital spine a small edge or edge on specimens >60 OCL (absent on one large animal), frequently small on crayfish 40-60 OCL, small to large on specimens 20-40 OCL and large or very large on specimens <20 OCL. Suborbital spine medium sized to large (one very large animal with small spine, perhaps due to abrasion). Lateral margin of antennal squame slightly or distinctly convex, except on specimens <20 OCL with straight or slightly concave margin; squame widest slightly proximal to midlength on specimens >80 OCL, usually proximal or very proximal on smaller animals; marginal spines absent. Interantennal spine usually broad (occasionally moderately shaped) on specimens >20 OCL, very broad on many smaller animals; spine margin toothed or occasionally very scalloped. Basipodite spine very small or small on specimens >60 OCL, small to large on animals 40-60 OCL, medium sized to very large on smaller specimens. Coxopodite spine small to medium sized on specimens >60 OCL, small to large on lesser animals.

ScL/OCL 0.13-0.39 d.

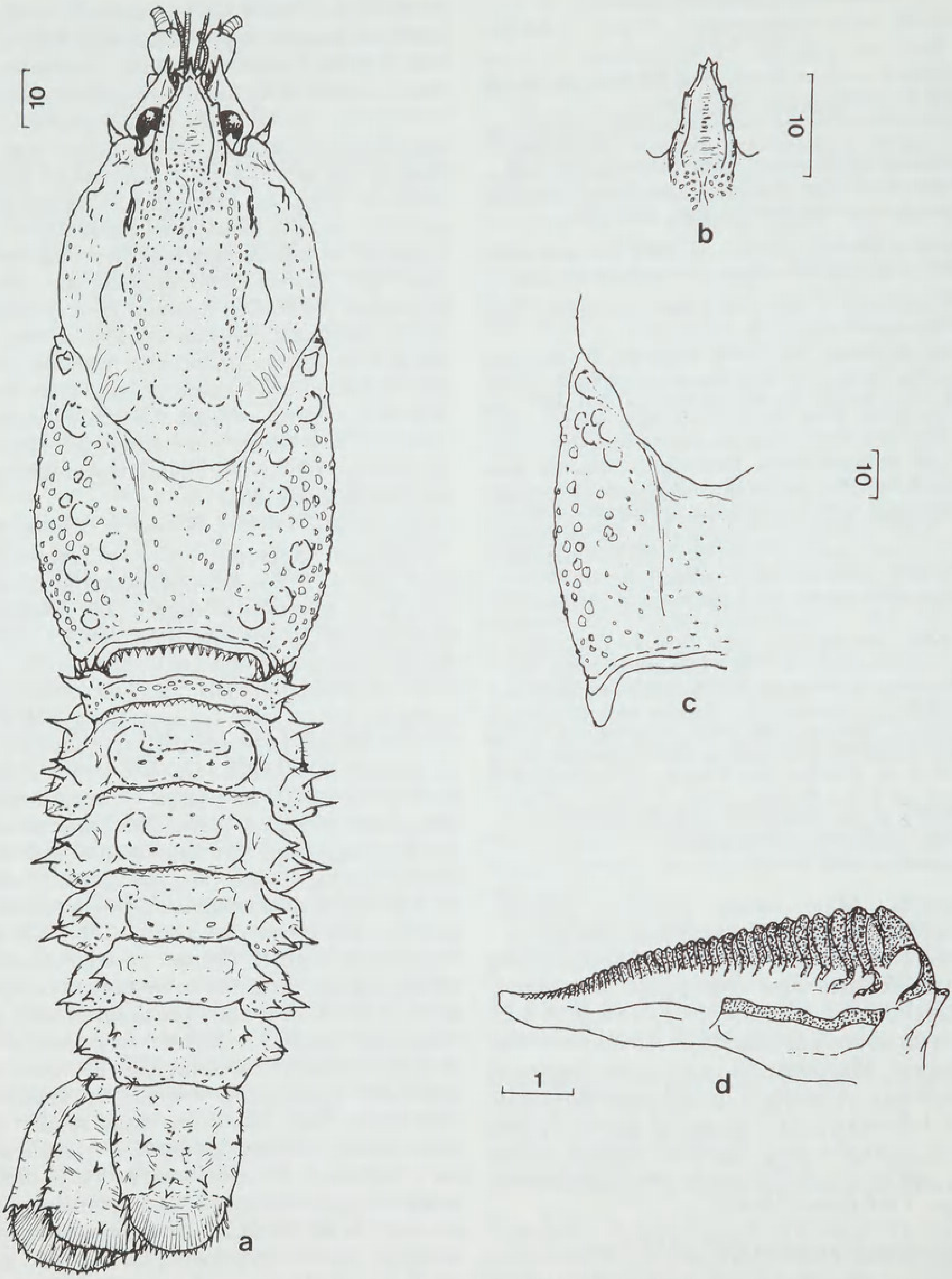

Figure 16. *Euastacus kershawi* – a, dorsal view lectotype ♂, Moe R., NMV J869; b, rostrum (allometry), ♀, Martins Ck, NMV J5939; c, thorax, dorsal spines reduced, paralectotype ♀, Moe R., NMV J869; d, zygocardiac ossicle, ♂, Bunyip R., Francois collection.

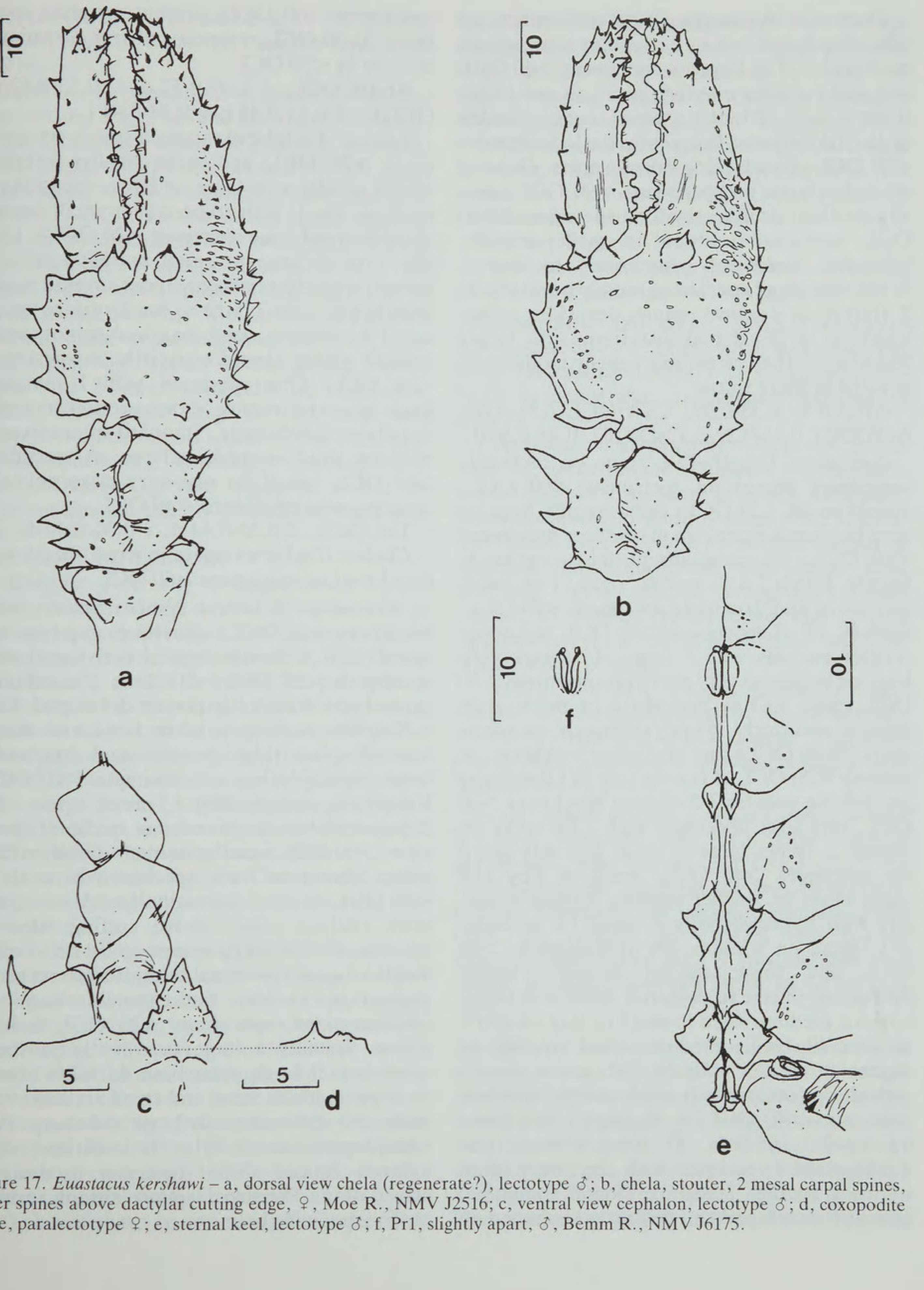

Figure 17. *Euastacus kershawi* – a, dorsal view chela (regenerate?), lectotype ♂; b, chela, stouter, 2 mesal carpal spines, fewer spines above dactylar cutting edge, ♀, Moe R., NMV J2516; c, ventral view cephalon, lectotype ♂; d, coxopodite spine, paralectotype ♀; e, sternal keel, lectotype ♂; f, Pr1, slightly apart, ♂, Bemm R., NMV J6175.

Thorax: 1-10 (usually 3-6) dorsal spines per side, distributed in 1 or 2 irregular rows; spines medium sized or large on specimens >40 OCL and many smaller crayfish, small on specimens close to and <20 OCL; spines blunt, rounded or flat (dorsalmost frequently flat). Specimens <20 OCL often lacking dorsal spines. General tubercles large on specimens >80 OCL, usually medium sized or small on specimens 20-80 OCL, very small or absent on smaller animals; tubercles moderately distributed to sparse. Some very small specimens merely punctate. 1-2 (rarely 3) cervical spines per side; spines small to large, dorsalmost frequently larger and sharper than remaining usually moderately pointed or blunt spines.

ArL/OCL 0.33-0.37. CaW/OCL 0.58-0.62. ArW/OCL 0.16-0.22 d. CaD/OCL 0.48-0.56 d.

Abdomen: Usually D-L spine on somite 1, sometimes absent on specimens <60 OCL, absent on all <20 OCL; spine usually large or very large and sharp, small on some specimens <40 OCL. D spine absent from somite 1. Somite 2 with 2-4 Li spines, rarely 1 on small specimens and 0 on some specimens <20 OCL; somites 3-5 of specimens >20 OCL and some smaller animals with 1 spine. Li spines very large or large and very sharp on specimens >40 OCL, large to tiny and sharp or moderately pointed anteriorly, blunt posteriorly on specimens 20-40 OCL, tiny and blunt or absent on animals <20 OCL. 1 (rarely 2 or 3) Lii spine(s) per side on somites 3-5 of most specimens >20 OCL, one large specimen with 1 Lii spine on somite 2; spines large to small and very sharp on specimens >40 OCL, small or tiny and often blunt on smaller animals. Somite 6 usually with 1, occasionally 2, small Lii spine(s). D-L spine on somites 2-6 of specimens >40 OCL and some smaller animals; spines decreasing in size to posterior from very large, large or medium sized to small or tiny on specimens >40 OCL, medium sized to tiny or absent on smaller animals; D-L spines usually very sharp (occasionally moderate or blunt) on specimens >40 OCL, moderate to very blunt on smaller animals. D spine absent (one medium sized specimen with tiny, very blunt spine on somites 2 and 3). Dorsal abdominal boss well developed and distinctly U-shaped on specimens >60 OCL, present on most specimens 20-60 OCL, vague or absent on animals close to or <20 OCL.

AbdW/OCL: ♂ 0.49-0.57 d; ♀ 0.53-0.62 di. OCL/L: ♂ 0.33-0.46 i; ♀ 0.34-0.41 i.

Tailfan: 4-7 telsonic surface spines on specimens >20 OCL and most smaller animals; spines usually very large or large, occasionally medium sized, with some spines small (spines absent on only one specimen <20 OCL). Usually 1 or 2 large to small marginal telsonic spines, sometimes absent. Inner uropod ramus usually with 1 or 2 large to small surface spines and 1-4 similarly sized marginal spines; occasionally spines absent especially on specimens <40 OCL. One specimen with 1 marginal spine on outer ramus of one uropod; margins usually merely bumpy. Standard spines usually medium sized or medium/large on specimens >60 OCL (small on one very large animal), large on most specimens <40 OCL.

TeL/OCL: ♂ 0.30-0.44 d; ♀ 0.34-0.40 di.

Chelae: Chelae elongate to stout. Teeth well developed on specimens >60 OCL.

Propodus: 2 lateral spine rows on most specimens >20 OCL, sometimes gap between apical 1 or 2 ventral spines and remainder; specimens <20 OCL with 2 to 1 condition, ventral row frequently poorly developed. Lateral spines medium sized or large and sharp. Lateral spine ridge present and frequently large, usually vague on specimens <20 OCL. Usually 5, occasionally 4, mesal spines. 2-3 dorsal apical spines on normal chelae of specimens >60 OCL; smaller animals usually with 1 spine, absent on some specimens close to or <20 OCL. 1-3 (occasionally 4 or 5 on regenerate chelae) spines above cutting edge of specimens >20 OCL; spines apical or to midlength of gape (proximal to midlength on some regenerate chelae) and usually large or medium sized; specimens <20 OCL lacking spines. Usually a large or very large sharp spine lateral to dactylar base dorsally, absent on some medium sized and small animals; ventrally, 1-3 spines, usually large and sharp. Proximal spine at dactylar articulation often inflated. Spines absent posterior to dactylar articulation. Precarpal spines absent (except on one specimen).

PropL/OCL: ♂ 0.76-0.92 i; ♀ 0.78-0.86. PropW/PropL 0.36-0.47 id. PropD/PropL 0.21-0.29 id.

Dactylus: 1-6 (usually 2-4) spines above dactylar cutting edge, absent on some specimens <20 OCL; spines apical or reaching proximal to midlength of gape, occasionally to full gape; spines large to medium sized, small on specimens <20 OCL. 1 extra dorsal apical dactylar spine on all specimens >60 OCL and on most smaller specimens except those <20 OCL; one animal with 2 extra spines. 1-4(usually 2 or 3) dorsal mesal dactylar basal spines, sometimes reaching distal to midlength of dactylus; marginal mesal basal spines usually absent, sometimes 1 or 2 spines especially on regenerate chelae; basal spines large or very large and sharp. 3-4 apical mesal spines (2 on one chela of one specimen), sometimes reaching basal spines. Dactylar groove vague or absent on large specimens, usually present on small animals.

DactL/PropL 0.52-0.61.

Carpus: Normally 2 large mesal carpal spines, usually with 1 or 2 bumps proximal to 2nd spine, occasionally 3 mesal spines; distal spine usually much larger than 2nd, 3rd, if present, usually small. 2 lateral carpal spines, medium sized to very large. Articulation spine absent on all but some specimens <40 OCL. Dorsal spines usually absent (two specimens with a low bump on both carpi). Ventral carpal spine very large. Largest ventromesal spine usually medium sized or small, rarely large; 1 or 2 tiny additional ventromesal spines.

Merus: 5-9 dorsal spines. Outer meral spine medium sized or large, very large on most animals <40 OCL.

Keel: Pr1: Posterior margins usually sloped, almost semi-abrupt on some medium sized and small animals, very rarely semi-abrupt; ventral edges angled down, rarely rounded; processes close or slightly apart (apart on some specimens <40 OCL) and usually parallel, occasionally slightly closed or open. Keel after Pr1 sometimes with very low spine. Pr2: Open or very open. Keel after Pr2 recessed or slightly pronounced anteriorly. Pr3: Scoops absent, slight or gradual (well developed on one specimen), bases sharp to rounded. Keel after Pr3 usually moderately pronounced. Pr4: Scoops usually absent, occasionally slight; posterior edges usually sharp or moderately sharp and sightly convex, straight or irregular; anterior edges angular or very angular. Processes 3 and 4 usually narrow on specimens >100 OCL (one specimen with broad processes), narrow or just broad on specimens 60-100 OCL, broad or very broad on smaller animals.

Setation: Light.

Punctation: Moderate to dense. Thoracic punctation usually sparser than cephalic.

Gastric Mill: TAP count 7.0-9.5; TAA count 0.5; spread 6.5-9.0. Teeth small and close, ear long. Urocardiac ridges 7-11 (frequently difficult to count due to irregular merging of ridges).

Coloration: Body dorsally dark green, green/blue or green/brown. Thoracic spines dark, sometimes black; general tubercles often pale. Lateral abdominal somites often blue; abdominal spines tipped yellow or orange. Carpus of cheliped dark blue/green with some dark mottling, spines tipped orange. Propodus similar to carpus, mesal edge and fingers aquamarine; spine lateral to dactylar base usually cream or orange.

Body ventrally orange, green or blue. Carpus of cheliped green or blue, laterally sometimes orange, spines orange. Propodus orange with midventral mottling, margins and fingers blue or green.

Sexes: Males possess a usually broad cuticle partition. Females <40 OCL have unopen gonopores. One female (OCL51.3 mm) has open pores, but pores on the two 60-80 OCL females examined are unopen. Females >100 OCL are mature. It appears that female maturity may occur over a considerable size range, probably between 50 to 80 or 90 mm OCL.

Distribution and biology. The species occurs at elevations from sea level to 250 m a.s.l. (and probably slightly higher) in southerly flowing streams of Gippsland, Victoria, from near the New South Wales border in the east to mountains approximately 80 km east of Melbourne, a distance of approximately 320 km (Fig. 7). Heavy amateur fishing and land development may have severely reduced the range of *E. kershawi* in major rivers near human settlement (e.g., Latrobe River). Vegetation along streams is commonly *Eucalyptus* spp. (including *E. regnans*) and tree ferns (*Cyathea*) though sometimes the crayfish is found in dry sclerophyll forest and in cleared pasture if vegetation persists along creek banks. *Euastacus kershawi* is sympatric with *E. yarraensis* in some eastern tributaries of the Yarra and Tarago Rivers and is frequently found in association with *Engaeus* species.

Remarks. A lectotype and two paralectotypes are here selected from Smith's syntype series in the Museum of Victoria. Smith did not designate types in his original publication and all his specimens therefore are syntypic. Rick's (1969) listing of a holotype, allotype and paratype is consequently invalid.

Euastacus kershawi displays little geographical variation across its large range. Infraspecific variation is largely allometric. The species is quite distinct and usually readily recognised yet has caused considerable confusion for past workers. Clark (1936, 1937a, 1937b, 1941) confused *E. kershawi* with *E. woiwuru*, *E. yarraensis*, *E. bispinosus* and *E. neodiversus*. All specimens regarded as *E. kershawi* by Kane (1964) are *E. woiwuru*. Rick (1969) recognised *E. kershawi* but the cited characters distinguishing it from *E. bispinosus* are inaccurate.

Euastacus kershawi can be distinguished from the similar *E. bispinosus* by differences in the male cuticle partition, the spine lateral to the dactylar base dorsally and the profile of the first keel process (Pr1).

Euastacus neodiversus Rick

Figures 18, 19

Euastacus nobilis kershawi.–Clark, 1936: 16 (in part, Wilsons Promontory locality).

Euastacus nobilis.–Clark, 1941: 23 (in part, Wilsons Promontory locality).

Euastacus neodiversus Rick, 1969: 908.

Material examined. Holotype: ♂, OCL 44.9 mm, NMV J4531. Vic., National Park, Wilsons Promontory, in stream on east slope of Sealers Cove Track about 1000 ft above sea level, 25 Nov 1922, J.A. Kershaw.

Paratype: Vic. Top of Vereker Range, Wilsons Promontory, Dec 1912, J.A. Kershaw, NMV J4532, 1♂.

Other specimens: Vic. Sealers Ck tributary, near Mt Ramsay, Wilsons Promontory, Apr 1980, GJM, NMV J6229, 3♀♀; Growlers Ck tributary, Wilsons Promontory, (39°04′S., 146°21′E.), 14 Sep 1982, GJM and SJH, NMV J5958, 1♀; Growlers Ck tributary, Wilsons Promontory, (39°04′S., 146°22′E.), 14 Sep 1982, GJM and SJH, NMV J5955, 1♂, 2♀♀; Lilly Pilly Gully, Wilsons Promontory, (39°03′S., 146°20′E.), 15 Sep 1982, GJM and SJH, NMV J5959, 2♂♂, 2♀♀; Agnes R. at junction with Dingo Ck, (38°36′S., 146°33′E.), 16 Sep 1982, GJM and SJH, NMV J5960, 1♀; Turtons Ck north of Foster, (38°33′S., 146°14′E.), 16 Sep 1982, GJM and SJH, NMV J5957, 3♂♂, 2♀♀; Tarra Valley Park, 12 Apr 1960, J. Coventry, 1♀; Fern Gully, Bulga National Park, (38°25′S., 146°34′E.), 13 Nov 1981, GJM and SJH, NMV J5956, 2♂♂, 2♀♀; Creek in Tarra Valley National Park, (38°27′S., 146°32′E.), 13 Nov 1981, GJM and SJH, NMV J5940, 3♂♂, 1♀.

Diagnosis. As for *E. bidawalus* except:

Rostral base sometimes slightly divergent. 2-5 Li spines on abdominal somite 2. Usually 2 lateral propodal spine rows. 1 apical spine above propodal cutting edge or spine absent. Spines above dactylar cutting edge apical. 2-4 dorsal mesal dactylar basal spines. Marginal mesal dactylar basal spines usually absent (rarely 1). 2-4 apical mesal dactylar spines, forming row with basal spines. Largest ventromesal carpal spine spine usually as large as or larger than ventral spine. TAP count 6.0-7.5.

Description. Maximum OCL: 44.9 mm.

Rostrum: Rather short rostrum, to base of 3rd antennal segment on largest specimen (holotype), between base and midlength of segment on most specimens 20-40 OCL, to or distal to midlength on specimens <20 OCL. Rostral sides parallel or slightly convergent; base slightly or distinctly divergent and carinae of medium length or short, slightly or distinctly spread. 2-4 (rarely 5) rostral spines per side, reaching to about midlength of carinae; spines small on specimens >30 OCL, small to medium sized on specimens 20-30 OCL, distal spines large on smaller animals; spines rounded on specimens >30 OCL, moderately pointed or sharp on most smaller specimens. Acumen spine similar to or slightly larger than marginal spines on specimens >20 OCL, sometimes much larger on smaller animals.

OCL/CL 0.79-0.88 i. RW/OCL 0.15-0.23 d.

Cephalon: Spination moderate to poor, with 2-5 small spines and several low bumps ventral to postorbital ridges. 1st postorbital spine an edge or small on most specimens >20 OCL, medium sized or large on some specimens near 20 OCL and all <20 OCL. 2nd spine usually small edge or edge, small or medium sized on specimens close to and <20 OCL. Suborbital spine small or medium sized, large on some specimens <20 OCL. Lateral margin of antennal squame usually convex, sometimes straight on small specimens; squame widest at slightly distal to midlength on largest specimen, at or slightly proximal to midlength on specimens 20-40 OCL, distinctly proximal on smaller animals; marginal spines absent. Interantennal spine elongate on largest specimen, medium width or broad on smaller animals; spine margin slightly or distinctly scalloped. Basipodite spine small on largest specimen, medium sized on most animals 20-40 OCL, large on some smaller specimens. Coxopodite spine small.

ScL/OCL 0.11-0.28 d.

Thorax: Approximately 6-20 dorsal thoracic spines per side, in zone or 2 irregular rows; spines medium sized, frequently with some small spines, or all small on some animals close to or <20 OCL; spines moderately pointed or blunt, rounded on small specimens. Some very small specimens lacking dorsal spines. General tubercles medium sized on large specimens, medium or small on small animals, very small on some specimens <20 OCL; tubercles dense on most specimens >20 OCL, moderately distributed on small specimens, sparse or very sparse on very small animals; tiny specimens merely punctate. Usually 2-3(4) cervical spines per side, medium sized or small and moderately pointed or blunt; spines usually similarly sized, though dorsalmost spine occasionally slightly larger and sharper than others.

ArL/OCL 0.36-0.39. CaW/OCL 0.51-0.58. ArW/OCL 0.13-0.21 d. CaD/OCL 0.45-0.54 d.

Abdomen: Medium sized or small D-L spine on somite 1 of specimens >30 OCL and some slightly smaller animals; most <30 OCL lacking spine. Tiny D spine on somite 1 of largest animal (holotype), absent on other specimens. Somite 2 with 2-5 (usually 3-4) Li spines, somites 3-5 of specimens >30 OCL and some smaller animals with 1 spine; Li spines decreasing in size posteriorly from large to medium sized on most specimens >30 OCL, medium sized or small to tiny on smaller animals, specimens <20 OCL often lacking spines; Li spines very sharp or sharp on animals >30 OCL, sharp to blunt on smaller specimens. 1-3 Lii spines frequently on somites 2-6 of large specimens, rarely on specimens <30 OCL; spines medium sized to tiny on largest specimen, small or tiny or absent on lesser animals and very sharp to blunt on the largest, moderately pointed to very blunt on smaller specimens. D-L spine on somites 2-4 of specimens >30 OCL and some smaller animals; spine medium sized to tiny and moderately pointed (rarely sharp) to blunt or very blunt; somites 5 and 6 of large specimens sometimes with rudimentary D-L bump. Somite 2 and sometimes 3, of large specimens with D spine; spine small or tiny and moderately pointed to very blunt; largest specimen with D bump on somites 4 and 5. Most specimens <20 OCL lacking abdominal spines. Dorsal boss usually absent, slightly developed on largest specimen.

AbdW/OCL: ♂ 0.48-0.55 d; ♀ 0.52-0.55. OCL/L 0.37-0.44 i.

Tailfan: Spines absent on telson and uropods, margins slightly bumpy at setal bases. Standard spines small or medium sized on specimens >30 OCL, medium or large on lesser individuals.

TeL/OCL 0.33-0.42 d.

Chelae: Chelae usually stout or intermediate in shape, quite elongate on largest specimen and some small animals. Cutting teeth well developed on specimens close to or >40 OCL.

Propodus: Usually 2 lateral propodal spine rows, on some specimens <30 OCL ventral row poorly developed (2 to 1 rows); lateral spines small or medium sized and rather sharp. Lateral spine ridge medium sized to vague, absent on some specimens <20 OCL. Usually 5 mesal spines, sometimes 6, 4 on some small or regenerate chelae. Usually 1 dorsal apical propodal spine on specimens >30 OCL, absent on smaller crayfish. 0 or 1 spine above cutting

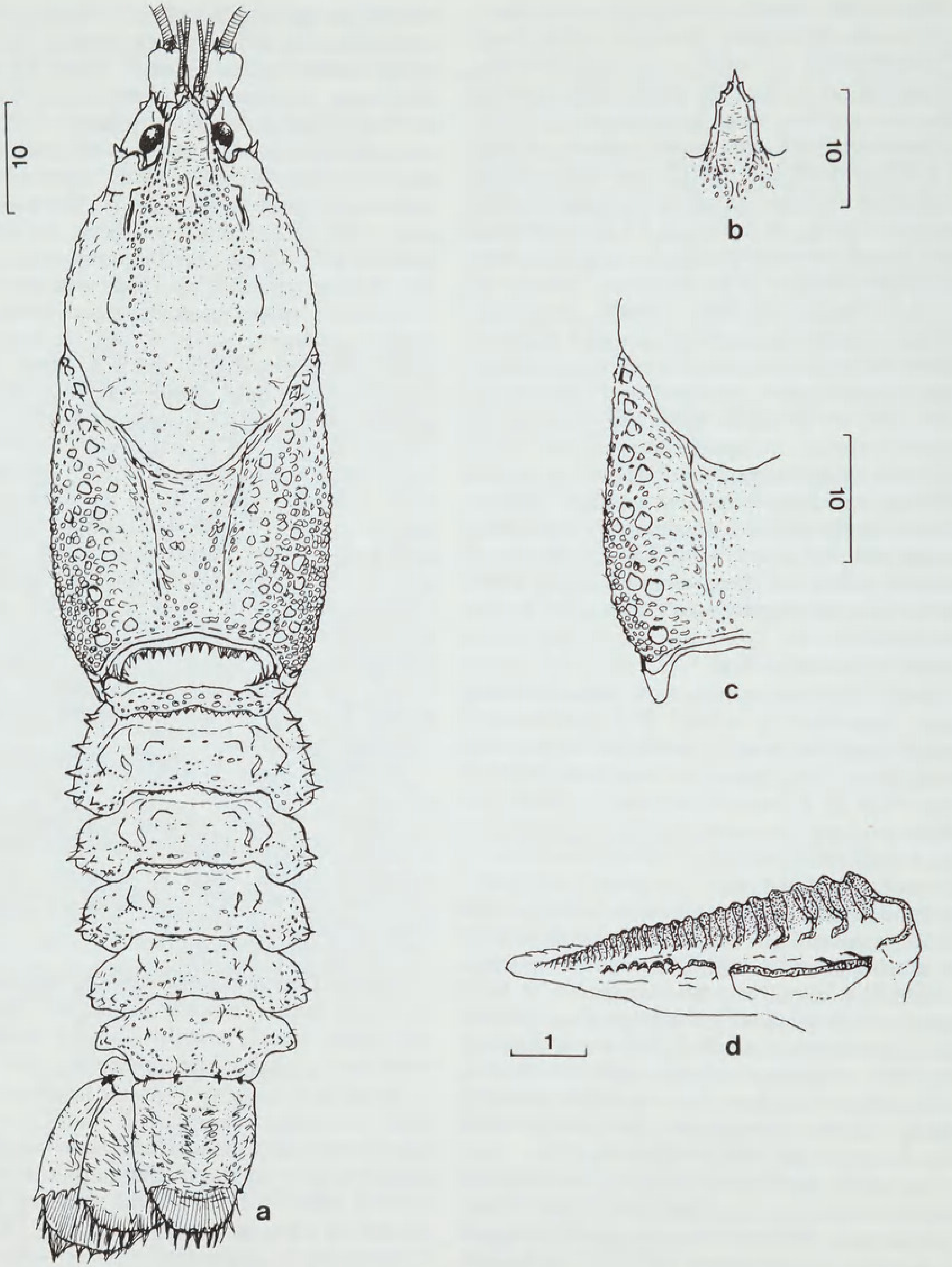

Figure 18 . *Euastacus neodiversus* – a, dorsal view holotype ♂, Wilsons Promontory, NMV J4531; b, rostrum, more numerous and slightly larger spines, ♀, Lilly Pilly Gully, NMV J5959; c, thorax, larger spines, ♀, Lilly Pilly Gully, NMV J5959; d, zygocardiac ossicle, with secondary ears, holotype ♂, Francois collection.

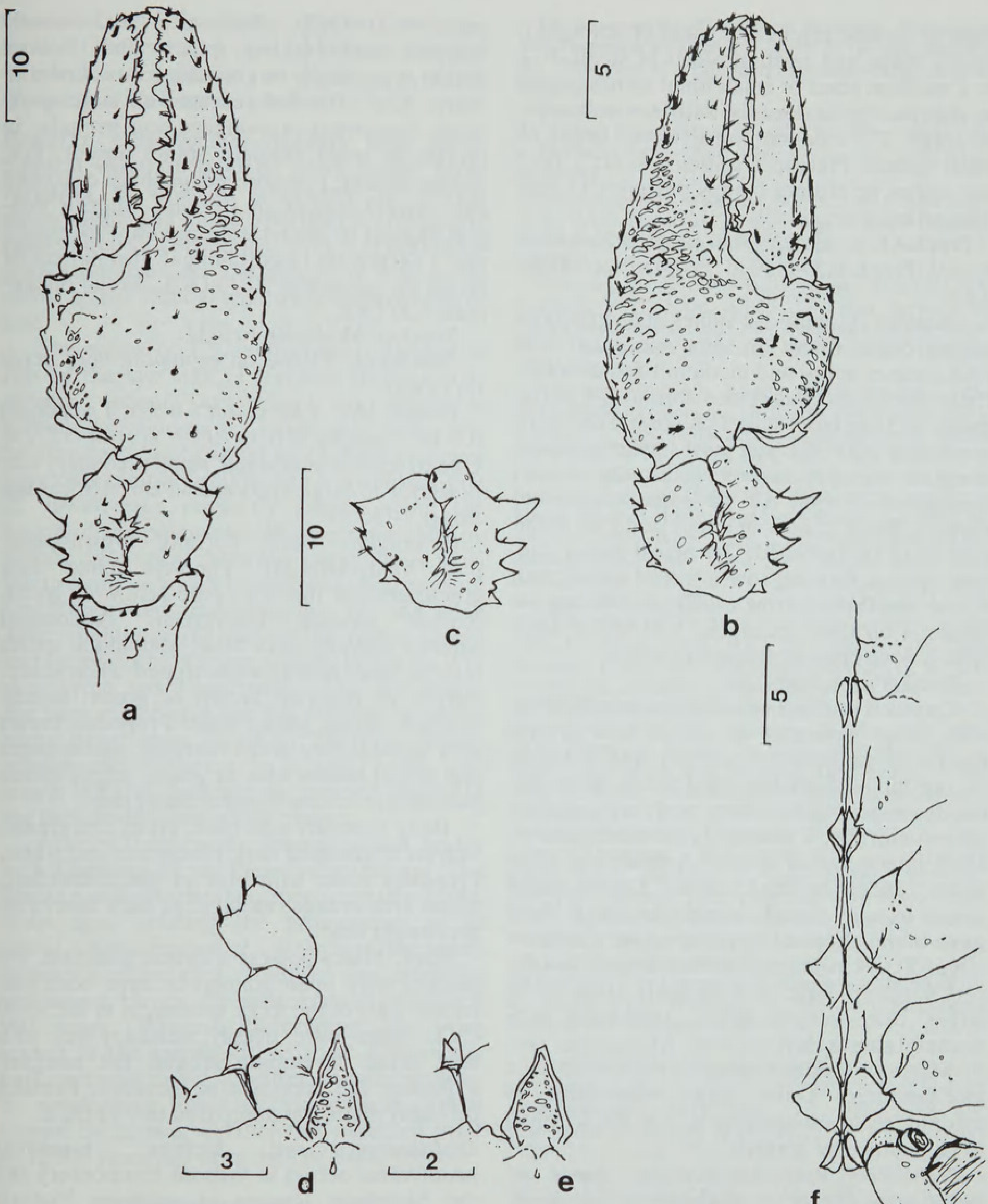

Figure 19. *Euastacus neodiversus* – a, dorsal view chela, holotype ♂; b, chela, spines lateral to dactylar base, 3 mesal carpal spines, more distinct spine posterior to dactylar articulation, ♀, Dingo Ck, NMV J5960; c, carpus, 3(+1) mesal spines, ♂, Growlers Ck, NMV J5955; d, ventral view cephalon, holotype ♂; e, cephalon, paratype ♂, Vereker Ra., NMV J4532; f, sternal keel, holotype ♂.

edge (3 on one regenerate chela of holotype); spines apical and medium sized or small. 0, 1 or 2 medium sized or small blunt spines lateral to dactylar base dorsally with some bumps; ventrally, 1-3 medium sized (rarely large) or small spines. Precarpal spines absent; 1 or 2 low spines or distinct bumps posterior to dactylar articulation.

PropL/OCL: ♂ 0.77-0.97 i; ♀ 0.76-0.82 i. PropW/PropL 0.39-0.50 id. PropD/PropL 0.26-0.32.

Dactylus: Usually 1-2 spines above dactylar cutting edge, absent on some specimens <30 OCL; spines apical and medium sized or small. Extra dorsal dactylar spines absent. 2-4 dorsal mesal dactylar basal spines on normal chelae of specimens >20 OCL and most smaller animals; marginal mesal basal spines usually absent, sometimes 1 spine (2 on some regenerate chelae); basal spines medium sized or small and blunt or flattened. 2-4 apical mesal dactylar spines, forming row of mesal spines with dorsal basal spines (row usually numbering 5-8 spines, 4 on some specimens <20 OCL). Dactylar groove present, frequently deep.

DactL/PropL 0.53-0.60.

Carpus: Usually 3 mesal carpal spines, often with bump proximal to spines and several specimens (including holotype) with 4 spines on one or both chelae; 1st (distal) spine distinctly larger than others and only slightly offset ventrally. 2 (rarely 3) medium sized or small lateral carpal spines. Articulation spine absent, except on small animals. Dorsal carpal spines usually absent, sometimes small blunt spine/bump. Ventral carpal spine very large or large. 2-3 ventromesal spines, largest usually very large or large and similarly sized to or larger than ventral spine; remaining ventromesal spines tiny.

Merus: 6-9 dorsal spines, medium sized or medium/large. Outer spine very small to medium sized on specimens >30 OCL, small to large on lesser animals.

Keel: Pr1: Posterior margins sloped or almost semi-abrupt (semi-abrupt on one specimen); ventral margins angled down (rarely rounded); processes close or slightly apart and parallel. Keel after Pr1 low and devoid of spines. Pr2: Open, or very open on some specimens <20 OCL. Keel after Pr2 usually recessed and lacking spines. Pr3: Scoops absent, very slight or gradual; bases curved to sharp. Keel after Pr3 recessed on large specimens, somewhat pronounced and irregular in profile on small animals; spines absent. Pr4: Scoops absent; posterior edges sharp or curved and slightly convex or straight; anterior margins angular or moderately curved. Processes 3 and 4 narrow on largest animal, just narrow or broad on specimens 20-40 OCL, broad on animals <20 OCL.

Setation: Moderate to light.

Punctation: Dense on cephalon, very dense on thorax.

Gastric Mill: TAP count 6.0-7.5; TAA count 0.0-1.0 (usually 0.0 or 0.5); spread 5.5-7.0. One to several additional, small secondary ears posterior to large zygocardiac ear. Urocardiac ridges 7-13.

Coloration: Body dorsally brown/green, paler ventrolaterally. Thoracic spines dark green; general tubercles pale yellow or green. Rostral carinae blue/green. Abdominal somites laterally dark blue; abdominal spines blue or blue/brown, white tipped when sharp. Carpus of cheliped brown or green, usually mottled, mesal spines blue. Propodus brown with variable blue/green mottling, mesal spines and dorsal bumps blue or green, lateral spines pale blue or cream. Fingers blue/green.

Body ventrally pale blue, green and cream. Carpus of cheliped dark blue/green and white. Propodus white with blue or green mottling, mesal area orange, mesal edge dark blue. Fingers bright blue.

Sexes: Males possess a cuticle partition. No females with open gonopores have been collected. Two of the three specimens in the 30-40 OCL range have deeply incised pores with light setae developing around the margins, indicating the approach of maturity. Females probably mature at approximately 40 OCL.

Distribution and biology. *Euastacus neodiversus* occurs in Wilsons Promontory and the Strzelecki Ranges of southern Victoria (Fig. 7) at elevations of 50 to 600 m a.s.l. Coastal heath and sclerophyll forest occur on ridges and lilly pilly (*Eugenia* sp.), ferns and vines along banks in Wilsons Promontory.

Mountain ash (*Eucalyptus regnans*) and tree ferns (*Cyathea* sp.) are dominant in the Strzeleckis. *Euastacus neodiversus* is often sympatric with *Engaeus* species.

Remarks. The species displays little geographical variation over its small range. Most variation is due to allometry or sexual dimorphism and large specimens are poorly represented in collections. Riek's (1969) diagnostic characters for the species of four mesal carpal spines and dactylar spination are inaccurate.

The range of *E. neodiversus* is divided in two by the low land of Yanakie isthmus. The isthmus appears at present an unsuitable habitat for *Euastacus*, being low lying and bearing patches of coastal heath. Many streams have only temporary flow and it is unlikely that *E. neodiversus* presently ranges along the length of the peninsula. There are virtually no visible differences between populations from the two areas, which is somewhat unexpected. Small specimens from the two regions often differ slightly in the size of the rostral spines and 1st postorbital spine, usually larger on Wilsons Promontory specimens. The differences are very minor and are not evident on specimens larger than 30 OCL. There is distinct infraspecific variation in areola width and length but this does not correspond closely to the two subdivisions of the range.

Wilsons Promontory formed a land bridge with Tasmania during Pleistocene ice ages. The bridge was finally broken approximately 12 000 years ago, isolating the promontory as an island. Over a period of 4 000 years, the sandy isthmus accumulated re-uniting the mainland and island. Hence, for approximately the last 8 000 years, Wilsons Promontory has been joined to the mainland. At some time in the past, perhaps under a wetter climatic regime, *E. neodiversus* inhabited the isthmus, but it cannot be certain whether this occurred prior to 12 000 years ago or in the last 8 000 years.

Euastacus woiwuru sp. nov.

Figures 20, 21

Astacopsis kershawi Smith, 1912: 161, pl. 20 (Narracan R. locality for "Small Gippsland Crayfish").

Euastacus nobilis.–Clark, 1936: 16 (in part, Narracan R. and Thompson R. localities).–1941: 22 (in part, Narracan R., Thompson R., Thorpdale, Ferntree Gully, Belgrave localities).

Euastacus nobilis kershawi.–Clark, 1936: 16 (in part, Thorpdale, Ferntree Gully localities).–1937b: 186, 192, fig.

Euastacus crassus Riek, 1969: 896 (in part, inclusive distribution).

Material examined. Holotype: ♂, OCL 56.6 mm, NMV J4527. Vic., Dobsons Ck, near Alpine Road Crossing, Dandenong Mountains east of Melbourne, 9 Jun 1982, P. Horwitz.

Paratypes: Vic. Narracan R., Gippsland, Mar 1890, J.A. Kershaw, NMV J4528, 4♂♂, 1♀; Creek between Mt Evelyn and Wandin North, Sep 1963, JRK, NMV J4529, 2♀♀; Masons Falls, Kinglake, 14 Mar 1963, D. Denning, NMV J4530, 1♀.

Other specimens: Vic. Wandin North, Sep 1963, JRK, NMV J9202, 1♀; Between Mt Evelyn and Wandin North, 8 Sep 1962, JRK, NMV J9239, 1♂; Between Mt Evelyn and Wandin North, 16 Feb 1964, JRK, NMV J9201, 2♂♂; Creek between Ferntree Gully and Upwey, north side of road (Dandenongs), 1962, JRK, NMV J9236, 1♂, 2♀♀; Top of Ferntree Gully, Dandenong Range, Feb 1872, W. Kershaw, NMV J9208, 4♂♂, 2♀♀; Alpine Road, Dandenongs, JRK, NMV J9214, 3♀♀; Alpine Road, Dandenongs, JRK, NMV J9203, 1♂, 2♀♀; Alpine Road, Dandenongs, JRK, NMV J9217, 2♂♂; Mt Dandenong, 20 May 1962, JRK, NMV J9219, 1♀; Ferntree Gully, 26 Mar 1906, G. Sweet, NMV J9212, 1♀; Olinda Falls (Dandenongs), 15 Jan 1963, JRK, NMV J9209, J9213, 1♂, 1♀; Menzies Ck, Emerald, 27 Apr 1963, A. Lo, NMV J9210, 1♀; Woori Yallock Ck tributary near Emerald, 4 Jan 1963, JRK, NMV J9237, 1♂; Sassafras, 23 Mar 1963, JRK, NMV J9204, 1♂; Baynes Ck, Monbulk, 6 Mar 1982, A. Patak, NMV J9241, 1♂; The Basin, Dandenongs, 27 Mar 1982, A. Patak, NMV J9242, 1♂; Ferny Ck, tributary of Dandenong Ck, (37°52'S., 145°18'E.), 20 Apr 1982, GJM and SJH, NMV J5961, 1♀; Olinda Ck above Olinda Falls, (37°50'S., 145°20'E.), 20 Apr 1982, GJM and SJH, NMV J5962, 3♂♂; Sassafras Ck near Kallista, (37°52'S., 145°20'E.), 20 Apr 1982, GJM and SJH, NMV J5965, 4♂♂; Clematis Ck, Sherbrooke State Forest, (37°54'S., 145°20'E.), 20 Apr 1982, GJM and SJH, NMV J5966, 3♂♂, 2♀♀; 1 mile east of Gembrook, 7 Feb 1964, JRK, NMV J9215, 1♂; Diamond Ck, Gembrook, 16 Sep 1979, K. Hortle, 2♀♀; Diamond Ck, Mortimer Park Forest Reserve near Gembrook, (38°00'S., 145°40'E.), 21 Apr 1982, GJM and SJH, NMV J5964, 1♀; Beer Ck, Gilderoy, 10 Sep 1977, L. Metzeling, NMV J9225, 1♀; Don R. north of Launching Place, (37°45'S., 145°37'E.), 22 Apr 1982, GJM and SJH, NMV J5963, 1♂; Blue Jacket Ck, Maroondah Catchment, 10 Mar 1977, D. Robinson, NMV J9230, 1♀; Lilydale, 27 Apr 1964, J. Martin, NMV J9238, 1♀; Masons Falls (Kinglake), 8 Jun 1963, JRK, NMV J9223, 2♀♀; Masons Falls, 14 Mar 1963, D. Denning, NMV J9228, 1♀; Running Ck, Kinglake, 17 Jan 1978, NMV J9227, 4♂♂, 2♀♀; Running Ck, 2 Nov 1978, NMV J9226, 2♂♂, 2♀♀; Kinglake, Jun 1963, JRK, NMV J9207, 1♂; Lake Mt., 4,500 ft, 29 Nov 1962, A. Martin, 2♂♂; Lake Mt., 4,600 ft, 18 Jan 1965, Neboiss, NMV J9235,

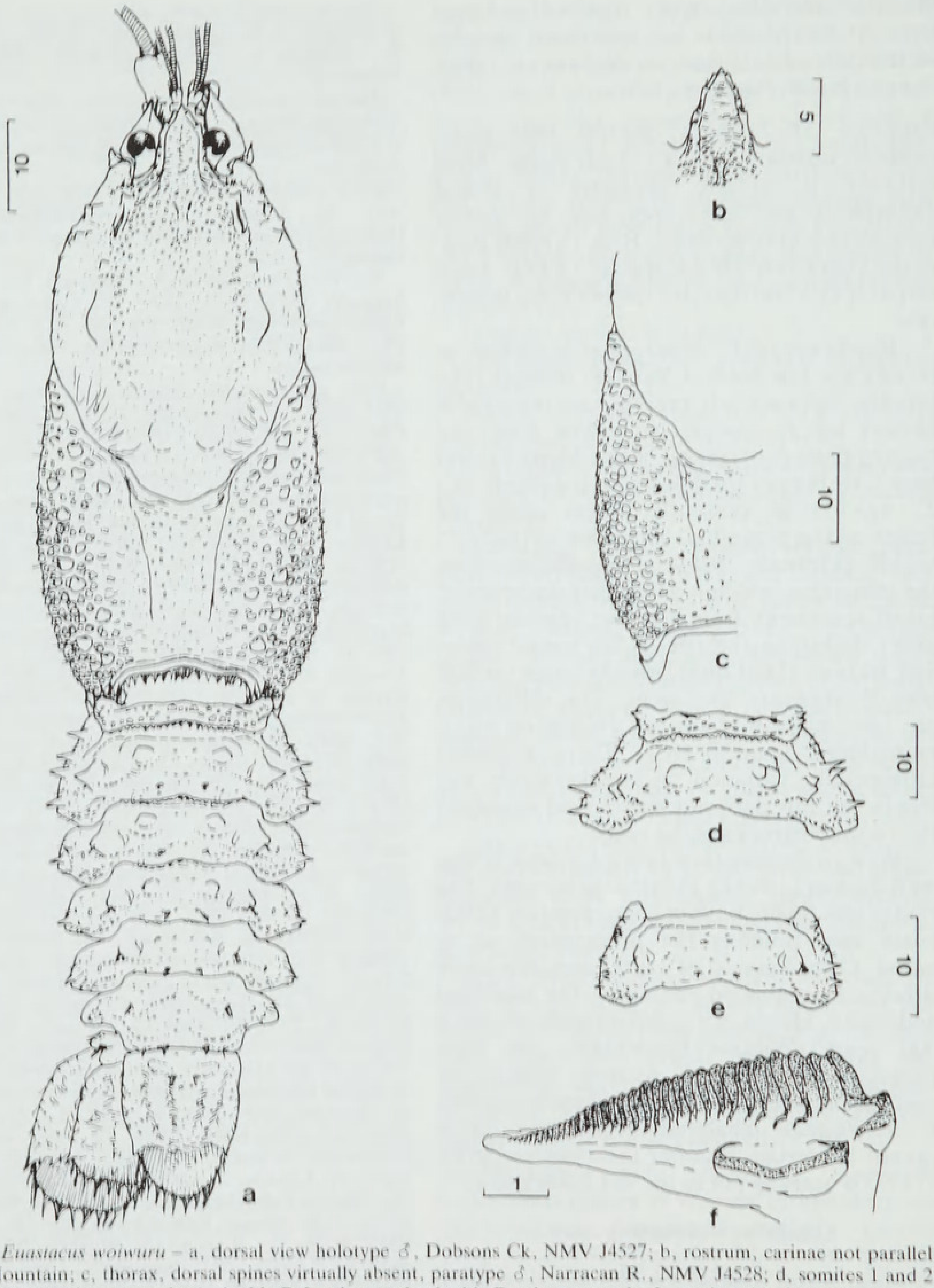

Figure 20. *Euastacus woiwuru* – a, dorsal view holotype ♂, Dobsons Ck, NMV J4527; b, rostrum, carinae not parallel, ♀, Lake Mountain; c, thorax, dorsal spines virtually absent, paratype ♂, Narracan R., NMV J4528; d, somites 1 and 2, D-L and slight D spine on somite 1, double D-L spines and a double D spine on somite 2, somite wide (sexual), paratype ♀, Mt Evelyn-Wandin North, NMV J4529; e, somite 2, many small and tiny Li spines, poor D-L spine, absent D spines, ♂, Lake Mountain ; f, zygocardiac ossicle (can be secondary ears posterior to main ear), holotype ♂.

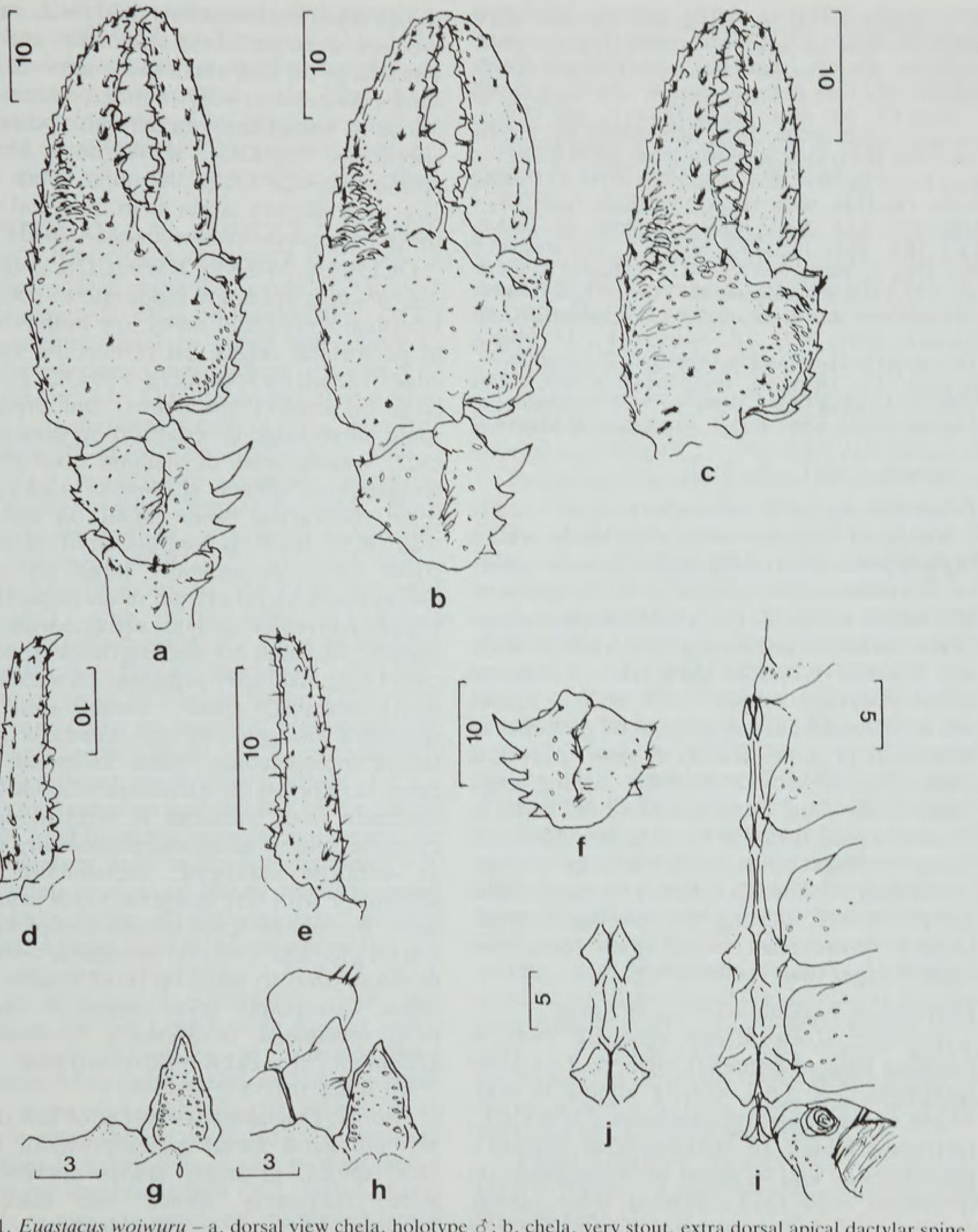

Figure 21. *Euastacus woiwuru* – a, dorsal view chela, holotype ♂; b, chela, very stout, extra dorsal apical dactylar spine, spine lateral to dactylar base, paratype ♂, NMV J4528; c, chela, elongate, larger and more numerous mesal dactylar spines, several spines lateral to dactylar base, ♀, Stirling R., NMV J9244; d, dactylus, fewer spaced mesal spines, paratype ♀, NMV J4529; e, dactylus, many dorsal mesal spines, 1 marginal mesal basal spine (rare), paratype ♀, Masons Falls, NMV J4530; f, carpus, 4 mesal spines (rare), ♂, Don R., NMV J5963; g, ventral view cephalon, (right antenna deformed), holotype ♂; h, ventral view cephalon, paratype ♀, NMV J4529; i, sternal keel, holotype ♂; j, sternal keel, processes narrower, paratype ♀, NMV J4529.

3♀♀; Echo Flat, Lake Mt., 19 Feb 1967, I.B. Muir, NMV J9220, 1♂; Lake Mt. pond, 4 Jun 1980, D. Booth, NMV J9224, 1♂; Echo Flat, Lake Mt., 4 Sep 1980, 1♂; Woods Point, 29 Dec 1963, P. Rawlinson, NMV J9231, 1♀; South Cascade Ck, east slopes of Mt Erica, 11 Apr 1960, J. Coventry, NMV J9234, 2♂♂; Murrundindi R., 15 Mar 1964, JRK and G.O. Kelly, NMV J9206, J9232, 2♂♂, 1♀; King Parrot Ck, May 1963, JRK, NMV J9211, 2♀♀; King Parrot Ck, JRK, NMV J9221, 2♂♂; King Parrot Ck, 4 May 1963, T.Q., NMV J9229, 1♂; Snobs Ck, Eildon, 1962, JRK, NMV J9233, 1♀; Stirling R. near Buxton, 6 Mar 1982, A. Patak, NMV J9244, 1♀; Buffalo R. tributary, 6 km south of Dandongadale, 7 Oct 1982, P. Horwitz, 1♀; Narracan R., Narracan, Gippsland, Mar 1890, W. Kershaw, NMV J9222, 1♂; Narracan R., 1♂ (dried); Thorpdale (on Narracan R.), Gippsland, 21 Nov 1888, W. Kershaw, 1♀; Thorpdale, small stream in hills, 1 Dec 1888, W. Kershaw, NMV J9205, 1♂, 1♀; Gippsland, Feb 1906, C. French, NMV J9218, 1♀; Victoria, 23 May 1906, S. Fulton, NMV J9216, 1♂.

No locality. NMV, 4♂♂, 3♀♀.

Diagnosis. As for *E. bidawalus* except:

Antennal squame more frequently widest slightly proximal to midlength. Thoracic spines small, medium sized or absent. 3-9 Li spines on abdominal somite 2. D abdominal spine sometimes medium sized on anterior somites. Usually 2 lateral propodal spine rows. 1-4 dorsal apical propodal spines (>30 OCL). Spines above propodal cutting edge to or proximal to midlength of gape. Rarely 7 mesal propodal spines. Spines above dactylar cutting edge reaching proximal to midlength or full gape. 2-5 dorsal mesal dactylar basal spines. Marginal mesal dactylar basal spines usually absent, occasionally 1 spine. 2-5 (rarely 6) apical mesal dactylar spines, forming row with basal spines. Largest ventromesal carpal spine sometimes slightly larger than ventral spine.

Description. Maximum OCL: 74.5 mm.

Rostrum: Rostrum not reaching base or reaching base of antennal segment 3 on most specimens >30 OCL (rarely almost to midlength of segment); on specimens 20-30 OCL, rostrum to base or midlength of segment; sometimes to end or distal to 3rd segment on specimens <20 OCL. Rostral sides usually parallel or slightly convergent, rarely distinctly convergent; base divergent or very divergent and carinae medium length or short, slightly or distinctly spread. 1-6(usually 2-4) rostral spines per side, distributed to midlength or slightly short of or proximal to midlength of carinae; spines small on specimens >30 OCL, small or medium sized on lesser specimens and sometimes large on very small specimens <20 OCL; spines rounded or very rounded on most large animals, sometimes moderately pointed on specimens <40 OCL, moderate or sharp on specimens <20 OCL. Acumen spine similar size to or slightly larger than marginal spines, much larger on some specimens <20 OCL.

OCL/CL 0.76-0.89 i. RW/OCL 0.13-0.23 d.

Cephalon: Spination moderate to poor, with 1-5 small spines and many low bumps ventral to postorbital ridges. 1st postorbital spine an edge or small on specimens >30 OCL, small to large on smaller specimens. 2nd postorbital spine small edge or edge on specimens >30 OCL, usually small or medium sized on lesser animals; occasional specimens lacking 2nd spine. Suborbital spine small on specimens >40 OCL, small to medium sized on animals 20-40 OCL, occasionally large on smaller specimens. Lateral margin of antennal squame slightly convex or straight; squame widest at or slightly proximal to midlength on specimens >30 OCL, distinctly proximal on smaller animals; marginal spines absent (one large specimen with spine on one squame). Interantennal spine medium width to broad, sometimes very broad on specimens <20 OCL (one specimen from Narracan R. with moderately elongate spine); spine margins usually slightly or distinctly scalloped, occasionally almost smooth or with tiny marginal tooth near spine apex. Basipodite spine usually absent or small (rarely medium sized) on specimens >40 OCL, medium sized to large on most smaller specimens. Coxopodite spine absent or small on most specimens, occasionally medium sized and unimodal, weakly bifid or serrated.

ScL/OCL 0.12-0.25 d.

Thorax: Dorsal spines absent or few small to medium sized dorsal spines posterior to cervical spines, or many spines distributed in zone; frequently spines just discernible. Western forms (e.g., Dandenongs) usually with dorsal spines, eastern and northern specimens usually lacking distinct spines. General tubercles medium sized or medium/large dorsally on most specimens >30 OCL, medium sized to small or very small on lesser animals;

tubercles densely to moderately distributed on specimens >30 OCL and most 20-30 OCL, sparse to very sparse on smaller specimens, absent on some very small animals. 2(rarely 1)-5 cervical spines per side, medium sized or small and usually moderately pointed or blunt; dorsal spine often larger and sharper than others.

ArL/OCL 0.33-0.38. CaW/OCL 0.52-0.60 i. ArW/OCL 0.14-0.20 d. CaD/OCL 0.45-0.56.

Abdomen: D-L spine frequently on somite 1 of specimens >30 OCL and some 20-30 OCL; spine medium sized to small and sharp to blunt; spine sometimes absent or rarely 2 spines on one side. D spine usually absent from somite 1, sometimes small or tiny, blunt or very blunt D spine/bump. Somite 2 with 3 (rarely 2)-9 (usually 3-6) Li spines, specimens from eastern sites frequently with more numerous spines than on western specimens; some specimens <30 OCL with 0-1 spine. Somites 3-5 of specimens >30 OCL and most 20-30 OCL with 1 Li spine. Li spines decreasing in size posteriorly, large or medium sized to small or tiny on specimens >30 OCL, medium or small to tiny on lesser individuals; spines very sharp or sharp on specimens >40 OCL and most 30-40 OCL, moderately pointed or blunt on smaller animals. 1-2 Lii spines sometimes on somites 2-5 of specimens >30 OCL (Lii spines unusual on somite 2); spines medium sized to tiny on specimens >50 OCL, small or tiny on lesser crayfish; spines occasionally sharp, usually moderately pointed to blunt. Somite 6 with 1-2 small or tiny Lii spines on most specimens >30 OCL. D-L spine on somites 2-4 (sometimes 5) of most specimens >30 OCL and some smaller specimens; spines diminishing to posterior from medium sized or small to tiny and usually moderately pointed (rarely sharp) anteriorly to blunt or very blunt posteriorly. Sometimes tiny, blunt D-L spine on somite 6 of large animals. Some specimens >60 OCL with 2 (rarely 3) D-L spines on one, or both, side(s) of somite 2. D spine on somites 2 and 3, occasionally on somite 4, rarely on 5, of most specimens >30 OCL and some smaller specimens; D spines medium sized to small or tiny on large animals, small or tiny on specimens <50 OCL and blunt or very blunt. D spines often only bumps. Specimens <20 OCL usually lacking abdominal spines. Dorsal boss weakly developed on some specimens >50 OCL, absent on smaller animals.

AbdW/OCL: ♂ 0.46-0.54 d; ♀ 0.47-0.65 di. OCL/L: ♂ 0.37-0.46 i; ♀ 0.37-0.45 id.

Tailfan: Tailfan spines absent, feint setal bumps along margins of telson and uropods. Standard spines very small or small on specimens >50 OCL, small to medium sized on animals 20-50 OCL, large on some smaller animals.

TeL/OCL: ♂ 0.29-0.41 d; ♀ 0.32-0.41 di.

Chelae: Chelae stout to elongate, variation between populations. Teeth well developed on specimens >40 OCL.

Propodus: Usually 2 lateral propodal spine rows, 2 to 1 condition on some specimens <30 OCL; lateral spines medium sized to small and rather sharp. Lateral spine ridge usually small or vague. Mesal propodal spines numbering 5 or 6, occasionally 7 (4 on some regenerate chelae). 1-3 (rarely 4) dorsal apical spines on specimens >30 OCL and some smaller animals, eastern and northern specimens commonly with higher counts than Dandenong animals. 2-5 (usually 3-4) spines above propodal cutting edge of specimens >30 OCL and most animals 20-30 OCL; spines to or proximal to midlength of gape (sometimes full gape) and very large or large on most specimens >50 OCL, large to small on lesser individuals (basal spine frequently largest); some specimens <30 OCL and all <20 OCL with 0-1 spine above cutting edge. Frequently 1 (rarely 2) medium sized or small blunt spine(s) lateral to dactylar base dorsally, with several low bumps; ventrally, 1-3 (occasionally 4-5) spines, usually medium sized or small, rarely large. Precarpal spines absent. A low, blunt spine or bump posterior to dactylar articulation.

PropL/OCL: ♂ 0.72-0.92; ♀ 0.71-0.90. PropW/PropL 0.35-0.52 id. PropD/PropL (0.23)0.25-0.33.

Dactylus: 3-9 (usually 4-6) spines above dactylar cutting edge of specimens >30 OCL and most 20-30 OCL, Dandenong specimens usually with lower counts than more northern (e.g., Kinglake) crayfish; spines reaching proximal to midlength or to full length of gape, spines large or medium sized (rarely small); some specimens 20-30 OCL with only 1 or 2 small spines, rarely apical; specimens <20 OCL lacking spines. 1(rarely 2) extra dorsal dactylar spine(s) often present; Dandenong and Narracan crayfish usually lacking spine, north-eastern populations (e.g., Lake Mountain) usually with spine. Usually 2-5 dorsal mesal dactylar basal spines, reaching distal to midlength of dactylus. Marginal basal spines usually absent; some specimens, especially from Kinglake, with 1 spine (often on one chela only). Basal spines medium sized to small and moderately raised or flattened. 2-5 (rarely 6) apical spines,joining dorsal basal spines in mesal dactylar row. Eastern and Kinglake specimens with most numerous spines, Dandenong specimens frequently with fewer spines and some large specimens from near Wandin with large gaps between basal spines. Specimens <30 OCL often with fewer spines, absent on some very small specimens <20 OCL. Dactylar groove present, sometimes deep.

DactL/PropL 0.53-0.61(0.63).

Carpus: 3 mesal carpal spines, rarely 4 on one chela, some regenerate chelae with proximal spine very reduced i.e., 2(+1) spines. 2, occasionally 3(rarely 1), lateral carpal spines, large or medium sized on specimens >30 OCL, medium or small on lesser individuals. Articulation spine absent on all but smallest specimens. Low dorsal spine/bump occasionally present. Ventral carpal spine very large or large. Largest ventromesal spine medium sized to very large on specimens >40 OCL, sometimes similar to or slightly larger than ventral spine; 1 or 2 small additional ventromesal spines/bumps.

Merus: 5-9 medium sized dorsal spines. Outer meral spine absent or small on specimens >20 OCL, medium sized or large on lesser individuals.

Keel: Pr1: Posterior margins sloped or almost semi-abrupt, occasionally semi-abrupt on small specimens; ventral edges angled down, occasionally slightly rounded; processes close or slightly apart (apart on one specimen from Buffalo R.) and parallel or open. Keel after Pr1 low and lacking obvious spines, anterior sometimes slightly pronounced. Pr2: Almost parallel or open. Keel after Pr2 low, sometimes with a low spine. Pr3: Scoops usually absent, sometimes slight or very gradual, bases sharp to rounded. Keel after Pr3 usually slightly saddle-shaped, 1 or 2 small spines sometimes present. Pr4: Scoops usually absent, rarely slight; posterior edges usually sharp (occasionally moderate) and convex, straight or irregular; anterior edges moderately rounded to angular. Processes 3 and 4 narrow (or very narrow) on specimens >40 OCL, just narrow or broad on smaller animals, very broad on some specimens <20 OCL.

Setation: Usually moderate to light; specimens from Lake Mountain and Buffalo R. more hirsute than western animals.

Punctation: Dense or very dense.

Gastric Mill: TAP count 7.0-9.0; TAA count 0.0-1.0 (usually 0.0 or 0.5); spread 6.5-9.0. Frequently 1 or more small secondary ears posterior to main zygocardiac ear. Urocardiac ridges 9-11.

Coloration: Body dorsally brown or brown/green, paler ventrally. Thoracic spines (when present) usually dark green; general tubercles pale brown, green or cream. Rostral carinae and postorbital spines blue or green. Abdominal somites laterally blue; abdominal spines brown or cream. Carpus of cheliped brown with dark blue or green mottling, mesal spines green or blue with pale tips. Propodus like carpus, mesal and lateral edges often bright blue, spines pale. Fingers blue or green.

Body ventrally cream, blue and orange. Carpus of cheliped orange midventrally, blue and green marginally. Propodus white or pale brown with green or blue mottling, mesally orange or brown, mesal edge blue/green. Fingers bright blue in Dandenongs, usually dark brown or green in east.

Geographical variation in intensity of blues.

Sexes: Males bear a cuticle partition. Females <30 OCL have unopen gonopores. One female near the upper limit of the 30-40 OCL range has open pores. Three of ten females examined in the 40-50 OCL range appear mature and three have setae developing around opening pores. Females >50 OCL have open gonopores and one is berried. It appears that female maturity usually occurs at sizes between 40 and 60 mm OCL.

Distribution and biology. Euastacus woiwuru inhabits streams in central Victoria from the Dandenong Mountains, east of Melbourne, north-east to Eildon and Dandongadale, east to Woods Point and Erica and south-east to the region of Thorpdale (Fig. 7). Included in this range are tributaries of the Yarra, Murray and Latrobe Rivers and some small coastal streams. The species appears separated from *E. neodiversus* by low country along the Morwell River. *Euastacus woiwuru* usually occurs at altitudes above 200 m a.s.l., occasionally at lower elevations. Specimens have been collected at sites greater than 1 400 m a.s.l., snow covered in winter. Natural vegetation in the species' range includes mountain ash and tree ferns, with dry sclerophyll forest at lower altitudes. Much of the range is cleared and blackberry is common in areas. *Euastacus woiruru* is most common where vegetation is dense. The species is frequently sympatric with *Engaeus* species and has been observed berried in spring (September).

Remarks. Euastacus woiwuru has been collected extensively from the Dandenongs and the species has a long taxonomic history. Clark (1936, 1941), Kane (1964) and Riek (1969) confused *E. woiwuru* with other species, especially *E. kershawi* and *E. crassus*.

Euastacus woiwuru is a variable species and several characters show geographical variation. Some eastern high country specimens (e.g., from Woods Point and Mt Erica) have slightly larger and more extensive rostral spines than do western specimens (e.g., from the Dandenongs). Dandenong specimens usually have better developed thoracic spines than do those animals from sites to the north-east and south. Most eastern forms lack thoracic spines.Eastern specimens frequently bear more numerous Li spines on abdominal somite 2 and more numerous spines above the propodal and dactylar cutting edges than do animals from the Dandenongs. Eastern and northern specimens usually have more numerous mesal dactylar spines. An extra dorsal dactylar spine is more frequently developed on eastern specimens, especially Lake Mountain crayfish, than on Dandenong specimens. Kinglake specimens commonly bear a marginal dactylar basal spine, unusual for the species. Gastric mill TAP counts are usually lower in the north of the range (especially in Murray R. tributaries) than in other areas.

A specimen (NMV J9238) from Lilydale, near Melbourne (presumably from Olinda Ck, a tributary of the Yarra R.) is unusually spiny. The dorsal thoracic, rostral, suborbital and dorsal abdominal spines are atypically large for *E. woiwuru* and converge towards the *E. yarraensis* condition. In most respects, however, the animal is more typical of *E. woiwuru* with three mesal carpal spines, extensive spines above the cutting edges of chelae, a low spine posterior to the dactylar articulation, no telsonic spines and narrow keel processes 3 and 4.

A small specimen from Diamond Ck near Gembrook has poor mesal dactylar spination, large 1st postorbital spines, large rostral acumen spine and no spines above the cutting edges of the chela. These conditions are partly due to the small size of the animal but are extreme nonetheless.

A specimen recently collected from the Buffalo River, south of Dandongadale, is unusual in several respects. The animal is more hirsute than other members of the species, though the Kinglake crayfish approach this condition. The mesal dactylar spines are reduced in number, though dorsal basal spines still extend distal to midlength of the dactylus. The interantennal spine is more elongate than usual.

Euastacus yarraensis (McCoy)

Figures 22, 23

Astacopsis serratus yarraensis McCoy, 1888: 225-7, pl. 16.–Smith, 1912: 159.

Astacopsis serratus.–Smith, 1912: 158-9, pl. 17 (in part, Yarra, Plenty and Curdies Rivers localities).–McCulloch, 1917: 237-8 (in part, Yarra R. locality).–Hale, 1927: 75-6 (in part, inclusive distribution?).

Euastacus nobilis kershawi.–Clark, 1936: 16-17 (in part, Warburton locality).

Euastacus nobilis.–Clark, 1941: 20-2 (in part, Warburton, Yarra R. locality).

Euastacus yarraensis (McCoy).–Clark, 1936: 14-15, pl. 2 fig. 13.–1937a: 35.–1937b: 186.–1941: 15-16, pl. 3 (in part, some locality streams drain Murray R. *E. armatus*).–Clark & Burnet, 1942: 90-2.–Riek, 1969: 894.

Euastacus bispinosus.–Hobbs, 1974: 23, fig. 20.

Material examined. Vic. Yarra R., Asylum Paddock, Kew, Oct 1882, NMV J6152, 1♀; Yarra R., Melbourne, 1♀; Yarra R., 1♂; Plenty R., 11 Jan 1918, Glass, 1♂; Yarra R., Warburton, 27 Nov 1905, Tanderson, NMV J5972, J6158, 3♂♂, 3♀♀; Woori Yallock Ck, JRK, NMV J5996, 1♂; Cockatoo, 26 Jan 1966, A.L. Dyce, AM P15320, 1♂; Plenty R., 30 Mar 1896, Keastland, NMV J5974, 1♂; Badger Ck below Sanctuary, 13 Oct 1963, M. Littlejohn, NMV J5999, 1♂; Badger Ck, Healesville Sanctuary, 8 Mar 1978, P.S. Lake, NMV J5991, 1♂; Badger Ck, Healesville, 21 Mar 1982, A. Patak, 1♀; Badger Ck, Coranderrk Reserve, 1982, L. Pahl, NMV J9242, 1♀; Badger Ck, 1 km east of Sanctuary (37°42′S., 145°35′E.), 22 Apr 1982, GJM and SJH, NMV J5968, 2♂♂; Diamond Ck, tributary of Bunyip R. near Bunyip North, 20 Oct 1963, JRK, NMV J6153, 1♀; Diamond Ck, Feb 1964, JRK, NMV J5981, 1♂; Diamond Ck, Tonimbuk, 6 Apr 1977, 1♂; Bunyip R., Gippsland, Jan 1880, W. Kershaw, NMV J5985, 1♂/♀; Diamond Ck, Tonimbuk, 15 Mar 1983, P. Humphries and P.S. Lake, NMV J9245, 1♂; Bunyip R., near Bunyip, 1 km below junction with Tarago R., 17 Mar 1979, K. Hortle, NMV J5976, 4♂♂; Bunyip R., near Bunyip, 21 Sep 1979, G. Hortle, NMV J5993, 1♂, 2♀♀; Bunyip R., Bunyip, 10 Jul 1979, K. Hortle, NMV J5975, 2♂♂, 3♀♀; Bunyip R., top of road from Princes Highway, 18 Feb 1977, P.S. Lake, NMV J6156, 2♂♂; Beer Ck, Gilderoy, 10 Sep 1977, L. Metzeling, NMV J5995, 1♀; Little Yarra R., near Gilderoy (37°50′S., 145°40′E.), 22 Apr 1982, GJM and SJH, NMV J5967, 2♂♂; Tarago R. near Warragul, Feb 1938, Hill, NMV J6151, 1♀; Labertouche Ck, tributary of Tarago R., 27 Oct 1963, JRK, NMV J5977, 1♀; Labertouche Ck, 1982, P. Horwitz, 1♂; Lerderderg R. headwaters near Blackwood, 15 Oct 1956, NMV J5978, 1♀; Lerderderg R., 14 Dec 1977, 1♂; O'Briens Crossing on Lerderderg R., 3 Jan 1980, P.S. Lake and D. Coleman, 3♂♂; Werribee R. below weir, 30 Jan 1980, P.S. Lake and D. Coleman, 1♂, 1♀; Underbank, Werribee R. 2 miles downstream of weir, 30 Jan 1980, P.S. Lake and D. Coleman, 1♂; Geelong Angling Club, 1 Apr 1942, NMV J5988, 1♀; Forrest, July 1948, Wilhelms, NMV J5984, 1♀; Gellibrand R. near Gellibrand, 30 Mar 1970, A. Neboiss, NMV J5970, J5973, 2♂♂, 2♀♀; Gellibrand R. south of Colac, JRK, NMV J5980, 1♂; Loves Ck Reserve, tributary of Gellibrand R., 12 Nov 1963, JRK, NMV J6154, 3♀♀; Loves Ck, 19 Apr 1963, JRK, NMV J5971, J5990, 2♂♂, 5♀♀; Near Gellibrand, JRK, 15 Oct 1956, NMV J5979, 2♂♂, 2♀♀; Beauchamp Falls, Otways, 3♂♂, 2♀♀; Calder R., Cape Otway, Mar 1971, T. Pescott, NMV J5982, 1♂; Aire R., Otways (38°40′S., 143°32′E.), 24 Mar 1982, GJM and SJH, NMV J5969, 4♂♂, 2♀♀; Kennedys Ck, Cobden, tributary of Curdies R. (site uncertain since Kennedys Ck flows into Gellibrand R. but Cobden is near Curdies R.), Oct 1897, W.A. Hall, NMV J6157, J6159, 1♂, 1♀; Victoria, 1♂.

No locality: NMV R2567, 1♀; NMV, 3♂♂, 3♀♀.

Diagnosis. Similar to *E. armatus* except:

Rostral base rarely parallel, usually divergent. Thoracic spines medium sized or large. General tubercles moderately distributed to dense. 2-5 (usually 3-4) Li spines on abdominal somite 2. D abdominal spines medium sized or small, less distinctly curved towards anterior. 2-17 telsonic surface spines. Spines above propodal and dactylar cutting edges apical or reaching proximal to midlength of gape. 1-3 (rarely 0) dorsal mesal dactylar basal spines. 2-4 apical mesal dactylar basal spines. Occasionally 2 (+1) or 3 mesal carpal spines. Keel Pr1 sloped to abrupt, close or apart. TAP count 4.0-7.0. [1st extra zygocardiac tooth not between teeth 5 and 6].

Description. Maximum OCL: 76.8 mm.

Rostrum: Rostrum quite broad, not reaching base of 3rd antennal segment or reaching midlength of segment on specimens >60 OCL, proximal to midlength or to end of segment on specimens 20-60 OCL, to or distal to end of segment on specimens <20 OCL. Rostral sides usually parallel or slightly convergent, occasionally convergent. Base usually divergent or very divergent (occasionally parallel), carinae medium length or long. 2-5 (usually 3-4) rostral spines per side, usually distributed to or proximal to midlength of carinae (occasionally apical or to full length); spines usually large to medium sized, rarely small on large specimens; moderately pointed or sharp. Acumen spine usually distinctly larger or much larger than marginal spines, rarely only slightly larger than marginals on large specimens.

OCL/CL 0.72-0.87 i. RW/OCL 0.13-0.24 d.

Cephalon: Cephalon very spiny to moderately spiny on specimens >20 OCL, moderately to poorly spined on lesser individuals, with 1-4 spines and several bumps ventral to postorbital ridges. 1st postorbital spine small or medium sized on specimens >60 OCL, small to large on lesser animals and very large on some specimens <20 OCL; 2nd spine an edge or small on specimens >40 OCL, usually medium sized to large on smaller animals. Suborbital spine medium sized to large. Lateral margin of antennal squame straight or convex, slightly concave on some specimens <20 OCL;

squame widest proximal or very proximal to midlength; marginal spines absent. Interantennal spine medium width or broad on specimens >40 OCL, broad or very broad on lesser specimens; margins usually toothed or scalloped; often tiny spine in centre of interantennal spine. Basipodite spine small to large, very large on some specimens <40 OCL. Coxopodite spine small to large, usually unimodal or bifid, occasionally weakly serrated.

ScL/OCL 0.15-0.41 d.

Thorax: 3-11 (usually 5-10) thoracic spines per side on specimens >20 OCL, in thin zone or 1 or 2 irregular rows; spines medium sized or large and moderately pointed or sharp, usually with some blunt spines dorsally; specimens <20 OCL with 1-6 spines, sometimes absent, spines medium sized or small and moderately pointed to flat. General tubercles large to medium sized on specimens >40 OCL, usually medium to small on specimens 20-40 OCL, small or absent on specimens <20 OCL; tubercles dense or moderately distributed on specimens >40 OCL, frequently sparse on smaller animals, very sparse or absent on many <20 OCL. 1-5 (usually 2-3) cervical spines per side, 1st (dorsalmost) and sometimes 2nd usually large and sharp, others medium sized or small and moderately pointed.

ArL/OCL 0.36-0.41. CaW/OCL 0.54-0.64 i. ArW/OCL 0.15-0.21 d. CaD/OCL 0.45-0.57 d.

Abdomen: D-L spine on somite 1 of specimens >20 OCL and some smaller animals; spine usually large or medium sized and sharp, except on small animals. D spine frequently on somite 1, absent on some specimens of all sizes; spine usually medium sized or small and sharp to blunt. On somite 2, 2-5 (usually 3-4) Li spines, 0-1 spines on some animals close to or <20 OCL. Somites 3-5 of specimens >20 OCL with 1 Li spine. Li spines very large to medium sized (small on specimens close to or <20 OCL) and very sharp, moderately pointed on some small specimens, decreasing in size and sharpness posteriorly. 1-2 Lii spines frequently on somites 3-6 (rarely somite 2); Lii spines large to small (tiny on some specimens <40 OCL) and very sharp on large specimens, moderately pointed or blunt on most specimens <40 OCL. D-L spine on somites 2-6 of specimens >40 OCL and most 20-40 OCL; some specimens >40 OCL with 2 D-L spines per side on somite 6. D-L spine very large to small, decreasing in size posteriorly and very sharp on specimens >40 OCL, sharp to blunt on smaller animals. D spine on somites 2-5 of most specimens >40 OCL and some smaller animals; somite 6 of large specimens usually with 1-3 D spines, 5 tiny spines on one specimen. D spines medium sized to tiny and sharp to blunt, decreasing in size posteriorly, though spines on somite 6 frequently sharp. Specimens <20 OCL usually lacking abdominal spines. Dorsal abdominal boss present on large animals, but not obvious; specimens 40-60 OCL with vague boss on somites 2-4, usually absent on specimens <40 OCL.

AbdW/OCL: ♂ 0.46-0.55 d; ♀ 0.50-0.63 i. OCL/L: ♂ 0.35-0.44 i; ♀ 0.35-0.42 i.

Tailfan: 2-17 (usually 4-10) telsonic surface spines on specimens >20 OCL; spines very large or large on specimens >60 OCL and most smaller specimens, though small animals usually with some medium sized and/or small spines; specimens <20 OCL usually lacking spines, sometimes 1 or 2 very small spines. Often 1, sometimes 2, large to small marginal telsonic spines per side. Inner ramus of uropod usually with 1-2 (rarely 3) surface spines, sometimes on one uropod only, and 1-3 extra marginal spines (rarely absent); outer ramus of uropod usually with 1-4 marginal spines; uropod spines large to small, absent on specimens <20 OCL. Standard spines medium sized to large.

TeL/OCL: ♂ 0.30-0.44 d; ♀ 0.33-0.44 d.

Chelae: Chelae elongate to stout, usually intermediate in shape. Teeth well developed on specimens >60 OCL.

Propodus: Lateral spine rows usually in 2 to 1 condition, almost 2 rows on some specimens; ventral row often poorly developed on specimens <20 OCL. Lateral spines large or medium sized (small and blunt on some large specimens, probably due to abrasion). Lateral spine ridge present on specimens >20 OCL, obvious to vague. Usually 5 mesal spines, occasionally 4, rarely 6. Usually 1-2 dorsal apical spines, sometimes absent especially on small crayfish. 2-4 spines above cutting edge on

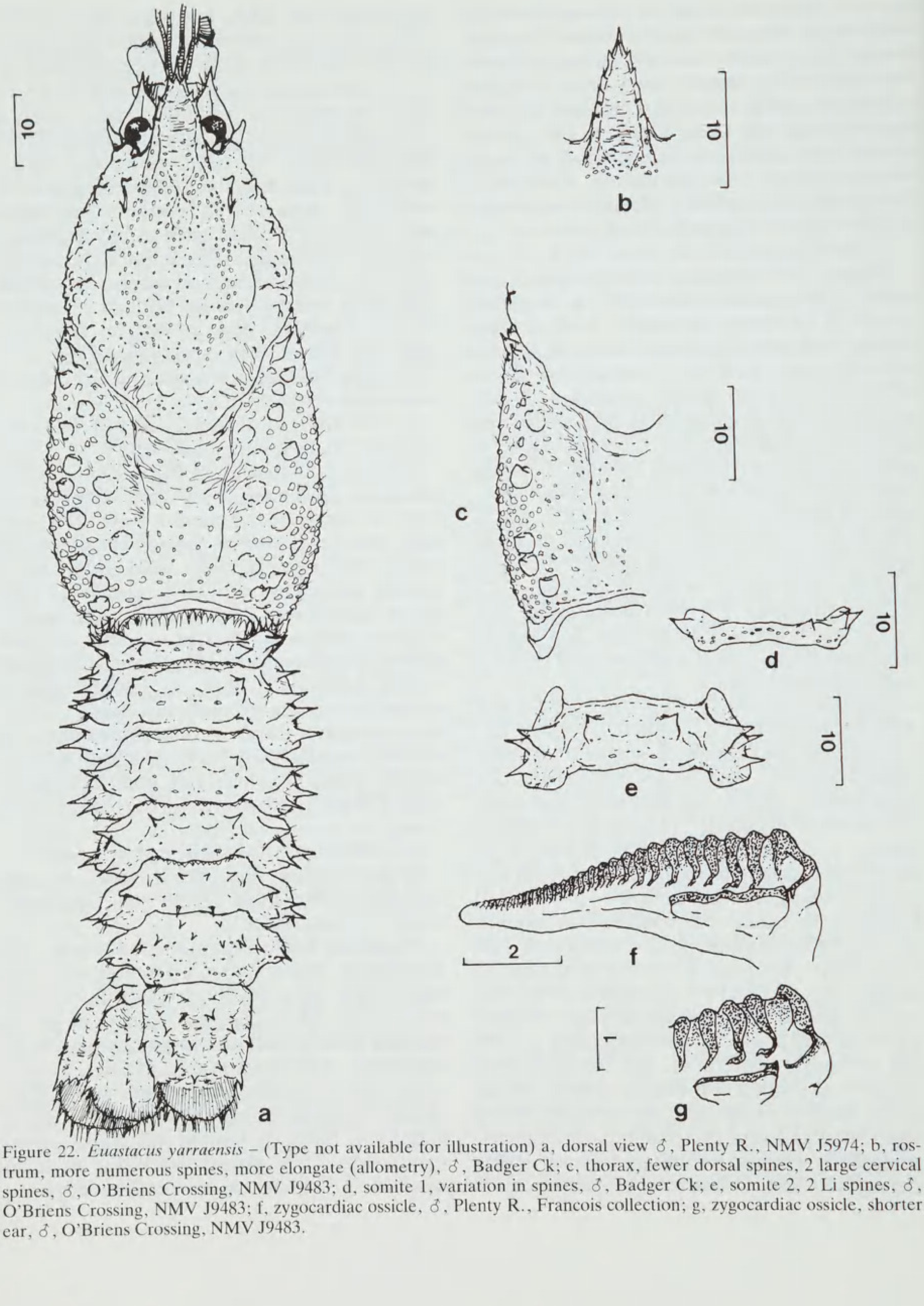

Figure 22. *Euastacus yarraensis* – (Type not available for illustration) a, dorsal view ♂, Plenty R., NMV J5974; b, rostrum, more numerous spines, more elongate (allometry), ♂, Badger Ck; c, thorax, fewer dorsal spines, 2 large cervical spines, ♂, O'Briens Crossing, NMV J9483; d, somite 1, variation in spines, ♂, Badger Ck; e, somite 2, 2 Li spines, ♂, O'Briens Crossing, NMV J9483; f, zygocardiac ossicle, ♂, Plenty R., Francois collection; g, zygocardiac ossicle, shorter ear, ♂, O'Briens Crossing, NMV J9483.

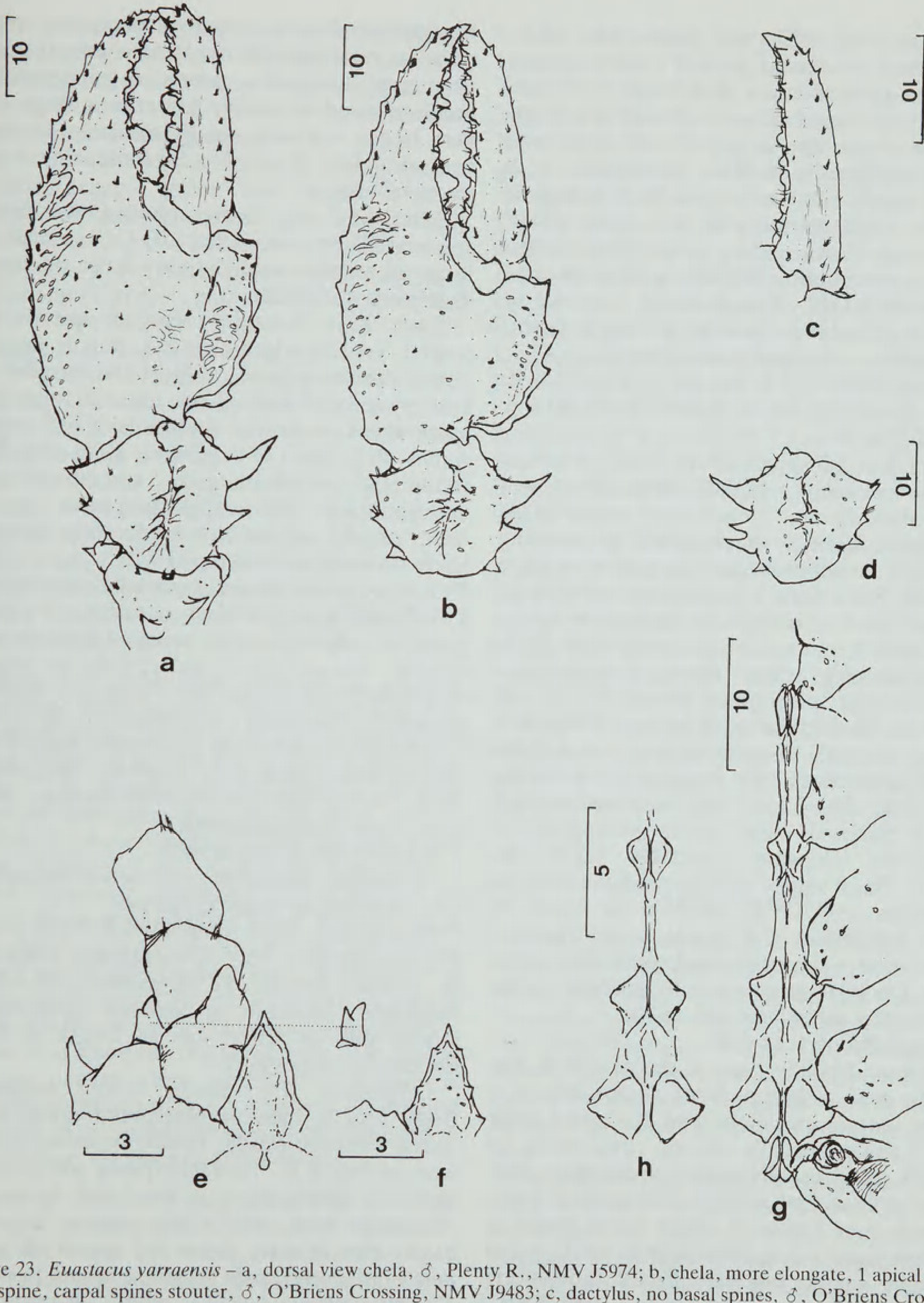

Figure 23. *Euastacus yarraensis* – a, dorsal view chela, ♂, Plenty R., NMV J5974; b, chela, more elongate, 1 apical propodal spine, carpal spines stouter, ♂, O'Briens Crossing, NMV J9483; c, dactylus, no basal spines, ♂, O'Briens Crossing, NMV J9483; d, carpus, 3 mesal spines (rare), ♂, Diamond Ck; e, ventral view cephalon, ♂, Plenty R., NMV J5974; f, cephalon, toothed interantennal spine, larger basipodite spine, ♂, O'Briens Crossing, NMV J9483; g, sternal keel, ♂, Plenty R., NMV J5974; h, sternal keel, processes broader (partly allometry), ♂, Aire R., NMV J5969.

specimens >40 OCL and most 20-40 OCL, some small specimens with 0-1 spine; spines large to small, apical or distributed to or proximal to midlength of gape. Dorsal spines lateral to dactylar base usually absent, sometimes small (occasionally medium sized) spine with several small, low bumps; usually 1-3 large or medium sized spines ventrally, often distributed some distance along finger; spines often small on specimens <40 OCL, absent on most animals <20 OCL. Spines absent posterior to dactylar articulation, except on some regenerate chelae; precarpal spines absent.

PropL/OCL: ♂ 0.75-0.97 i; ♀ 0.74-0.90 (0.95). PropW/PropL 0.37-0.49. PropD/PropL (0.20)0.23-0.31 i.

Dactylus: 2-7 spines above dactylar cutting edge on specimens >40 OCL, sometimes fewer on smaller animals (regenerate chelae often with fewer spines); spines apical or reaching midlength or full chela gape, and medium sized or small. Specimens from western areas (e.g., Otways) usually with more numerous spines than eastern animals. Specimens <20 OCL usually lacking spines above cutting edge. Extra dactylar apical spines absent. Usually 1-3 dorsal mesal dactylar basal spines, sometimes absent; marginal dactylar basal spines usually absent, sometimes 1 or 2 spines especially on regenerate chelae (one large specimen with 3 and 4 marginal basal spines joining apical spines on elongate, probably regenerate chelae). Basal spines large or medium sized on specimens >60 OCL, medium or small on lesser specimens. 2-4 apical mesal dactylar spines, except on some small specimens with 1 spine. Dactylar groove usually present, vague or absent on some large specimens.

DactL/PropL 0.51-0.60.

Carpus: Usually 2 mesal carpal spines, frequently with a bump distal and/or mesal to spines, several specimens with 2(+1) and some with 3 spines, usually on one chela only; 1st (distal) spine usually much larger than 2nd; when 3 spines, 2nd and 3rd contiguous at base. 2 (rarely 1 or 3) lateral carpal spines, large or medium sized on specimens >40 OCL, small on some smaller animals. Small articulation spine sometimes on specimens <40 OCL, medium sized or large on smaller animals. Dorsal carpal spines usually absent, tiny spine on some small specimens. Ventral carpal spine very large. Largest ventromesal spine usually medium sized or small, sometimes large (or very large) and occasionally similarly sized to ventral spine; 2 or 3 additional tiny ventromesal bumps.

Merus: 5-9 large dorsal spines. Outer meral spine small on specimens >60 OCL, small to large on smaller animals, very large on some specimens <20 OCL.

Keel: Pr1: Posterior margins abrupt to sloped; ventral edges rounded, flat or angled down; processes close or apart and parallel or open (rarely closed). Keel after Pr1 usually pronounced anteriorly, sometimes 1 or 2 sharp spines. Pr2: Open or very open. Keel after Pr2 frequently saddle-shaped, sometimes an anterior spine. Pr3: Scoops present or absent, bases usually rounded or moderately curved, sharp on some specimens <20 OCL. Keel after Pr3 quite pronounced especially anteriorly. Pr4: Scoops usually absent, occasionally slight; posterior edges sharp or rounded and slightly convex, straight or irregular; anterior edges moderately rounded or angular (rarely rounded). Processes 3 and 4 usually broad or very broad, occasionally just broad, narrow on one specimen from near Geelong. Specimens from the Otways usually with broader processes than eastern crayfish.

Setation: Moderate to light.

Punctation: Dense or very dense on cephalon, moderate or dense on thorax.

Gastric Mill: TAP count 4.0-7.0; TAA count 0.5-1.0; spread 3.0-6.5. Geographical variation in counts (lowest in Werribee/Lerderderg specimens, highest in eastern specimens) largely due to differences in length of ear. Urocardiac ridges 8-11.

Coloration: Two major colour variants. Body usually blue or blue/green dorsally in Yarra drainage (east), brown or brown/green west of Yarra R. Thoracic spines and general tubercles tipped white in east, pale brown or orange in west. Abdominal somites laterally bright blue in east; abdominal spines white or pale blue in east, pale brown or cream in west. Tailfan spines usually white. Carpus of cheliped bright blue with white tipped spines in east, green or brown with pale brown or orange spines in west. Propodus white with blue mesal area in east, pale brown, green or cream, often mottled, in west. Fingers white in east, cream or blue/green in west.

Body ventrally white and blue in east, brown, orange, green and cream in west. Carpus of cheliped mesally blue and laterally white in east, green and brown/orange in west. Propodus white with blue mesal edge and white spines in east, pale orange often mottled with cream in west. Fingers white in east, cream (often tinged green) in west.

Some eastern specimens (e.g., from Tarago drainage) with colour similar to that of western forms. Small specimens throughout range similarly green and brown.

Sexes: Males lack a cuticle partition. One female almost 40 OCL (OCL38.7 mm) has open gonopores. All available females >40 OCL except one (OCL41.9 mm) have open pores and many are berried. Female maturity appears to occur at sizes close to 40 mm OCL, with little variation in maturation size.

Distribution and biology. The species inhabits southerly flowing rivers of Victoria from the Bunyip/Tarago system in the east to the Gellibrand River of the Otway region in the west (Fig. 7) at elevations below 300 m a.s.l. Two museum specimens bear the site label of Kennedys Creek, a tributary of the Curdies River near Cobden, but Kennedys Creek is a tributary of the Gellibrand River and lies 20 km to the east of Curdies River. Vegetation in the species range includes dry sclerophyll forest and wattle (*Acacia* spp.), blackberry in semi-cleared areas and tree ferns (*Cyathea*) in some sheltered valleys. *Euastacus yarraensis* is present in some cleared areas, especially if vegetation persists along streams. The species is sometimes sympatric with *E. kershawi*. Berried females of *E. yarraensis* have been collected in September, October and November.

Remarks. Eastern specimens represent the "classic" condition of *E. yarraensis*. Specimens from the Yarra and Tarago drainages are usually vivid blue and white. Some variation is evident, however, as two specimens collected recently from Labertouche and Diamond Creeks, tributaries of the Tarago River near Warragul, were reddish brown, similar to the colours of Lerderderg and Otway specimens. Specimens from the Lerderderg and Werribee Rivers and the Otways are brown or brown/green. Compared to eastern crayfish, specimens from the Otways usually have smaller telsonic and ventral antennal spines, a slightly shorter antennal squame, bumpier dorsal surfaces of chelae, frequently a larger ventromesal carpal spine, more numerous spines above the cutting edges of chelae and frequently broader keel processes 3 and 4. Eastern specimens have gastric mill TAP counts of 5.5-7.0 and spreads of 5.0-6.5; Werribee and Lerderderg specimens, 4.0-4.5 and 3.0-3.5; Otway crayfish, 5.0-6.0 and 4.5-5.5. Tooth counts generally increase from the Werribee area to the east and west.

Larger specimens have been collected from eastern streams than from the west. Females from all sites mature at a similar size and the apparent size differences may be due to collecting bias. It is possible, however, that there is some geographical variation in maximum size.

The holotype of *E. yarraensis* was lodged in the British Museum (Natural History) but has been lost (Riek, 1969). The type locality is the Yarra River, Victoria.

Other species

Euastacus crassus Riek ranges into Victoria along the Victorian Alps from New South Wales and the Australian Capital Territory. *Euastacus crassus* can be distinguished from the small Victorian species (*E. woiwuru, E. bidawalus, E. neodiversus, E. diversus*) by its lack of a male cuticle partition. Very few specimens of *E. crassus* have been collected in Victoria.

An undescribed species of *Euastacus* ranges a few kilometres into Victoria from the south-east corner of New South Wales. Like *E. crassus*, the species lacks a male cuticle partition.

Euastacus crassus and *Euastacus* sp. nov. will be described in the New South Wales paper of this series (Morgan, in prep. b).

General remarks

Euastacus armatus, E. bispinosus and *E. kershawi* are spiny species attaining sizes in excess of 100 mm OCL. *Euastacus bidawalus, E. diversus* and *E. neodiversus* are less spiny species, possibly not exceeding 50 mm OCL. *Euastacus yarraensis* and *E. woiwuru* are intermediate in size between the above groups; *E. yarraensis* is a spiny species, *E. woiwuru* relatively poorly spined.

Euastacus armatus and *E. yarraensis* are similar species, distinguishable in spination of the abdomen, telson and great chela, rostral shape and gastric mill condition. These species are readily distinguished from *E. bispinosus* by the shape of thoracic and abdominal spines and development of the abdominal boss. *Euastacus kershawi* differs from the other spiny species in possessing a male cuticle partition.

Euastacus bidawalus and *E. diversus* are distinguished from *E. woiwuru* and *E. neodiversus* by the extent of dactylar spination. *Euastacus diversus* is readily recognised by its squamal spination. *Euastacus woiwuru* is a variable species but is distinguishable from *E. neodiversus* in spination of the chela and thorax.

The species-pairs *E. woiwuru-E. neodiversus* and *E. bidawalus-E. diversus* may be considered "species complexes" as defined by Mayr (1969: 47). Phylogenetic relationships within the genus *Euastacus* can be discussed only when all species are described adequately (Morgan, in prep. a, b).

Acknowledgements

I thank Drs G.C.B. Poore and P.S. Lake and Professors H.H. Hobbs, Jr and W. D. Williams for invaluable advice in the course of this study and preparation of the manuscript. The following curators generously made available loan material from their institutions – Dr Poore (Museum of Victoria) and Dr J.K. Lowry (Australian Museum). Mr D. Ross (Cunningham Laboratories, CSIRO) contributed much assistance in the computer analysis of data. Ms S.J. Harders assisted in extensive collection of material.

The study was supported in part by a grant from the Australian Museum. During the course of the study, I received a Commonwealth Post-Graduate Research Allowance. Sampling permits were provided by Victorian National Parks and Fisheries and Wildlife Services.

References

Clark, E., 1936. The freshwater and land crayfishes of Australia. *Mem. natn. Mus. Vict.* 10: 5-58.

Clark, E., 1937a. The freshwater crayfishes and yabbies of Victoria. *Victorian Yearbook 1936-1937*: 33-8.

Clark, E., 1937b. The life history of the Gippsland crayfish. *Aust. Mus. Mag.* 6: 186-92.

Clark, E., 1941. Revision of the genus *Euastacus* (crayfishes, family Parastacidae) with notes on the distribution of certain species. *Mem. natn. Mus. Vict.* 12: 7-30.

Clark, E. & Burnet, F.M., 1942. The application of serological methods to the study of the Crustacea. *Aust. J. exptl Biol. med. Sci.* 20: 89-95.

Eades, D.K., 1976. *The Dharawal and Dhurga languages of the New South Wales south coast. Research and Regional Studies 8.* Australian Institute of Aboriginal Studies: Canberra. 97 pp.

Faxon, W., 1898. Observations on the Astacidae in the United States National Museum and in the Museum of Comparative Zoology, with descriptions of new species. *Proc. U.S. nat. Mus.* 12: 619-34.

Faxon, W., 1914. Notes on the crayfishes in the United States National Museum and the Museum of Comparative Zoology, with descriptions of new species and subspecies. *Mem. Mus. comp. Zool. Harv.* 40: 351-427.

Fitzpatrick, J.F., 1977. The statistical relationships of different techniques of measurements in a crayfish species. Pp. 471-9 in Lindqvist, O.V., (ed.) *Freshwater Crayfish vol. 3.* University of Kuopio: Finland.

Forskål, P., 1775. *Descriptiones animalium, avium, amphibiorum, piscium, insectorum, vermium; quae itinere Orientali observavit P.F. Post mortum auctoris edidit C. Niebuhr. Adjuncta est Materia Media Kahirina atque tabula Maris Rubri geographica.* Hauniae. 164 pp.

Francois, D.D., 1960. Freshwater crayfishes. *Aust. Mus. Mag.* 13: 217-21.

Francois, D.D., 1962. *A revision of the Australian freshwater crayfish genus* Euastacus *(Decapoda, Parastacidae).* Ph.D. thesis, Cornell University.

Hale, H.M., 1927. *The crustaceans of South Australia, Part I.* Government Printer: Adelaide. 201 pp.

Haswell, W.A., 1882. *Catalogue of the Australian stalk- and sessile-eyed Crustacea.* Australian Museum: Sydney. 324 pp.

Heller, C., 1865. Crustacea. *Reise "Novara"* 2: 100-4.

Hercus, L.A., 1969. *The languages of Victoria. A late survey, Parts I and II. Linguistic Series 6.* Australian Institute of Aboriginal Studies: Canberra. 210 pp.

Hobbs, H.H., Jr, 1974. Synopsis of the families and genera of crayfishes (Crustacea: Decapoda). *Smithson. Contr. Zool.* 164: 1-32.

Huxley, T.H., 1878. On the classification and the distribution of the crayfishes. *Proc. zool. Soc. Lond.* 1878: 752-88.

Huxley, T.H., 1880. *The crayfish. An introduction to the study of zoology*. International Science Series 28. 371 pp.

Johnson, H.T., 1974. Biological information on *Euastacus armatus*. *New South Wales State Fisheries pamphlet, File* 73/2270.

Kaires, R., 1980. Observation on the physiology of the freshwater crayfish *Euastacus armatus* and *Cherax destructor*. *Aust. Soc. Limnol. Newsl.* 18: 13.

Kane, J., 1964. *Australian freshwater Malacostraca and their epizoic fauna*. M.Sc. thesis, University of Melbourne.

Mayr, E., 1969. *Principles of systematic zoology*. McGraw-Hill: New York. 428 pp.

McCoy, F., 1867. Recent zoology and paleontology of Victoria. *Ann. Mag. nat. Hist. (3)* 20: 189.

McCoy, F., 1878. *Astacoides serratus* (Shaw sp.). *Prodromus Zool. Vict.* 1: 17-18, pl. 15.

McCoy, F., 1888. *Astacopsis serratus* (Shaw sp.) var. *yarraensis*. *Prodromus Zool. Vict.* 2: 225-7, pl. 16.

McCulloch, A.R., 1917. Studies in Australian Crustacea, 4. *Rec. Aust. Mus.* 11: 231-8.

Monroe, R., 1977. A new species of *Euastacus* (Decapoda: Parastacidae) from north Queensland. *Mem. Qd Mus.* 18: 65-7.

Morgan, G.J., in prep. a. Freshwater crayfish of the genus *Euastacus* Clark (Decapoda, Parastacidae) from Queensland.

Morgan, G.J., in prep. b. Freshwater crayfish of the genus *Euastacus* Clark (Decapoda, Parastacidae) from New South Wales.

Ortmann, A.E., 1902. The geographical distribution of freshwater decapods and its bearing upon ancient geography. *Proc. Am. phil. Soc.* 41: 267-400.

Patak, A. & Baldwin, J., 1984. Electrophoretic and immunochemical comparisons of haemocyanins from Australian fresh-water crayfish (family Parastacidae): phylogenetic implications. *J. crust. Biol.* 4: 528-35.

Riek, E.F., 1951. The freshwater crayfish (family Parastacidae) of Queensland, with an appendix describing other Australian species. *Rec. Aust. Mus.* 22: 368-88.

Riek, E.F., 1956. Additions to the Australian freshwater crayfish. *Rec. Aust. Mus.* 24: 1-6.

Riek, E.F., 1969. The Australian freshwater crayfish (Crustacea: Decapoda: Parastacidae), with descriptions of new species. *Aust. J. Zool.* 17: 855-918.

Riek, E.F., 1972. The phylogeny of the Parastacidae (Crustacea: Astacoidea), and description of a new genus of Australian freshwater crayfishes. *Aust. J. Zool.* 20: 369-89.

Schenk, E.T. & McMasters, J.H., 1956. *Procedure in taxonomy*. Stanford University Press: Stanford. 119 pp.

Shaw, G., 1794. *Zoology of New Holland* 1: 21, pl. 8.

Smith, G., 1912. The freshwater crayfishes of Australia. *Proc. zool. Soc. Lond.* 1912: 144-71.

Spence-Bate, C., 1888. Report on the Crustacea Macrura collected by H.M.S. Challenger during the years 1873-76. *Rep. scient. Results. explor. Voyage Challenger* 24: i-xc, 1-942, pls. 1-148.

Turvey, S.P., 1980. *Aspects of the biology of the freshwater crayfish* Euastacus spinifer *(Heller) (Decapoda: Parastacidae)*. M.Sc. thesis, University of Sydney.

von Martens, E., 1866. On a new species of *Astacus*. *Ann. Mag. nat. Hist. (3)* 17: 359-60.

von Martens, E., 1868. Übrblick der neuholländischen Flusskrebse. *Monats. Akad. Wiss., Berlin* 1868: 615-19.

Watson, K., 1935. A new *Astacopsis* from north Queensland. *Mem. Qd Mus.* 10: 232-5.

Watson, K., 1936. *Astacopsis fleckeri*. *Mem. Qd Mus.* 11: 52.

Zeidler, W., 1982. South Australian freshwater crayfish. *S. Aust. Nat.* 56: 36-43.