

A REASSESSMENT OF *PAGURUS TRICARINATUS*
(STIMPSON, 1858)
(CRUSTACEA: DECAPODA: ANOMURA: PAGURIDAE)

Patsy A. McLaughlin

Abstract.—*Pagurus tricarinatus* (Stimpson) is redescribed and is illustrated for the first time. The presence, in females, of paired first pleopods modified as gonopods requires that this taxon be removed from *Pagurus*. In female morphology this species agrees well with *Ceratopagurus*; however, as males have not been described, it can only be transferred provisionally to this genus.

Stimpson (1858) described a new taxon, *Eupagurus tricarinatus* based on a single specimen of unspecified sex from Kagosima Bay, Japan. That specimen was presumably lost, with much of Stimpson's other materials, in the Chicago fire of 1871 (cf. Rathbun 1883). Although Stimpson's (1858) description (repeated in a posthumous publication in 1907) was brief and not accompanied by an illustration, the taxon was clearly defined by three crenulated keels on the dorsal surface of each chela. However, a superficially similar species, *Eupagurus triserratus*, having three spinose ridges on the right chela was subsequently described by Ortmann (1892) from Sagami Bay, Japan. Ortmann distinguished his species from Stimpson's (1858) by the absence of a rostrum in this latter species.

In their redescription and assignment of Ortmann's (1892) taxon to *Australeremus*, McLaughlin & Gunn (1992) noted that these two seemingly similar Japanese species had been reported and probably confounded by several authors. McLaughlin & Gunn reviewed the published records of each species and concluded that most, if not all of those records actually pertained to *A. triserratus*.

Supplemental to Ortmann's (1892) type material and the specimens from the Bonin Islands that Melin (1939) subsequently used to redescribe *A. triserratus*, McLaughlin &

Gunn (1992) examined a specimen from the South China Sea from the Franz B. Steiner collection belonging to the California Academy of Science (CAS). A continuing study of that collection has now provided two specimens, both females, of Stimpson's *P. tricarinatus*. As was the case in Ortmann's (1892) taxon, females of Stimpson's (1858) species have paired first pleopods, modified as gonopods. Consequently *P. tricarinatus* too must be removed from the genus *Pagurus*. In the conformation of the cephalic shield and appendages, the unarmed sternite of the third maxillipeds, the shapes of the sternites of the third and fifth pereopods, the subequal chelipeds, the elongate and slightly twisted dactyls of the ambulatory legs, the single row of scales on the propodal raps of the fourth pereopods, and general configuration of the telson, this species agrees with *Ceratopagurus* as redefined by McLaughlin (1988). However, until males are known, Stimpson's (1858) taxon can only be provisionally assigned to this genus.

Ceratopagurus tricarinatus
(Stimpson, 1858)
Figs. 1, 2

Eupagurus tricarinatus Stimpson, 1858:251 [89]; 1907:228.—Ortmann, 1892:309.—Alcock, 1905:177.—Balss, 1913 (? in part):52, ? not 58 (see remarks).—Terao, 1913:372.

Pagurus tricarinatus: Gordon, 1956:336 (in part); see remarks. — McLaughlin & Gunn, 1992:90.

Not *Pagurus tricarinatus* Norman, 1869:264 [= *Pagurus alatus* Fabricius (cf. Ingle, 1985)].

Not *Eupagurus tricarinatus*: Sars, 1885:11, pl. 2, figs. 8–10. — Hansen, 1908:28 [= *Pagurus alatus* Fabricius (cf. Ingle, 1985)].

?Not *Pagurus tricarinatus*: Miyake, 1982: 197 [?= *Australeremus triserratus* (Ortmann, 1892)].

Material. — Taiwan Strait, South China Sea: 1 ♀ (shield length 2.4 mm), off Penghu Islands (Peng-hu Tao), 30–40 m, Apr 1971, coll. F. B. Steiner, CAS 046655; 1 ovigerous ♀ (shield length 4.2 mm), Formosa Bank, 50 m, Jul, 1973, coll. F. B. Steiner, CAS 046661.

Redescription. — Shield broader than long; anterior margin between rostrum and lateral projections concave; posterior margin truncate. Rostrum obsolete. Lateral projections produced, obtusely rounded and with terminal spinule. Interocular lobes (“bracteole” of Stimpson 1858) well developed. Ocular peduncles moderately short, equaling or slightly longer than shield but overreached by antennular peduncles; cornea strongly dilated. Ocular acicles developed into deeply grooved rectangular process armed with strong submarginal spine; separated basally by approximately entire width of 1 acicle.

Antennular peduncles with scattered setae on all 3 segments.

Antennal peduncles with scattered setae on fifth and fourth segments; third segment with small spine at ventrodistal angle; second segment with dorsolateral distal angle produced, terminating in small spine and with numerous long, stiff setae, dorsomesial distal angle with small spine; first segment produced ventrally and with 3 or 4 small spines laterally. Antennal acicle long, arcuate, terminating in small spine, mesial margin with long stiff setae.

Right and left chelipeds subequal, shorter

than ambulatory legs. Dactyl of right cheliped $\frac{1}{5}$ to approximately as long as palm; cutting edge with 3 or 4 large calcareous teeth in proximal half, row of small corneous teeth in distal half; terminating in small corneous claw; dorsomesial margin with row of very blunt spiniform processes, dorsal surface unarmed but with few scattered setae, mesial and ventral surfaces with scattered tufts of setae. Palm $\frac{2}{3}$ – $\frac{3}{4}$ length of carpus; dorsomesial margin elevated into prominent crenulated keel, dorsal midline and dorsolateral margins each also with prominently elevated, crenulated keel extending almost entire length of fixed finger, crenulations becoming more tuberculate or spiniform on fixed finger; dorsal surface between keels unarmed; cutting edge of fixed finger with strong calcareous teeth in proximal $\frac{2}{3}$, small calcareous teeth interspersed with minute corneous teeth in distal third, terminating in small corneous claw; mesial, lateral and ventral surfaces all with short, transverse rows of long, stiff setae. Carpus with somewhat trapezoidal dorsal surface, dorsomesial margin with row of moderately small acute spines, second irregular row of somewhat smaller spines traversing dorsal surface from midline distally to dorsolateral margin proximally; all surfaces with short, transverse rows of long stiff setae. Merus subtriangular; approximately $\frac{2}{3}$ length of carpus; dorsal margin with few tufts of long setae in transverse rows; mesial and lateral faces with short, transverse rows of long stiff setae in ventral halves, ventromesial and ventrolateral margins each 1 or 2 spines and tufts of long stiff setae. Ischium with 2 small tubercles on ventral margin proximally.

Left cheliped with dactyl slightly longer than palm; cutting edge with row of very closely spaced corneous teeth; terminating in corneous claw; dorsomesial margin with row of blunt spines or tubercles, decreasing in size distally; mesial and ventral surfaces with scattered tufts of long stiff setae. Palm with dorsomesial margin elevated into prominent crenulated keel, dorsal midline

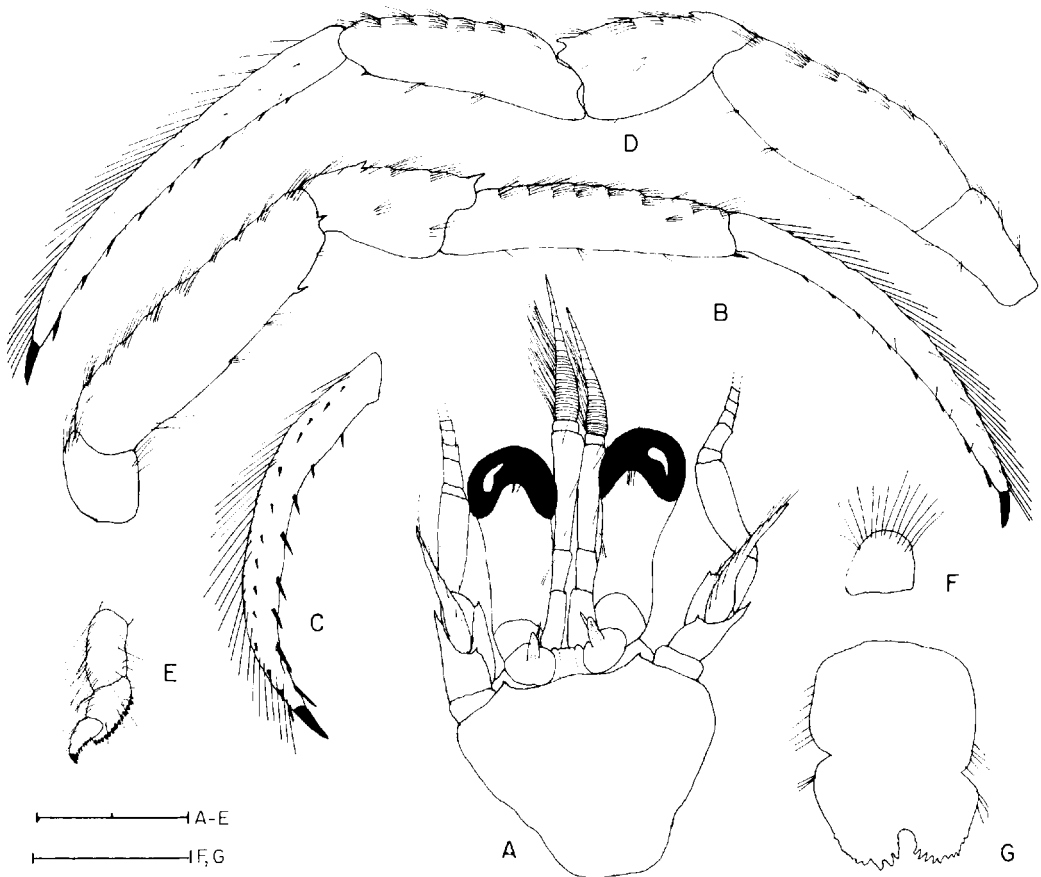


Fig. 1. *Ceratopagurus tricarinatus* (Stimpson, 1858), female, CAS046661. A, Shield and cephalic appendages. B, Right second pereopod, lateral view. C, Dactyl of right second pereopod, mesial view. D, Left third pereopod, lateral view. E, Left fourth pereopod, lateral view. F, Anterior lobe of sternite of third pereopods. G, Telson. Scales equal 2.0 mm. A-E and 1.0 mm, F, G.

and dorsolateral margins each with prominent, elevated and crenulated keel extending onto fixed finger and becoming more spiniform, dorsal surface unarmed except for 1 or 2 small spines at articulation of dactyl and fixed finger; mesial, lateral and ventral surfaces all with short, transverse rows of long stiff setae; cutting edge of fixed finger with row of evenly-spaced small calcareous teeth. Carpus slightly longer than merus; dorsomesial margin with row of moderately small spines, dorsolateral margin with shorter row of somewhat smaller spines practically obscured by tufts of long setae; lateral and mesial faces each with short

transverse rows of long stiff setae, ventrolateral margin with 1 or 2 spines or tubercles distally, ventral margin with transverse, sometimes spinulose ridges and long stiff setae. Merus subtriangular; dorsal margin with few transverse rows of setae; ventrolateral margin with 2 or 3 acute spines, ventrodistal margin with 1 to several small spinules or tubercles, ventromesial margin with 2 or 3 acute spines; lateral and mesial faces with short transverse rows of long stiff setae. Ischium with row of minute spinules on ventral margin and 2 slightly larger tubercles proximally.

Second and third pereopods elongate,



Fig. 2. *Ceratopagurus tricarinatus* (Stimpson, 1858), female, CAS 046661. Left, Left cheliped. Right, Right cheliped. 11× Magnification.

generally similar from left to right. Dactyls at least half again length of propodi; in dorsal view, slightly twisted; in lateral view, slightly curved ventrally; dorsal surfaces each with row of long stiff bristles becoming spiniform in distal half and accompanied by short corneous spines, increasing in size distally, lateral faces with row of very short setae, mesial faces each with row of corneous spinules dorsally, ventral margin proximally and ventromesial margin distally with row of corneous spines, increasing in size distally. Propodi $1\frac{1}{4}$ to twice length of carpi, dorsal margins each with short transverse rows of long setae, ventral margins tufts of setae and corneous spine at distal margin. Carpi $\frac{1}{2}$ to $\frac{2}{3}$ length of meri; dorsal surfaces each with spine at distal

margin and 1 smaller spine in proximal third. Meri with tufts of setae on dorsal and ventral margins, second pereopods also with 1 acute spine on distolateral margin and 1 spine on ventral margin distally. Ischia with few tufts of setae dorsally and ventrally.

Sternite of third pereopods with row of long setae on subquadrate anterior lobe.

Uropods markedly asymmetrical. Telson with transverse suture; posterior lobes with prominent median cleft; terminal margins each with row of small spines extending onto lateral margins.

Distribution.—Japan and Taiwan, to 50 m.

Remarks.—In a report on East Asian decapods, Balss (1913) provided a key to the Japanese species of *Pagurus* (as *Eupagurus*)

which accurately distinguished both *Ceratopagurus tricarinatus* and *Australeremus triserratus*, although the latter species was not mentioned in his species account. Balss did identify a single female from Sagami Bay as *E. tricarinatus*, remarking that Stimpson's (1858) taxon was only a variety of the European species *Eupagurus excavatus* (Herbst). However, his comment that his specimen differed from Stimpson's (1858) description by the presence of a distinct rostral spine led McLaughlin & Gunn (1992) to suspect that Balss's (1913) specimen was actually *A. triserratus*.

Norman (1869) described a new species of hermit crab from the Atlantic Shetland Islands as *Pagurus tricarinatus*, not realizing that the name was preoccupied by Stimpson's Pacific taxon. *Pagurus tricarinatus* sensu Norman was also used by Sars (1885) for a species collected off Norway, and by Hansen (1908) for specimens collected in the North Atlantic. However, A. Milne Edwards & Bouvier (1892) placed Norman's (1869) *P. tricarinatus* in synonymy with *P. excavatus* (Herbst). In contrast, Hansen (1908) thought it might be the senior synonym of *P. variabilis* (A. Milne Edwards & Bouvier). Forest (1955) considered *P. excavatus*, Norman's *P. tricarinatus*, *P. meticulous* Roux, and *P. angulatus* Risso all synonyms of *P. alatus* Fabricius. Gordan's (1956) bibliographic citation of *P. tricarinatus* included authors that were referring to both the Atlantic and Pacific taxa. The confusion over the identities of the Atlantic species was finally resolved by Ingle (1985).

As pointed out by McLaughlin & Gunn (1992), Miyake (1978, 1982) was uncertain about the distinctiveness of *A. triserratus* and *C. tricarinatus*. In his "Anomura of Sagami Bay," Miyake (1978) accurately figured and briefly described *A. triserratus* (as *Pagurus*); however, in his index to the species, he questionably equated it to *C. tricarinatus* (as *Pagurus*). In his subsequent publication on Japanese crustaceans, Mi-

yake (1982) listed the taxon as *P. tricarinatus* [= *P. triserratus*]. Based upon his 1978 description and figure, it appears that Miyake's references to *P. tricarinatus* pertain to *A. triserratus*.

Among Pacific pagurids, *C. tricarinatus* is singularly distinctive. The dorsal crenulated keels of both chelae set it apart from all other described species, although a superficial similarity does exist with the Atlantic species *P. alatus* and *P. excavatus*. All three taxa lack rostrums, have relatively short, stout ocular peduncles, spinose posterior telsonal lobes, and keeled right chelae. However, both Atlantic species have triangular, spinose anterior lobes of the sternite of the third pereopods, grossly unequal chelipeds and lack female paired first pleopods modified as gonopods. There is also a distinct difference in the morphology of the keels between the Atlantic species and *C. tricarinatus*.

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Shannon Point Marine Center, Western Washington University, 1900 Shannon Point Road, Anacortes, Washington 98221-4042, U.S.A.