Austinograea williamsi, New Genus, New Species, a Hydrothermal Vent Crab (Decapoda: Bythograeidae) from the Mariana Back-Arc Basin, Western Pacific
Author(s): Robert R. Hessler and Joel W. Martin
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AUSTINOGRAEA WILLIAMSI, NEW GENUS, NEW SPECIES, A HYDROTHERMAL VENT CRAB (DECAPODA: BYTHOGRAEIDAE) FROM THE MARIANA BACK-ARC BASIN, WESTERN PACIFIC

Robert R. Hessler and Joel W. Martin

ABSTRACT

Austinograea williamsi is described from hydrothermal vents in the Mariana Back-Arc Basin, a spreading center in the western North Pacific, at depths of 3,595–3,660 m. This is the first bythograeid crab described from the western Pacific, extending the range of the Bythograeidae approximately 12,500 km from the nearest previous collection sites along the East Pacific Rise. The species differs remarkably from all other brachyuran crabs in lacking eyes or moveable eyestalks; the possible remnant of the eyestalk is fused to the surrounding orbital region of the carapace and bears no cornea or pigment. The species is further distinguished by the coxa of the third maxilliped, which is nearly covered by the juxtaposition of the margin of the carapace with the sternum and chelipedal coxa, a character proposed herein to be of generic importance. Other characters serving to separate *A. williamsi* from species in the genera *Bythograea* and *Cyanagraea* are the presence of setose fields on the subhepatic surface and on the ventral dactylar surface of the chelae in both sexes, densely setose ventral margins on the merus and basi-ischium of all walking legs, chelipeds with fingers that meet along their entire occluding margins in both sexes (i.e., do not gape), and a relatively straight male first pleopod that bears small spinules and is longer than the second pleopod. The third maxillipeds and male pleopods of *Cyanagraea*, previously unknown, are described from a specimen taken at 13°N on the East Pacific Rise; the pleopods are more similar to those of *Austinograea* than to those of *Bythograea*. A key to the genera of the Bythograeidae is provided.

Crabs of the family Bythograeidae are known only from deep waters at marine hydrothermal vents. The family was originally erected by Williams (1980) to accommodate *Bythograea thermydron* from the Galapagos vent fields. Subsequent to that species description there have been scattered reports of other bythograeids from the Galapagos and from other vent areas of the Pacific and Atlantic Oceans. *Bythograea microps* Saint Laurent, 1984, was described on the basis of one adult female (the 23.5-mm carapace length holotype) and several subadults or juveniles. Saint Laurent (1984) also erected a second genus and a third species, *Cyanagraea praedator*, to accommodate two large adult females taken from the vicinity of black smokers at the 13°N vent fields on the East Pacific Rise. Subsequently, more specimens of *C. praedator* have been collected; three of them, including two males, were among material collected by physiologists of the Scripps Institution of Oceanography on the French Hydronaut Expedition to the same locality. More recently, Saint Laurent (1988) erected a fourth species, *Bythograea intermedia*, on the basis of a single megalopa larva and on the assumption that some of the smaller juveniles described by Williams (1980) were of this previously unrecognized species. Finally, Williams (1988) described *Bythograea mesatlantica* from vents along the Mid-Atlantic Ridge. Guinot (in press) erected the genus *Segonzacia* on the basis of this species. In the present paper, we describe a new genus and species of the Bythograeidae from hydrothermal vents on the spreading center of the Mariana Back-Arc Basin in the western North Pacific Ocean. This find extends the known range of the family Bythograeidae approximately 12,500 km to the west from the nearest previous collection sites along the East Pacific Rise.

MATERIALS AND METHODS

The material forming the basis of this report was collected during a series of dives with the submarine *Alvin* in April–May 1987. The collection sites consisted of 3 active vent fields along the spreading center of the Mariana Back-Arc Basin at about 18°N, just west of the Mariana Island Arc. These vent fields were spaced along 3.5 km of the ridge crest at depths between 3,595 and 3,660 m (Hessler *et al.*, 1988).

Most of the crabs were caught in baited traps actually intended for obtaining scavenging amphipods (Ingram and Hessler, 1983, fig. 2a). Consequently, the opening at the inner end of the entrance funnel was smaller than would accommodate the larger crabs. The traps were brought back to the surface within an insulated box. Most of the crabs were fixed in 4% buffered Formalin and stored in 80% ethanol. A few were left in Formalin.

The male *Cyanagraea praedator* used in our comparison was taken on the 1987 French Hydronaut Expedition to 13°N on the East Pacific Rise.

All drawings were made with the aid of a Wild M5 dissecting stereoscope with camera lucida.

Genus *Austinograea*, new genus

Diagnosis.—No moveable articulated eyestalks. Third maxilliped with only most medial portion of coxa visible in ventral view; remainder covered by confluence of ventral border of carapace with sternum and chelipedal coxa. First male pleopod longer than second.

Type Species.—*Austinograea williamsi*, new species.

Etymology.—From Austin (after Austin B. Williams, who first described the family) and *graea* (Greek for sea crab).

Austinograea williamsi, new species
Figs. 1–4

Material.—137 adult or subadult crabs (69 ♂♂, 68 ♀♀) collected from 3 vent fields along the crest of the spreading center in the Mariana Back-Arc Basin, western North Pacific, as follows: dive 1825, 10 April 1987, Ilium vent field, 3,595 m, 18°12.805′N, 144°42.425′E, 1 ♀; dive 182? (exact dive unknown), date and locality unknown, 1 ♀; dive 1835, 26 April 1987, Snail Pits portion of Burke vent field, 3,660 m, 18°10.948′N, 144°43.204′E, 10 ♂♂, 3 ♀♀; dive 1836, 27 April 1987, Burke vent field (both Snail Pits and Anemone Heaven portions), 3,660 m, 18°10.917–.948′N, 144°43.210–.204′E, 40 ♂♂, 12 ♀♀; dive 1838, 29 April 1987, Ilium vent field, 3,595 m, 18°12.805′N, 144°42.425′E, 2 ♀♀; dive 1843, 4 May 1987, Alice Springs vent field, 3,640 m, 18°12.599′N, 144°42.431′E, 4 ♂♂, 3 ♀♀; and dive 1845, 6 May 1987, Alice Springs vent field, 3,640 m, 18°12.599′N, 144°42.431′E, 15 ♂♂, 46 ♀♀.

Type Material.—Holotype ♂, carapace length (CL) 24.5 mm, dive 1836, National Museum of Natural History, Smithsonian Institution, USNM 243241; allotype ♀, CL 25.8 mm, dive 1836, USNM 243242. Paratypes distributed as follows: National Museum of Natural History, Smithsonian Institution, Washington, D.C., USNM 243243, 3 ♂♂, 3 ♀♀, dive 1836; Natural History Museum of Los Angeles County, Los Angeles, California, 4 ♂♂, 1 ♀, dive 1836, and 1 ♂, 4 ♀♀, dive 1845; Academy of Natural Sciences, Philadelphia, Pennsylvania, 1 ♂, 1 ♀, dive 1845; Muséum National d'Histoire Naturelle, Paris, France, MNHN B 20910, 2 ♂♂, 2 ♀♀, dive 1845; Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands, D 37730, 1 ♂, 1 ♀, dive 1836; Zoologisk Museum, University of Copenhagen, Denmark, 1 ♂, 1 ♀, dive 1845; Zoological Museum, Moscow University, USSR, 1 ♂, 1 ♀, dive 1836; and National Science Museum, Tokyo, Japan 1 ♂, 1 ♀, dive 1845.

All other paratypes are in the Benthic Invertebrate Collection, Scripps Institution of Oceanography, La Jolla, California. Several specimens that were not inspected in detail, but are almost surely this species because they came from the same samples, were donated to the Emperor of Japan's Imperial Museum as well as to the working collections of Dr. S. Ohta (Ocean Research Division, University of Tokyo), C. Van Dover (Woods Hole Oceanographic Institution), and G. Somero (Scripps Institution of Oceanography).

Description

In the following description, we treat only those characters that serve to distinguish this species from other crabs in the family Bythograeidae. Corresponding character states of *B. thermydron* (bt) and *C. praedator* (cp), the only other Pacific species for which an adequate description exists, are enclosed in brackets [ ] following the description of the character state for *A. williamsi*. Comparisons with other bythograeids, some of which are incompletely described because of the relative lack of material, are deferred to the Discussion. Because we were concerned about possible allometric effects, we used specimens of equivalent size for comparison with *B. thermydron*. This was not possible with *C. praedator*, all specimens of which were considerably larger.

Size.—Male carapace length (CL) from 10.2 mm (dive 1843, our specimen no. 73) to 25.3 mm (dive 1836, our specimen no. 2), mean = 18.1 mm; female CL from 8.6 mm (dive 1845, our specimen no. 82) to 25.8 mm (allotype, dive 1836, our specimen no. 1) mean = 17.3. No sexual size differences evident (Fig. 3).

Measurements of the holotype male and allotype female (mm) are as follows (* right chela used for measurements):

	male	female
Carapace length (CL)	24.5	25.8
Carapace width	37.8	39.7
Depth of cephalothorax	14.2	13.5
Fronto-orbital width	8.6	8.6
Propodus* lower margin	34.2	34.6
Dactylus* length	22.3	19.9
Palm* height	14.2	13.0

Carapace (Figs. 1a, 2a, 3).—Length 0.63 width [shorter, 0.53 (Williams, 1980, fig. 8)

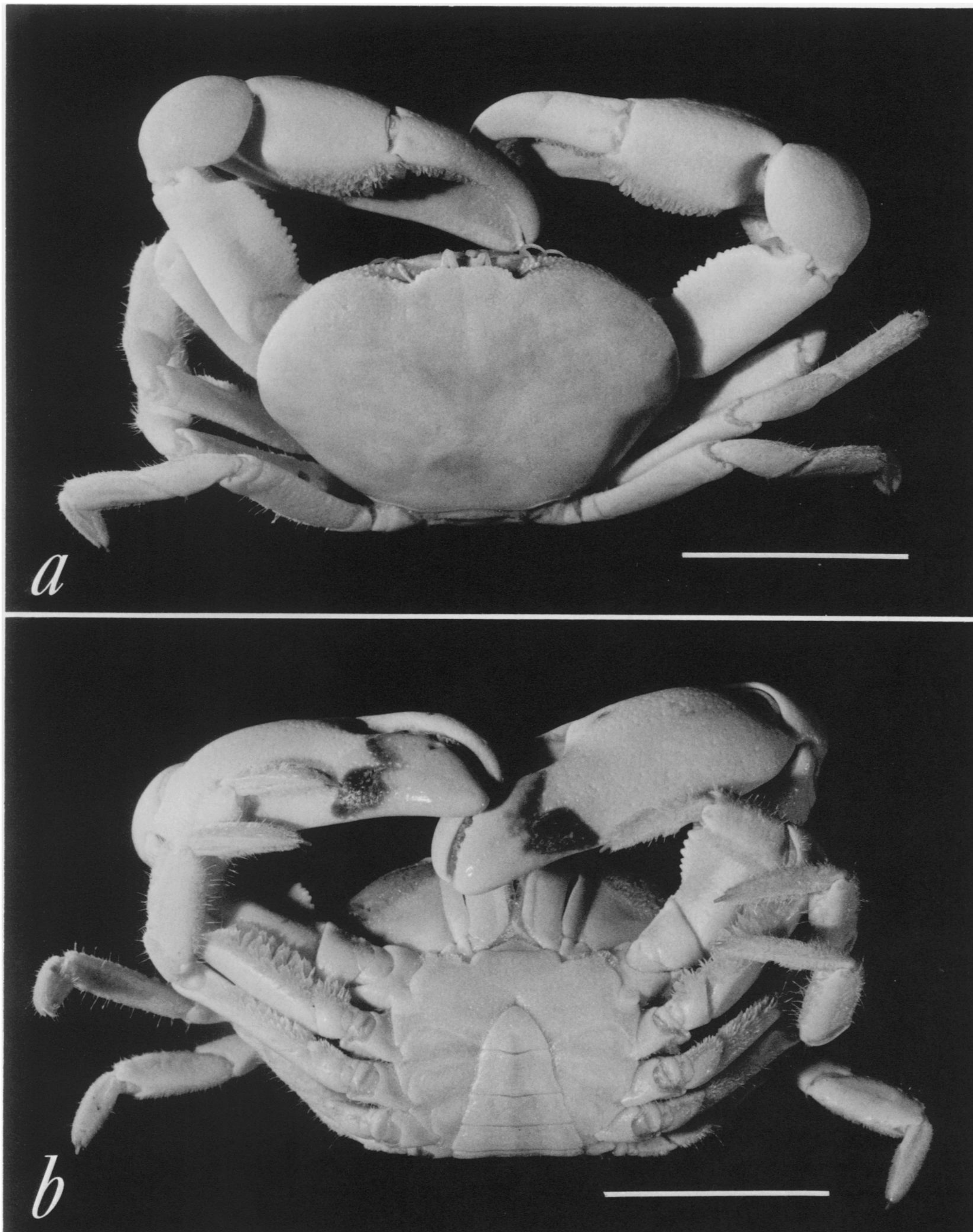


Fig. 1. *Austinograea williamsi*. Male holotype. a, dorsal view; b, ventral view. Scale bar = 2.0 cm.

(bt)]. Slightly granulate to completely smooth; transverse row of granules marking crest of frontal border at best weakly developed [with well-developed line of granules marking frontal border (bt)]. Subhepatic area in both sexes with densely setose patch [males with at most small setal patch at lateral edge of subhepatic area; female lacking patch (bt); patch lacking in both sexes (cp)]; this patch sharply separated from granulate suborbital margin by distinct suture dorsally and stopping abruptly along

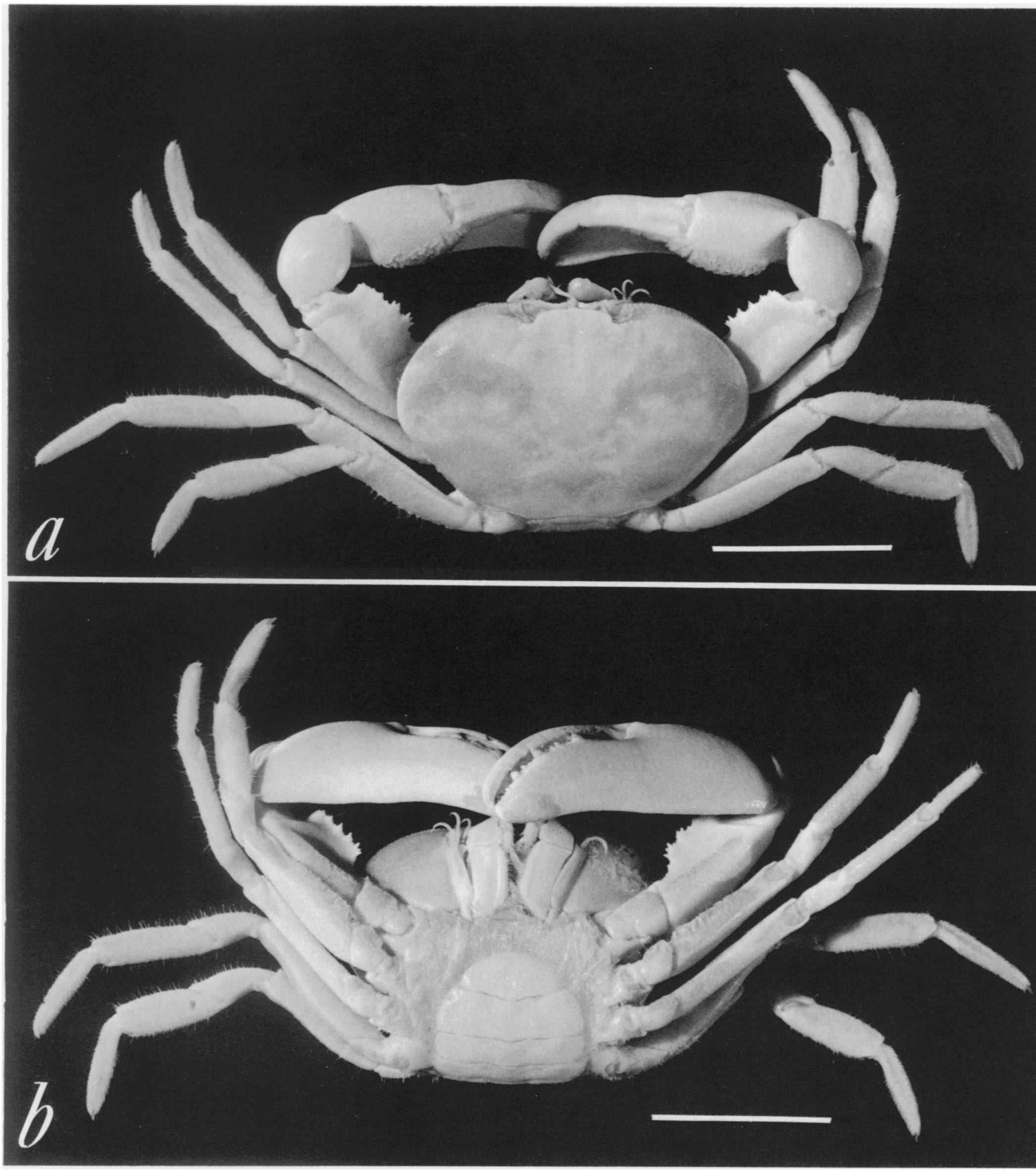


Fig. 2. *Austinograea williamsi*. Female allotype. a, dorsal view; b, ventral view. Scale bar = 2.0 cm.

oblique posteroventral line (pleural suture) on subhepatic surface (Figs. 4a, 5a, 6a).

Orbital Region (Figs. 4a, b, 5a).—Eyestalks absent in juvenile and adult; potential eyestalk vestige well-demarcated elongate oval region in posterior orbital wall lateral to second antenna (Figs. 4b, 5a) [mobile eyestalks (bt, cp)]. Orbital region extending as groove lateral to region containing vestigial eyestalks and antennae [no groove lateral to eye (cp)]; not distinctly delimited laterally by lines of tubercles [distinctly delimited by converging dorsal and ventral tubercle rows (bt)]. "Floor" of orbital region minutely granulate, nearly horizontal [distinctly sloping anteriorly (bt)]. Ventral surface of fronto-orbital border (location of dorsal portion of antennular septum in other brachyurans) with small, but distinct, median lobe or keel [only minute remnant of antennular septum (bt, cp)].

Epistome (Figs. 4a, 5a).—Dorsal margin lacking paired blunt protrusions (Fig. 5b) into mouth field [obvious blunt lobes extending ventrally into mouth field (bt)]. Plate bordering lateral edge of mouth field (Fig. 5a) broad, dorsally rounded [narrower, dorsally acute (bt)].

Maxilliped 1.—Distal endopodal segment bearing small, blunt, setose protrusion ("portunid lobe"; see Williams, 1980); portunid lobe blunt, rolled inward and distinctly proximal to distomesial corner (difficult to see because of dense plumose setation of proximal lacinia and basal maxilliped segments) [portunid lobe flattened, not rolled, located on or near distomesial lacinia border (bt); distal lobe acutely produced (cp)].

Maxilliped 2.—Dactylus distally rounded and bearing row of uniform stout spines on distomesial border; dactylus and propodus with dense setose fields arising from areas of thin cuticle on dorsal (functionally mesial) border forming even medial brush [dactylus distally lanceolate, lacking row of short spines (bt); setae of dactylus and propodus not of uniform length, not brushlike (cp)].

Maxilliped 3 (Figs. 6a, 7a, 8b).—In inner view of distal end of exopodal peduncle (Fig. 7a,ex) medial cristate lobe (Fig. 7a,cl) distally located [cristate lobe projecting subterminally (bt, cp)]. Dactylus broadest near midpoint [broadest near base (bt, cp)], not curved [curved toward mouth field (cp)]; dorsal margin not densely setose [densely setose (cp)]; insertion on propodus (Fig. 7a, arrow) not visible in outer view [propodal base of insertion distinctly visible (bt, cp)]. Setae of medial margin of propodus and dactylus proportionately shorter than on bt, longer than on cp. Coxa: proximal portion of lateral projections not visible ventrally (Fig. 8b), hidden by confluence of sternum and chelipedal coxa with ventral border of carapace [elongate, laterally tapering projection visible (bt, cp)]; lateral coxal projections visible only when dissected (Fig. 7), with single prominent lobe (Fig. 7al$_1$) on middle region [two lobes (bt); three lobes (cp)]; embayment in lateral end of coxal projection for attachment of gill broader than in bt or cp; lobe distal to embayment (Fig. 7al$_2$) barely more prominent than that proximal to it [distal lobe much larger (bt)]. Merus: lateral margin more angular than on bt, with main curvature proximal to midpoint [main curvature midway (bt, cp)]; medial lobe (Fig. 7a,ml) only half length of medial margin [occupying most of margin's length (cp)]; margin of medial lobe facing medially (parallel to proximal portion of lateral margin) [facing proximomedially (not parallel to proximolateral margin) (bt, cp)]; distal end (Fig. 7a,de) more acutely produced than on bt or cp; inner medial keel with dense tuft of setae [sparsely setose (bt)].

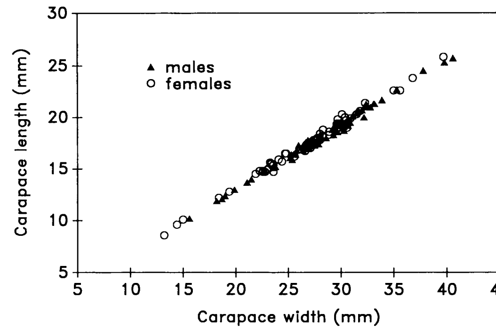


Fig. 3. Carapace length-width relationships of all specimens of *Austinograea williamsi*. For males and females: $y = 0.45 + 0.63x$, $r = 0.995$.

Chelipeds (Figs. 9–12).—Relatively long, right propodus being 1.06 carapace width (male), 0.89 carapace width (female) [average for 6 females = 0.67, for 3 males = 0.79 (bt); average for 1 male and 1 female = 0.85 (cp)]; right and left equal in size, slightly dimorphic or strongly dimorphic; crusher nearly always on right; dimorphism prevalent mostly on smaller males [relatively smaller, almost all with obvious crusher and cutter (bt)].

Cutter (Figs. 9b, 10a, b, 11b, d–h).—Dactylus: distal end thick; occluding margin except for proximal portion smooth, lacking ventral teeth [more pointed (bt, cp), with teeth on occluding margin (cp)]; inner occluding surface with groove bearing patch of dense, plumose setae [no dense setation (bt, cp)]; occluding margins of dactylus and propodus not gaping, meeting along entire length [distinct gape in largest individuals (bt, cp)]. Propodus: ventral margin relatively straight [concave due to inflation of palm (bt, cp)], height greatest at base of dactylus [height greatest more proximally (bt)];

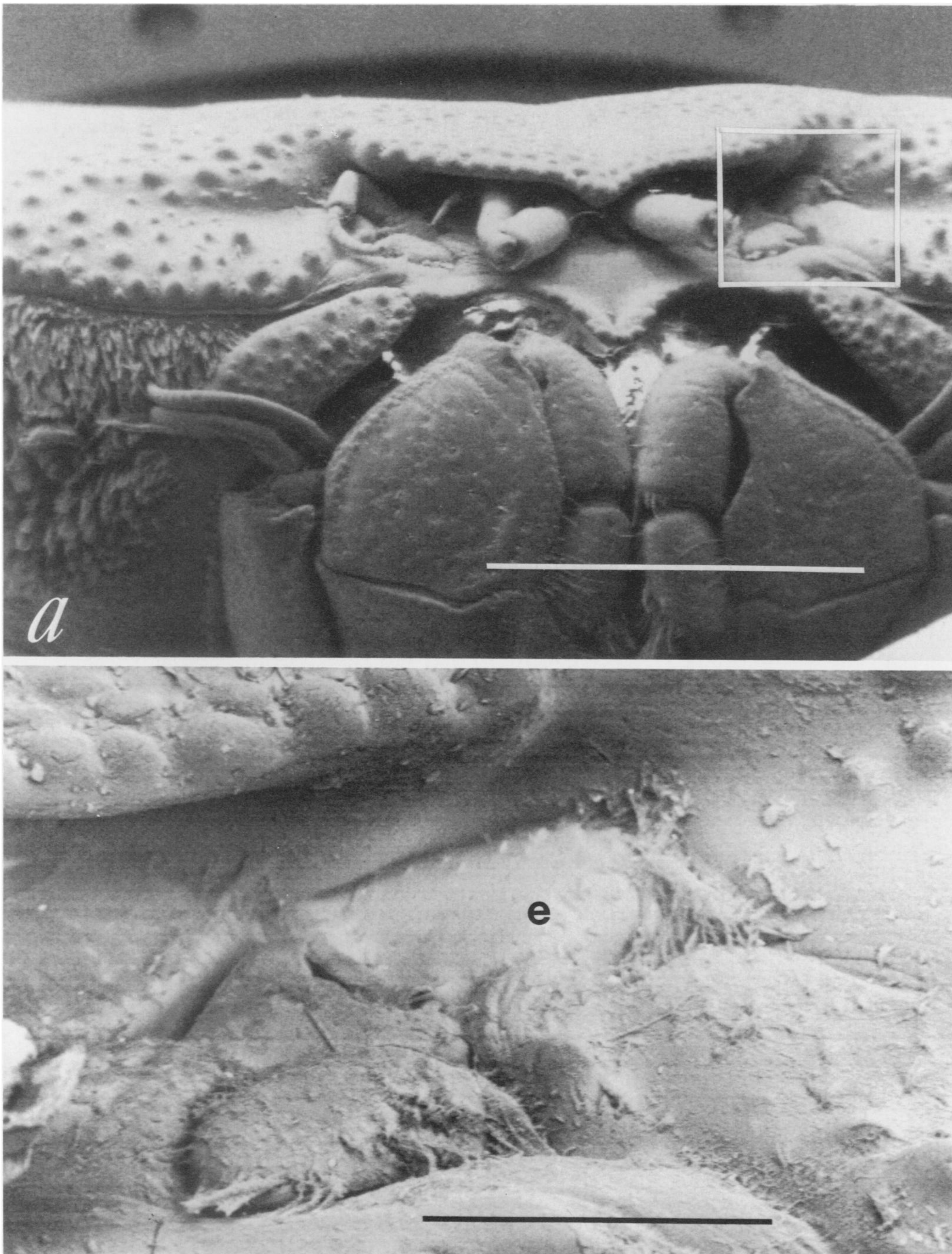


Fig. 4. Scanning electron micrograph of frontal and orbital regions of female *Austinograea williamsi,* CL = 20.3 mm. a, frontal region, distal portions of left first and second antennae removed; b, higher magnification of orbital region outlined in white in a. Note oval plate, possibly a remnant of the eyestalk (e), fused to the surrounding cuticle and lacking visual apparatus. Scale bar = 5 mm for a, 1 mm for b.

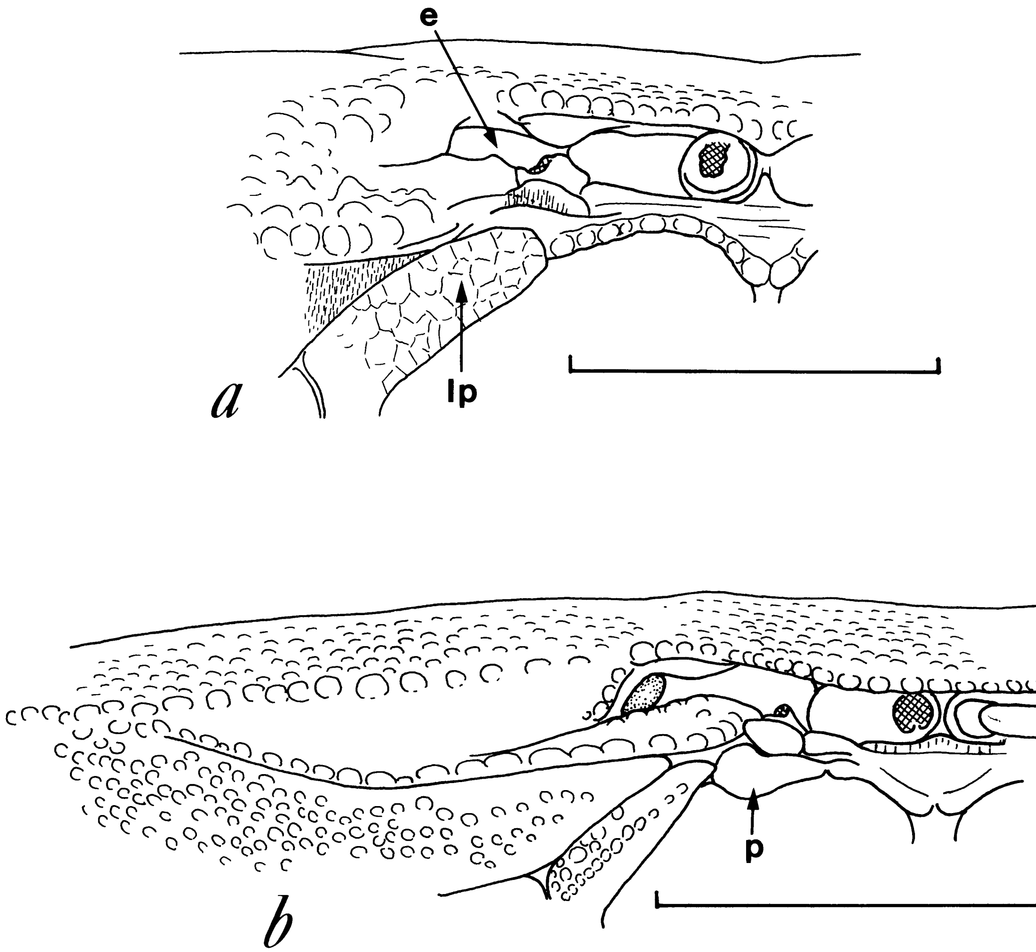


Fig. 5. Right frontal region of two genera of the Bythograeidae, distal portions of first and second antennae removed (torn ends are cross-hatched). a, *Austinograea williamsi*, male, CL = 18.7 mm; b, *Bythograea thermydron*, male, CL = 16.4 mm. Scale bars = 5 mm. Abbreviations: e, possible eyestalk remnant; lp, plate bordering lateral edge of mouth field; p, protrusion into mouth field.

inner surface with midcentral patch of dense, plumose setae [less pronounced in males (bt), absent (cp)]; finger very broad [less broad on bt, slender on cp]; inner surface of finger markedly dished or spooned [not markedly dished (bt, cp)]; outer surface on larger males with small, often brown-stained, pitted area just proximal to, and in line with, ventral border of dactylus [pitted area lacking (bt, cp)]. Merus: seen in ventral view, produced cristate ridge on anteromedial margin of constant prominence throughout length [increasing in prominence distally (bt); not present (cp)]. Ischium and merus with patch of dense, plumose setae on ventral surface in females [lacking in both sexes (bt, cp)].

Crusher (in Comparison to Cutter) (Figs. 9c, 11a, c).—Dactylus blunter, with coarse dentition on occluding margin, more curved, yielding gape between it and occluding margin of propodal finger; dense, plumose setae limited to basal third. Propodus relatively higher, with height subequal to dactylar length.

Walking Legs (Figs. 1b, 2b).—Ventral margins of all walking legs with tract of dense, plumose setae on ventral margin of basiischium and merus; number of setae decreasing posteriorly [setal tracts lacking (bt, cp)]. Dorsal and ventral margins of dactylus and propodus, and to minor extent dorsal

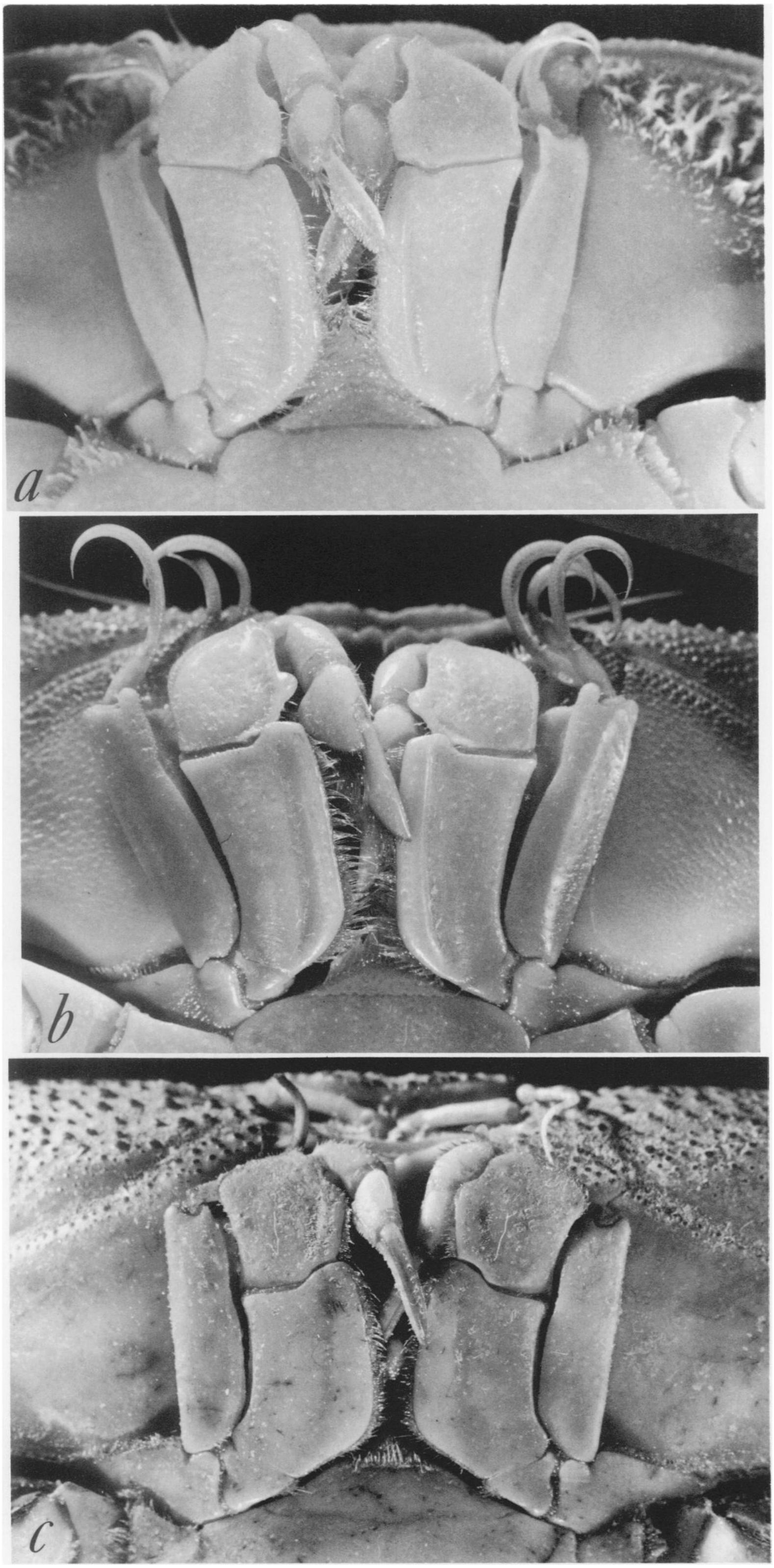


Fig. 6. Mouth field of three genera of the Bythograeidae. a, *Austinograea williamsi,* male, CL = 19.5 mm; b, *Bythograea thermydron,* male paratype (Allan Hancock Foundation 799), CL = 33.2 mm; c, *Cyanagraea praedator,* male, CL = 45.8 mm. Note amount of coxa of third maxilliped visible in a compared to b and c.

Fig. 7. Right third maxilliped of three genera of the Bythograeidae; distal portion of epipod omitted on b and c. a, *Austinograea williamsi,* male, CL = 18.7 mm; b, *Bythograea thermydron,* male, CL = 16.4 mm; c, *Cyanagraea praedator,* male, CL = 45.8 mm. Scale bars = 5 mm. Abbreviations: cl, cristate lobe; de, distal end of merus; ex, exopod; l_1, lobe on middle region of coxa; l_2, lobe distal to embayment; ml, medial lobe of merus. Arrow indicates insertion on propodus.

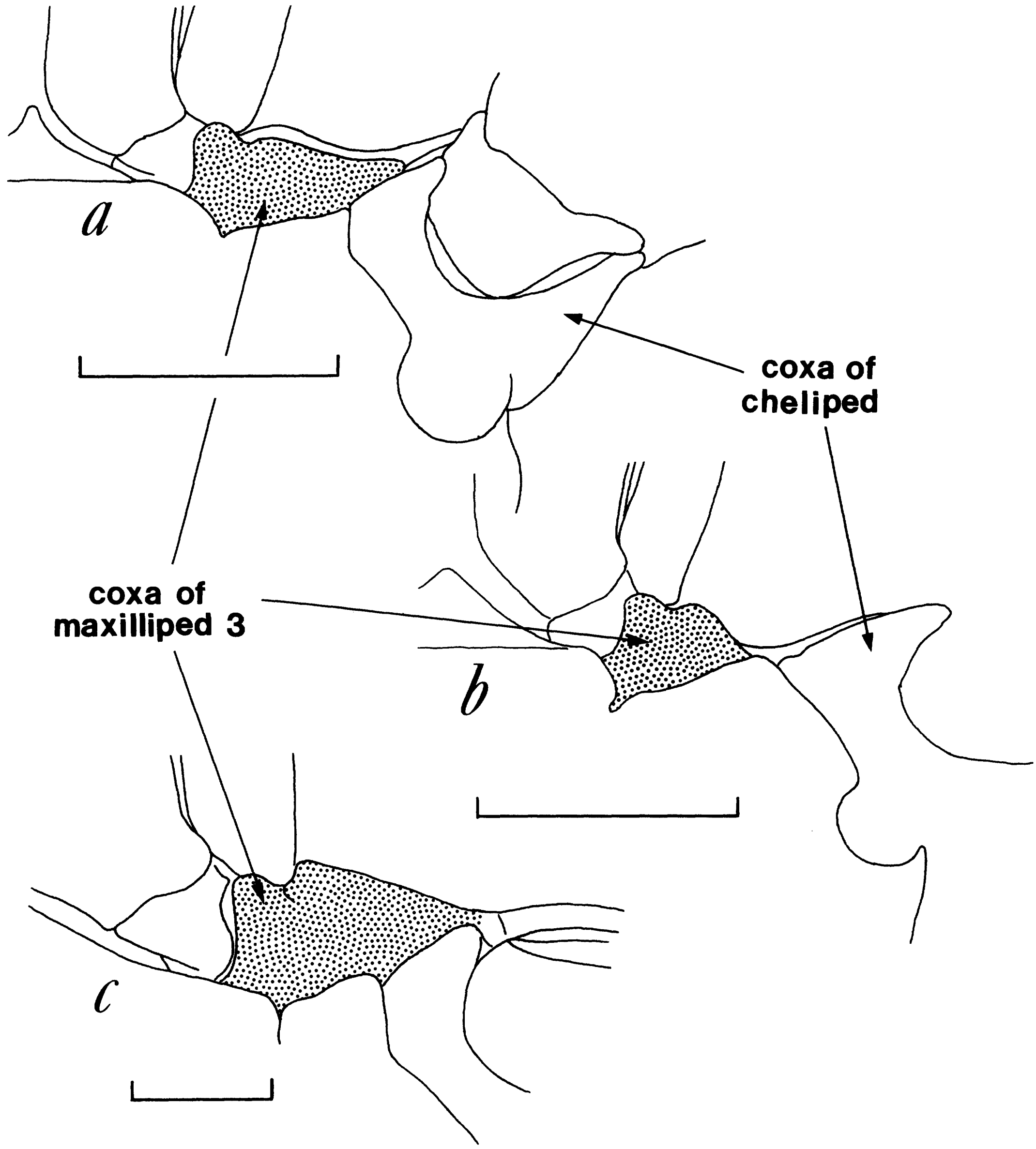


Fig. 8. Sternal view of base of left third maxilliped of three genera of the Bythograeidae, showing the degree to which the coxa of that appendage (stippled) forms part of the sternal surface. a, *Bythograea thermydron,* male, CL = 18.4 mm; b, *Austinograea williamsi,* male, CL = 18.7 mm; c, *Cyanagraea praedator,* male, CL = 45.8 mm. Scale bars = 5 mm.

margin of carpus, with fields of short, spine-like setae [lacking on propodus and carpus (bt); entirely lacking (cp)]. Difference from bt not as obvious on walking leg 5.

Abdomen (Figs. 1b, 2b, 13a).—Pleonite 6 on male (Fig. 13a) tapering markedly distally [sides nearly parallel (bt, cp)]. Female telson proportionately narrower (allotype 0.71 width pleonite 6) [wider, 0.81 width pleonite 6 (bt with carapace width 44.7 mm)].

Male Pleopods (Figs. 14a–e).—First pleopod nearly twice length of second (male paratype no. 68 with first and second pleopods 9.2 and 5.1 mm, respectively), narrow, more or less straight, grooved posteriorly and anteriorly, with mesial double row of short stout sclerotized spines [distinctly

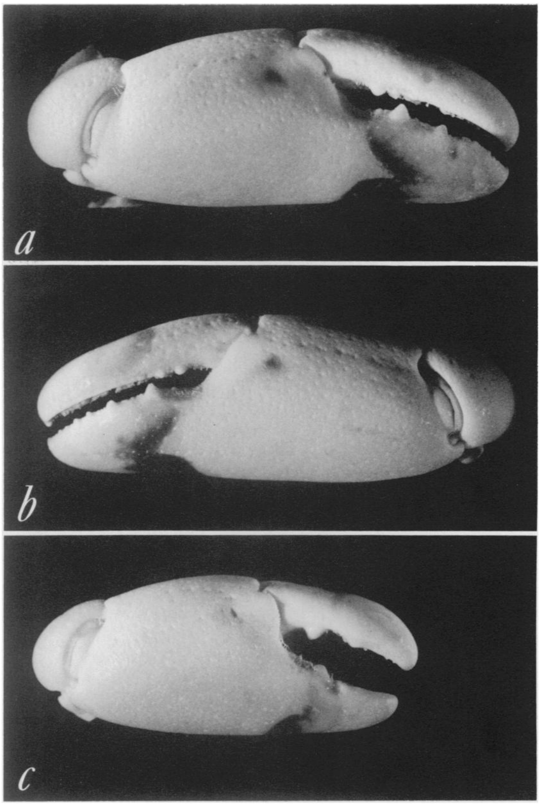


Fig. 9. *Austinograea williamsi,* male chelae. a and b, holotype, right and left, respectively; c, right crusher from smaller male, CL = 19.5 mm.

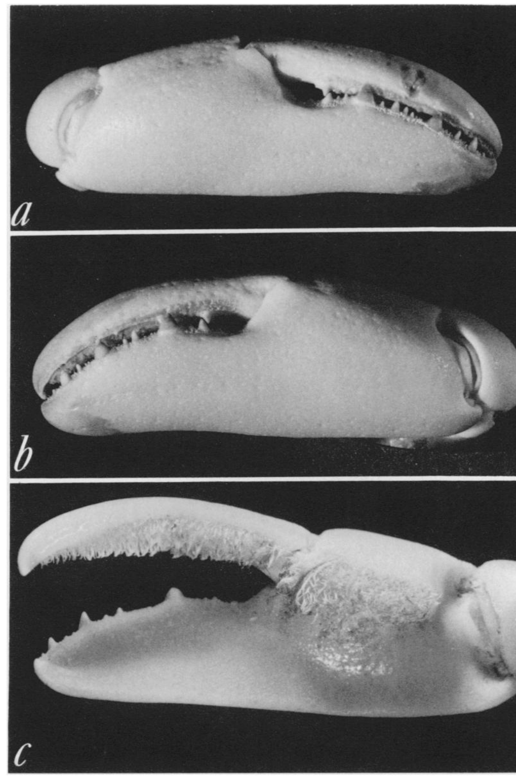


Fig. 10. *Austinograea williamsi,* female chelae. a and b, allotype, right and left, respectively; c, inner surface of different female (CL = 19.5 mm), showing dishing of inner surface of immovable finger and setose patch on palmar surface.

shorter than second, stout, dextrally twisted (bt); nearly equal, slightly stouter (cp); sclerotized spines not as obvious (bt, cp)]. Second pleopod with bend about two-thirds length at level of small oval area fringed with short setae (Fig. 14e, arrow); distally flattened and bladelike [with oval seta-lined area at about midlength (bt, cp); distally curving (cp)].

Etymology.—We are pleased to name this species after our friend and colleague, Austin B. Williams, in recognition of his excellent contributions to the systematics of hydrothermal vent decapods.

Sexual Dimorphism

There are no apparent differences in the overall size and shape of the carapace in males and females, and carapace shape does not change with ontogeny (Fig. 3). However, sexual dimorphism exists in the chelipeds. Female chelae are more slender and more ventrally curved than male chelae, and they bear sharper and more delicate teeth on both dactylus and propodus. In addition, the strongly concave propodal inner margin, merging eventually with a ventral propodal keel, is much more pronounced in females. Male chelae, on the other hand, in addition to being slightly more inflated (i.e., the propodal height is relatively greater; see Fig. 12), are also longer relative to carapace size and are occasionally dimorphic, with distinct crusher and cutter claws. This condition exists mostly in some intermediate-sized males (those points above the line in Fig. 12), but there are also some larger males with one chela that we would term a "crusher." Female chelae are never strongly dimorphic. Females have patches of dense plumose setae on the ventromesial margin of the chelipedal basi-ischium, whereas males do not, or bear at most a small setose

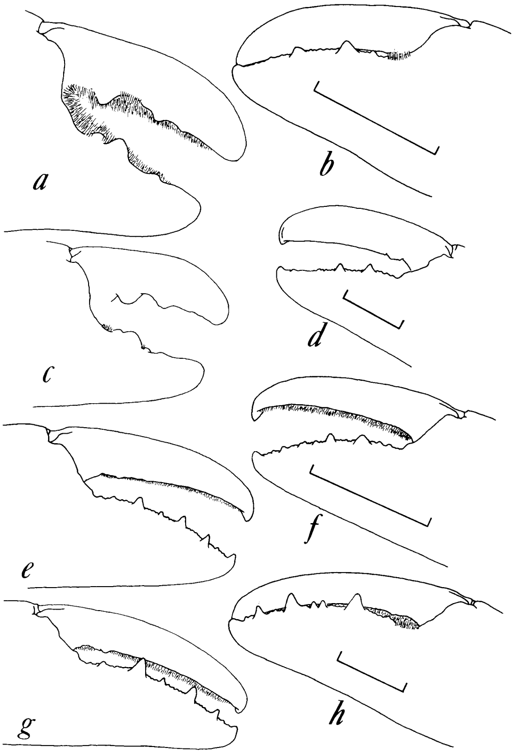


Fig. 11. Chelipedal fingers of *Austinograea williamsi,* outer surface, illustrating both the smallest individuals and those at the large end of the range. a and b, right crusher and left cutter, respectively, male, CL = 12.4 mm; c and d, right crusher and left cutter, respectively, male, CL = 19.3 mm; e and f, right and left cutters, respectively, female, CL = 12.2 mm; g and h, right and left cutters, respectively, female, CL = 20.0 mm. Scale bars = 5 mm.

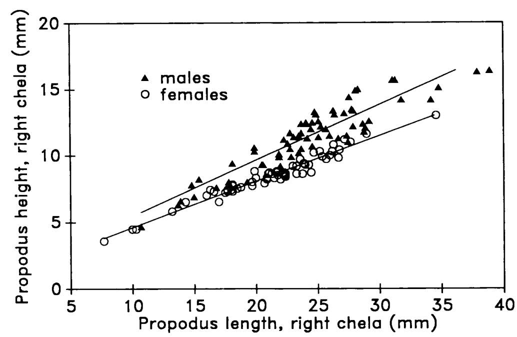


Fig. 12. Length-height relationship of propodus of chela, right side only, in all specimens of *Austinograea williamsi* with right chela intact. For males, $y = 1.27 + 0.42x$, $r = 0.922$; for females, $y = 1.18 + 0.34x$, $r = 0.975$. Note scatter around line for males, reflecting presence of crusher and cutter morphologies in males.

patch at the base of the merus. Females also are more setose on the anterior part of the sternum (compare Figs. 1b, 2b).

Natural History

A general description of the Mariana hydrothermal vents and their communities was given by Hessler *et al.* (1988). *Austinograea williamsi* was found in abundance on the patches of snails, *Alvinoconcha hessleri* Okutani and Ohta, 1988, that frequently filled vent openings. As with other bythograeids, *A. williamsi* occurred more sparsely within the surrounding vent field. Observations of behavior suggest that it is a scavenger and probably a carnivore.

No females in our collection were carrying eggs. Nor did we see any egg-bearing individuals during the dives. This is in strong contrast to *B. thermydron* from the Galapagos vents, many females of which were brooding eggs (Van Dover *et al.,* 1985).

The overall ratio of males to females was 1:1 (69 males, 68 females), but the sex ratio of crabs from different localities was skewed. For example, dive 1845 to Alice Springs yielded 46 females and only 15 males, while dive 1836 to the Burke field resulted in 40 males and 12 females.

Key to Genera of the Family Bythograeidae

1. Coxa of maxilliped 3 partially obscured in ventral view, lateral extension hidden by juxtaposition of ventral margin of carapace in the pterygostomial region with anterolateral sternal border and chelipedal coxa. Eyestalk absent or merely fused portion of orbital wall. Dactylus of cheliped with recessed ventral border bearing dense setae .... *Austinograea* (monotypic; *Austinograea williamsi,* new species)

– Coxa of maxilliped 3 not obscured in ventral view, lateral extension visible, not hidden by ventral pterygostomial margin of carapace, sternum, and chelipedal coxa. Mobile eyestalks present at all stages of development. Dactylus of cheliped without recessed ventral border bearing setae 2

2. Frontal border in dorsal view nearly straight (Fig. 15a). Widest point of carapace just posterior to frontal border (across anterior one-fourth to one-third of carapace). Eyes located in small, clearly defined pockets .... *Cyanagraea* (monotypic; *Cyanagraea praedator* Saint Laurent, 1984)

- Frontal border in dorsal view rounded (Figs. 1a, 2a). Widest point of carapace near midline, slightly displaced anteriorly. Eyes bordered laterally by large depressed regions demarcated by dorsal and ventral row of granules 3
3. Oval patch of cuticle with special texture located ventrolateral to orbit .... *Segonzacia* (monotypic; *Segonzacia mesatlantica* (Williams, 1988))
- No such patch present .... *Bythograea*

(Three described species of *Bythograea*: *B. thermydron* Williams, 1980, *B. microps* Saint Laurent, 1984, and *B. intermedia* Saint Laurent, 1988. The status of *B. intermedia* is uncertain due to inadequate information. Guinot (1988) mentioned an unidentifiable specimen in a vial of juveniles of *B. thermydron* and *B. microps*.)

Discussion

Characters of Generic Importance

There can be no doubt that the species described herein is a member of the family Bythograeidae. The overall resemblance to previously described species of *Bythograea* and, to a lesser extent, *Cyanagraea* is obvious. However, there is one character exhibited by *A. williamsi* that falls outside the original familial diagnosis offered by Williams (1980). There is no moveable eyestalk in specimens of *Austinograea* of any size (our smallest specimen was a female, CL = 8.6 mm, dive 1845); indeed, it is not even certain that a fused eyestalk remnant is present. The significance of this difference is still unclear; several authors have pointed out that there is a tendency in bythograeids for reduction of the eyestalk. Larger specimens of *Bythograea thermydron* have proportionately smaller eyes, and *B. microps* was named for a further reduction in the eyestalks (Saint Laurent, 1984). The eyestalk in *Cyanagraea*, although rather large, moves very little, and may indicate incipient fusion with the carapace. To accommodate *A. williamsi*, we need only modify Williams' familial diagnosis of the Bythograeidae (Williams, 1980: 444) from "Stalked eyes movable, cornea unpigmented" to "Eyes present or absent, cornea unpigmented; stalk distinct or absent."

Several morphological characters prevent us from placing the current species within any other genus. Most salient, apart from the absence of eyes noted above, are the shape and ventral external exposure of the third maxilliped. In *Austinograea*, the posterolateral extension of the coxa of this appendage is obscured from view by the confluence of the ventral border of the pterygostomial region of the carapace with the anterolateral margin of the sternum and the chelipedal coxa. This is not the case in other genera, in which the maxillipedal posterolateral coxal process is easily seen in ventral view (Figs. 6, 8). The male pleopods differ from those of *B. thermydron*, in that they are relatively straight and not twisted in *Austinograea*, and in that the second pleopod is distinctly shorter than the first. The male pleopods have not been previously described for *Cyanagraea*. The overall condition in *Cyanagraea* is similar to that in *Austinograea*, but in *Cyanagraea* the second pleopod more nearly approaches the length of the first (Fig. 14h, i). On *Segonzacia*, the broad, setose tip of pleopod 1 and the coiled tip of pleopod 2 are unique among known bythograeids, as is the oval cuticular patch ventrolateral to the orbit. Although it is easy to envision intermediate states for all of our generic characters, we feel that until morphological diversity within the Bythograeidae is more fully appreciated, the most conservative approach is the erection

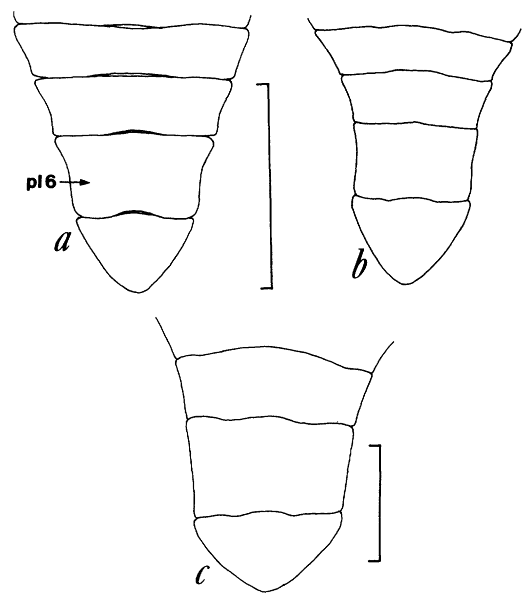
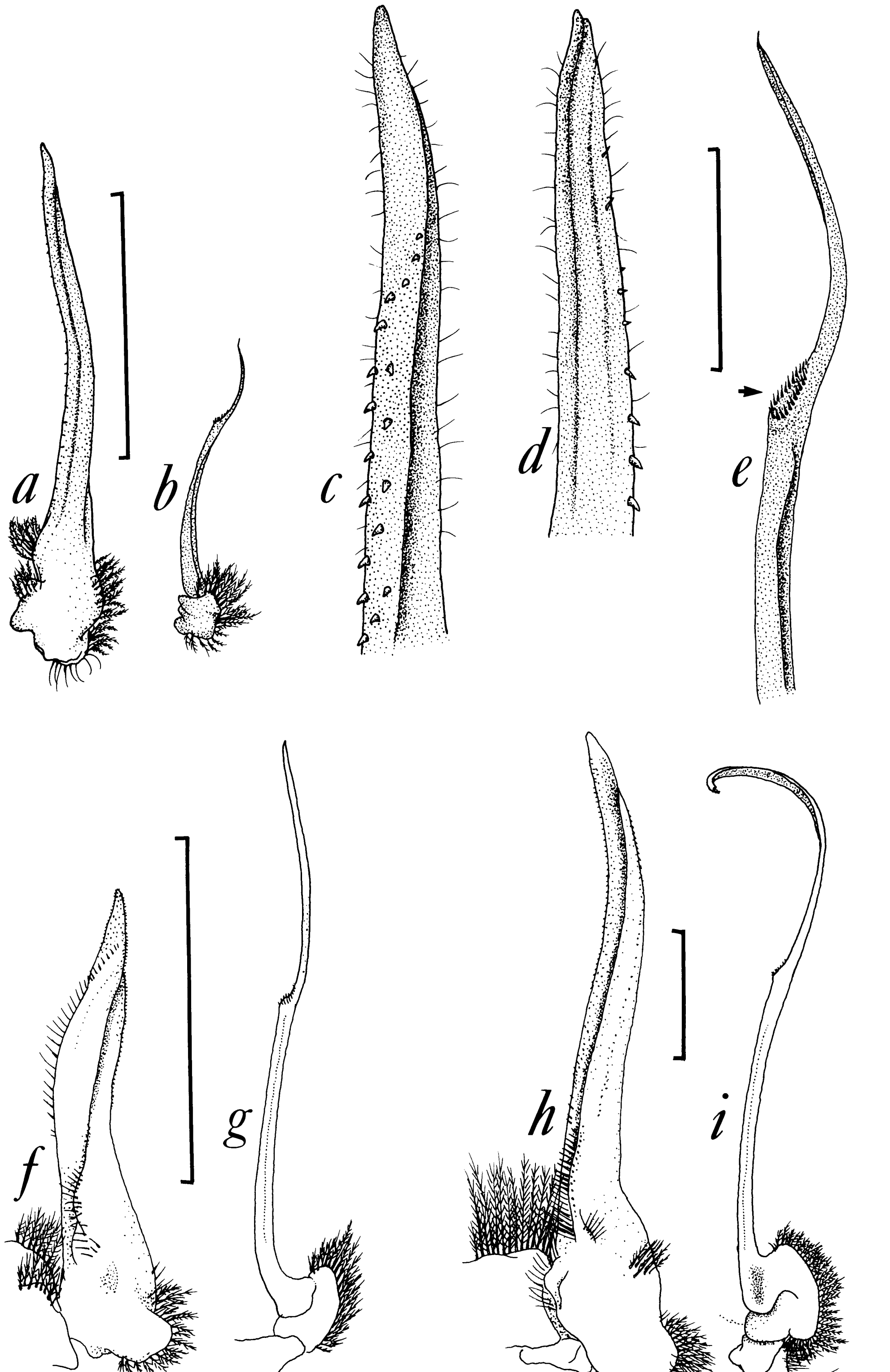


Fig. 13. Male pleon of three genera of the Bythograeidae, ventral view, setation not shown. a, *Austinograea williamsi*, holotype; b, *Bythograea thermydron*, CL = 18.4 mm; c, *Cyanagraea praedator*. CL = 45.8 mm. Scale bars = 10 mm; a and b are to the same scale. Abbreviation: pl6, pleonite 6.


a
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of a fourth genus to accommodate the Mariana species.

Species Comparison

Comparisons of characters of *A. williamsi* with *B. thermydron* and *C. praedator* are presented in the species description, with characters of the last two species set off in brackets. *Bythograea microps* and *B. intermedia,* both of which have eyes and mobile eyestalks, are still too poorly known to justify detailed comparison.

Allometric changes can be demonstrated for some characters within the Bythograeidae. In males of *A. williamsi,* the fingers of the crushing cheliped do not gape in smaller individuals, but do to some extent in larger ones. In *B. thermydron,* the male pleopod 1 is twisted and S-shaped in large individuals, but is less curved in young individuals (Fig. 14f) and more closely approximates the condition seen in *Austinograea* and *Cyanagraea.*

In comparing *A. williamsi* to *B. thermydron,* we avoided allometric considerations by limiting comparison to individuals of similar size. This was impossible with *C. praedator,* because only three extremely large individuals were available. Potential allometric effects might include the degree of setation, the gape of the cheliped, and the presence of teeth on the occluding margins of the chelipedal fingers. This is of concern, because in all of these features, our specimens of *C. praedator* differed from the other species.

Our largest specimen has a CL of only 25.8 mm compared to 33.1 mm for the male holotype of *B. thermydron.* Although the traps at Mariana were size limiting, personal observation by the first author suggests that *A. williamsi* does not reach as large a size. The overall shape of *A. williamsi* and *B. thermydron* is similar. There are numerous and obvious differences, including the shape of the orbital region, carapace, chelipeds, walking legs, maxillipeds, abdomen, and male pleopods.

There are equally as many differences between our species and *C. praedator.* Indeed, we feel that *Austinograea* is closer to *Bythograea* than to *Cyanagraea,* most obviously in the shape of the carapace and shape and size of the orbital region (Fig. 15). However, in some other characters, such as the shape of the male pleopods, *Austinograea* and *Cyanagraea* are more similar than either is to *Bythograea* (Fig. 14).

Our observations of previously described species differ from published accounts on two points. We found the antennular septum of *C. praedator,* previously described as complete (Saint Laurent, 1984), to be incomplete at best. The inner propodal surface of the cheliped on males of *B. thermydron* was described as glabrous (Williams, 1980). We found that some males bear a setal patch in this position, although not so large a patch as that of *A. williamsi.*

Bythograea mesatlantica was described from a single, small female (CL 13.8 mm) from 23°22′N on the Mid-Atlantic Ridge (Williams, 1988). Guinot (in press) erected the genus *Segonzacia* for this species on the basis of several additional specimens from the same area. We have not personally inspected specimens of this species and therefore do not make a detailed comparison herein. Some characters of *A. williamsi* resemble those of *S. mesatlantica* more than those of the East Pacific Rise species *B. thermydron.* The orbital region is not as clearly demarcated in either species as it is in *B. thermydron.* The last three segments of the walking legs are similarly setose. However, in addition to differing in the diagnostic generic characters, *A. williamsi* also differs from *S. mesatlantica* in the shape of the chelipeds, the location of setal patches, the shape of the endopod of the third maxilliped, and the more tapering male pleonite 6. In addition, the male first pleopod of *S.*

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Fig. 14. Male first and second pleopods (gonopods) in three genera of the Bythograeidae. *Austinograea williamsi,* CL = 19.5 mm. a and b, first and second pleopods, respectively; c and d, higher magnification of distal fourth of first pleopod in posterior and anterior views, respectively; e, distal half of second pleopod. *Bythograea thermydron,* small male, CL = 18.4 mm. f and g, first and second pleopods, respectively. *Cyanagraea praedator,* male, CL = 45.8 mm. h and i, first and second pleopods, respectively. Scale bars = 5 mm for a and b, f and g, h and i; scale bar = 1 mm for c–e (latter scale bar located between Figs. d, e). Arrow in e indicates oval, seta-lined field.

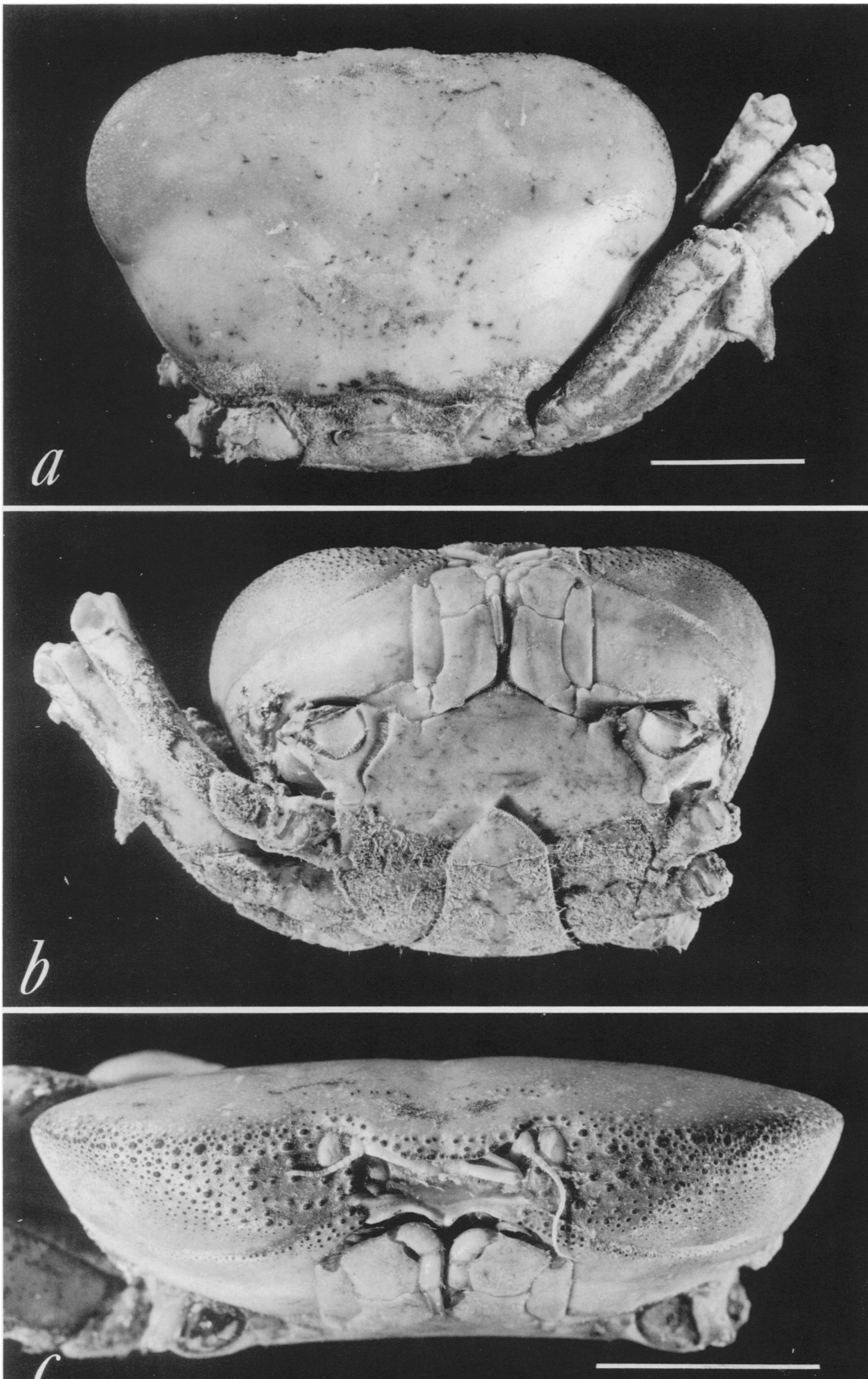

Fig. 15. Male of *Cyanagraea praedator* Saint Laurent, 1984. a, dorsal view; b, ventral view; c, frontal view. Scale bars = 2 cm.

mesatlantica is distally truncate and setose, and the second pleopod terminates in a tight spiral (Guinot, personal communication).

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Addresses: (RRH) Scripps Institution of Oceanography, La Jolla, California 92093; (JWM) Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, California 90007.