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Freshwater Crayfish of the Genus *Euastacus* Clark (Decapoda: Parastacidae) from New South Wales, With a Key to all Species of the Genus

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ABSTRACT. Twenty-four species of *Euastacus* are recorded from New South Wales. Nine new species are described: *E. clarkae, E. dangadi, E. dharawalus, E. gamilaroi, E. gumar, E. guwinus, E. rieki, E. spinichelatus* and *E. yanga*. The following species are synonymised: *E. alienus* with *E. reductus, E. aquilus* with *E. neohirsutus, E. clydensis* with *E. spinifer, E. keirensis* with *E. hirsutus, E. nobilis* with *E. australasiensis* and *E. spinosus* with *E. spinifer*. This study brings the number of recognised species in *Euastacus* to 41. A key to all species of the genus is provided. Relationships between taxa are discussed and comments on habitat are included.

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Contents

Introduction

The species of the endemic Australian genus of freshwater crayfish *Euastacus* Clark, 1936 have been the subject of several revisionary studies (Morgan, 1986, 1988, 1989), often in association with other genera of the Parastacidae (Clark, 1936, 1941; Riek, 1951, 1956, 1969, 1972; Patak & 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 Francois (1962) and Kane (1964) reviewed the genus in unpublished theses. This work is the final and largest part of the revision, and reviews the species found in New South Wales. Five of these species have already been discussed in the Victorian (Morgan, 1986) or Queensland (Morgan, 1988) studies and receive only brief mention here.

The major collections and taxonomic investigations were done some years ago. Because of within-species morphological diversity it is still difficult to distinguish some species. Electrophoretic and DNA analyses have the resolution to potentially elucidate intra- and interspecific relationships in ways not possible with older techniques. Allozyme surveys have been completed on *Cherax* (Austin, 1995*a,b*) and *Engaeus* (Horwitz *et al.*, 1990); preliminary DNA comparisons between *Euastacus* and other parastacid genera have also been undertaken (Crandall *et al.*, 1995).

The methods and abbreviations employed are documented by Morgan (1986, 1988). The main parts of those methods sections are repeated here.

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 Morgan (1986), the systematics of *Euastacus* was summarised only by Riek (1969) and in part by Monroe (1977).

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 (Morgan, 1986).

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 of vegetation and hydrology were made at each site and brief mention of the habitat of each species is given.

Colours of live specimens were recorded before immersion 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 callipers. 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 of little taxonomic value and discarded. Characters are illustrated in Figures 1–2 and selected character states in Figures 3–5.

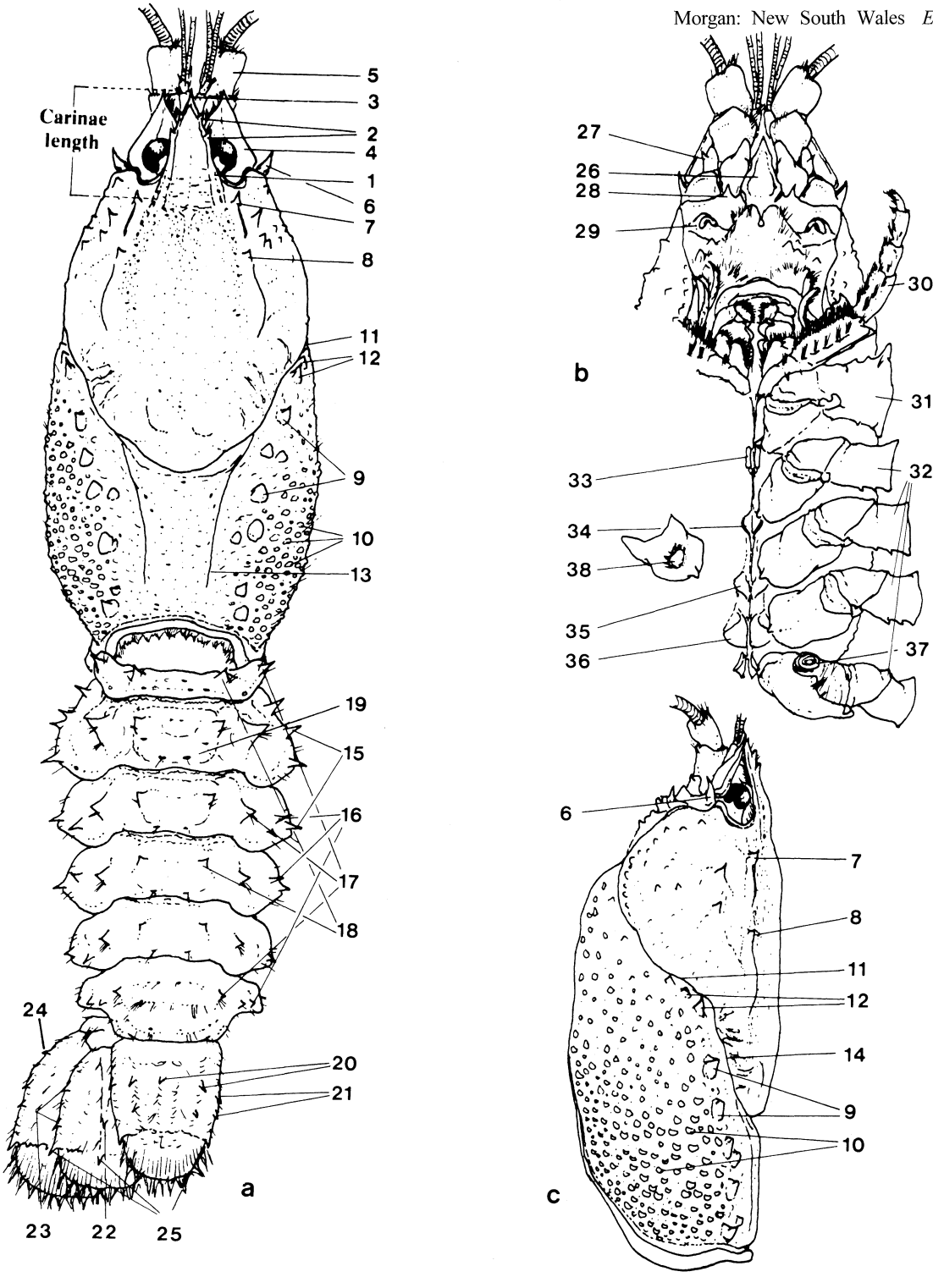

Fig. 1. Morphological characters: a, dorsal view cephalothorax and abdomen; b, ventral view cephalothorax; c, lateral view cephalothorax. 1, rostral carina; 2, rostral marginal spines; 3, rostral acumen spine; 4, antennal squame (scale); 5, 3rd antennal segment; 6, suborbital spine; 7, 1st postorbital 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, kell 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).

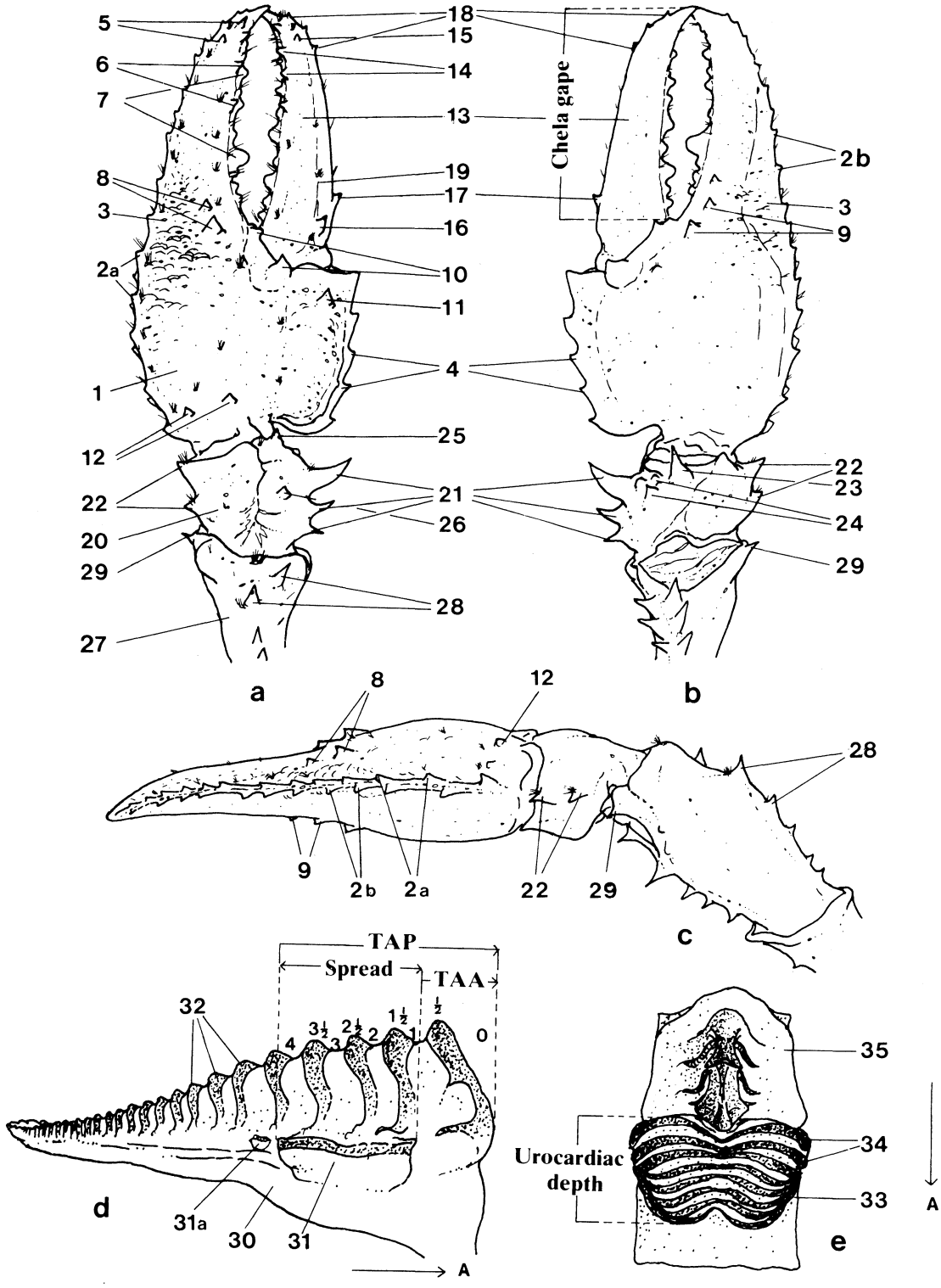

Fig. 2. Morphological characters: a, dorsal view left chela; b, ventral view left chela; c, lateral view left chela; d, e, gastric mill ossicles. 1, propodus; 2, lateral propodal spine rows: a dorsal, b ventral; 3, lateral spine ridge; 4, mesal propodal spines; 5, dorsal apical propodal spines; 6, spines 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.

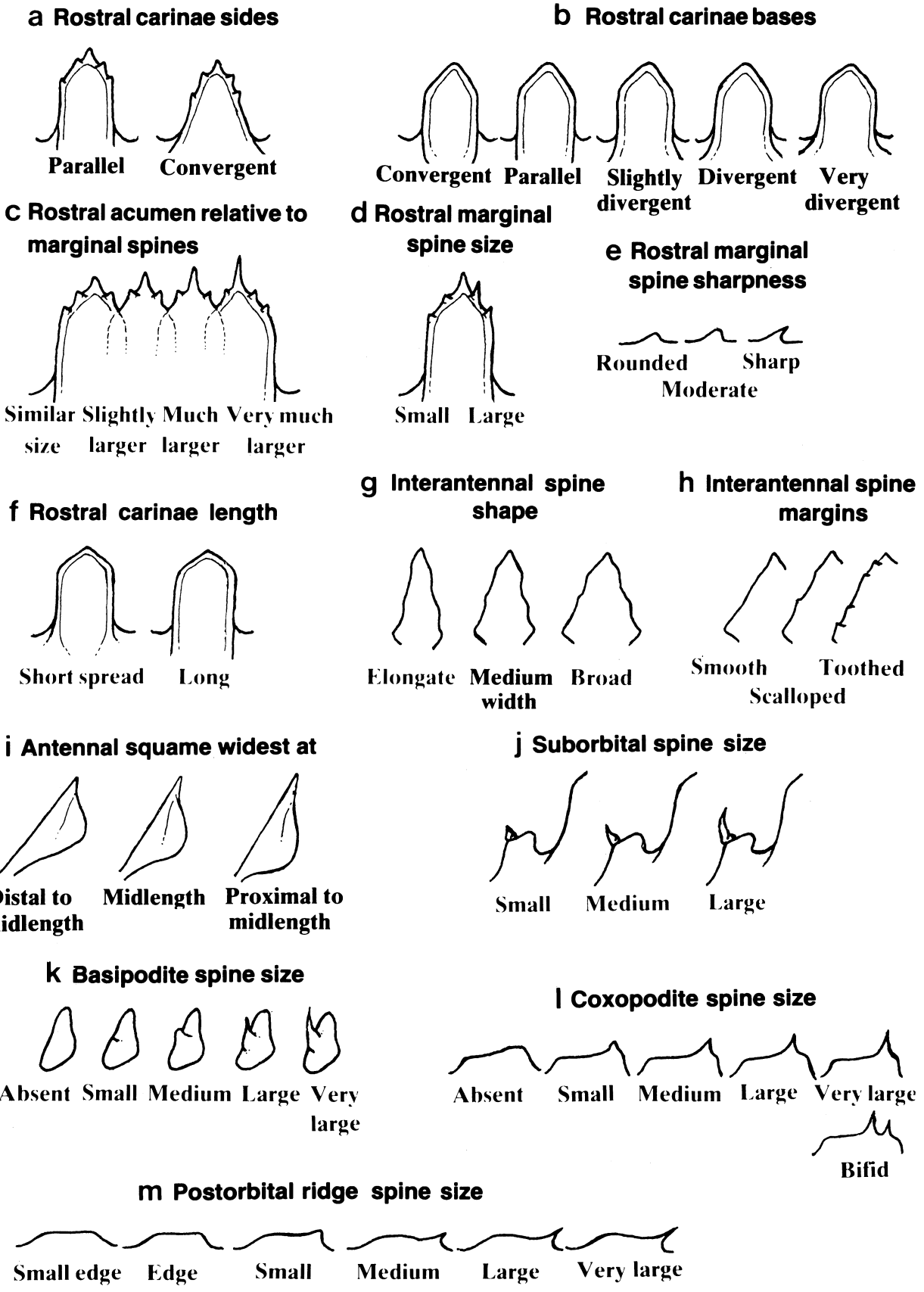

Fig. 3. Selected character states.

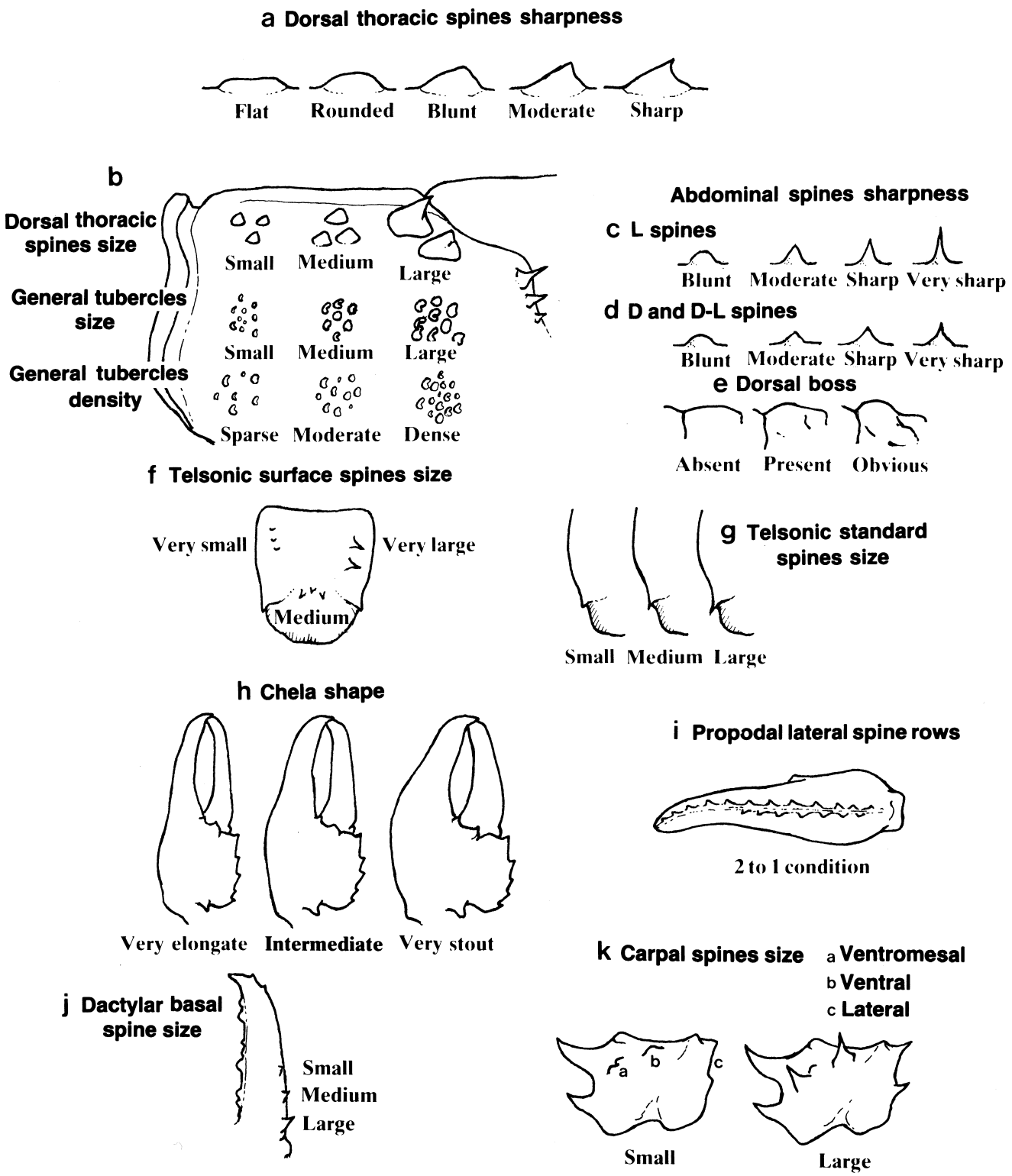

Fig. 4. Selected character states (continued).

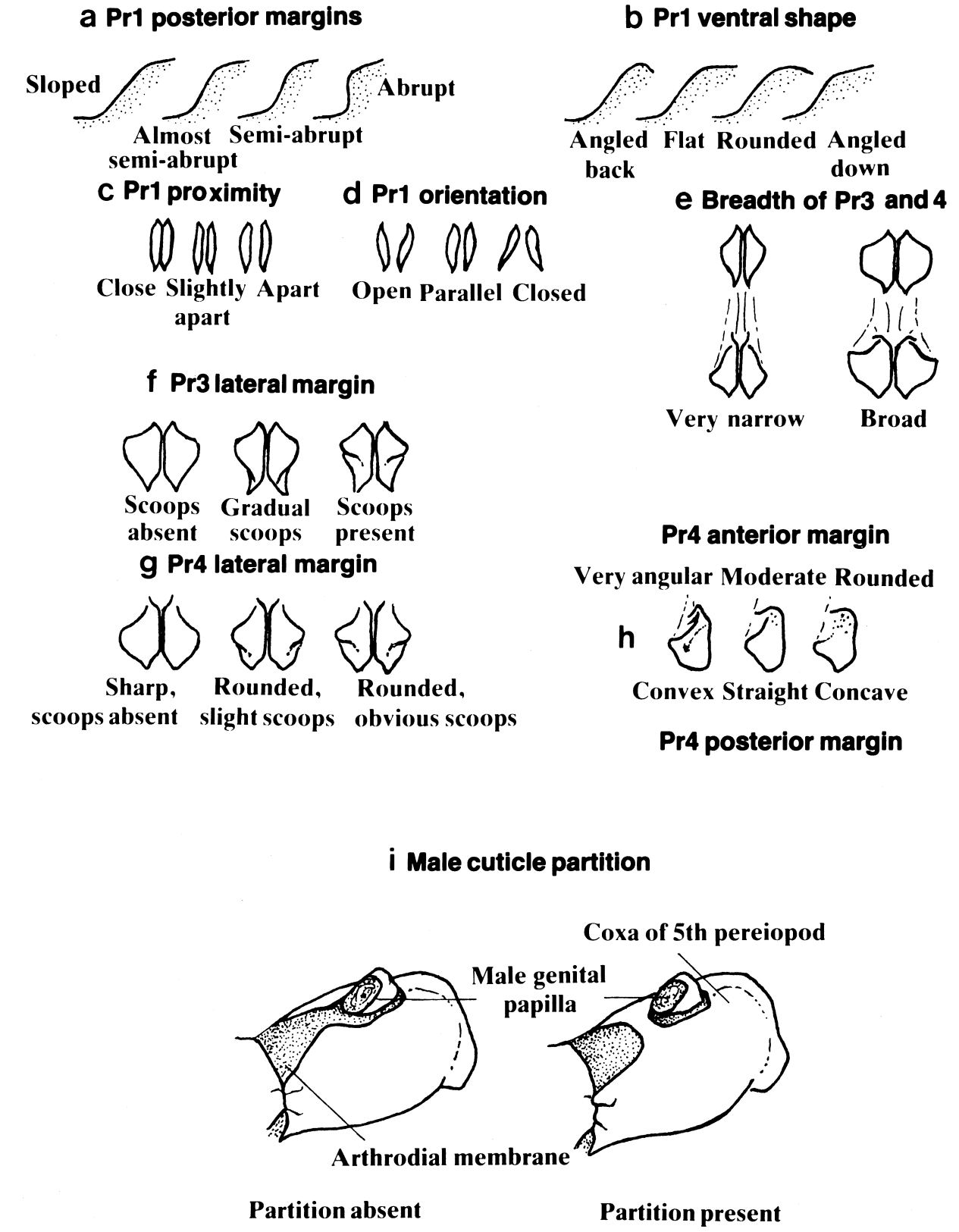

Fig. 5. Selected character states (continued).

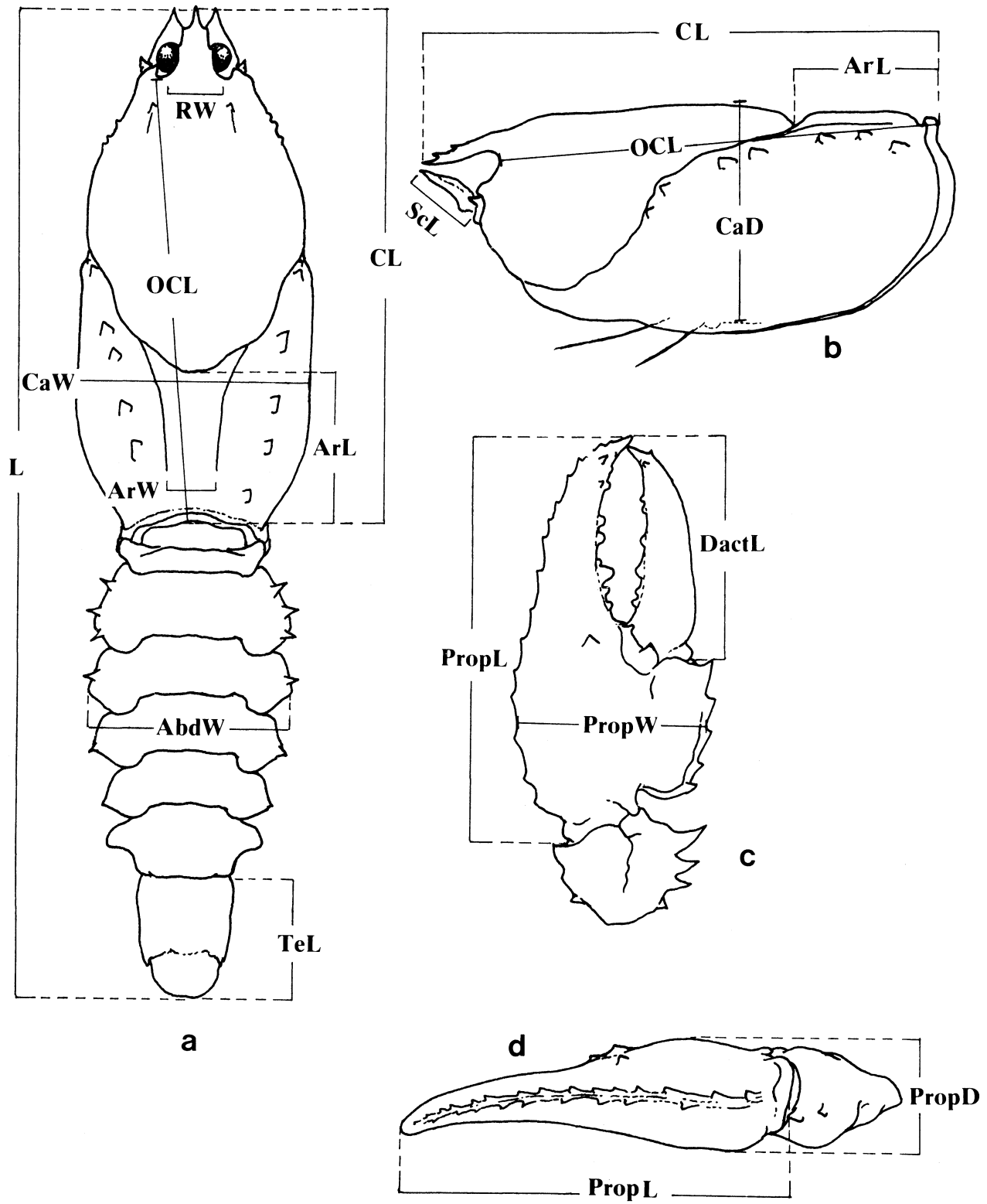

Fig. 6. Measurements: a, dorsal view cephalothorax and abdomen; b, lateral view cephalothorax; c, dorsal view left chela; d, lateral view left chela. OCL—occipital carapace length; CL—carapace length; L—total body length; CaW—carapace width; CaD—carapace depth; ArL—areola length; ArW—areola width; RW—rostral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

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, 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 size (e.g., of spines) between large and small. The term "moderate" usually describes intermediacy in sharpness or shape of spines or other substances.

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 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 for 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 2–1 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) indicates 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": ration 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 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 margin of the ear were counted as the TAA; subtracting the TAA from TAP give 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 and earlier studies (Fig. 2d,e; Morgan, 1986).

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 programme 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 programmes employed and the printouts.

Species descriptions are extensive and adhere to a standard format used in earlier works on *Euastacus*

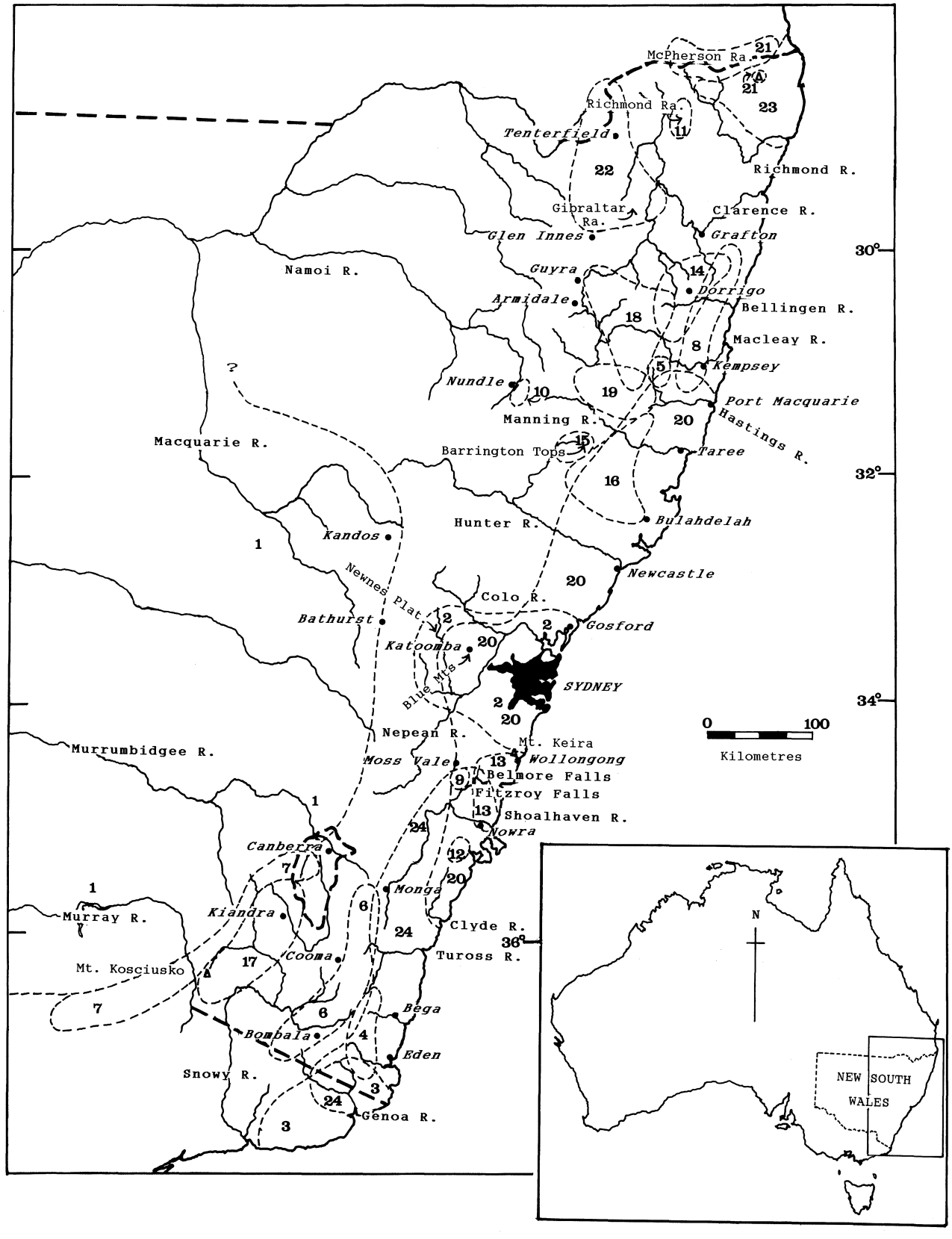

Fig. 7. Distributions of *Euastacus* species in New South Wales. (1), *E. armatus*; (2), *E. australasiensis*; (3), *E. bidawalus*; (4), *E. brachythorax*; (5), *E. clarkae*; (6), *E. claytoni*; (7), *E. crassus*; (8), *E. dangadi*; (9), *E. dharawalus*; (10), *E. gamilaroi*; (11), *E. gumar*; (12), *E. guwinus*; (13), *E. hirsutus*; (14), *E. neohirsutus*; (15), *E. polysetosus*; (16), *E. reductus*; (17), *E. rieki*; (18), *E. simplex*; (19), *E. spinichelatus*; (20), *E. spinifer*; (21), *E. sulcatus*; (22), *E. suttoni*; (23), *E. valentulus*; (24), *E. yanga*.

species (e.g., Morgan, 1986, 1988, 1989). For new species, paratypes are designated to "show the range of variation within the species" (Schenk & 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: AM—Australian Museum, Sydney; NMV—Museum of Victoria, Melbourne; QM—Queensland Museum, Brisbane. The state—New South Wales—is abbreviated in material examined as NSW, and the Australian Capital Territory as ACT. The following collectors are designated by initials except in citing type locality data: EFR—E.F. Riek, JRK—J.R. Kane, SJH—S.J. Harders, GJM—G.J. Morgan. Scales in Figures 8–48 are in millimeters.

The eastern areas of New South Wales were sampled extensively by the author in 1981. Distributions of species are illustrated in Figure 7.

Key to the species of *Euastacus* (specimens >20 mm OCL)

The conventions and method of use of this key are those noted for the Key to Victorian species of Morgan (1986). The primary couplet relies on a sexual character evident only in males. This is regrettable but, for construction of a practical key, unavoidable. If only females are available for identification, the worker should assume the cuticle partition to be present in the first instance, as 70% of species meet this condition. The key must be used in conjunction with species' diagnoses. Three species, *E. fleckeri, E. hirsutus* and *E. yanga*, do not key exclusively. Due to the paucity of male specimens examined, the usual condition of the male cuticle partition in *E. fleckeri* is uncertain and it is keyed for both partition present and absent. Some specimens of *E. hirsutus* and *E. yanga* are superficially more similar to other species than to some conspecific animals. Species occurring in New South Wales are indicated by an asterisk.

1 Male cuticle partition present 2

—— Male cuticle partition absent 32

2(1) Very shallow depression in dorsal surface of carpus of cheliped [mesial dactylar spines absent] 3

—— Deep longitudinal groove in dorsal surface of carpus of cheliped 4

3(2) Ventrolateral propodal spine row poorly developed and central; usually 4–5 mesial propodal spines; keel Pr 3 and 4 usually narrow; TAP count 8.0–9.5. [Rostrum U-shaped on large specimens] ..... *E. fleckeri* Watson, 1935

—— Ventrolateral propodal spine row reaching to apex; 6–9 mesial propodal spines; keel Pr 3 and 4 broad; TAP count 4.5–5.0 [Rostrum usually triangular] ..... *E. robertsi* Monroe, 1977

4(2) Thoracic and telsonic spines medium sized to large, or if spines small or absent: ventrolateral propodal spine row of chela not reaching apex of finger, rostral carinae of medium length to long, suborbital spine large to very large. Usually 2 mesial carpal spines on chela, or if 3 spines: usually large thoracic spines or large D–L abdominal spines. [Large specimens with large and sharp Li and D–L abdominal spines; species can grow very large] 5

—— Thoracic spines absent or only just discernible and without above combination of characters, or if thoracic spines medium sized or small: rostral carinal bases usually short,

3 or more mesial carpal spines on chela, or if 2 carpal spines: either 0 or 1 dorsal apical propodal spine and moderately distributed to sparse general tubercles, or numerous protuberances on dorsal face of propodus of chela lateral to dactylar base 10

5(4) No basal spines on dactylus of chela 6

—— 1 or more dorsal basal spines and sometimes marginal basal spines on dactylus of chela 7

6(5) 3 or 4 apical mesial spines on dactylus of chela. 5 (very rarely 6) mesial propodal spines. [Dorsal propodal face poorly spinose lateral to dactylar base] ..... *E. valentulus* Riek, 1951*

—— 1 or 2 apical mesial spines on dactylus of chela. 6 or 7 mesial propodal spines. [Usually numerous protuberances lateral to dactylar base dorsally. D–L and D abdominal spines accentuated by dark spots] ..... *E. dangadi* n.sp.*

7(5) Dorsal thoracic spines absent. Telsonic spines small or absent. Usually 2–10 dorsal apical propodal spines on chela. TAP≤5.0 ..... *E. sulcatus* Riek, 1951*

—— Dorsal thoracic spines medium sized or large. Telsonic spines usually medium sized or large (sometimes small). Usually 0 or 1 dorsal apical propodal spine on chela, or if more than 1 spine: large telsonic spines present. TAP≥5.0 8

8(7) Telsonic spines small or medium sized. D abdominal spine present and usually sharp on somites 2–4. Red spines on abdomen and thorax ..... *E. suttoni* Clark, 1941*

—— Telsonic spines usually large. D abdominal spine absent on somites 2–4 (rounded boss present), or if very blunt D spines present: 2 distinct spines anterior to mouth. Overall colour dark green, including spines 9

9(8) 3–6 lateral spines on outer ramus of uropod. Dorsal abdominal boss not distinctly U-shaped (sometimes very blunt D spines). Several D–L and D spines on somite 6. Keel Pr1 abrupt. 2 ventral spines anterior to mouth. TAP 5.0–6.0 ..... *E. hystricosus* Riek, 1951

—— Lateral spine on outer ramus of uropod rarely present. Dorsal abdominal boss distinctly U-shaped on specimens >50 OCL. D spines absent on somite 6. Keel Pr1 usually sloped. Several spines anterior to mouth. TAP 7.0–9.5 .... *E. kershawi* (Smith, 1912)

10(4) Ventrolateral spine row on propodus of chela absent or poorly developed (usually 4 or fewer central spines if present). Largest ventromesial spine on carpus of chela similarly sized to or larger than ventral spine. Usually 4 or more mesial carpal spines, 1st (distal) spine sometimes smaller than 2nd, or if 3 mesial spines: above characters and characters below apply and spines absent above propodal cutting edge. [Dactylar basal spines absent. 1 or 2 apical mesial dactylar spines. Thoracic spines absent. TAP≤4.0] 11

—— Ventrolateral spine row on propodus of chela well developed, or if poorly developed: largest ventromesial spine on carpus of chela smaller than ventral spine, or if slightly larger than ventral spine: dactylar basal spines present. Fewer than 4 mesial carpal spines with distal spine largest, or if 4 mesial spines: marginal spines on antennal squame present or ventrolateral propodal spine row always well developed 16

11(10) Li abdominal spines small (or medium sized) on somite 2, or if spines obsolete: cephalon poorly punctose. Keel Pr3 parallel and 1 apical mesial dactylar spine 12

—— Li abdominal spines reduced to low protuberances and above combination of characters not applicable 15

12(11) 1–3 spines above propodal cutting edge, or if spines absent (rare): suborbital spine small or very small, antennal squame widest at or slightly proximal to midlength and usually 5 or 6 mesial propodal spines ..... *E. reductus* Riek, 1969*

—— Spines absent above propodal cutting edge and above combination of characters not applicable 13

13(12) Dorsal apical propodal spines absent. Antennal squame widest very proximal to midlength. Keel Pr3 parallel. [1 or 2 small rostral spines, apical or reaching midlength of carinae. Suborbital spine small] ..... *E. urospinosus* (Riek, 1956)

—— 1 or 2 dorsal apical propodal spines, or if absent: antennal squame widest at or slightly proximal to midlength and suborbital spine medium sized to medium-large 14

14(13) Rostral spines distributed along full length of carinae. Keel Pr 1 close. Suborbital spine small ..... *E. maidae* (Riek, 1956)

—— Rostral spines apical or reaching midlength of carinae. Keel Pr1 apart or very apart. Suborbital spine medium sized to medium-large ..... *E. balanensis* Morgan, 1988

15(11) Suborbital spine medium sized to very large. 2 apical mesial dactylar spines. Antennal squame widest very proximal to midlength ..... *E. setosus* (Riek, 1956)

—— Suborbital spine small or very small. 1 apical mesial dactylar spine. Antennal squame widest slightly proximal to midlength ..... *E. jagara* Morgan, 1988

16(10) 2 mesial carpal spines on chela (very rarely 3 and then on one chela only and 2nd and 3rd spines contiguous). [0 or 1 dorsal apical propodal spine. General tubercles moderately distributed to sparse. Medium sized or small thoracic spines usually present] 17

—— 3 (rarely 4) mesial carpal spines on chela, or if 2 spines: 2 dorsal apical propodal spines or numerous protuberances on dorsal surface of propodus of chela lateral to dactylar base. [General tubercles usually moderately distributed to dense] 18

17(16) Dorsal apical propodal spines absent. Suborbital spine small. TAP 2.5–4.5 ..... *E. simplex* Riek, 1956*

—— 1 dorsal apical propodal spine. Suborbital spine medium sized or large. TAP 7.0–8.0 ..... *E. clarkae* n.sp.*

18(16) Dorsal thoracic spines absent or barely discernible (sometimes 1 or 2 minute blunt spines posterior to cervical spines). Rostral spines not markedly decreasing in size proximally, usually reaching proximal to midlength of carinae, or if spines apical: rostrum usually very narrow and 2–7 dorsal apical propodal spines. [TAP usually 2.5–4.0, or if 4.5–5.0: ventrolateral spine row on propodus of chela reaching apex of finger and 2 or 3 dorsal apical propodal spines] 19

—— Dorsal thoracic spines medium sized or small, or if absent: rostral spines rarely reaching midlength of carinae with spines obviously diminishing in size proximally, rostrum not unusually narrow and dorsal apical propodal spines usually absent, or dorsomesial basal spines extending beyond midlength of dactylus, or marginal spines present on antennal squame 26

19(18) Spines above propodal and dactylar cutting edges of chela distributed proximal to midlength or to full gape. Usually 2 or more dorsal apical propodal spines. [Marginal dactylar basal spines absent] 20

—— Spines above cutting edges of chela apical on propodus and rarely distributed slightly proximal to midlength of gape on dactylus. 0 or 1 dorsal apical propodal spine, or if 2 spines: either 2 mesial carpal spines or usually 1 marginal basal spine on dactylus 23

20(19) Rostrum distinctly narrow. Rostral spines apical. PropL/OCL of males usually >1.00 ..... *E. spinichelatus* n.sp.*

—— Rostrum not very narrow. Rostral spines usually distributed proximal to midlength of carinae. PropL/OCL of males <1.00 21

21(20) 1st postorbital spine absent. Dorsal carpal spines absent. Keel Pr1 apart and slightly convergent anteriorly ..... *E. monteithorum* Morgan, 1989

—— 1st postorbital spine present. Dorsal carpal spines present or absent. Keel Pr1 close and parallel 22

22(21) Numerous blunt spines and protuberances on dorsal and ventral surfaces of propodus lateral to dactylar articulation, these distributed some distance along fixed finger. Dorsal carpal spines absent. 4th (proximal) mesial carpal spine subequal to or only slightly smaller than 3rd spine ..... *E. bindal* Morgan, 1989

—— 1 or 2 small or medium sized spines on dorsal and ventral surfaces of propodus lateral to dactylar articulation, sometimes with some minute lateral bumps or rugosities not distributed along fixed finger. Dorsal carpal spines present. 4th mesial carpal spine absent or if present much smaller than 3rd spine ..... *E. eungella* Morgan, 1988

23(19) Usually 2 or 3 dorsal apical propodal spines on chela. 1 or 2 dorsomesial basal spines and usually 1 marginal basal spine on dactylus of chela. Usually 4 or more spines on ventral surface of propodus of chela lateral to dactylar base, spines often extending along finger in 2 short rows. TAP 4.5–5.0 ..... *E. gamilaroi* n.sp.*

—— 0 or 1 dorsal apical propodal spine on chela, or if 2 apical spines: 2 mesial carpal spines. Rarely 1 dorsomesial basal spine and marginal basal spines absent on dactylus of non-regenerate chela. Usually fewer than 4 spines on ventral surface of propodus lateral to dactylar base. TAP 2.5–4.0 24

24(23) Setation moderate to light, few tufts of setae on chela. Fingers of chela punctate. Ventrolateral row of spines on propodus reaching or almost reaching apex of finger. Keel Pr1 usually narrow and close. [3 mesial carpal spines on chela] ..... *E. polysetosus* Riek, 1951*

—— Setation moderate to heavy, setal tufts obvious on chela. Punctation absent or very faint on fingers of chela and ventrolateral spine row on propodus absent or poorly developed, or if moderate punctation on fingers and ventrolateral propodal spine row reaching apex of finger: setation heavy. Keel Pr 1 usually robust. [Usually 3 mesial carpal spines on chela, or if 2 spines: 2 dorsal apical propodal spines] 25

25(24) Ventrolateral spine row on propodus of chela absent or subapical. AbdW/OCL of males 0.45–0.51 ..... *E. neohirsutus* Riek, 1950*

—— Ventrolateral spine row on propodus of chela extending from approximate midlength of propodus to apex. AbdW/OCL of males 0.49–0.56 ..... *E. hirsutus* (McCulloch, 1917)*

26(18) 1 apical mesial dactylar spine on chela, or if 2 spines: telsonic spines absent and many small spines and protuberances on dorsal surface of propodus of chela lateral to dactylar base [TAP 3.0–3.5], or TAP 4.5–5.0 27

—— 2 or more apical mesial dactylar spines on chela. Either telsonic spines present (if small then setation very heavy) or TAP 6.0–9.0 28

27(26) Broad zone of small dorsal thoracic spines. TAP 3.0–3.5. [Numerous protuberances on dorsal surface of propodus of chela lateral to dactylar base. Spines above cutting edge of propodus extending proximal to midlength or to full gape. Dactylar mesial basal spines absent. Rostral spines usually distributed proximal to midlength of carinae] ..... *E. gumar* n.sp.*

—— Dorsal thoracic spines absent, or if present: spines rarely arranged in zone and rostral spines usually apical with most proximal spines small and blunt. TAP 4.5–10.0 ..... *E. australasiensis* (H. Milne Edwards, 1837)*

28(26) Telsonic spines medium sized or small (if small, setation very heavy). TAP 3.0–4.5. [Thoracic spines medium sized or small] ..... *E. hirsutus**

—— Telsonic spines absent (surface of telson sometimes uneven). TAP 6.0–9.0 29

29(28) 2–5 dorsomesial basal spines on dactylus of chela usually extending distal to midlength of dactylus. Marginal mesial dactylar basal spines usually absent. 3–5 (rarely 2) apical mesial dactylar spines, usually meeting row of mesial basal spines 30

—— 1 (rarely 2) dorsomesial basal spine(s) on dactylus of chela. 1 or 2 marginal mesial dactylar basal spines. 2 apical mesial dactylar spines, disjunct from mesial basal spines 31

30(29) Spines above propodal and dactylar cutting edges distributed to or proximal to mid-length of gape. Thoracic spines usually small or absent ..... *E. woiwuru* Morgan, 1986

—— Spines above propodal and dactylar cutting edges apical. Thoracic spines medium sized and small ..... *E. neodiversus* Riek, 1969

31(29) Marginal spine(s) present on antennal squame. Dorsal thoracic spines absent ..... *E. diversus* Riek, 1969

—— Marginal spines absent on antennal squame. Dorsal thoracic spines medium sized ..... *E. bidawalus* Morgan, 1986*

32(1) Dorsal surface of carpus of cheliped with shallow depression ..... *E. fleckeri* Watson, 1935

—— Dorsal surface of carpus of cheliped with deep longitudinal groove 33

33(32) Telsonic spines absent or small. Uropod spines absent. 3 (rarely 4) mesial carpal spines on chela, or if 2 spines: either TAP ≥8.0 or thoracic spines small or absent. Rostral carinae usually short. [Rostral spines small or medium sized. D abdominal spines minute and blunt or absent] 34

—— Spines on telson and uropods usually large or medium sized (sometimes absent). 2 (rarely 3) mesial carpal spines. D abdominal spines usually large or medium sized and often sharp on anterior somites. Rostral carinae of medium length or long 40

34(33) 3 (or 4) mesial carpal spines on chela 35

—— 2 mesial carpal spines on chela 38

35(34) 2nd and 3rd mesial carpal spines close or contiguous. Rostral carinae not distinctly spread 36

—— 2nd and 3rd mesial carpal spines not distinctly closer than 1st and 2nd. Rostral carinae short and spread 37

36(35) 1 dorsal, and 1 or 2 marginal, mesial dactylar basal spines on chela. TAP≤7.0 ..... *E. claytoni* Riek, 1969*

—— Usually 1 or more (rarely 0) dorsomesial dactylar basal spines. Marginal dactylar basal spines absent. TAP ≥8.0 ..... *E. yanga* n.sp.*

37(35) Usually 2 (very rarely 1 or 3) apical mesial dactylar spines on chela. Chela finger punctation usually very sparse. TAP 5.5–11.0. ArL/OCL usually 0.33–0.35 ..... *E. crassus* Riek, 1969*

—— Usually 1 apical mesial dactylar spine. Chela finger punctation usually moderate. TAP 2.0–3.0 (usually 2.5). ArL/OCL usually 0.36–0.37 ..... *E. rieki* n.sp.*

38(34) More than 1 dorsomesial dactylar basal spine on chela. Setation usually moderate to heavy ..... *E. yanga**

—— 1 dorsomesial dactylar basal spine. Setation light 39

39(38) Largest ventromesial carpal spine of chela smaller than ventral spine. Dorsal surface of propodus lateral to dactylar base only slightly uneven (often punctate). Antennal basipodite spine absent or small. TAP 8.0–10.0 ..... *E. brachythorax* Riek, 1969*

—— Largest ventromesial carpal spine of chela similarly sized to or larger than ventral spine. Dorsal surface of propodus lateral to dactylar base very uneven. Antennal basipodite spine medium sized or large. TAP 6.5–8.0 ..... *E. guwinus* n.sp.*

40(33) General tubercles dense (sometimes moderately distributed). Dorsal abdominal boss obsolete or absent. Thoracic spines small, or if medium sized or large: setation moderately heavy or heavy ..... *E. yanga**

—— General tubercles moderately distributed to sparse, or if dense: setation moderate or light (and TAP≤7.0). Dorsal boss present, or if absent: setation light and/or TAP≤8.0 41

41(40) Thoracic spines usually large but flat or rounded (rarely blunt 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 OCL. [Keel Pr1 abrupt. Usually 2 Li spines per side on somite 2]..... *E. bispinosus* Clark, 1936

—— Thoracic spines sharp or blunt, rarely rounded. D abdominal spines present, often sharp. Abdominal boss not very pronounced (obscured by broad D spines) or absent 42

42(41) Dorsal abdominal boss absent. D abdominal spines small and sharp. Rostral carinae thin. [Chela often with small dorsal carpal spines and spines on dorsal surface of propodus anterior to carpus. TAP 6.5–8.0] ..... *E. dharawalus* n.sp.*

—— Dorsal abdominal boss present under D spines (boss often weakly developed on specimens <60 OCL but then D spines usually blunt). Rostral carinae not distinctly thin. Spines usually absent dorsally on carpus and propodus of chela 43

43(42) TAP ≥7.5. Chela dorsally dark green or green-brown. Often several D–L and D spines on abdominal somite 6. [General tubercles moderately distributed or sparse] ..... *E. spinifer* (Heller, 1865)*

—— TAP <7.5. Chela pale or white dorsally. If general tubercles sparse, D abdominal spines usually curved towards anterior on specimens >50 OCL 44

44(43) D abdominal spines usually curved towards anterior on specimens >50 OCL. Rostral carinae usually parallel proximally. General tubercles moderately distributed or sparse. Telsonic spines medium sized or small (sometimes absent). Dorsomesial dactylar basal spines usually absent. Usually 2 Li spines per side on abdominal 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* (von Martens, 1866)*

—— D abdominal spines not strongly curved to anterior. Rostral carinae usually divergent proximally. General tubercles often dense. Telsonic spines usually large. Usually 1–3 dorsomesial dactylar basal spines. Usually more than 2 Li spines per side on abdominal 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* (McCoy, 1888)

Euastacus armatus (von Martens)

Astacus armatus von Martens, 1866: 359, 360.
Euastacus armatus.–Clark, 1941: 13–15, pl. 2; Riek, 1969: 894; Morgan, 1986: 13–19, figs 8, 9.
Euastacus elongatus Clark, 1941: 12, 13, pl. 1.

Distribution and biology. *Euastacus armatus* occurs throughout much of the Murray River and its major tributaries in New South Wales and Victoria, from Kandos, 160 km west of Newcastle, to the upper reaches of the Goulburn River, a north-south distance of 450 km, and over 800 km east-west. The species ranges from close to sea level to over 700 m a.s.l. in streams flowing through wet and dry sclerophyll forests and cleared pasture.

Remarks. *Euastacus armatus* was redescribed and discussed, with a comprehensive synonymy, by Morgan (1986).

Euastacus australasiensis (H. Milne Edwards)

Figs 8–10

Astacus australasiensis H. Milne Edwards, 1837: 332, pl. 24, figs 1–5; Audouin & Milne Edwards, 1841: 36 [after Clark, 1941: 16]; Gray, 1845: 408, 410 [after Francois, 1962: 62]; Spence-Bate, 1888: 206; Faxon, 1898: 675.
Astacus australiensis (misspelling).–Erichson, 1846: 94 [after Francois, 1962: 62]; Heller, 1865: 100; von Martens, 1868: 618, 619.
Astacoides nobilis Dana, 1852: 526, pl. 33, figs 3a, 3b; Hess, 1865: 164 [after Francois, 1962: 62]; Heller, 1865: 101; von Martens, 1866: 360; Spence-Bate, 1888: 196.
Astacus nobilis.–von Martens, 1868: 615, 616.
Astacopsis nobilis.–Huxley, 1880: 402; Haswell, 1882: 175; Faxon, 1898: 670, 675; Faxon, 1914: 402; Smith, 1912: 159, 160.
Astacopsis australiensis (misspelling).–Haswell, 1882: 178; Smith, 1912: 159, 160.
Astacopsis australasiensis.–Nobili, 1901: 246 [after Francois, 1962: 63]; Faxon, 1914: 351, 352.
Astacopsis serratus.–Smith, 1912: 149, 157–160 (in part, "Small Parramatta Crayfish" and "Blue Mountains Crayfish", *Astacus australiensis* in synonymy); McCulloch, 1917: 237, 238 (in part, several species); Hale, 1927: 75, 76 (in part, inclusive distribution?) (Not *Cancer serratus* Shaw, 1794).
Euastacus serratus.–Clark, 1936: 12, 13 (in part, *Astacus australasiensis* and *Astacopsis australasiensis* in synonymy); Clark, 1941: 16, 17 (in part, as above).
Euastacus nobilis.–Clark, 1936: 15–17 (in part, several species included); Clark, 1937*a*: 35 (in part, several species); Clark, 1937*b*: 186 (in part, including *E. kershawi*); Clark, 1941: 20–22 (in part, several species); Clark & Burnet, 1942: 90, 91; Riek, 1951: 383–385 (in part, including *E. crassus*); Riek, 1969: 893.
Euastacus australasiensis.–Riek, 1969: 893.

Type material. COTYPES in Muséum national d'Histoire naturelle, Paris (not examined). Sydney area, New South Wales. TYPES of *E. nobilis* lost in shipwreck of the sloop "Peacock", in 1841.

Other material examined. NSW Pearl Beach—Patonga Road, Brisbane Water National Park, H. Posamentier, 19–20 Nov. 1971, AM P18546, 2 ♀♀; Creek at Warrah Reserve, Pearl Beach, near Woy Woy, 27 Sept. 1958, D.D. Francois, AM P15473, 3 ♂♂, 8 ♀♀; Dillons Mount, south of Woy Woy, 30 Jun. 1964, J. Campbell, AM P15525, ♀; Yarramalong Mount, Gosford district, Jan. 1930, J.A. Wright & W. Barnes, AM P9428–9, 2 ♀♀; Waterfall Creek near Pearl Beach, Brisbane Water N.P., (33°33'S 151°18'E), 9 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34069, 13 specimens; Floods Creek, near Somersby Falls, (33°25'S 151°16'E), 10 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34059, 4 ♂♂, 2 ♀♀; Moonee Moonee Creek, Pacific Highway north of Sydney, (33°26'S 151°15'E), 10 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34071, 2 ♂♂; McCarrs Creek, Kuringai Chase near Sydney, 24 Sept. 1958, D.D. Francois & F.J. Beeman, AM P15472, 2 ♂♂, 3 ♀♀; McCarrs Creek, Kurringai Chase, 23 Sept. 1967, J.C. Yaldwyn, AM P15557, ♂, ♀; Tributary Spring Gully Creek, Kuringai Chase N.P., (33°40'S 151°10'E), 11 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34066, 3 ♀♀; McCarrs Creek, Kuringai Chase N.P., (33°40'S 151°15'E), 11 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34067, 6 specimens; Salvation Creek, Kuringai Chase N.P., (33°42'S 151°15'E), 11 Oct. 1981, G.J. Morgan & S.J. Harders, AM

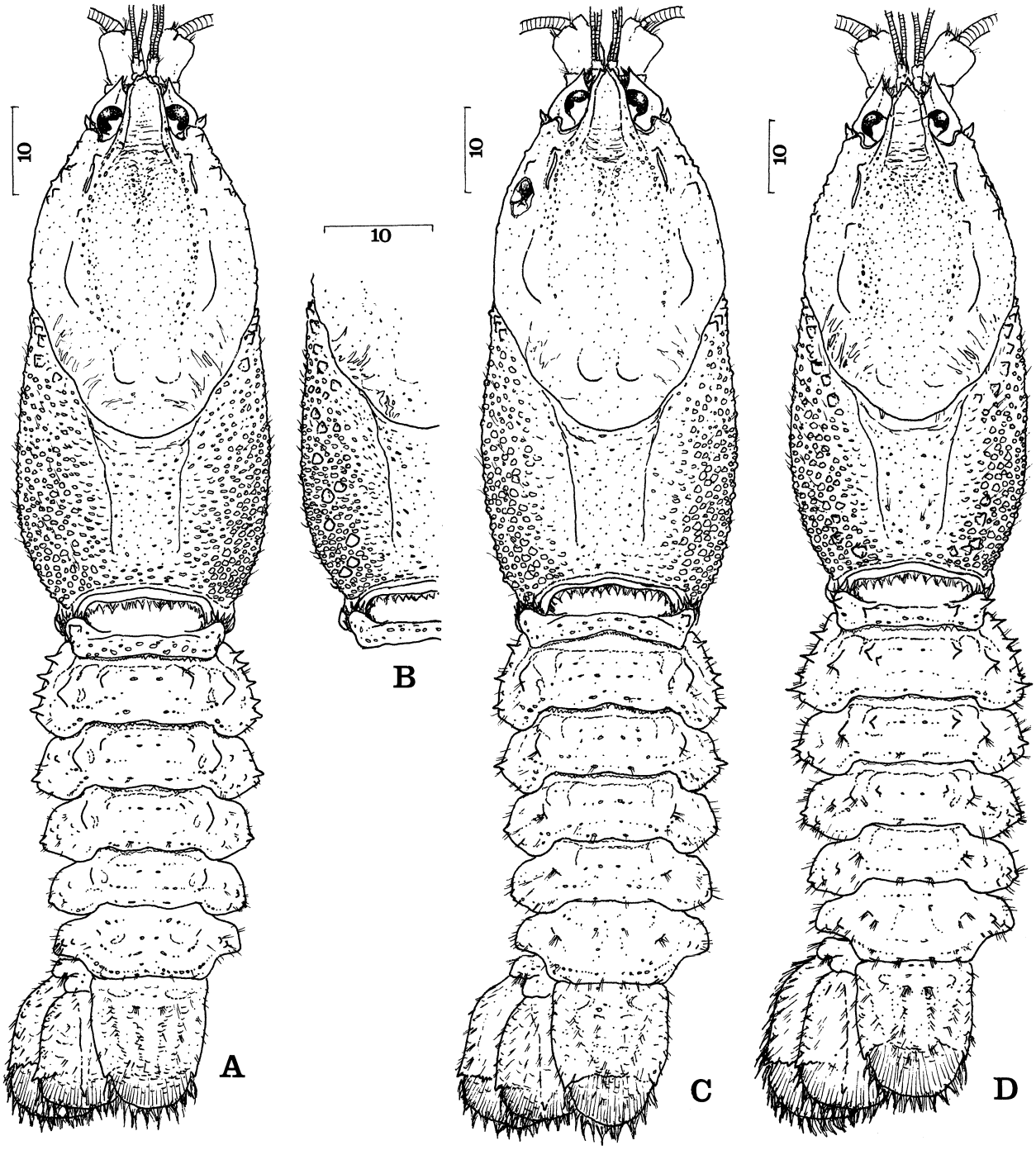

Fig. 8. *Euastacus australasiensis* (H. Milne Edwards). A, dorsal view, male, tributary Moonee Moonee Creek, AM P34071; B, dorsal view thorax, abdominal somite 1, medium sized thoracic spines, spines absent on somite 1, male, tributary Hacking River, AM P34068; C, dorsal view, male, Wentworth Falls, AM P15477; D, dorsal view, female, Jenolan-Kanangra, AM P15061.

P34065, 2 ♀♀; Tributary Coal and Candle Creek, Kuringai Chase N.P., (33°42'S 151°14'E), 11 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34070, 2 ♂♂; Currawong Beach, Pittwater, Sydney, 24 Jan. 1978, J. Broadbent, AM P26705, ♀; Creek at Brooklyn, near Pacific Highway, Hawkesbury estuary, 21 Feb. 1959, H. Lane, AM P15474, 2 ♂♂, 2 ♀♀; Asquith, near Hornsby, Apr. 1963, A.L. Dyce, AM P15298, ♂, ♀; Tributary Berowa Creek, Berowa, near Hornsby, 20 Apr. 1964, H.J. Disney, AM P14581, 2 ♂♂, 2 ♀♀; Inglebar Road, Allambie Heights, North Manly, Sydney, 12 Jun. 1963 (?), E. Boyden, AM P14462, ♂; Creek below Ovens Place, St Ives, Sydney, 7 Apr. 1964, J.C. Yaldwyn, AM P14582, ♀; Creek near Sydney, 1890, AM, ♂; Near Sydney, May 1908, AM P657, ♀; Euroka Street, Northbridge, Sydney, Jul. 1958, E.C. Pope, AM P15471, ♀; Upper reaches Middle Harbour, Sydney, 17 Dec. 1944, AM P15526, ♂, ♀; Port Jackson ?, Sept. 1886 (?), Dr Cox(?), AM P10380, ♂; Dover Heights, Sydney, Mar. 1945, Mr Pentecost (?), AM P11608, ♂;

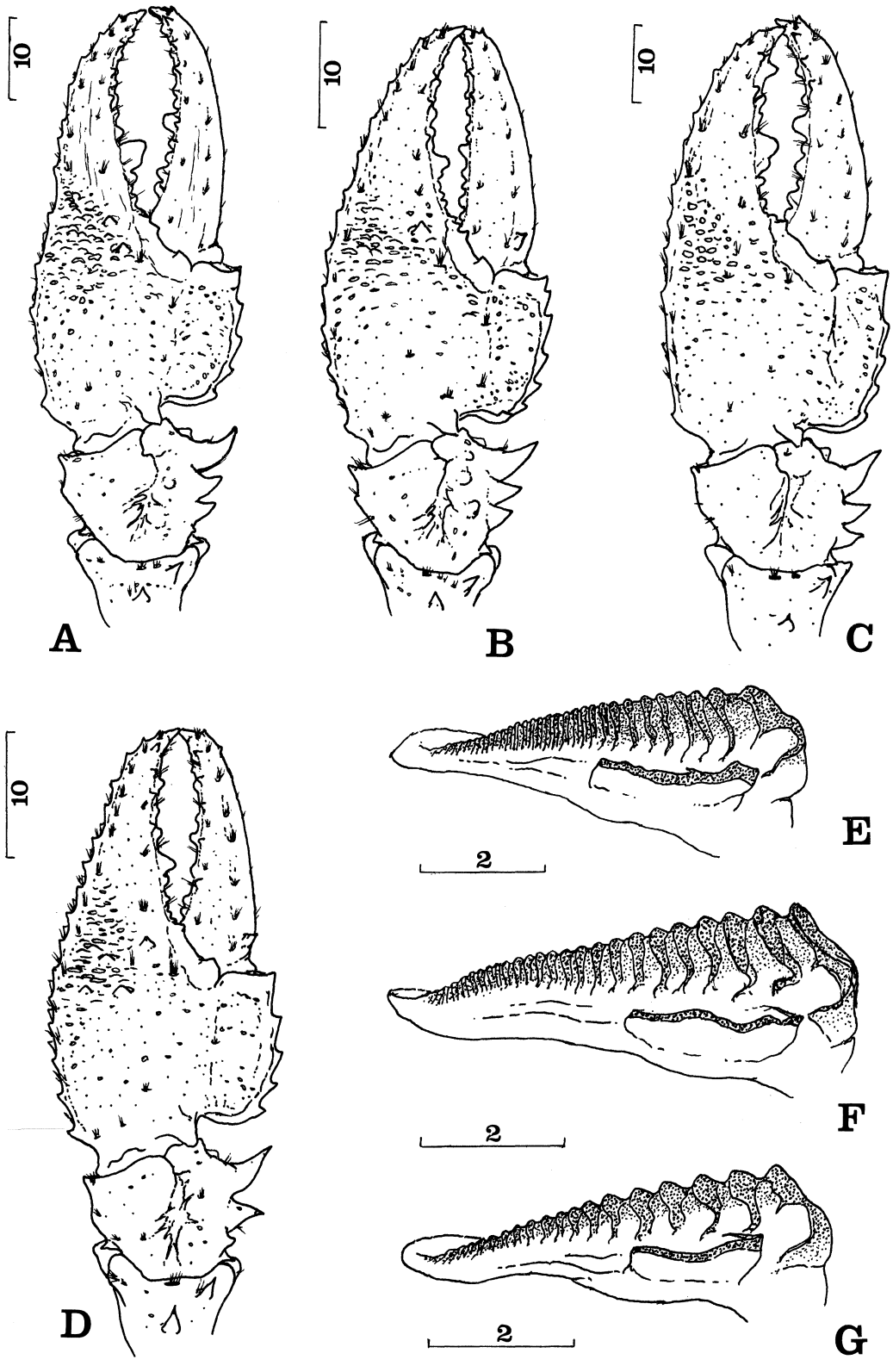

Fig. 9. *Euastacus australasiensis* (H. Milne Edwards). A, dorsal view chela, male, Moonee Moonee Creek, AM P34071; B, stouter chela, dorsomesial dactylar basal spine, 7 mesial propodal spines, male, North Manly, AM P14462; C, chela, male, Wentworth Falls, AM P15477; D, chela, third mesial carpal spine vestigial, female, Jenolan-Kanangra, AM P15061; E, ventral view zygocardiac ossicle, male, Moonee Moonee Creek, AM P34071; F, zygocardiac ossicle, male(?), (Francois collection), Wentworth Falls, AM P15477(?); G, zygocardiac ossicle, male, Morong Creek, AM P34073.

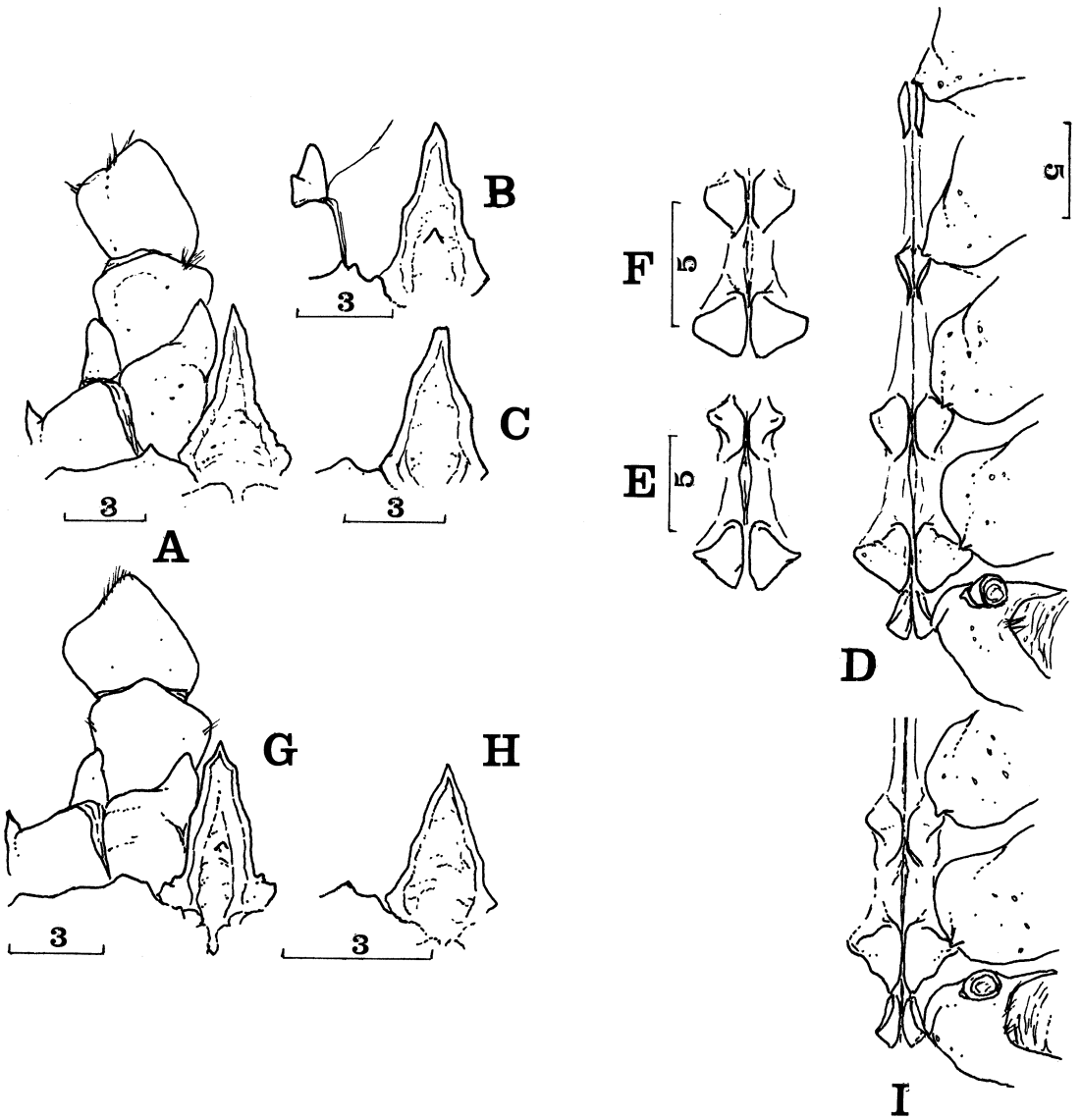

Fig. 10. *Euastacus australasiensis* (H. Milne Edwards). A, ventral view cephalon, male, Moonee Moonee Creek, AM P34071; B, ventral view cephalon, trifid coxopodite spine, basipodite spine present, median spinule on epistome, male, tributary Black Gin Creek, AM P34058; C, epistome, male, North Manly, AM P14462; D, sternal keel, male, Moonee Moonee Creek, AM P34071; E, sternal keel processes 3 and 4, male, Black Gin Creek, AM P34058; F, keel processes 3 and 4, male, Waterfall Creek, AM P34069; G, ventral view cephalon, male, Wentworth Falls, AM P15477; H, epistome, male, Kedumba Creek, AM P34064; I, sternal keel, male, AM P15477.

Sutherland, Sydney, Apr. 1959, H. Hughes, AM P15475, ♀; Kirrawee, near Royal National Park, Apr. 1968, AM P16164, ♂; National Park, Sydney, Nov. 1956, A. Racek, AM P15470, ♀; Waterfall, National Park, A. Racek, AM P13023, ♀; Creek on road to Garie, National Park, 28 Jan. 1928, AM P9026, ♂, 3 ♀♀; Tributary Black Gin Creek, road to Garie, Royal N.P., (34°10'S 151°04'E), 20 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34058, 4 specimens; Tributary Hacking River near National Falls, (34°09'S 151°00'E), 20 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34068, 2 ♂♂; Bellambi Creek, south of Bulli Pass, (34°20'S 150°52'E), 20 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34072, 2 ♀♀; Wentworth Falls Creek, 2300 ft, below falls, Blue Mountains, 2 Feb. 1959, D.D. Francois & R.B. Donnelly, AM P15477–9, 2 ♂♂, 4 ♀♀, ♂♂/♀♀; Tributary Govetts Glen Brook, above Horshoe Falls near Blackheath, (33°37'S 150°19'E), 17 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34061, ♂, 4 ♀♀; Jamieson Creek (= Wentworth Falls Creek) above Wentworth Falls, (33°44'S 150°23'E), 15 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34063, ♂, 2 ♀♀; Leura Falls Creek near The Cascades, (33°43'S 150°20'E), 16 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34060, 3 ♂♂; Kedumba Creek near Sky Way near Katoomba, (33°44'S 150°19'E), 16 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34064, 3 ♂♂, ♀; Yosemite Creek above Minne Ha Ha Falls, (33°41'S 150°20'E), 16 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34062, 2 ♂♂, 2 ♀♀; Streams above Horshoe and Bridal Veil Falls, Blackheath, 12–15 Mar. 1939, M. Ward, AM P13446, P15501, 5 ♂♂, 3 ♀♀; Blackheath, above Bridal Veil Falls, QM W1279, ♀; Grose River, 3/4 mile downstream from junction with Govetts

Leap Creek, Blue Mountains, 3 Oct. 1966, D.D. Francois and F.H. Talbot, AM P15530, ♀; Leura, Blue Mountains, 23 Jan. 1968, B. Bertram, AM P16162, ♀; Swamp between Jenolan Caves and Kanangra Walls, Blue Mountains, 9 Nov. 1965, I.B. McArtney, AM P15061, ♀; Morong Creek, tributary of Boyd River, Kanangra-Boyd National Park, (33°58'S 150°03'E), 18 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34073, ♂, ♀; Tributary Ganbenang Creek, south of Hampton, (33°40'S 150°03'E), 17 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34074, 2 ♂♂, ♀; Mount Wilson, Blue Mountains, 7 Jan. 1958, E.F. Riek, AM P15301, 6 ♂♂, 4 ♀♀; Mount Wilson, waterfall stream 3000 ft, 12 Aug. 1965, J.C. Yaldwyn, AM P15885, ♂, ♀; Creek 15 km north of Lithgow, 1 km east of prison farm, Newnes Plateau, 28 Oct. 1978, AM P29520, ♀; Bathurst, 1880(?), T. Hill(?), AM A8143, ♂ [no record of this specimen can be found in the Marine Invertebrate Crustacea Database, AM (Prod. Editor, 1997)]; Blue Mountains, May 1908(?), AM P645, ♀; Edge of swamp near prison farm, Central Newnes Plateau, 17 Jan. 1979, AM P29521, ♂.

Diagnosis. Male cuticle partition present. Rostral spines apical or reaching midlength of carinae. Rostral base divergent or very divergent, carinae medium length or short, spread. Antennal squame widest at, or slightly distal or proximal to, midlength. Lateral squamal spines absent (some specimens with mesial spine). Suborbital spine small or medium sized. Thoracic spines usually small or barely discernible, sometimes medium sized or absent. General tubercles medium sized or small, moderately or densely distributed on specimens >30 OCL. 2–7 Li spines on abdominal somite 2. D spine small or absent. Abdominal boss absent. Telsonic spines usually absent, sometimes small spines present. Uropods lacking marginal spines. Ventrolateral propodal spine row usually almost reaching apex of finger. Dorsal apical propodal spines usually absent, sometimes 1 spine. Spines above cutting edges of chela apical or distributed to or proximal to midlength of gape. 4–7 mesial propodal spines. 1 or 2 dorsomesial dactylar basal spines or spines absent. Marginal mesial dactylar basal spines usually absent. 1 or 2 apical mesial dactylar spines. 3 mesial carpal spines. Ventromesial carpal spines smaller than ventral spine. Keel Pr1 abrupt, semi-abrupt or sloped and usually slightly apart and parallel. TAP count 4.5–10.0.

Description. Maximum OCL: 59.4 mm.

Rostrum: Rostrum short, not reaching beyond midlength of 3rd antennal segment on specimens >30 OCL, to midlength on some smaller crayfish particularly in coastal populations. Rostral sides convergent or parallel, variation particularly evident between coastal populations. Rostral base divergent to very divergent; carinae of medium length or short, spread. 1–3 (rarely 4) rostral spines per side, spines often apical, to midlength of carinae on some specimens >30 OCL and slightly proximal to midlength on one smaller specimen (spines always distal to midlength of carinae in Wentworth Falls area); spines small on crayfish >40 OCL, occasionally medium sized on small specimens (distal spines rarely large on some crayfish <20 OCL); spines rounded or moderately pointed on specimens >30 OCL, occasionally sharp on smaller crayfish; spines decreasing in size and sharpness after distal pair. Acumen spine similar to or slightly larger than marginal spines.

OCL/CL 0.75–0.89 i; RW/OCL 0.14–0.26 d.

Cephalon: Cephalon spinose to poorly spinose, all spines small. Blue Mountains specimens usually less spiny than coastal specimens. 1st postorbital spine an edge or small on specimens >30 OCL, medium sized on some smaller crayfish, large on some specimens <20 OCL; 2nd spine sometimes absent, or present as small edge or small spine, sometimes on one side only. Suborbital spine small or medium sized. Lateral margin of antennal squame convex or straight; squame widest at midlength or slightly proximal or distal to midlength. Lateral squamal spines absent (one specimen with spine on one squame); some specimens from Kanangra area with spine on mesial margin of squame. Epistome (interantennal spine) elongate to medium width on specimens >30 OCL, moderately broad or broad on smaller specimens; spine margin toothed or scalloped. Antennal basipodite spine absent or small on specimens >40 OCL, sometimes medium sized and rarely large on smaller crayfish. Coxopodite spine small or medium sized (occasionally absent) and unimodal, bifid or serrated.

ScL/OCL 0.12–0.29 d.

Thorax: Dorsal spine development extremely variable within and between populations. In coastal populations sometimes 1–20 spines per side, or spines barely discernible, or absent on some specimens <30 OCL and most <20 OCL; spines usually small, rarely medium sized and usually blunt, rarely moderately pointed. Spines usually absent in populations near Katoomba, sometimes minute blunt spine posterior to cervical groove; spines barely discernible or 1 or 2 distinct spines in Blue Mountains populations peripheral to Katoomba. General tubercles medium sized or small, very small or absent on specimens <30 OCL; tubercles usually moderately distributed or dense on coastal and Kanangra specimens, sparse or absent on some crayfish <30 OCL, usually less dense in Katoomba area. 1–5 (usually 3 or 4) cervical groove spines per side, spines medium sized or small (minute on some small animals) and moderately pointed or blunt (very rarely sharp).

ArL/OCL 0.30–0.39; ArW/OCL 0.14–0.23; CaW/OCL 0.53–0.63; CaD/OCL 0.45–0.56 d.

Abdomen: Somite 1 sometimes with D–L spine, often on one side only; when present, spine usually small or minute and blunt, rarely medium sized and sharp. D spine usually absent from somite 1, very rarely small spine present. Somite 2 with 2–7 (usually 3–5) Li spines per side on specimens >30 OCL; usually fewer spines on smaller crayfish, spines sometimes absent particularly on specimens <20 OCL; usually 1 Li spine on somites 3–5 of animals >40 OCL, spines less developed on Katoomba specimens. Li spines usually moderately pointed or sharp on somite 2, blunter on posterior somites and blunter and smaller on small crayfish. Lii spines often absent or merely protuberances at setal

bases, sometimes small or medium sized and moderately pointed or sharp. D–L spines usually small or obsolete, rarely medium sized, and usually blunt, rarely moderately pointed (large Kanangra specimens sometimes with sharp D–L spines). D spines small or absent, usually blunt, sometimes sharp on coastal specimens. D and D–L spines sometimes on one side only. Abdominal spines usually poor on crayfish <30 OCL, absent on many animals <20 OCL. Dorsal boss absent.

AbdW/OCL ♂ 0.48–0.57, ♀ 0.50–0.61 i; OCL/L ♂ 0.34–0.45 i, ♀ 0.35–0.43 i.

Tailfan: Spines usually absent on telson and uropods; several coastal specimens with 1–4 small or minute telsonic spines (one specimen with 4 medium sized spines); 2 specimens from Katoomba area with small surface spine on one inner ramus of uropod; lateral margins of uropods with only faint setal protuberances. Standard spines usually small (rarely medium sized) on large animals, medium sized on small specimens.

TeL/OCL 0.33–0.44 d.

Chelae: Chelae elongate to stout on coastal animals, intermediate in shape in Blue Mountains (regenerate chelae sometimes elongate); specimens <20 OCL often with elongate chelae. Teeth usually well developed at OCL >30 mm.

Propodus: Ventrolateral spine row often extending close to apex of finger, occasionally row absent on specimens <20 OCL; lateral spines usually small or medium sized, moderately pointed or sharp. Lateral spine ridge medium sized, small or vague. 4–7 (usually 5 or 6) mesial propodal spines. Dorsal apical spines usually absent, some large specimens with 1 spine on one or both chelae. 1–6 (usually 2–4) spines above cutting edge on crayfish >30 OCL; smaller animals and regenerate chelae often with fewer or lacking spines; spines large to small and apical or extending to slightly proximal to midlength of gape. Sometimes numerous medium sized and small spines and protuberances on dorsal surface of propodus lateral to dactylar base or surface almost smooth and merely punctate (variation between populations); usually poor development of spines in Katoomba area. Usually 1–10 or more small spines lateral to dactylar base ventrally. Specimens <30 OCL with poor development of dorsal and ventral spines; spines usually absent on crayfish <20 OCL. Usually very low ridge posterior to dactylar articulation, rarely small spine present. Precarpal spines usually absent, some coastal animals with 1–3 small spines.

PropL/OCL ♂ 0.75–1.08 i, ♀ 0.75–0.95 i; PropW/PropL 0.34–0.53 i; PropD/PropL 0.23–0.33 i.

Dactylus: 1–8 (usually 2–5) spines above cutting edge, spines apical or extending to proximal to midlength of gape, occasionally to full gape; spines large to small, absent on some specimens <30 OCL; Katoomba specimens often with fewer spines than other populations. Extra dorsal dactylar spines absent. Dorsomesial basal spines numbering 0–2 (3 on one malformed chela), usually 0 or 1, often only one chela with spine; never more than 1 dorsomesial basal spine on Blue Mountains specimens except on regenerate chelae. Marginal mesial basal spine usually absent; when present, usually on regenerate chelae (one specimen with 2 spines on apparently normal chela). Basal spines large to small. Usually 1 apical mesial dactylar spine; some Blue Mountains specimens with 2 spines (regenerate chelae often with 2–4 spines). Dactylar groove seldom deep, usually shallow or absent.

DactL/PropL 0.52–0.63.

Carpus: Usually 3 mesial carpal spines, rarely 4th small spine (usually on one chela only); 1st and largest spine usually distinctly offset ventrally to remainder on coastal specimens, less obviously so on Blue Mountains crayfish; 2nd and 3rd spines usually close. 1–3 medium sized or small (rarely large) lateral carpal spines. Articulation spine minute or absent, medium sized on some very small animals. 1–4 dorsal carpal spines often present on coastal specimens, absent on Blue Mountains crayfish. Ventral spine large or medium sized on specimens >30 OCL, smaller on some smaller animals. Usually 3 or 4 ventromesial spines, largest medium sized or small and smaller than ventral spine.

Merus: Usually 5–10 medium sized or small dorsal spines. Outer spine absent, minute or small, rarely large on very small specimens.

Keel: Keel shape very variable.

Pr1: Posterior margins abrupt to sloped, usually semi-abrupt (variation largely between populations); ventral edges usually angled down, sometimes flat or rounded; processes usually slightly apart, sometimes close or apart; orientation usually parallel, occasionally open (closed on one specimen). Keel after Pr1 lacking spines.

Pr2: Almost parallel to very open. Keel after Pr2 lacking spines, often centrally recessed.

Pr3: Usually curved gradual scoops with bases sharp to rounded, or no scoop with bases moderately curved to sharp. Keel after Pr3 low or slightly raised, sometimes more pronounced anteriorly.

Pr4: Scoops usually absent and posterior edges sharp to moderately curved but sometimes slight scoops present and almost rounded bases; anterior edges moderately curved (rarely rounded) to angular; posterior margins usually slightly convex, straight or irregular.

Pr3 and 4 usually narrow on specimens >40 OCL, broad on some smaller animals. Populations in north with distinctly open, broad processes grading to narrow in southern populations.

Setation: Moderately light on most specimens; some Blue Mountains populations (e.g., near Kanangra) slightly more hirsute.

Punctation: Dense.

Gastric mill: TAP count 4.5–10.0; TAA count 0–1.5; spread 3.0–9.5. Differences due to variation in tooth size and ear length. Urocardiac ridges 6–13, showing allometric and geographical variation.

Coloration: Body dorsally very dark green or black with tinge of red on coast, dark green-brown or red-brown in Blue Mountains (B.M.); paler ventrolaterally. Dorsal thoracic and cervical spines (when present) bright red or orange on coast, pale brown or yellow in B.M. General tubercles pale red on coast, pale yellow or orange in B.M. Bright orange and red spines and patches on lateral surface of cephalon on coast, pale yellow protuberances in B.M. Li abdominal spines orange on coast, yellow or cream in B.M.; D–L spines red on coast, pale orange in B.M.; D spines highlighted by red spots on coast; sometimes red band across somite 6 of coastal specimens, especially in north. Cheliped articulations red or orange. Carpus of cheliped red with darker crimson mottling on coast, dark blue-green mottling on brown in B.M.; dorsal protuberances red or black on coastal forms; mesial spines black with red or yellow tips on coast, bright blue on specimens from southern Kanangra area; lateral spines paler. Propodus red with dark mottling on coast, brown or blue-green with faint mottling in B.M.; mesial and lateral spines tipped with yellow or cream. Fingers red or orange on coast, usually slightly tinged blue in B.M.; finger tips yellow. Dactylus often distinct blue-green in B.M.

Body ventrally orange or red on coast, orange and green in B.M. Keel orange, often with blue tinges in B.M. Carpus of cheliped mesially dark red-green or black on coast, blue-green in B.M.; lateral area orange; ventral spines orange, brighter on coast. Propodus bright red on coast, orange with slight mottling in B.M.; mesial edge darker (dark blue in B.M.). Fingers pale near tips (yellow or pale blue). Dactylus usually darker on mesial edge.

Sexes: Male cuticle partition present. Females <30 OCL have closed gonopores. Most females 30–40 OCL and all females >40 OCL have open pores, hence female maturation appears to occur in the 30–40 OCL range.

Distribution and biology. *Euastacus australasiensis* extends 110 km along the coast from Ourimbah south through Sydney to the Bulli Pass, 10 km north of Wollongong, and west into the Blue Mountains area from the Newnes Plateau south to the Kanangra Boyd National Park. Its range is drained by small coastal streams including tributaries of the Hawkesbury and Port Hacking Rivers, and in higher country by tributaries of the Grose and Coxs Rivers.

The species was collected from altitudes between 50 m and 1100 m a.s.l. The dominant geology of the area is sandstone and granite with some conglomerates and the vegetation primarily eucalypt and heath forest with occasional patches of temperate rainforest. Some areas have been largely cleared. Most of the streams are permanent, fed by springs. *Euastacus australasiensis* was collected from under rocks and from burrows in both open and shaded stretches of streams.

Berried females were collected in October, 1981.

Specimens carried between 44 and 155 burgundy or red and white eggs, the number increasing with size of the female. Ovigerous specimens were collected in January and November and a female carrying hatched young in November. Overwintering of eggs is probably usual, with hatching in summer.

Euastacus australasiensis can be sympatric with *E. spinifer* over much of the former's range. The latter species appears to prefer shaded areas, either under vegetation or rocky ledges, while the former occurs wherever some shelter is available.

Remarks. *Euastacus australasiensis* displays obvious variation, most particularly in rostral shape, thoracic spine size and number, general tubercle density, shape of chelae (especially length of the dactylus), development of spines lateral to the dactylar base, apical dactylar spine number, development of dorsal carpal bumps or spines, shape of keel Pr3, profile of keel 3/4 and width of Pr3 and Pr4. Colour is also variable. Variation is partly clinal in a north to south direction but is also irregular between populations. In addition, there is an irregular gradient of characters to the west into the Blue Mountains and Newnes Plateau.

Euastacus australasiensis (H. Milne Edwards) and *E. nobilis* (Dana) were, after *E. spinifer* (Heller), the earliest species of *Euastacus* described. Type specimens of *E. nobilis* were lost at sea. There has been continued confusion concerning the validity of these species.

Clark (1936, 1941) did not acknowledge the name *E. australasiensis* except as a synonym of *E. serratus*. Clark (1941) recorded and described *E. nobilis* as one of nine species of *Euastacus* and included many Victorian specimens of *E. kershawi* (Smith), *E. woiwuru* Morgan, *E. neodiversus* Riek and probably *E. yarraensis* (McCoy) (see Morgan, 1986). Her species description and the key characters of "an abdomen with 3 rows of sharp spines and a large rounded ridge on dorsum of each segment" are valid only for *E. kershawi* and even then the first character is variable. Her figure labelled *E. nobilis* (Clark, 1941: plate VI) undoubtedly depicts *E. kershawi*.

Riek (1969) recognised both *E. australasiensis* and *E. nobilis* and recorded the range of both to be "coastal NSW in the vicinity of Sydney". He correctly dismissed Clark's Victorian *E. nobilis* and stated these to be *E. kershawi, E. yarraensis* and *E. crassus* Riek. (Most of Riek's Victorian *E. crassus* are in fact *E. woiwuru*). In Riek's key (1969: 872), *E. nobilis* and *E. australasiensis* were distinguished on the basis of two (or three) characters. Riek recorded that *E. nobilis* displays a U-shaped rostrum, while *E. australasiensis* has a narrow rostrum with parallel or slightly concave margins. The keel Pr3 of *E. nobilis* are supposedly distinctly concave while those of *E. australasiensis* are almost straight. A secondary feature recorded is that the keel between Pr3 and 4 of *E. australasiensis* is strongly raised anteriorly, implying that it is often not so on *E. nobilis*.

Examination of specimens from the Sydney area labelled *E. australasiensis* and *E. nobilis* by Riek, and some more recently collected specimens, revealed animals that display all combinations of these characters. The variation is marked between sites but can be evident within populations from a single site. These key characters do not effectively separate two species in the Sydney area. Riek's uncertainty regarding the identification of these species is reflected in the labelling of museum specimens. Of the 68 examined specimens labelled *E. australasiensis*, only 25 are in fact that species. The remaining animals are predominantly *E. yanga* n.sp. and *E. hirsutus* (McCulloch). The collecting sites of many of these specimens can scarcely be regarded as in the vicinity of Sydney. Most specimens labelled *E. nobilis* by Riek are from the Sydney area but specimens of *E. dharawalus* n.sp. (e.g., AM P13454) from Fitzroy Falls also bear that label.

Francois (1962) included reference to the species *E. nobilis* only in the synonymy of *E. australasiensis*. Interestingly, only one of Francois' gastric mills bears the label *E. australasiensis*. The remainder referred to in the text as *E. australasiensis* bear the label *E. nobilis* as do a number of specimens labelled by Francois. Francois described variation in gastric mills of *E. australasiensis* from coastal streams near Sydney and proposed that future work would almost certainly reveal more than one species. Francois (1962) considered nine specimens from Wentworth Falls, Blue Mountains as a separate species. He distinguished these specimens from *E. australasiensis* on the basis of gastric mill counts and, less clearly, some external characters.

In this study, the species *E. australasiensis* and *E. nobilis* are synonymised in one nominal species, *E. australasiensis*. The Wentworth Falls specimens of Francois (1962) are also included here. No clear hiatus in morphological characters warrants the recognition of two or more species.

Specimens from the Katoomba area are readily distinguishable from most coastal animals. Katoomba animals lack thoracic spines, while they are usually present on coastal specimens. Protuberances on the carpi of the chelipeds are absent while usually present on lowland animals. In addition, there are notable colour differences (see Coloration). However in areas peripheral to Katoomba, especially Mount Wilson and the Newnes Plateau to the north and north-west respectively, animals are intermediate between specimens from the Katoomba area and those of the more coastal streams.

Virtually all lowland specimens >30 OCL have vivid red spines on carapace, abdomen and chelae and a bright red-orange ventral surface. Two specimens (AM P18546) from Pearl Beach are described on the label as grey and yellow, which is quite remarkable and these can only be regarded as colour variants. Certain morphological trends are evident. Northern specimens frequently display more elongate chelae and antennal squames than southern animals and the width of keel processes 3 and 4 declines from north to south. A character not included in taxonomic considerations of this study is the female genital pore shape. The pore is rounded in northern specimens, being slightly and then distinctly elongate in populations near Sydney. Other characters, particularly rostral shape and thoracic spine development vary more irregularly but are frequently close to constant within populations.

Two specimens (AM P15298) from Asquith (a northern suburb of Sydney, near Hornsby) have 4 mesial carpal spines on their larger chelae. Occasional specimens display 4 carpal spines, though the 4th is usually very small.

The specimens from the Kanangra area south of the Blue Mountains proper are relatively distinct in being more hirsute and having larger abdominal (especially D–L and D) spines and narrower sternal keels than most other members of the species. The dactyli of chelae usually have 2 apical mesial spines. Specimens are similar to lowland forms in possessing moderately distributed to dense general tubercles and obvious thoracic spines of variable size but resemble Blue Mountain animals in coloration.

There are some differences in morphological proportions over the range of the species. Lowland forms have slightly longer rostra on average than Blue Mountains specimens but there is considerable variation in both areas. Relative carapace depth may be slightly less in coastal specimens.

Gastric mill counts of *E. australasiensis* are extremely variable and are more clinal in variation than are most external characters. Northern populations have the highest TAP counts of the species with values up to 10.0. Populations to the immediate north of Sydney (e.g., Brooklyn and Kuringai Chase) show a drop in counts to 6.5–9.0 and in Sydney proper, specimens have counts of 7.0–8.0. South of Sydney in the Royal National Park area, TAP counts drop slightly further and Bulli Pass specimens have TAP counts as low as 5.5. Specimens from near Katoomba and Wentworth Falls show little variation with a TAP of 6.5–7.0 but other populations in the Blue Mountains have counts to 7.5. TAA counts are lower than in coastal specimens. Populations at Mount Wilson and Newnes Plateau show considerable variation in mill counts which can be rather higher than those of Katoomba animals. TAP counts of Kanangra specimens are obviously lower than elsewhere due to larger teeth and a slightly shorter ear. Reduction in ear length also results in TAA counts up to 1.5. Urocardiac ridges number 6–13, increasing in part with the size of the specimen.

In overall similarity, there appears to be a progression in characters from the Woy Woy area north of Sydney in an arc to the Newnes-Mount Wilson areas and thence to the central Katoomba area and on to Kanangra. Interestingly, this pattern of similarity parallels that proposed for *E. spinifer* (Heller) in this study, where the coastal populations appear to grade to highland forms via the same arc.

Euastacus bidawalus Morgan

Euastacus bidawalus Morgan, 1986: 19–23, figs 10, 11.

Distribution and biology. The species ranges from near Mount Imlay south of Eden, New South Wales to Lind National Park near Cann River, Victoria, a distance of 90 km. Specimens occur at altitudes between 150 m and 400 m a.s.l. in streams bordered by wet sclerophyll with dry sclerophyll and heath on ridges.

Remarks. *Euastacus bidawalus* was described and discussed by Morgan (1986).

Euastacus brachythorax Riek

Figs 11, 12

Euastacus brachythorax Riek, 1969: 912, fig. 16F.

Type material. HOLOTYPE ♂, OCL 31.7 mm, AM P15716. NSW Brown Mountain, 2 Dec. 1956, E.F. Riek. ALLOTYPE: ♀, OCL 34.3 mm, type locality, AM P15717.

Other material examined. NSW Rutherford Creek tributary, Brown Mountain Flora Reserve, (36°36'S 149°25'E), 2 Nov. 1981, G.J. Morgan & S.J. Harders, AM P34055, 3 ♂♂, 2 ♀♀; Rutherford Creek, (36°35'S 149°25'E), 2 Nov. 1981, G.J. Morgan & S.J. Harders, AM P34053, 2 ♂♂; Upper Nunnock River, near Brown Mountain, (36°36'S 149°26'E), 3 Nov. 1981, G.J. Morgan & S.J. Harders, AM P34056, 3 ♀♀; Devils Creek near Tantawangalo Mount, south-west of Candelo, (36°50'S 149°31'E), 7 Nov. 1981, G.J. Morgan & S.J. Harders, AM P34057, 7 specimens; Near Timbillica, south of Eden, 4 Jan. 1982, P. Horwitz, ♀.

Diagnosis. Male cuticle partition absent. Rostral spines apical or distributed to slightly proximal to midlength of carinae. Rostral base divergent or very divergent, carinae medium length or short. Antennal squame widest at, or only slightly distal or proximal to, midlength. Squamal spines absent. Suborbital spine medium sized or small. Thoracic spines medium sized or small. General tubercles medium sized or small and moderately or sparsely distributed. 2–4 medium sized or small Li spines on abdominal somite 2. D spine obsolete or absent. Abdominal boss absent. Telsonic spines minute or absent. Uropods lacking marginal spines. Ventrolateral propodal spine row well developed, almost reaching apex of finger. Usually 1 (rarely 2) dorsal apical propodal spines. Spines above cutting edges of chela apical. 5 mesial propodal spines. 1 dorsomesial dactylar basal spine. Marginal mesial dactylar basal spines usually absent, occasionally 1 present. 2 apical mesial dactylar spines. 2 mesial carpal spines. Ventromesial carpal spines smaller than ventral spine. Keel Pr 1 sloped, or less commonly semi-abrupt, and close or slightly apart and parallel. TAP count 8.0–10.0.

Description. Maximum OCL: 35.7 mm.

Rostrum: Short rostrum, usually just reaching or failing to reach base of 3rd antennal segment, seldom to midlength of segment on small specimens. Rostral sides slightly convergent or parallel; bases divergent or very divergent and carinae medium length or short and spread. 2–4 marginal spines, small and moderately pointed to rounded (sharp on some specimens <20 OCL); spines usually apical or just reaching midlength of carinae, specimens (including types) >30 OCL with spines reaching slightly proximal to midlength of carinae. Acumen spine similar to marginals, rarely slightly larger.

OCL/CL 0.81–0.88 i; RW/OCL 0.16–0.21 d.

Cephalon: Cephalon poorly spinose, usually with 1 medium sized or small spine ventral to postorbital ridges and some protuberances on lateral surface. 1st postorbital spine small or merely an edge (rarely medium sized on specimens <20 OCL); 2nd spine an edge or barely discernible. Suborbital spine medium sized or small. Lateral margin of antennal squame slightly convex or convex; squame widest at or slightly proximal to midlength, slightly distal to midlength on some large specimens; marginal squamal spines absent. Epistome broad or medium width, margins scalloped or faintly toothed. Antennal basipodite spine small or medium-small (absent on one specimen >30 OCL). Coxopodite spine small or medium-small on animals >20 OCL, medium sized on some smaller crayfish; spine weakly bifid or serrated.

ScL/OCL 0.15–0.22 d.

Thorax: As many as 12 dorsal thoracic spines per side, these small and blunt or rounded, or spines barely discernible; spines absent on specimens <20 OCL. General tubercles small on animals >30 OCL, absent on some very small specimens; tubercles moderately distributed to sparse on large specimens, sparser on smaller animals. 1 or 2 cervical spines, small or medium sized and usually blunt, occasionally moderately pointed.

ArL/OCL 0.32–0.37; ArW/OCL 0.16–0.22 d; CaW/OCL 0.53–0.56; CaD/OCL 0.45–0.52 d.

Abdomen: Usually 1 small or very small D–L spine on somite 1 of crayfish >30 OCL, rarely on smaller animals. Minute D spine on somite 1 of some large specimens. 2–4 Li spines on somite 2 of most specimens >20 OCL, these medium sized to minute and moderately pointed to sharp; some specimens <30 OCL and all <20 OCL lacking Li spines. Small or minute Li spine on somites 3–5 of large specimens, rarely on crayfish <30 OCL. Li spines decreasing in size to posterior somites. Lii spines merely blunt protuberances on some large specimens. D–L spines small or medium sized anteriorly on some large specimens decreasing in size posteriorly; spines blunt or very blunt. D spines merely as low protuberances on somites 2–6, or absent. D–L and D spines absent on somites 2–6 of specimens <30 OCL. Dorsal boss absent.

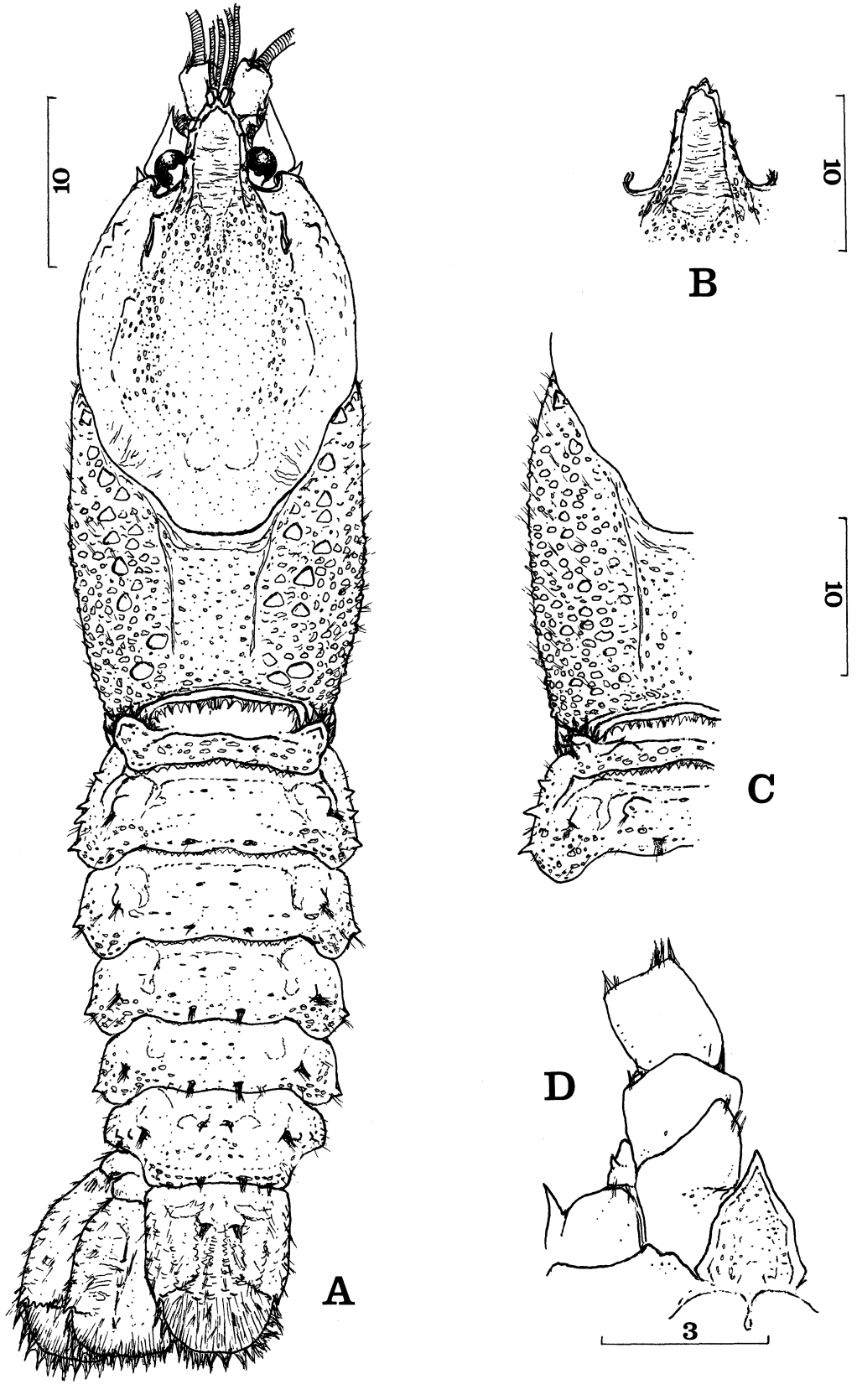

Fig. 11. *Euastacus brachythorax* Riek. A, dorsal view, holotype male, Brown Mountain, AM P15716; B, dorsal view rostrum, male, tributary Rutherford Creek, AM P34055; C, thorax and anterior abdomen, thoracic spines barely discernible, D abdominal spines present, male, AM P34055; D, ventral view cephalon, holotype male, AM P15716.

AbdW/OCL 0.50–0.54; OCL/L 0.37–0.42 i.

Tailfan: Tailfan spines rarely present; 2 specimens >30 OCL (including allotype) with 4 minute telsonic spines. Margins of telson and uropods slightly uneven at setal bases. Standard spines medium sized to small.

TeL/OCL 0.34–0.39.

Chelae: Chelae stout to elongate on specimens >20 OCL; all smaller crayfish with elongate chelae. Teeth moderately to well developed on large specimens, often poor on specimens <30 OCL.

Propodus: Ventrolateral propodal spine row often extending very close to propodal apex (hence approaching 2 lateral rows); lateral spines small or medium sized and sharp. Lateral spine ridge well developed to small. 5 mesial propodal spines (6 or 7 on some regenerate chelae). Usually 1 (rarely 2) dorsal apical spine, absent on some specimens <30 OCL particularly on regenerate chelae. 1 or 2 small or medium sized apical spines above cutting edge of propodus, absent on some regenerate chelae and some specimens <30 OCL. Sometimes 1 small, blunt spine on dorsal surface of propodus lateral to dactylar base, but spines usually absent and low protuberances or general irregularities more common; ventrally, 1 or 2 medium sized or small spines lateral to dactylar base, vague or absent on small crayfish. Slight ridge or low protuberances posterior to dactylar articulation. Precarpal spines usually absent, sometimes present especially on regenerate chelae.

PropL/OCL ♂ 0.81–0.91 i, ♀ 0.83–0.87; PropW/PropL 0.40–0.47 i; PropD/PropL 0.27–0.32.

Dactylus: 1 or 2 spines above cutting edge; spines apical and medium sized or small; regenerate chelae and specimens <20 OCL sometimes lacking spines. Extra dorsal spines absent. Usually 1 dorsomesial dactylar basal spine; some regenerate chelae with 0 or 2 spines and one specimen <20 OCL with 2 spines on both chelae. Marginal dactylar basal spines usually absent; some regenerate chelae and, rarely, apparently normal chelae, with 1 marginal spine. Basal spines medium sized or small and moderately sharp, occasionally rounded. Usually 2 apical mesial dactylar spines; 1 on some very small specimens (one medium sized specimen with 3 on one chela). Dactylar groove shallow or deep.

DactL/PropL 0.53–0.59.

Carpus: 2 mesial carpal spines (some regenerate chelae with 3 spines); 1st (distal) only slightly offset ventrally to or at similar level to 2nd. Lateral carpal spines medium sized or small. Articulation and dorsal spines absent. Ventral spine large or medium sized. 2–5 ventromesial spines, largest medium sized to small.

Merus: 5–9 dorsal spines. Outer meral spine very poorly developed or absent.

Keel: *Pr1*: Posterior margins usually sloped, rarely semi-abrupt; ventral edges angled down or almost rounded; processes close, rarely slightly apart, apart on some specimens <20 OCL, and parallel. Keel after Pr1 lacking spines.

Pr2: Open to almost parallel on large animals; some specimens <20 OCL with very open processes. Keel after Pr2 lacking spines.

Pr3: Usually slight or gradual scoops, with moderately rounded bases; specimens <20 OCL lacking scoops. Keel after Pr3 recessed, slightly more pronounced on very small specimens.

Pr4: Scoops slight or absent; posterior edges moderately curved or rounded and slightly convex or straight; anterior edges moderately rounded or angular.

Pr3 and 4 usually narrow, approaching broad on some specimens, distinctly broad on specimens <20 OCL.

Setation: Moderate to light.

Punctation: Dense to very dense.

Gastric mill: TAP count 8.0–10.0; TAA count 0.5–1.0; spread 7.0–9.5. Teeth small and closely spaced; zygocardiac ear long, though somewhat variable in size. Urocardiac ridges 8–9.

Coloration: Body dorsally medium brown, paler ventrally; some yellow and blue-grey on lateral face of cephalon. General tubercles and dorsal spines when present pale brown or orange. Li abdominal spines slightly paler. Cheliped articulations red. Carpus of cheliped brown-orange with blue-grey mottling; spines blue with yellow tips. Propodus rust brown, sometimes tinged green, with blue-grey mottling; mesial edge blue-grey; spines yellow. Dactylus blue-green with darker mesial edge.

Body ventrally orange and green-blue. Carpus of cheliped deep blue mesially, laterally pale orange. Propodus deep blue mesially, orange medially, laterally pale orange. Dactylus pale blue, darker near tip. Variation in blue intensity on chelae.

Sexes: Males lack a cuticle partition. All collected females have unopen gonopores. The two females in the 30–40 OCL range have wider abdomens than similarly sized males, implying the approach of maturity. The onset of female maturity probably occurs in the 40–50 OCL range.

Distribution and biology. The species is known from the Brown Mountain area west of Bemboka, 25 km south along mountains to near Mount Darragh, north-west of Wyndham. A specimen from near Timbillica, a further 60 km south, indicates that the species extends to near the Victorian border, though the distribution may be patchy.

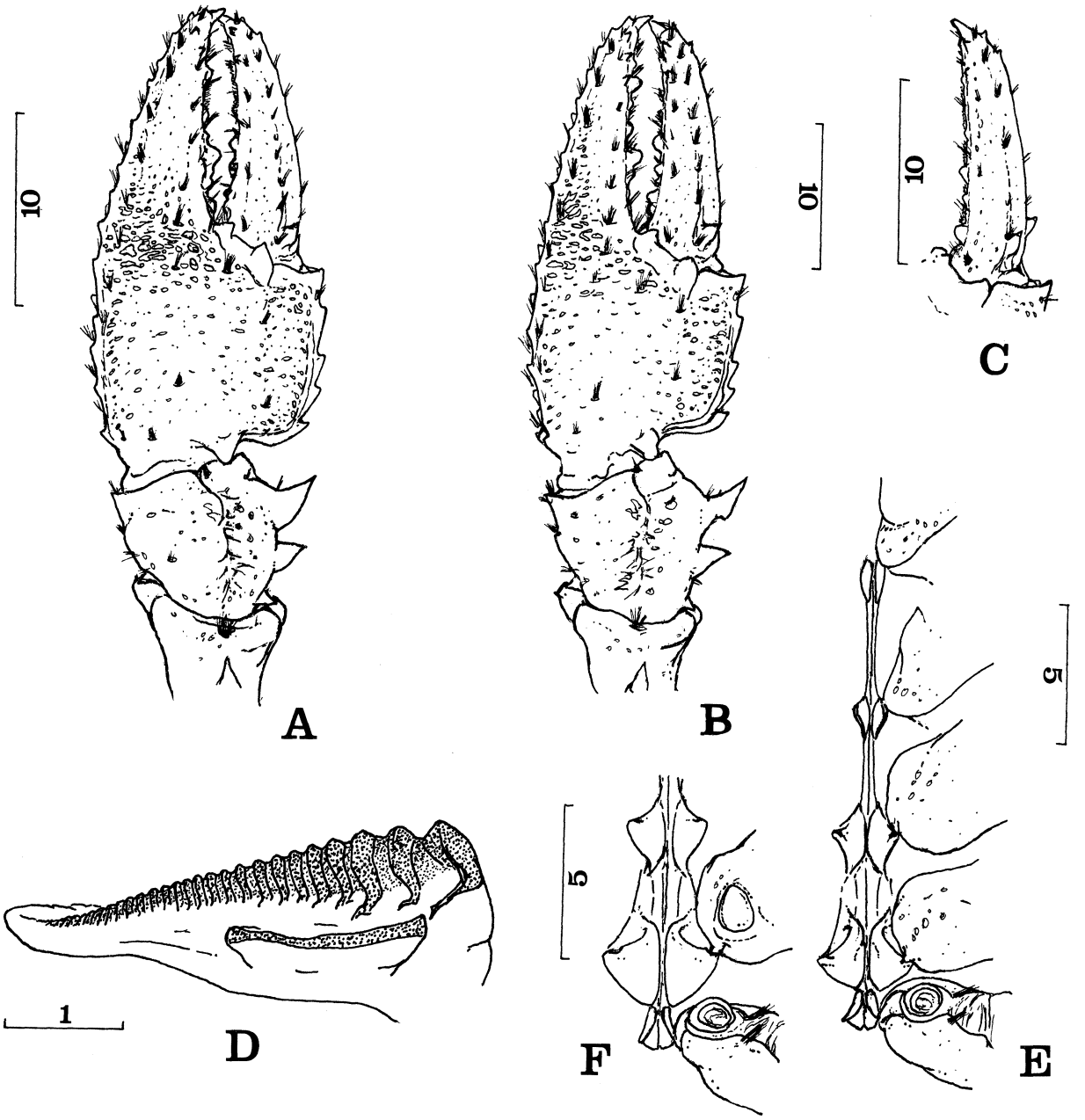

Fig. 12. *Euastacus brachythorax* Riek. A, dorsal view chela, holotype male, Brown Mountain, AM P15716; B, more elongate chela, male, tributary Rutherford Creek, AM P34055; C, dactylus of chela, marginal basal spine, intersex, Devils Creek, AM P34057; D, ventral view zygocardiac ossicle, holotype male, AM P15716; E, sternal keel, holotype male, AM P15716; F, keel processes 3, 4 and 5, intersex gonopores, Devils Creek, AM P34057.

Euastacus brachythorax was collected from streams in granite country between 240 m and 1000 m a.s.l., with light temperate rainforest or tree ferns along stream banks and dry sclerophyll on ridges above. Streams were well shaded. The Timbillica specimen was presumably from a lower altitude, though the habitat was described as similar (P. Horwitz, pers. comm.).

Euastacus brachythorax can be sympatric with *E. yanga* n.sp. and *E. claytoni* Riek inhabits flowing streams to the west.

Remarks. The species has been collected from only a small area of south-eastern New South Wales and does not display marked geographical variation. The one specimen from near Timbillica south of Eden bears 3 mesial carpal spines but both chelae are obviously regenerate.

Riek (1969: 912) described *E. brachythorax* from three specimens. Two are the type specimens (AM P15716–17) but the third (AM P15541) is a specimen of *E. yanga* from near Bermagui. Riek's description was

very brief and recorded the species as bearing "a single marginal row" of abdominal spines and a dactylus "only very slightly grooved". The projected onset of sexual maturity of females indicates that the species acquires larger sizes than any specimens examined to date. Larger specimens when collected will certainly display obvious D–L and probably small D abdominal spines, as evidenced by the small blunt spines on the largest specimens examined here. The dactylus is usually distinctly grooved.

Euastacus brachythorax lacks a male cuticle partition and is probably most closely related to *E. crassus* Riek, *E. rieki* n.sp. and *E. claytoni* to the west and, more distantly, to the parapatric (sometimes sympatric) *E. yanga*. Though extremely variable, the last species can be distinguished from *E. brachythorax* in possessing larger and more extensive rostral spines, larger ventral antennal and suborbital spines, a spinier cephalon, more numerous apical dactylar spines and usually a longer thorax.

Euastacus clarkae n.sp.

Figs 13, 14

Type material. HOLOTYPE ♂, OCL 32.8 mm, AM P34051. NSW Tributary of Cockerawombeeba Creek, tributary of Forbes River, north of Birdwood, (31°11'S 152°22'E), 21 Sept. 1981, G.J. Morgan & S.J. Harders. PARATYPES: NSW Type locality, AM P34052, 2 ♂♂, ♀; Cockerawombeeba Creek at Reserve, (31°11'S 152°22'E), 21 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34050, 3 ♂♂, 3 ♀♀.

Diagnosis. Male cuticle partition present. Rostral spines distributed to or proximal to midlength of carinae. Rostral base divergent or very divergent, carinae of medium length. Antennal squame widest at approximately its midlength. Squamal spines absent. Suborbital spine medium sized or medium-large. Thoracic spines absent. General tubercles medium sized, moderately distributed. 3–6 medium sized or small Li spines on abdominal somite 2. D spine absent or minute on somites 2 or 3. Abdominal boss absent. Telsonic spines minute, often barely discernible. Uropods lacking marginal spines. Ventrolateral propodal spine row reaching apex or terminating just short of apex of finger. 1 dorsal apical propodal spine on large specimens. Spines above cutting edges of chela apical or reaching midlength of gape. 5–7 mesial propodal spines. 1 dorsomesial dactylar basal spine. Marginal mesial dactylar basal spines usually absent, occasionally 1 present. 2 or 3 apical mesial dactylar spines. 2 mesial carpal spines. Ventromesial carpal spines much smaller than ventral spine. Keel Pr1 sloped or semi-abrupt and close or slightly apart, parallel. TAP count 7.0–8.0.

Description. Maximum OCL: 33.0 mm.

Rostrum: Rostrum rather short, not reaching midlength of 3rd antennal segment on large crayfish, rarely to midlength on specimens <20 OCL. Rostral sides slightly convergent; base divergent or very divergent and carinae of medium length. 3 or 4 rostral spines per side, distributed to or proximal to midlength of carinae; spines small or medium sized, usually moderately pointed, sometimes rounded. Acumen spine similar to marginals, occasionally slightly larger.

OCL/CL 0.79–0.86 i; RW/OCL 0.17–0.23 d.

Cephalon: Spination moderate to poor, with 1–3 spines and minute protuberances ventral to postorbital ridges. 1st postorbital spine small on specimens >30 OCL, medium sized or large on crayfish <20. 2nd postorbital spine barely discernible or small on specimens >30 OCL, occasionally absent, small or medium sized on animals <20 OCL. Suborbital spine medium sized or medium-large. Lateral margin of antennal squame straight, rarely slightly concave, squame widest at about its midlength, slightly proximal to midlength on small specimens; marginal spines absent. Epistome (interantennal spine) medium width or broad, margins serrated. Antennal basipodite spine small or very small on large specimens, medium sized on some animals <20 OCL; coxopodite spine very small or small, slightly bifid or serrated.

ScL/OCL 0.16–0.24 d.

Thorax: Dorsal spines absent (one large specimen with 1 or 2 enlarged tubercles posterior to cervical spines). General tubercles medium sized on large specimens, very small or absent on crayfish <20 OCL; tubercles moderately spaced or moderately dense on large specimens, very sparse when present on very small crayfish. 2–4 cervical spines, small or medium sized (dorsal spine often larger than remainder) and moderately pointed.

ArL/OCL 0.32–0.35; ArW/OCL 0.16–0.20 d; CaW/OCL 0.55–0.59; CaD/OCL 0.48–0.52.

Abdomen: Small or very small D–L spine on somite 1 of crayfish >30 OCL, absent on specimens <20 OCL. D spine absent from somite 1 (2 large specimens with vague protuberance in D–L position). 3–6 Li spines per side on somite 2 of large crayfish, absent on specimens <20 OCL; Li spine usually on somites 3–5 of large specimens; Li spines sharp and medium sized or small anteriorly, decreasing to minute on posterior segments. Lii spines poorly developed, slight protuberances sometimes evident. D–L spines on somites 2 and 3 (vague on 4) of some large specimens; spines small or minute and blunt or very blunt. Minute D spine sometimes on somite 2, rarely on somite 3. Crayfish <20 OCL lacking abdominal spines. Dorsal boss absent.

AbdW/OCL ♂ 0.51–0.53, ♀ 0.52–0.55 i; OCL/L 0.35–0.41 i.

Tailfan: Telson usually with 1–5 minute dorsal spines on specimens >30 OCL, though spines sometimes barely discernible; specimens <20 OCL lacking spines. Uropod spines absent, telson and uropod margins uneven at setal bases. Standard spines small or medium sized on large

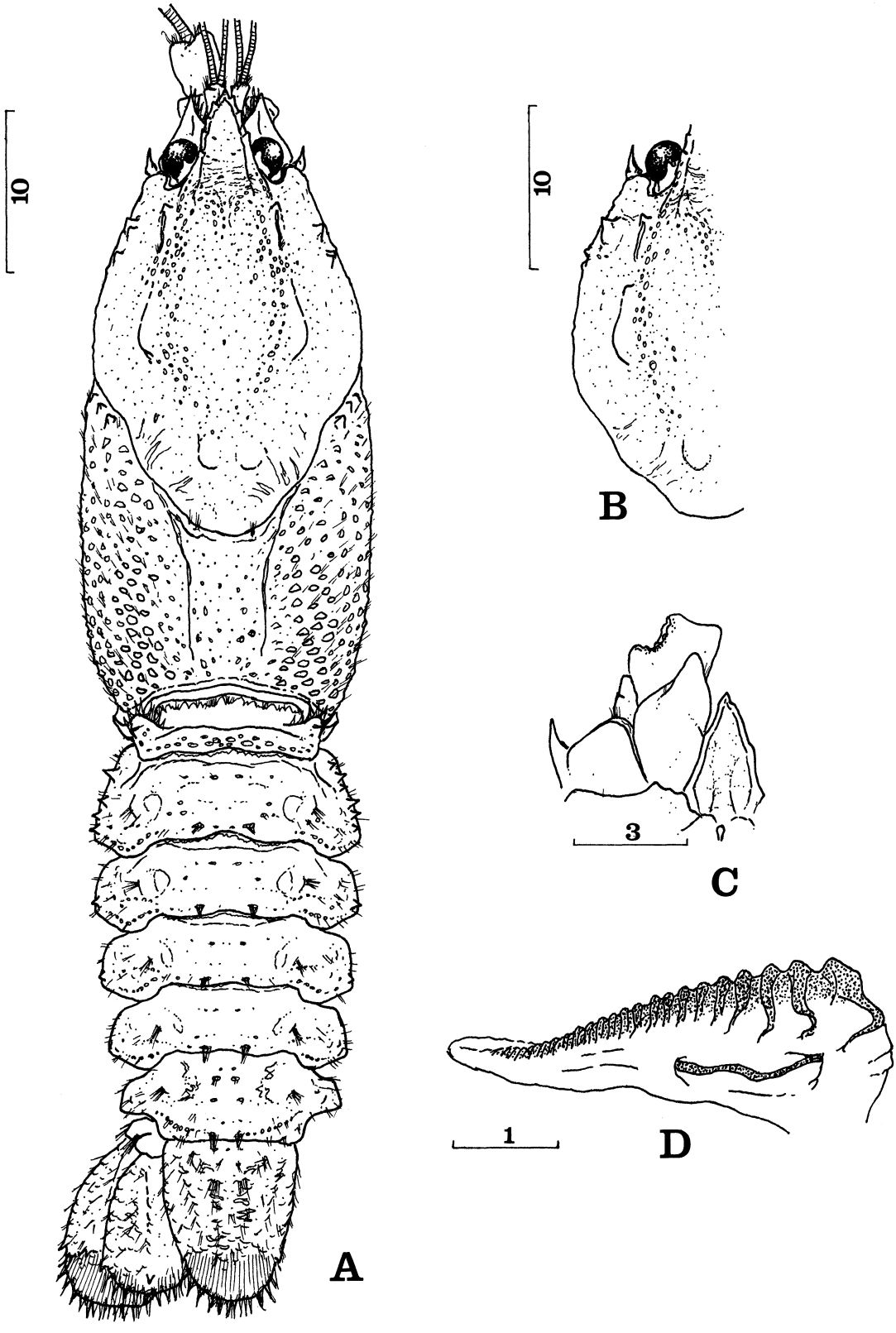

Fig. 13. *Euastacus clarkae* n.sp. A, dorsal view holotype male, Cockerawombeeba Creek, AM P34051; B, cephalon, larger spine ventral to postorbital ridges, second postorbital ridge with distinct edge, paratype female, Cockerawombeeba Creek, AM P34050; C, ventral view cephalon, holotype male, AM P34051; D, ventral view zygocardiac ossicle, holotype male, AM P34051.

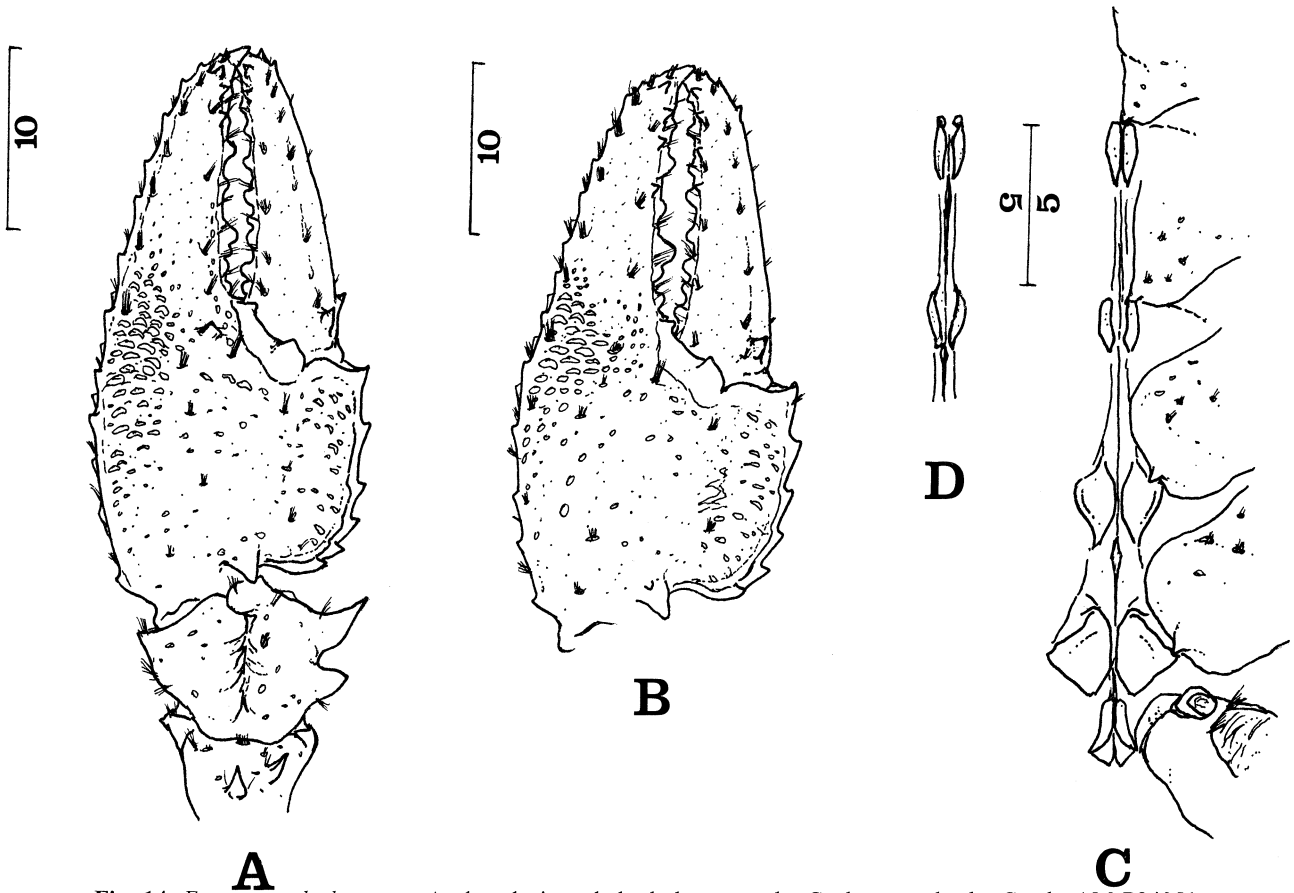

Fig. 14. *Euastacus clarkae* n.sp. A, dorsal view chela, holotype male, Cockerawombeeba Creek, AM P34051; B, chela, marginal mesial dactylar basal spine absent, more numerous spines above cutting edges, spine lateral to dactylar base absent, paratype male, Cockerawombeeba Creek, AM P34050; C, sternal keel, holotype male, AM P34051; D, keel processes 1 and 2, paratype male, AM P34050.

specimens, large on some small animals.

TeL/OCL 0.35–0.44 d.

Chelae: Chelae intermediate in shape to elongate. Teeth moderately to well developed on specimens >30 OCL.

Propodus: Ventrolateral spine row reaching or almost reaching apex of finger; lateral spines medium sized or small and sharp. Lateral spine ridge present, small on small specimens. 5–7 (usually 6) mesial propodal spines. 1 dorsal apical spine on specimens >30 OCL, absent on crayfish <20 OCL. Large specimens with 2 or 3 spines above cutting edge, usually apical (to midlength of gape on one specimen); spines small or medium sized; 0 or 1 apical spine on specimens <20 OCL. 1 medium sized or small spine and low protuberances on dorsal propodal surface lateral to dactylar base; ventrally, 1–3 medium sized or small, moderately sharp spines lateral to dactylar base. Spines absent posterior to dactylar articulation. Precarpal spines absent.

PropL/OCL ♂ 0.86–0.95 i, ♀ 0.87–0.89; PropW/PropL 0.40–0.47; PropD/PropL 0.28–0.30.

Dactylus: 2–4 medium sized spines above cutting edge of specimens >30 OCL, apical or to midlength of gape; usually 1 or 2 small apical spines on smaller specimens, absent on one small animal. Extra dorsal dactylar spines absent. Dorsomedial basal spine present (except on one very small specimen); marginal basal spines usually absent, present on 2 specimens; basal spines medium sized or large, usually sharp. 2 or 3 mesial apical spines. Dactylar groove present but often shallow.

DactL/PropL 0.54–0.57.

Carpus: 2 mesial carpal spines, 1st (distal) larger than and slightly offset ventrally to 2nd; sometimes small protuberances proximal to 2nd spine (one very small animal with 3rd spine split from base of 2nd). 2 (rarely 1) medium sized or large lateral carpal spines. Articulation spine usually absent, small or medium sized on some small specimens. Dorsal spines absent. Ventral spine large or very large; 2 or 3 ventromesial spines, largest medium-small or small.

Merus: 6–9 large or medium sized dorsal spines, distal 2 distinctly larger on some small crayfish. Outer spine small or medium sized.

Keel: *Pr1*: Posterior margins sloped or semi-abrupt; ventral edges flat or angled down; orientation close

or slightly apart and parallel (open on one small specimen). Keel after Pr1 lacking spines, slight protuberance sometimes present.

Pr2: Open or almost parallel. Keel after Pr2 like that after Pr1.

Pr3: Scoops absent or very gradual; bases moderately sharp. Keel after Pr3 low, often concave.

Pr4: Slight or absent scoops; anterior edges moderately curved to angular; posterior edges straight or slightly convex and moderately curved or sharp.

Pr3 and 4 narrow on specimens >30 OCL, broad and sharp on some specimens <20 OCL.

Setation: Moderate.

Punctation: Moderate to dense.

Gastric mill: TAP count 7.0–8.0; TAA count 0.5–1.5 (usually 1.0); spread 5.5–7.5 (variation due to length of ear). Teeth rather small and close; ear reasonably long and frequently notched. Urocardiac ridges 9–10.

Coloration: Body dorsally deep green-brown, paler ventrolaterally. Patch of blue ventrolaterally on cephalon. General tubercles slightly darker dorsally, paler brown ventrolaterally. Rostral spines pale orange. Carpus of cheliped deep green-brown, spine tipped in orange. Propodus rusty brown or green-brown with darker green mottling, mesial edge with orange spines. Fingers olive-brown, tips slightly paler.

Body ventrally orange and green. Carpus mesially dark green or green-blue, laterally orange. Propodus orange, darker medially, mesial edge green or green-blue. Fingers olive green.

Sexes: Males with a rather thin cuticle partition. All females have closed gonopores, hence it appears that they mature at >33.0 OCL.

Distribution and biology. The species has been collected only from two tributaries of Cockerawombeeba Creek in Mount Boss State Forest near Mount Werrikimbe, approximately 45 km south-west of Kempsey. The streams drain into the Forbes, and thence the Hastings Rivers. Streams were cool and well shaded, at above 670 m, with rainforest along the banks and dry sclerophyll on exposed ridges. Water flow was fast in September, 1981.

At the 670 m site, *E. clarkae* was sympatric with *E. spinifer* but at the slightly higher type locality only *E. clarkae* was found.

Etymology. Named in respect of Ellen Clark's pioneering parastacid studies.

Remarks. The species has been collected from two nearby sites and geographical variation is not evident. *Euastacus clarkae* most closely resembles *E. simplex* Riek. The two species can be distinguished on the basis of differences in size of the suborbital spine, numbers of mesial propodal and dorsal apical propodal spines and the gastric mill TAP count. The two species also show some differences in habitat with *E. clarkae* preferring well vegetated, rainforest lined streams and *E. simplex* occurring in rather open eucalypt or cleared terrain.

Euastacus claytoni Riek

Figs 15, 16

Euastacus claytoni Riek, 1969: 909, 910, fig. 16D (in part, MacLaughlin River, NSW as a locality).

Type material. HOLOTYPE ♂, OCL 46.9 mm, AM P15728, NSW MacLaughlin River near Nimmitabel, 30 Dec. 1965, E.F. Riek; ALLOTYPE ♀, OCL 49.8 mm, type locality, AM P15729; PARATYPES: Type locality, AM P15311, 5 ♂♂, 8 ♀♀.

Other material examined. NSW MacLaughlin River at Nimmitabel-Bombala road bridge, 7 Mar. 1966, J.C. Yaldwyn & F.J. Beeman, AM P15548, ♀; "Sautelle", Bendock River between Craigie and Victorian border, 2 miles from border, 5 Mar. 1966, J.C. Baldwyn & F.J. Beeman, AM P15542, 3 ♂♂, ♀; Tuross River above Falls at Countegany, 17 Dec. 1953, E.F. Riek, AM P15532, ♂; Big Badja River, tributary Murrumbidgee River, on back road from Boggy Plain to Snowball, Cooma area, 1 Mar. 1966, J.C. Yaldwyn and F.J. Beeman, AM P15543, ♂, AM P34096, ♀; Tributaries Sawmill Creek, Tallaganda State Forest on Lowden Forest Road, north-east of Captains Flat, (35°31'S 149°35'E), 27 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34049, 4 ♂♂, 2 ♀♀; Lowden Creek, near Lowden Forest Park, (35°30'S 149°36'E), 27 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34048, 2 M.

Diagnosis. Male cuticle partition absent. Rostral spines apical, or rarely distributed to midlength of carinae. Rostral base divergent, carinae medium length. Antennal squame widest at midlength. Squamal spines absent. Suborbital spine small or medium sized. Thoracic spines medium sized, sometimes large, moderately pointed or blunt. General tubercles medium sized or small and densely or moderately distributed. 3–8 large or medium sized Li spines on abdominal somite 2. Very small D spine on large specimens. Abdominal boss poorly developed. Telsonic spines usually absent, rarely minute. Uropods lacking marginal spines. Ventrolateral propodal spine row well developed, sometimes approaching apex of finger. 1 dorsal apical propodal spine. Spines above cutting edges of chela apical on propodus; apical, to midlength or full length of gape on dactylus. 5 or 6 mesial propodal spines. 1 dorsomesial dactylar basal spine. 1 or 2 marginal mesial dactylar basal spines. 2 or 3 apical mesial dactylar spines. 3 (rarely 4) mesial carpal spines. Ventromesial carpal spines often as large as or larger than ventral spine. Keel Pr1 sloped or semi-abrupt and close and usually parallel. TAP count 3.5–7.0.

Description. Maximum OCL: 58.5 mm.

Rostrum: Rostrum short, reaching to base or proximal to midlength of 3rd antennal segment (one specimen to slightly distal of midlength). Rostral sides convergent

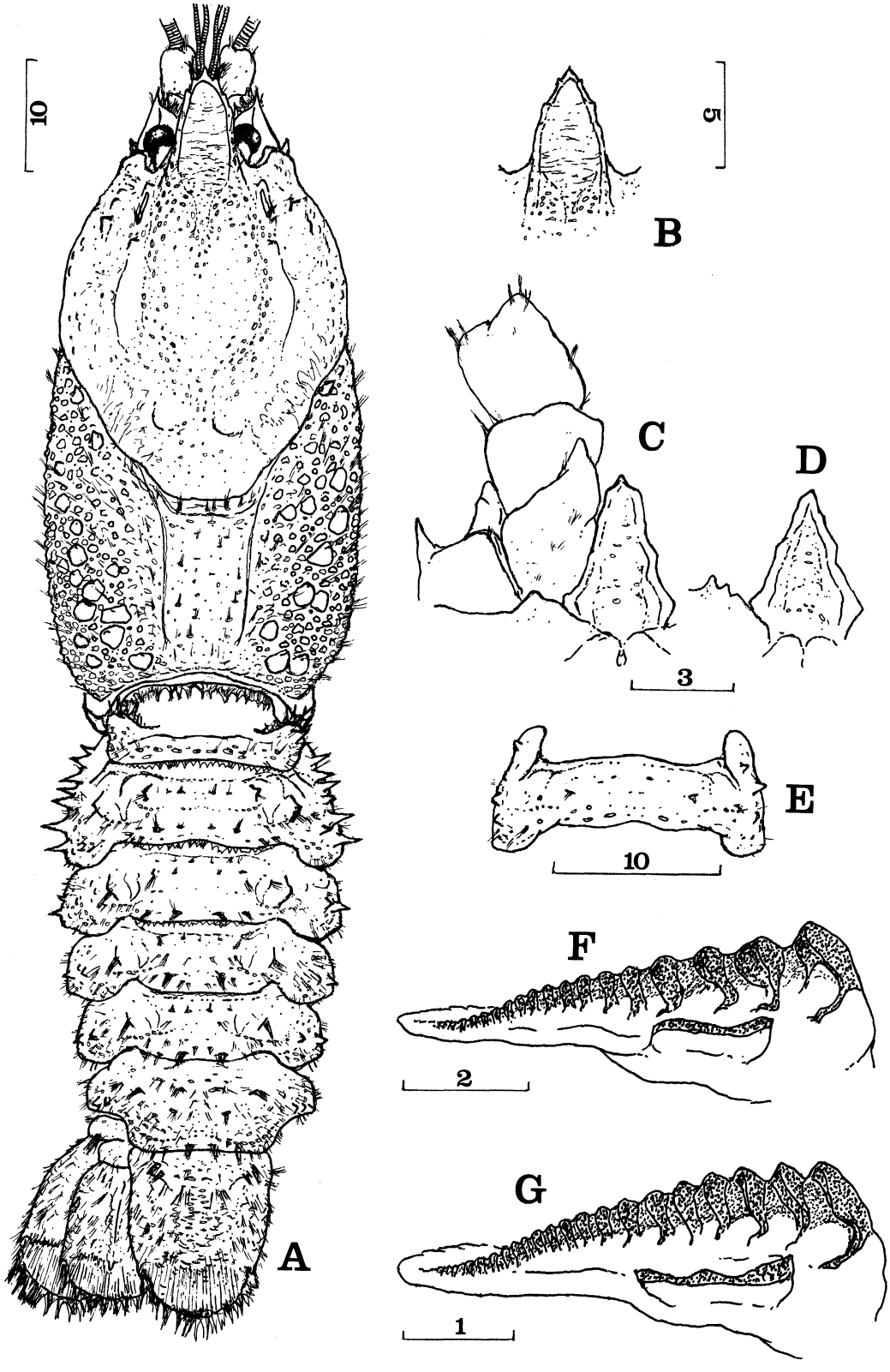

Fig. 15. *Euastacus claytoni* Riek. A, dorsal view, holotype male, MacLaughlin River, AM P15728; B, rostrum, female, Sawmill Creek, AM P34049; C, ventral view cephalon, holotype male, AM P15728; D, epistome and trifid coxopodite spine, allotype female, MacLaughlin River, AM P15729; E, abdominal somite 2, male, Sawmill Creek, AM P34049; F, ventral view, zygocardiac ossicle, paratype female, MacLaughlin River, AM P15311; G, zygocardiac ossicle, male, Big Badja River, AM P11543.

or parallel, usually slightly convergent. Base divergent, carinae of medium length and only slightly spread. 1–4 (usually 2 or 3) rostral spines per side, usually apical or to proximal of midlength of carinae, rarely to midlength; spines small or medium sized and moderately pointed or rounded. Acumen spine similarly sized to, or slightly larger than, marginal spines.

OCL/CL 0.82–0.87 i; RW/OCL 0.15–0.23 d.

Cephalon: Spination poor or moderate with 1–4 medium sized or small spines ventral to postorbital ridges. 1st postorbital spine merely an edge on specimens >30 OCL, small on many smaller animals; 2nd postorbital spine barely discernible, or sometimes absent on one or both sides especially on northern Tallaganda specimens. Suborbital spine small or medium sized. Lateral margin of antennal squame slightly concave, straight or convex; squame widest at or slightly proximal to midlength and lacking marginal spines. Epistome of medium width or moderately elongate on specimens >40 OCL, broader on smaller specimens, very broad on some crayfish <30 OCL; margin almost smooth, scalloped or slightly toothed. Antennal basipodite spine usually very small or small, sometimes absent, medium sized on some specimens <30 OCL. Coxopodite spine small and weakly bifid or serrated.

ScL/OCL 0.13–0.20 d.

Thorax: 7–30 thoracic spines per side, in zone or 2 irregular rows; spines large or medium sized and moderately pointed or blunt on specimens >30 OCL, medium sized or small and rounded or flat on lesser crayfish. General tubercles medium sized on crayfish >30 OCL, small on lesser individuals, barely discernible on specimens <20 OCL; tubercles dense to moderately distributed on most specimens >20 OCL, sparse on smaller crayfish. 1–5 (usually 2–4) cervical spines, these medium sized on specimens >30 OCL, small on lesser crayfish; dorsal spine usually larger than remainder and moderately pointed or sharp, remainder rather blunt.

ArL/OCL 0.32–0.37; ArW/OCL 0.15–0.19 d; CaW/OCL 0.53–0.60; CaD/OCL 0.49–0.57.

Abdomen: Sometimes 1 (rarely 2) D–L spine on somite 1 of specimens >30 OCL, spine medium sized or small and sharp or very sharp. D spine on somite 1 sometimes small or minute and moderately sharp or blunt, but absent on many specimens. 3–8 Li spines per side on somite 2 of specimens >20 OCL, number increasing with OCL; subsequent somites usually with single Li spine. Li spines decreasing in size to posterior somites from large to medium sized or small on crayfish >40 OCL, medium sized to minute on animals 30–40 OCL, small or minute on most specimens 20–30 OCL; spines very sharp or sharp on specimens >30 OCL, sharp to blunt (if present) on smaller specimens. Lii spines medium sized to minute, numbering 1–5 on somites 2–6 of most specimens >30 OCL, usually less numerous and smaller on smaller specimens; spines sometimes sharp, usually moderately pointed or blunt. D–L spine usually on somites 2–5, occasionally 6, of specimens >30 OCL; spine medium sized (rarely large) to minute and very sharp to blunt, decreasing in size and sharpness to posterior somites. On specimens 20–30 OCL, minute, very blunt D–L spine sometimes present. Small or minute D spine usually on somites 2 and 3 (rarely 4 and 5) of specimens >40 OCL; smaller specimens rarely with minute spine on somite 2 and 3; spines moderately pointed to very blunt. Specimens <20 OCL lacking all abdominal spines. Some specimens >40 OCL with slightly raised dorsal abdominal boss.

AbdW/OCL ♂ 0.48–0.55 i, ♀ 0.48–0.63 i; OCL/L 0.38–0.43 i.

Tailfan: Telsonic and uropod spines usually absent (2 large specimens with 2 minute telsonic surface spines); margins of telson and uropods irregular. Standard spines small, occasionally medium sized on small specimens, large in population near Countegany.

TeL/OCL ♂ 0.31–0.43 d, ♀ 0.32–0.44 di.

Chelae: Chelae usually stout or very stout, some northern Tallaganda specimens with slightly more elongate chelae. Teeth well developed on most specimens >30 OCL.

Propodus: Ventrolateral spine row well developed, sometimes approaching apex and hence 2 row condition; lateral spines medium sized to small and rather sharp. Lateral spine ridge present, small on specimens <30 OCL. 5 or 6 mesial propodal spines (rarely 7 on regenerate chelae). Most specimens >30 OCL with 1 dorsal apical spine, absent on smaller specimens. 1 or 2 spines above cutting edge on specimens >30 OCL, 0 or 1 on smaller specimens; spines apical and medium sized on specimens >40 OCL, medium sized or small on lesser crayfish. 1–4 medium sized or small spines on dorsal surface of propodus lateral to dactylar base, or spines absent and lateral protuberances present; ventrally, usually 1 or 2 (rarely 3) spines, medium sized to large on specimens >30 OCL, small to medium on lesser animals. Some small crayfish lacking dorsal and ventral spines. Low ridge or protuberance posterior to dactylus. Sometimes 1 or 2 small precarpal spines.

PropL/OCL 0.73–0.83 i; PropW/PropL (0.41) 0.45–0.53; PropD/PropL 0.29–0.34.

Dactylus: 1–5 medium sized or small spines above cutting edge, proximal spine usually largest; spines either apical or, for higher counts, extending full gape. Extra dorsal dactylar spines absent. 1 dorsomesial dactylar spine and 1 or 2 marginal basal spines (one specimen <20 OCL lacking marginal spine); basal spines large or medium sized and sharp. 2 or 3 apical dactylar spines, occasionally 1 on regenerate chelae or very small specimens. Dactylar groove present but shallow on some large specimens.

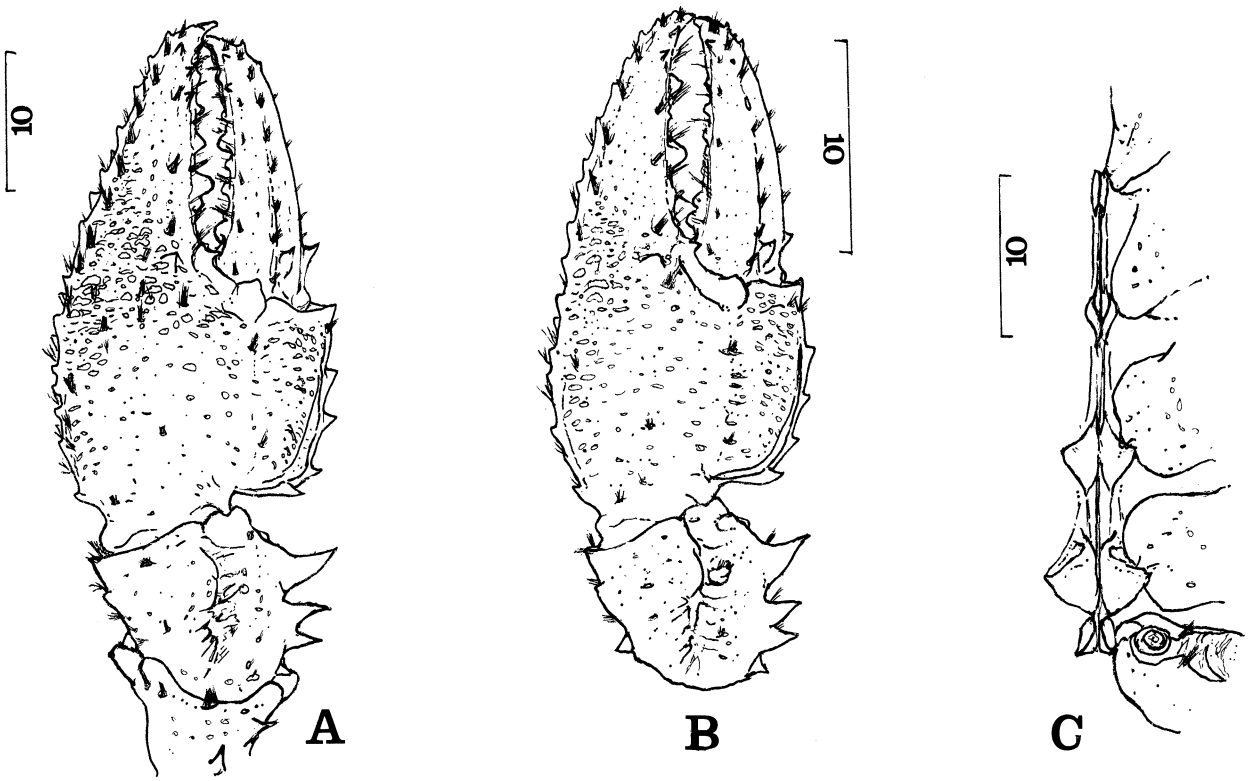

Fig. 16. *Euastacus claytoni* Riek. A, dorsal view chela, holotype male, MacLaughlin River, AM P15728; B, chela, dorsal carpal spines present, apical propodal spine absent, male, Sawmill Creek, AM P34049; C, sternal keel, holotype male, AM P15728.

DactL/PropL 0.52–0.62.

Carpus: Usually 3 mesial carpal spines (2 specimens with 4 on one chela, one specimen with 4 on both possibly regenerate carpi); 1st (distal) spine at same level as or slightly offset ventrally to remainder, 2nd and 3rd spines closer than 1st and 2nd and commonly contiguous. 2 medium sized or large lateral carpal spines. Articulation spine absent, or minute on some specimens <30 OCL. 1 or 2 small dorsal spines or protuberances, or spines absent. Ventral carpal spine very large or large. 3–5 ventromesial spines, largest medium sized to large or very large, northern specimens frequently with ventromesial spine similar to or larger than ventral spine.

Merus: 6–9 dorsal spines, large or medium sized in south, often smaller in north. Outer meral spine absent or minute on specimens >30 OCL, small on some lesser individuals.

Keel: *Pr1*: Posterior margins sloped or semi-abrupt; ventral edges usually angled down, sometimes rounded or flat; processes close (or slightly apart on some specimens <30 OCL) and usually parallel, rarely open or closed. Keel after Pr1 devoid of spines.

Pr2: Open or almost parallel, frequently steeply pronounced from keel. Keel after Pr2 low, usually without spines (one specimen with small spine).

Pr3: Scoops absent or very gradual, bases sharp to moderately rounded. Keel after Pr3 moderately raised on large specimens, more so on small animals; one specimen with distinct spine.

Pr4: Scoops absent or slight; posterior edges sharp or moderately sharp and slightly convex or irregular; anterior edges angular or very angular.

Pr 3 and 4 definitely narrow on specimens >30 OCL, approaching broad on some specimens 20–30 OCL, broad on specimens <20 OCL.

Setation: Moderately heavy on types, peripheral populations (both north and south) less, sometimes lightly, setose.

Punctation: Dense.

Gastric mill: TAP count 3.5–7.0; TAA count 1.0–2.0; spread 2.0–5.5. Differences due to variation in ear and tooth size. Urocardiac ridges 6–10 (usually increasing with size).

Coloration: Body dorsally medium brown with some darker patches grading to pale orange ventrolaterally. Dorsal spines sometimes slightly darker, more obvious on larger specimens; general tubercles lighter. Cheliped articulations red. Carpus of cheliped red-brown with dark green mottling, mesial spines blue green with yellow tips. Propodus red-brown with darker mottling mesially, mesial edge dark green with yellow spines.

Fingers pale yellow with faint green-blue tinge, especially near base; dactylus can be deep blue-green mesially.

Body ventrally pale brown grading to blue distally on legs. Carpus of cheliped dark blue-green mesially, pale orange-cream laterally. Propodus as per carpus; larger spines orange. Fingers cream, sometimes with slight pink tinge.

Sexes: Males lack a cuticle partition. All females <40 OCL (except one very close to 40 OCL) have closed gonopores. Most specimens 40–50 OCL and the one female >50 OCL are mature. Hence, female maturity usually occurs at or slightly above a size of 40 OCL.

Distribution and biology. The species is distributed from the Craigie area, near the New South Wales and Victorian border, north through the Nimmitabel type localities to the vicinity of Captains Flat, a distance of 160 km along the Great Divide. The range is drained by tributaries of the Snowy, Tuross Murrumbidgee and Shoalhaven Rivers.

Riek (1969) did not describe the type locality of *E. claytoni* but the MacLaughlin River near Nimmitabel is narrow with deep (>2 m) pools and shallow rocky stretches, with grass and some sclerophyll forest along the banks. Much of the area has been cleared and no specimens were found there in 1981. Elsewhere the species was collected from streams in mainly granite country with poor temperate rainforest and tree ferns along the banks, dry sclerophyll on ridges. Specimens were collected at elevations over 800 m. Crayfish holes were very common along streams in the area, including several flowing through *Pinus radiata* plantations.

Riek (1969) recorded in some detail the burrow of *E. claytoni*. Two or more surface holes, sometimes plugged with mud, lead to the burrow network, with a central chamber. A burrow extends to the water table. Similar burrows have been observed for other species and this pattern may be typical for *Euastacus*, at least in relatively soft stream banks.

Euastacus claytoni can be sympatric with *E. yanga* n.sp. The Monaro separates *E. claytoni* from *E. crassus* Riek and *E. rieki* n.sp.

Remarks. *Euastacus claytoni* was described by Riek (1969: 909, 910) as possessing an "abdomen with only a marginal row of spines". This description is inaccurate since sharp D–L spines and, frequently, Lii spines are also present. The branchiostegite "enlarged bosses" are frequently sharp spines on large specimens. The specimens Riek regarded as *E. claytoni* from south-east coastal New South Wales are *E. yanga* and Riek's Cambewarra Creek specimens are *E. hirsutus* (McCulloch).

The species has a long, thin range along the Great Divide, yet geographical variation, while present, does not conform to a north-south gradient. Type specimens are more hirsute than most other specimens but no character hiati are evident in external characters. Gastric mills, however, display notable variation. There appears to be an hiatus in mill counts in the Countegany area, north-east of Cooma. Populations from Countegany to Captains Flat show TAP counts of 5.5–7.0 and TAA counts of 1.0–1.5. Populations south of Countegany have TAP counts of 3.5–4.5 and TAA counts of 1.5–2.0. Differences in counts are due to variation in both zygocardiac ear length and tooth size. There is some geographical variation in external proportions. Types specimens have a longer thorax than do most specimens from areas to the north (e.g., Tuross River) and slightly longer than specimens to the south (e.g., Craigie area), yet are similar to far northern Tallaganda animals. Areola width is greater on northern and southern specimens than on the types and decreases relatively with growth.

Euastacus crassus, E. rieki and *E. claytoni* inhabit mid south-eastern New South Wales and some north-eastern areas of Victoria. The species lack a male cuticle partition, are closely allopatric (possibly parapatric) and are probably closely related phylogenetically. *Euastacus claytoni* is distinguished from *E. crassus* and *E. rieki* by its thin rostral carinae of medium length basally, the contiguous 2nd and 3rd mesial carpal spines and generally larger thoracic spines. Gastric mill counts separate *E. claytoni* from *E. rieki*. Mill counts for northern specimens of *E. claytoni* overlap with those of some Victorian specimens of *E. crassus* discussed in the Remarks section for that species.

Euastacus crassus and *E. rieki* are distinguished on the basis of several external characters but primarily on differences in gastric mill counts. Populations of *E. claytoni* with differing mill counts are not assigned specific status. This was decided on the basis of a lesser difference in tooth counts between the populations, greater variation in counts within the populations (unlike the near constancy of *E. rieki*) and variation in external characters that do not coincide with the gastric mill differences. Additionally, there is no obvious difference in habitat between the populations, though southern areas of the range of *E. claytoni* have been more extensively cleared for agriculture.

The three species differ somewhat in habitat, with *E. rieki* at the highest altitudes, and *E. claytoni*, the lowest. *Euastacus rieki* and *E. crassus* are nearly parapatric; *E. claytoni* is separated by relatively flat, now largely cleared pastoral land.

Euastacus crassus Riek

Figs 17, 18

Astacopsis serratus.–Smith, 1912: 149, 160 (in part, Victorian Highlands as a locality). (Not *Cancer serratus* Shaw, 1794).

Euastacus nobilis crassus Riek, 1951: 383, 384.

Euastacus crassus Riek, 1969: 896 (in part, Australian Capital Territory as a locality).

Type material. HOLOTYPE ♂, OCL 50.8 mm, AM P11937. ACT Small stream at Bendora, 12 Mar. 1949, E.F. Riek. ALLOTYPE ♀, OCL 52.9 mm, type locality, AM P11938. PARATYPES: Type locality, AM P11939–40, 5 ♂♂, 7 ♀♀, ♂♂/♀♀.

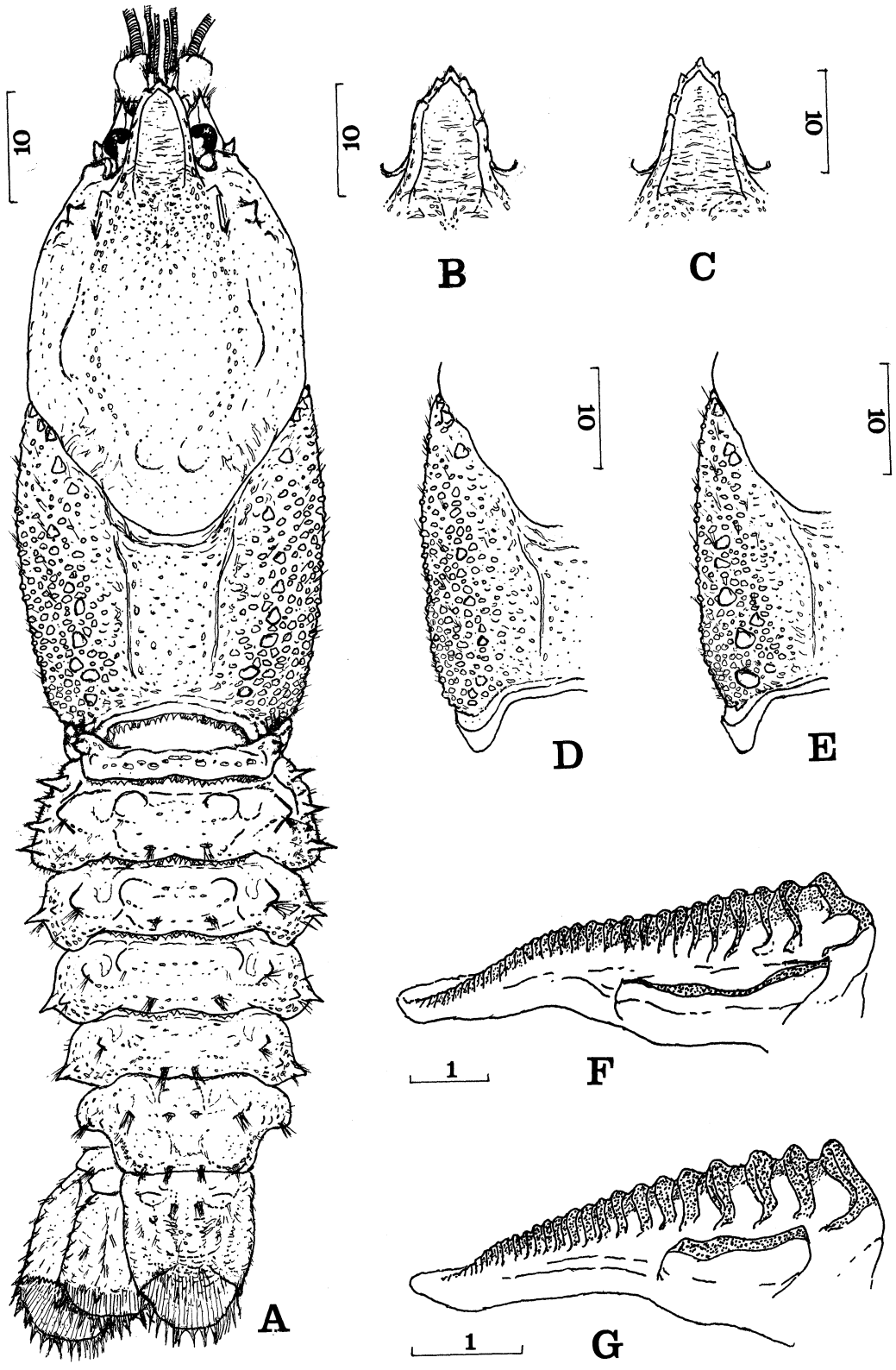

Fig. 17. *Euastacus crassus* Riek. A, dorsal view, holotype male, Bendora, AM P11937; B, rostrum, female, Blundells, AM P11941; C, rostrum, female, Geehi, AM P34045; D, thorax, small thoracic spines, paratype male, Bendora, AM P11939; E, thorax, larger thoracic spines, male, Blundells, AM P11941; F, ventral view zygocardiac ossicle, holotype male, AM P11937 (Francois collection); G, zygocardiac ossicle, female, Mt Hotham, NMV.

Other material examined. NSW and ACT Blundells, Condor Creek, ACT, 6 Apr. 1948, E.F. Riek, AM P11941, ♂, 3 ♀♀; 1 mile past Bendora shelter on Mount Franklin Road, 20 miles south-west of Canberra, ACT, 18 Sept. 1958, D. Francois, E.F. Riek & R. Klay, AM P15476, 10 specimens; Tributary Collins Creek, south of Bendora Hut, ACT, (35°27'S 148°47'E), 25 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34044, ♂, ♀; Tributary Condors Creek, ACT, 26 Apr. 1982, P. Horwitz, AM P34046, ♂; Tidbinbilla National Park, ACT, 5 May 1982, P. Horwitz, AM P34047, ♂, ♀; Tributary Murray River on Alpine Way, 13 km south of Geehi, (36°26'S 148°10'E), 6 Oct. 1981, G.J.Morgan & S.J. Harders, AM P34045, ♀.

VICTORIA. Mount Hotham, 4000 ft, 1 Dec. 1962, A. Martin, ♀; Bogong High Plains, M.L. and R.F. (?), ♂; Stony Creek, Benambra-Corryong Road, 20 km north of Benambra, 29 Oct. 1982, P. Horwitz & G. Edgar, ♂; Tributary Sassafras Creek, 50 km north of Benambra, 19 Oct. 1982, P. Horwitz & G. Edgar, ♀; Springs Creek on Falls Creek Road, 12 km south-east of Mount Beauty, 1 Nov. 1982, P. Horwitz & G. Edgar, ♀.

Diagnosis. Male cuticle partition absent. Rostral spines apical. Rostral base divergent or very divergent, carinae of medium length or short. Antennal squame widest at midlength. Squamal spines absent. Suborbital spine small or medium sized. Thoracic spines medium sized, small or barely discernible. General tubercles medium sized or small and densely or moderately distributed. 2–6 Li spines on abdominal somite 2. D spine small or obsolete. Abdominal boss poorly developed on specimens >40 OCL. Telsonic spines usually absent, sometimes several minute spines. Uropods lacking marginal spines. Ventrolateral propodal spine row well developed, sometimes reaching apex of finger (but then usually subapical gap in row). 1 (rarely 0 or 2) dorsal apical propodal spine on large specimens. Spines above cutting edges of chela apical or occasionally reaching midlength of gape. 5 mesial propodal spines. 1 (rarely 0 or 2) dorsomesial dactylar basal spine. 1 marginal mesial dactylar basal spine sometimes present. 2 (rarely 1 or 3) apical mesial dactylar spines. 3 mesial carpal spines. Ventromesial carpal spines usually smaller than, sometimes similar to, ventral spine. Keel Pr1 sloped or semi-abrupt and close and parallel. TAP count 5.5–11.0.

Description. Maximum OCL: 58.0 mm.

Rostrum: Rostrum short, not reaching midlength of 3rd antennal segment and often not reaching base of segment. Rostral sides slightly convergent or parallel; base divergent or very divergent and carinae of medium length or short, usually moderately or distinctly spread. Usually 2 or 3 rostral spines, not reaching midlength of carinae; most specimens from type locality (near Bendora) with only 1 apical spine. Rostral spines small and moderately pointed to rounded. Acumen spine similar to or slightly larger than marginal spines.

OCL/CL 0.83–0.88 i; RW/OCL 0.15–0.20 d.

Cephalon: Cephalic spination poor, with 1–3 small spines and several protuberances ventral to postorbital ridges. 1st postorbital spine an edge, 2nd spine absent or barely discernible, sometimes on one side only. Suborbital spine small, or rarely medium sized. Lateral margin of antennal squame usually straight or slightly concave, some populations (e.g., Condor Creek) with squamal margins convex; squame usually widest at or slightly distal to midlength, slightly proximal to midlength on Blundells population and specimens <20 OCL; marginal spines absent. Epistome of medium width or elongate on animals >40 OCL, broader on some smaller specimens; spine margin slightly or distinctly scalloped. Antennal basipodite spine small or very small on specimens >20 OCL, medium sized on crayfish <20 OCL. Coxopodite spine small or medium sized, usually serrated, occasionally bifid especially in Blundells population.

ScL/OCL 0.13–0.20 d.

Thorax: Thoracic spine size and number variable; usually 2–18 per side in zone or row, sometimes spines only just discernible but often with 1 or 2 small spines posterior to cervical spines; spines small to medium sized, moderately pointed to rounded. Spines often absent on specimens <20 OCL. General tubercles medium sized on specimens >40 OCL, medium sized and small on lesser individuals, very small on crayfish <20 OCL; tubercles dense on large animals, moderately distributed on specimens <40 OCL, sparse or very sparse on specimens <20 OCL. 2–5 medium sized or small cervical spines, dorsal spine frequently larger than rest, moderately pointed to blunt.

ArL/OCL 0.32–0.36; ArW/OCL 0.15–0.19; CaW/OCL 0.52–0.58; CaD/OCL 0.45–0.51.

Abdomen: Usually medium sized to minute, sharp or moderately pointed, D–L spine on somite 1 of specimens >30 OCL; spine occasionally absent. D spine usually absent from somite 1, some large specimens with vague protuberance or minute, blunt spine. Specimens <30 OCL lacking D–L and D spines on somite 1. Li spines numbering 3–5(6) per side on specimens >40 OCL, 2–4 on crayfish 20–40 OCL, absent on specimens <20 OCL; somites 3–5 of specimens >40 OCL and some smaller animals usually with single Li spine. Li spines on animals >40 OCL large to small and very sharp or sharp to blunt, decreasing in size and sharpness to posterior somites; spines large to minute and sharp to blunt (sometimes absent posteriorly) on specimens 30–40 OCL; crayfish <30 OCL with small or minute Li spines, often absent on posterior somites. D–L spine on somites 2–6 medium sized to minute and moderately pointed to very blunt on crayfish >30 OCL, decreasing to posterior somites where it may be absent; smaller animals with small, minute or no D–L spines. D spine on somites 2–4 small or minute and moderately pointed to very blunt on large specimens; somites 5 and 6 and crayfish <30 OCL usually lacking D spines. Crayfish <20 OCL lacking all abdominal spines. Low dorsal boss on specimens >40 OCL, obsolete or absent on most smaller crayfish.

AbdW/OCL ♂ 0.46–0.53, ♀ 0.48–0.60 di; OCL/L ♂ 0.40–0.45 i, ♀ 0.38–0.44 id.

Tailfan: Tailfan spines usually absent; some specimens >20 OCL with 2 or 3 small or minute telsonic spines.

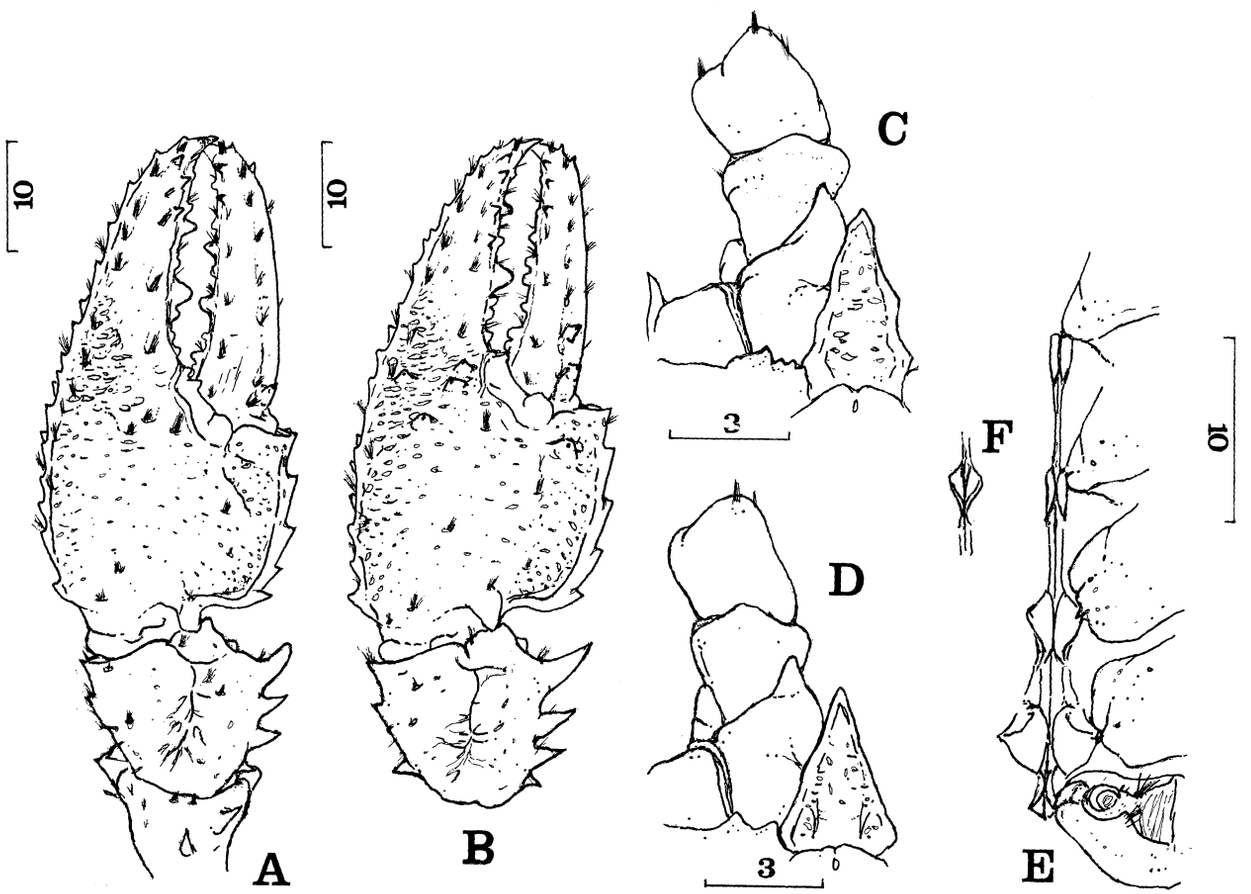

Fig. 18. *Euastacus crassus* Riek. A, dorsal view chela, holotype male, Bendora, AM P11937; B, chela, 2 mesial dactylar basal spines, spines lateral to dactylar base, spine posterior to dactylar articulation, female, Blundells, AM P11941; C, ventral view cephalon, holotype male, AM P11937; D, ventral view cephalon, bifid coxopodite spine, small basipodite spine, female, AM P11941; E, sternal keel, holotype male, AM P11937; F, keel processes 1, female, AM P11941.

Standard spines small or very small on crayfish >30 OCL, medium sized on some smaller specimens.

TeL/OCL ♂ 0.29–0.36 d, ♀ 0.30–0.40 di.

Chelae: Chelae moderately elongate to stout, elongate on some small specimens. Teeth well developed on specimens >50 OCL.

Propodus: Ventrolateral spine row well developed, sometimes reaching apex of finger; if 2 lateral rows, often subapical gap in ventral row and then 1 or 2 spines to apex; lateral spines medium sized or small and rather sharp. Lateral spine ridge present, sometimes obvious, usually very small on crayfish <20 OCL. Usually 5 mesial propodal spines (4 or 6 on some regenerate chelae). Usually 1 dorsal apical propodal spine on specimens >40 OCL, sometimes absent and occasionally 2 spines; absent on all specimens <30 OCL. 1–3 spines above cutting edge of specimens >30 OCL (one specimen lacking spines); spines apical, rarely extending to midlength of gape, and medium sized or large on large specimens, small on crayfish near 30 OCL; smaller specimens lacking spines above cutting edge. Usually 1–4 small or medium sized (rarely large) rather blunt spines on dorsal surface lateral to dactylar base with some low protuberances on lateral ridge; spines occasionally absent, particularly on small specimens. Ventrally, 1–3 small to large spines lateral to dactylar base except on very small specimens. Low ridge or protuberances posterior to dactylar articulation (one specimen with low spine on possibly regenerate chela). Precarpal spines usually absent, sometimes minute spines present especially on regenerate chelae.

PropL/OCL (0.68) 0.70–0.91 i; PropW/PropL 0.43–0.51; PropD/PropL 0.26–0.32.

Dactylus: 1–4 spines above cutting edge on specimens >30 OCL, spines often absent on specimens <30 OCL; spines apical or rarely reaching to midlength of gape and medium sized or small and usually sharp. Extra dorsal spines absent. Usually 1 dorsomesial dactylar basal spine, sometimes absent on normal chelae (and many regenerate); large specimens from Blundells with 2 dorsomesial spines. Marginal basal spine either present

or absent. Basal spines medium sized or large, small on the animals <20 OCL. Usually 2 apical dactylar spines; sometimes only 1 spine especially on small specimens, one large specimen with 3 apical spines on one chela. Dactylar groove present, usually shallow on large crayfish.

DactL/PropL 0.54–0.61.

Carpus: Usually 3 mesial carpal spines (3 specimens <40 OCL with 3(+1) on one chela and one specimen with 2 spines on one carpus); 1st (distal) spine larger than and slightly offset ventrally to remainder, 2nd larger than or similar to 3rd spine; spines approximately equally spaced. Lateral spines medium sized or large on specimens >30 OCL, frequently small on smaller specimens. Articulation spine absent or tiny. Dorsal carpal spines absent (except on regenerate chela of one specimen). Ventral carpal spine medium sized to very large. 2–5 ventromesial spines, largest small to large, occasionally similar to ventral spine.

Merus: Usually 5–8 dorsal spines, often fewer or more on regenerate chelae; spines medium sized to small. Outer meral spine absent or minute (small on some crayfish <30 OCL).

Keel: *Pr1*: Posterior margins sloped or semi-abrupt; ventral edges angled down; processes close (slightly apart on smallest crayfish) and parallel. Keel after Pr1 lacking spines.

Pr2: Almost parallel or occasionally open, frequently close. Keel after Pr2 lacking spines, though sometimes slightly pronounced after processes.

Pr3: Scoops absent or gradual, usually with moderately curved to rounded bases, sometimes sharp. Keel after Pr3 often recessed; smallest specimen with keel slightly pronounced.

Pr4: Scoops present or absent (variation between populations); posterior edges moderately curved to rounded (sharp on smallest specimen) and slightly convex, straight or irregular; anterior edges angular or moderately rounded.

Processes 3 and 4 narrow, approaching broad on specimens <30 OCL.

Setation: Moderate to light.

Punctation: Dense or very dense, cephalon moderately punctate on some large specimens.

Gastric mill: TAP count 5.5–11.0; TAA count 0–1.5; spread 4.5–10.5. Variation due primarily to differences in length of zygocardiac ear. Urocardiac ridges 7–12.

Coloration: Body dorsally deep brown sometimes with red tinges, paler ventrolaterally; orange patch on ventrolateral surface of cephalon. Cervical groove and thoracic spines and general tubercles pale orange. L abdominal spines pale orange. Articulations of chelipeds red. Carpus of cheliped very dark green-brown; lateral spines yellow, mesial spines tipped yellow. Propodus deep brown with faint paler mottling or ochre with dark green mottling; lateral and mesial spines yellow. Fingers tinged blue or blue-green, especially near tips.

Body ventrally orange and green. Carpus of cheliped mesially deep green-blue, laterally orange with green tinges; ventral spines yellow. Propodus orange with dark green mottling medially and mesially; mesial edge dark green (sometimes blue tinges). Fingers blue near tips, grading through green to orange at base.

Sexes: The male cuticle partition is absent. Some females approach maturity (very deep, flexible gonopores) in the 30–40 OCL range. Some females in the 40–50 OCL range have setae developing around the gonopores and hence are very close to maturity. All females >50 OCL have open gonopores. One female from near Tom Groggin, south-west of Kosciusko, in the 30–40 OCL range is mature and berried.

Distribution and biology. *Euastacus crassus* is present in the Australian Capital Territory, especially in the high country west of Canberra, west of the ACT (e.g., near Brindabella), west of the Snowy Mountains and into the eastern semi-alpine country of Victoria as far as the Mount Beauty-Mount Hotham region. The range extends from north-east to south-west approximately 210 km. Drainage is via the Murrumbidgee, Murray and Victorian Murray tributaries (e.g., Mitta Mitta, Kiewa and Ovens Rivers).

Euastacus crassus was collected in 1981 at only two sites, one in the Brindabella Range near the type locality (altitude 1220 m), the other rather lower (640 m) east of Tom Groggin, near the New South Wales-Victorian border. Both sites were in largely granite areas, with dry sclerophyll and heath the dominant vegetation. Ferns were abundant along the banks near the type locality. It appears that the species has a patchy distribution in the ACT, occurring in high streams with relatively undisturbed vegetation. Extensive state forests east of Tumut also support populations of *E. crassus*. The Victorian localities are high (above 1000 m) and may be snow covered in winter.

A berried female was collected in early November, 1981. Eggs were pale burgundy. The allotype and a large paratype are berried, indicating the presence at Bendora of ovigerous females in March 1949. These may represent a late brood soon to hatch, or, more likely, a recent clutch that will hatch in spring and summer after overwintering.

The higher country of the Snowy Mountains and areas north to near Yarrangobilly support the very similar species, *E. rieki*. The precise partitioning of the two species is uncertain.

Remarks. *Euastacus crassus* as described by Riek (1951, 1969) included specimens of *E. rieki* and *E. woiwuru* of Victoria. Additionally, *E. hirsutus* from near Wollongong, *E. australasiensis* from Bathurst and *E. claytoni* from near Countegany have been identified in museum collections as *E. crassus*.

Euastacus crassus is a moderately variable species but external morphology does not display strong clinal trends.

Gastric mill variation is rather more obvious and a

general decrease in TAP counts appears to follow a north-south gradient. TAP counts in specimens from the type locality range from 8.5–11.0, TAA counts from 0–1.5 and spreads from 8.0–10.5. East of Bendora, TAP counts are slightly lower, ranging from 7.0–10.5, TAA counts vary from 0–1.0 and spreads from 6.5–9.0. Specimens from other sites are few but one from Brindabella west of the ACT has a TAP count of 7.5, TAA of 1.0 and spread of 6.5 and one from south-east of Mount Kosciusko, has a TAP of 7.5–8.0, TAA of 1.0–1.5 and spread of 6.0. Variation is largely due to differences in the length of the zygocardiac ear. Urocardiac ridges are similarly numerous in the type area, ranging from 9–14; elsewhere ridges number 8–12.

Specimens from the Bogong High Plains area of Victoria appear to be *E. crassus*. Their mill counts are lower than those described above with TAP counts of 5.5–6.5, TAA counts of 1.0–1.5 and spreads of 4.5–5.0. Urocardiac ridges number 7–8. Until further collection indicates otherwise, the gastric mills are considered to continue the north-south decline in tooth counts. This conclusion is supported by the presence on one zygocardiac ossicle of the Bogong specimen of a secondary ear posterior to the major ear, effectively lengthening it by one tooth to a TAP of 7.5 and hence converging on more northern *E. crassus* counts.

Euastacus crassus and *E. rieki* are very similar. Some external differences adequately distinguish virtually all specimens. *Euastacus crassus* usually has 2 apical dactylar spines, *E. rieki* usually only one, and the ArL:OCL ratio of *E. crassus* is consistently lower than that of *E. rieki* i.e. the thorax is shorter. In the area north-west of Adaminaby, where the two species are close to parapatric, some convergence of characters is evident. Some specimens of *E. rieki* from near Kiandra and Yarrangobilly bear 2 apical dactylar spines while a specimen of *E. crassus* from near Brindabella has only a single spine. The specimen of *E. rieki* from Mount Gingera has a shorter thorax than the southern animals.

The species can be distinguished readily by gastric mill differences. The tooth counts of *E. crassus* are variable but very distinct from the near constant count of *E. rieki*. The absence of intermediate counts supports the recognition of two species. Francois (1962) recognised the gastric mill differences and proposed a separate species for the Kosciusko specimens. This material is included in the species described here as *E. rieki* n.sp. Francois' conclusions on the relationships of *E. crassus* and *E. rieki* are regarded here as doubtful however. Francois accorded gastric mill characters a major importance in the determination of *Euastacus* phylogenies. He regarded the similarity of *E. crassus* and *E. rieki* to be attributable to extreme convergence and that the species are not closely related. This argument is dependent upon the assumption that gastric mills are more constant and conservative than external characters, a contention not supported by the present study. *Euastacus rieki* displays a constant mill count but *E. crassus* is certainly variable. The presence or absence of a male cuticle partition is a constant character for all species and is regarded here as a better indicator of *Euastacus* phylogenies. *Euastacus rieki* and *E. crassus* lack a cuticle partition and, with their strong external similarity, are regarded as close relatives.

The difference in gastric mills remains to be explained. The populations of Kosciusko high country crayfish may be relatively isolated by their adaptation to extremely low water and air temperatures. *Euastacus rieki* is commonly collected from streams off melting snow. It is possible that the larger gastric teeth may have some adaptive value in the feeding strategy of this highland species. Very little is known of the feeding preferences of *Euastacus* species and stomach contents of specimens of *E. rieki* indicate nothing to dispute a primarily detritophagous diet, typical of the genus. It is also possible that the gastric mill counts are subject to genetic drift and not necessarily directly affected by environment.

Euastacus dangadi n.sp.

Figs 19, 20

Euastacus valentulus.–Riek, 1969: 896 (in part, Lowanna, Dorrigo Plateau, NSW as a locality).

Type material. HOLOTYPE ♂, OCL 42.8 mm, AM P34078. NSW Stockyard Creek, downstream of Cedar Park in Ingalba State Forest, north of Kempsey, (30°53'S 152°48'E), 17 Sept. 1981, G.J. Morgan & S.J. Harders. PARATYPES: NSW Tributary of Bellingen River near Richardsons Crossing near Orama south of Dorrigo, (30°26'S 152°40'E), 15 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34077, 4 ♂♂, 3 ♀♀.

Other material examined. NSW Creek 3 miles north of Glenreagh, 7 Mar. 1959, D.D. Francois & J. Evans, AM P15462, ♀; Headwaters of Little Nymboida River at Lowana, Dorrigo Plateau, Jun. 1949, E.F. Riek, AM P11947, ♀; Tributary of Bellingen River, G.J. Morgan & S.J. Harders, AM P34076, ♂; Tributary of Orara River, Bucca State Forest, (30°13'S 153°02'E), 9 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34075, 2 ♂♂, 2 ♀♀; Apple Tree Creek, Mistake State Forest north of Taylors Arm, (30°44'S 152°41'E), 16 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34079, 6 specimens; Collombatti Creek, near Mungay Mountain, south of Taylors Arm, (30°52'S 152°43'E), 16 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34080, 3 specimens; Eungai Creek at Cedar Crossing, north of Kempsey, (30°55'S 152°47'E), 17 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34081, ♂; Tributary of Wilson River, 5.9 miles from Telegraph Point towards Rolland Plains Road, 6 Mar. 1959, D.D. Francois & J. Evans, AM P15458–61, 4 ♀♀.

Diagnosis. Male cuticle partition present. Rostral spines reaching proximal to midlength or full length of carinae. Rostral base divergent or very divergent, carinae medium length. Antennal squame widest at or slightly proximal to midlength. Squamal spines absent. Suborbital spine large or medium-large. Thoracic spines large or medium sized. General tubercles medium sized or small and moderately dense. 2 or 3 rather large Li spines on abdominal somite 2. D spine small or minute and blunt on anterior somites (accented by dark colour). Abdominal boss obsolete or absent. Telsonic surface spines small

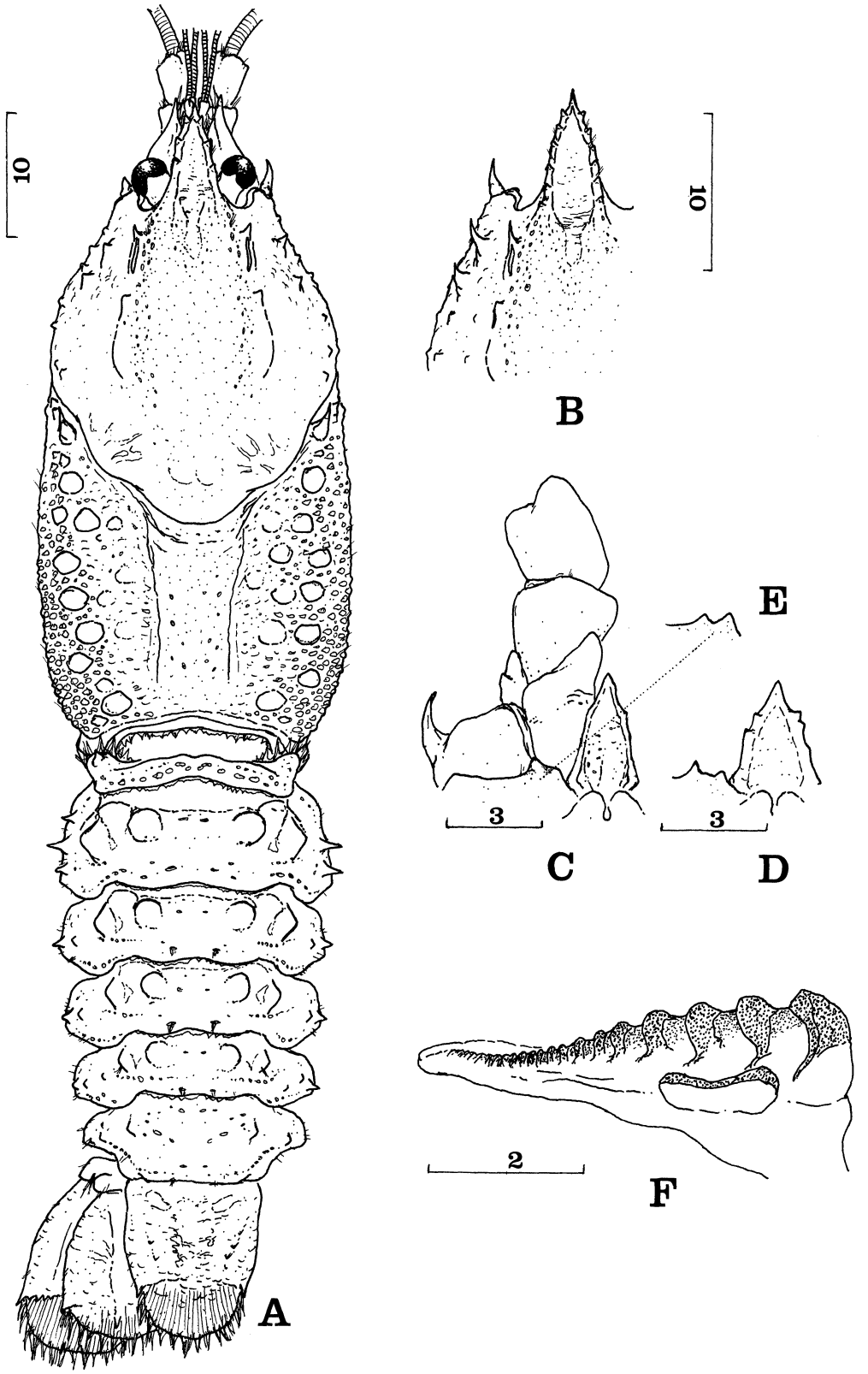

Fig. 19. *Euastacus dangadi* n.sp. A, dorsal view, holotype male, Stockyard Creek, AM P34078; B, more numerous rostral spines, larger cephalic spines, paratype female, tributary Bellingen River, AM P34077; C, ventral view cephalon, holotype male, AM P34078; D, broad epistome, paratype male, Bellingen River, AM P34077; E, bifid coxopodite spine, female, tributary Orara River, AM P34075; F, ventral view zygocardiac ossicle, holotype male, AM P34078.

or minute. Marginal spines on uropods absent. Ventrolateral propodal spine row not reaching apex of finger. 1 or 2 dorsal apical propodal spines. Spines above cutting edges of chelae apical or reaching midlength of gape (sometimes proximal to midlength on propodus). Usually 6 or 7 mesial propodal spines. Mesial dactylar basal spines absent. 1 or 2 apical mesial dactylar spines. 2 or 3 mesial carpal spines. Ventromesial carpal spines smaller than ventral spine. Keel Pr1 sloped to semi-abrupt and apart. TAP count 3.0–4.0.

Description. Maximum OCL: 42.8 mm.

Rostrum: Rostrum not reaching or just reaching midlength of 3rd antennal segment on specimens >30 OCL, distal to midlength on some smaller specimens. Rostral sides parallel or slightly convergent, distinctly convergent on some very small specimens. Base divergent or very divergent, carinae medium length and slightly spread. Rostral spines numbering 3–7 per side, reaching proximal to midlength or full length of carinae; spines medium-small to large and moderately pointed to sharp. Acumen spine slightly larger than marginal spines.

OCL/CL 0.77–0.85 i; RW/OCL 0.16–0.23 d.

Cephalon: Cephalon moderately spiny on specimens >20 OCL, poorly spinose on most smaller specimens, usually with 2 (occasionally 1–4) sharp spines and low protuberances ventral to postorbital ridges. 1st postorbital spine large or medium sized, rarely small. 2nd postorbital spine an edge or small on specimens >30 OCL, small to large on smaller animals. Suborbital spine usually large or medium-large. Lateral margin of squame usually straight or convex, occasionally slightly concave; squame widest at or slightly proximal to midlength on specimens >20 OCL, distinctly proximal to midlength on smaller animals; marginal spines absent. Epistome medium width or broad on specimens >40 OCL, broad or very broad on smaller specimens; margin serrated or toothed. Antennal basipodite spine small or medium sized on specimens >30 OCL, large or very large on some smaller animals. Coxopodite spine small or medium sized and unimodal, bifid or serrated.

ScL/OCL 0.16–0.29 d.

Thorax: Approximately 6–13 dorsal thoracic spines, arranged in thin zone or 2 irregular rows; spines large or medium sized on specimens >20 OCL, small or very small on smaller specimens; spines moderately pointed, blunt or rounded, usually with some flat spines dorsally. General tubercles medium sized to small and moderately dense on specimens >20 OCL; tubercles medium sized to very small, moderately sparse to very sparse on very small animals. 1–3 cervical spines per side, dorsalmost spine usually sharper and longer than others.

ArL/OCL 0.37–0.41; ArW/OCL; 0.15–0.22 d; CaW/OCL 0.57–0.65 i; CaD/OCL 0.47–0.53.

Abdomen: Small D–L spine sometimes on somite 1 but frequently absent. D spine absent from somite 1. 2 or 3 Li spines per side on somite 2, except on some specimens <20 OCL. 1 Li spine on somites 3–5. Li spines large to small, decreasing posteriorly, on specimens >20 OCL, medium sized or small when present on specimens <20 OCL; spines very sharp or sharp on specimens >30 OCL, sharp to blunt on smaller animals. On specimens >20 OCL usually 1–3 small or minute Lii spines on somites 3–6, sometimes absent; Lii spines moderately pointed or blunt. D–L spine on somites 2–5 of specimens >30 OCL and on some 20–30 OCL; D–L spines medium sized to minute and usually blunt or moderately sharp, occasionally sharp on large spcimens. Somite 6 sometimes with 1 or 2 minute D–L spines. Small or minute D spine usually on somites 2–5 of specimens >30 OCL and some 20–30 OCL; D spines blunt or very blunt. D–L and D spines accentuated on live specimens by broad, very dark spots. Specimens <20 OCL frequently lacking spines. Abdominal boss very poorly developed or absent.

AbdW/OCL J 0.50–0.56, K 0.51–0.65 i; OCL/L 0.35–0.42 i.

Tailfan: 2–13 usually small or minute dorsal spines on telson of specimens >30 OCL and most specimens 20–30 OCL. Lateral spines absent on telson and uropods, though setal protuberances obvious. Standard telsonic spines usually medium sized or large (small on one specimen >40 OCL).

TeL/OCL ♂ 0.32–0.41 d; ♀ 0.34–0.41.

Chelae: Chelae intermediate or elongate in shape. Teeth well developed on most specimens >30 OCL.

Propodus: Ventrolateral spine row ending subapically. Lateral spines small or medium sized and moderately blunt to sharp. Lateral spine ridge obsolete on most specimens. Usually 6 or 7 mesial propodal spines, fewer on regenerate chelae. Usually 1, sometimes 2, dorsal apical spines, some specimens <20 OCL lacking spine. 2–6 spines above propodal cutting edge of specimens >20 OCL and some smaller specimens; spines apical or reaching to or proximal to midlength of chela gape, and small to large. Many small and medium sized spines and protuberances lateral to dactylar base dorsally, 1 or 2 of these sometimes distinctly larger than others. Ventrally, usually 4–11 medium sized or small spines lateral to dactylar base, fewer on some specimens <30 OCL. Very low ridge posterior to dactylar articulation. Precarpal spines usually absent (rarely small protuberance).

PropL/OCL ♂ (0.88) 0.90–1.05 i, ♀ 0.86–1.04; PropW/PropL 0.41–0.47; PropD/PropL 0.24–0.28.

Dactylus: 1–4 spines above dactylar cutting edge of specimens >20 OCL and some smaller specimens (spines absent on some regenerate chelae); spines large or medium sized (rarely small) and apical or reaching midlength of gape. Extra dorsal dactylar spines absent. Mesial dactylar basal spines absent (except on some regenerate chelae). 1 or 2 apical spines. Dactylar groove shallow, absent on some large specimens.

DactL/PropL 0.55–0.59.

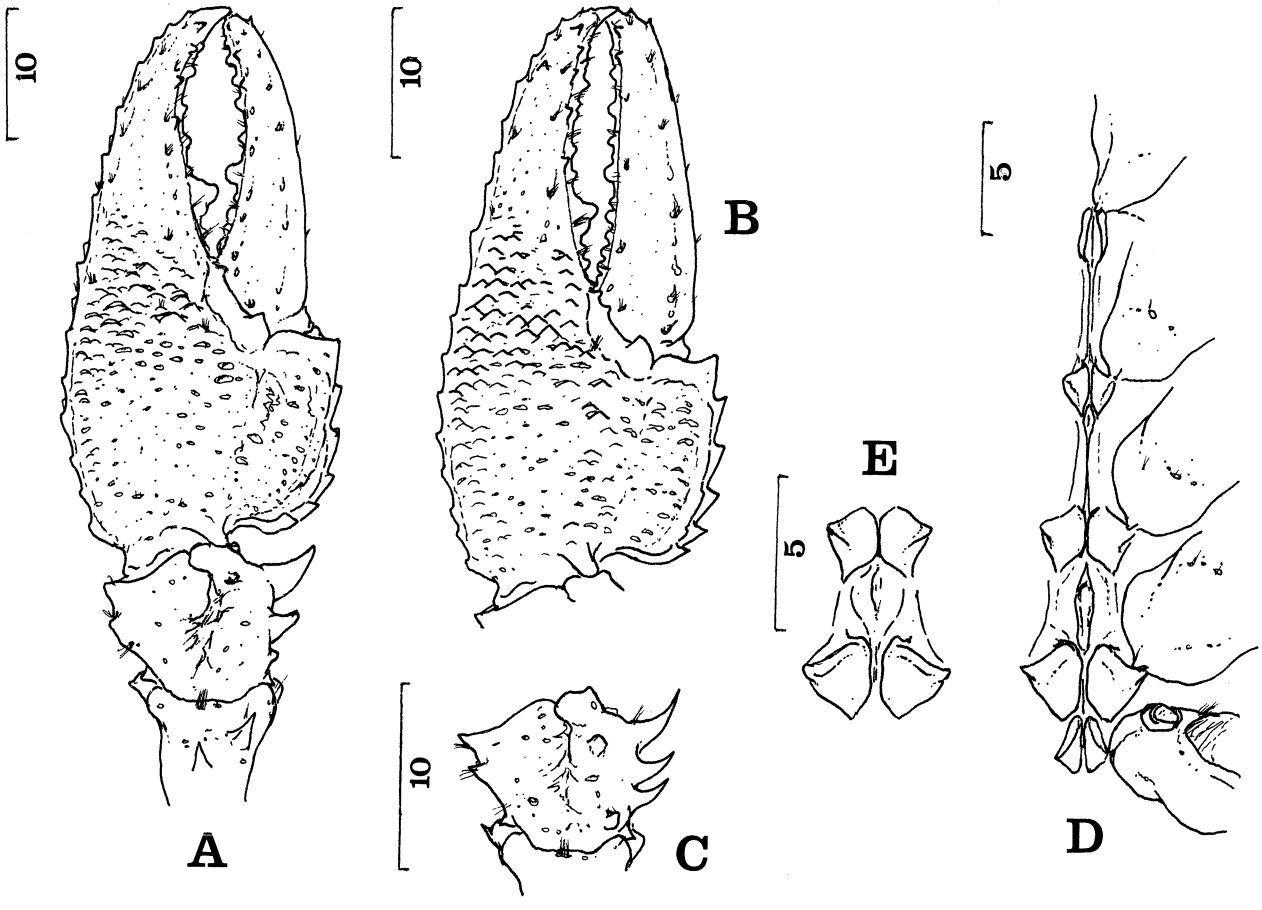

Fig. 20. *Euastacus dangadi* n.sp. A, dorsal view chela, holotype male, Stockyard Creek, AM P34078; B, chela, 2 dorsal apical propodal spines, very spinose lateral to dactylar base, female, Telegraph Point, AM P15459; C, carpus of cheliped, third mesial spine and dorsal spines well developed, paratype female, tributary Bellingen River, AM P34077; D, sternal keel, holotype male, AM P34078; E, keel processes 3 and 4, paratype female, Bellingen River, AM P34077.

Carpus: Usually 2(+1) or 3 mesial carpal spines, some specimens with only 2 spines and one animal with small 4th spine on one carpus. Distal spine usually distinctly larger than and ventrally offset to others. 2, rarely 3, medium sized or large lateral carpal spines. Articulation spine absent, minute or small. 1 or 2 dorsal carpal spines usually present, though some specimens of all sizes lacking spines. Ventral carpal spine large or very large; largest ventromesial spines medium sized or small, others minute.

Merus: 5–9 large dorsal meral spines. Outer spine large to small.

Keel: *Pr1*: Posterior margin sloped to semi-abrupt; ventral edges flat, rounded or angled down or slightly back. Processes apart, and parallel or closed. Keel after Pr1 frequently with low spine.

Pr2: Almost parallel, open or very open; always apart. Keel after Pr2 rather low but generally slightly pronounced anteriorly.

Pr3: Posterior margin rounded or moderately curved with distinct or slight scoops. Keel after Pr3 broad, moderately or distinctly produced but variable in profile, often produced anteriorly or at midlength.

Pr4: Moderately curved or rounded posterior margins on specimens >20 OCL, usually sharp on smaller animals, margins slightly convex, irregular or straight. Scoops usually absent, rarely developed. Anterior edges angular or very angular.

Processes 3 and 4 broad on specimens >40 OCL, very broad on most smaller animals.

Setation: Light.

Punctation: Dense.

Gastric mill: TAP count 3.0–4.0 (usually 3.5); TAA count 1.0–1.5; spread 1.5–2.5. Teeth large and spaced, ear short. Urocardiac ridges 6–7 (rarely 8).

Coloration: Body dorsally brown or green, paler ventrolaterally. Thoracic and cephalic spines very dark brown or black, general tubercles and cephalic protuberances pale orange. Abdominal L spines light

orange, D–L and D spines dark brown or black. Carpus of cheliped dark green-brown or blue-green with mesial spines and lateral margin tinged orange. Propodus of cheliped green-brown or red, mesial spines blue or green, lateral spines orange. Finger tips usually pale, often tinged blue.

Body ventrally orange and red, with blue patches on sternal keel. Carpus of cheliped laterally orange, dark green or blue-green mesially, ventral spines orange. Propodus with blue-green mottling on orange or more uniformly dark orange.

Sexes: Males possess a cuticle partition. Females in the 20–30 OCL range have closed gonopores, though pores on one specimen almost 30 OCL appear to be opening. Five of the seven females in the 30–40 OCL range have open gonopores (three are berried) and the other two specimens appear to be opening. This indicates that female maturation usually occurs in the 30–40 OCL range, though one female larger than 40 OCL has gonopores deeply incised, but unopen.

Distribution and biology. *Euastacus dangadi* ranges through the coastal mountains of New South Wales from immediately north of Coffs Harbour to Rollands Plains west of Port Macquarie, a distance of 130 km. Drainage includes the Clarence, Nambucca and Bellingen systems. The species inhabits streams in rainforest with wet or dry sclerophyll forest on higher ridges. Berried females were collected in September. *Euastacus dangadi* is occasionally sympatric with *E. neohirsutus* Riek.

Etymology. Named after Dangadi, the major aboriginal language in the species' range (Capell, 1963).

Remarks. *Euastacus dangadi* displays variation in thoracic and abdominal spine development over its range. Typically, the abdominal D–L and D spines are accentuated by obvious broad, very dark brown or black spots, but the spots show geographical variation and are usually paler in the south. The degree of spination on the propodus lateral to the dactylar base dorsally and ventrally, the spination of the rostrum and the profile of the sternal keel between processes 3 and 4 are particularly variable.

Euastacus dangadi is most similar to *E. valentulus* Riek and *E. gumar* n.sp. *Euastacus dangadi* can be distinguished from *E. valentulus* by the former's fewer apical mesial dactylar spines, more numerous mesial propodal spines and numerous protuberances on the dorsal surface of the chela propodus lateral to the dactylar base. The differences from *E. gumar* are noted for that species.

Euastacus dharawalus n.sp.

Figs 21, 22

Euastacus serratus.–Clark, 1941: 17 (in part, Fitzroy Falls Kangaroo River as a locality) (Not *Cancer serratus* Shaw, 1794).

Type material. HOLOTYPE ♂, OCL 50.0 mm, AM P34094. NSW Fitzroy Falls, stream above falls, 7–11 Mar. 1939, M. Ward(?). PARATYPES: Type locality, AM P13454, 8 ♂♂, 2 ♀♀; Type locality, AM P13452, 7 ♂♂, 2 ♀♀; Type locality, AM P13461, 2 ♀♀; Type locality, AM P15463, 16 specimens.

Other material examined. NSW Wildes Meadow near Mossvale, Jan. 1909, T. Steel (?), AM P8195, ♂; Fitzroy Falls, Kangaroo River, 1 Jul. 1941, QM W1276, ♂, ♀, Wildes Meadow Creek, Fitzroy Falls, 26 Aug. 1980, R.A.F., AM P34043, ♂; Wildes Meadow Creek, near Wildes Meadow, (34°37'S 150°30'E), 22 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34042, 5 specimens.

Diagnosis. Male cuticle partition absent. Rostral spines apical, rarely to midlength of carinae. Rostral base divergent, carinae medium length or long. Antennal squame widest at midlength. Squamal spines absent. Suborbital spine medium sized, sometimes large. Thoracic spines large, in 2 irregular rows. General tubercles medium sized or small, moderately distributed or sparse. 2–5 large Li spines on abdominal somite 2. D spine medium sized or small, usually sharp. Abdominal boss absent. Telsonic spines large or medium sized. Uropods with medium sized or small marginal spines. Ventrolateral propodal spine row rarely reaching distal to midlength of propodus. 1 dorsal apical propodal spine sometimes present. Spines above cutting edges of chela apical or reaching midlength of gape. 5 or 6 mesial propodal spines. 1, sometimes 2 or 3, dorsomesial dactylar basal spines. 1, sometimes 2 or 3, marginal mesial dactylar basal spines, these rarely absent. 2–4 apical mesial dactylar spines. 2 mesial carpal spines, sometimes small 3rd (proximal) spine. Ventromesial carpal spines usually smaller than ventral spine. Keel Pr1 semi-abrupt or abrupt and apart and parallel. TAP count 6.5–8.0.

Description. Maximum OCL: 60.8 mm.

Rostrum: Rostrum reaching distal to midlength of 3rd antennal segment on some specimens of all sizes but frequently shorter than midlength on animals >40 OCL. Rostral sides parallel or convergent. Carinae divergent or very divergent at base, and of medium length or long. 2–4 rostral spines per side, usually apical, rarely to midlength of carinae; spines medium sized or small and moderately pointed or rounded (large and sharp on one specimen <20 OCL). Acumen spine similar to or slightly larger than marginal spines.

OCL/CL 0.76–0.85 i; RW/OCL 0.17–0.24 d.

Cephalon: Cephalon spiny to poorly spinose, usually 1 enlarged sharp spine ventral to postorbital ridges,

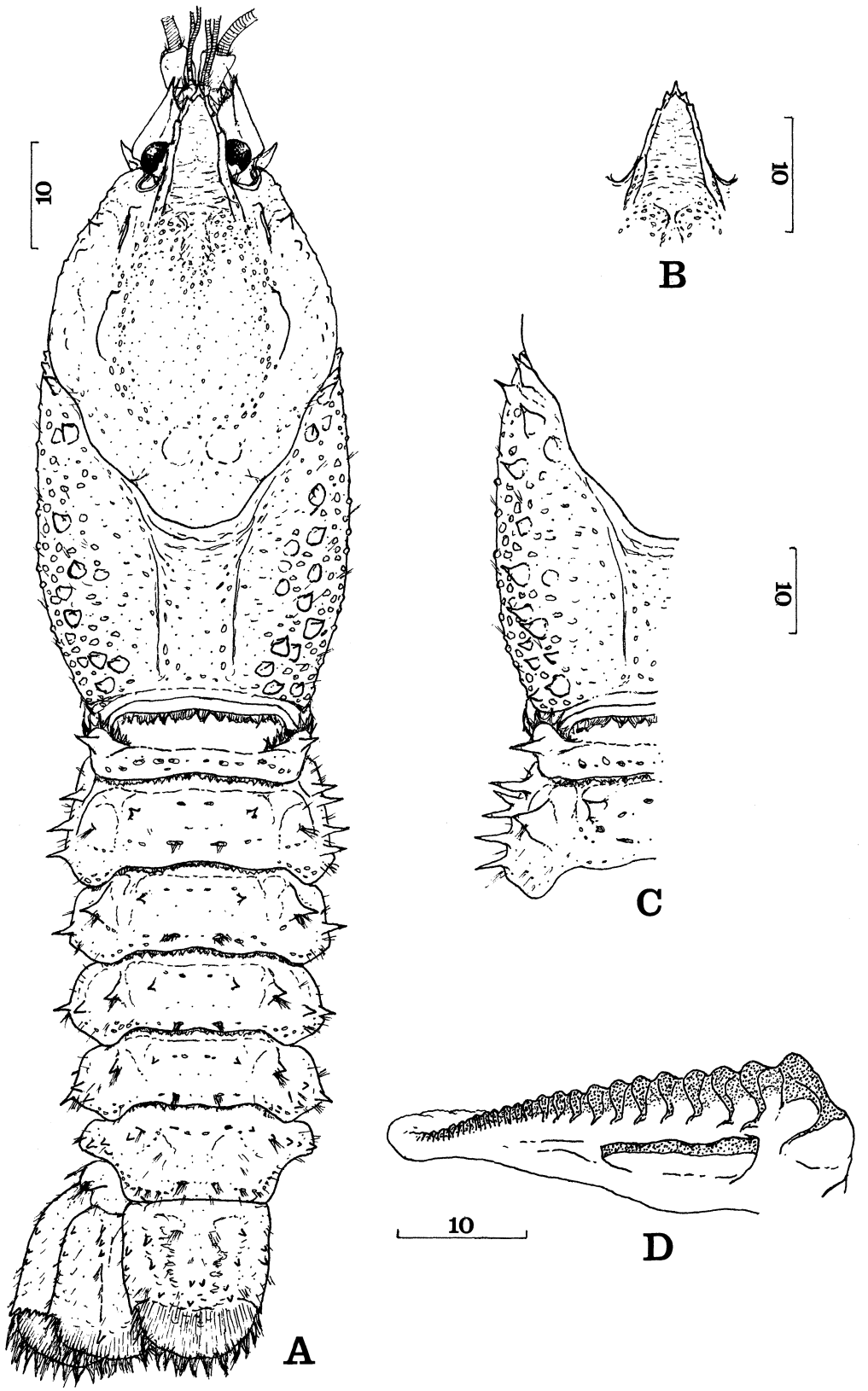

Fig. 21. *Euastacus dharawalus* n.sp. A, dorsal view, holotype male, Fitzroy Falls, AM P13454; B, rostrum, paratype female, Fitzroy Falls, AM P13461; C, thorax and anterior abdomen, thoracic spines sharper, D–L spines on somite 2, paratype male, Fitzroy Falls, AM P13454; D, ventral view, zygocardiac ossicle, paratype male, AM P13454.

sometimes 2 or 3 spines and protuberances; spination poorer on small specimens. 1st postorbital spine merely an edge or barely discernible on specimens >40 OCL, small on crayfish 20–40 OCL, medium sized on specimen <20 OCL. 2nd postorbital spine usually barely discernible, small on specimens <20 OCL. Suborbital spine medium sized, rarely large. Lateral margin of antennal squame slightly or distinctly convex; squame widest at midlength or slightly proximal to midlength on small specimens. Marginal squamal spines absent. Epistome broad or very broad, margin scalloped or toothed. Antennal basipodite spine small or very small, absent on one specimen, large on specimens <20 OCL. Coxopodite spine medium sized or small, usually bifid, occasionally serrated.

ScL/OCL 0.14–0.28 d.

Thorax: Dorsal thoracic spines well developed in zone or approximately 2 rows, numbering about 8–18 per side (specimen <20 OCL lacking spines); spines on specimens >30 OCL usually large, together with medium sized or small spines; spines sharp on specimens >40 OCL, usually with some moderately pointed or blunt; specimens <40 OCL with moderately pointed or blunt spines. General tubercles medium sized on specimens >40 OCL, small on lesser animals; tubercles moderately distributed or sparse. 2–4 cervical spines per side (1 on specimen <20 OCL); dorsal and frequently a 2nd spine large and usually sharp.

ArL/OCL 0.34–0.38; ArW/OCL 0.14–0.19 d; CaW/OCL 0.58–0.63; CaD/OCL 0.49–0.59 d.

Abdomen: Medium sized or small, very sharp or sharp D–L spine on somite 1 of specimens >30 OCL, spine absent on many smaller specimens. D spine absent on somite 1 (one specimen with small spine on one side). On somite 2, 3–5 Li spines per side on specimens >40 OCL, 2–4 on animals 20–40 OCL. Usually Li spine on somites 3–5 of specimens >20 OCL. Li spines large or medium sized (decreasing to posterior somites) on large specimens, usually small on crayfish <40 OCL; spines very sharp on most specimens, moderately pointed or blunt on specimens <40 OCL. Somites 3–5 usually with 1–3 Lii spines; Lii spines medium sized or small on specimens >40 OCL, usually minute on smaller specimens. Somite 6 usually with 2 or 3 small or minute Lii spines, these sometimes merely protuberances. D–L spine on specimens >30 OCL, decreasing in size to posterior somites from large or medium sized to small or minute; spine sharp or very sharp on specimens >50 OCL, blunt on most crayfish 30–50 OCL, particularly on posterior segments. Frequently 2 or 3 small D–L spines on somite 6. D–L spine sometimes absent on one or both sides of somites 2 and 3. Medium sized to minute D spine on somites 2–5 of most specimens >40 OCL and some smaller crayfish; spine usually very sharp or sharp on specimens >40 OCL, sometimes moderately pointed or blunt, especially on posterior somites; usually 1 or 2 small or minute D spines on somite 6 of large animals. Some specimens 30–40 OCL with blunt D spine, especially on anterior somites. Specimen <20 OCL lacking all abdominal spines. Dorsal boss absent.

AbdW/OCL ♂ 0.51–0.57 d, ♀ 0.61–0.64 (40–60 OCL); OCL/L 0.34–0.41 i.

Tailfan: Approximately 6–13 telsonic surface spines on specimens >30 OCL; spines large or medium sized on animals >50 OCL, medium sized or small on smaller specimens. 1–3 large to small marginal telsonic spines on most crayfish >30 OCL. 1–3 large to small median spines on inner ramus of uropod of large specimens, merely protuberances on most specimens <30 OCL. Often 1 or 2 medium sized or small marginal spines on inner ramus and 1–3 on outer ramus of specimens >40 OCL; Standard spines medium sized or small.

TeL/OCL ♂ 0.33–0.42; ♀ 0.37–0.42 (40–60 OCL).

Chelae: Chelae frequently stout, sometimes intermediate in shape on specimens >20 OCL, elongate on smallest animal. Teeth well developed on most specimens >40 OCL.

Propodus: Ventrolateral spine row usually terminating at about midlength of propodus; lateral spines medium sized or small and sharp. Lateral spine ridge present. 5 or 6 mesial propodal spines (rarely 4 with obvious gap). 0 or 1 dorsal apical spine on specimens >30 OCL, absent on smaller specimens. 2–4 spines above cutting edge of specimens >40 OCL, 1–3 spines on specimens 30–40 OCL; spines apical or to midlength of gape (slightly proximal to midlength on one specimen) and large or medium sized (small on some 30–40 OCL specimens); spines moderately pointed to rounded. Specimens <30 OCL lacking spines above cutting edge. Spines usually absent on dorsal face of propodus lateral to dactylar base, sometimes 1 medium sized or small spine with some additional protuberances; ventrally 1–4 (usually 1 or 2) spines lateral to dactylar base, spines medium sized or large on specimens >40 OCL, smaller on lesser specimens. Low ridge or protuberances posterior to dactylar articulation. Frequently 1 or 2 small precarpal spines.

PropL/OCL ♂ 0.76–1.05 i, ♀ 0.84–0.91 (40–60 OCL); PropW/PropL 0.39–0.50 i; PropD/PropL 0.26–0.31 id.

Dactylus: 1–4 medium sized or small spines above cutting edge on most specimens >20 OCL, these apical or just extending to midlength of gape; specimens <20 OCL lacking spines. Extra dorsal dactylar spines absent. Usually 1, sometimes 2 or 3, dorsomesial dactylar basal spines on nonregenerate chelae. Usually 1, occasionally 2 or 3 marginal basal spines, sometimes absent; basal spines rather sharp and large or medium sized, smaller on specimens <30 OCL. 2 or 3, rarely 4, apical dactylar spines (marginal basal and apical spines joining in mesial row on one specimen). Dactylar groove usually present, sometimes shallow or absent.

DactL/PropL 0.54–0.49.

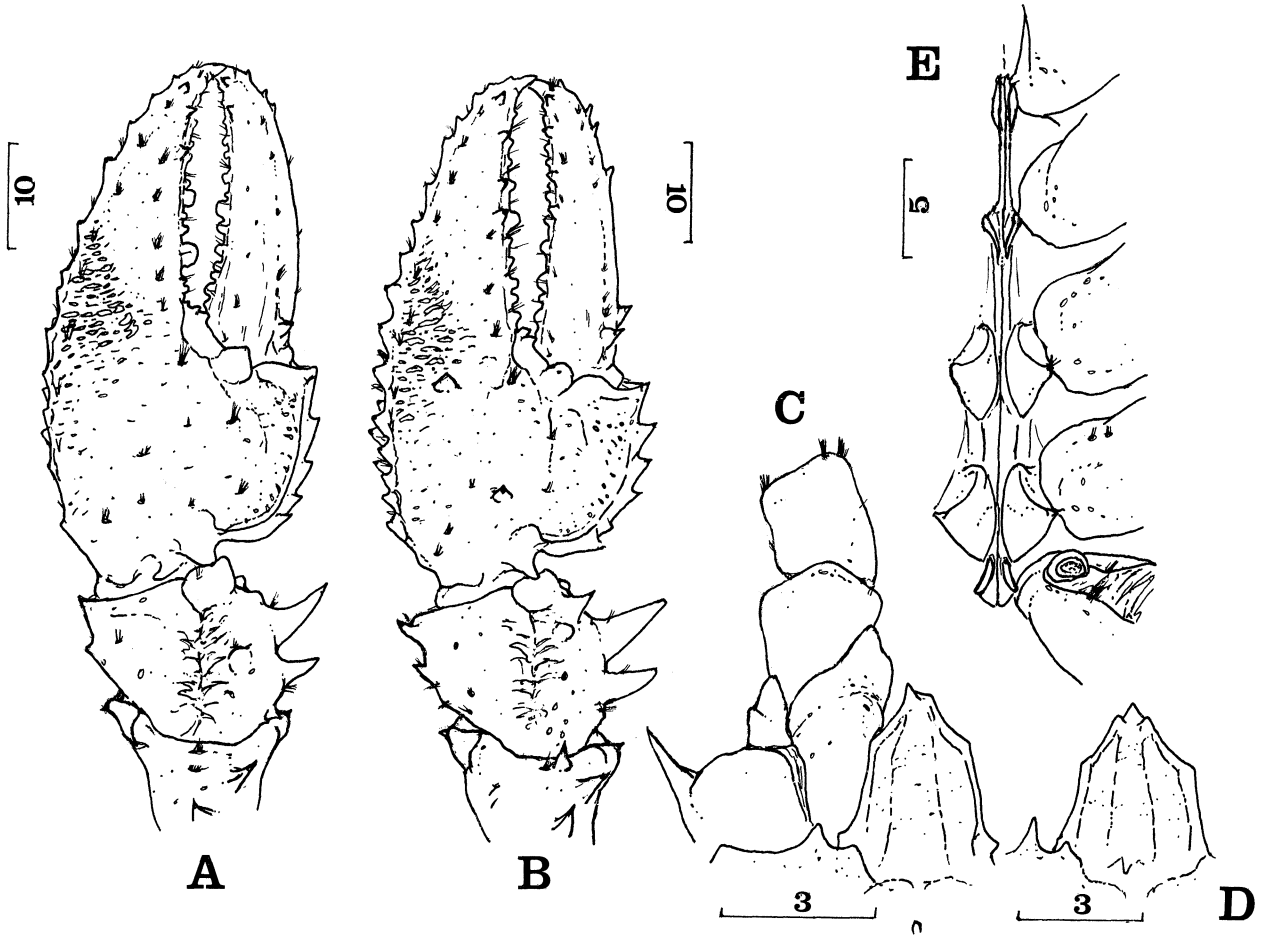

Fig. 22. *Euastacus dharawalus* n.sp. A, dorsal view chela, holotype male, Fitzroy Falls, AM P34094; B, probable regenerate chela, more numerous dactylar and cutting edge spines, dorsal spines on propodus and carpus, paratype male, Fitzroy Falls, AM P13454; C, ventral view cephalon, holotype male, AM P34094; D, stronger coxopodite spines, paratype male, AM P13454; E, sternal keel, holotype male, AM P34094.

Carpus: 2 or 2(+1) mesial carpal spines and usually low protuberance distal and/or proximal to spines (rarely 3 spines on regenerate chelae); 1st (distal) spine much larger than 2nd and slightly offset ventrally. 2 lateral carpal spines, large or medium sized on specimens <40 OCL, medium sized or small on lesser specimens. Articulation spine absent (except on smallest crayfish). Usually 1 or 2 low, blunt dorsal carpal spines, sometimes only indistinct protuberances. Ventral spine large or very large. 3–7 ventromesial spines, largest medium sized or small, occasionally large, rarely similar size to ventral spine.

Merus: Usually 6 or 7 dorsal spines; spines large on specimens >30 OCL, distal 2 spines often distinctly larger than remainder. Outer meral spine large to minute.

Keel: *Pr1*: Posterior margins semi-abrupt or abrupt, sloped on specimens <20 OCL; ventral edges flat, angled down, rounded or angled back; processes apart, occasionally only slightly or very apart and parallel (open on one specimen). Keel after Pr1 lacking spines, sometimes slight projection.

Pr2: Open or very open (almost parallel on one specimen). Keel after Pr2 low, often slightly concave.

Pr3: Scoops absent, gradual or very slight; moderately sharp to rounded bases. Keel after Pr3 recessed or slightly projecting on specimens >20 OCL, moderately projecting on smallest crayfish; spines absent.

Pr4: Scoops absent or slight; posterior edges moderately rounded to sharp and slightly convex, irregular or almost straight; anterior edges moderately angular to very angular.

Pr3 and 4 just narrow on largest specimen, usually broad on smaller animals.

Setation: Light.

Punctation: Moderately dense to dense.

Gastric mill: TAP count 6.5–8.0 (usually 7.0–7.5); TAA count 1.0–1.5; spread 5.0–6.5. Teeth usually low and moderately spaced, zygocardiac ear of moderate length or long. Urocardiac ridges 7–9, usually increasing with size.

Coloration: Body dorsally dark olive green or green-brown. Thoracic spines slightly darker. General tubercles pale orange. Orange patch on lateral spines of cephalon. L abdominal spines pale orange. Chelae articulations red. Carpus dark green. Propodus ochre or green-brown with dark green mottling. Fingers with salmon or yellow tinge.

Body ventrally pale orange and cream. Carpus of cheliped laterally pale orange, mesially dark blue-green. Propodus light orange with dark green mesially. Fingers pale salmon; dactylus often green mesially.

Sexes: Males lack a cuticle partition. All examined females are in the 40–60 OCL range and possess open gonopores. Hence, female maturity probably occurs around 40 OCL but further sampling could reveal smaller mature females.

Distribution and biology. *Euastacus dharawalus* is known from only a small area in and near the northern section of Morton National Park, south-west of Robertson, New South Wales, drained by tributaries of the Kangaroo and thence Shoalhaven Rivers. The species was found in 1981 at only one site, to the north-east of Fitzroy Falls from where most specimens have been collected. The site was largely cleared with some eucalypts along the stream banks. The crayfish inhabited a catacomb of holes in the soft stream bed.

Euastacus yanga was collected more frequently in the area, apparently preferring those streams bordered by temperate rainforest. *Euastacus hirsutus* also inhabits streams nearby in similar habitat to *E. dharawalus*. No sympatry of species was observed at any site.

Etymology. Named after the Dharawal aboriginal language, including the range of the species (Eades, 1976).

Remarks. Specimens have been collected from only a small area and infraspecific variation is only moderate.

Euastacus dharawalus has caused problems of identification for previous workers. Riek did not note the occurrence of *Euastacus* from Fitzroy Falls in any paper (1951, 1956, 1969) yet had examined and labelled several museum jars of specimens from this site. A large jar of specimens from Fitzroy Falls (AM P13454) Riek labelled as "*E. nobilis*"; a single specimen (AM P8195) from Wildes Meadow is labelled as "*Euastacus* nr. *australasiensis*"; an additional specimen from Fitzroy Falls is labelled "*Euastacus* n. sp. nr. *spinosus*". Riek labelled two museum jars of Fitzroy Falls crayfish with an unpublished name used in Francois (1962). All of the above specimens are *E. dharawalus*.

Francois (1962) did not record *Euastacus* from Fitzroy Falls, but recorded (pp. 50–51) AM P8195 from Wildes Meadow as "being specifically different from any described form". Francois' description of the specimen is puzzling however, as he noted it to lack spines "at the junction of the pleura and terga" (D–L abdominal spines) and on the telson. Low D–L spines are present as are 6 small telsonic spines. The gastric mill in his collection is labelled "serratus". Francois did not mention the many museum specimens from Fitzroy Falls, such as AM P13452 and P13461, collected in 1939.

Euastacus dharawalus is most similar to *E. spinifer*, especially those specimens of the latter from the Blue Mountains. The species can be distinguished by the less extensive rostral spines, thinner rostral carinae, absence of an abdominal boss and lower TAP counts of *E. dharawalus*. It appears that females of *E. dharawalus* mature at a smaller size than those of *E. spinifer*.

Euastacus gamilaroi n.sp.

Figs 23, 24

Euastacus neohirsutus Riek, 1969: 897 (in part, Hanging Rock as locality).

Type material. HOLOTYPE ♂, OCL 41.4 mm, AM P13045. NSW Hanging Rock (near Nundle), 27 Mar. 1954, E.F. Riek. PARATYPES: Type locality, AM P34086, 6 ♂♂, 6 ♀♀.

Other material examined. NSW Hanging Rock Reservoir, 27 Mar. 1954, E.F. Riek, AM P13053, ♀.

Diagnosis. Male cuticle partition present. Rostral spines extending proximal to midlength or to full length of carinae. Rostral base divergent or very divergent, carinae short. Antennal squame widest at or slightly proximal to midlength. Squamal spines absent. Suborbital spine medium sized or large. Thoracic spines absent. General tubercles small and densely distributed. 2–5 medium sized Li spines on abdominal somite 2. D spine absent or barely discernible. Abdominal boss absent. Telsonic spines absent. Uropods lacking marginal spines. Ventrolateral propodal spine row extending to or close to apex of finger. 2 or 3 dorsal apical propodal spines. Spines above cutting edges of chela apical or reaching midlength of gape. 5 or 6 mesial propodal spines. 1 or 2 dorsomesial and usually 1 marginal dactylar basal spines. 2 or 3 apical mesial dactylar spines. 3 mesial carpal spines. Ventromesial carpal spines much smaller than ventral spine. Keel Pr1 semi-abrupt or abrupt, close and parallel. TAP count 4.5–5.0.

Description. Maximum OCL: 41.8 mm.

Rostrum: Rostrum rather short, never reaching distal to midlength of 3rd antennal segment, often shorter than base of segment. Rostral sides slightly convergent or almost parallel; base divergent or very divergent; carinae short and moderately spread. 2–4 rostral spines reaching proximal to midlength or to full length of carinae; spines medium sized or small, moderately pointed on specimens >30 OCL, sharp on some specimens <30 OCL. Acumen spine similar to marginal spines.

OCL/CL 0.82–0.87 i; RW/OCL 0.14–0.17 d.

Cephalon: Cephalon moderately to poorly spinose with 2–5 small spines and several protuberances ventral to

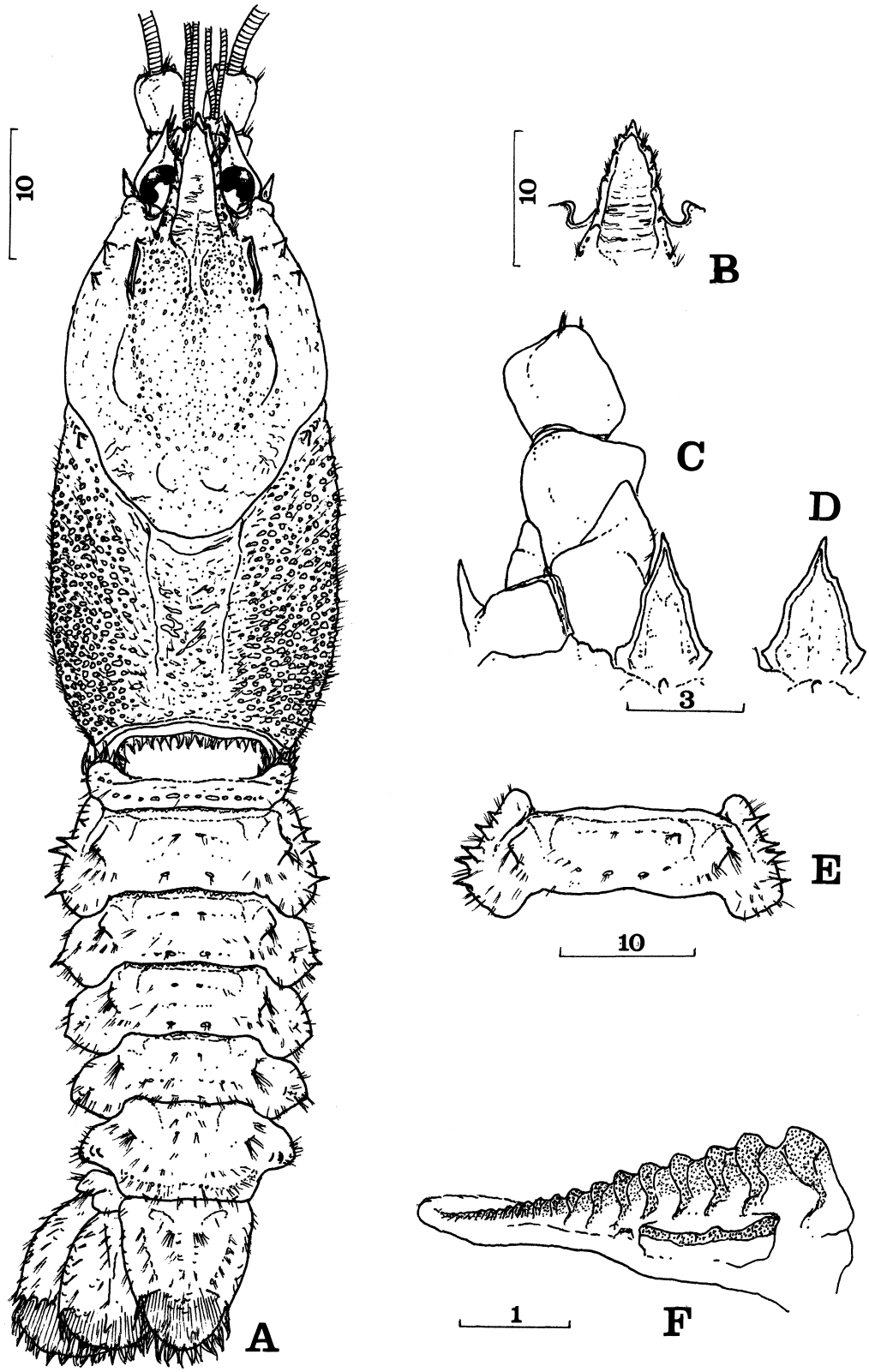

Fig. 23. *Euastacus gamilaroi* n.sp. A, dorsal view, holotype male, Hanging Rock, AM P13045; B, broader rostrum, paratype female, Hanging Rock, AM P34086; C, ventral view cephalon, holotype male, AM P13045; D, epistome, paratype male, AM P34086; E, abdominal somite 2, D spine on one side, broader (sexual), paratype female, AM P34086; F, ventral view, zygocardiac ossicle, holotype male, AM P13045.

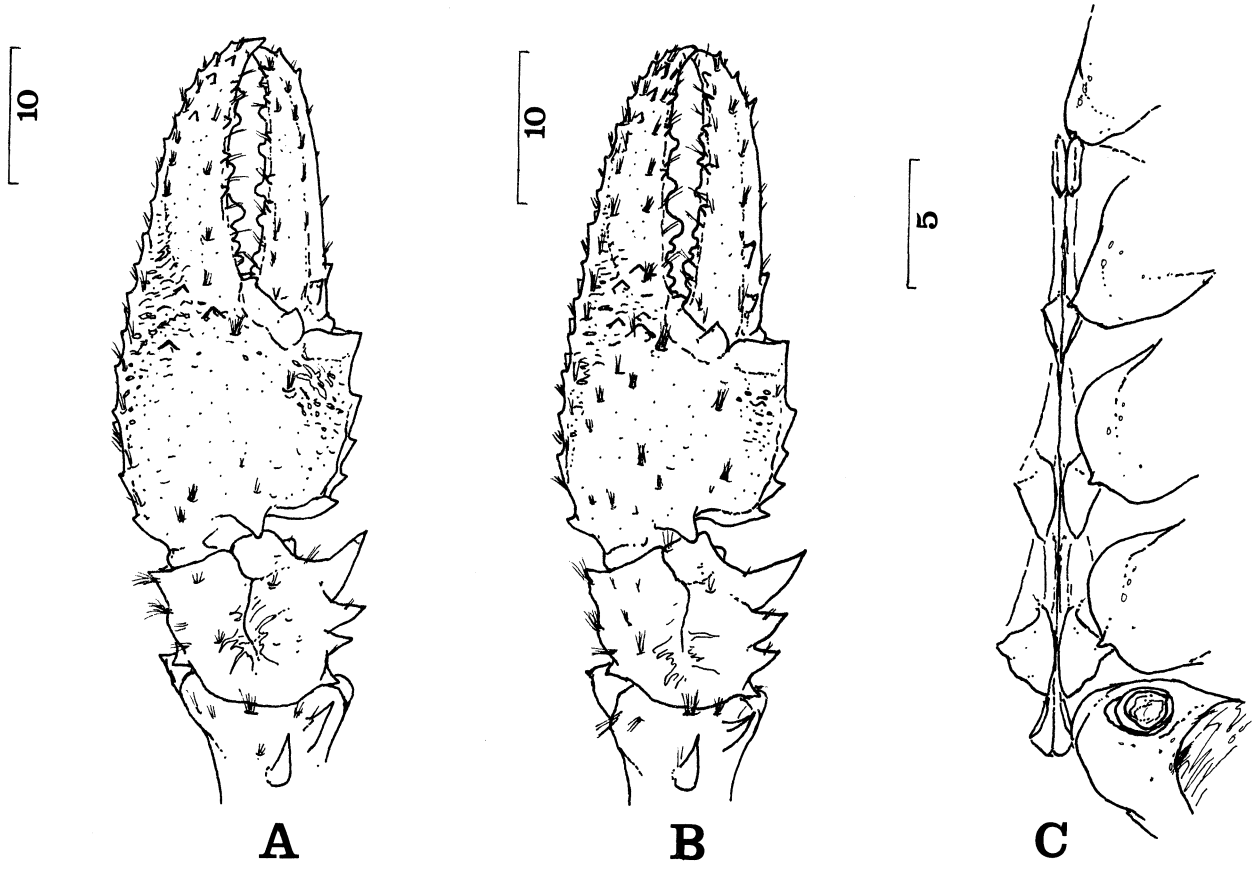

Fig. 24. *Euastacus gamilaroi* n.sp. A, dorsal view chela, holotype male, Hanging Rock, AM P13045; B, chela, 2 dorsomesial dactylar basal spines, paratype female, Hanging Rock, AM P34086; C, sternal keel, holotype male, AM P13045.

postorbital ridges. 1st postorbital spine small (rarely medium sized); 2nd spine absent or barely discernible. Suborbital spine medium sized or large. Lateral margin of antennal squame straight or slightly convex; squame widest at midlength on specimens >40 OCL, at or slightly proximal to midlength on crayfish 30–40 OCL, distinctly proximal on smaller specimens; marginal spines absent. Epistome elongate or medium width on specimens >30 OCL, broad on many smaller crayfish; margin scalloped. Antennal basipodite spine small or medium sized (large on one specimen), usually serrated with one cusp distinctly larger.

ScL/OCL 0.15–0.19 d.

Thorax: Dorsal spines absent, occasionally just discernible. General tubercles small, very small on some specimens near 20 OCL; tubercles very dense or dense on specimens >30 OCL, dense to rather sparse on smaller animals. 2–5 cervical spines, medium sized or small, moderately pointed to blunt.

ArL/OCL 0.36–0.39; ArW/OCL 0.14–0.16; CaW/OCL 0.53–0.57 i; CaD/OCL 0.46–0.49.

Abdomen: Abdomen rather broad. D and D–L spines usually absent from somite 1, minute D–L spine sometimes present. 2–5 Li spines per side on somite 2, medium sized and very sharp or sharp on crayfish >40 OCL, frequently small or minute and blunter on smaller animals, absent on some specimens close to 20 OCL; somites 3–5 usually with 1 medium sized, small or minute Li spine, diminishing in size to posterior. Lii spines (sometimes several) on many large specimens, these small or minute and moderately pointed or blunt; 1–3 minute Lii protuberances on somite 6 of most crayfish. D–L spine on somites 2–4 of most specimens >30 OCL, rarely on somite 5; spines small or minute, occasionally rather sharp but usually moderately pointed or blunt. Minute blunt D spine on somite 2 of some specimens. Abdominal spination poor on specimens close to 20 OCL. Dorsal boss absent.

AbdW/OCL ♂ 0.51–0.54 d, ♀ 0.53–0.59 i; OCL/L 0.38–0.42 i.

Tailfan: Surface and marginal spines absent from telson and uropods. Standard spines small or rarely medium sized.

TeL/OCL ♂ 0.32–0.38 d, ♀ 0.35–0.39 d.

Chelae: Chelae intermediate in shape to elongate; lateral margin often slightly concave. Teeth well developed at >30 OCL.

Propodus: Ventrolateral spine row well developed,

extending to or very close to apex of finger (2 lateral rows); lateral spines small (occasionally medium sized) and sharp. Lateral spine ridge small, often vague. 5 or 6 mesial propodal spines. 2 or 3 dorsal apical spines on crayfish >30 OCL and frequently on smaller specimens. Regenerate chelae and some small animals (especially near 30 OCL) with 1 or 2 apical spines. Usually 2–4 medium sized or large spines above cutting edge, apical or reaching to midlength of gape (rarely slightly proximal to midlength). 1–6 medium sized, blunt spines lateral to dactylar base dorsally with some protuberances; ventrally, on specimens >30 OCL, 3–9 medium sized and small spines, often extending along finger and frequently arranged in two rows (some specimens <30 OCL with fewer spines). Low ridge or rarely small blunt spine posterior to dactylar base. Precarpal spines usually absent, rarely small protuberance or spine. Fingers lightly punctate.

PropL/OCL ♂ 0.92–1.00, ♀ (0.85) 0.87–0.95; PropW/PropL 0.43–0.47; PropD/PropL 0.27–0.30.

Dactylus: 2–6 medium sized spines above cutting edge of dactylus, usually apical or reaching midlength of gape, occasionally slightly proximal to midlength; only 1 spine on some small specimens. Extra dorsal dactylar spines usually absent, sometimes 1 on large specimens. 1 or 2 dorsomesial and usually 1 marginal dactylar basal spines, medium sized or approaching large and sharp. 2 or 3 apical mesial spines. Dactylar groove present, often deep.

DactL/PropL 0.53–0.59.

Carpus: 3 mesial spines, one specimen with 3 (+1), distal spine largest and offset ventrally to others. Usually 1, occasionally 2, small or medium sized lateral carpal spines. Articulation spine usually absent, minute on some small specimens. Dorsal carpal spines absent. Ventral spine large or very large; largest ventromesial spine medium sized or small, with 1 or 2 additional minute spines or protuberances.

Merus: 6–9 medium sized dorsal spines. Outer spine minute or small.

Keel: *Pr1*: Posterior margins usually semi-abrupt or abrupt, occasionally sloped; ventral edges usually angled down, occasionally flat or rounded; processes close and parallel, often rather thin. Keel after Pr1 devoid of spines though low protuberance sometimes present.

Pr2: Almost parallel or open. Keel after Pr2 low, without spines.

Pr3: Gradual scoops usually present, sometimes absent; posterior margins moderately curved. Keel after Pr3 usually concave in profile.

Pr4: Slight scoops absent; posterior edges moderately sharp to rounded and convex, slightly convex or irregular in profile; anterior edges moderately curved to angular.

Pr3 and 4 very narrow or narrow.

Setation: Moderate to heavy especially on thorax; setae short.

Punctation: Very dense.

Gastric mill: TAP count 4.5–5.0; TAA count 1.0–1.5; spread 4.0. Teeth moderately spaced, ear rather long. Urocardiac ridges 7–8.

Coloration: No live specimens of *E. gamilaroi* were examined in this study and Riek (1969) did not record natural colours of Hanging Rock specimens.

Sexes: Males possess a cuticle partition. All females <40 OCL have unopen gonopores. The one specimen >40 OCL has open pores and is berried. It appears that female maturity occurs at or near a size of 40 OCL.

Distribution and biology. The species is known only from Hanging Rock near Nundle, NSW and was not collected during field work for this study. Riek (1969) did not record data regarding its habitat.

Etymology. Named after the Gamilaroi aboriginal language of the species' range (Capell, 1963).

Remarks. There is some inherent risk in describing a species of *Euastacus* from one site without an indication of geographical variation. *Euastacus gamilaroi* is similar to *E. polysetosus* Riek, *E. neohirsutus* Riek and *E. spinichelatus* n.sp. Several character states warrant its recognition as a valid species. The species has several dorsal apical propodal spines, well developed dactylar basal spines and usually several spines on the ventral face of the chela propodus lateral to the dactylar base. In addition, the gastric mill is distinct from the other three species.

It is not inconceivable, however, that future sampling might reveal intergrade specimens between the presently known ranges of *E. gamilaroi* and *E. polysetosus*.

Euastacus gumar n.sp.

Figs 25, 26

Type material. HOLOTYPE ♀, OCL 37.2 mm, AM P34039. NSW Gorge Creek, Richmond Range State Forest, on Gorge Creek-Sextonville Road, (28°45'S 152°42'E), 6 Sept. 1981, G.J. Morgan & S.J. Harders. PARATYPES: NSW Type locality, AM P34037–8, 4 ♂♂, 7 ♀♀.

Other material examined. NSW Richmond Range in shallow creek, 19 Apr. 1976, R.J. Raven, 6 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34036, ♀.

Diagnosis. Male cuticle partition present. Rostral spines extending to or proximal to midlength of carinae. Rostral base divergent or very divergent, carinae medium length. Antennal squame widest at or slightly proximal to midlength. Squamal spines absent. Suborbital spine medium sized. Thoracic spines small and blunt or rounded. General tubercles medium sized or small and densely or moderately densely distributed. 3–6 Li spines on abdominal somite 2. D spine and abdominal boss absent. Telsonic spines absent. Uropods lacking marginal spines. Ventrolateral propodal spine row not reaching apex of finger. 1 dorsal apical propodal spine on

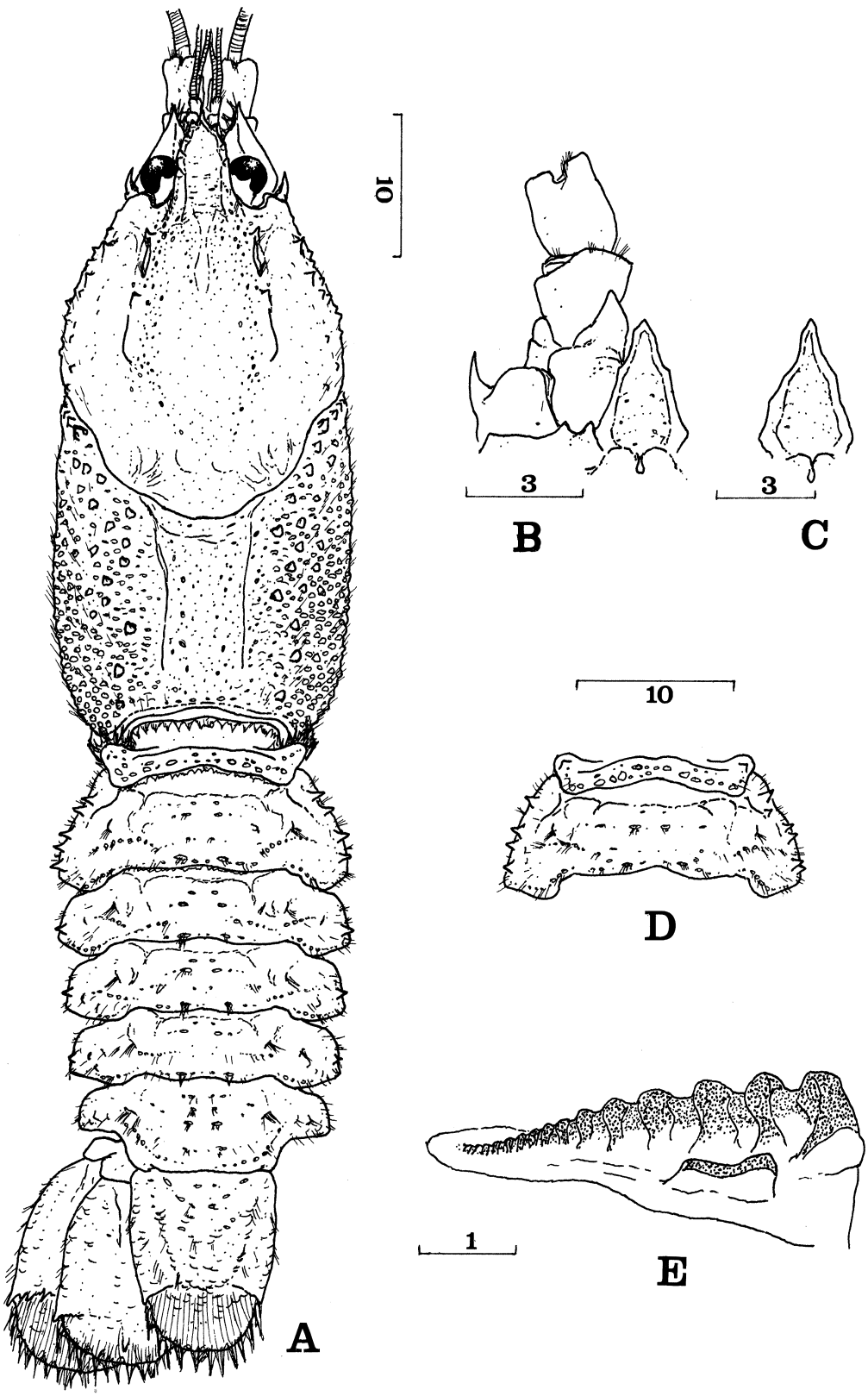

Fig. 25. *Euastacus gumar* n.sp. A, dorsal view, holotype female, Gorge Creek, AM P34039; B, ventral view cephalon, holotype female, AM P34039; C, epistome, paratype female, Gorge Creek, AM P34037; D, abdominal somites 1 and 2, small D–L spines on somite 1, paratype female, AM P34037; E, ventral view zygocardiac ossicle, holotype female, AM P34039.

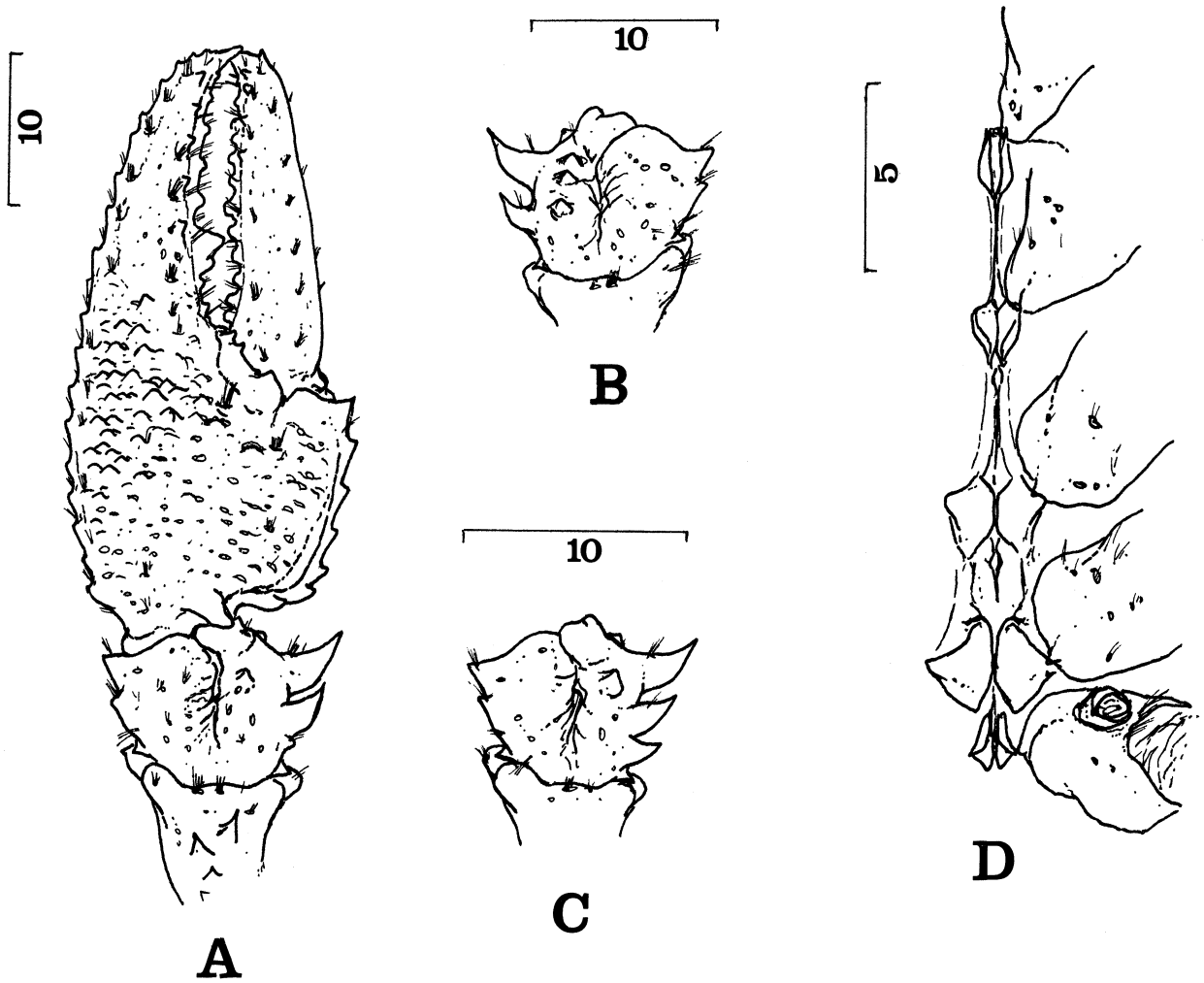

Fig. 26. *Euastacus gumar* n.sp. A, dorsal view chela, holotype female, Gorge Creek, AM P34039; B, carpus of cheliped, 2 mesial spines, 3 dorsal spines, (possibly regenerate), paratype female, Gorge Creek, AM P34037; C, carpus, 3 large mesial spines, paratype female, AM P34037; D, sternal keel, paratype male, AM P34037.

specimens >30 OCL. Spines above cutting edges of chela extending proximal to midlength of gape on propodus, apical or to midlength on dactylus. 6–8 mesial propodal spines. Mesial dactylar basal spines absent. 1 or 2 apical mesial dactylar spines. 2(+1) or 3 mesial carpal spines. Ventromesial carpal spines smaller than ventral spine. Keel Pr1 sloped or semi-abrupt and apart and parallel. TAP count 3.0–3.5.

Description. Maximum OCL: 37.2 mm.

Rostrum: Rostrum reaching base of 3rd antennal segment on specimens >30 OCL, to base or midlength of segment on smaller specimens. Rostral sides parallel or slightly convergent. Base divergent or very divergent with carinae medium length, sometimes slightly spread. 3 or 4 rostral spines per side, to or proximal to midlength of carinae; spines small or medium sized, usually moderately pointed or sharp. Acumen spine similar size to or slightly larger than marginal spines.

OCL/CL 0.80–0.86 i; RW/OCL 0.16–0.22 d.

Cephalon: Cephalic spination moderate on specimens >20 OCL, poor on smaller specimens, with usually 2 sharp spines and some smaller protuberances ventral to postorbital ridges. 1st postorbital spine medium sized or large; 2nd spine an edge or small. Suborbital spine medium sized on specimens >20 OCL, large on some smaller specimens. Antennal squame with lateral margin straight or slightly convex, widest at or slightly proximal to its midlength on specimens >20 OCL, distinctly proximal on specimens <20 OCL; marginal spines absent. Epistome medium width or broad; margin serrated or toothed. Antennal basipodite spine small or medium sized, sometimes large on small specimens; coxopodite spine medium sized or small and usually distinctly bifid.

ScL/OCL 0.15–0.23 d.

Thorax: Approximately 10–20 dorsal spines per side on specimens >20 OCL; spines small and blunt or rounded (occasionally flat) and distributed in broad zone; spines

absent on specimens <20 OCL. General tubercles medium sized or small and dense or moderately dense on specimens >20 OCL; tubercles barely discernible or absent on smaller animals. 2–4 cervical spines per side, medium sized or small, dorsalmost spine usually largest and sharp.

ArL/OCL 0.38–0.41 i; ArW/OCL 0.16–0.19 d; CaW/OCL 0.57–0.62; CaD/OCL 0.48–0.52 d.

Abdomen: Small or minute D–L spine sometimes on somite 1, frequently absent. D spine absent from somite 1. On specimens >20 OCL, somite 2 with 3–6 Li spines per side and somites 3–5 usually with 1 Li spine; Li spines medium sized or small, decreasing posteriorly, and sharp or moderately pointed on specimens >30 OCL, moderate to blunt on smaller crayfish. Small or minute, blunt Lii spine frequently on somites 3–5; somite 6 usually with 2 minute, blunt Lii spines per side. Minute blunt D–L spine on some specimens >30 OCL. D spines and abdominal boss absent. Specimens <20 OCL lacking abdominal spines.

AbdW/OCL J 0.51–0.53, K 0.51–0.61 i; OCL/L 0.36–0.42 i.

Tailfan: Telsonic and uropodal spines absent, though margins with obvious setal protuberances. Standard spines small on specimens >30 OCL, small or medium sized on smaller animals.

TeL/OCL ♂ 0.34–0.39 d, ♀ 0.34–0.39 di.

Chelae: Chelae elongate. Teeth well developed on specimens >30 OCL.

Propodus: Ventrolateral spine row not reaching apex of finger and poorly developed on some specimens <20 OCL. Lateral spines small and rounded to sharp. Lateral spine ridge moderately developed or small; 6–8 mesial propodal spines (one specimen with 5 spines on one possibly regenerate chela). 1 dorsal apical propodal spine on specimens >30 OCL, absent on some smaller specimens. 3–7 spines above propodal cutting edge of specimens >20 OCL; spines extending proximal to midlength or full length of chela and medium sized or small; spines absent on specimens <20 OCL. Many medium sized and small spines and protuberances lateral to dactylar base dorsally, 1 or 2 often slightly larger than others. Ventrally, about 5–12 medium sized and small spines lateral to dactylar base, reaching some distance along finger; some regenerate chelae and specimens <20 OCL with fewer spines. Low protuberances or ridge posterior to dactylar base. Frequently 1–3 small precarpal spines, more common on regenerate chelae.

PropL/OCL 0.90–1.03 i; PropW/PropL 0.40–0.46; PropD/PropL 0.26–0.31.

Dactylus: 2–5 spines above dactylar cutting edge of specimens >20 OCL, 1 spine on smaller specimens; spines medium sized or small, apical or reaching midlength or slightly proximal to midlength of chela gape. Extra dorsal dactylar spine absent. Mesial dactylar basal spines absent on normal chelae (sometimes 1 dorsomesial spine on regenerate chelae). 1 or 2 apical dactylar spines. Dactylar groove shallow on large specimens, often deep on smaller animals.

DactL/PropL 0.52–0.59 i.

Carpus: Usually 2(+1) or 3 mesial spines, 3rd (proximal) spine sometimes very small (one specimen with 2(+2) spines on one carpus). 1st (distal) spine usually distinctly larger than and offset ventrally to others. 2, rarely 3, medium sized lateral carpal spines, small on some specimens <20 OCL. Articulation spine absent or minute, small on some specimens <20 OCL. 1 or 2 (rarely 3) small dorsal carpal spines usually present. Ventral carpal spine large. 1 or 2 ventromesial spines, largest medium sized or small and distinctly smaller than ventral spines.

Merus: Usually 6–10 medium sized or large dorsal spines. Outer meral spine minute or small on specimens >20 OCL, small or medium sized on smaller crayfish.

Keel: Pr1: Posterior margins sloped or semi-abrupt, ventral edges angled down or flat; processes slightly or distinctly apart and parallel. Keel after Pr1 frequently with small blunt spine.

Pr2: Open or almost parallel and apart. Keel after Pr2 pronounced anteriorly, sometimes small spine.

Pr3: Rounded with distinct scoops. Keel after Pr3 sharp and distinctly pronounced especially anteriorly.

Pr4: Usually lacking, or with slight, scoops. Anterior edges angular or very angular; posterior edges straight, slightly convex or irregular in profile and rounded.

Pr 3 and 4 narrow on specimens >30 OCL, just broad on smaller animals.

Setation: Moderate.

Punctation: Dense on cephalon and thorax.

Gastric mill: TAP count 3.0–3.5; TAA count 1.5; spread 1.5–2.0.

Teeth large and spaced, zygocardiac ear short. Urocardiac ridges 5–7.

Coloration: Body dorsally green-brown. Thoracic spines dark brown. Cephalic spines and thoracic general tubercles pale brown. Abdominal L spines light yellow. Carpus of cheliped red with orange distal edge, mesial spines tipped with orange. Propodus red or orange, dorsal protuberances brighter red. Fingers red with yellow tips.

Body ventrally orange. Abdominal pleura blue. Carpus of cheliped orange, mesially tinged with green. Propodus orange grading to red on fingers.

Sexes: Males possess a cuticle partition. All females >30 OCL are mature and berried. Females in the 20–30 OCL range have closed gonopores, though on one

specimen the pores may be opening. Hence female maturity appears to occur at sizes close to 30 OCL.

Distribution and biology. *Euastacus gumar* inhabits some tributaries of the Clarence River in the Richmond Range of northern New South Wales. The two sites at which it was collected were over 300 m in altitude with rainforest along gullies and wet and dry sclerophyll forest on exposed ridges. The surrounding lower country has been extensively cleared for agriculture and was inhabited by species of *Cherax* and *Macrobrachium* and *Paratya australiensis*. Berried females of *E. gumar* were collected in September.

Etymology. Derived from "gumar" (= blood) in the Bandjalang aboriginal language of northern NSW including the Richmond Range (Crowley, 1978). Red or orange is dominant on the chelipeds.

Remarks. The species has been sampled from only two proximal sites and no geographical variation can be described. A museum specimen bears the imprecise label of "Richmond Ra.". *Euastacus gumar* is similar in many respects to *E. dangadi* but the species can be distinguished by respective development of thoracic and telsonic spination, and colour differences.

Euastacus guwinus n.sp.

Fig. 27

Type material. HOLOTYPE ♂, OCL 29.5 mm, AM P34041. NSW Tianjara Creek above Falls, tributary Shoalhaven River, near Tianjara, (35°07'S 150°20'E), 28 Oct. 1981, G.J. Morgan & S.J. Harders. PARATYPES: Type locality, AM P34040, 5 ♂♂, 3 ♀♀.

Diagnosis. Male cuticle partition absent. Rostral spines not reaching midlength of carinae. Rostral base slightly divergent or parallel, carinae medium length and thin. Antennal squame widest proximal to midlength. Squamal spines absent. Suborbital spine medium sized. Thoracic spines barely discernible. General tubercles medium sized or small and moderately distributed or sparse. 1–4 small Li spines on abdominal somite 2. D spine absent. Abdominal boss absent. Telsonic spines absent. Uropods lacking marginal spines. Ventrolateral propodal spine row poorly developed and ending at least 1/3 propodal length from apex. Dorsal apical propodal spines absent. 1 small apical spine above cutting edges of propodus and dactylus of chela, or spine absent. 5 mesial propodal spines. 1 dorsomesial dactylar basal spine. Marginal dactylar basal spines usually absent. 2 or 3 apical mesial dactylar spines. 2 mesial carpal spines. Ventromesial carpal spines usually similar to or larger than ventral spine. Keel Pr1 semi-abrupt and apart and parallel. TAP count 6.5–8.0.

Description. Maximum OCL: 29.5 mm (no specimens <20 OCL).

Rostrum: Rostrum short, at most reaching midlength of 3rd antennal segment. Rostral sides slightly convergent or parallel; base slightly divergent or divergent, carinae bases of medium length; carinae rather thin. 1 or 2 (rarely 3) rostral spines per side; spines distal to midlength of carinae and medium sized to small, moderately pointed or rounded. Acumen spine similar to or slightly larger than marginal spines.

OCL/CL 0.80–0.83 i; RW/OCL 0.17–0.20 d.

Cephalon: Spination poor, usually 1 medium sized or small spine ventral to postorbital ridges, with some protuberances. 1st postorbital spine an edge or small; 2nd spine an edge or barely discernible when present, absent on several specimens. Suborbital spine medium sized. Lateral margin of antennal squame slightly or distinctly convex; squame widest at slightly or distinctly proximal to midlength; marginal spines absent. Epistome broad or very broad, margin scalloped. Antennal basipodite spine medium sized on specimens >25 OCL, large on some smaller specimens. Coxopodite spine medium sized and unimodal or bifid with one cusp distinctly larger.

ScL/OCL 0.17–0.21 d.

Thorax: Dorsal spines barely discernible. General tubercles medium sized or small, very small on specimens close to 20 OCL and moderately distributed to sparse. 2 or 3 cervical groove spines, medium sized or small and moderately pointed to blunt.

ArL/OCL 0.33–0.36; ArW/OCL 0.18–0.20; CaW/OCL 0.54–0.58; CaD/OCL 0.51–0.53.

Abdomen: Somite 1 and subsequent somites lacking D and D–L spines. 1–4 small or minute Li spines per side on somite 2 of specimens >25 OCL, smaller specimens lacking Li spines; spines moderately pointed to blunt; subsequent somites lacking Li spines (sometimes slight protuberance). Merely protuberances in Lii position.

AbdW/OCL 0.50–0.54; OCL/L 0.38–0.39.

Tailfan: Spines absent on telson and uropods, margins obviously irregular. Standard spines small or medium sized.

TeL/OCL 0.37–0.40.

Chelae: Chelae usually stout or very stout, more elongate on some small specimens. Teeth well developed on some specimens near 30 OCL.

Propodus: Ventrolateral spine row beginning some distance from propodal base and usually terminating 1/3 or 1/2 propodal length from finger apex; lateral spines small and sharp. Lateral spine ridge moderately developed. 5 mesial propodal spines, occasionally 5(+1) or 4(+1).

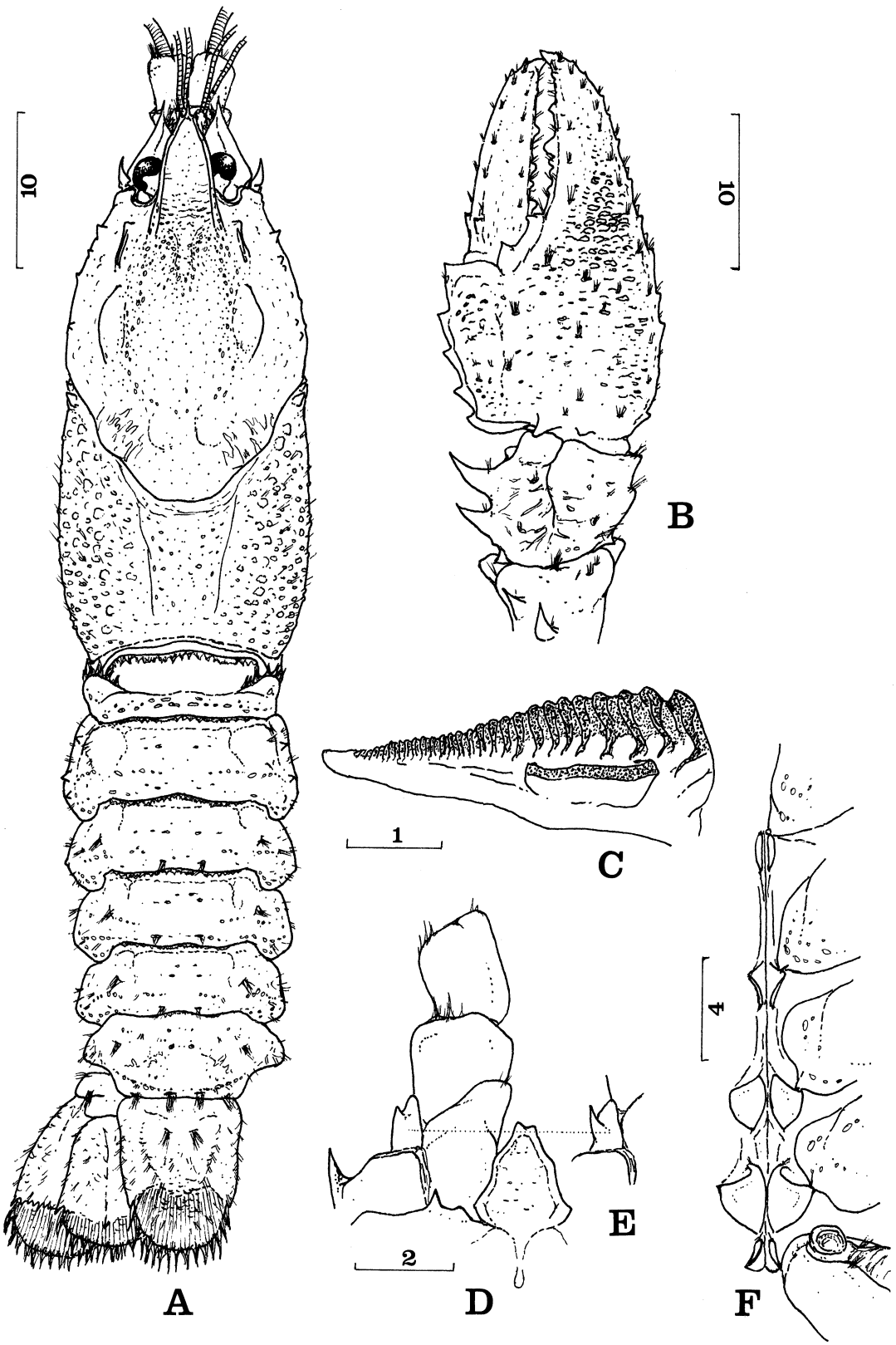

Fig. 27. *Euastacus guwinus* n.sp. A, dorsal view holotype male, Tianjara Creek, AM P34041; B, dorsal view chela, holotype male; C, ventral view zygocardiac ossicle, holotype male; D, ventral view cephalon, holotype male; E, large basipodite spine, paratype female, Tianjara Creek, AM P34040; F, sternal keel, holotype male.

Dorsal apical spines absent. 1 small apical spine above cutting edge or spines absent. Many obvious protuberances on dorsal surface lateral to dactylar base; ventrally, sometimes medium sized or small spine, frequently absent. Several low protuberances posterior to dactylar articulation. Precarpal spines absent but propodal dorsal surface irregular.

PropL/OCL 0.76–0.84; PropW/PropL 0.42–0.50 i; PropD/PropL 0.28–0.32.

Dactylus: 1 small apical spine above dactylar cutting edge, or spines absent. Extra dorsal dactylar spines absent. 1 dorsomesial dactylar basal spine; marginal basal spines usually absent (one specimen with spine on one chela); basal spines medium sized and usually rather sharp. 2 or 3 apical mesial dactylar spines. Dactylar groove present, sometimes deep.

DactL/PropL 0.51–0.55.

Carpus: 2 mesial carpal spines (one specimen with 3 spines on one chela); 1st (distal) spine slightly offset ventrally to 2nd; 2nd and 3rd spines fused at bases on one specimen with 3 spines. 2 lateral carpal spines medium sized to small. Small articulation spine. Dorsal carpal protuberances usually present, sometimes small blunt spine. Ventral carpal spine large or very large. Largest ventromesial spine large or very large on most specimens, usually similar size to or larger than ventral spine.

Merus: 5–7 dorsal spines. Outer meral spine absent or small.

Keel: *Pr1*: Posterior margins semi-abrupt; ventral edges flat or rounded; processes apart and parallel. Keel after Pr1 not very pronounced, without spines.

Pr2: Open or very open. Keel after Pr2 usually recessed or concave.

Pr3: Scoops absent; posterior edges sharp or moderately curved. Keel after Pr3 slightly pronounced or obviously pronounced on small animals.

Pr4: Scoops absent; posterior edges sharp and slightly convex or irregular; anterior edges angular.

Pr3 and 4 broad or very broad.

Setation: Light.

Punctation: Dense.

Gastric mill: TAP count 6.5–8.0; TAA count 1.0–1.5; spread 5.5–6.5. Teeth fairly close, ear of medium length. Urocardiac ridges 8–9.

Coloration: Body dorsally deep brown-green grading to paler brown ventrolaterally, some pale spots on lateral surface of thorax. General tubercles slightly paler dorsally; cervical spines light yellow. Li abdominal spines slightly paler. Cheliped articulations red. Carpus of cheliped dark green-brown, mesial spines tipped orange, lateral spines tipped yellow. Propodus rusty brown with green mottling, mesial area dark green with orange spines; spines at dactylar base red. Fingers green-blue.

Body ventrally orange and green. Carpus of cheliped blue-green with pale orange laterally; ventral spines orange. Propodus orange (especially bright medially) with some dark green mottling; mesial edge dark green; spines at dactylar base orange. Fingers pale green, often tinged blue, with dactylus mesially dark green.

Sexes: Males lack a cuticle partition. Some have well-developed papillae implying maturity at <30 OCL. Only one female has been collected and it has unopen gonopores. Female maturity occurs at sizes >30 OCL.

Distribution and biology. The species is known only from Tianjara Creek, above Tianjara Falls, a tributary of the Shoalhaven River near the southern boundary of Morton National Park, 30 km west of Jervis Bay, New South Wales. It is possible that the species extends north-west through the unsampled wilderness core of Morton National Park or south to the headwaters of the Clyde River.

The type locality is a small stream with sandstone bedrock, the banks lined by dry sclerophyll and heath forest. Though apparently typical of other creeks in the area, only this site revealed populations of *E. guwinus*. The site was open and rather poorly shaded but crayfish were more common under rocks in the shade of a bridge. The species was sympatric with *E. yanga* n.sp. and no habitat partitioning could be discerned.

Etymology. Derived from the word "guwin" (= ghost) from the Dharawal language of the area (Eades, 1976). The species was somewhat incorporeal, being found at only one site.

Remarks. Only six specimens of *E. guwinus*, all in the 20–30 OCL size range and from one site, have been examined and hence no geographical variation is evident.

The single sampled population of *E. guwinus* has adequate unique character combinations to warrant specific status but it is possible that other populations when sampled may markedly extend infraspecific variation. *Euastacus guwinus* is most similar to *E. dharawalus*. Some geographically intermediate sites were sampled without evidence of intergrade specimens but it is possible that future collections in Morton National Park may reveal them to be synonymous. On the basis of present material however, *E. guwinus* is a unique morphospecies that can be distinguished by differences in thoracic spination, degree of uneveness on the propodal surface lateral to the dactylar base and relative sizes of the antennal basipodite spine and of the ventromesial carpal spine. Both species lack a male cuticle partition and are probably closely related.

Euastacus hirsutus (McCulloch)

Figs 28–30

Astacopsis serratus var. *hirsutus* McCulloch, 1917: 238, pl. 43.
Euastacus serratus s.sp. *hirsutus*.–Clark, 1936: 14, pl. 2, fig. 14; Clark, 1937*b*: 186.
Euastacus hirsutus.–Clark, 1941: 17, 18; Riek, 1951: 385; Riek, 1969: 894.
Euastacus claytoni.–Riek, 1969: 909, 910 (in part, Cambewarra Creek as a locality). (Not *E. claytoni* Riek).
Euastacus keirensis Riek, 1969: 910, 911.

Type material. HOLOTYPE ♂, OCL 30.7 mm, AM P3706. NSW Belmore Falls Creek, 1913(?). PARATYPES: Type locality, AM P3707–15, 3 ♀♀, 6 M. TOPOTYPES: Belmore Falls, 5 Sept. 1948, AM P11915, 4 ♂♂, 3 ♀♀; Belmore Falls, M. Ward, AM P11916, ♂, ♀.

Other material examined. NSW Stream above falls, Belmore Falls Creek, Kangaroo River, near Kiama, 9 Mar. 1939, M. Ward, AM P15500, 2 ♂♂, 4 ♀♀; Belmore Falls, stream above falls, 9 Mar. 1939, M. Ward(?), AM P13450, 5 ♂♂, 10 ♀♀; Belmore Falls near Mittagong, Haswell(?), AM P15059–60, ♂, ♀; Barrengarry Creek (= Belmore Falls Creek) above Belmore Falls, (34°38'S 150°34'E), 22 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34029, ♂, 3 ♀♀; Tributary Kangaroo River near Bells Hill, north of Belmore Falls, (34°38'S 150°36'E), 22 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34030, 2 ♂♂, ♀; Tributary Minnamurra Creek near Falls picnic area (34°38'S 150°44'E), 21 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34031, 2 ♂♂, 2 ♀♀; Tributary Mullet Creek near Huntley Colliery, west of Dapto, (34°31'S 150°44'E), 21 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34032, 7 specimens; Tributary Byarong Creek, southern slope of Mount Keira, (34°25'S 150°51'E), 20 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34033, 10 specimens; Mount Keira, near Wollongong, 4 Nov. 1956, E.F. Riek, AM P15725–7, 8 ♂♂, 7 ♀♀, (types of *E. keirensis* Riek); Mount Keira, near Diggers Home, 28 Jun. 1962, R. Hauenstein, AM P14580, 3 ♂♂; Russells Creek near Camp Road, Mount Keira, 29 Jun. 1962, R. Hauenstein, AM P14579, ♂, 4 ♀♀; Wollongong, Feb. 1898, C. Hoskins, AM G1814, ♀; Headwaters of Cambewarra Creek, 8 miles west of Nowra, 5 Oct. 1958, J.P. Baldie, AM P15492, 7 ♂♂, 4 ♀♀; Tributary Sawyers Creek, near Beaumont, above Kangaroo Valley, (34°48'S 150°34'E), 21 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34016, ♂, ♀.

Diagnosis. Male cuticle partition present. Rostral spines usually to or proximal to midlength of carinae. Rostral base divergent, carinae rather short, spread. Antennal squame widest at or slightly distal or proximal to midlength. Squamal spines absent. Suborbital spine medium sized or large. Thoracic spines medium sized, small, barely discernible or absent. General tubercles medium sized or small and densely or moderately distributed. 2–6 medium sized or small Li spines on abdominal somite 2. D spine poorly developed or absent. Abdominal boss absent. Telsonic spines usually medium sized or small, sometimes absent. Uropods sometimes with marginal spines on inner ramus. Ventrolateral propodal spine row well developed, sometimes reaching apex of finger. 1 dorsal apical propodal spine on specimens >30 OCL. Spines above cutting edges of chela apical or reaching to or proximal to midlength of gape. Usually 5 or 6 (rarely 4 or 7) mesial propodal spines. 1 or 2 dorsomesial dactylar basal spines, or spines absent. Marginal mesial dactylar basal spines usually absent, sometimes 1 spine. 2 apical mesial dactylar spines. 3 mesial carpal spines. Ventromesial carpal spines smaller than ventral spine. Keel Pr1 sloped or semi-abrupt (rarely abrupt) and apart, usually parallel. TAP count 3.0–4.5.

Description. Maximum OCL: 44.0 mm.

Rostrum: Rostrum short, frequently not or only just reaching base of 3rd antennal segment, sometimes reaching beyond base of segment on Belmore Falls specimens and on some specimens <20 OCL. Rostral sides convergent or parallel; base divergent and slightly or distinctly spread. 2–5 (usually 3 or 4) rostral spines per side, usually distributed to or proximal to midlength of carinae, occasionally apical; spines medium sized or small, approaching large on some specimens <20 OCL; spines moderately pointed or rounded, occasionally sharp on specimens <30 OCL. Acumen spine similar size to, rarely slightly larger than, marginal spines.

OCL/CL 0.79–0.88 i; RW/OCL 0.14–0.23 d.

Cephalon: Spination moderate or poor with 2–5 medium sized or small spines ventral to postorbital ridges. 1st postorbital spine small or medium sized on specimens >30 OCL, sometimes large on smaller crayfish. 2nd postorbital spine an edge or small on specimens >30 OCL, medium sized on some smaller specimens, large on some very small crayfish. Suborbital spine medium sized or large. Lateral margin of antennal squame straight or slightly convex, rarely slightly concave; squame usually widest at approximately its midlength, sometimes slightly distal to or proximal to midlength, distinctly proximal to midlength on some specimens <20 OCL; marginal spines absent. Epistome of medium width or broad, very broad on some specimens <30 OCL; margin scalloped or slightly toothed. Antennal basipodite spine usually very small or medium sized, large on some small crayfish. Coxopodite spine usually small or medium sized, rarely large, and bifid or serrated.

ScL/OCL 0.14–0.29 d.

Thorax: Usually 5–16 thoracic spines per side, in thin zone or 2 irregular rows, sometimes fewer spines particularly on specimens <20 OCL; spines medium sized or small, very small on some specimens <30 OCL, and moderately pointed to blunt, rounded or flat on very small specimens. Some crayfish <30 OCL with barely discernible spines and specimens <20 OCL often lacking spines. Spines decreasing in size from north to south; specimens from Cambewarra Creek area lacking dorsal spines except for some specimens with minute rounded spines posterior to cervical spines. General tubercles medium sized or small on specimens >30 OCL, small or very small on specimens <30 OCL; tubercles dense

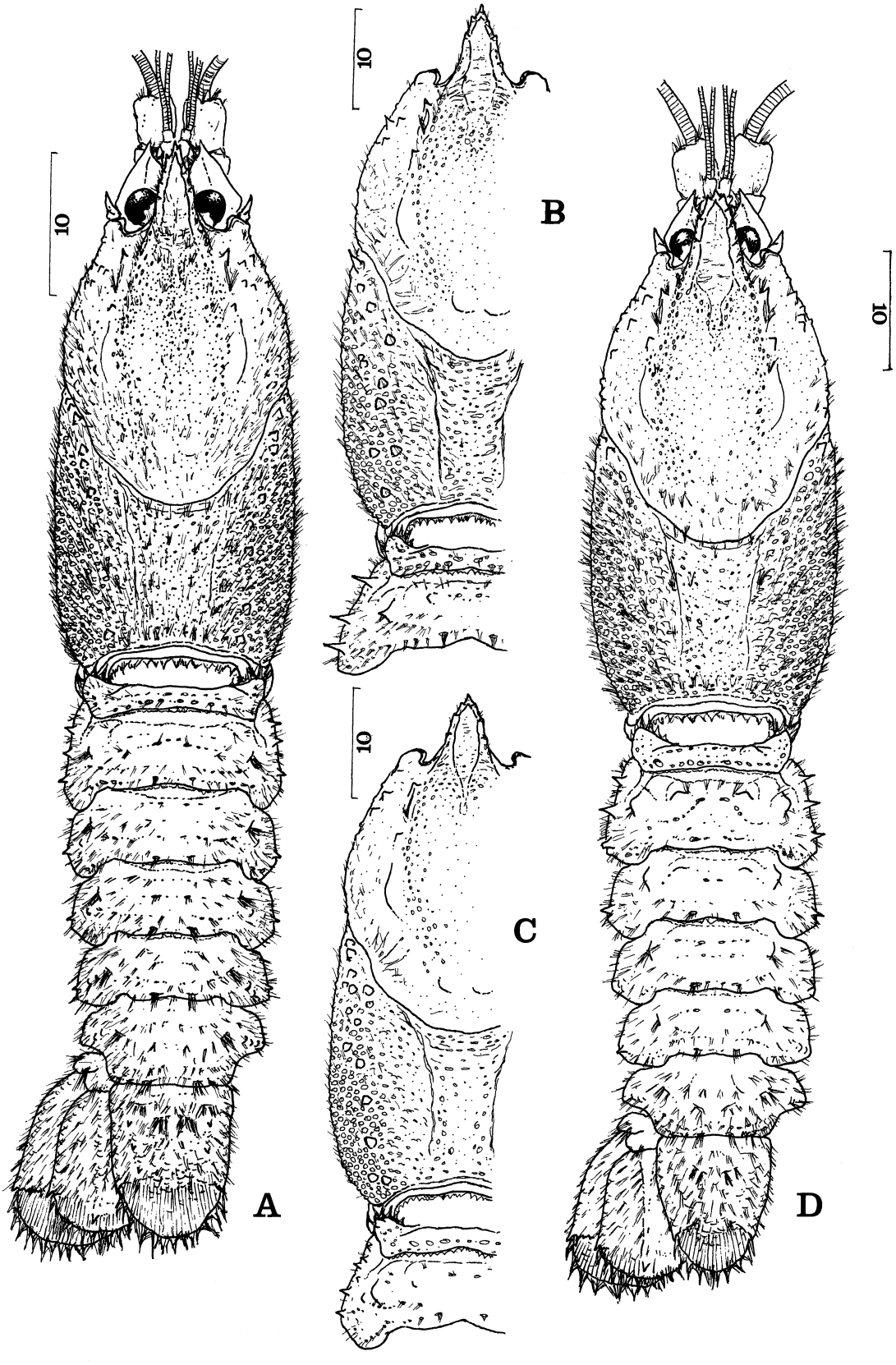

Fig. 28. *Euastacus hirsutus* (McCulloch). A, dorsal view, holotype male, Belmore Falls Creek, AM P3706; B, thoracic and abdominal spines larger, D–L and D spines on abdominal somite 2, rostrum less elongate, reduced setation, female, Minna Murra Creek, AM P34031; C, similar to B but further reduction in setation, smaller abdominal spines, D–L spine on somite 1, male, Mt Keira, AM P15727 (paratype of *E. keirensis* Riek); D, dorsal view, male, Cambewarra Creek, AM P15492.

to moderately dense on most specimens >30 OCL, sparse on most smaller animals. 1–5 (usually 2 or 3) cervical spines; spines usually medium sized, rarely large, small on specimens <30 OCL, and moderately pointed to sharp; dorsal spine frequently larger and sharper than remainder.

ArL/OCL 0.35–0.41; ArW/OCL 0.15–0.22 d; CaW/OCL 0.50–0.61 i; CaD/OCL 0.45–0.54 d.

Abdomen: Small or minute, sharp to blunt D–L spine sometimes on somite 1. D spine absent from somite 1. Usually 3–6 Li spines per side on somite 2, 1 or 2 spines on some specimens <30 OCL, absent on many <20 OCL. Single Li spine on somites 3–5 of most specimens, absent on some small crayfish; Li spines usually medium sized or small (rarely large), decreasing to posterior somites; spines very sharp or sharp on specimens >30 OCL, moderately pointed or blunt on some smaller specimens. 1 or 2 (occasionally 3) Lii spines per side, or spines absent especially on specimens <30 OCL; when present, spines small or minute and moderately pointed (rarely sharp) to very blunt. D–L spine on somites 2–5 of most specimens >40 OCL, frequently on specimens 30–40 OCL, less commonly on smaller crayfish; D–L spine rarely present on somite 6; D–L spines occasionally medium sized on anterior somites of large animals, usually small or minute and sharp to very blunt, bluntest on posterior somites. D–L spines poorly developed on Camberwarra specimens. D spines very weakly developed on some specimens >30 OCL, small to minute and blunt or very blunt when present. Abdominal boss absent.

AbdW/OCL J 0.49–0.56, K 0.46–0.65 i; OCL/L 0.37–0.43 i.

Tailfan: Telsonic surface spines usually present on specimens >20 OCL, numbering 2–11 and medium sized (rarely large) to small; specimens <20 OCL often lacking spines; spines largest on specimens from Mount Keira, decreasing in size to south, absent on Cambewarra crayfish. Lateral telsonic spines absent. Usually 1–3 medium sized or small median spines on inner ramus of uropod, absent on some specimens of all sizes; sometimes 1–3 extra lateral spines on inner ramus, but these frequently absent especially on specimens <40 OCL. Lateral margin of outer ramus lacking spines. Standard spines small or medium sized on specimens >30 OCL, medium sized or large on smaller animals.

TeL/OCL ♂ 0.34–0.40 d, ♀ 0.35–0.42 d.

Chelae: Chelae elongate to stout. Teeth well developed in specimens >40 OCL and on some >30 OCL.

Propodus: Ventrolateral spine row well developed, sometimes reaching apex of finger, frequently gap in row with 1 or 2 spines near apex. Lateral spines medium sized or small and rather sharp. Lateral spine ridge moderately or poorly developed. Usually 5 or 6 mesial propodal spines, sometimes 4 or 7. Most specimens >30 OCL with 1 dorsal apical propodal spine (one specimen with 2), often only slightly offset from spines above cutting edge and frequently absent on specimens <30 OCL. Usually 1–4 spines above cutting edge of specimens >20 OCL, often absent on smaller animals; spines apical or distributed to or proximal to midlength of gape, and medium sized (occasionally large) on specimens >30 OCL, smaller on lesser crayfish. Regenerate chelae frequently with fewer or lacking spines. Northern specimens generally with higher counts of spines above cutting edge than southern and western animals. 1–4 medium sized or small spines and protuberances on dorsal surface of propodus lateral to dactylar base, or propodal surface generally very irregular. Ventrally, usually 1–5 medium sized or small spines lateral to dactylar base, absent on some specimens, especially <20 OCL; northern specimens usually with higher counts than southern specimens. Rarely low spine after dactylar articulation. Precarpal spines usually absent except on regenerate chelae.

PropL/OCL ♂ 0.80–1.02 i, ♀ 0.81–0.99 i; PropW/PropL (0.32) 0.36–0.50 i; PropD/PropL (0.22) 0.26–0.32.

Dactylus: Usually 2–6 spines above cutting edge of specimens >20 OCL, sometimes only 1 spine, smaller crayfish often lacking spines; spines apical or extending to or proximal to midlength of gape, sometimes to full gape; spines medium sized (rarely large) or small. Spines often more extensive on northern specimens than southern. Regenerate chelae often lacking spines. Extra dorsal dactylar spine absent. Usually 1 (occasionally 2) dorsomesial dactylar basal spine(s); some specimens lacking spine. Marginal dactylar basal spines usually absent, occasionally single spine. Basal spines usually medium sized (rarely large) and rather sharp. Usually 2, occasionally 1 or 3, apical dactylar spines. Dactylar groove present, sometimes deep or only shallow.

DactL/PropL 0.51–0.61 i.

Carpus: 3 mesial carpal spines; one large specimen with 2(+1) on one chela and one from Belmore Falls with 3(+1) on one chela. 1st (distal) spine largest and usually only slightly offset ventrally to remainder; 2nd larger than 3rd spine. 2 or 3 small to large lateral carpal spines. Articulation spine usually absent, small on some large animals and medium sized on some specimens <20 OCL. Dorsal carpal spines absent on normal chelae. Ventral carpal spine very large to medium sized. 2–4 ventromesial spines; largest spine medium sized or small and smaller than ventral spine.

Merus: 5–10 dorsal spines; spines large or medium sized, small on some specimens <30 OCL. Outer meral spine small or medium sized.

Keel: *Pr1*: Posterior margins sloped or semi-abrupt, rarely abrupt; ventral edges flat, rounded or angled down; processes apart and usually parallel, sometimes closed or open. Keel after Pr1 usually lacking spines, sometimes slightly produced.

Pr2: Open or very open. Keel after Pr2 rather low, frequently with slight prominence or low spine.

Pr3: Usually distinctly concave, with gradual or distinct scoops; bases moderately curved to rounded. Keel after

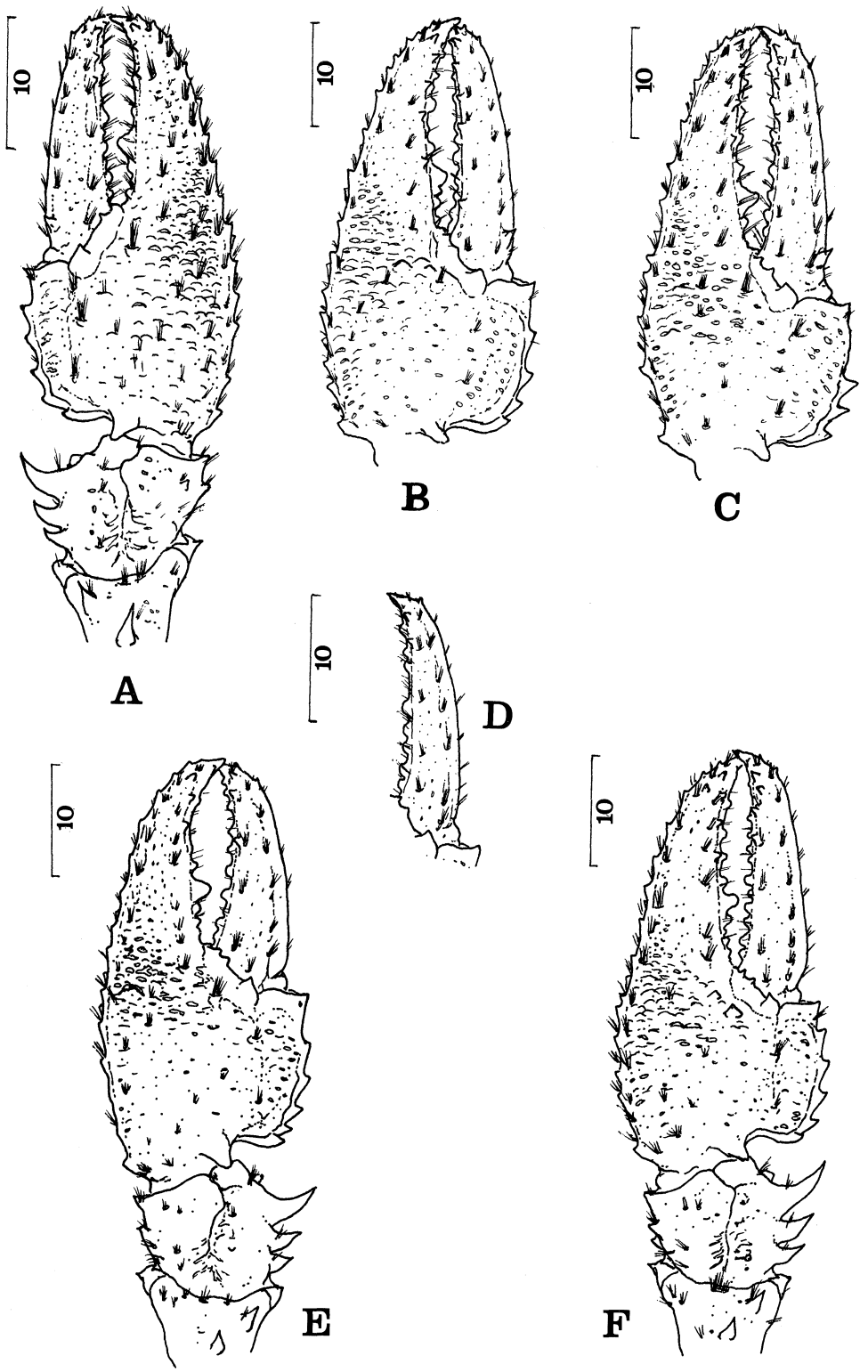

Fig. 29. *Euastacus hirsutus* (McCulloch). A, dorsal view chela, holotype male, Belmore Falls Creek, AM P3706; B, chela, 5 mesial propodal spines, more numerous spines above cutting edges, less setose, female, Mt Keira, AM P15727 (paratype of *E. keirensis* Rie); C, more elongate chela (possibly regenerate), 4 mesial propodal spines, female, Minna Murra Creek, AM P34031; D, dactylus of chela, dactylar basal spine absent, 1 apical mesial dactylar spine, female, AM P34031; E, chela, male, Cambewarra Creek, AM P15492; F, more elongate chela (possibly regenerate), spines lateral to dactylar base, 2 dorsal apical propodal spines, female, Sawyers Creek, AM P34016.

Pr3 variable in profile. Northern specimens with moderately pronounced keel, distinctly pronounced on specimens <20 OCL; keel less pronounced in southern specimens, sometimes recessed.

Pr4: Northern specimens often with slight or distinct scoops; scoops generally diminish to south and west and may be absent; posterior edges moderately curved or rounded, occasionally sharp on specimens <20 OCL and slightly convex, irregular or straight; anterior edges angular to rounded.

In north, Pr3 and 4 narrow on specimens >40 OCL, approaching broad or distinctly broad on smaller specimens. Belmore Falls specimens with broad processes, very broad on specimens <30 OCL. Specimens from intermediate sites with intermediate states.

Setation: Moderate to heavy, increasing from north to south.

Punctation: Dense to very dense (varying with setation since most pores are intrusions for setal bases).

Gastric mill: TAP count 3.0–4.5 (usually 3.5–4.0); TAA count 1.0–1.5; spread 2.0–3.5 (usually 2.5–3.0). Urocardiac ridges 5–8, usually increasing with size.

Coloration: Body dorsally dark green-brown of variable shades, slightly lighter ventrally; sometimes blue tinges on ventrolateral surface of cephalon. Dorsal spines either slightly lighter (pale orange) or darker; cervical spines orange. General tubercles slightly paler (light brown or orange). Cephalic protuberances-spines brown, orange or yellow. L and D–L abdominal spines orange; minute D spines dark. Cheliped articulations red. Carpus of cheliped very dark green with some blue distally; lateral spines yellow; mesial spines orange tipped. Propodus dark green or brown with green mottling; blue lateral and mesial edges; spines yellow, dorsolateral protuberances pale blue or cream. Fingers tinged blue, dark blue-green or green-grey; brighter blue distally.

Body ventrally orange and green. Carpus of cheliped mesially blue or dark blue-green, laterally cream-orange and green; mesial spines tipped orange; ventral spine orange. Propodus orange (especially bright medially); mesial edge dark green-blue. Fingers blue, brighter near tips, or tinged green or blue-grey with yellow tips; spines at dactylar articulation red.

Sexes: Males possess a cuticle partition. All females <30 OCL have closed gonopores. Females become mature and can be berried in the 30–40 OCL range and all specimens >40 OCL are mature.

Distribution and biology. The species ranges from Mount Keira near Wollongong, south and west to just north-east of Nowra, a distance of 55 km. The range is drained by small eastern flowing creeks and some larger streams, including Minnamurra and Cambewarra Creeks and the Kangaroo (Shoalhaven) River. *Euastacus hirsutus* was collected at altitudes between 200 m and 600 m a.s.l. from sedimentary (especially sandstone) areas with light temperate rainforest bordering streams and wet and/or dry sclerophyll above the creeks. Most sites were moderately to well shaded.

Berried females were collected in October, 1981. Three specimens carried 55, 73 and 84 eggs but the largest specimen bore only 14 eggs. This low number may represent the remainder of a recent hatching. Eggs were burgundy with white patches, indicating the development of embryos (Turvey, 1980). Two specimens (the allotype and a large paratype of *E. keirensis* Riek) are ovigerous and were collected in early November, 1956. It appears that the species overwinters with eggs, hatching occurring in spring and summer.

The range of *E. hirsutus* overlaps that of *E. yanga* and though their habitats appear similar, the two species were not found sympatric at any site. *Euastacus dharawalus* also occurs in the area.

Remarks. *Euastacus hirsutus* is extremely variable over its relatively small range, particularly in the degree of setation and punctation, chela spination (especially the number of dactylar basal spines), rostral shape, areola width, thoracic and telsonic spine size and sternal keel shape.

Euastacus keirensis Riek is here synonymised with *E. hirsutus* on the basis of variation within the Mount Keira populations and the existence of morphologically intermediate populations. Both *E. keirensis* and *E. hirsutus* had been described only from their type localities, Mount Keira near Wollongong and Belmore Falls on the Barrengarry River respectively. Riek (1969) briefly mentioned *E. hirsutus* also from Cambewarra Creek near Nowra without further reference. Clark (1941) noted a specimen from Bulli Pass but this is a specimen of *E. australasiensis*.

During 1981, Mount Keira and Belmore Falls were sampled together with several geographically intermediate localities and six sites revealed populations of *Euastacus* that are part of the *hirsutus* group. The only specimens that could be undeniably assigned to *E. keirensis* were those from Mount Keira and the only specimens clearly identifiable as *E. hirsutus* were those from Belmore Falls.

The characters of *E. hirsutus* and *E. keirensis* have been misrepresented in the past. *Euastacus hirsutus* was an early named variety of *Euastacus* and is described at some length by Clark (1941) who raised it to specific status. In her key (Clark, 1941: 12) and description (1941: 17, 18), *E. hirsutus* was recorded to lack tubercles or spines on the thorax. Small or medium sized spines are in fact present. The species was also noted by Clark to possess a "carpus with four sharp spines on upper margin". These undoubtedly refer to the mesial carpal spines which actually number 3. Only one specimen displays a small fourth carpal spine.

Riek (1969: 871, 872) keyed *E. hirsutus* and *E. keirensis* by way of three character states noted for *E. hirsutus*. He recorded that the dactylus is "not longitudinally grooved"; *E. hirsutus* specimens frequently

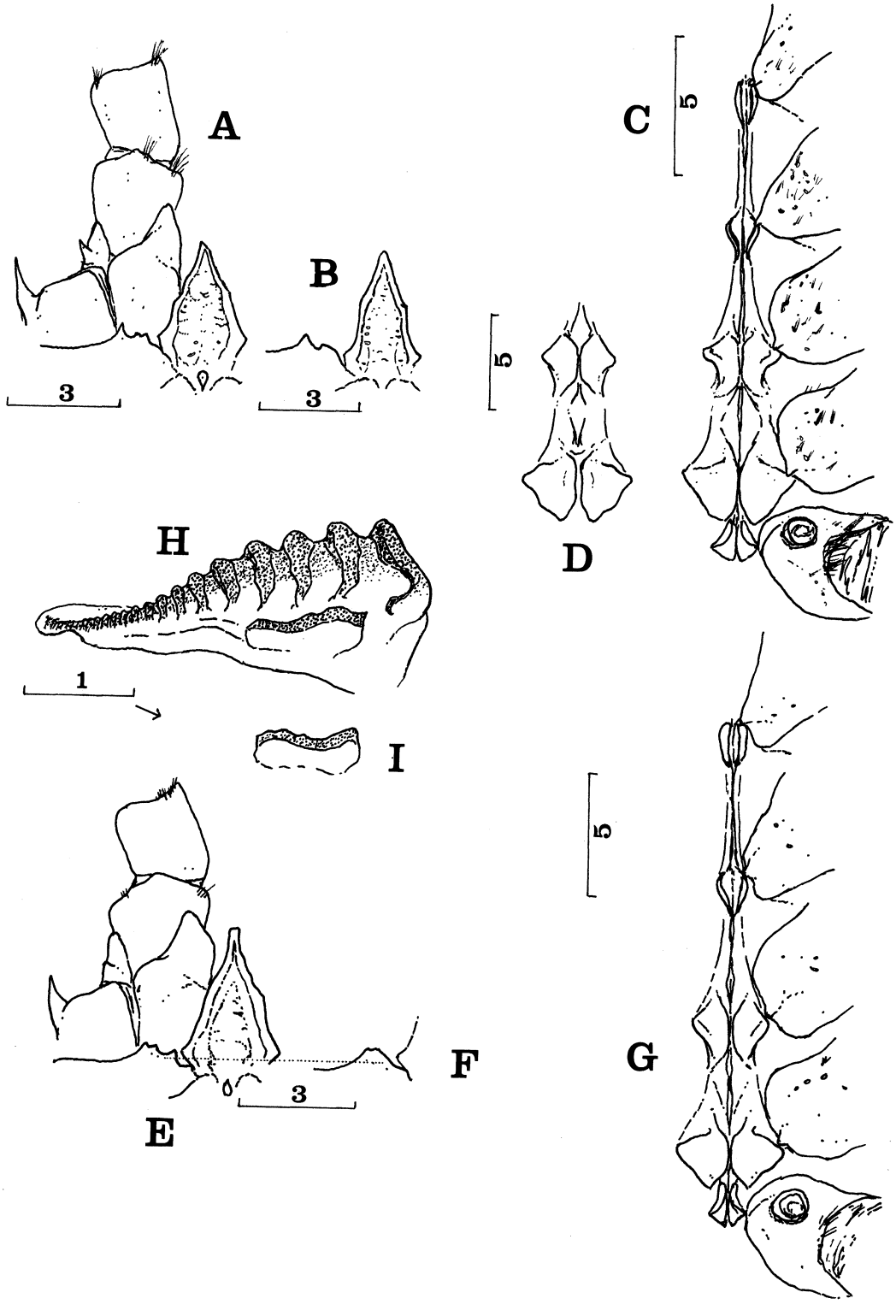

Fig. 30. *Euastacus hirsutus* (McCulloch). A, ventral view cephalon, holotype male, Belmore Falls, AM P3706; B, epistome and coxopodite spine, male, Belmore Falls, AM P13450; C, sternal keel, holotype male, AM P3706; D, keel processes 3 and 4, female, Minna Murra Creek, AM P34031; E, ventral view cephalon, male, Cambewarra Creek, AM P15492; F, coxopodite spine, female, Sawyers Creek, AM P34016; G, sternal keel, male, AM P15492; H, ventral view zygocardiac ossicle, holotype male, AM P3706 (Francois collection); I, ventral ear, female, Byarong Creek, AM P34033.

display a grooved dactylus and the groove may be obvious. Secondly, Riek, like Clark (1941), stated *E. hirsutus* to have "branchiostegites without an upper zone of obviously enlarged tubercles". Specimens from Belmore Falls have dorsally enlarged spines ranging from small to medium sized, rather obscured by dense setae. Thirdly, Riek recorded that *E. hirsutus* has an "abdomen with only a marginal row of spines". While the abdomen of *E. hirsutus* is not spiny by the standards of *Euastacus*, small Lii and D–L spines are usually present on large specimens.

Riek (1969) noted *E. keirensis* to have a "body not obviously hairy". In fact, populations of crayfish from Mount Keira are particularly variable in setal development and while some have only light to moderate setation (including the types AM P15725–27), the Russell Creek specimens (AM P14579) are rather densely setose and intermediate between the type *E. keirensis* and *E. hirsutus* conditions. Secondly, *E. keirensis*, like *E. hirsutus*, was noted to have only a marginal row of abdominal spines. Like specimens from Belmore Falls, those from Mount Keira frequently have Lii and small D–L spines and some large specimens have minute D spines or protuberances especially on somite 2. In addition, Riek (1969: 910, 911) described *E. keirensis* as differing from *E. hirsutus* in possessing 2 rows of spines on the lower margin of the propodus. This character is not diagnostic.

Francois (1962) discussed *E. hirsutus* only briefly. Two gastric mills from Mount Keira crayfish in his Australian Museum collection labelled "n. sp." are not included in his thesis. Unlike external characters, gastric mills show only slight variation. Zygocardiac ears are often slightly longer on southern and western populations resulting in TAP and spread counts usually 0.5 to 1.0 higher than those of northern populations. Variation within populations, however, incorporates interpopulation differences.

The major differences between the Mount Keira and Belmore Falls populations are the degree of setation and punctation and areola width. The first two characters are closely correlated as the pores are usually intrusions for the bases of setae. There is sufficient interpopulation variation and intermediacy in these traits to warrant their being regarded as infraspecific variation. Student's t-tests (Elliot, 1977) were carried out on relative areola widths between geographical populations within the size classes, 30–40, 20–30 and <20 OCL. Size classes were employed to reduce allometric effects. Areola width was significantly greater ($p<.01$) on Belmore Falls specimens than at Mount Keira. Differences between Belmore Falls animals and Cambewarra Creek crayfish were not significant, yet the Cambewarra specimens resemble most closely in other characters the specimens of Minnamurra Creek which are not significantly different in areola width from Mount Keira crayfish. Bells Hill specimens appear to have significantly different ($p<.05$) areola widths from Belmore Falls specimens, yet resemble them closely in most other characters. The effect is a blurring of any difference in areola width between populations.

The Cambewarra specimens (AM P15492) have proven awkward for other workers. Riek (1969: 894) recorded *E. hirsutus* from the headwaters of Cambewarra Creek but in the same paper (1969: 909, 910) described *E. claytoni* and included in its distribution, the headwaters of Cambewarra Creek. There are no museum specimens labelled either *E. hirsutus* or *E. claytoni* from this site; the specimens AM P15492 are labelled *E. australasiensis* by Riek. Largely on the basis of gastric mills, Francois (1962) considered the Cambewarra specimens to be *E. neohirsutus*. In addition to Riek's label of *E. australasiensis*, the specimens carry Francois' identification as "*neobusutus*", presumably a spelling error. Francois conceded that these specimens were "300 miles south" of the range of *E. neohirsutus* and suggested the possibility of convergence in characters.

In overall morphology, specimens from Cambewarra and Sawyers Creeks more closely resemble *E. neohirsutus* than type specimens of *E. hirsutus*. However, Cambewarra and Sawyers Creeks are approximately 500 km south of the southernmost sites of *E. neohirsutus* and several species of *Euastacus* occur in the intervening zone. I regard it as unlikely that a pocket of *E. neohirsutus* exists so distant from the remainder of the species and in close proximity to the similar and variable *E. hirsutus*. The Cambewarra and Sawyers Creeks populations show considerable convergence in morphology towards the *E. neohirsutus* condition.

The populations of *E. hirsutus* can be interpreted as subdivisions of a cline extending in a generally north-south direction from Mount Keira to Cambewarra Creek. Telsonic spines are largest in the north, generally decreasing in size to the south and west. Telsonic spines can be small on some Belmore Falls specimens and absent on the southern Cambewarra specimens. Thoracic spines are similarly variable in size, though less distinctly in a north to south gradient. On the basis of morphological similarities and the condition of the male cuticle partition, *E. hirsutus* is most closely related to *E. australasiensis, E. polysetosus, E. neohirsutus, E. spinichelatus* and *E. gamilaroi.*

Euastacus neohirsutus Riek

Figs 31, 32

Astacopsis serratus.–McCulloch, 1917: 237, 238 (in part, Dorrigo, NSW as a locality). (Not *Cancer serratus* Shaw, 1794).
Euastacus neohirsutus Riek, 1956: 3; Riek, 1969: 897.
Euastacus aquilus Riek, 1969: 911.

Type material. HOLOTYPE ♂, OCL 36.1 mm, AM P34088. NSW 20 miles west of Dorrigo, 20 Mar. 1954, E.F. Riek. ALLOTYPE ♀, OCL 42.7 mm, type locality, AM P34089. [Largest ♂ and ♀ assumed to be holotype and allotype respectively.] PARATYPES: Type locality, AM P13039, 4 ♂♂, 8 ♀♀.

Other material examined. NSW Tributary of Nana Creek, tributary of Orara River, south-west of Nana Glen, (30°13'S

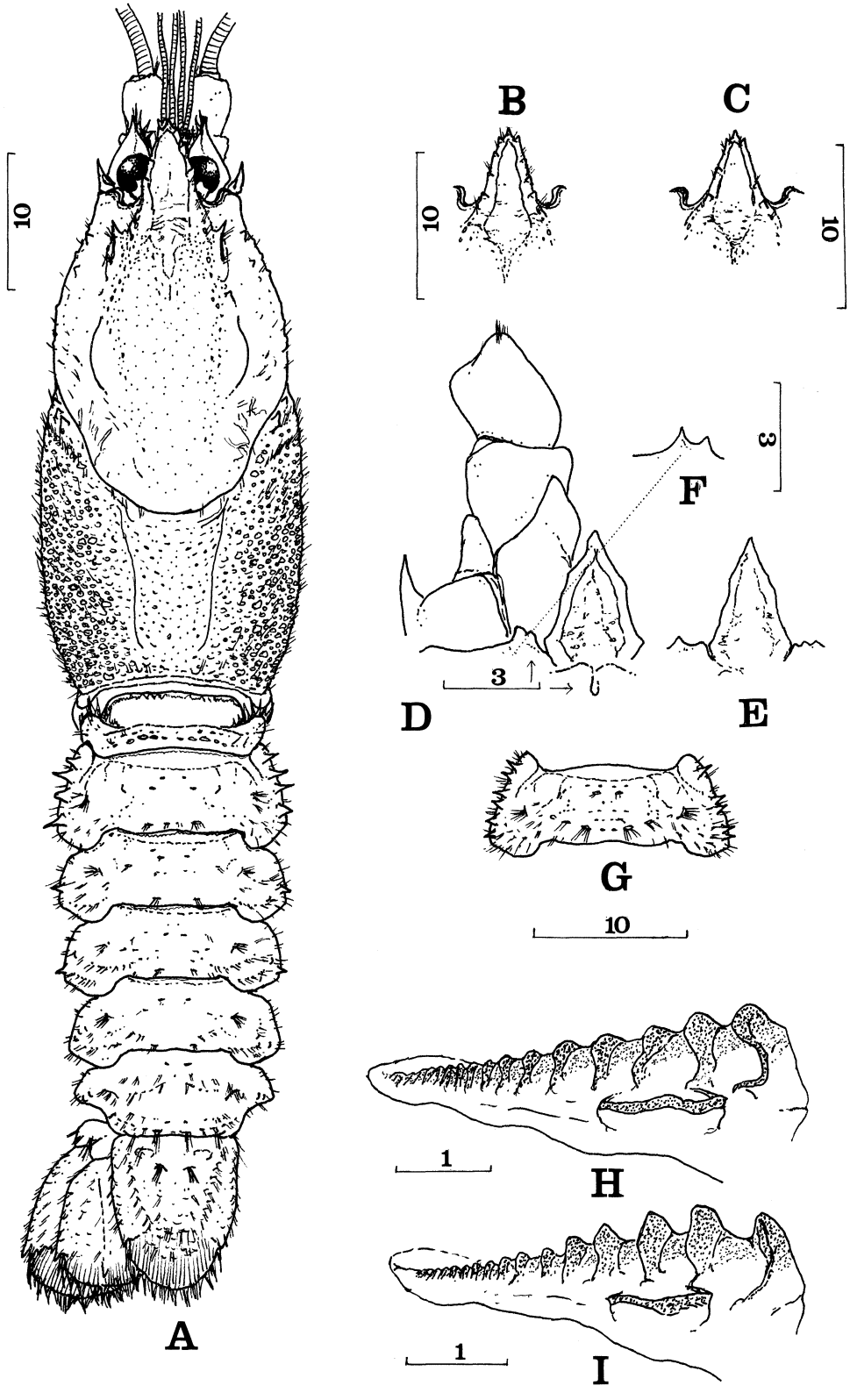

Fig. 31. *Euastacus neohirsutus* Riek. A, dorsal view, holotype male, west of Dorrigo, AM P34088; B, rostrum, male, Nana Creek, AM P34023; C, rostrum, female, Sullivans Creek, AM P34099; D, ventral view cephalon, holotype male, AM P34088; E, epistome, male, AM P34023; F, bifid coxopodite spine, intersex, Little Murray River, AM P34025; G, abdominal somite 2, more numerous L1 spines, more hirsute, male, AM P34023; H, ventral view zygocardiac ossicle, allotype female, west of Dorrigo, AM P34089; I, zygocardiac ossicle, male, AM P34023.

152°57'E), 10 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34023, 4 ♂♂, 2 ♀♀; Brimbin Creek, tributary of Little Nymboida River near Lowanna, (30°14'S 152°55'E), 10 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34028, 2 ♂♂, 3 ♀♀; Bobo River tributary near Lowanna, (30°14'S 152°50'E), 11 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34024, 2 ♂♂; Tributary of Flaggy Creek near Lowanna, (30°12'S 152°45'E), 11 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34017, 4 specimens; Moonmerri Creek, tributary of Nymboida River, (30°11'S 152°42'E), 11 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34020, 4 specimens; Tributary of Rosewood Creek, 200 m above Crystal Shower Falls, Dorrigo National Park, (30°23'S 152°43'E), 12 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34026, 6 specimens; Tributary of Rosewood Creek, above Callicoma Falls, Dorrigo National Park, (30°21'S 152°47'E), 12 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34019, ♂, 2 ♀♀; Dorrigo, 21 Mar. 1954, E.F. Riek, AM P13041, 2 ♂♂, 9 ♀♀, ♂♂/♀♀; Little Murray River, on Dorrigo-Ebor Road, (30°23'S 152°24'E), 12 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34025, ♂, ♂♂/♀♀; Coutts Water, Nymboida River, (30°21'S 152°29'E), 13 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34022, ♂, 2 ♀♀; Coutts Water, 18 miles west of Dorrigo, 22 Feb. 1966, E.F. Riek, AM P15721, ♀; Allans Water, Nymboida River, (30°21'S 152°28'E), 13 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34021, ♂; Boundary Creek, Nymboida River, (30°21'S 152°27'E), 13 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34027, ♀; Creek between Banksia and Lookout Points, New England National Park, (30°31'S 152°24'E), 14 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34018, 3 ♂♂, ♀; New England National Park, 9 Mar. 1954, E.F. Riek, AM P13040, 9 ♂♂, 8 ♀♀, 2 ♂♂♂/♀♀; New England National Park, beach forest near Point Lookout, 20 Feb. 1966, E.F. Riek, AM P15718–20 (holotype ♂, allotype ♀ and 6 paratypes of *E. aquilus* Riek); Sullivans Creek near Mount Killiekrankie, tributary of Nambucca River, 15 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34099, ♀, AM P34034, 2 ♂♂, ♀; Tributary of McKays Creek near headwaters, tributary of Nambucca River (30°32'S 152°33'E), 15 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34035, 2 ♂♂, ♀; Tributary Bellingen River near Richardsons Crossing west of Orama, (30°26'S 152°40'E), 15 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34007, 2 M.

Diagnosis. Male cuticle partition present. Rostral spines distributed to or proximal to midlength of carinae. Rostral base divergent or very divergent, carinae short and spread. Antennal squame widest at or proximal to midlength. Squamal spines absent. Suborbital spine medium sized (rarely large). Thoracic spines absent or just discernible. General tubercles medium sized or small and moderately or densely distributed. 2–6 medium sized or large Li spines on abdominal somite 2. D spine usually absent, sometimes barely discernible on somite 2. Abdominal boss absent. Telsonic spines absent. Uropods lacking marginal spines. Ventrolateral propodal spine row poorly developed or absent. 1 or 2 dorsal apical propodal spines. Spines above cutting edges of chela apical or reaching midlength of gape, sometimes proximal to midlength on dactylus. 5 or 6 (rarely 4) mesial propodal spines. 1 dorsomesial dactylar basal spine sometimes present. 1 or 2 apical mesial dactylar spines. 2 or 3 mesial carpal spines. Ventromesial carpal spines smaller than ventral spine. Keel Pr1 sloped or semi-abrupt and close or apart, usually parallel. TAP count 3.0–4.0.

Description. Maximum OCL: 42.8 mm.

Rostrum: Rostrum short, seldom reaching midlength of 3rd antennal segment, often not reaching base of segment. Rostral sides convergent or almost parallel. Base divergent or very divergent; carinae spread. 2–5 (usually 3 or 4) rostral spines per side, reaching to or proximal to midlength of carinae or full length; spines medium sized or small and moderately pointed or sharp. Acumen spine similar size to or slightly larger than marginal spines.

OCL/CL 0.80–0.89 i; RW/OCL 0.14–0.22 d.

Cephalon: Cephalon poorly to moderately spinose, 1–4 sharp spines and some protuberances ventral to postorbital ridges. 1st postorbital spine medium sized or small; 2nd spine absent, an edge or small, sometimes on one side only. Suborbital spine medium sized or sometimes large. Lateral margin of antennal squame slightly convex or straight, rarely slightly concave; widest at or proximal to midlength of squame; marginal spines absent. Epistome elongate to broad on specimens >20 OCL, medium width to very broad on smaller animals (epistome generally more elongate in western populations); margin scalloped or slightly toothed. Antennal basipodite spine absent or small; coxopodite spine small or medium sized, usually weakly bifid or serrated.

ScL/OCL 0.13–0.29 d.

Thorax: Dorsal thoracic spines absent or just discernible and obscured by setae. General tubercles medium sized or small on specimens >30 OCL, often very small on specimens <30 OCL; tubercles moderately dense or dense on specimens >20 OCL, sparser on smaller crayfish, absent on some very small animals. 1–6 cervical spines, medium sized or small and moderately pointed or blunt; dorsal spine sometimes slightly larger than others and sharp.

ArL/OCL 0.34–0.41; ArW/OCL 0.14–0.21 d; CaW/OCL 0.50–0.60; CaD/OCL 0.41–0.56 d.

Abdomen: Abdomen rather narrow and poorly spinose. D–L and D spines absent on somite 1. Usually 2–6 Li spines per side on somite 2 of crayfish >20 OCL, 1 spine on some specimens near 20 OCL, absent on most specimens <20 OCL. Subsequent somites with varying development of Li spines. On some specimens, Li spines absent on somites posterior to 2; in other populations, Li spine present on somites 3–5. Li spines large or medium sized on somite 2, to small or minute posteriorly, and very sharp to blunt; size and sharpness increasing with OCL. Lii spines usually absent, small or minute if present. D–L spines absent. D spines rare; minute blunt D spine sometimes on somite 2 of large crayfish, absent on subsequent somites. Dorsal boss absent.

AbdW/OCL J 0.45–0.51, K 0.46–0.60 i; OCL/L 0.37–0.43 i.

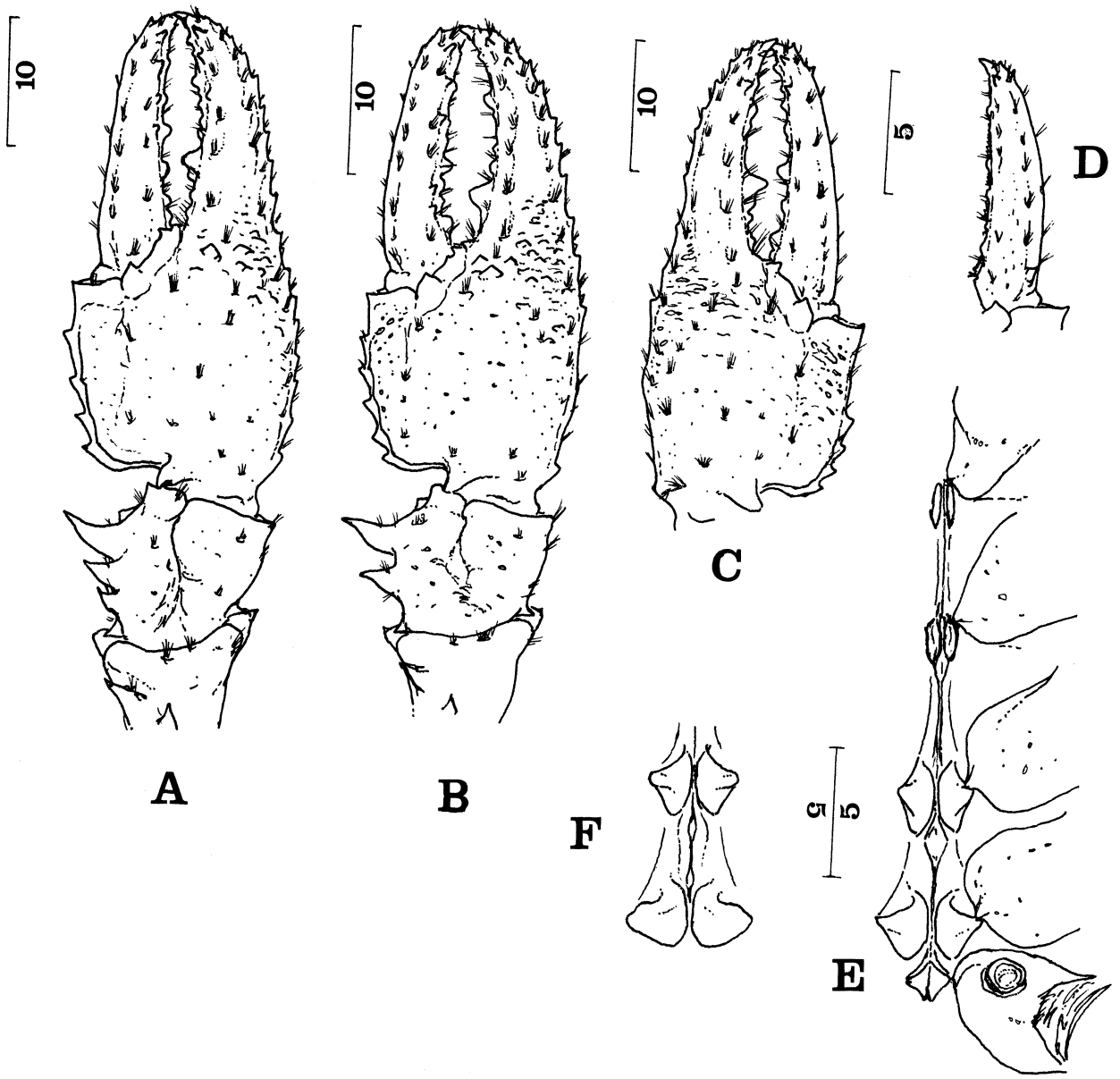

Fig. 32. *Euastacus neohirsutus* Riek. A, dorsal view chela, holotype male, west of Dorrigo, AM P34088; B, chela, 2 mesial carpal spines, 2 apical propodal spines, female, Sullivans Creek, AM P34099; C, chela, few spines above cutting edges, 2 apical mesial dactylar spines, male, Nana Creek, AM P34023; D, dactylus of chela, dorsomesial dactylar basal spine, female, Boundary Creek, AM P34027; E, sternal keel, holotype male, AM P34088; F, keel processes 3 and 4, male, AM P34023.

Tailfan: Telson and uropods lacking spines (one specimen with single lateral spine on one uropod); setal protuberances on lateral margins of uropods. Standard spines medium sized or small.

TeL/OCL ♂ 0.32–0.42 d, ♀ 0.33–0.40.

Chelae: Chelae elongate or intermediate in shape, lateral margin often concave. Teeth well developed in 20–40 OCL range. Usually obvious tufts of setae on propodus and dactylus.

Propodus: Ventrolateral propodal spine row often very poorly developed or absent, particularly in north-east of range; when present, ventrolateral row often confined to middle of propodal margin (sometimes more numerous spines on regenerate chelae). Lateral spine ridge small or very small. 5 or 6 (rarely 4, or 7 on regenerate chelae) mesial propodal spines. Usually 1 (occasionally 2) dorsal apical propodal spine(s) on large specimens, sometimes absent, as on many crayfish <20 OCL. 1 or 2 spines above cutting edge, or absent on some specimens 20–30 OCL and most <20 OCL (some regenerate chelae with 3 spines above cutting edge); spines apical or to midlength of gape, and medium sized or small. 0–2 medium sized or small

blunt dorsal spines lateral to dactylar base, lateral protuberances sometimes present; ventrally, 0–4 spines lateral to dactylar base, similar in size to those dorsally. No precarpal spines nor spines after dactylar articulation. Fingers lacking dense punctation.

PropL/OCL ♂ (0.79) 0.85–1.10 i, ♀ 0.84–1.05 i; PropW/PropL 0.36–0.46; PropD/PropL 0.24–0.31.

Dactylus: Usually 1–3 (occasionally 0, 4 or 5) spines above cutting edge of dactylus, spines apical or reaching to or proximal to midlength of gape (sometimes full gape), spines most extensive on southern animals; spines medium sized or small. Extra dorsal dactylar spines absent. 1 dorsomesial dactylar basal spine sometimes present, usually on regenerate chelae; marginal mesial basal spines absent except on some regenerate chelae; spines when present medium sized and rather sharp. 1 or 2 apical dactylar spines (one specimen with 3 on one deformed chela). Dactylar groove usually present, often shallow.

DactL/PropL 0.49–0.61.

Carpus: Usually 3 mesial carpal spines, distal spine largest and slightly offset ventrally to others; some southern populations with 2 carpal spines; 4 spines on some regenerate chelae. 1 or 2 lateral carpal spines, medium sized or small. Articulation spine only on small crayfish. Distinct dorsal spines absent. Ventral spine large or very large; 1 or 2 ventromesial spines, largest medium sized or small, sometimes large on regenerate chelae.

Merus: 6–10 medium sized or small dorsal meral spines, more on some regenerate chelae. Outer spine small, rarely medium sized on small crayfish.

Keel: *Pr1*: Posterior margins sloped or semi-abrupt; ventral edge angled back, almost flat, rounded or angled down; processes close, slightly apart or apart (some geographical variation) and usually parallel, occasionally closed, rather robust and pronounced. Keel after Pr1 lacking obvious spines.

Pr2: Open or almost parallel and rather robust; processes apart. Keel after Pr2 low, rarely with small spine.

Pr3: Scoops distinct or gradual (rarely absent); laterally rounded, moderately curved or sharp on some specimens <20 OCL. Keel after Pr3 recessed or slightly pronounced, often concave or anteriorly produced.

Pr4: Scoops usually absent, sometimes slight. Anterior edges rounded to angular (population variation); posterior edges slightly convex, irregular, or almost straight and usually rounded.

Pr3 and 4 narrow on large specimens, narrow or approaching broad on specimens 20–30 OCL, usually broad or very broad on specimens <20 OCL.

Setation: Moderately heavy or heavy, some populations less setose.

Punctation: Dense or very dense.

Gastric mill: TAP count 3.0–4.0 (usually 3.5); TAA count 1.0–1.5 (0.5 on one specimen); spread 2.0–3.0. Teeth large and spaced, zygocardiac ear frequently bearing notch and/or small ridge. Urocardiac ridges 5–7. Urocardiac ossicle rather shallow.

Coloration: Body dorsally dark brown, often tinged with green with some orange ventrolaterally. General tubercles and cephalic protuberances pale brown. Abdominal Li spines pale orange. Carpus of cheliped dark green, green-blue or green-brown, spines tipped with orange. Propodus similar to carpus, usually mottled, mesial spines blue or blue-green. Fingers blue-green.

Body ventrally orange and green, often with blue patches. Carpus of cheliped mesially dark green-blue or blue, laterally orange with green tinges. Propodus mesially dark green-blue with blue spines, laterally orange with green mottling.

Sexes: Male cuticle partition present, rather broad. All females in 20–30 OCL range have unopen gonopores but some show slight development of setae around the pores which may indicate approaching maturity. Of the 15 females in the 30–40 OCL range, 9 have open gonopores (3 are berried) and an additional 4 appear to be opening. Both females >40 OCL are mature. Hence, female maturity most commonly occurs in the 30–40 OCL range.

Distribution and biology. The species ranges from the coastal mountains 20 km north-west of Coffs Harbour, south and west through the Dorrigo region to New England National Park and Mount Killiekrankie area, a distance along the north-east to south-west axis of approximately 65 km. Main river systems are the Orara and Nymboida Rivers to the north (Clarence River drainage) and the Bellingen and Nambucca Rivers flowing east.

In the east of its range, *E. neohirsutus* is found in generally small, very cool (9.6–11.8°C in September) creeks fringed by rainforest and frequently with sclerophyll forest on the higher, more exposed ridges. Altitudes range from 480 m to 710 m a.s.l. Two specimens (AM P34007) were collected from a tributary of the Bellingen River at only 70 m a.s.l. The stream was cool (11.9°C) and lined with rainforest. This find may indicate movement of the species dowstream during a prolonged drought. In the west of its range on the Dorrigo Plateau at altitudes between 1070 m and 1250 m a.s.l., the species occurs in streams in areas largely cleared for agriculture, bearing at most a sparse border of eucalypts, wattles and raspberry along the creek banks. Berried females were collected from several sites in September, 1981.

In the west, *E. neohirsutus* is often sympatric with *E. simplex* Riek. The two species can be collected from under the same rock on the stream bed. Farther west, *E. simplex* replaces *E. neohirsutus* in the open, sclerophyll forested streams.

Remarks. *Euastacus neohirsutus* is a variable species. It is possible to recognise populations from most sites sampled across the species' range. While generally short or very short, rostra may be distinctly triangular (sides convergent) or rather narrow with sides almost parallel. Specimens from the north-east of the range (e.g., near Lowanna, north of Dorrigo) have shorter, more triangular rostra than those from the south-west (e.g., New England National Park). Rostral spines are usually less numerous on specimens from the south-west. Most specimens from New England National Park lack a second postorbital spine, while populations around Dorrigo frequently bear an edge or small spine, if only on one side. In the north-east, the spine is usually absent again. Specimens from New England National Park usually possess a more elongate epistome (interantennal spine) than do animals from the Dorrigo and north-eastern sites. Specimens from the north-east usually bear only a dorsolateral propodal spine row though 1 or 2 ventrolateral spines may be present. Across the range of the species, the ventrolateral row usually comprises only 2–4 central spines but is best developed to the south-west. Apical mesial dactylar spines usually number 1 in the south-west, usually 2 in the east and around Dorrigo. The number of spines above the cutting edges of chelae is higher in the south-east than elsewhere. Some south-eastern specimens have only 2 mesial carpal spines.

Euastacus aquilus Riek is here regarded as a junior synonym of *E. neohirsutus*. *Euastacus aquilus* was described by Riek on the basis of eight specimens from New England National Park. The description (Riek, 1969: 911) is difficult to compare to that of *E. neohirsutus* (see Riek, 1956: 3) because very few characters are common to both descriptions. The only character difference that can be inferred is that *E. neohirsutus* has the "cephalic region slightly more than twice as long as areola" while *E. aquilus* has the "cephalon almost twice as long as the thorax (areola)". This difference would be very minor if it were valid but in fact the specimens of *E. aquilus* display proportions that are within in the variation displayed by *E. neohirsutus*. Riek (1969: 871–872) keyed the two species by stating *E. neohirsutus* to possess branchiostegites "without an upper zone of obviously enlarged tubercles, usually densely hairy" while *E. aquilus* is "not obviously hairy". This contradicts his description of the latter species (Riek, 1969: 911) as possessing "dense fine hairs". There is some variation in the setation of *E. neohirsutus* but specimens are usually moderately to heavily setose with rather short setae. The specimens of *E. aquilus* are moderately, sometimes almost heavily, setose.

Euastacus polysetosus Riek

Figs 33, 34

Astacopsis serratus.–McCulloch, 1917: 237, 238 (in part, Barrington Tops as a locality). (Not *Cancer serratus* Shaw, 1794).

Euastacus polysetosus Riek, 1951: 384; Riek, 1969: 896.

Type material. HOLOTYPE ♂, OCL 47.4 mm, AM P11917. NSW Tubrabucca Creek, tributary of Hunter River, Barrington Tops, 7 Apr. 1949, E.F. Riek. ALLOTYPE ♀, OCL 43.2 mm, type locality, AM P11918. PARATYPES: Type locality, AM P11919, 5 ♂♂, 7 ♀♀.

Other material examined. NSW Western branch of Barrington River, Barrington Tops near Dungog, 5000 ft, Apr. 1925, T. Campbell & Prof. Harrison, AM P7931–44, 7 ♂♂, 8 ♀♀; Barrington River, Barrington Tops, Nov. 1926, A. Musgrave & T. Campbell, AM P8710–11, 2 ♀♀; Manning River headwaters, Barrington Tops, 7 Apr. 1949, E.F. Riek, AM P11936, 2 ♂♂, ♀; Williams River, O'Gradys Hub, 4600 ft, 16 Jan. 1947, AM P11907, ♂, ♀; Dilgry River, Barrington Tops, (31°54'S 151°31'E), 30 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34003, 2 ♂♂, 2 ♀♀; Manning River, Barrington Tops, (31°53'S 151°30'E), 30 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34005, 5 ♂♂, ♀; Polblue Creek, below Polblue Swamp, Barrington Tops, (31°58'S 151°26'E), 30 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34006, 3 ♂♂, ♀; Gunyah Creek near headwaters, Barrington Tops, (31°55'S 151°35'E), 1 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34004, M.

Diagnosis. Male cuticle partition present. Rostral spines extending proximal to midlength or full length of carinae. Rostral base divergent or very divergent, carinae short. Antennal squame widest at or slightly proximal to midlength. Squamal spines absent. Suborbital spine medium sized or small. Thoracic spines absent (sometimes just discernible posterior to cervical groove). General tubercles medium sized or small, usually densely distributed. 2–5 medium sized or small Li spines on abdominal somite 2. D spine usually absent. Abdominal boss absent. Telsonic spines usually absent (rarely 2–5 minute spines). Uropods lacking marginal spines. Ventrolateral propodal spine row reaching distal tip of finger or ending subdistally. 0 or 1 dorsal apical propodal spine. Spines above chela cutting edges usually apical, rarely reaching to midlength of gape. 5 or 6 (rarely 4) mesial propodal spines. Sometimes 1 dorsomesial dactylar basal spine. 2 (rarely 1) apical mesial dactylar spines. 3 (rarely 4) mesial carpal spines. Ventromesial carpal spines smaller than ventral spine. Keel Pr 1 sloped or semi-abrupt and close or slightly apart, parallel. TAP count 2.5 to 3.5.

Description. Maximum OCL: 56.6 mm.

Rostrum: Rostrum not or just reaching base of 3rd antennal segment, or reaching just short of midlength of segment on small crayfish. Rostral sides slightly convergent or parallel; base divergent or very divergent, carinae moderately spread or spread. 2–5 rostral spines

per side, reaching to midlength or full length of carinae; spines small or medium sized, occasionally large on specimens <20 OCL and usually moderately pointed, sometimes rounded, or sharp on specimens <20 OCL. Acumen spine similar to marginal spines.

OCL/CL 0.80–0.90 i; RW/OCL 0.13–0.21 d.

Cephalon: Spination poor, usually with 1 or 2 sharp and slightly larger spines and several protuberances ventral to postorbital ridges. 1st postorbital spine an edge or small; 2nd spine absent or an edge, often on one side only. Suborbital spine medium sized or small. Lateral margin of antennal squame straight or convex; squame widest at or slightly proximal to midlength on large specimens, distinctly proximal on small animals; marginal spines absent. Epistome elongate or medium width on specimens >30 OCL, broad on most smaller crayfish; margin scalloped or slightly toothed. Antennal basipodite spine absent or very small; coxopodite spine small on specimens >40 OCL, medium sized on some smaller crayfish, spine bifid or serrated.

ScL/OCL 0.12–0.26 d.

Thorax: Thoracic spines usually absent or just discernible on some specimens >30 OCL, sometimes slightly enlarged tubercles posterior cervical spines. General tubercles medium sized or small and very dense to moderately dense on specimens >30 OCL, moderately spaced on specimens 20–30 OCL, sparse or absent on animals <20 OCL. 2–5 cervical spines per side, small (1 rarely medium sized) and moderately pointed or blunt.

ArL/OCL 0.35–0.40; ArW/OCL 0.14–0.21 d; CaW/OCL 0.51–0.59 i; CaD/OCL (0.46) 0.48–0.53.

Abdomen: D–L spines usually absent on somite 1, occasionally small spine present. D spines absent on somite 1. 2–5 Li spines per side on somite 2, absent on some specimens <20 OCL. 1 Li spine usually present on somites 3–5 of specimens >20 OCL; Li spines medium sized to small or minute, decreasing posteriorly; spines very sharp on some large crayfish, small and blunt on small animals. Lii spines small or absent; usually 1 or 2 small Lii spines on somite 6 of large crayfish. D–L spines poorly developed, often absent, usually only on somites 2 and 3 and then small or minute and moderately pointed to very blunt. D spines usually absent; one large specimen (holotype) with minute D spine on one side of somite 2. Specimens <20 OCL often lacking abdominal spines. Dorsal boss absent.

AbdW/OCL J 0.49–0.56, K 0.50–0.63 i; OCL/L 0.36–0.44 i.

Tailfan: 2–5 minute dorsal spines on telson of some large and medium sized specimens but spines normally absent. Uropods usually lacking spines (very rarely median spine on inner ramus); lateral margins of uropods usually irregular. Telsonic standard spines small or medium sized.

TeL/OCL ♂ 0.32–0.42 d; ♀ 0.35–0.41 di.

Chelae: Chelae usually intermediate in shape, occasionally stout on large specimens, elongate on some small animals (some geographical variation). Teeth well developed in 20–40 OCL range.

Propodus: Ventrolateral spine row well developed on crayfish >20 OCL, sometimes reaching apex of finger; lateral spines usually small, occasionally medium sized; lateral ridge small or absent. 5 or 6 (rarely 4) mesial propodal spines. 0 or 1 dorsal apical spine. Usually 2 or 3 (rarely 1) medium sized or large spines above cutting edge of specimens >20 OCL; spines apical or very rarely to midlength of gape; spines often absent on animals <20 OCL and some larger specimens. Usually 1 or 2 medium sized, rather blunt spines lateral to dactylar base dorsally, generally with some small protuberances; ventrally, about 1–4 medium or small spines; dorsal and ventral spines often absent on crayfish <30 OCL. Spines posterior to dactylar articulation and precarpal spines absent. Cheliped fingers rather punctate.

PropL/OCL ♂ (0.78) 0.83–1.01 i, ♀ (0.76) 0.81–0.92 i; PropW/PropL (0.34) 0.38–0.51 i; PropD/PropL 0.26–0.32.

Dactylus: 1–4 (usually 1 or 2) spines above cutting edge on most specimens >20 OCL, these usually apical and occasionally reaching midlength of gape (proximal to midlength on one specimen); spines medium sized or small; spines usually absent on crayfish <20 OCL (and on some larger specimens). Extra dorsal dactylar spines absent. Sometimes 1 dorsomesial dactylar basal spine, though often absent on crayfish of all sizes (one specimen with 2 dorsomesial spines on one chela); when present, spine medium sized or large. Marginal mesial dactylar spines absent on all but some regenerate chelae. Usually 2 (rarely 1) apical mesial spines. Dactylar groove present.

DactL/PropL 0.52–0.60 i.

Carpus: 3 mesial carpal spines, very rarely 4 or 2(+1) on regenerate and some apparently non-regenerate chelae; 1st (distal) and largest spine offset ventrally, 2nd slightly or considerably larger than 3rd. 1 or 2 medium sized or small lateral carpal spines. Dorsal spines absent. Ventral spine large or very large; largest ventromesial spine medium sized or small.

Merus: Usually 7–10 dorsal meral spines. Outer spine absent or small.

Keel: Pr1: Posterior margins sloped or semi-abrupt; ventral margins usually angled down, occasionally flat or rounded (angled back on one specimen); processes close or slightly apart, and parallel. Keel after Pr1 lacking obvious spines.

Pr2: Usually open, occasionally very open or almost parallel; processes rather thin and usually close. Keel after Pr2 low, without spines.

Pr3: Gradual scoops, nearly parallel on some specimens; posterior margins rounded, occasionally sharp. Keel after Pr3 recessed or only slightly pronounced, often anteriorly.

Pr4: Scoops sometimes present but commonly absent;

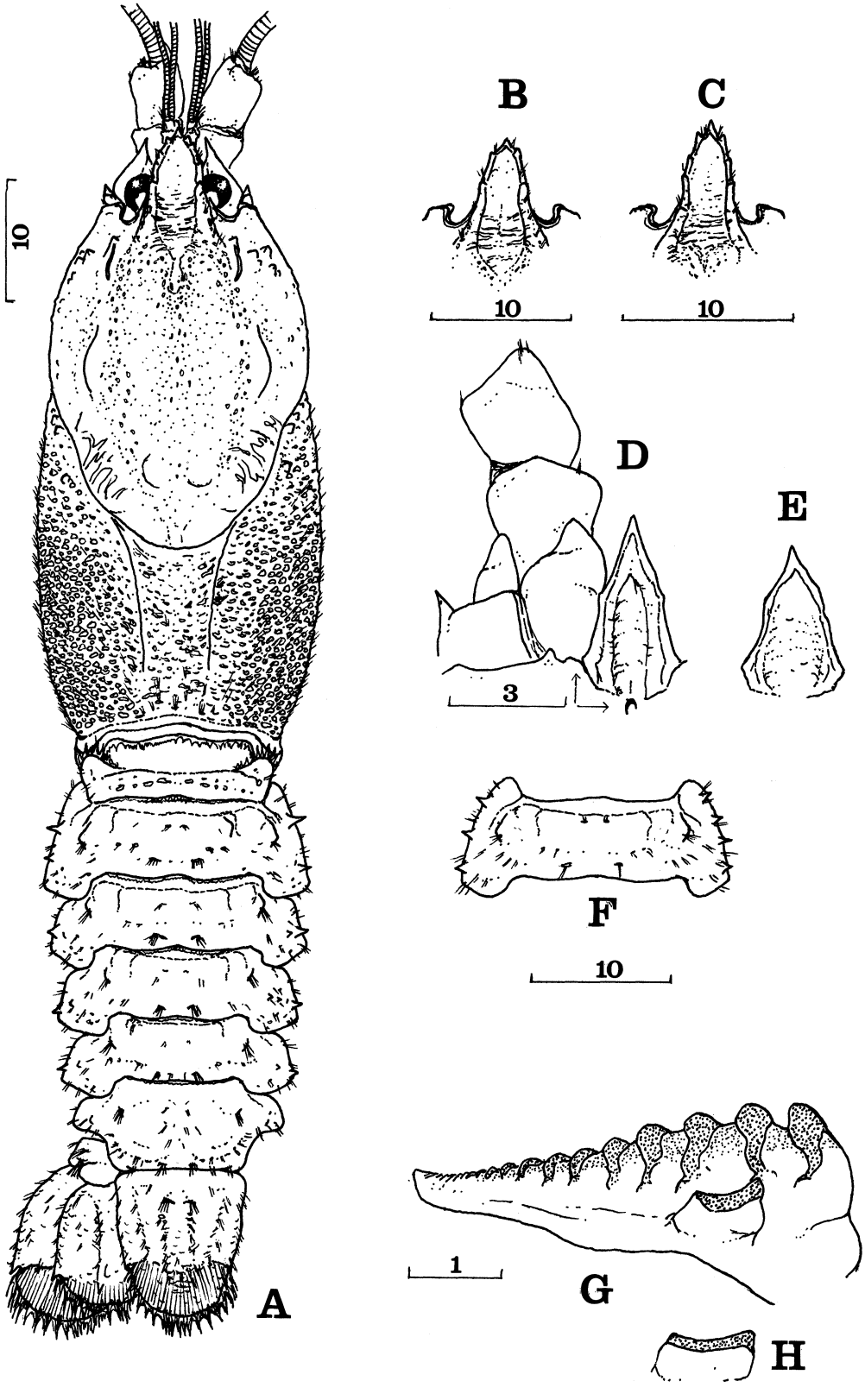

Fig. 33. *Euastacus polysetosus* Riek. A, dorsal view, holotype male, Tubrabucca Creek, AM P11917; B, rostrum, allotype female, Tubrabucca Creek, AM P11918; C, rostrum, male, Manning River, AM P34005; D, ventral view cephalon, holotype male, AM P11917; E, epistome, allotype female, AM P11918; F, abdominal somite 2, more numerous L1 spines, paratype female, Tubrabucca Creek, AM P11919; G, ventral view zygocardiac ossicle, paratype, AM P11919 (Francois collection); H, ventral ear, holotype male, AM P11917 (Francois collection).

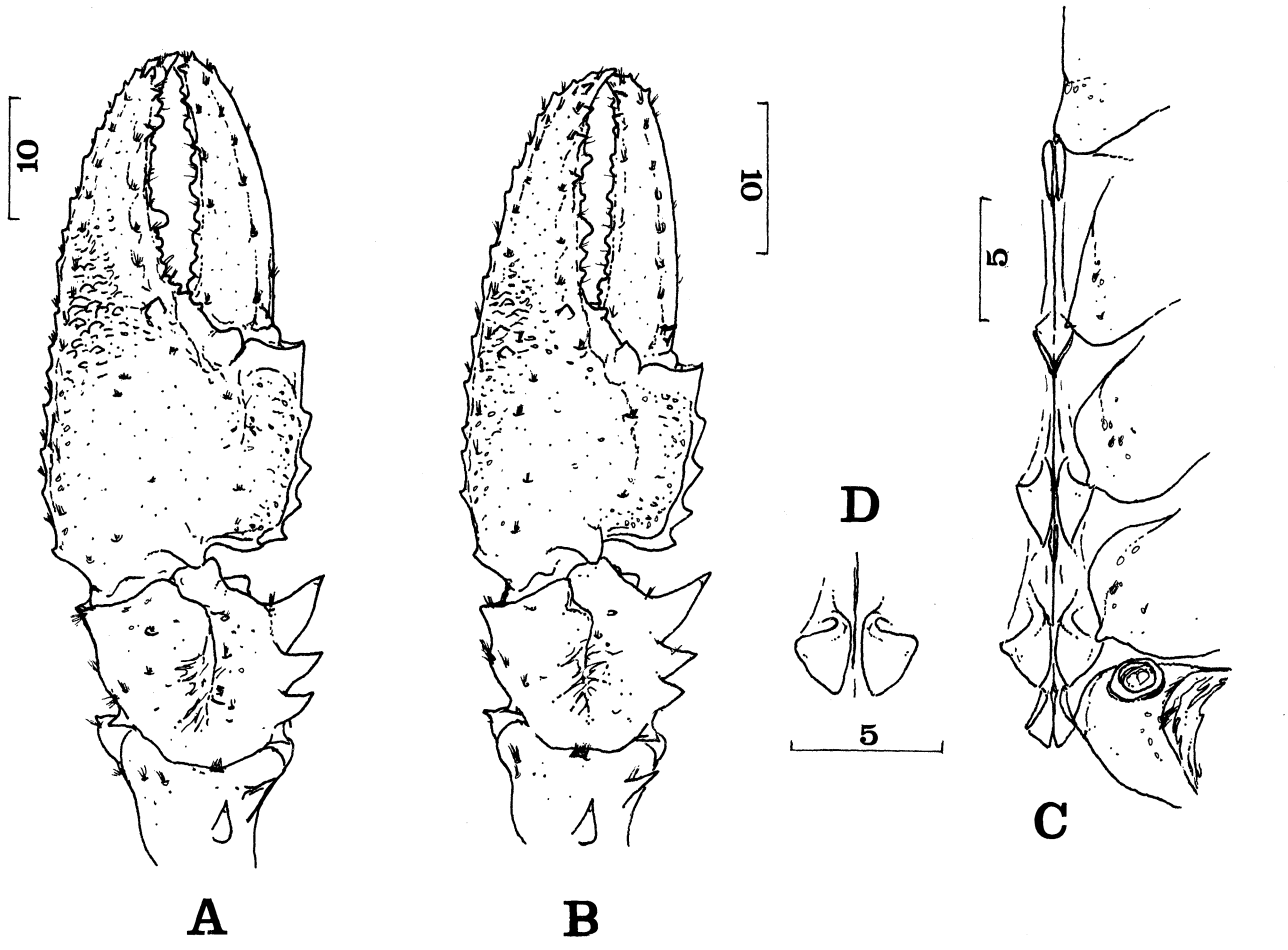

Fig. 34. *Euastacus polysetosus* Riek. A, dorsal view chela, holotype male, Tubrabucca Creek, AM P11917; B, chela (possibly regenerate), dorsomesial dactylar basal spine, male, Dilgry River, AM P34003; C, sternal keel, holotype male, AM P11917; D, keel processes 4, male, Manning River, AM P34005.

posterior margins rounded or moderately curved and irregular or slightly convex; anterior edges angular or very angular.

Pr3 and 4 very narrow or narrow on specimens >40 OCL, narrow to almost broad on animals 20–40 OCL, narrow to broad on specimens <20 OCL.

Setation: Moderate on most specimens >20 OCL, light on some smaller animals.

Punctation: Dense or very dense.

Gastric mill: TAP count 3.0 (rarely 2.5 or 3.5); TAA count 1.0–1.5; spread 1.5–2.5. Teeth large, usually rounded; zygocardiac ear short. Urocardiac ridges 5–8.

Coloration: Body dorsally deep brown-green or brown, paler and greyer ventrolaterally. Carpus of cheliped deep blue, blue-green or green, with orange near propodal articulation; carpal spines tipped orange or yellow. Propodus green or ochre with dark blue or green mottling; mesially darker. Dactylus blue or green.

Body ventrally orange, green and blue-green. Abdominal pleura green with salmon tinges. Cheliped carpus mesially dark green or green-blue, laterally orange. Propodus orange mottled with green, mesial edge dark green. Fingers dark orange, dactylus with mesial edge green or blue-green.

Sexes: Male cuticle partition present, usually rather thin. Females <30 OCL have unopen gonopores though two specimens have light setae bordering the pores implying onset of maturity. Some 30–40 OCL females and all >40 OCL have open pores. Female maturation therefore usually occurs at sizes near 40 OCL.

Distribution and biology. *Euastacus polysetosus* inhabits streams at altitudes above 1000 m a.s.l. in the Barrington Tops area approximately 60 km west of Taree, New South Wales. The range of the species is drained by tributaries of the Manning River to the east and Hunter River to the west. Stream banks are vegetated by dry sclerophyll forest often with some tree ferns, subalpine grassland with snow gums and negrohead beechforest.

Remarks. *Euastacus polysetosus* has a limited range in the Barrington Tops area and while moderately variable does not display marked clinal variation. The shape of chelipeds appears particularly variable.

D. Francois' collection of gastric mills in the Australian Museum has several mills bearing the label "*E. nobilis* var." from Barrington Tops, in addition to mills labelled as *E. polysetosus*. The former mills are also those of *E. polysetosus*.

Euastacus polysetosus most closely resembles *E. neohirsutus* Riek, *E. spinichelatus* n.sp. and *E. gamilaroi* n.sp. The four species occur in an area approximately 250 km by 150 km in northern New South Wales. They share poor cephalic, thoracic and abdominal spination, absent or minute telsonic spines, short rostra and relatively dense general tubercles on the thorax. Coloration is also similar. *Euastacus polysetosus* can be distinguished by its relatively light setation, well-developed ventrolateral propodal spine row, close sternal keel Pr1 and poor spination on the chelae.

An unusual specimen (AM P4068) lacks a locality label but its registration number places it from Barrington Tops. It has 3 and 4 dorsal apical propodal spines, atypical of E. polysetosus but converging on *E. gamilaroi*. There are 4 apical dactylar spines, a unique state for these four species. The dactylar basal spine configuration and gastric mill are more typical of *E. polysetosus* and it is probably a variant of that species. It may represent an intergrade between *E. polysetosus* and *E. gamilaroi* and these species might possibly be synonymous.

Euastacus reductus Riek

Figs 35, 36

Euastacus reductus Riek, 1969: 907, fig. 16B.
Euastacus alienus Riek, 1969: 907, 908.

Type material. HOLOTYPE ♂, OCL 29.9 mm, AM P15731. NSW Upper Allyn River, southern slope of Barrington Tops, 8 Jan. 1958, E.F. Riek. ALLOTYPE ♀, OCL 28.5 mm, type locality, AM P15732. PARATYPES: NSW Type locality, AM P15733, 4 ♂♂, 7 ♀♀; Upper Allyn River, 16 Feb. 1966, E.F. Riek, AM P15322, ♂, 3 ♀♀.

Other material examined. Dingo Creek tributary, on Elands-Wingham Road, (31°38'S 152°11'E), 29 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34011, ♀; Duffers Creek, Copeland Tops State Forest west of Barrington, (31°59'S 152°49'E), 30 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34012, 2 ♂♂, 4 ♀♀; Martins Creek, tributary of Karuah River west of Stratford, (32°08'S 151°50'E), 1 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34014, ♂, ♀; Whispering Gully, tributary of Karuah River, (32°10'S 151°50'E), 1 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34002, 4 ♀♀; Telegherry River, Telegherry Forest Park, (32°15'S 151°49'E), 2 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34008, ♂; Jerusalem Creek, Jerusalem Creek Forest Park, (32°18'S 151°50'E), 2 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34009, ♂, 2 ♀♀; Upper Allyn River tributary, near Peach Tree Park, Barrington Tops, (32°16'S 151°28'E), 2 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34013, ♂, ♀; Sandy Creek, Myall Range, west of Bulahdelah, (32°23'S 152°10'E), 3 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34010, 9 specimens; Bulahdelah Mountain, near Stroud, 8 Sept. 1960, E.F. Riek, AM P15722–4 (holotype, allotype and paratype of *E. alienus* Riek).

Diagnosis. Male cuticle partition present. Rostral spines distributed proximal to midlength or full length of carinae. Rostral base divergent or very divergent, carinae spread. Antennal squame widest at or slightly proximal to midlength. Squamal spines usually absent, sometimes present on one or both squames. Suborbital spine small. Thoracic spines absent. General tubercles small and densely distributed. 1–8 medium sized or small Li spines on abdominal somite 2. D spine absent. Abdominal boss absent. Telsonic spines absent. Uropods lacking marginal spines. Ventrolateral propodal spine row not reaching apex of finger and sometimes absent. Spines above cutting edges of chela apical or extending proximal to midlength of gape, or sometimes absent. 4–7 mesial propodal spines. Mesial dactylar basal spines absent. 1 or 2 apical mesial dactylar spines. 4 mesial carpal spines. Largest ventromesial carpal spine usually larger than ventral spine. Keel Pr1 sloped and close, usually parallel. TAP count 3.5 (rarely 3.0).

Description. Maximum OCL: 34.5 mm.

Rostrum: Rostrum very short, not reaching base of 3rd antennal segment except on some very small specimens. Sides slightly to distinctly convergent; base divergent or very divergent, carinae short and spread. 2–4 spines per side, reaching between midlength and full length of carinae; spines medium sized or small, moderately pointed or sharp (rarely rounded, probably due to abrasion). Acumen spine similar to marginal spines.

OCL/CL 0.85–0.91 i; RW/OCL 0.12–0.19 d.

Cephalon: Spination poor, with 1 or 2 small spines and protuberances ventral to postorbital ridges. 1st postorbital spine small or medium sized; 2nd postorbital spine absent. Suborbital spine usually small or very small, medium sized on some specimens <20 OCL and on specimens from Bulahdelah region. Lateral margin of antennal squame straight or convex; squame widest at or slightly proximal to midlength. Most specimens lacking marginal spines on squame; some with spine on one or both squames; one specimen with 3 spines on both squames. Epistome elongate on crayfish >30 OCL, usually broader on smaller specimens; margin slightly toothed, scalloped or fairly smooth. Antennal basipodite spine absent or small. Coxopodite spine medium sized on most specimens >20 OCL, smaller on small crayfish; spine usually bifid, occasionally serrated.

ScL/OCL 0.12–0.19 d.

Thorax: Dorsal thoracic spines absent. General tubercles small (slightly larger dorsally), very small on specimens <20 OCL; tubercles very dense or dense at >30 OCL, dense to moderately sparse on specimens 20–30 OCL, very sparse on some very small crayfish. 1–4 cervical spines, small or very small and moderately pointed to very blunt.

ArL/OCL 0.35–0.41; ArW/OCL 0.13–0.22 d; CaW/OCL 0.48–0.57 i; CaD/OCL 0.40–0.47 d.

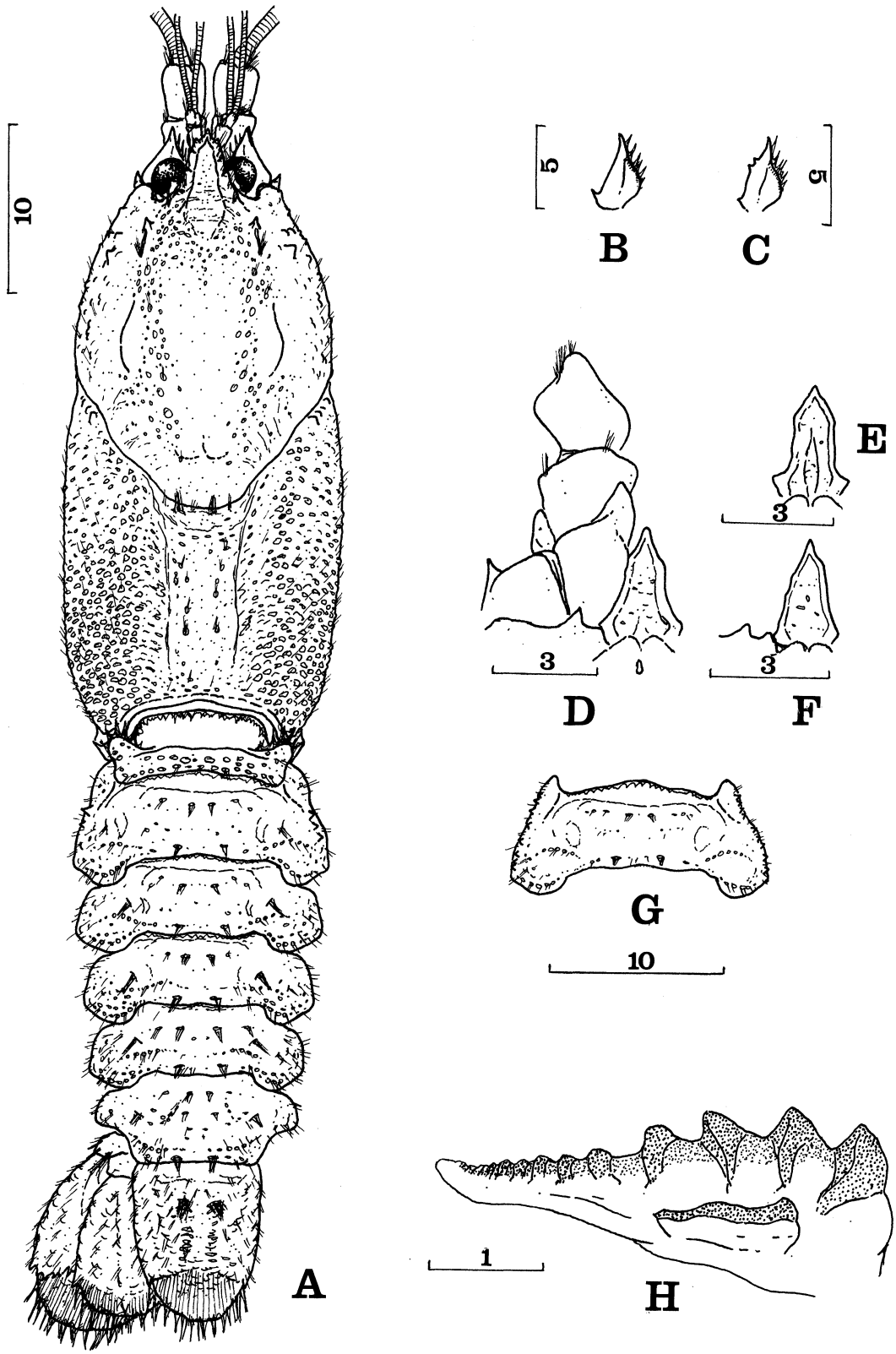

Fig. 35. *Euastacus reductus* Riek. A, dorsal view, holotype male, Upper Allyn River, AM P15731; B, antennal squame, lateral spine, female, "Bulahdelah Mountain", AM P15722 (holotype of *E. alienus* Riek); C, antennal squame, 3 lateral spines, male, Telegherry River, AM P34008; D, ventral view cephalon, holotype male, AM P15731; E, epistome, paratype male, Upper Allyn River, AM P15733; F, epistome, female, Duffers Creek, AM P34012; G, abdominal somite 2, numerous small L1 spines, female, Jerusalem Creek, AM P34009; H, ventral view zygocardiac ossicle, female, AM P34012.

Abdomen: Abdominal spination poor. D–L and D spines absent from all somites. Somite 2 with 1–8 (usually 2–5) medium sized to small, sharp or moderately pointed Li spines, number and sharpness increasing with size of animal. One specimen with 11 very small Li spines on one side of somite 2. Li spines on somites 3–6 poorly developed, when present minute and usually blunt. Lii spines absent or represented as tiny protuberances associated with abdominal setae. Some specimens <20 OCL lacking abdominal spines. Dorsal boss absent (most somites dorsally flattened).

AbdW/OCL J 0.45–0.51, K 0.40–0.54 i; OCL/L 0.37–0.45 i.

Tailfan: Spines absent on telson and uropods (one specimen with median spine on inner rami of uropods); obvious setal protuberances on margins of uropods. Standard spines very small or small, sometimes medium sized on specimens <20 OCL.

TeL/OCL ♂ 0.30–0.37 d, ♀ 0.32–0.40.

Chelae: Most specimens with chelae intermediate in shape, some elongate or stout, with lateral margin usually slightly concave. Teeth well developed on specimens >30 OCL.

Propodus: Ventrolateral spine row not reaching apex of finger and sometimes absent (development of row varying between populations); 1–4 (usually 1 or 2) ventrolateral spines centrally placed or towards proximal border of propodus, spines absent on many very small crayfish; spines medium sized or small. Lateral spine ridge poorly developed or absent. 4–7 (usually 5 or 6) mesial spines, often asymmetrical between chelae. Dorsal apical propodal spines usually absent, though some specimens with 1 or 2 spines (variation largely on population basis); crayfish <20 OCL usually lacking spines. Usually 1–3 spines above cutting edge (4 on some regenerate chelae), absent on some specimens; when present, spines medium sized or small, often spaced, sometimes distributed to proximal of midlength of gape. 1 or 2 small or medium sized spines and several protuberances or minute spines lateral to dactylar base, both dorsally and ventrally. Low ridge posterior to dactylar articulation and rarely minute precarpal spine. Propodus usually very punctate.

PropL/OCL ♂ 0.77–1.00 i, ♀ 0.78–0.95 i; PropW/PropL 0.39–0.50; PropD/PropL 0.24–0.34.

Dactylus: Usually 1–3 spines above cutting edge of dactylus, spines occasionally absent especially on specimens <20 OCL; regenerate chelae may be more or less spinose; spines usually apical, sometimes extending full gape of chela with spines very spaced; spines small to large, largest often proximal. Extra dorsal dactylar spines absent. Dactylar basal spines absent. Usually 1, sometimes 2, apical dactylar spines, absent on many specimens <20 OCL. Dactylar groove present.

DactL/PropL 0.51–0.60.

Carpus: 4 mesial spines (3 on some regenerate chelae, 5 on chela of one small specimen). 1st (distal) and 3rd spines usually slightly offset ventrally to 2nd and 4th; 3rd and 4th often similarly sized, usually closer together than 1st, 2nd and 3rd. 1 or 2 (rarely 3) small or minute lateral carpal spines. Articulation spine absent or small. Dorsal carpal spines absent. Ventral carpal spine small or medium sized, usually smaller than largest ventromesial spine which may be small to large; 2 or 3 additional small or minute ventromesial spines.

Merus: Usually 6–9 small dorsal spines, distal 2 often poorly developed. Outer spine small or absent.

Keel: Pr1: Posterior margins very sloped or sloped; ventral edges angled down. Processes usually close, sometimes slightly apart, usually parallel, very rarely closed. Keel after Pr1 lacking spines, sometimes with slight protuberance.

Pr2: Usually almost parallel, sometimes open; processes produced steeply from keel. Keel after Pr2 usually low, sometimes slight anterior protuberance.

Pr3: Usually moderately sharp with gradual scoops, sometimes rounded with slight scoops. Keel after Pr3 moderately or distinctly pronounced.

Pr4: Posterior edges moderately sharp to rounded and straight to convex; scoops absent or slight; anterior edges usually angular, sometimes moderately curved (rounded on one specimen).

Pr3 and 4 narrow on specimens >30 OCL, broad or very broad on smaller crayfish.

Setation: Moderate to heavy.

Punctation: Moderate to dense.

Gastric mill: TAP count 3.5 (rarely 3.0); TAA count 1.0–1.5; spread 2.0 (rarely 2.5). Teeth large and spaced, ear moderately long and frequently notched. Urocardiac ridges 3–6, generally increasing with specimen size. Ossicle shallow.

Coloration: Body dorsally deep green-brown or red-brown, paler ventrolaterally. Orange patch ventrolaterally on cephalon. Somites of abdomen slightly darker along posterior margins. Carpus of cheliped intense blue, blue-green, green-brown or orange and green dorsally, with orange near articulation with propodus. Propodus mostly blue, blue-brown or deep green with median green mottling often on paler orange tinged background. Fingers dark blue, tips paler and yellower.

Body ventrally orange, green and cream. Carpus of cheliped cream with blue areas or darker blue-green, ventromesial spines orange. Propodus white or cream with median blue mottling and deep blue-green along mesial edge. Fingers usually blue.

Sexes: Male cuticle partition present. Three of the 16 females in the 20–30 OCL range have open gonopores (one bears juveniles and one is berried) and one more

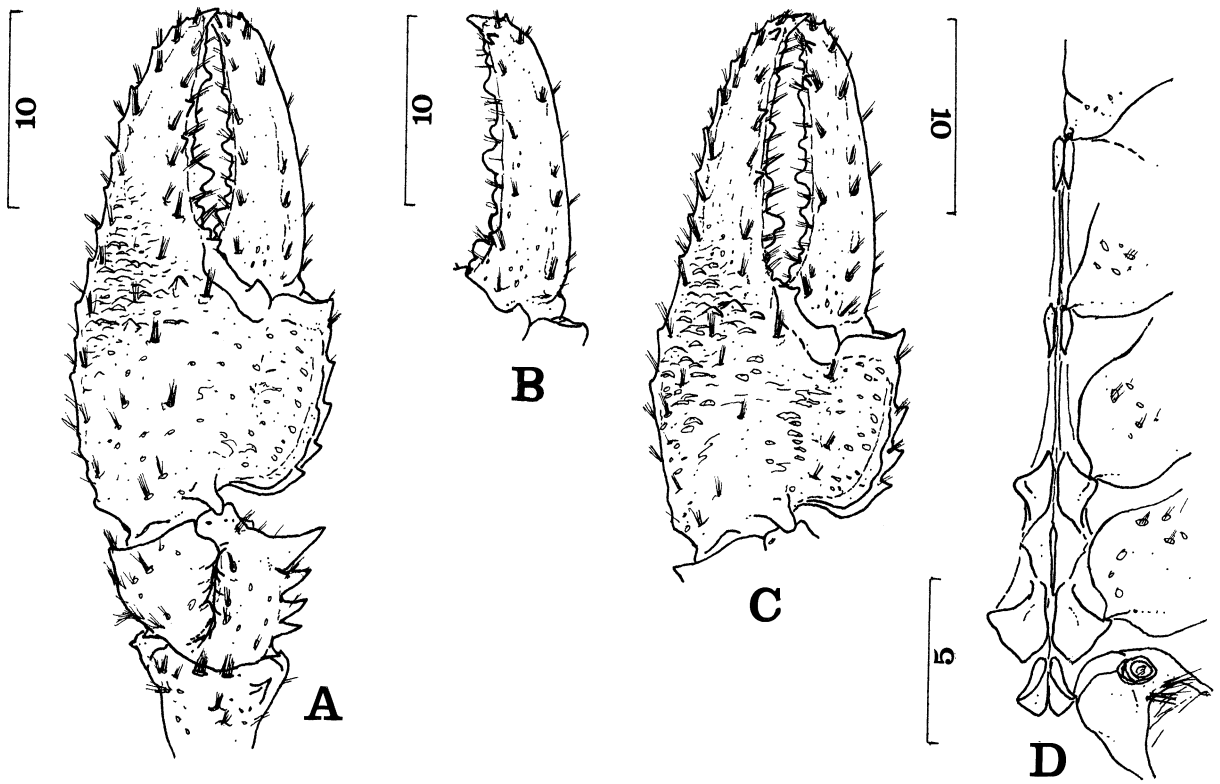

Fig. 36. *Euastacus reductus* Riek. A, dorsal view chela, holotype male, Upper Allyn River, AM P15731; B, dactylus of chela, second proximal spine above cutting edge, paratype male, Upper Allyn River, AM P15733; C, chela, more elongate, 4 mesial propodal spines, dorsal apical propodal spine, female, Duffers Creek, AM P34012; D, sternal keel, holotype male, AM P15731.

appears to be opening. All three females >30 OCL have open pores (two are berried). Female maturation usually occurs as individuals approach 30 OCL.

Distribution and biology. *Euastacus reductus* inhabits small streams with temperate rainforest along the banks and dry sclerophyll on elevated ridges. The species ranges from near Elands, south-west of Comboyne, 100 km south-west to the Barrington Tops area and also inhabits the Myall Range near Bulahdelah. Altitudes of inhabited streams were 75 m to 550 m a.s.l. Berried females have been collected in late September and October. Eggs are bright yellow.

At many sites *E. reductus* is sympatric with *E. spinifer*. The smaller *E. reductus* appears to prefer, or is displaced into, shallower habitats than *E. spinifer*.

Remarks. The species shows moderate variation, especially in the number and extent of rostral spines, number of Li spines on abdominal somite 1, dorsal apical propodal spines and spines above propodal and dactylar cutting edges.

Riek (1969) established both *E. reductus* and the very similar *E. alienus*. The only difference in descriptions of the two species was that the latter possessed a marginal spine on the antennal squame. *Euastacus alienus* was described from three specimens from "Bulahdelah Mount, near Stroud". The small paratype lacks the squamal spine but this might arguably develop with age. Sampling in 1981 revealed variation in *E. reductus* in the development of the squamal spine. Several specimens from throughout the range of the species bear a spine on one or both squames and one specimen has three spines on both squames. Most of these specimens were collected from populations which included specimens lacking squamal spines. Although the type locality of *E. alienus*, "Bulahdelah Mount", could not be located, collection west of Bulahdelah in the Myall Range yielded specimens of *E. reductus* lacking squamal spines.

The marked variation in this character in *E. reductus* and absence of spines on specimens from near the type locality of *E. alienus* suggests that the two species should be regarded as synonymous. Under Article 24(a) of the International Code of Zoological Nomenclature (Principle of First Reviser), I assign the name *E. reductus* to have precedence over *E. alienus* on the basis that more specimens are recognisable as the former than as the latter and that *E. reductus* preceded *E. alienus* in Riek's original publication.

Euastacus reductus is very similar to those species previously designated as members of the genus *Euastacoides* Riek of south-eastern Queensland. *Euastacoides* was synonymised with *Euastacus* by Morgan (1988).

Euastacus rieki n.sp.

Figs 37, 38

Euastacus nobilis.–Clark, 1936: 15, 16 (in part, Mount Kosciusko as a locality. (Not *Astacoides nobilis* Dana, 1852).

Euastacus nobilis crassus Riek, 1951: 383, 384 (in part, Mount Kosciusko as a locality).

Euastacus crassus.–Riek, 1969: 896 (in part, Mount Kosciusko Plateau as a locality).

Type material. HOLOTYPE ♂, OCL 46.4 mm, AM P15299. NSW Snowy River Bridge, Mount Kosciusko, 8 Feb. 1966, E.F. Riek. PARATYPES: Type locality, AM P34095, 8 ♂♂, 4 ♀♀, ♂♂/♀♀.

Other material examined. NSW and ACT Snowy River 3000–7000 feet, Apr. 1908(?), AM P650–4, 3 ♂♂, 3 ♀♀; Mount Kosciusko, above hotel, 10 Feb. 1946, AM P11942, 7 ♂♂, 10 ♀♀; Snowy River below Charlotte Pass, Mount Kosciusko, 7 Nov. 1961, E.F. Riek, AM P15302, ♂; Mount Kosciusko, 6800 ft, 27 Jan. 1957, E.F. Riek, AM P15293, ♂, 3 ♀♀; Upper Perisher Creek, near Smiggins Holes, Mount Kosciusko, 8 Feb. 1956, R. Mackay, AM P13051, ♂, 2 ♀♀; Near Wilsons Valley, Mount Kosciusko, 1908(?), AM P648–9, 2 ♂♂; Diggers Creek near Sponars Inn, Kosciusko National Park, (36°23'S 148°29'E), 4 Nov. 1981, G.J. Morgan & S.J. Harders, AM P34015, 3 ♂♂; Wraggs Creek, between Sponars and Smiggin Holes, (36°24'S 148°25'E), 4 Nov. 1981, G.J. Morgan & S.J. Harders, AM P33997, ♂; Creek at Island Bend, (36°21'S 148°29'E), 5 Nov. 1981, G.J. Morgan & S.J. Harders, AM P34001, 2 ♂♂, ♀; Little Thredbo River on Alpine Way, (36°26'S 148°24'E), 6 Nov. 1981, G.J. Morgan & S.J. Harders, AM P33998, ♂, ♀; Creek on Alpine Way, 12 km north-east of Khancoban, (36°10'S 148°10'E), 6 Nov. 1981, G.J. Morgan & S.J. Harders, AM P33999, ♂, 2 ♀♀; Tributary Tooma River, Alpine Way, 3.7 km south-west of Tooma Dam, (36°05'S 148°13'E), 6 Nov. 1981, G.J. Morgan & S.J. Harders, AM P33996, ♀; Section Creek, 5 km west of 3 mile Dam, north of Cabramurra, (35°54'S 148°24'E), 7 Nov. 1981, G.J. Morgan & S.J. Harders, AM P34000, ♂, ♀; Bolaro, Murrumbidgee, 4 miles from New Adaminaby, 4 Sept. 1966, E.F. Riek, AM P15297, 2 ♀♀; Junction of Murrumbidgee River and Tantangara Creek (north of Kiandra), 20 Mar. 1966, E.F. Riek, AM, 2 ♂♂, ♀; Mount Gingera, ACT, 12 Dec. 1956, E.F. Riek, AM, ♀; Creek between Sawyers Hill (Kiandra) and Adaminaby, 13 May 1982, P. Horwitz, ♂; Creek near Yarrangobilly, 12 May 1982, P. Horwitz, ♀.

Diagnosis. Male cuticle partition absent. Rostral spines apical or distributed to midlength of carinae. Rostral base divergent or very divergent, carinae short and spread. Antennal squame widest at or slightly distal to midlength. Squamal spines absent. Suborbital spine small or medium sized. Thoracic spines small or medium sized, or sometimes barely discernible. General tubercles small or medium sized, and moderately or densely distributed. 2–6 medium sized or small Li spines on abdominal somite 2. D spine minute and blunt or absent. Abdominal boss absent or poorly developed. Telsonic spines absent. Uropods lacking marginal spines. Ventrolateral propodal spine row well developed, often almost reaching apex of finger. 1 dorsal apical propodal spine, or spine absent. Spines above cutting edges of chela apical. Usually 5 mesial propodal spines. Dorsomesial dactylar basal spines usually absent, sometimes 1 or more present. Marginal mesial dactylar basal spines usually absent, sometimes 1 present. 1 or 2 apical mesial dactylar spines. 3 mesial carpal spines. Ventromesial carpal spines usually smaller than ventral spine. Keel Pr1 sloped or semi-abrupt and close and parallel or closed. TAP count 2.5 (rarely 2.0 or 3.0).

Description. Maximum OCL: 52.7 mm.

Rostrum: Rostrum short, not reaching midlength of 3rd antennal segment of specimens >30 OCL, occasionally to midlength of segment on smaller specimens (distal to midlength on some animals <20 OCL). Rostral sides slightly convergent or parallel; base divergent or very divergent and carinae moderately short or short and usually distinctly spread. 1–3 rostral spines (rarely 4) per side, apical or extending to (or slightly proximal to) midlength of carinae; spines medium sized to very small and moderately pointed to rounded. Acumen spine similar size to or slightly larger than marginal spines.

OCL/CL 0.81–0.89 i; RW/OCL 0.14–0.22 d.

Cephalon: Spination moderate to very poor with 1–4 small spines and varying numbers of protuberances ventral to postorbital ridges. 1st postorbital spine small or merely an edge, 2nd usually absent (several specimens with edge or small edge on one side only and two specimens from Bolaro with edge on both sides). Suborbital spine small or very small on animals >40 OCL, usually slightly larger on smaller crayfish, medium sized on some specimens <30 OCL. Lateral margin of antennal squame straight or convex; squame widest at or slightly distal to midlength on most specimens >30 OCL and many smaller specimens, slightly proximal to midlength on some small animals. Marginal squamal spines absent. Epistome elongate or medium width on specimens >40 OCL, medium or broad on smaller specimens, very broad on some specimens <20 OCL; spine margin slightly or distinctly scalloped (sometimes weakly toothed with 2 small teeth near apex). Antennal basipodite spine small or absent. Coxopodite spine medium sized or small, usually serrated (3 or 4 cusps) or weakly bifid.

ScL/OCL 0.12–0.20 d.

Thorax: 7–30 small or medium sized, rarely large, dorsal thoracic spines per side, usually blunt or rounded, occasionally moderately pointed, in zone or 1 irregular row, or only 1 or 2 spines posterior to cervical spines with barely discernibly enlarged tubercles dorsally; spines vague or absent on specimens <20 OCL. General tubercles medium sized or small and moderately distributed or dense on crayfish >30 OCL; small and moderately distributed to sparse on 20–30 OCL specimens; very small and very sparse or absent on specimens <20 OCL. 2–5 cervical spines, small to medium sized (very

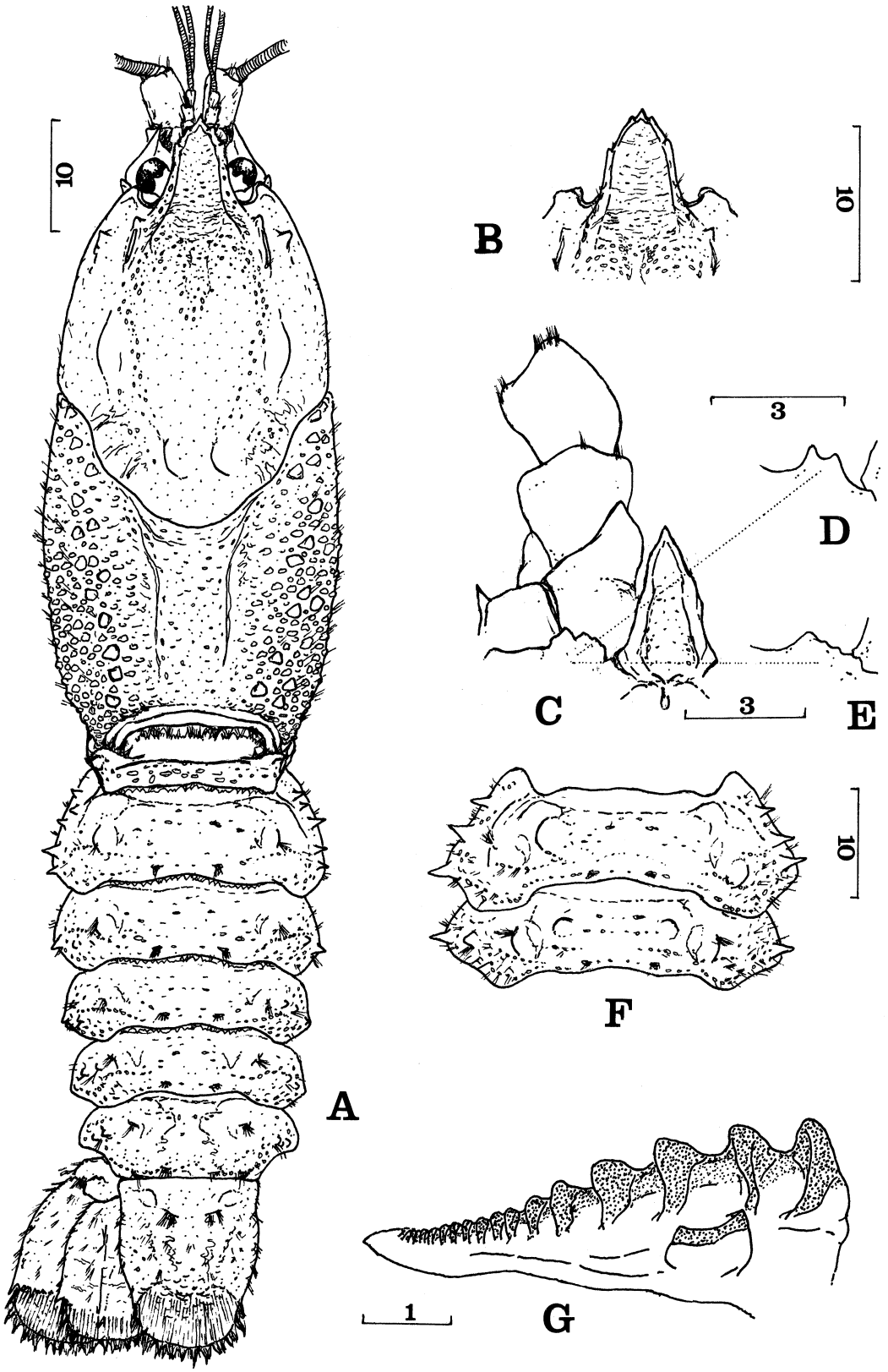

Fig. 37. *Euastacus rieki* n.sp. A, dorsal view, holotype male, Snowy River, AM P15299; B, rostrum, female, Bolaro, AM P15297; C, ventral view cephalon, holotype male, AM P15299; D, bifid coxopodite spine, paratype male, Snowy River, AM P34095; E, low coxopodite spine, male, Murrumbidgee River, AM P15294; F, abdominal somites 2 and 3, broader (sexual), small blunt D spines present, female, AM P15297; G, ventral view zygocardiac ossicle, male, Spencers Creek, AM P15481 (Francois collection).

small on some specimens <30 OCL) and moderately pointed to very blunt; spines similarly sized or dorsal spine larger than remainder.

ArL/OCL 0.35–0.40; ArW/OCL 0.14–0.20; CaW/OCL 0.54–0.60; CaD/OCL 0.46–0.55.

Abdomen: Small or minute, moderately pointed or sharp D–L spine on somite 1 of most specimens >30 OCL, absent on most <30 OCL and all specimens <20 OCL. D spine absent on somite 1 (one Bolaro specimen with slight protuberance on one side). 3–5 (rarely 6) Li spines per side on somite 2 of specimens >30 OCL, 2–4 on 20–30 OCL specimens, 0–1 on crayfish <20 OCL. Somites 3–5 usually with 1 Li spine on specimens >40 OCL, frequently absent on smaller crayfish. Li spines medium sized or small and very sharp or sharp anteriorly on specimens >30 OCL, diminishing in size and sharpness to posterior segments; spines small or minute and moderately pointed or blunt on specimens <30 OCL. 1–4 small or minute Lii spines, sometimes absent, on specimens >30 OCL, usually absent on smaller specimens; spines moderately pointed or blunt. D–L spine small or minute on specimens >40 OCL, minute or absent on lesser individuals; D–L spines usually blunt or very blunt, decreasing in size and sharpness to posterior segments. Minute, very blunt D spine on somite 2 (and occasionally 3) of some specimens >30 OCL. Vague dorsal boss on specimens >40 OCL.

AbdW/OCL J 0.49–0.54, K 0.49–0.61 i; OCL/L 0.36–0.45 i.

Tailfan: Tailfan spines absent; some setal protuberances on telson of large specimens and on margins of uropods and telson. Standard spines very small or small on most animals >30 OCL, medium sized on smaller specimens.

TeL/OCL ♂ 0.30–0.40 d, ♀ 0.31–0.41 di.

Chelae: Chelae frequently stout on crayfish of all sizes, sometimes intermediate in shape or occasionally elongate, particularly on small crayfish and regenerate chelae. Teeth well developed on most specimens >30 OCL.

Propodus: Ventrolateral spine row often closely approaching finger tip (almost 2 rows); lateral spines small, occasionally medium sized and rather sharp. Lateral spine ridge present, often small. Usually 5 (sometimes 3–6) mesial propodal spines. 0 or 1 dorsal apical propodal spine, always absent on crayfish <20 OCL. Usually 1 or 2 spines above cutting edge of specimens >20 OCL, absent on some small individuals (3 on some regenerate chelae); spines apical (to full length of gape on some regenerate chelae) and large or medium sized on specimens >40 OCL, medium sized or small on lesser individuals, absent on crayfish <20 OCL. Usually 1 or 2, rarely 3, medium sized or small, blunt spines on dorsal surface lateral to dactylar base, sometimes absent, with some minute protuberances or irregularities on lateral propodal spine ridge; ventrally, usually 1–3(4) medium sized or small spines lateral to dactylar base. Specimens <20 OCL often lacking both dorsal and ventral spines lateral to dactylar base. Spines absent posterior to dactylar articulation; precarpal spines usually absent, sometimes 1 or 2 minute spines, especially on regenerate chelae.

PropL/OCL ♂ (0.69) 0.73–0.95 i, ♀ 0.73–0.86; PropW/PropL 0.44–0.52; PropD/PropL 0.27–0.36.

Dactylus: Usually 1 or 2, occasionally 3, apical spines above cutting edge (some regenerate chelae with 4 spines extending to midlength of gape); 3 individuals from Murrumbidgee River north of Kiandra with 3 or 4 spines extending full length of gape, with distinct gap between distal 2 or 3 and proximal spine; spines medium sized or large on specimens >30 OCL, small on some lesser individuals, absent on some <30 OCL and many <20 OCL. Extra dorsal dactylar spines absent. Most specimens lacking dorsomesial basal spines on nonregenerate chelae (regenerate chelae frequently with 1, occasionally 2) though some specimens with dorsomesial spine on normal chelae, especially in northern populations (one northern crayfish with 3 dorsomesial spines on its larger chela). Marginal basal spines absent on most nonregenerate chelae, though some specimens from Kiandra and Bolaro region with 1 spine (and some regenerate chelae with 1 or 2 small spines). Basal spines medium sized or small. Usually 1 apical dactylar spine, absent on one large specimen and many crayfish <20 OCL; some northern specimens (Kiandra area) with 2 apical spines. Dactylar groove present, sometimes deep.

DactL/PropL 0.53–0.59.

Carpus: 3 mesial carpal spines, evenly spaced; some regenerate chelae with 2(+1) or 2(+2) carpal spines, one specimen with 4 spines on one chela. 2 (occasionally 1 or 2+1) medium sized or small lateral spines. Articulation spine usually absent, minute on some small specimens. Dorsal carpal spines absent except on one minute specimen. Ventral carpal spine very large to medium sized; largest ventromesial spine large to small, sometimes similarly sized to (rarely larger than) ventral spine.

Merus: 4–7 dorsal spines on normal chelae; spines medium sized to small. Outer meral spine absent or minute.

Keel: *Pr1*: Posterior margins sloped or approaching semi-abrupt, semi-abrupt on some specimens <20 OCL; ventral edges usually angled down, sometimes rounded or flat; processes close (or slightly apart on some specimens <20 OCL) and parallel or closed in configuration. Keel after Pr1 lacking spines.

Pr2: Usually almost parallel, occasionally open and rather sharp and steeply pronounced from keel. Keel after Pr2 lacking spines.

Pr3: Slight or gradual scoops (sometimes absent) with moderately curved to rounded bases. Keel after Pr3

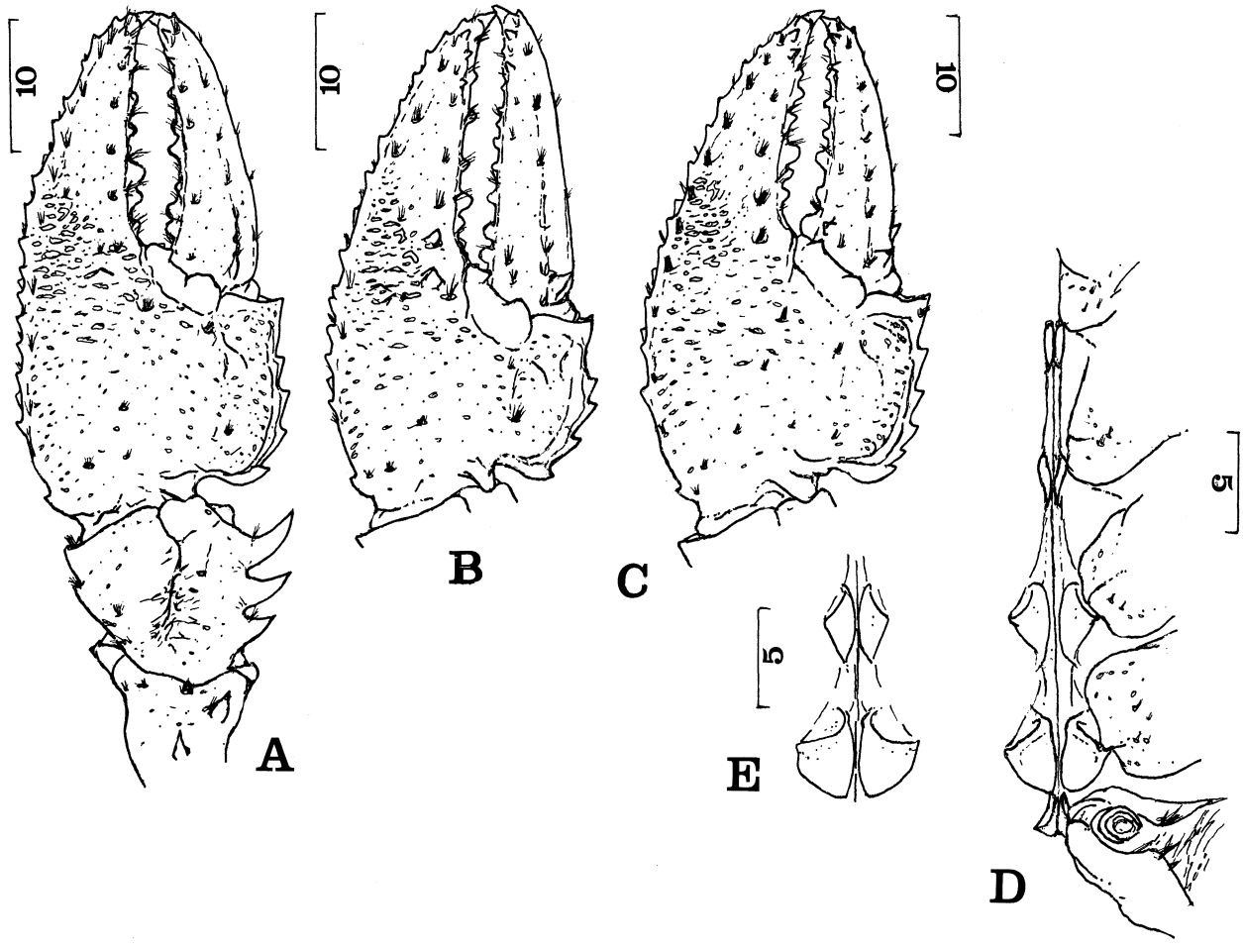

Fig. 38. *Euastacus rieki* n.sp. A, dorsal view chela, holotype male, Snowy River, AM P15299; B, chela (probably regenerate), more elongate dactylus, dorsomesial dactylar basal spine, paratype male, Snowy River, AM P34095; C, chela, dorsomesial and marginal dactylar basal spines, 2 apical dactylar spines, proximal spine above dactylar cutting edge, male, Murrumbidgee River, AM P15294; D, sternal keel, holotype male, AM P15299; E, keel processes 3 and 4, female, Bolaro, AM P15297.

frequently recessed, slightly pronounced on some crayfish <20 OCL.

Pr4: Scoops absent or slight, posterior edges sharp to rounded and straight, slightly convex or irregular; anterior edges moderately curved to very angular, rounded on one specimen.

Pr3 and 4 narrow on specimens >30 OCL, often broad on 20–30 OCL crayfish, very broad on very small specimens.

Setation: Moderate to light, setae short.

Punctation: Dense to very dense.

Gastric mill: TAP count 2.5 (very rarely 2.0 or 3.0); TAA count 1.0–1.5; spread 1.0 (rarely 1.5). Teeth large and spaced, ear short. Urocardiac ridges 4–9 (usually 5 or 6) increasing with growth.

Coloration: Body dorsally chocolate brown grading to slightly paler brown or orange ventrolaterally; orange area on lateral surface of cephalon. Dorsal spines sometimes slightly darker. General tubercles pale orange. Carpus of cheliped light ochre with dark green mottling. Propodus ochre with dark green mottling. Fingers green tinged.

Body ventrally pale brown and cream. Carpus of cheliped mesially deep green-blue, laterally pale orange; ventral spine yellow. Propodus mesially deep green-blue with some blue mottling medially. Dactylus light orange with slight blue tint or distinctly blue, darker green-blue mesial edge.

Sexes: Male cuticle partition absent. Females <30 OCL have unopen gonopores. One female in 30–40 OCL range has open pores and another appears to be opening, but most are closed. Only two females have been examined in the >40 OCL range; one has open gonopores, the other is opening with light setae

around the pores. It appears that female maturity is usually attained in the 40–50 OCL range, occasionally at a slightly smaller size.

Distribution and biology. The species is known from the high alpine and semi-alpine country of the Snowy Mountains, particularly around Mount Kosciusko, north to the Kiandra and Yarrangobilly regions, south-west of the ACT, a north-south distance of 100 km. Major drainage is via tributaries of the Snowy, Murray and Murrumbidgee Rivers.

Euastacus rieki was collected at altitudes above 560 m a.s.l., and usually above 1000 m (to 1520 m). From museum records, it is likely that the species extends into the highest areas of the Kosciusko region. Vegetation along the sampled creeks was dry sclerophyll (largely snow gums at high altitudes) with heath or tussock grass. Shade on the streams was moderate to poor and water was clear with very little algal growth. Stream beds were largely gravel with some loose rocks, bedrock in places. *Euastacus rieki* was collected from under rocks and from burrows in the stream beds. Most of the sampled streams are covered in snow or ice in winter. Presumably the species is then dormant or semi-dormant in its burrows. No berried females have been collected.

The boundary between ranges of *E. rieki* and the similar *E. crassus* to the north and west is uncertain but appears at least partially related to altitude.

Etymology. Named in respect of the pioneering parastacid systematic works of E.F. Riek. The name was originally suggested by D. Francois (1962) but never published.

Remarks. *Euastacus rieki* has a rather small range and geographical variation is quite limited. Northern specimens from the Kiandra, Bolaro and Yarrangobilly areas display some minor differences from more southern populations, including the type series. Northern crayfish frequently have a better development of the 2nd postorbital spine; slightly smaller thoracic and abdominal D and D–L spines; sometimes stouter chelae; sometimes more numerous spines above the dactylar cutting edge (especially in Kiandra area); more commonly a dorsomesial (and sometimes marginal) dactylar basal spine; more commonly a second apical dactylar spine; and are usually more hirsute.

The gastric mill count is constant over the range of *E. rieki* and serves to certainly identify the species, especially from the very similar *E. crassus*. The mill constancy is in marked contrast to many species showing obvious variation and clinal trends (e.g., *E. crassus, E. australasiensis, E. spinifer*) and is in part attributable to the zygocardiac tooth size. When teeth are small and numerous, a small shift in the position or size of the zygocardiac ear will alter the tooth count more obviously than when teeth are very large and spaced.

Euastacus rieki is most similar and probably closely related to *E. crassus* and *E. claytoni*. The similarities and differences between the three are discussed under Remarks of the latter two species.

Euastacus simplex Riek

Figs 39, 40

Astacopsis serratus.–McCulloch, 1917: 237, 238 (in part, Armidale as locality). (Not *Cancer serratus* Shaw, 1794).
Euastacus simplex Riek, 1956: 2, 3; Riek, 1969: 897.

Type material. HOLOTYPE ♂, OCL 54.4 mm, AM P13048. NSW 15 miles north of Armidale, 25 Mar. 1954, E.F. Riek. ALLOTYPE ♀, OCL 56.3 mm, AM P34090, type locality. PARATYPE: Type locality, AM P34091, ♀.

Other material examined. NSW Majors Creek, north-east of Ebor, (30°23'S 152°24'E), 5 Apr. 1981, G.J. Morgan & S.J. Harders, AM P33899, ♂, ♀; Majors Creek, (30°23'S 152°24'E), 12 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33898, 3 ♂♂; Little Falls Creek, on Dorrigo-Ebor Road, (30°20'S 152°25'E), 12 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33897, 2 ♂♂; Coutts Water (Nymboida River), (30°21'S 152°29'E), 13 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33894, 2 ♂♂, 2 ♀♀; Allans Water, (30°21'S 152°28'E), 13 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33900, ♂; Boundary Creek, (30°21'S 152°27'E), 13 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33896, ♂; Guy Fawkes River, Ebor Falls, (30°25'S 152°21'E), 13 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33893, 5 specimens; Guy Fawkes River, Ebor Falls, 8 Sept. 1980, R. Pigeon, AM P33901, 6 specimens; Little Styx River, edge of New England National Park, (30°30'S 152°22'E), 13–14 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33891, ♂, ♀, ♂♂/♀♀; Little Styx River tributary near Toms Cabin, New England National Park, (30°30'S 152°24'E), 14 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33895, ♂, ♀; Little Styx River, New England National Park, 20 Mar. 1954, E.F. Riek, AM P13049, 4 ♂♂, 6 ♀♀; Five Day Creek tributary, near Wrights Lookout, New England National Park, (30°30'S 152°24'E), 14 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33892, ♂; Falconer Creek, 3 miles east of Guyra, Mar. 1954, E.F. Riek, AM P13056, ♀; Fenwicks Creek south of Yarrowitch, (31°18'S 151°59'E), 23 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33993, ♂; Styx River near Armidale, 17 Apr. 1953, E.F. Riek, AM P13050, ♀; Styx River near Hillgrove, Armidale area, 20 Dec. 1959, E.F. Riek, AM P15714, 3 ♂♂, ♀; Native Dog Creek, Cathedral Rock National Park, (30°24'S 152°16'E), 13 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33902, 3 ♀♀.

Diagnosis. Male cuticle partition present. Rostral spines apical or distributed to midlength of carinae. Rostral base divergent or very divergent, carinae short or medium length. Antennal squame widest at midlength. Squamal spines absent. Suborbital spine small or very small. Thoracic spines medium sized, small or only just discernible. General tubercles medium sized or small, moderately distributed or sparse. Usually 3–7 sharp Li spines on abdominal somite 2. D spine poorly developed. Abdominal boss absent. Telsonic spines absent. Uropods lacking marginal spines. Ventrolateral propodal spine row well developed but not reaching apex of finger. Dorsal apical propodal spines absent. Spines above cutting edges of chela apical, sometimes absent on specimens <30 OCL. 5 (sometimes 6) mesial propodal

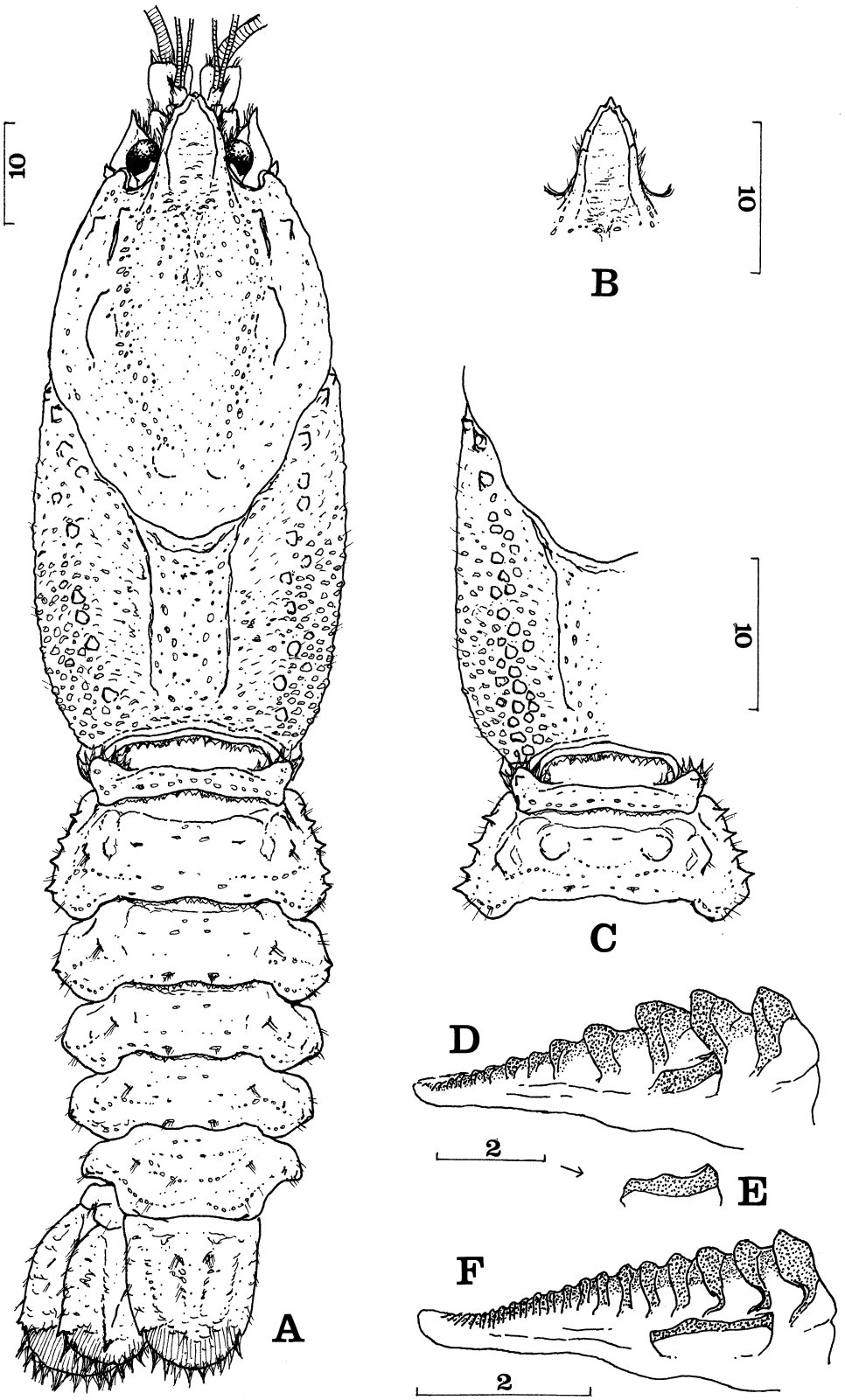

Fig. 39. *Euastacus simplex* Riek. A, dorsal view, holotype male, north of Armidale, AM P13048; B, rostrum, female, Styx River, AM P13050; C, thorax and anterior abdomen, broader zone of thoracic spines, D–L spines on somite 1, D spines on somite 2, female, AM P13050; D, ventral view zygocardiac ossicle, holotype male, AM P13048 (Francois collection); E, ventral ear, female, Little Styx River, AM P13049 (Francois collection); F, zygocardiac ossicle, female, AM P13050 (Francois collection).

spines. 0 or 1 dorsomesial and marginal mesial dactylar basal spines. Usually 1–3 apical mesial dactylar spines. 2 or 2(+1) mesial carpal spines. Ventromesial carpal spines usually smaller than ventral spine. Keel Pr1 semi-abrupt or abrupt and usually close and parallel. TAP count 2.5–4.5.

Description. Maximum OCL: 56.3 mm.

Rostrum: Rostrum rather short, usually not reaching midlength of 3rd antennal segment on most specimens >20 OCL and often not reaching base of segment (sometimes reaching distal to midlength of segment on very small animals). Rostral sides convergent or parallel; base slightly to very divergent, carinae short and moderately spread to medium length; spines usually apical though sometimes to midlength of carinae; spines very small or small on specimens >20 OCL, medium sized on some smaller crayfish; spines usually rounded, sometimes moderately pointed on specimens <30 OCL and sharp on some very small specimens. Acumen spine usually similar to marginal spines.

OCL/CL 0.79–0.88 i; RW/OCL 0.15–0.23 d.

Cephalon: Spination poor, usually 1 or 2 small spines and protuberances ventral to postorbital ridges. 1st postorbital spine an edge or small on specimens >20 OCL, sometimes medium sized on smaller crayfish. 2nd spine usually an edge or small; spine sometimes absent or on one side only. Suborbital spine very small or small on specimens >40 OCL, rarely medium sized on smaller specimens. Lateral margin of antennal squame straight or convex; squame widest at approximately its midlength, proximal to midlength on some small animals; marginal spines absent. Epistome usually medium width, elongate on some large specimens, broad on small specimens; margins toothed or scalloped. Antennal basipodite spine usually absent or small on specimens >30 OCL, medium sized on some smaller crayfish. Coxopodite spine usually absent or small, medium sized on some animals <30 OCL; spine usually bifid or serrated.

ScL/OCL 0.13–0.24 d.

Thorax: Dorsal spines usually medium sized or small, sometimes just discernible, absent on some specimens 20–30 OCL, usually absent at <20 OCL. Spines numbering approximately 6–20 per side in zone or irregular row; spines blunt, rounded or flat. General tubercles small or medium sized on most specimens, small or absent on crayfish <20 OCL; tubercles moderately distributed or sparse, very sparse or absent on small specimens <20 OCL. 1–5 cervical spines, usually small or minute and moderately pointed or blunt (dorsal spine often slightly larger and sharper).

ArL/OCL 0.34–0.40; ArW/OCL 0.13–0.21 d; CaW/OCL 0.53–0.60; CaD/OCL 0.50–0.58.

Abdomen: D–L spine usually absent on somite 1, sometimes small or minute spine, moderately pointed to very blunt. D spines absent on somite 1. Somite 2 with 3–7 sharp Li spines per side on specimens >30 OCL, often fewer and blunter on smaller specimens, absent on some specimens <20 OCL; usually minute Li spine on somites 3–5, absent on most specimens <20 OCL. Lii spines merely protuberances, or absent. D–L spines on somites 2–5 small or minute if present and moderately sharp to very blunt; D–L spines usually absent on specimens <30 OCL. D spines present only on some large crayfish. D and D–L spines absent from somite 6. Dorsal boss absent.

AbdW/OCL ♂ 0.48–0.53, ♀ 0.48–0.62 i; OCL/L 0.35–0.44.

Tailfan: Dorsal and marginal spines absent on telson and uropods. Standard spines small on large crayfish, medium sized on small specimens.

TeL/OCL ♂ 0.32–0.43 d, ♀ 0.33–0.39 di.

Chelae: Chelae usually stout or very stout, often pyriform, regenerate chelae and chelae of some very small animals elongate. Teeth well developed at >30 OCL.

Propodus: Ventrolateral spine row usually well developed but not reaching apex of finger; sometimes only 1–3 ventrolateral spines on crayfish <20 OCL; lateral spines medium sized or small, sharp or rounded. Lateral spine ridge moderately or poorly developed. Usually 5 mesial spines, sometimes 6 on one chela, rarely 4 (distal spine undeveloped) on regenerate chelae and chelae of small crayfish. Dorsal apical propodal spines absent (one specimen with spine on smaller, probably regenerate chela). 1–3 spines above cutting edge, absent on many specimens <30 OCL and on most crayfish <20 OCL; spines medium sized or small and usually apical, rarely to midlength of gape. Spines lateral to dactylar base poorly developed; dorsally 0–2 medium sized or small spines with some low protuberances and similar number ventrally. Spines absent posterior to dactylar base. Precarpal spines absent.

PropL/OCL ♂ 0.76–0.92 i, ♀ (0.69) 0.74–0.85 i; PropW/PropL 0.41–0.53 i; PropD/PropL 0.28–0.34.

Dactylus: 1–3 spines above cutting edge on specimens >30 OCL, 0–2 on smaller crayfish; spines apical, medium sized or small. Extra dorsal dactylar spines absent. 0 or 1 dorsomesial and marginal dactylar basal spines. Usually 1–3 apical mesial spines. Dactylar groove present.

DactL/PropL 0.52–0.60 i.

Carpus: Usually 2 mesial spines, occasionally 2(+1), rarely 3 on one carpus (one specimen with 3 distinct spines on both carpi, but 2nd and 3rd spines contiguous); 1st (distal) spine largest and only slightly offset ventrally to remainder. 1 or 2 small or medium sized lateral spines. Small articulation spine sometimes on crayfish <30 OCL. Ventral spine usually large or very large,

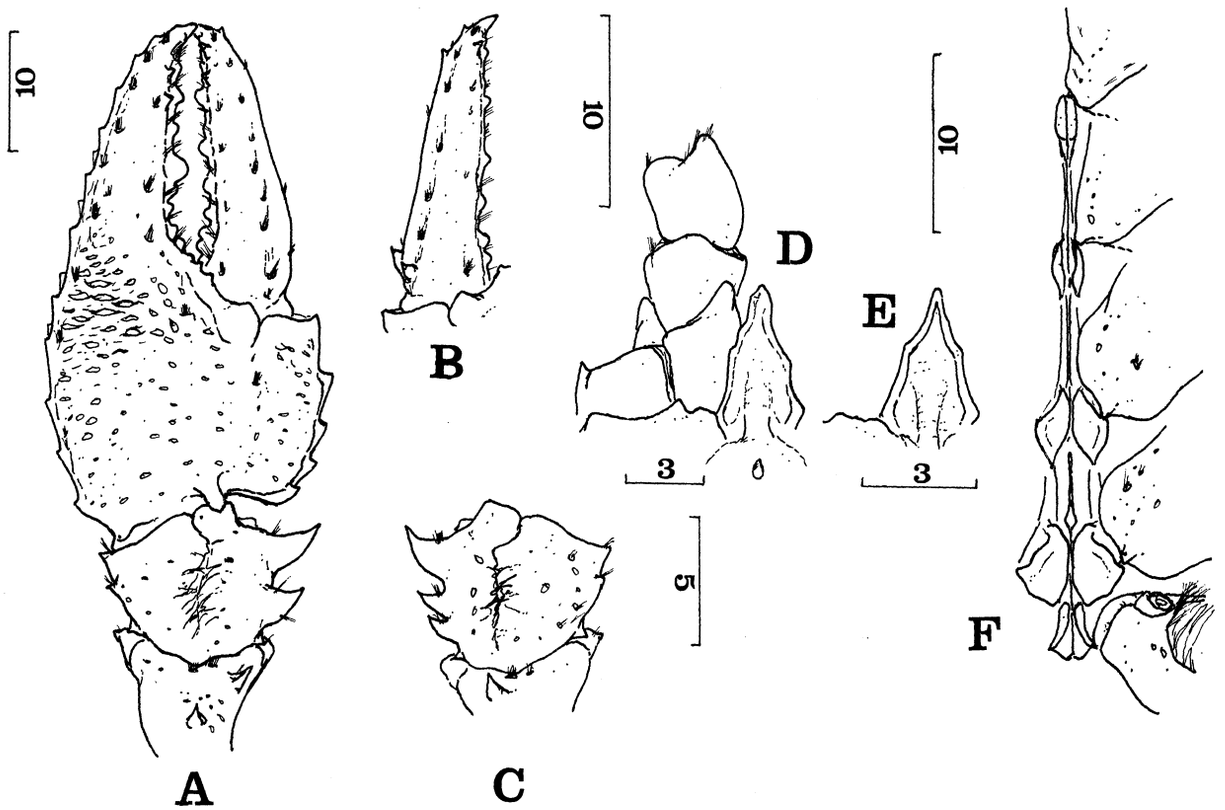

Fig. 40. *Euastacus simplex* Riek. A, dorsal view chela, holotype male, north of Armidale, AM P13048; B, dactylus of chela, mesial basal spines, 2 apical mesial spines, female, Styx River, AM P13050; C, carpus of cheliped, 3 mesial spines, male, Ebor Falls, AM P33893; D, ventral view cephalon, holotype male, AM P13048; E, epistome, female, AM P13050; F, sternal keel, holotype male, AM P13048.

medium sized on some specimens <20 OCL; largest ventromesial spine medium sized or small, usually smaller than ventral spine, rarely similarly sized.

Merus: Usually 6–9 medium sized or small dorsal spines, smaller on regenerate chelae and small crayfish. Outer spine small or absent.

Keel: *Pr1*: Posterior margins semi-abrupt or abrupt; ventral edges commonly rounded, sometimes angled down, angled back or flat; processes usually close and parallel, sometimes slightly apart or apart on small animals, very rarely open or closed. Keel after Pr1 lacking spines.

Pr2: Almost parallel to open, processes generally produced steeply from the keel. Keel after Pr2 low.

Pr3: Usually parallel, sometimes slightly open (rarely distinctly open) with gradual scoops; posterior margins sharp to moderately curved. Keel after Pr3 frequently pronounced slightly anteriorly.

Pr4: Scoops absent or gradual; anterior edges angular or very angular; posterior edges moderately curved or sharp and straight to convex, usually slightly convex.

Pr3 and 4 narrow or very narrow on specimens >30 OCL, narrow or approaching broad on specimens 20–30 OCL, broad on most specimens <20 OCL.

Setation: Moderate to light.

Punctation: Moderate to dense.

Gastric mill: TAP count 2.5–4.5; TAA count 1.0–2.0; spread 1.0–3.5. Urocardiac ridges 6–8 on specimens >30 OCL, often 4–6 on smaller specimens. Urocardiac ossicle shallow.

Coloration: Body dorsally green-brown, red-brown or olive green, paler ventrolaterally. Orange patch laterally on cephalon. Thoracic spines sometimes pale orange. Li abdominal spines pale orange. Carpus of cheliped blue-green or green, sometimes orange laterally, spines orange tipped. Propodus brown, red, ochre or olive with green or blue-green mottling. Fingers green, green-blue or green-orange, tips pale yellow.

Body ventrally orange, cream and green. Carpus of cheliped mesially deep blue-green or blue, laterally

pale orange. Propodus laterally pale orange or cream, centrally bright orange, mesially blue-green. Fingers orange or pale green.

Sexes: Males have a cuticle partition. All females <30 OCL have unopen gonopores. One female in the 30–40 OCL range has pores with light setation and two of the females >40 OCL have open gonopores. Female maturation appears to occur at or above a size of 40 OCL.

Distribution and biology. The species ranges from 25 km west of Dorrigo, 90 km to the Armidale and Guyra areas of New South Wales and one specimen from near Yarrowitch indicates the species extends south along the Botumbulla Range for a similar distance. Major drainage systems include the Nymboida, Styx and Guy Fawkes Rivers in the north and the Hastings River in the south.

Euastacus simplex has been collected from small to medium sized, open streams with banks vegetated by dry sclerophyll forest and heath or largely cleared for pasture at elevations between 1100 m and 1380 m a.s.l. Though water was clear and usually cool, brown algal growth was often moderately heavy in open streams.

The species is sympatric with *E. neohirsutus* at several sites in the east of the former's range. In the south, the species can co-occur with *E. spinichelatus* n.sp.

Remarks. Most variation in *E. simplex* is in the number of basal and apical spines on the dactyli of the chelae. Gastric mill counts are also rather variable depending upon the length of the zygocardiac ear. Interestingly, high TAP counts correlate with the presence of dactylar basal spines.

Euastacus simplex is similar to *E. clarkae* and can be distinguished by characters discussed for the latter species.

Euastacus spinichelatus n.sp.

Figs 41, 42

Type material. HOLOTYPE ♀, OCL 38.8 mm, AM P34103. NSW Fenwicks Creek, tributary of Hastings River on Oxley Highway south of Yarrowitch, (31°18'S 151°59'E), 23 Sept. 1981, G.J. Morgan & S.J. Harders. PARATYPES: NSW Type locality, AM P33962, 7 specimens; Joyces Creek, tributary of Yarrowitch River on Oxley Highway, (31°17'S 151°59'E), 23 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33960, 3 ♂♂, ♀; Bobbin Creek near source, tributary of Dingo Creek west of Elands, (31°17'S 151°10'E), 28 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33966, 3 M.

Other material examined. NSW Tobin River tributary (Hastings River), north-west of Mount Seaview, (31°20'S 152°05'E), 22 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33967, 2 ♂♂, 2 ♀♀; Numble Creek below New Country Swamp, tributary of Manning River, (31°20'S 151°52'E), 22 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33961, 2 ♂♂; Tia River above Tia Falls, Apsley Gorge National Park, (31°10'S 151°51'E), 23 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33965, ♀; Fenwicks Creek on Fenwicks Road, downstream of Oxley Highway, (31°19'S 152°01'E), 24 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33964, 2 ♂♂, 3 ♀♀; Cells River tributary, Myrtle Scrub near Oxley Highway, (31°21'S 152°01'E), 24 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33963, ♂, 3 ♀♀.

Diagnosis. Male cuticle partition present. Rostrum narrow. Rostral spines apical or reaching midlength of carinae. Rostral base divergent or very divergent, carinae short. Antennal squame widest at or slightly proximal to midlength. Squamal spines absent. Suborbital spine small or medium sized. Thoracic spines absent. General tubercles small and densely distributed. 3–7 medium sized Li spines on abdominal somite 2. D spine and abdominal boss absent. Telsonic spines absent. Uropods lacking marginal spines. Ventrolateral propodal spine row sometimes reaching apex of finger. 3–6 dorsal apical propodal spines. Spines above cutting edges of chela extending proximal to midlength or full length of gape. 5 or 6 (rarely 4) mesial propodal spines. Mesial dactylar basal spines usually absent. 2 or 3 apical mesial dactylar spines. 3 mesial carpal spines. Ventromesial carpal spines much smaller than ventral spine. Keel Pr1 sloped or abrupt, close and parallel. TAP count 3.0 to 4.0.

Description. Maximum OCL: 38.8 mm.

Rostrum: Rostrum either not reaching base of 3rd antennal segment or reaching proximal to midlength of segment. Rostral sides usually parallel, rarely slightly convergent on some small specimens. Base divergent or very divergent, carinae spread. Rostrum distinctly narrow. 2–4 rostral spines per side, reaching midlength of carinae (very rarely slightly proximal to midlength); spines usually medium sized and moderately pointed (sometimes sharp on specimens <20 OCL). Acumen spine similar to marginal spines.

OCL/CL 0.81–0.87 i; RW/OCL 0.14–0.19 d.

Cephalon: Spination poor with 1 or 2 small spines and some minor protuberances ventral to postorbital ridges. 1st postorbital spine an edge, small or medium sized; 2nd spine usually absent, small on some specimens, often on one side only. Suborbital spine usually small or medium sized, large on some specimens <30 OCL. Lateral margin of squame usually straight or slightly concave; squame widest at or slightly proximal to midlength; marginal spines absent. Antennal basipodite spine very small or absent; coxopodite spine small or medium sized and rounded, weakly bifid or serrated.

ScL/OCL 0.14–0.23 d.

Thorax: Dorsal spines absent. General tubercles small, very small on specimens <20 OCL; tubercles dense on crayfish >30 OCL, dense to moderately distributed on specimens 20–30 OCL, sparser or absent on smaller animals. 2–5 cervical spines, small or medium sized, blunt or moderately pointed.

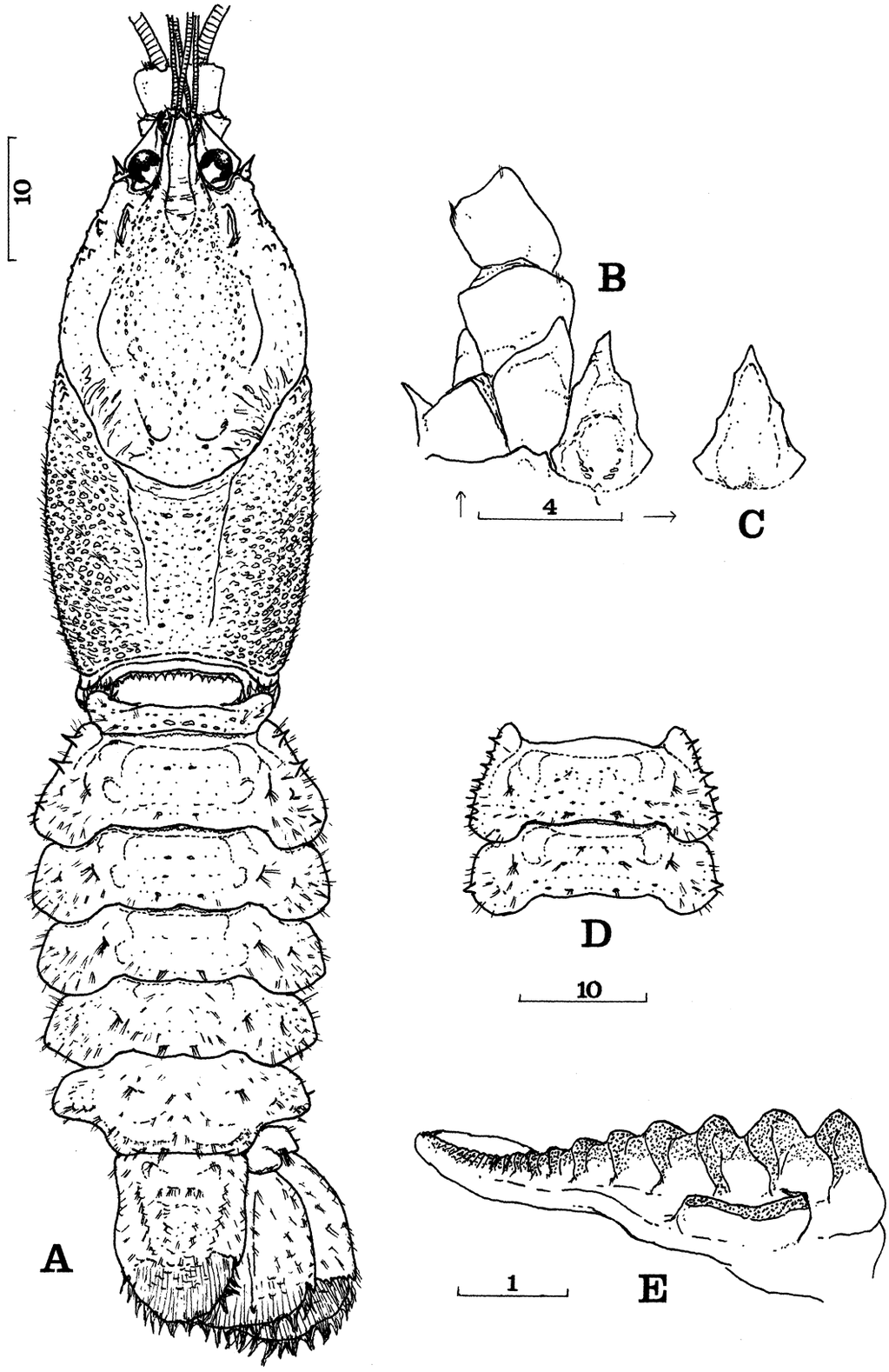

Fig. 41. *Euastacus spinichelatus* n.sp. A, dorsal view, holotype female, Fenwicks Creek, AM P34103; B, ventral view cephalon, holotype female, AM P34103; C, epistome, paratype male, Joyces Creek, AM P33960; D, abdominal somites 2 and 3, narrower (sexual), more numerous L1 spines, paratype male, AM P33960; E, ventral view zygocardiac ossicle, holotype female, AM P34103.

ArL/OCL 0.35–0.40; ArW/OCL 0.16–0.20 d; CaW/OCL 0.54–0.60; CaD/OCL 0.45–0.52.

Abdomen: Abdomen rather broad. Somite 1 usually lacking D–L and D spines (3 specimens with very small D–L spines). 3–7 Li spines per side on somite 2, absent on some specimens <20 OCL; somites 3 and 4 usually with small Li spine on large crayfish (minute spine sometimes on somite 5); Li spines usually medium sized and very sharp or sharp on somite 2, diminishing posteriorly. Lii spines poorly developed; several protuberances sometimes on large specimens. D–L and D spines absent on somites 2–6. Dorsal boss absent.

AbdW/OCL ♂ 0.50–0.56 i, ♀ 0.51–0.64 i; OCL/L ♂ 0.36–0.42 i, ♀ 0.38–0.41.

Tailfan: Telson and uropods lacking surface or lateral spines. Standard spines very small on specimens >30 OCL, small or medium sized on smaller animals.

TeL/OCL ♂ 0.33–0.39 d, ♀ 0.35–0.41 i.

Chelae: Chelae usually elongate, sometimes very elongate. Lateral margin usually slightly concave. Teeth well developed at >30 OCL.

Propodus: Ventrolateral spine row well developed, sometimes reaching apex of finger on specimens >20 OCL; row poorly developed or absent on most smaller crayfish and on some large specimens; lateral spines medium sized or small, usually sharp. Lateral spine ridge very small or absent. 5 or 6 (occasionally 4) mesial propodal spines. 3–6 dorsal apical spines on specimens >30 OCL, extending proximally along propodal finger; usually fewer spines on smaller specimens, animals <20 OCL often lacking spines. 3–8 spines above cutting edge on large (and many small) crayfish, reaching proximal to midlength or full length of gape of chela (one specimen <20 OCL with 2 spines on one chela but still extending full gape); spines medium sized or large, proximal spine commonly largest. 1 or 2 medium sized blunt protuberances lateral to dactylar base dorsally with several small bumps, or many similarly sized small blunt spines; 1–5 medium sized or small spines ventrally, vague on some crayfish <20 OCL. Spines absent posterior to dactylar base; precarpal spines absent. Fingers punctate.

PropL/OCL ♂ 0.96–1.08 i, ♀ 0.91–1.04 i; PropW/PropL 0.39–0.45; PropD/PropL 0.26–0.30.

Dactylus: 5–9 medium sized or large spines above cutting edge, extending proximal to midlength or to full length of gape of chela of specimens >20 OCL; sometimes fewer spines on smaller specimens. Extra dorsal apical spine sometimes present. Mesial dactylar basal spines usually absent, sometimes 1 medium sized or small dorsomesial basal spine. Usually 2 or 3 apical mesial dactylar spines, 1 spine on some specimens <20 OCL. Dactylar groove present.

DactL/PropL 0.52–0.58.

Carpus: 3 mesial carpal spines, distal and largest ventrally offset to others. Usually 1 (occasionally 2) lateral carpal spines. Articulation spine small, medium sized on crayfish <20 OCL. Dorsal carpal spines absent. Ventral spine large or very large; largest ventromesial spine medium sized or small, with 1 or 2 additional minute spines.

Merus: About 6–9 medium sized or small dorsal meral spines. Outer meral spine small if present.

Keel: Pr1: Posterior margins sloped, semi-abrupt or abrupt; ventral profile rounded, angled or flat; processes close or slightly apart and parallel. Keel after Pr1 lacking spines.

Pr2: Almost parallel or open, rather robust. Keel after Pr2 low, without spines.

Pr3: Usually slight scoops with moderate or rounded posterior edges; occasionally scoops distinct or entirely absent. Keel after Pr3 recessed or moderately pronounced, often with saddle depression.

Pr4: Scoops absent; anterior edges moderately curved or angular; posterior edges moderately curved or rounded, slightly convex or convex.

Pr3 and 4 narrow on specimens >30 OCL, narrow to broad on specimens 20–30 OCL, broad on smaller crayfish.

Setation: Moderately heavy on specimens >20 OCL, rather light on smaller animals.

Punctation: Very dense.

Gastric mill: TAP count 3.0–4.0; TAA count 1.0 (rarely 1.5); spread 1.5–3.0. Teeth relatively large and spaced, ear rather short. Urocardiac ridges 5–7. Urocardiac ossicle rather shallow.

Coloration: Body dorsally green-brown or green-blue. General tubercles slightly darker dorsally. Abdomen slightly darker than cephalothorax. Carpus of cheliped green, green-brown or green-blue; spines more distinctly tinged with blue. Propodus ochre or green-brown with dark green or blue-green mottling. Fingers darker green.

Body ventrally orange, green and cream. Carpus of cheliped mesially dark green, laterally orange or cream. Propodus cream faintly tinged with orange, some central green mottling, mesially dark blue-green or blue. Fingers darker orange, tips blue. Dactylar mesial edge green or blue.

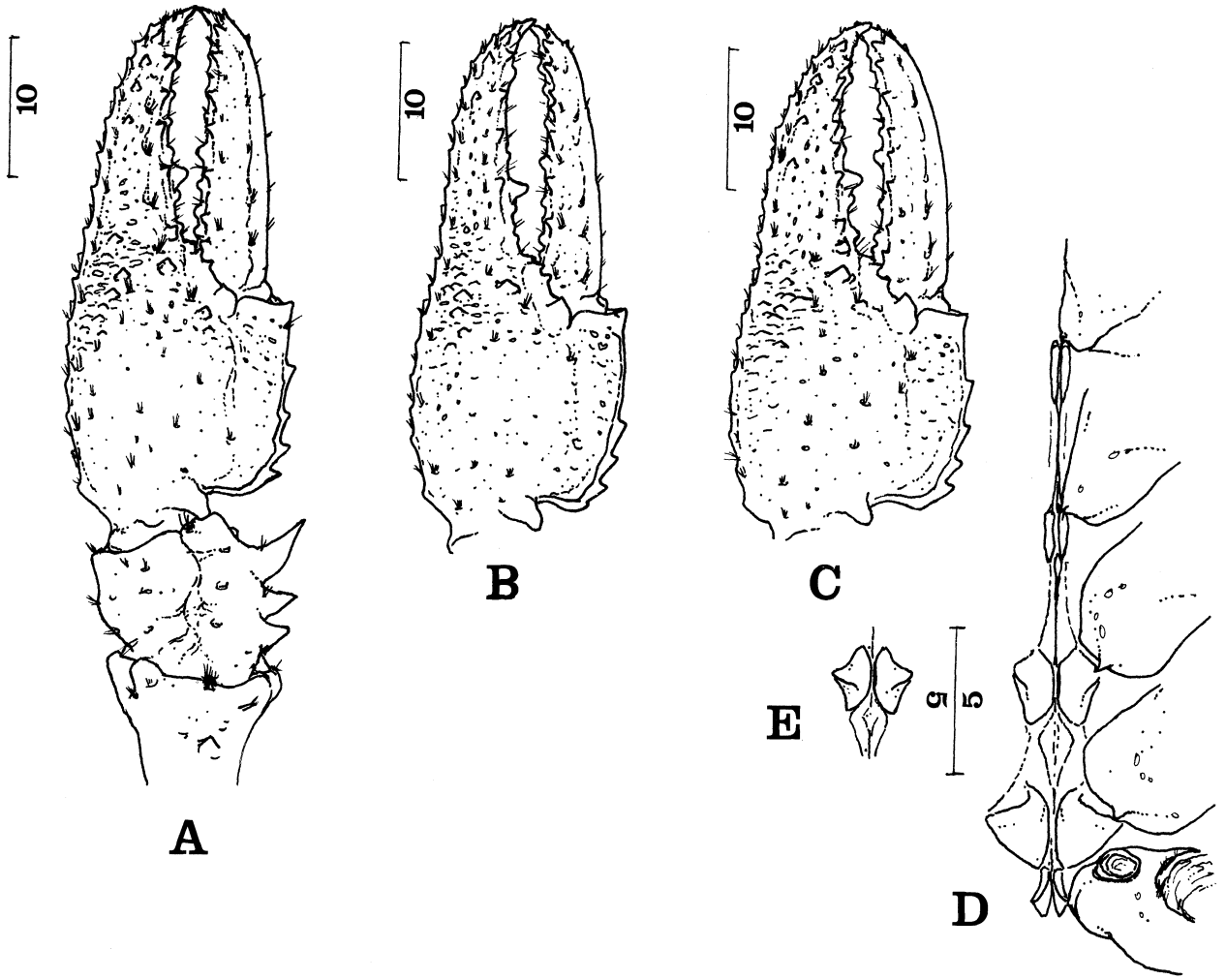

Fig. 42. *Euastacus spinichelatus* n.sp. A, dorsal view chela, holotype female, Fenwicks Creek, AM P34103; B, chela, paratype male, Bobbin Creek, AM P33966; C, chela, paratype male, Joyces Creek, AM P33960; D, sternal keel, paratype male, AM P33960; E, keel processes 3, paratype male, AM P33966.

Sexes: Males possess a cuticle partition. Of the 10 females in the 20–30 OCL range, 2 have open gonopores (and are berried) and 4 have gonopores that appear to be opening or are developing some surrounding setae. The one female >30 OCL is open and berried. Female maturation therefore usually occurs at close to 30 mm OCL.

Distribution and biology. *Euastacus spinichelatus* has been collected from an area approximately 20 km by 40 km on and about the Hastings Range, 70 km north-west of Port Macquarie, and from mountains 30 km west of Comboyne, NSW Drainage is via tributaries of the Apsley (Macleay), Hastings and Manning Rivers. The species inhabits small streams at altitudes above 680 m a.s.l., with banks supporting temperate rainforest and wet sclerophyll or dry sclerophyll forest. Populations of the species persist in streams with banks cleared for pasture.

Euastacus spinichelatus is sometimes sympatric with *E. spinifer* at low elevation sites. At the type locality, *E. spinichelatus* co-occurred with *E. simplex*.

Etymology. Named from the Latin for the numerous spines above propodal and dactylar cutting edges and dorsal apical propodal spines.

Remarks. There is some variation in the number of Li spines on abdominal somite 2, development of the ventrolateral propodal spine row, number of dorsal apical propodal spines and number of propodal spines lateral to the dactylar base ventrally. Chelae are usually elongate, but those of specimens from the most southern locality near Bulga, west of Comboyne are particularly attenuated.

Euastacus spinichelatus can be distinguished from *E. polysetosus, E. neohirsutus* and *E. gamilaroi* by the numerous spines above propodal and dactylar cutting edges, several dorsal apical propodal spines and very narrow rostrum.

Euastacus spinifer (Heller)

Figs 43–45

Cancer serratus Shaw, 1794: 21–23, pl. 8. (Not *Cancer serratus* Forskål, 1775) [after Faxon, 1898: 670, 671; Faxon, 1914: 402].
Potamobius serratus.–White, 1850: 95, pl. 15.
Astacoides spinifer Heller, 1865: 102, pl. 9.
Astacus serratus.–von Martens, 1868: 615 [after Francois, 1962: 8, 78].
Astacoides serratus.–Miers, 1876: 413 (in part, as "Australian Crayfish"); McCoy, 1878: 17 (in part).
Astacopsis serratus.–Haswell, 1882: 174; Haswell, 1901: 237; Ortmann, 1902: 292 (in part); Smith, 1912: 157–160, pls. 16–18 (in part); McCulloch, 1917: 237, 238 (in part); Hale, 1927: 75, 76 (in part); Watson, 1935: 235 (in part).
Astacopsis spinifer.–Spence-Bate, 1888: 195, 205, pl. 28 (in part).
Astacopsis parramattensis Spence-Bate, 1888: 202, pl. 27, fig. 1; Faxon, 1898: 675 (misspelt *paramattensis*).
Astacopsis sydneyensis Spence-Bate, 1888: 204, pl. 27, fig. 2; Faxon, 1898: 675.
Astacopsis spinifera.–Faxon, 1898: 670; Faxon, 1914: 402 (in part).
Euastacus serratus.–Clark, 1936: 12, 13, pls 1–2, figs 1, 12 (in part, including *E. armatus*); Clark, 1941: 16, 17 (in part).
Euastacus spinifer.–Riek, 1951: 385; Riek, 1956: 2; Riek, 1969: 893.
Euastacus spinosus Riek, 1956: 2, pl. 1; Riek, 1969: 897.
Euastacus clydensis Riek, 1969: 911, 912.
Not *Astacoides serratus* sensu McCoy, 1867: 189 (Murray River Crayfish).
Not *Astacopsis serratus* sensu Hale, 1925: 272 (Murray River Lobster).
Not *Euastacus serratus* sensu Clark, 1937*a*: 34; Clark, 1937*b*: 186 (Murray Crayfish).

Type material. HOLOTYPE, New Holland. In Zoological Museum, Berlin [after Riek, 1969: 893]. Not examined.

Other material examined. NSW Upper reaches of Hastings River, Oct. 1953, B.H. Dick, AM P13033, ♂, AM P13034, ♀, AM P13032, ♀. (The holotype, allotype and paratype respectively of *E. spinosus* Riek); Wilsons River, Wilsons River Primitive Reserve, (31°13'S 152°29'E), 21 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33977, ♂, 2 ♀♀; Cockerawombeeba Reserve, (31°11'S 152°22'E), 21 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33986, ♂; Lower Cockerawombeeba Creek, north of Birdwood, (31°18'S 152°20'E), 21 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33976, ♀; Tobin River near Mount Seaview, (31°21'S 152°05'E), 22 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33979, 4 ♂♂, 2 ♀♀; Black Creek south-west of Wauchope, (31°35'S 152°36'E), 27 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34109, AM P34110, 3 ♂♂; Tributary of Camden Haven River, near Wauchope, 20 Apr. 1978, AM P27027, 2 ♀♀; Waterfall Creek, above Bridal Veil Falls, (31°35'S 152°30'E), 27 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34108, ♂, ♀; Mumfords Creek, south-west of Comboyne, (31°38'S 152°27'E), 28 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34101–2, 2 ♂♂, ♀; Mumfords Creek, 5 miles south of Comboyne, near Taree, 5 Mar. 1959, D.D. Francois & J. Evans, AM, ♂, 4 ♀♀; Jackys Creek on road to Ellenborough Falls, (31°37'S 152°21'E), 28 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33987, 2 ♂♂; Ellenborough River above Falls, (31°37'S 152°18'E), 28 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33982, ♂, ♀; Ellenborough River near headwaters, (31°35'S 152°12'E), 28 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33980, ♂, ♀; Frenchs Creek, north-west of Bulga, (31°34'S 152°12'E), 28 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33990, ♂, ♀; Bobbin Creek near source, west of Elands, (31°37'S 152°10'E), 28 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33983, 3 ♀♀; Lower Bobbin Creek, (31°38'S 152°18'E), 28 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33988, 2 ♂♂, 2 ♀♀; Tributary Dingo Creek south of Elands, (31°38'S 152°18'E), 29 Sept. 1981, G.J. Morgan & S.J. Harders, AM P33992, ♀; Mud Hut Creek, west of Upper Bowman, (31°55'S 152°44'E), 30 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34106, ♂; Bowman River near Upper Bowman (31°55'S 151°45'E), 30 Sept. 1981, G.J. Morgan & S.J. Harders, AM P34105, ♂; Martins Creek, tributary Karuah River south-west of Stratford, (32°08'S 151°50'E), 1 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33984, ♂, 2 ♀♀; Whispering Gully, tributary Karuah River, (32°10'S 151°50'E), 1 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33978, ♂, 2 ♀♀; Tributary Allyn River near Peach Tree Park, Barrington Tops, (32°16'S 151°28'E), 2 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33994, 2 ♀♀; Tributary Allyn River on Allyn River Road, (32°16'S 151°31'E), 1 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33981, ♀; Barrington Tops, Jun. 1963, AM, ♂; Upper Allyn River, 16 Feb. 1966, E.F. Riek, AM P15329, ♂; Sandy Creek west of Bulahdelah, (32°23'S 152°10'E), 3 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33985, ♂, ♀; Boolambayte Creek, north-east of Bulahdelah, (32°23'S 152°16'E), 3 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33989, ♀; Bulahdelah Mountains near Stroud, 8 Sept. 1960, E.F. Riek, AM P15292, ♂; Boarding House Dam, Watagan State Forest north-west of Morisset, (32°55'S 151°23'E), 4 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33954, 9 specimens; Tributary of Dora Creek at Pines Camp area, Watagan State Forest, (33°05'S 151°25'E), 4 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33957, 12 specimens; Wollombi Brook, Basin Camp area, Olney State Forest west of Morisset, (33°03'S 151°09'E), 5 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33956, ♂; Berowa Creek, near Hornsby, Sydney, Feb. 1927, W. Thorpe, T. Campbell, H. Fletcher, AM P8774–8, 2 ♂♂, 3 ♀♀; McCarrs Creek, Kuringai Chase, 24 Sept. 1927, D.D. Francois & F.J. Beeman, AM P15482, 3 ♂♂, ♀; Creek in Bouddi Grand Deep, walk to Maitland Bay, Bouddi National Park, (33°31'S 151°23'E), 8 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33975, ♀; Floods Creek, near Somersby Falls, (33°25'S 151°16'E), 10 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33973, 2 ♀♀; McCarrs Creek, Kuringai Chase, (33°40'S 151°15'E), 10 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33974, 2 ♂♂, ♀; Frenchs Forest, Sydney, 25 Nov. 1964, H. Hughes & C. Turner, AM P15005, ♂; Oxford Falls, Frenchs Forest, 8 Feb. 1960(?), M. Ward(?), AM P13449, ♀; 1 mile above Oxford Falls, Frenchs Forest, Nov. 1963, J.R. Kinghorn, AM P14460, ♀; Lane Cove River, quarter mile upstream of Kissing Point road crossing at Browns Waterhole, Sydney, 18 Apr. 1972, J. Paxton, AM P19587, ♂; North Shore Sydney, 9 Feb. 1960 (?), M. Ward(?), AM P13457, ♀; Terr[e]y Hills, near Sydney, 8 Nov. 1968, J.C. Yaldwyn, AM P16322–3, 2 ♂♂; Upper reaches, Middle Harbour, Sydney, 17 Dec. 1944, AM P11935, 5 ♂♂, 8 ♀♀; Port Hacking River, National Park, Nov. 1958, D.D. Francois & K. Hancock, AM P15499, 2 ♂♂, ♀; Flat Rock Creek, Royal National Park, (34°07'S 151°05'E), 19 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33972, ♂; Parramatta, May 1908(?),

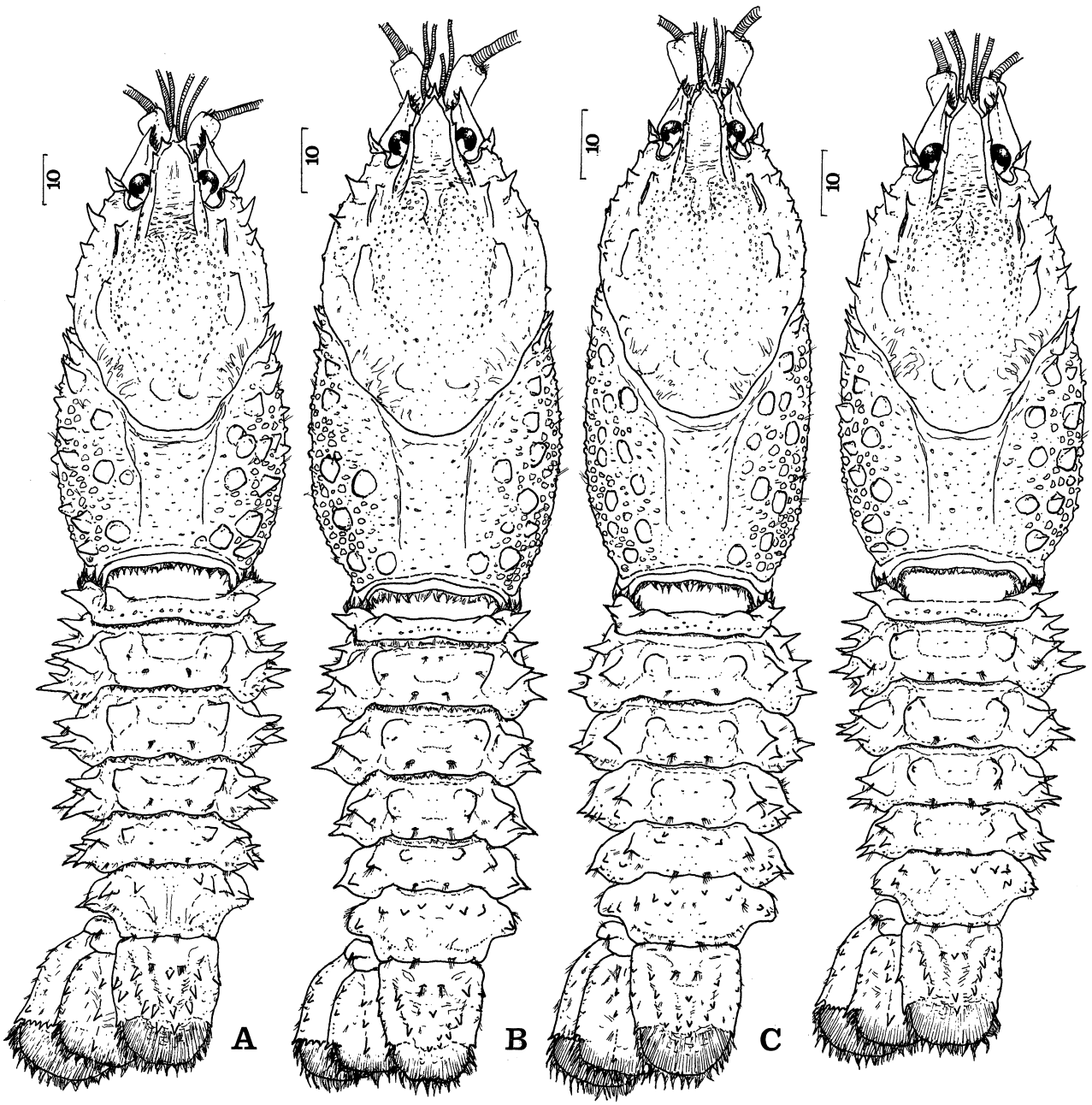

Fig. 43. *Euastacus spinifer* (Heller). A, dorsal view, male, Hastings River, AM P13033; B, dorsal view, male, Berowra Creek, AM P8775; C, dorsal view, female, Wentworth Falls, AM P15464; D, dorsal view, male, Clyde River, AM P15491. Note variation in number, size and shape of cephalic, thoracic, abdominal and tailfan spines.

A. McCulloch(?), AM P647, ♂; No locality, 2 ♂♂, 2 ♀♀; Wentworth Falls Creek, Blue Mountains, 20 Nov. 1958, D.D. Francois & D.K. McAlpine, AM P15464–9, 50 specimens; Sassafras Creek, Nepean River tributary, near Faulconbridge, Blue Mountains, 20 Mar. 1965, H.E. Moran, 2 ♀♀; Sassafras Creek, near Faulconbridge, (33°42'S 150°32'E), 15 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33969, 7 specimens; Above Cataract Falls, south of Lawson, (33°44'S 150°27'E), 15 Oct. 1981, G.J. Morgan & S.J. Harders, AM P39971, ♂; Below Fairy Falls, north of Lawson, (33°43'S 150°26'E), 15 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33970, ♂; Jamieson Creek (= Wentworth Falls Creek), above Wentworth Falls, (33°44'S 150°23'E), 15 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33968, 11 specimens; Blackheath, below Bridal Veil and Horshoe Falls and at Walls Cave, 12–15 Mar. 1939, M. Ward (?), AM P13458, 2 ♂♂, ♀; Mount Victoria near Lookout, 15 Dec. 1946, AM, 4 ♂♂; Cox River near Little Hartley, Mount Victoria, 3 Jun. 1963, A.A. Racek, AM P14463, ♂; Springwood (Blue Mountains), Mar. 1913(?), AM P3632–5, 3 ♂♂, ♀; Kuringai Chase, Sydney, Nov. 1967, C.N. Smithers, AM P16163, ♂; Maroubra, Sydney, 15 Oct. 1963, AM P14461, ♀; Cascade Creek at Girrakool, Brisbane Water National Park, (33°27'S 151°17'E), 9 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33959, 5 specimens; Euroka Creek near

Euroka Crossing near Glenbrook, (33°48'S 150°36'E), 14–15 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33958, 7 specimens; Glenbrook Crossing on Campfire Creek near Glenbrook, (33°47'S 150°36'E), 14 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33955, 2 ♂♂; Spring at Taihoa, Mount Irvine, Blue Mountains, M. Ward(?), AM P13440, ♂; Bowens Creek near Mount Irvine, M. Rawlins, AM P13451, 3 ♂♂; Bell, Blue Mountains, 27 Nov. 1956, E.F. Riek, AM P15295, 2 ♂♂, ♀; Junction of Govetts Leap Creek and Grose River Blue Mountains, 3 Oct. 1966, D.D. Francois & F.H. Talbot, AM P15529, ♀; Mount Wilson, Blue Mountains, 3000 ft, 12 Aug. 1965, J.C. Yaldwyn, AM P15012, ♂; Near Blackheath, Blue Mountains, R.J. Campbell, AM P15494, ♂, 3 ♀♀; Blackheath, Blue Mountains, 1909(?), J.R. Kinghorn (?), AM P2017, ♀; Colo Vale, west of Wollongong, 1902(?), AM G4105, ♂; "Sydney", 30 Nov. 1925, AM, ♀; Clyde River near Brooman, Ulladulla area, 25 May 1959, N. Williams, AM P15491, ♂ (holotype of *E. clydensis* Riek); Stream at Conjola near Ulladulla, 19 Jun. 1959, D.D. Francois & J. Harvie, AM P15489, P15488, P15490, 3 ♀♀ (allotype and 2 paratypes of *E. clydensis* Riek); Creek on eastern side of Clyde River between Brooman and Shallow Crossing, near Batemans Bay, 28–29 Feb. 1966, J.C. Yaldwyn & F.J. Beeman, AM P15544–5, ♂, 2 ♀♀; Cabbage Tree Creek, eastern foot Clyde Mountain, Aug. 1954, E.F. Riek, AM P13052, ♀; Boyne Creek on Yadboro Road, west of Ulladulla, (35°23'S 150°16'E), 29 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33995, ♀; Stoney Creek, Western Distributor Road, north-west of Brooman (35°28'S 150°05'E), 29 Oct. 1981, G.J. Morgan & S.J. Harders, AM P34111–2, ♂, ♀.

Diagnosis. Male cuticle partition absent. Rostral spines distributed to or proximal to midlength of carinae. Rostral base parallel or divergent, carinae medium length or long. Antennal squame widest at or proximal to midlength. Squamal spines absent (rarely spine on one side). Suborbital spine medium sized or large. Thoracic spines large, moderately pointed or sharp. General tubercles medium sized or large, moderately or sparsely distributed. 3–6 very large to medium sized Li spines on abdominal somite 2. D spine present on anterior somites, often large and sharp. Abdominal boss present on species >60 OCL. Telsonic spines small to very large. Uropods with marginal spines of variable size. Ventrolateral propodal spine row well developed, sometimes reaching apex of finger. 1–4 dorsal apical propodal spines. Spines above cutting edges of chela usually apical, sometimes to midlength of gape of dactylus. 5 (rarely 4 or 6) mesial propodal spines. 1–4 dorsomesial and marginal dactylar basal spines, or spines absent. 2–6 apical mesial dactylar spines. 2 (rarely 3) mesial carpal spines. Ventromesial carpal spines smaller than ventral spine. Keel Pr1 abrupt or semi-abrupt and apart or very apart, usually parallel. TAP count 7.5–13.0.

Description. Maximum OCL: 116.7 mm.

Rostrum: Rostral shape and length extremely variable. Rostrum sometimes extending only to base or as far as distal border of 3rd antennal segment of specimens >40 OCL, beyond 3rd segment on some smaller crayfish. Southern specimens with longest rostra, Blue Mountains animals with shortest. Rostral sides parallel or convergent; base parallel or divergent, carinae medium length to long. 2–5 rostral spines per side, apical or distributed to proximal of midlength of carinae on specimens of all sizes; spines large or medium sized (rarely small), sharp or moderately pointed. Acumen spine similar to, or slightly or much larger than marginal spines. Rostral spines of Blue Mountains specimens smallest and bluntest, those of southern specimens largest and sharpest.

OCL/CL 0.72–0.88 i; RW/OCL 0.15–0.25 d.

Cephalon: Cephalon very to poorly spinose on specimens >20 OCL, moderately to poorly spinose on smaller specimens. Southern and northern specimens spiniest, Sydney and Blue Mountains specimens generally least spinose. 1–5 medium sized or large, moderately pointed or sharp spines ventral to postorbital ridges, with several small spines or protuberances. On specimens >60 OCL 1st postorbital spine an edge or medium sized, large on some southern specimens; spine usually medium sized or large on specimens <60 OCL, occasionally very large. 2nd postorbital spine barely discernible or small on specimens >60 OCL, large on some southern specimens; spine small to large on crayfish <60 OCL. Suborbital spine medium sized to very large (variation between populations). Lateral margin of antennal squame convex or straight (rarely slightly concave); squame widest at or proximal to midlength on specimens >60 OCL, very proximal to midlength on some specimens <40 OCL; squame shortest on Blue Mountains specimens; marginal spines usually absent (two southern specimens with spine on one side only). Epistome moderately elongate to broad on specimens >40 OCL, usually broad or very broad on smaller specimens (broadest on southern specimens); spine margin almost smooth, scalloped or toothed, usually smoothest on Blue Mountains specimens. Antennal basipodite spine usually small or medium sized on specimens >60 OCL, large on some Sydney and southern specimens and absent on some Blue Mountains crayfish; spine usually medium sized to very large on crayfish <60 OCL, small on some Blue Mountains specimens. Coxopodite spine medium sized to very large on specimens of all sizes except some Blue Mountains crayfish with small spine; spine always large or very large on southern specimens; spine usually bifid or serrated with lateral cusp much larger than mesial one or two, unimodal on some small specimens.

ScL/OCL 0.13–0.35 d.

Thorax: About 6–20 thoracic spines per side, dispersed in zone or 2 irregular rows; spines usually large with some medium sized or small spines on specimens >40 OCL and most 20–40 OCL, spines small or absent on animals <20 OCL. Spines moderately pointed to very sharp on most specimens >60 OCL, particularly sharp on some northern and southern specimens; spines moderately pointed to rounded on Blue Mountains specimens (often subrectangular in shape near Wentworth Falls); spines sometimes sharp on specimens <60 OCL

(especially in north), usually moderately pointed to blunt or rounded. Dorsalmost spines usually bluntest, anterior and posterior spines frequently sharpest. General tubercles medium sized or large on specimens >40 OCL, smaller on lesser specimens; tubercles moderately distributed or sparse, very sparse on some specimens <40 OCL, absent on some animals <20 OCL. 2–5 cervical spines on specimens >40 OCL, 1–3 on most crayfish <40 OCL, absent on some very small specimens; dorsal spine frequently larger than remainder, though 2 or 3 spines sometimes large; spines medium sized on some Blue Mountains specimens; cervical spines sharp or very sharp on large specimens, moderately pointed on some crayfish <60 OCL.

ArL/OCL 0.33–0.40; ArW/OCL 0.14–0.24 d; CaW/OCL 0.54–0.65; CaD/OCL 0.45–0.56 d.

Abdomen: Sharp D–L spine usually on somite 1 of specimens >40 OCL, frequently on specimens 20–40 OCL, usually absent on crayfish <20 OCL; one northern specimen with 2 D–L spines on one side of somite 1. Often moderately pointed to blunt D spine on somite 1, absent on specimens <20 OCL. On somite 2, 3–6 Li spines per side on specimens >40 OCL; on smaller specimens, 1–5 Li spines, or spines absent particularly on specimens <20 OCL. On somites 3–5, usually single Li spine on specimens >40 OCL, frequently on specimens 20–40 OCL, usually absent on specimens <20 OCL. Li spines very large to medium sized on specimens >60 OCL, large to small on specimens 20–60 OCL and minute or absent on specimens <20 OCL; Li spines very sharp or sharp on specimens >40 OCL, sharp to blunt on smaller animals. Lii spines usually absent on somite 2, 1 or 2 rarely present on some Blue Mountains and southern animals; on somites 3–6, usually 1 or 2, rarely 3, Lii spines per side of specimens >40 OCL and some 20–40 OCL. Lii spines more numerous on somites 5 and 6 than on anterior somites; Lii spines very large to small on crayfish >60 OCL, decreasing in size to posterior somites; large to minute or absent on smaller specimens; spines very sharp to moderately pointed on specimens >60 OCL, sometimes blunt on smaller crayfish. D–L spine usually on somites 2–5 of crayfish >40 OCL, sometimes on specimens 20–40 OCL; on somite 6, 1–4 D–L spines on specimens >40 OCL, 0–2 on specimens 20–40 OCL. D–L spines very large to small on specimens >60 OCL, except some Blue Mountains crayfish with minute D–L spines on posterior segments; on specimens <60 OCL D–L spines may be very large on anterior somites but usually large to minute; spines absent on specimens <20 OCL; sharpness like size, decreasing to posterior from very sharp to blunt on specimens >40 OCL, except some southern specimens with all D–L spines very sharp; on specimens <40 OCL, D–L spines usually moderately pointed (occasionally sharp) to very blunt. D spine usually on somites 2–5 of crayfish >60, many 40–60 OCL and some 20–40 OCL crayfish; on somite 6, 1–3, rarely 4 or 5, D spines per side on specimens >60 OCL, spines often absent on smaller specimens. D spines large to minute, never exceeding medium sized on Blue Mountains specimens; spines very sharp to blunt on somites 5 and 6. On most crayfish >40 OCL, Lii, D–L and D spines form irregular series of spines, of various sizes, across somite 6. Spines usually largest and sharpest on northern and southern specimens, smallest and bluntest on Blue Mountains crayfish. Dorsal boss present (sometimes obvious) on somites 2–4 of specimens >60 OCL, obsolete or absent on smaller crayfish. Boss usually obscured by broad D spines.

AbdW/OCL ♂ 0.47–0.56 d, ♀ 0.52–0.59 i; OCL/L 0.34–0.45 i.

Tailfan: 4–10 telsonic spines on specimens >20 OCL, spines usually medium sized to very large, with some small spines on many Blue Mountains crayfish and some Sydney and northern specimens; on specimens <20 OCL, spines usually fewer, or sometimes absent. 1 or 2, rarely 3, additional lateral telsonic spines on most specimens >40 OCL and many 20–40 OCL; spines very large to small. Inner ramus of uropod of specimens >40 OCL usually with 1–4 median spines, occasionally absent; specimens 20–40 OCL often with 1–3 median spines, merely small protuberances on specimens <20 OCL. 1–5 (usually 2 or 3) lateral spines on inner ramus of most specimens >40 OCL and some 20–40 OCL. Outer ramus of uropod of specimens >40 OCL usually with 1–6 lateral spines; some crayfish of all sizes lacking lateral spines on one uropod and some Blue Mountains specimens with lateral margin merely irregular. Uropod spines small to very large, often largest on northern and southern specimens. Standard spines small to large, usually decreasing with increasing OCL, largest on southern and northern specimens.

TeL/OCL ♂ 0.28–0.43 d, ♀ 0.32–0.43 di.

Chelae: Chelae elongate to moderately stout, stout on some Blue Mountains specimens; some specimens <20 OCL with very elongate chelae. Teeth well developed on most specimens >80 OCL and some 60–80 OCL crayfish.

Propodus: Ventrolateral spine row on propodus well developed, sometimes reaching apex of finger, on specimens >20 OCL; ventral row vague or absent on some specimens <20 OCL. Lateral spines large in south, large or medium sized in north, large to small near Sydney and medium sized or small in Blue Mountains; spines sharp. Lateral spine ridge present, often well developed, on specimens >40 OCL, medium sized or small on lesser animals. Usually 5, occasionally 4 or 6, mesial propodal spines. 1 (rarely 2) dorsal apical propodal spines on specimens >60 OCL from the south and Sydney, 1–3 on Blue Mountains animals, 1–4 (usually 2 or 3) in north; smaller specimens frequently lacking spines. Specimens >60 OCL usually with 1–3 spines above cutting edge but spines absent on some Sydney specimens; specimens <60 OCL with 0–2 spines; specimens <20 OCL lacking spines above cutting edge. Spines usually apical, almost to midlength of gape on some northern animals; spines large to small, increasing with size of specimen and largest in north and south.

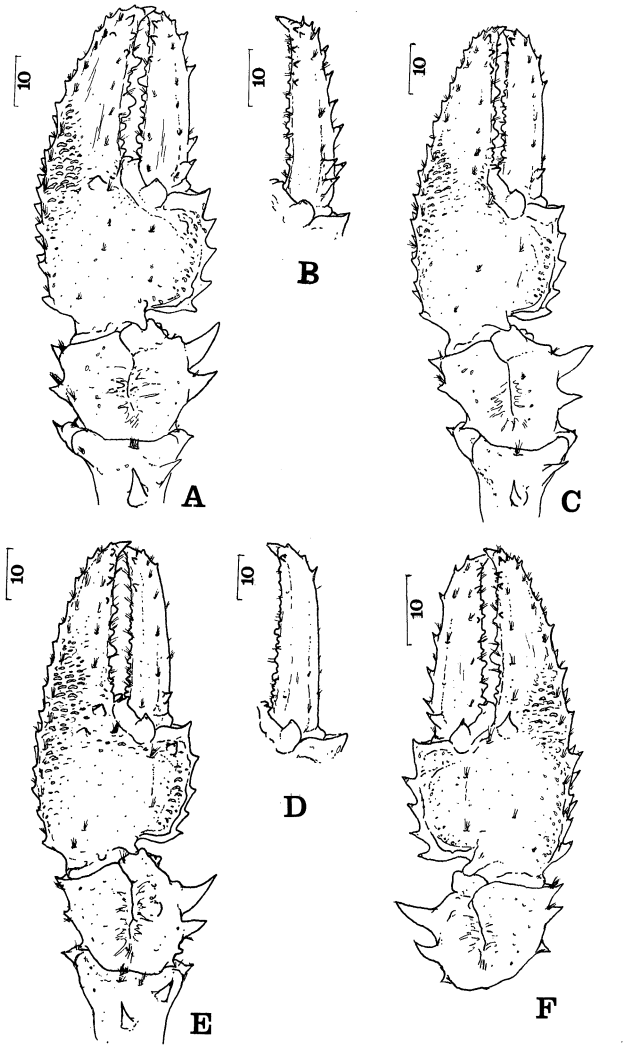

Fig. 44. *Euastacus spinifer* (Heller), dorsal view chelae. A, male, Hastings River, AM P13033; B, dactylus, numerous mesial spines, female, Hastings River, AM P13034; C, male, Berowra Creek, AM P8775; D, dactylus, basal mesial spines absent, female, Berowra Creek, AM P8774; E, female, Wentworth Falls, AM P15464; F, female, Boyne Creek, AM P33995.

Spines on dorsal propodal surface lateral to dactylar base varying geographically: in south, 1, rarely 2, usually large spines (smaller on small animals); 1–3 spines on Blue Mountains specimens, spines rarely large; 0 or 1 large to small spine on northern specimens; Sydney specimens usually lacking spine but 1 medium sized or small spine sometimes present. Some lateral protuberances present on most specimens. Ventrally, 1–6 spines lateral to dactylar base, usually fewest in Sydney area. Specimens <20 OCL frequently lacking dorsal and ventral spines. Spines usually absent posterior to dactylar articulation but small to large spine sometimes present. Precarpal spines usually absent, occasionally 1 or 2 small spines.

PropL/OCL ♂ 0.80–1.01 i, ♀ (0.78) 0.82–0.95; PropW/PropL 0.32–0.47; PropD/PropL 0.21–0.30 id.

Dactylus: 1–5 spines above cutting edge (6 on some regenerate chelae) on specimens >40 OCL, usually fewest on Sydney and Blue Mountains animals; specimens 20–40 OCL with 1–3 spines, or spines absent; crayfish <20 OCL lacking spines; spines apical on Sydney animals, apical or to or slightly proximal to midlength of gape in other areas; spines large to small. Extra dorsal dactylar spine present on some large northern specimens. Mesial dactylar spines varying geographically: specimens >20 OCL from north and south with 1–3, rarely 4, dorsomesial basal spines, sometimes extending distal to midlength of dactylus; Blue Mountains specimens with 1, rarely 2, dorsomesial basal spines; Sydney animals with 0 or 1 spine. Marginal basal spines numbering 0–4 in north, 1–3 in south, 0–1 in Blue Mountains and Sydney; regenerate chelae often with higher counts; basal spines sharp and very large to medium sized or small, largest in north and south, smallest in Blue Mountains. Apical dactylar spines numbering 3–6 in north and south (fewer on some very small animals), 2–5 (usually 3 or 4) in Sydney, 2 or 3 in Blue Mountains. In north and south, basal and apical dactylar spines usually forming mesial row or rows along dactylus. Dactylar groove usually shallow or absent on large specimens, deeper on small crayfish.

DactL/PropL 0.49–0.60.

Carpus: Usually 2 mesial carpal spines, often with protuberances distal and/or proximal to spines; some specimens with minute 3rd spine, rarely with 3 distinct spines. Distal spine usually distinctly larger than 2nd. Usually 2 lateral carpal spines, large to small, smallest in Blue Mountains. Articulation spine usually absent on specimens >60 OCL, small or medium sized on most specimens 20–40 OCL, large on most animals <20 OCL. Small dorsal carpal spines or protuberances sometimes present. Ventral carpal spine large or very large. 1–4 ventromesial spines, largest medium sized (large on 2 specimens).

Merus: Usually 5–10 dorsal spines, some specimens <20 OCL with only 3 or 4; spines large, rarely medium sized. Outer meral spine large in south, large to small in north and near Sydney, rarely large in Blue Mountains except on small specimens.

Keel: *Pr1*: Posterior margins abrupt or semi-abrupt, sloped on some specimens <40 OCL; ventral edges angled down, flat, rounded or occasionally angled back; processes slightly to very apart and usually parallel, sometimes open or closed. Keel after Pr1 frequently bearing 1 or 2 large or small spines, sometimes merely pronounced.

Pr2: Open or very open. Keel after Pr2 often with 1 or 2 spines.

Pr3: Scoops usually absent, often slight or very gradual, sometimes distinct on Blue Mountains specimens; bases sharp to rounded. Keel after Pr3 sometimes low, usually moderately pronounced or distinctly raised on small specimens; spine frequently present.

Pr4: Scoops distinct, slight or absent; posterior edges sharp to rounded and slightly convex, straight or irregular; anterior edges usually angular or very angular.

Pr3 and 4 broad or narrow on specimens >80 OCL, distinctly broad or very broad on smaller specimens.

Setation: Moderate to light.

Punctation: Moderate to dense, occasionally very dense on small specimens.

Gastric mill: TAP count 7.5–13.0; TAA count 0–1.5 (usually 0.5–1.0); spread 6.0–12.5. Variation in tooth counts partially due to size and proximity of teeth but more to length of zygocardiac ear. Urocardiac ridges 7–14, increasing with OCL, and varying between populations.

Coloration: Body dorsally dark green-brown, often with reddish tinge in Blue Mountains, paler ventrolaterally. Orange, yellow or blue patch ventrolaterally on cephalon. Thoracic spines darker, sometimes almost black, sometimes with orange or yellow tips especially in Blue Mountains and southern areas. General tubercles pale orange, yellow or cream. L and D–L abdominal spines orange or red, D spines usually orange or red but black in northern populations. Cheliped articulations red. Carpus of cheliped dark green or olive-brown, sometimes with ochre mottling, mesial and lateral spines with orange or brown tips. Propodus dark green or brown, sometimes tinged with blue, most spines tipped with orange, yellow or red. Fingers blue or dark green.

Body ventrally orange, green and cream. Carpus of cheliped dark green or blue-green mesially, orange laterally; ventral spine usually orange. Propodus dark green or blue-green mesially and orange with green or blue mottling medially, or entirely blue or blue-green or mostly cream with some green or brown mottling medially; lateral margin orange. Fingers dark blue or green.

Sexes: Males lack a cuticle partition. Inflated papillae, evidence of precocious males (Turvey, 1980) were observed on specimens <40 OCL. There is some variation in the size at onset of female maturity as evidenced by open gonopores and setal development around the pores. Only one specimen <60 OCL (from near Newcastle, 49.8 mm OCL) is mature but several specimens have gonopores that appear deeply incised and soon to open. Most females become mature in the 60–80 OCL range, though one southern specimen with OCL of 80.2 mm has closed gonopores.

Distribution and biology. *Euastacus spinifer* is distributed from the upper reaches of the Hastings River north-west of Port Macquarie, south through Sydney and the Blue Mountains to the vicinity of Clyde Mountain near Brooman, a range of approximately 550 km north-south and inland approximately 100 km. The range is drained by numerous eastward flowing coastal streams. *Euastacus spinifer* was sampled at altitudes between 70 and 800 m a.s.l. but probably extends to lower altitudes where conditions are suitable. Inhabited streams are moderately to well shaded by dry sclerophyll and heath vegetation, occasionally with wet sclerophyll and temperate rainforest along the banks. Needless to say, much of the Sydney area has been drastically altered. Fishing and development pressures have concentrated populations of *E. spinifer* in relatively undisturbed areas of national park, state forest and water catchments.

Studies by Turvey (1980) indicate that *E. spinifer* from the Loddon River south of Sydney mates and spawns in May and June, carrying the eggs over winter and spring, releasing young in summer. Berried specimens of *E. spinifer* were collected for this study in September and October, 1981. Turvey found small males (<45 mm OCL) in the population with very inflated genital papillae which he termed "precocious". Similar specimens were collected during this study from populations throughout the range of the species.

At some localities *E. spinifer* was sympatric with *E. australasiensis, E. clarkae, E. spinichelatus, E. reductus* and *E. yanga* n.sp.

Remarks. *Euastacus spinifer* is a large, generally spiny species but with obvious variation in the following: overall spininess, including the number and size of thoracic and abdominal spines; size of the general tubercles; size of postorbital spines; size and shape of the antennal squame; size of antennal basipodite and coxopodite spines; rostral shape and spination; size of telsonic spines; number and size of mesial dactylar spines; size of spines above cutting edges of chelae; size of spine(s) on the dorsal surface of the propodus lateral to the dactylar base; shape of keel processes 3 and 4 and gastric mill counts.

Euastacus spinifer has a very large range. While variation can be marked between nearly adjacent populations, broad trends in characters are evident over the range of the species. The following general changes in morphology are described over a north to south progression.

The northern specimens include those previously designated *E. spinosus* Riek. These animals are usually very spiny, the dactyli of chelae usually bear several apical and basal mesial spines that may form an irregular spine row, there is often a large spine on the dorsal surface of the chela propodus lateral to the dactylar base and the D abdominal spines are usually dark in colour. There is a general decrease in the size, and to a lesser extent, number of spines from north to south.

Riek (1956) recorded the species *E. spinosus* from its type locality, the upper Hastings River. This area has populations which include some of the spiniest specimens of *Euastacus*. Recent sampling for this study revealed the species to extend almost continuously from the *E. spinosus* type locality to Sydney in the range of *E. spinifer*. Over this distance of approximately 300 km, sufficient intermediate specimens were collected to

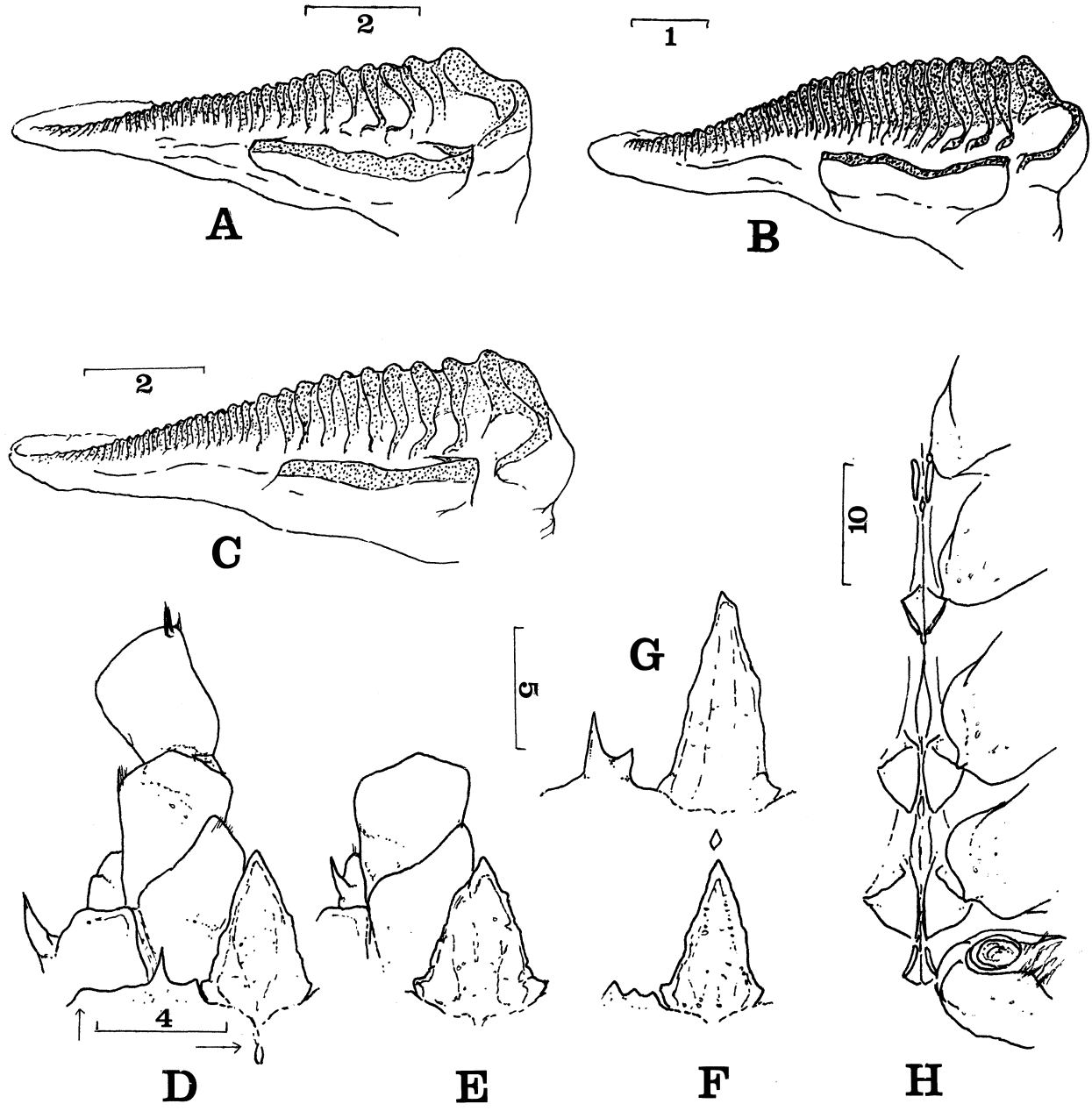

Fig. 45. *Euastacus spinifer* (Heller). A, ventral view zygocardiac ossicle, female, Girrakool, AM P33959; B, zygocardiac ossicle, male, Wentworth Falls, AM P15465–9 (Francois collection); C, zygocardiac ossicle, female, Hastings River, AM P13034 (Francois collection); D, ventral view cephalon, male, Berowra Creek, AM P8775; E, large basipodite spine, broad epistome, female, Sydney, AM; F, more elongate epistome, small trifid coxopodite spine, female, Maroubra, AM P14461; G, bifid coxopodite spine, very elongate epistome, male, AM P34109; H, sternal keel, male, Berowra, AM P8775.

synonymise *E. spinosus* and *E. spinifer*. The major morphological difference between specimens from the Hastings River west of Port Macquarie and those from Sydney is the development of mesial dactylar basal spines. Most Sydney crayfish have few or no dactylar basal spines while northern specimens have several, usually large spines, but there is considerable variation in populations between Sydney and Port Macquarie.

West of Newcastle, *E. spinifer* is moderately spiny and the number of mesial dactylar basal spines is variable. There may be only 1 spine, thus approaching the condition of Sydney crayfish. The dorsal abdominal spines are orange rather than the black of northern specimens. In many characters the Newcastle crayfish are intermediate between Sydney and mid-northern specimens, particularly those from the Bulahdelah and Barrington Tops area.

The Sydney area has considerable variation within and between its populations. The size and number of thoracic spines are variable but they are rarely sharp. Some specimens are as spiny on cephalon, thorax and abdomen as some northern crayfish; other specimens have smaller, blunt or rounded spines, approaching the condition of Blue Mountains populations. Chela shape is variable, as it is across the entire range of the species. Dactylar basal spines and spines on the propodus lateral to the dactylar base are frequently absent. D abdominal spines are orange or red.

To the west of coastal Sydney, specimens of *E. spinifer* show marked reduction in spination. Specimens from the Blue Mountains have thoracic spines which, though still large, are blunt or rounded. Some from the Wentworth Falls area have thoracic spines subrectangular in shape. General tubercles are reduced in size and hence appear sparser than on many northern specimens, though some specimens from Sydney are similar. Cephalic spines are reduced in size as are telsonic spines on some specimens. Chela spination is reduced, though not as markedly as on many Sydney specimens and a dorsomesial dactylar basal spine is always present. Blue Mountains specimens have shorter rostra with smaller rostral spines than most specimens to the north and south. Some specimens, however, have rostra identical to those of some Sydney specimens. In general morphology, the least spiny Blue Mountains specimens are very different from the far northern and southern animals but the spinier Blue Mountains specimens resemble closely some Sydney animals.

South of Sydney the collections of *E. spinifer* are patchy. Far southern specimens, from the mountains near Batemans Bay and Monga are very spiny crayfish, very similar to the far northern specimens of the Hastings River. Closer to Sydney, however, spination is reduced, particularly with regards to cephalic and postorbital spines. Specimens from Conjola, the paratypes of Riek's *E. clydensis*, are similar to Sydney crayfish except in the greater development of dactylar spines. Thoracic and abdominal spines are always large and frequently sharp. The D abdominal spines are usually orange. The rostrum is large, particularly on southern specimens, and the carinae are usually parallel.

Some small males (<40 OCL) of *E. spinifer* have grossly inflated genital papillae. Turvey (1980) noted the existence of these precocious males in populations of *E. spinifer* from the Sydney area. Precocious males were collected in 1981 from all areas of the species' range except in the south. This appears to be the only species of *Euastacus* to possess these unusual males and this character supports recognition of a single, polytypic species.

The far northern and southern specimens of *E. spinifer* are extremely similar. Described as separate species by Riek, he did not distinguish *E. spinosus* and *E. clydensis* by key (1969: 872) except to note the differences in type localities. Presumably he assumed them to be separate species due to the apparent distance between their ranges. Riek distinguished the two species in his description of *E. clydensis* (1969: 911) on the basis of three characters. Rostral shape is variable in both northern and southern populations and Riek himself noted some rostral variation (1969: 912). The "enlarged tubercles" of the branchiostegites (regarded as spines in this study) of *E. clydensis* may be extremely sharp and those of *E. spinosus* may be rather blunt and cannot be employed to separate species. The sternal keel is very variable in shape and can be raised in all populations of *E. spinifer*.

Riek (1969: 872) separated *E. spinosus* and *E. clydensis* from *E. spinifer* on the basis of processes on the mesial margin of the basipodite of the antenna. Comparison of numerous specimens leads me to believe that Riek in fact was referring to the coxopodite spine, but in any case, both basipodite and coxopodite spines are variable in *E. spinifer* and useless for specific diagnosis. Francois (1962) agreed to the validity of *E. spinosus* on the basis of the antennal basipodite (= coxopodite) spine and gastric mill counts. Intermediate sites indicate considerable variation and an irregular gradient in tooth counts. There are few collected specimens of *E. clydensis* and 80% of specimens labelled *E. clydensis* or "near *clydensis*" by Riek in museum collections are not conspecific with his type specimens, instead being southern spiny specimens of *E. yanga*.

The specimens of *E. spinifer* from Conjola and the Clyde River near Brooman, regarded by Riek as *E. clydensis*, were noted by Francois (1962) to display higher mill counts and he suggested they may be the extreme of a cline, a subspecies or a new species. Within his mill collections and on museum labels, Francois called these specimens "*E. williamsi*" but no such species is included in his thesis. Francois considered that "*spinifer* will probably be found to be more than one species". The mills of these specimens have counts that overlap those of other populations of *E. spinifer* and do not warrant species distinction.

The Blue Mountains crayfish are included in *E. spinifer* on the basis of intermediates between those specimens and the Sydney crayfish. The extreme specimens from some sites (e.g., Wentworth Falls) are certainly unusual for *E. spinifer*. Francois (1962) considered these crayfish as a separate undescribed species. He examined 52 specimens, 50 of which are from Wentworth Falls. The phenotype from this area displays more variation than was observed by Francois. Some gastric mills are present in his collection from Blue Mountains specimens not listed in his thesis. These specimens are not morphologically typical of his unpublished species. Gastric mill differences are also greater than Francois recorded. Riek (1969) included Blue Mountains specimens in *E. spinifer* but labelled several specimens with Francois' unpublished name.

Gastric mills display a general cline in tooth counts that roughly parallells that of external characters. Most northern specimens have relatively low tooth counts, usually with a TAP of 7.5–8.5, though some populations (e.g., near Comboyne) have a TAP of 9.0–

10.0. Specimens from around Sydney generally have a TAP of 9.5–11.5 though some populations (e.g., Girrakool) have a TAP of 8.5–9.0, overlapping with northern populations. In the Blue Mountains, TAP counts are the highest for the species at 10.0–13.0. Southern specimens have counts similar to those of Sydney animals, with the highest counts near the southern limits of the range. Generally tooth counts irregularly increase from north to south and west into the Blue Mountains, largely the result of extension of the ear towards the posterior of the zygocardiac ossicle.

Euastacus sulcatus Riek

Astacopsis serratus.–Watson, 1935: 235 (in part, Mount Tamborine and Lamington National Park as localities). (Not *Cancer serratus* Shaw, 1794).
Euastacus sulcatus Riek, 1951: 379; Riek, 1969: 895; Morgan, 1988: 22–27, figs 13, 14.
Euastacus cunninghami Riek, 1951: 379, 380; Riek, 1956: 1; Riek, 1969: 895.

Distribution and biology. *Euastacus sulcatus* ranges from Mount Tamborine to the Lamington Plateau, southern Queensland, and west along the McPherson Range bordering New South Wales. A relict population may exist on Mount Warning. The range is drained by Nerang, Albert, Logan, Brisbane, Condamine, Richmond and Tweed Rivers. The species occurs in streams at altitudes above 300 a.s.l., in rainforest and wet sclerophyll forest.

Remarks. *Euastacus sulcatus* was redescribed and discussed in detail by Morgan (1988).

Euastacus suttoni Clark

Astacopsis serratus.–McCulloch, 1917: 237, 238 (in part, Lyra near Stanthorpe as a locality). (Not *Cancer serratus* Shaw, 1794).
Euastacus nobilis.–Clark, 1936: 15–17 (in part, Stanthorpe as a locality). (Not *Astacoides nobilis* Dana, 1852).
Euastacus suttoni Clark, 1941: 18, 19, pl. 5; Clark & Burnet, 1942: 90, 91; Riek, 1951: 381; Riek, 1969: 895; Morgan, 1988: 27–31, figs 15, 16.

Distribution and biology. *Euastacus suttoni* extends from the Stanthorpe area, southern Queensland, 120 km south to Dundee near Glen Innes, New South Wales, and east along the Gibraltar Range. The range is drained by tributaries of the Severn, Dumaresque and Clarence Rivers. The species occurs at altitudes above 680 m a.s.l., in granite country, with open sclerophyll and heath forest, or cleared pasture, along streams.

Remarks. *Euastacus suttoni* was redescribed and discussed by Morgan (1988).

Euastacus valentulus Riek

Potamobius serratus.–White, 1850: 96 (in part, Richmond River as a locality?). (Not *Cancer serratus* Shaw, 1794.)
Euastacus valentulus Riek, 1951: 380; Riek, 1956: 1; Riek, 1969: 896, figs 16E, 20A–D, H–J; Morgan, 1988: 31–35, figs 17, 18.

Distribution and biology. *Euastacus valentulus* ranges from Currumbin Creek, south-east Queensland, 90 km south to the Ballina area of New South Wales and west to Woodenbong, about 100 km. The range is drained by the Tweed, Richmond and Clarence Rivers and small coastal streams. The species occurs from close to sea level to 600 m a.s.l. in rainforest, wet sclerophyll forest and in cleared pasture.

Remarks. *Euastacus valentulus* was redescribed and discussed by Morgan (1988).

Euastacus yanga n.sp.

Figs 46–48

Astacopsis serratus.–Hale, 1927: 76 (in part, inclusive distribution?). (Not *Cancer serratus* Shaw, 1794).
Euastacus claytoni Riek, 1969: 909, 910 (in part, Moruya and Tuross Rivers and Clyde Mountain as localities).
Euastacus brachythorax Riek, 1969: 912 (in part, Dignam Creek near Bermagui as locality).

Type material. HOLOTYPE ♂, OCL 47.2 mm, AM P34100. NSW Double Creek, tributary Boyne Creek near Pigeon House, west of Ulladulla, (35°22'S 150°15'E), 29 Oct. 1981, G.J. Morgan & S.J. Harders. PARATYPES: NSW Type locality, AM P33945, 2 ♂♂, 3 ♀♀; Stoney Creek near Sassafras on road to Tomerong, (35°07'S 150°28'E), 28 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33946, 2 ♂♂, 3 ♀♀; Tree Fern Gully, on Eastern Trail near Fitzroy Falls, (34°39'S 150°29'E), 22 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33948, 2 ♂♂, 2 ♀♀; Reedy Creek, on Tin Pot Road, west of Narooma, (36°15'S 149°58'E), 31 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33925, ♀; Tributary Running Creek, German Creek Road, south-west of Moruya, (36°01'S 149°53'E), 31 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33934, ♂, 2 ♀♀; Red Creek, west of Davidges Crossing, (36°15'S 149°52'E), 31 Oct. 1981, G.J.Morgan & S.J. Harders, AM P33936, 2 ♀♀; Tributary of Genoa River at bridge east of White Rock River on Towamba-Rockton Road, 23 Mar. 1968, J.C. Yaldwyn & F.J. Beeman, AM P16192, ♂, AM P34104, 6 ♂♂, 5 ♀♀; Old Battery Creek, tributary Nadgee River, Nadgee Nature Reserve near Eden, Oct. 1973, K. Rudder, AM P19589, M.

Other material examined. NSW Bundanoon, 1909(?), A. Ross(?), AM P2114, P2116, ♂, ♀; Fairy Bower, Bundanoon, 1922(?) A.A. Livingstone(?), AM P5737–9, P5741–2, 2 ♂♂, 3 ♀♀; Tributary Yarrunga Creek on Barrengarry Road to Fitzroy Falls, (34°41'S 150°30'E), 22 Oct. 1981, G.J. Morgan

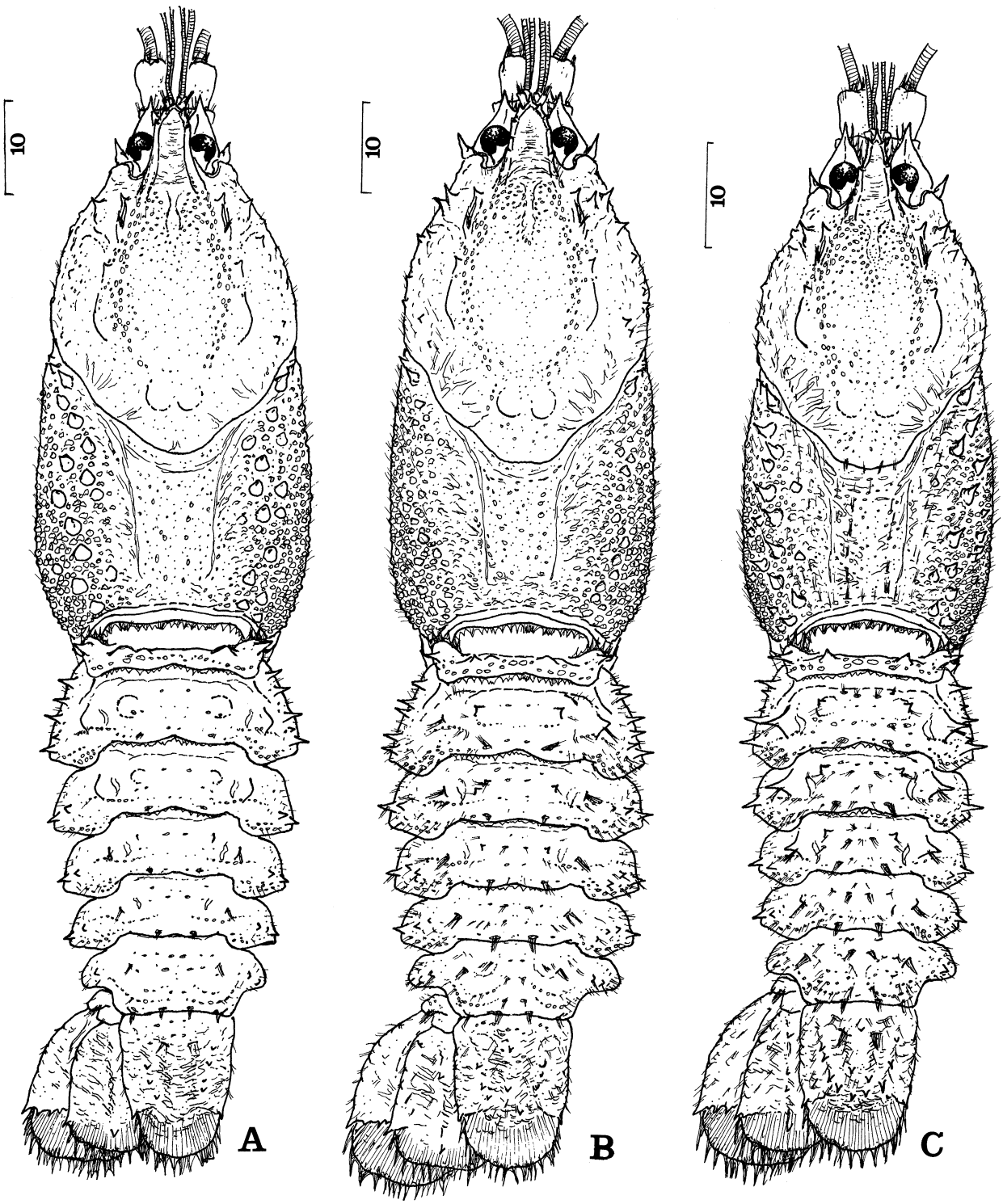

Fig. 46. *Euastacus yanga* n.sp. A, dorsal view, holotype male, Double Creek, AM P34100; B, dorsal view, paratype female, Reedy Creek, AM P33925; C, dorsal view, paratype male, Genoa River, AM P16192. Note variation in rostral shape and size of thoracic, abdominal and tailfan spines.

& S.J. Harders, AM P33919, 2 ♂♂; Burrawang Creek east of Wildes Meadow, (34°38'S 150°32'E), 22 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33944, 4 ♂♂, 3 ♀♀; Tributary Bundanoon Creek near Mount Morton Lookout on Fairy Bower walk, (34°40'S 150°20'E), 23 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33947, 2 ♀♀; Tianjara Creek above Falls near Tianjara, (35°07'S 150°20'E), 28 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33949, ♂, 2 ♀♀; Flat Rock Creek, near Turpentine, (35°02'S 150°30'E), 28 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33991, chela; Gap Creek, tributary Wandanian Creek near Wandanian, (35°07'S 150°26'E), 28 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33951, 3 ♂♂, 4 ♀♀; Headwaters Wandanian Creek, 7 miles south-west of Conjola near Ulladulla, 19 Jul. 1959, D.D. Francois & J. Harvie, AM P15485–7, 9 ♂♂, 4 ♀♀; Conjola Creek, 2 miles above Lake Conjola, 19 Jul. 1959, D.D. Francois, AM P15534, ♂, 2 ♀♀; Tributary Conjola Creek, 5 km north-west of Conjola, (35°11'S 150°26'E), 29 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33952, 2 ♂♂, ♀; Coryala Creek near Porters Creek Dam, (35°16'S 150°21'E), 29 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33953, 2 ♂♂, 3 ♀♀; Stoney Creek, on Western Distributor Road, south-west of Pigeon House, (35°28'S 150°05'E), 29 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33921, ♂, 3 ♀♀; Double Creek, Flat Rock State Forest (35°22'S 150°15'E), 29 Oct. 1981, G.J. Morgan & S.J. Harders, AM, 3 ♂♂, 2 ♀♀; Tributary Towamba River at Perico, 22 Mar. 1968, J.C. Yaldwyn & F.J. Beeman, AM P16190, 3 ♂♂, ♀; Pericoe Creek, south-west of Pericoe, (37°08'S 149°31'E), 8 Nov. 1981, G.J. Morgan & S.J. Harders, AM P33929, 4 ♂♂; Falkner Creek on Imlay Road south of Pericoe, (37°12'S 149°34'E), 8 Nov. 1981, G.J. Morgan & S.J. Harders, AM P33930, 2 ♂♂, 3 ♀♀; Tributary Imlay Creek, 1 km west of Anteater Road, (37°14'S 149°44'E), 8 Nov. 1981, G.J. Morgan & S.J. Harders, AM P33932, 3 ♀♀; Tributary Old Road Creek on Imlay Road, (37°14'S 149°45'E), 8 Nov. 1981, G.J. Morgan & S.J. Harders, AM P33933, ♀; Germans Creek on Germans Creek Road, west of Timbillica, (37°21'S 149°40'E), 8 Nov. 1981, G.J. Morgan & S.J. Harders, AM P33931, 2 ♂♂, 2 ♀♀; Mongarlowe River, Monga, 23 Jan. 1966, E.F.Riek, AM P15291, 2 ♂♂, 5 ♀♀; West slope of Clyde Mountain (near Monga), 1 Sept. 1948, E.F. Riek, AM P11946, 3 ♂♂; Mongarlowe River, Monga, on Clyde Mountain-Braidwood Road (tributary Shoalhaven River), 1–2 Mar. 1966, J.C. Yaldwyn & F.J. Beeman, AM P15547, 2 ♂♂, 12 ♀♀; Tributary Currowan Creek, tributary Clyde River, on Braidwood-Nelligen Road, (35°35'E, 150°04'E), 30 Oct. 1981, G.J. Morgan & S.J. Harders, 2 ♀♀; Tributary Mongarlowe River near Monga, (35°33'E, 149°55'E), 30 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33950, 3 ♂♂, 5 ♀♀; Mongarlowe River, 2 km west of Clyde Mountain, (35°32'S 149°56'E), 30 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33942, 3 ♂♂, 6 ♀♀; Eastern fall of Clyde Mountain, 18 Sept. 1953, E.F. Riek, AM P13047, 2 ♂♂, 4 ♀♀; Western fall of Clyde Mountain, Aug. 1954, E.F. Riek, AM P13055, ♀; Clyde Mountain, 28 Aug. 1972, 2 ♂♂; Larrys Mountain Creek (tributary Moruya River) near Moruya, 3 Mar. 1966, J.C. Yaldwyn & F.J. Beeman, AM P15546, 3 ♂♂, 3 ♀♀; Creek on Larrys Mountain near quarry, (35°51'S 150°00'E), 30 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33937, ♂; Little Belimbla Creek, on Bryces Road, west of Bodalla, (36°08'S 149°50'E), 31 Oct. 1981, G.J. Morgan & S.J. Harders, AM P33938, 6 ♂♂, 7 ♀♀; Davidges Crossing, upper Reedy Creek (tributary Tuross River), Bodalla-Cobargo back road, 18 Mar. 1968, J.C. Yaldwyn & F.J. Beeman, AM P16184, 6 ♂♂, 2 ♀♀, ♂♂/♀♀; Little Dromedary Creek near Central Tilba, 7 Oct. 1980, P.S. Lake, AM P33924, 4 specimens; Dignam Creek on Bodalla-Cobargo back road, 4 Mar. 1966, J.C. Yaldwyn & F.J. Beeman, AM P15541, ♂; Bermagui River at Coolagolite on Cobargo-Bermagui Road, 19 Mar. 1968, J.C. Yaldwyn & F.J. Beeman, AM P16189, ♂; Upper Brogo River (tributary Bega River) at Puen Buen, inland from Quaama, 19 Mar. 1968, J.C. Yaldwyan & F.J. Beeman, AM P16185–6, ♂, 3 ♀♀; Tributaries Murrah River, Bermagui-Quaama back road, J.C. Yaldwyn & F.J. Beeman, AM P16187–8, 2 ♂♂; Cuttagee Creek, east of Quaama, (36°28'S 149°57'E), 1 Nov. 1981, G.J. Morgan & S.J. Harders, AM P33941, ♂; Pipe Clay Creek, east of Quaama, (36°28'S 149°53'E), 1 Nov. 1981, G.J. Morgan & S.J. Harders, AM P33940, ♀; Tributary Brogo River, east of Brogo, (36°34'S 149°52'E), 1 Nov. 1981, G.J. Morgan & S.J. Harders, AM P33943, ♂, 3 ♀♀; Six Mile Creek (tributary Bemboka River) on Tantawanglo Mountains, 25 Mar. 1968, J.C. Yaldwyn & F.J. Beeman, AM P16194, 5 ♂♂, 8 ♀♀; Brown Mountain, south-east of Nimmitabel, 18 Jan. 1961, E.F. Riek, AM P15309, ♀; Sandy Creek (tributary Bemboka River), Bemboka-Candello back road, 25 Mar. 1968, J.C. Yaldwyn & F.J. Beeman, AM P16193, ♂; Polacks Creek north of Bemboka, (36°35'S 149°35'E), 2 Nov. 1981, G.J. Morgan & S.J. Harders, AM P33939, 6 specimens; Rutherford Creek, Brown Mountain Reserve, (36°35'S 149°25'E), 2 Nov. 1981, G.J. Morgan & S.J. Harders, AM P33928, 3 ♀♀; Tributary Station Creek, Trunk Road 91, (36°53'S 149°36'E), 7 Nov. 1981, G.J. Morgan & S.J. Harders, AM P33926, 9 specimens; Crawleys Creek, Trunk Road 91, (36°56'S 149°44'E), 8 Nov. 1981, G.J. Morgan & S.J. Harders, AM P33927, ♂, 3 ♀♀; Six Mile Creek, west of Pambula, (36°56'S 149°46'E), 8 Nov. 1981, G.J. Morgan & S.J. Harders, AM P33923, ♂; Creek into Merimbula Lake, 18 May 1967, J.C. Yaldwyn, AM P15554, ♀; Headwaters Pambula River, Wyndham-Pambula Road, 16 May 1967, J.C. Yaldwyn, AM P15555, 4 ♀♀. VICTORIA. Tributary Genoa River on Wangarabelle Road, north-west of Genoa,(37°27'S 149°35'E), 9 Nov. 1981, G.J. Morgan & S.J. Harders, NMV, 2 ♂♂, ♀.

Diagnosis. Male cuticle partition absent. Rostral spines reaching to or proximal to midlength of carinae. Rostral base slightly to very divergent, carinae medium length. Antennal squame widest at or slightly proximal or distal to midlength. Squamal spines absent. Suborbital spine medium sized or large. Thoracic spines large, medium sized or small, or barely discernible. General tubercles medium sized or small and densely or moderately distributed. 2–7 sharp Li spines on abdominal somite 2. D spine medium sized or small and sharp or blunt, sometimes absent. Abdominal boss poorly developed or absent. Telsonic spines usually present, varying from large to minute, sometimes absent. Uropods sometimes bearing marginal spines. Ventrolateral propodal spine row well developed, sometimes reaching apex of finger. 1–5 dorsal apical propodal spines usually present. Spines above cutting edges of chela apical or reaching proximal to midlength of gape. 5 or 6 (rarely 7) mesial propodal spines. 1–5 dorsomesial dactylar basal spines. Marginal mesial dactylar basal spines absent. 2–5 apical mesial dactylar spines. 2 or 3 mesial carpal spines. Ventromesial carpal spines smaller or similar to ventral spine. Keel Pr1 sloped or semi-abrupt, rarely abrupt, and close or apart, usually parallel. TAP count 5.5–11.0.

Description. Maximum OCL: 61.2 mm.

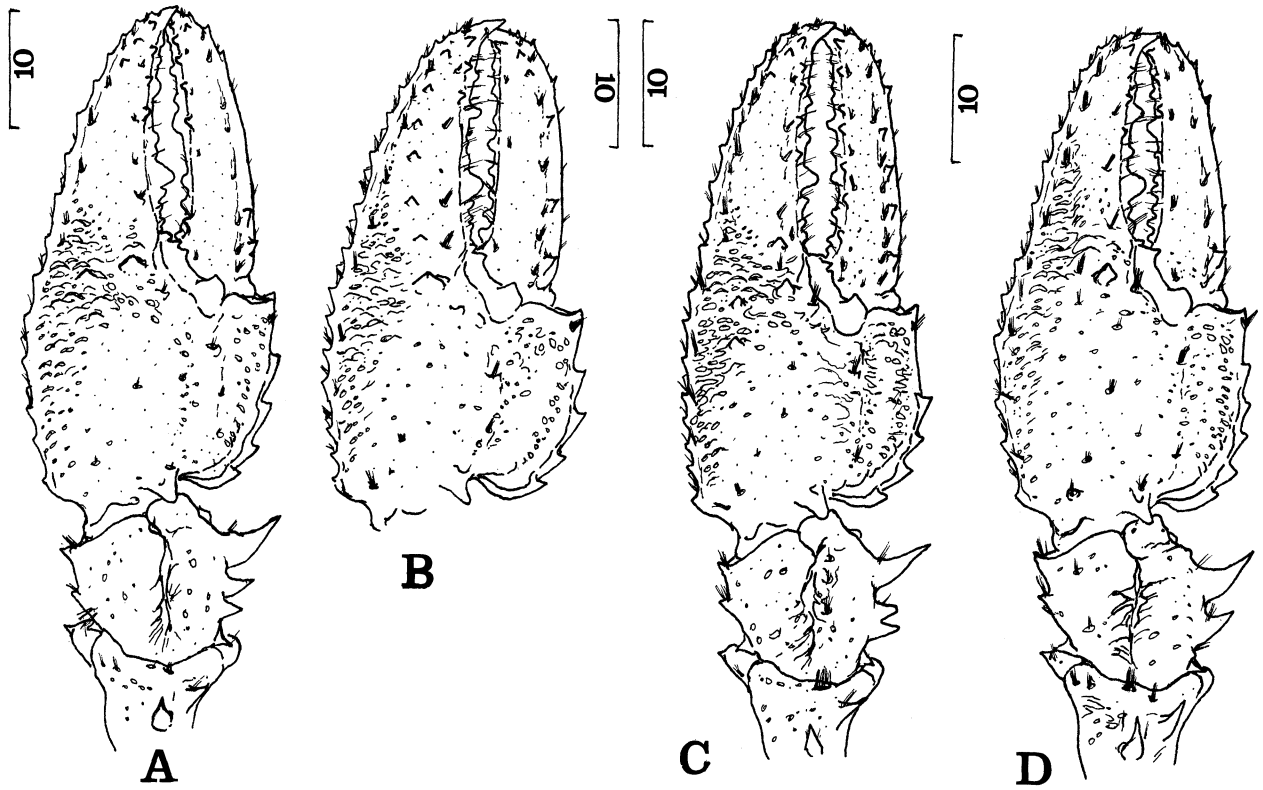

Fig. 47. *Euastacus yanga* n.sp., dorsal view chelae. A, holotype male, Double Creek, AM P34100; B, row of dorsomesial dactylar spines, propodal apical spines forming row with spines lateral to dactylar base, female, Fairy Bower, AM P33947; C, paratype female, Reedy Creek, AM P33925; D, 2 mesial carpal spines, paratype male, Genoa River, AM P16192.

Rostrum: Rostrum short, not reaching base of 3rd antennal segment on some specimens >50 OCL, to base or midlength of segment on most specimens 20–40 OCL, distal to midlength or to end of segment on some specimens <20 OCL. Rostral sides parallel or convergent, bases slightly to very divergent; carinae usually medium length and slightly spread, short on some specimens <20 OCL. 2–4 (rarely 5 or 6) rostral spines per side, to or proximal to midlength of carinae; spines large or medium sized, sharp or moderately pointed (rarely rounded on very large specimens). Acumen spine usually similar size to marginal spines, sometimes slightly larger, or distinctly larger on some specimens <20 OCL.

OCL/CL 0.77–0.89 i; RW/OCL 0.15–0.25 d.

Cephalon: Cephalon very to moderately spinose on most animals, poorly spinose on some specimens <20 OCL, with 1–4 sharp spines and low protuberances ventral to postorbital ridges. Southern specimens usually more spinose than northern. 1st postorbital spine small or medium sized on specimens >40 OCL, large on some smaller specimens. 2nd postorbital spine an edge or small on specimens >40 OCL, medium sized on some specimens 30–40 OCL, medium sized or large on most specimens <30 OCL. Southern specimens usually with largest postorbital spines. Suborbital spine medium sized or large (largest on southern specimens). Lateral margin of antennal squame straight or convex, occasionally concave on specimens <20 OCL; scale widest at or proximal to midlength, sometimes slightly distal to midlength on specimens >40 OCL (squame broadest on northern specimens); marginal squamal spines absent. Epistome medium width to broad (rarely elongate on specimens >40 OCL from near Moruya) and very broad on some animals <30 OCL; spine margin scalloped (often weakly), rarely slightly toothed. Antennal basipodite spine small to large, sometimes very large on specimens <30 OCL, rarely spine absent. Coxopodite spine small to large, very large on some specimens <20 OCL. Ventral antennal spines usually largest in south.

ScL/OCL 0.13–0.28 d.

Thorax: Usually 3–20 thoracic spines per side, distributed in broad or thin zone, or 1 or 2 irregular rows, or spines only just discernible; spines large to small on most specimens >20 OCL, small or absent on specimens <20 OCL; spines very sharp (especially posteriorly), moderately pointed or blunt, rounded or flat on some small specimens (spines largest and sharpest in south, smallest in central areas and usually well developed and blunt in north). General tubercles medium sized or small on specimens >30 OCL, usually small or very small on

animals 20–30 OCL, absent on some lesser specimens; tubercles densely to moderately spaced on specimens >30 OCL, usually moderately distributed to very sparse on smaller animals. 1–4 (rarely 5 or 6) cervical spines per side, 1st (dorsal) and/or 2nd spine often larger and sharper than remaining medium sized or small spines.

ArL/OCL 0.34–0.40; ArW/OCL 0.15–0.21 d; CaW/OCL 0.54–0.62; CaD/OCL 0.42–0.55 d.

Abdomen: Frequently 1 (rarely 2) D–L spine(s) on somite 1 of specimens >20 OCL; spine medium sized or small, very sharp to blunt. D spine less common on somite 1 but often present, especially on large specimens; spine medium sized to minute, sharp to very blunt. Somite 2 of specimens >20 OCL with 3–7 (rarely 2) Li spines per side, usually absent on specimens <20 OCL. Somites 3–5 of specimens >30 OCL and most specimens 20–30 OCL, with single Li spine. Li spines very sharp and decreasing in size to posterior from large or medium sized to small on specimens >40 OCL, usually small and very sharp to blunt on lesser specimens. Usually 1–3 distinct or minute Lii spines on somites 3–6 (rarely on 2) of large specimens, less obvious on specimens <40 OCL; spines usually medium sized to minute (rarely large) and very sharp to blunt. Single D–L spine usually on somites 2–5, less commonly on 6, sometimes absent; spine large to minute and very sharp to blunt, usually decreasing in size and sharpness to posterior somites. Rarely 2–4 minute D–L spines on somite 6 of large specimens. Often single D spine per side on somites 2–5 (rarely on 6 of large specimens), but absent on many specimens, especially <30 OCL; D spine medium sized to minute and very sharp to very blunt, diminishing to posterior somites. Very rarely, 2 D–L spines per side on some somites. (D–L and D spines largest and sharpest in south. Northern specimens sometimes lacking D–L and D spines; when present, D–L spines sharp on somite 1 or 2 and D spines blunt.) Specimens <20 OCL usually lacking abdominal spines. Dorsal abdominal boss very poorly developed on specimens >50 OCL, absent on smaller specimens.

AbdW/OCL ♂ 0.49–0.56, ♀ 0.48–0.65 i; OCL/L ♂ 0.36–0.44 i, ♀ 0.35–0.42 i.

Tailfan: Telsonic spines usually present, numbering to approximately 17; spines very large on some specimens >40 OCL, usually large to minute; specimens <20 OCL and some large animals lacking spines. Marginal telsonic spines absent. Inner uropod ramus with 0–4, large to minute median spines, 0–2 medium sized to minute marginal spines; outer ramus with 0–5 medium sized to minute marginal spines; uropod margins usually uneven at setal bases. (Uropod and frequently telsonic spines absent on northern specimens, spines increasing in number and size to south.) Standard spines small to large on specimens >30 OCL, usually medium sized or large on smaller animals, largest on southern specimens.

TeL/OCL ♂ 0.31–0.43 d, ♀ 0.34–0.43 di.

Chelae: Chelae of specimens >20 OCL usually intermediate in shaped or elongate, occasionally stout or very elongate; specimens <20 OCL with elongate or very elongate chelae. Teeth well developed on most specimens >30 OCL.

Propodus: Ventrolateral spine row well developed and sometimes reaching apex of finger, except on specimens <20 OCL which may lack ventral row; lateral spines medium sized or small, and rather sharp. Lateral spine ridge present, frequently small on specimens <20 OCL. Usually 5, commonly 6, rarely 7, mesial propodal spines, some small specimens with 4 spines. 1–4 (rarely 5) dorsal apical propodal spines on most specimens >30 OCL; some near 30 OCL and many smaller specimens lacking apical spines. (Spines of some large specimens approaching base of finger; usually more numerous in north and central regions than in south.) Usually 2 or 3, (rarely 1 or 4) spines above cutting edge on specimens 20–30 OCL; 0 or 1 apical spine on specimens <20 OCL. 1–4 medium sized or large, blunt spines on dorsal surface lateral to dactylar base with additional low protuberances; ventrally, 1–6 blunt spines lateral to dactylar base often with some protuberances and extending along finger. Some specimens <20 OCL lacking dorsal and/or ventral spines lateral to dactylar base. No distinct spines posterior to dactylar articulation. Frequently 1–3 small precarpal spines and protuberances.

PropL/OCL ♂ 0.81–1.10 i, ♀ 0.80–0.94 i; PropW/PropL 0.35–0.48 id; PropD/PropL 0.26–0.32 id.

Dactylus: 2–8 spines above dactylar cutting edge on specimens >40 OCL, sometimes 1 spine or spines absent on smaller specimens spines apical, or reaching to, or proximal to midlength of gape, sometimes to full length of gape; spines large or medium sized on specimens >40 OCL, often small on lesser specimens. (Spines most numerous and extensive in central areas of range.) Some specimens >40 OCL and one animal slightly <40 OCL with 1–3 dorsal apical dactylar spines. Usually 1–3 (rarely 4 or 5) dorsomesial dactylar basal spines, occasionally absent on small specimens and one >30 OCL. Marginal mesial basal spines absent, except on some regenerate chelae (one large specimen with 1 and 2 marginal basal spines on chelae uncertainly regenerate, another with 1 spine on one chela). Basal spines large or medium sized on specimens >30 OCL, medium sized or small on lesser animals and sharp or moderately pointed. 2–5, usually 3 or 4, apical dactylar spines, sometimes extending to midlength of dactylus. Dactylar groove shallow on most large animals, deeper on small specimens.

DactL/PropL 0.49–0.60.

Carpus: 2, 2(+1) or 3 mesial carpal spines; 1st (distal) spine distinctly larger than remainder, 2nd and 3rd spines usually very close or fused basally. 2 (rarely 1 or 3) lateral carpal spines, these large or medium sized on specimens >30 OCL, medium sized or small on most lesser specimens. Small or medium sized articulation

spine on some specimens <30 OCL. Occasionally 1 or 2 minute dorsal carpal protuberances. Ventral spine very large or large, small on some specimens <20 OCL. Largest ventromesial spine very large to small, sometimes similar to ventral spine; 1–4 small additional ventromesial spines.

Merus: Dorsally 5–10 spines, medium sized or large. Outer spine small or medium sized on specimens >40 OCL, small to large on lesser individuals; usually largest on southern specimens.

Keel: *Pr1*: Posterior margins sloped or semi-abrupt, occasionally abrupt; ventral edges angled down, occasionally flat, rounded or angled back; processes close, slightly or distinctly apart and usually parallel, occasionally open or closed. Keel after Pr1 low, rarely with a small anterior spine.

*Pr*2: Usually open, sometimes almost parallel or very open. Keel after Pr2 sometimes with small spine.

*Pr*3: Scoops usually absent or poorly developed, rarely well developed; bases sharp to rounded. Keel after Pr3 low, often slightly pronounced anteriorly.

Pr4: Scoops usually absent, occasionally slight or gradual; posterior edges sharp to rounded and straight, slightly convex or irregular; anterior edges angular or moderately curved.

Pr3 and 4 rather narrow on largest animals (>50 OCL), broad on smaller specimens, very broad on some <20 OCL.

Setation: Light to heavy, increasing in density from north to south.

Punctation: Usually dense or very dense.

Gastric mill: TAP count 5.5–11.0; TAA count 0–1.5; spread 4.5–9.5. Variation primarily due to differences in ear length. Urocardiac ridges 7–12, usually increasing with growth.

Coloration: Body dorsally deep brown, brown-green or red-brown, paler ventrolaterally, sometimes with grey or green-blue tinge; blue patch on lateral surface of cephalon in north. Dorsal thoracic spines dark, varying in shade, sometimes black; general tubercles pale brown, orange or yellow. Li abdominal spines yellow or pale orange, sometimes with blue tinge on large specimens; D–L and D spines (if present) usually darker, sometimes black. Cheliped articulations red or orange. Carpus of cheliped dark brown, brown-green or blue-green; lateral spines cream; mesial spines tipped with yellow, orange or red. Propodus brown, ochre, orange (or blue-green in far north) with darker mottling; mesial edge spines deep blue-green or green; spines at dactylar articulation yellow, orange, red in far south, blue in far north. Fingers deep blue-green, brown or orange; mesial edge of dactylus usually darker. Sometimes red finger tips in south.

Body ventrally green and yellow or orange, with some cream. Carpus of cheliped dark blue-green (especially mesially) or blue with variable areas of cream; ventral spines yellow or pale orange. Propodus orange (varying shade) medially with some blue or green mottling; lateral area blue-green, mesial edge very dark green or blue-green; spines at dactylar base orange (especially bright in south). Fingers dark blue-green or orange, with blue or blue-green at tips.

Sexes: Males lack a cuticle partition. Only one female in the 20–30 OCL range has open gonopores. Many gonopores are open or opening and 3 females are berried in the 30–40 OCL range, though some specimens >40 OCL are unopen. It appears that female maturity occurs between 30 and 50 OCL.

Distribution and biology. The species is distributed from the Robertson and Bundanoon areas to just inside the Victorian border west of Genoa, a distance of 400 km. The range is drained by many coastal streams including the Shoalhaven, Clyde, Tuross, Towamba, Womboyn and Genoa Rivers. *Euastacus yanga* was collected in 1981 from altitudes between 60 m and 720 m a.s.l. Vegetation along streams was predominantly temperate rainforest or ferns, with dry sclerophyll and heath on ridges. Some sites lacked rainforest, dry sclerophyll extending to the stream banks.

Berried females were collected in late October and November, 1981. Specimens carried between 43 and 164 eggs, number usually increasing with OCL. Eggs were burgundy with white patches, indicating developing embryos.

Euastacus yanga was sympatric with *E. guwinus* at the latter species' type locality. The species can also occur with *E. spinifer*. In the north of its range, around Robertson and Fitzroy Falls, *E. yanga* overlapped with *E. dharawalus* and *E. hirsutus*. The species were not collected together at any site and it appeared that *E. yanga* preferred smaller streams with rainforest banks.

Etymology. Named after "yanga" (= lobster) in the Dharawal and Dhurga languages of south-eastern New South Wales (Eades, 1976).

Remarks. *Euastacus yanga* has a large range, with only *E. armatus* and *E. spinifer* having larger distributions. Even by the standards of the genus, *E. yanga* is extraordinarily variable both within and between populations. It is possible that more than one species is here regarded as *E. yanga* but I believe evidence supports the establishment of a single polytypic species.

There is a broad north-south cline in the development of many characters. Moving south there is a general increase in abdominal, thoracic and tailfan spination, in density of setation and in the elongation of the antennal squame; there is a general decrease in the number of dorsal apical propodal spines and mesial dactylar spines.

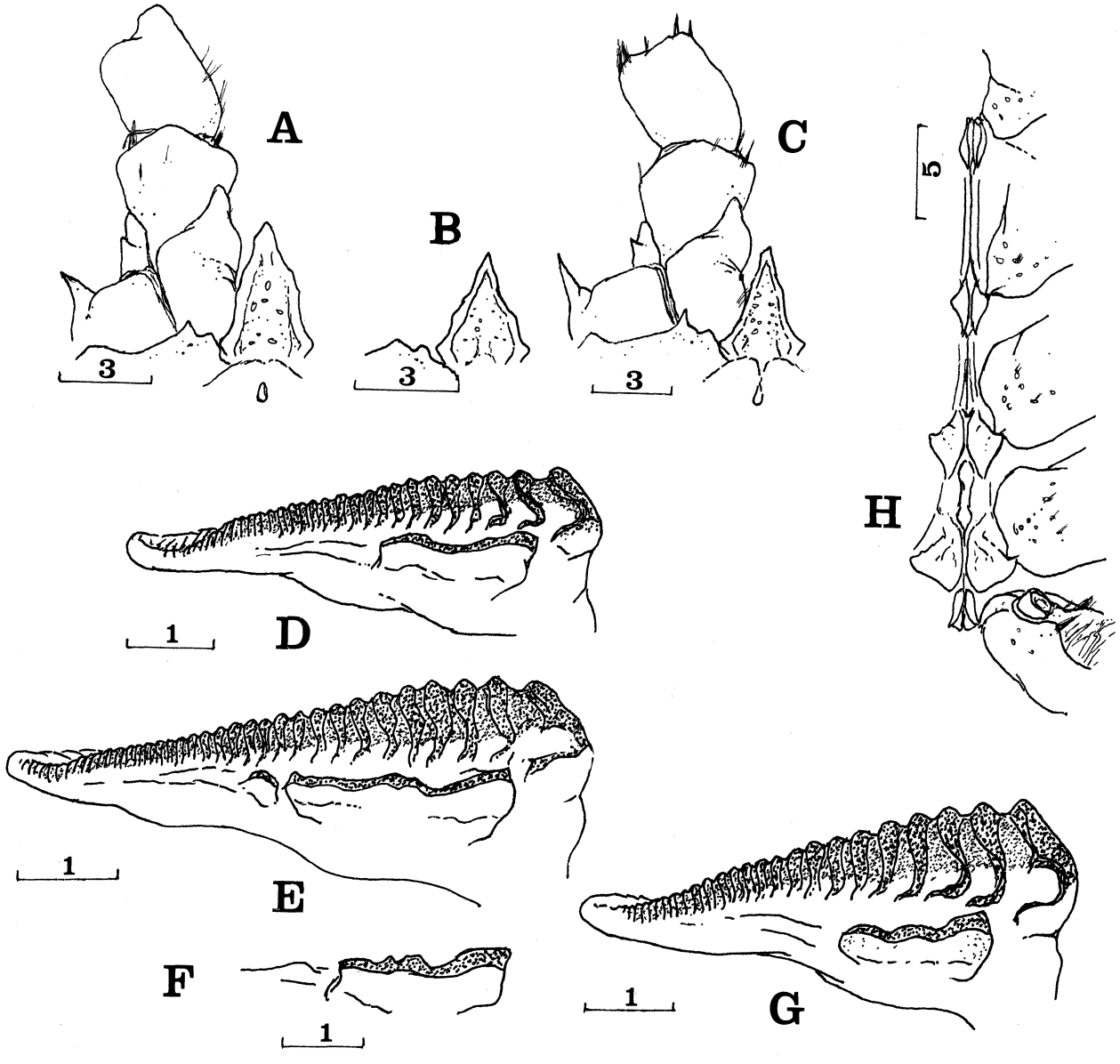

Fig. 48. *Euastacus yanga* n.sp. A, ventral view cephalon, holotype male, Double Creek, AM P34100; B, broad epistome, male, Wandanian Creek, AM P15485; C, ventral view cephalon, paratype female, Reedy Creek, AM P33925; D, ventral view zygocardiac ossicle, holotype male, Double Creek, AM P34100; E, zygocardiac ossicle, paratype female, Reedy Creek, AM P33925; F, ventral ear, paratype female, Red Creek, AM P33936; G, zygocardiac ossicle, paratype male, AM P16192; H, sternal keel, holotype male, AM P34100.

Additionally, there is less regular but very marked variation in rostral shape and spination, cephalic spination, cervical spine size and sharpness, chela shape, spine number above the dactylar cutting edge, mesial carpal spine number, keel shape and areola length and width. Variation can be distinct within and between populations from a small geographical area. Specimens in the south are more orange, almost red, than those in the north which are mostly brown. Chela spines can be bright orange (or red) in the far south. In the far north of the range, populations are more blue tinged, especially on the chelae.

The species has proven awkward for previous workers. The majority of Riek's (1969: 910) sites for *E. claytoni* are localities of *E. yanga*; only the type locality correctly places *E. claytoni*. The Dignam Creek locality (Riek, 1969: 912) of *E. brachythorax* is based upon a specimen of *E. yanga*. Specimens of *E. yanga* have also been identified as *E. clydensis, E. australasiensis* and *E. crassus*. Many specimens were identified by Riek as "*Euastacus* near *clydensis*", "near *claytoni*" and "near *australasiensis*". Francois (1962) considered specimens from Wandanian Creek near Conjola to be an undescribed species. The thirteen specimens are here classed as members of *E.*

yanga. Francois (1962) also recorded a specimen from Bundanoon as "specifically different from any described form" but this is also a specimen of *E. yanga*.

An unusual population was sampled at Pericoe Creek (AM P33929). The condition of the male cuticle partition is constant for *Euastacus* species but the rather small (<30 OCL) males at this site display a projection of cuticle distal to the genital papillae, almost resulting in a very thin partition. A break in the partition persists but it is extremely rare to find such variation in this character.

General Remarks

Habitats of New South Wales *Euastacus*

Species of *Euastacus* occur throughout most of New South Wales east of the Great Dividing Range. Only *E. armatus* is confined to western flowing streams.

Ecologically, most of the species can be divided into two broad groups. The first comprises species that occur at rather low altitudes, often little above sea-level, although some extend upstream to or higher than 500 m. These lowland species are in general medium sized to large forms. In this group are, from north to south, *E. valentulus, E. dangadi, E. spinifer, E. yanga, E. bidawalus* and *E. armatus* to the west.

The second group comprises small or medium sized species that occur at elevations usually exceeding 200 m. a.s.l. and frequently at much greater altitudes. Vegetation along the streams is usually wet sclerophyll forest, rainforest or subalpine vegetation. These species are *E. sulcatus, E. gumar, E. neohirsutus, E. simplex, E. clarkae, E. spinichelatus, E. polysetosus, E. reductus, E. hirsutus, E. guwinus, E. crassus, E. rieki, E. claytoni* and *E. brachythorax*.

Several species do not fit neatly into either category. *Euastacus suttoni* is a rather large species occurring only at the high elevations of the New England Tableland. *Euastacus australasiensis* is a small to medium sized species that ranges from sea-level to the higher parts of the Blue Mountains, an altitude range similar to that of the much larger and sympatric *E. spinifer. Euastacus dharawalus* is a relatively large species that is known only from a small area of high country. There are insufficient data available to comment upon the habitat of *E. gamilaroi*.

During sampling, it was observed that although ranges of species often overlapped, co-occurrence of two species at the same locality was uncommon. In general, there appears to be within any watercourse a narrow zone where both lowland and highland species co-exist. In more open, non-vegetated streams, especially at low altitudes, species of *Cherax* replace *Euastacus* as the dominant parastacids.

This pattern of lowland large species and highland smaller species also applies to Victorian *Euastacus* (Morgan, 1986). The situation is less clear in Queensland where lowland species occur only in the extreme south-east of the state. Elsewhere, *Euastacus* species are confined to highland wet sclerophyll and rainforest (Morgan 1988, 1989).

Speciation in *Euastacus*

Variation in the Astacoidea has been recorded by a number of workers (e.g., Fitzpatrick, 1975, 1978; Hazlett *et al*., 1979; Chambers *et al*., 1979) but there has been little detailed examination of parastacid variation. Swain *et al*. (1982) revised *Astacopsis*, and observed that geographical variation was especially marked in one of the two species, *A. franklinii*; most variation in spination was related to size. Horwitz (1990) noted morphological variation for all *Engaeus* species and Zeidler & Adams (1990) for the monotypic genus *Gramastacus*. These results demonstrate that parastacids are morphologically plastic.

Species of *Euastacus* can exhibit extreme morphometric variation across their ranges (Morgan 1986, 1988, 1989, this paper). Several species are relatively constant in morphology across small ranges and some species are rather invariant across medium sized or large ranges (e.g., *E. valentulus, E. armatus*), but this is unusual. Variation is frequently obvious across large ranges (e.g., *E. spinifer, E. australasiensis, E. yanga, E. woiwuru*) and sometimes in a small geographical area (e.g., *E. neohirsutus, E. hirsutus*).

Euastacus species inhabit flowing, aerated, cooler streams, usually in hilly or mountainous country, and often separated by either steep ridges or areas of lower, flatter country. Crayfish can disperse up or downstream, relief and current permitting, but at least some species are capable of limited overland movement. Although most overland movement would be expected between channels of the same river system where headwaters of several rivers lie in close proximity in montane areas, *Euastacus* species are present in more than one drainage system (Morgan, 1988). Steep ridges physically restrict overland walking and slow, warm, eutrophic lowland or plateau streams are unsuitable habitats or transit routes.

For the reasons listed above many *Euastacus* populations may be regarded as semi-isolated. The effectiveness of any geographical barrier is difficult to estimate though the broad lowland areas of coastal Queensland and New South Wales are certainly good isolating mechanisms resulting in elevated island populations of *Euastacus*. Isolation becomes less clear in southern areas with *Euastacus* at low altitudes and the ranges of species are frequently larger. Habitat modification by man will certainly contribute to further isolation of populations.

Within many species of *Euastacus*, several populations or population groups are recognisable and unique in some combination of characters. Turvey (pers. comm.) could recognise populations of *E. spinifer* from individual river systems in the Sydney area. In some cases, distinct populations of *Euastacus* have been collected from single sites. As this study shows variation between populations is partly clinal, but clinal variation of different characters is not necessarily parallel (Futuyma & Mayer, 1980) and trends are usually evident only over large geographical distances. Common morphological clines involve size or distribution of spines, degree of setation and number of zygocardiac teeth. Since many species of *Euastacus* extend along coastal mountain ranges, clines are often orientated north-south. Specific stocks can be very

distinctive at the extremes of their range; however, morphologically intergrade populations, usually from geographically intermediate sites, preclude specific recognition of the peripheral populations.

In broad terms, phenotypic variation in species will be determined by both environment and genotype (Mayr, 1969), but the cross-breeding potential of *Euastacus* populations appears to be dependent upon the contribution of genotype to their variability. Species of *Euastacus* can be collected from apparently similar habitats across their range yet display marked population variation, both clinal and irregular. Conversely, most species are found in two or more different habitats, some distinctly different (e.g., *E. neohirsutus, E. spinichelatus*). Morphological variation may be obvious or less marked, depending upon species, but does not appear to correspond closely to habitat. Clinal variation over large distance will often correlate with latitude but a variety of habitats and altitudes may be incorporated in the cline. There is little evidence to suggest that species are less spiny at sites where burrows are most evident though poor spination is associated with more specialised burrowing parastacid genera (e.g., *Engaeus, Cherax*). Species of *Euastacus* can be morphologically identical at rocky and clay bottom streams yet burrow more extensively in the latter. Many species of *Euastacus* appear to be facultative burrowers and behaviour rather than morphology is obviously affected by habitat.

Processes of speciation have been reviewed by a number of authors including Mayr (1969, 1978), Bush (1975), Endler (1977) and Wiley (1981) but it is generally accepted that allopatry is the most common mechanism of speciation (Anderson & Evensen, 1978) and, on existing evidence, must be regarded as the dominant process in speciation of *Euastacus*. It is proposed here that populations are major units of variation and evolution in *Euastacus* (see also Løvtrup, 1979).

Infraspecific geographical variation in gene frequencies is usually low in decapod crustaceans (Hedgecock *et al.*, 1982) but if populations vary sufficiently in a cline or irregularly over a considerable geographic distance, it is possible that some specimens may not be capable of successful interbreeding with specimens from other populations. Horwitz *et al.* (1990) found evidence for clinal variation in allelic frequencies of several *Engaeus* species. Horwitz *et al.* (1990) also suggested that *Engaeus* species had undergone repeated allopatric speciation. It is likely that many *Euastacus* species will also show low levels of heterozygosity with greater genetic variation within connected populations than within semi-isolated or isolated populations.

It is also possible that the extreme variability of many *Euastacus* species represents ongoing speciation. Futuyma & Mayer (1980) observed that in most instances "speciation occurs by the geographic isolation of small populations". If different species do not or cannot interbreed because of morphological, physiological or behavioural differences, then populations or population groups that approach species differentiation may be incapable of freely interbreeding. There may be a progressive reduction in the breeding capacity between populations with increasing geographical and morphological distance. This speciation model is consistent with the observed ranges, where "complexes" of similar species are parapatric or closely allopatric in distribution.

Phyletic considerations

Riek (1969) proposed a "phylogeny" of *Euastacus* species determined by the number of mesial carpal spines, and divided the genus into four groups. Although carpal spination is a useful taxonomic character, it is not regarded by the author as an indicator of infrageneric relationships. The species associations proposed in this study are divided on the male cuticle partition. Francois (1962) believed gastric mills to be conservative structures, indicative of phylogenetic relationships, and he divided *Euastacus* into two groups, proposed as possible subgenera. These groups concur in part with the cuticle partition divisions. The preference here for cuticle partition over gastric mill characters in estimating phylogeny is based upon the consistency of the former and often marked the variability of the latter.

In *Euastacus*, the cuticle partition separating the male sexual papilla from the arthrodial membrane between coxa and ischium is subject to virtually no observable variation within a species: a partition is either present or absent. No other character or character set approaches this constancy. Amongst the thousands of specimens examined for this and earlier studies (Morgan, 1986; 1988; 1989), there were only rare possible exceptions to the binary state of the partition. One population of *E. yanga* (AM P33929) has slight projections of cuticle forming an incomplete strip between the genital papillae and the arthrodial membrane. The sample has too few males to allow meaningful interpretation of this state and is not regarded as invalidating the conservative nature of the character. The situation in *Euastacus fleckeri* is also uncertain owing to the few sampled males (Morgan, 1988).

The condition of the male cuticle partition divides *Euastacus* into two groups (Table 1). Of 41 species, 30 (including *E. fleckeri*) have a cuticle partition while 11 lack the structure. The presence of a male cuticle partition is proposed to be plesiomorphic and its absence as the apomorphic condition. This decision is based upon two considerations. Firstly, the similar Tasmanian genus *Astacopsis* comprises two species, one rather constant morphologically but the second variable (Swain *et al.*, 1982), however both species possess a cuticle partition. The Madagascan genus *Astacoides* (Guérin), similar to *Euastacus* in many respects, also has a cuticle partition. Secondly, some very small juveniles (<10 mm OCL) of *Euastacus* species, lacking a cuticle partition as adults, have thin partitions which break down in very early growth. Though no juveniles were examined prior to hatching, it is possible that all species have a cuticle partition in early development. Ontogenetic is considered as evidence of a primitive condition in other groups (Nelson, 1978; Patterson, 1982).

Most of the large spiny species and some smaller species of southern Australia display the derived nonpartitioned condition, while most species in northern

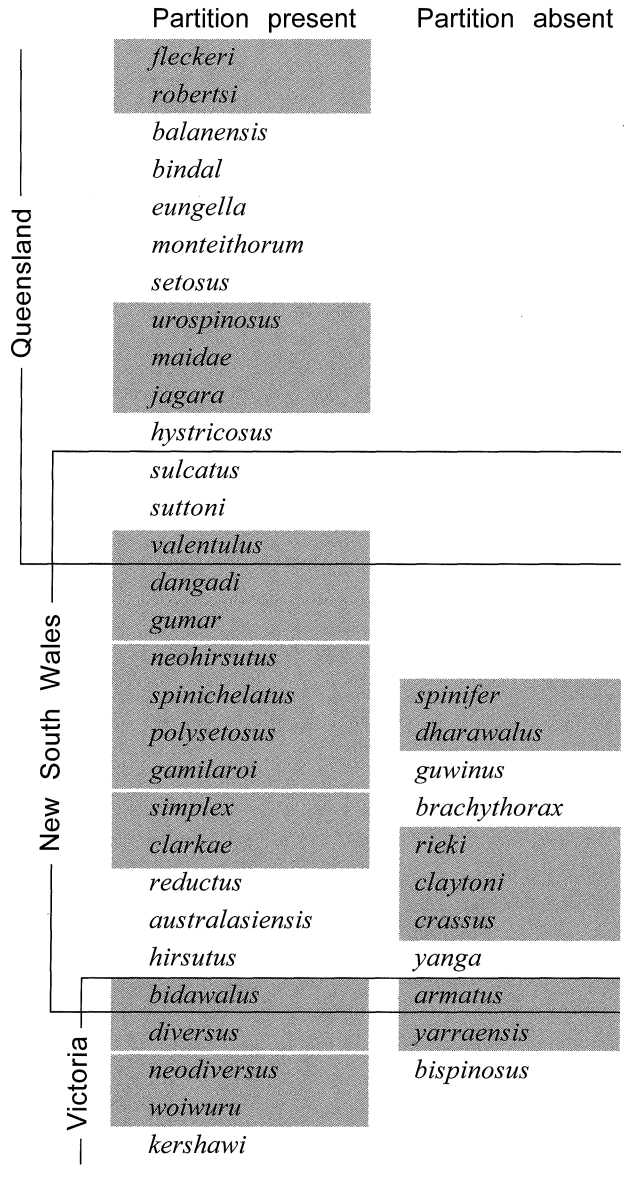

Table 1. Condition of male cuticle partition in *Euastacus* species. Species complexes indicated by shaded boxes.

New South Wales and all Queensland species have the primitive condition. Throughout New South Wales and Victoria where both conditions occur, there are groups of species in geographical areas which share the presence or absence of the partition. Local groups comprised of morphologically similar species may be regarded as "species complexes".

Species are allocated to a complex if (i) they are similar morphologically and (ii) closely allo- or parapatric. On the basis of these prerequisites, the species are proposed as close relatives. All species in a complex must share presence or absence of the male cuticle partition. The condition (ii), relating to geographical proximity of the species, is included to increase the phylogenetic relevance of the complex. Similar, geographically close, species probably share a more recent common ancestor than similar, widely separated species. The great variability of *Euastacus* species results in instances of convergence and hence similar, but geographically distant species, may not be close relatives. Recent studies of other genera have demonstrated intrageneric divergences (using electrophoretic data) between disparate geographic regions (Austin, 1995*b*). Austin (1995*a*) concluded that morphological characters are valid indicators to define genera, but may be unreliable for distinguishing species.

Subgenera have been previously erected by astacoid taxonomists (Hobbs, 1972; Fitzpatrick, 1978), but the author considers that existing morphological data do not support the recognition of formal species groupings within *Euastacus*—unless, perhaps, on the basis of the male cuticle partition. It cannot be stated with certainty that the derived nonpartitioned state is not polyphyletic. Evidence for its monophyly, however, is provided by the almost absolute occurrence of the binary states, with only very rare and then minor uncertainties.

Without a phylogenetic analysis there are is no strong evidence to suggest whether or not the loss of the cuticle partition developed early in *Euastacus* evolution, but morphological variation is extreme in both groups and appears to be as marked between species with the derived condition as between species possessing a partition. This may indicate that considerable time has lapsed since the breakdown of the partition allowing morphological divergence and that the apomorphic condition developed early in *Euastacus* evolution, before the dispersal of the genus throughout eastern Australia.

Riek (1972) proposed a phylogeny of the family Parastacidae based primarily upon cephalothoracic grooves, movement of chelae fingers and form of the male genital papillae. He proposed *Euastacus* to be most closely allied to *Euastacoides, Astacopsis* and *Astacoides*. *Euastacoides* was recently synonymised with *Euastacus* (Morgan, 1988).

Further detailed comparisons have been completed during this study of generic characters such as podobranchial structure (ala development, branchial filament distribution), telson structure (transverse suture, degree of calcification) and abdominal spination. These features together with genital papilla shape, abdominal width and a longitudinal rostral carina confirm that while *Astacopsis* and *Euastacus* are similar, there are sufficient differences to warrant continued recognition of the two genera. Patak & Baldwin (1984) found very few immunochemical differences in haemocyanins between species of *Astacopsis* and *Euastacus*, confirming the close relationship of the genera. The relationship to *Astacoides* of Madagascar, recently revised by Hobbs (1987), is less certain. *Astacoides* is superficially very similar to *Euastacus* and *Astacopsis* but has a much lower branchial formula of 12 or 13+epr+2–5r as compared to 21+epr in the latter two genera.

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