

Redescription of *Pinnotheres alcocki* RATHBUN, 1909, a Commensal Pea Crab New to Japan

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Abstract Pinnotherid crabs found in the mantle cavity of *Barbatia virescens* (REEVE) from the Seto Inland Sea are identified with *Pinnotheres alcocki* RATHBUN, 1909, which has been unknown from Japanese waters. They agree with the previous notes on the species in the general morphology of carapace, chelipeds and ambulatory legs, but are somewhat different in the hairiness of the ambulatory dactyli.

Commensal crabs of the family Pinnotheridae have been known to form an enigmatic group; their specific classification, especially in the genus *Pinnotheres*, is sometimes very difficult, because their life cycle is complicated, with the simplified morphology caused by the commensal habit mainly with bivalves, and because both sexes are so much different in size and shape as to have been described as different species. Thus, critical evaluation of morphological characters seems required for classifying the members of this family.

The genus *Pinnotheres* from Japan includes only the following 8 species and 1 subspecies (cf. SAKAI, 1976): *P. sinensis* SHEN, *P. sinensis atrinae* SAKAI, *P. parvulus* STIMPSON, *P. cyclinus* SHEN, *P. boninensis* STIMPSON, *P. pholadis* DE HAAN, *P. corbiculae* SAKAI, *P. bidentatus* SAKAI and *P. laquei* SAKAI. It is worth noting that *P. corbiculae* is living in brackish-water bivalve, *Corbicula japonica* PRIME, and *P. laquei* is obtained from brachiopod lamp-shell, *Laqueus rubellus* (SOWERBY), at the depths of 50 to 85 m. Most of the descriptions are based on the females, and the male crab remains unknown on five of them: *P. sinensis atrinae*, *P. cyclinus*, *P. corbiculae*, *P. bidentatus* and *P. laquei*.

The present study on *P. alcocki* RATHBUN from the Seto Inland Sea as an addition to the Japanese carcinological fauna provides 1) a critical examination of the female crab morphology, 2) information on the geographical extension and a new bivalve host, and 3) description of the male crab.

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Family Pinnotheridae

Genus *Pinnotheres* LATREILLE, 1825*Pinnotheres alcocki* RATHBUN, 1909

(Figs. 1, 2 f-h, 3)

Pinnotheres parvulus: DE MAN, 1887, p. 105; 1888, p. 383; BÜRGER, 1895, p. 376, pl. 9, fig. 18, pl. 10, fig. 17.

Pinnotheres parvulus: ALCOCK, 1900, p. 339.

Pinnotheres alcocki RATHBUN, 1909, p. 114; GORDON, 1936, p. 176, fig. 5.

Not *Pinnotheres alcocki*: SAKAI, 1936, p. 197, pl. 56, fig. 5 (= *P. sinensis atrinae* SAKAI).

Material examined. Mukaishima, Hiroshima Pref., Seto Inland Sea; 17 ♀♀ (2.3 × 2.0 ~ 9.6 × 6.5 mm in carapace breadth and length), 1 ♂ (4.2 × 3.7 mm in carapace breadth and length), from *Barbatia virescens* (REEVE) [Jpn. name: Karigane-egai], NSMT-Cr 9363; June 18, 1981, K. KONISHI leg.

Description. Female. Carapace nearly hexagonal rather than trapezoid, with weakly convex anterolateral, lateral and posterolateral angles; dorsal surface not strongly convex in most specimens, being provided with a pair of submedian longitudinal, shallow depressions. Frontorbital border distinctly thickened and almost transverse as a whole together with each anterior border of carapace to anterolateral angles of both sides; front weakly deflexed obliquely downward and slightly protruded forward from general level of frontorbital border, having a median shallow but distinct depression; cornea usually invisible but occasionally distinct in dorsal view; upper orbital border usually transverse or only weakly convex forward and rather distinctly separated from anterior border of carapace, but in some specimens oblique for most of its length and gently continuous with anterior border of carapace.

Chelipeds comparatively heavy and much thicker than ambulatory legs. Merus and proximal half of carpus just fitted to hepatic region below anterolateral angle of carapace. In most specimens the palm is widened distally or the upper border is weakly concave for its proximal half, making a slender appearance of palm. Fingers about half as long as palm and provided with short, soft hairs on inner surfaces and prehensile edges, being armed with a thin triangular tooth near proximal part of movable finger and with two smaller teeth; tips of both fingers tuberculated and confronted with each other with 90° in movable finger and 45° in immovable finger to the long axis.

Ambulatory legs, especially first two pairs, rather stout with compressed meri. Dactyli of first two pairs claw-like and half as long as propodi. Third ambulatory leg similar to the preceding two legs, but the merus is apparently more slender; dactylus variable in its length from about half as long as, to subequal to propodus, but always longer than dactyli of the preceding two legs and shorter than dactylus of the last leg. Last leg much shorter and slender as usual; dactylus equal to propodus in length, being provided with soft hairs of various lengths along its whole inner margin and on one-third of its distal upper surface, and with five spinules on inner margin near the tip.

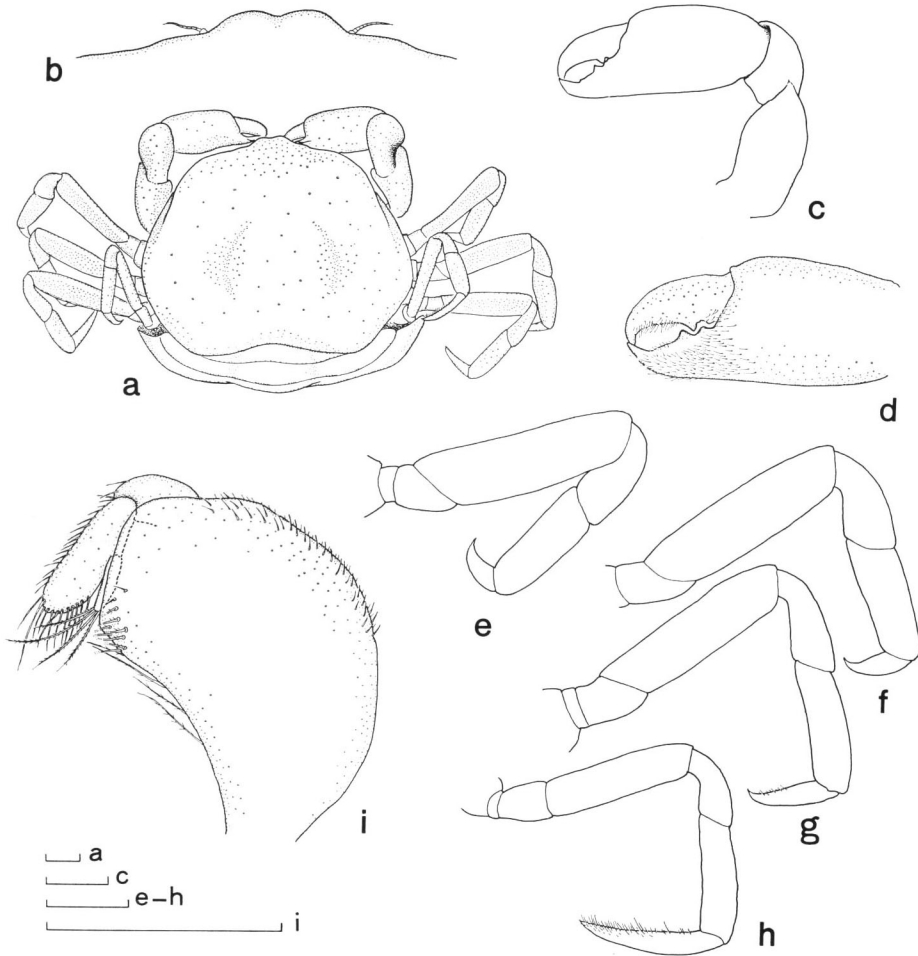


Fig. 1. *Pinnotheres alcocki* RATHBUN, ♀ from Mukaishima, Seto Inland Sea. a, Dorsal view; b, frontal region, enlarged; c and d, right cheliped in outer and inner view, respectively; e-h, first to fourth ambulatory legs; i, left third maxilliped. (Scales represent 1 mm.)

Male. Carapace excluding frontal region is exactly circular, and frontal region protruded forward about 1/5 as long as carapace proper; dorsal surface is evenly but fairly strongly convex in both directions, with very blunt, thick lateral margins along its anterior half; gastro-cardiac separation indicated at each lateral end by a shallow depression, being about 1/3 the breadth of carapace; whole dorsal surface devoid of hairs, with sparse minute pits along entire length of both lateral margins and with some wrinkles along each anterior part of lateral margins. Front directed very weakly downward, dorsally covered with minute pits, and provided with short setae along anterior margin and on dorsal median, shallow depression. In life the carapace was

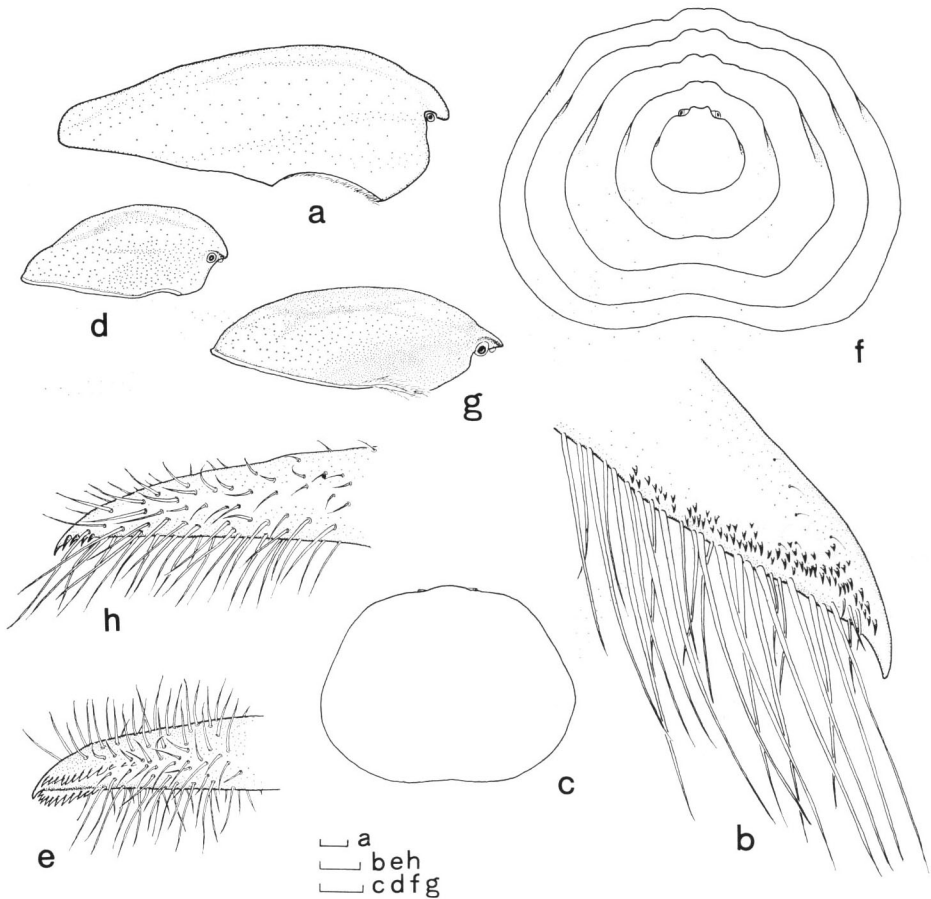


Fig. 2. *Pinnotheres cyclinus* STIMPSON, ♀ from unknown locality. a, Carapace in lateral view; b, tip of fourth ambulatory dactylus.

Pinnotheres sinensis SHEN. c, Carapace of ♀ from China in dorsal view; d, carapace of ♀ from Mukaishima, Seto Inland Sea in lateral view; e, tip of fourth ambulatory dactylus.

Pinnotheres alcocki RATHBUN, ♀♀ from Mukaishima. f, Contour of carapaces of five females in different developmental stages; g, carapace in lateral view; h, tip of fourth ambulatory dactylus. (Scales represent 1 mm.)

covered with chromatophores as represented in the text-figure 3.

Chelipeds and ambulatory legs covered with short setae, especially along margins. Chelae similar to those of female in shape and armature of fingers. First three pairs of ambulatory legs subequal in length and shape; in second and third pairs, each merus provided with long hairs along posterior margin, each carpus with a row of long hairs on its upper surface from basal part of posterior border to distal part of anterior border, and each propodus fringed with a row of long hairs along anterior part as continuation of a row of carpus; dactyli of three pairs not much different from each other, being rather short and subequal to one another. Last pair about 2/3

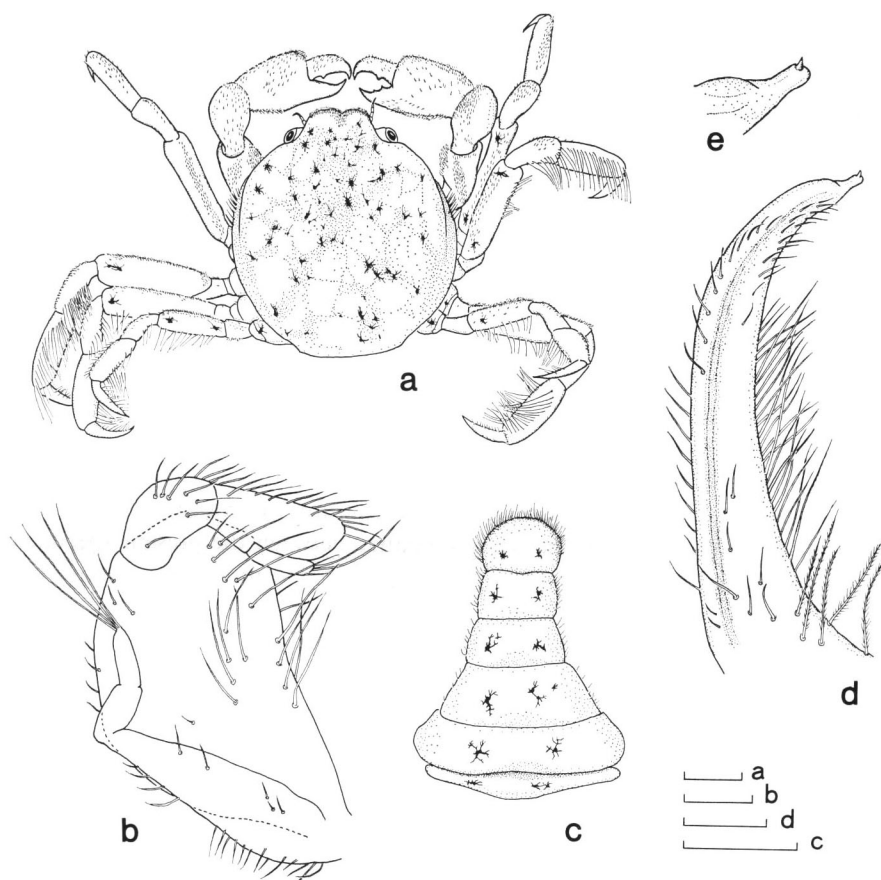


Fig. 3. *Pinnotheres alcocki* RATHBUN, ♂ from Mukaishima, Seto Inland Sea. a, Dorsal view; b, right third maxilliped in inner view; c, abdomen; d, left first pleopod; e, tip of the same, enlarged. (Scales represent 1 mm.)

as long as preceding pairs, with a fringe of long hairs each along posterior margins of merus and propodus; dactylus subequal to those of preceding pairs, but slenderer, and fringed with longish hairs along both margins.

Remarks. Chiefly based on the subtrapezoid shape of the carapace widening posteriorly, with the concave posterior border, the female specimens at hand were preliminary identified as *Pinnotheres cyclinus* which was originally described by SHEN (1932) and subsequently recorded by SAKAI (1939, 1976), KAMITA (1941) and KIM (1970, 1973, 1985). According to SHEN, *P. cyclinus* is distinguished from *P. sinensis* which was also described by him in the same publication, by the fourth ambulatory dactylus being fringed with longish hairs only along the inner margin, and also by the dactylus of the third maxilliped being extended to the extremity of the penultimate segment. He did not include the shape of the carapace in the diagnosis of *P. cyclinus*,

but the carapace is explained by sentences such as "Carapace slightly broader than long, broadest at bases of second legs," and "Antero-lateral angle of carapace is rounded," and also "Front deflexed, . . . more projected beyond the antero-lateral angle of carapace." SAKAI (1939) recorded several specimens from Japan and Korea. According to his diagnosis, the carapace is "somewhat narrower and trapez-form in outline," with "less markedly arcuate" anterolateral borders and "weakly angular" shoulders. KAMITA (1941) and KIM (1973) redescribed, with figures, additional specimens from Korea. KAMITA's paper written by the Japanese includes the important information about the variability of the third maxilliped. He mentioned that the dactylus rarely extends to the tip of the propodus, in contrast with the original author who considered the extension of the dactylus to the tip of the propodus as one of the specific characters. In the present specimens the general shape of the carapace agrees with the figure given by KAMITA except for the concave frontal margin. The frontorbital morphology agrees well with one of the photographs given by KIM, being thickened along the margin.

It is, however, mentioned here that the armature and hairiness of the last ambulatory dactylus show the distinctive discrepancy between the present specimens and a female found in the mantle cavity of a Japanese common clam from unknown locality, the latter of which seems to be typical *P. cyclinus*. As is figured (Fig. 2a-b), in the specimen identified with *P. cyclinus*, the dactylus is fringed with long hairs and numerous spinules on and along the inner margin, respectively. And, also as is figured for comparison (Fig. 2c-e), in *P. sinensis*, the dactylus is covered with long hairs on the whole surface and with two rows of spinules on the inner margin near the distal end. In the present specimens, as already mentioned, the dactylus shows the intermediate condition between the two species, being provided with longish hairs along the inner margin and shorter hairs on the upper surface and with some spinules near the distal claw.

The armature and hairiness of the ambulatory dactyli of the present specimens seem to be close to those of *P. sinensis atrinae* described by SAKAI (1939) on a female from the Kii Peninsula which was previously identified with *P. alcocki* by himself in 1936. This subspecies known only by the type specimen is distinguished from the full species by the different armature of the last ambulatory dactylus and also by the different shape of the carapace being less markedly divergent posteriorly, with the straight posterior border. A change of the carapace contour is shown with a series of the developmental stages in the specimens at hand (Fig. 2f); the most remarkable fact is that the posterior border of the carapace is almost straight or very weakly concave in the juvenile and young specimens, but shows a distinct concavity in the large specimens. All the present specimens with different stages differ from this subspecies in the shape of the carapace. It seems that SAKAI (1976) incorrectly synonymized his record of *P. alcocki* with *P. sinensis*.

On the other hand, in describing a new species, *P. tivelae*, GORDON (1936) figured the third maxilliped, the chela and the third and fourth ambulatory dactyli of *P.*

alcocki for comparison. Although she mentioned only the proportional difference of the third and fourth ambulatory dactyli in the two species, it is apparent that in one of her figures the fourth ambulatory dactylus is fringed with long hairs on the inner margin and armed with some spinules near the tip. GORDON herself used this character to distinguish *P. tivelae* and *P. alcocki* from *P. spinidactylus* and *P. similis* in the key. The hairiness of the fourth dactylus in the specimens at hand is somewhat different from that of *P. alcocki* figured by GORDON, but the shape of the carapace indicates the close affinity to, or identity with *P. alcocki*.

RATHBUN (1909) only proposed a substitute name for *Pinnotheres parvulus* recorded by DE MAN (1887, 1888), BÜRGER (1895) and ALCOCK (1900), without type designation. In this study the specimens from foreign localities were not examined for comparison, so that the present authors refrained from designating the lectotypes which must be selected from the specimens studied by the above authors.

As is well known, it is rather difficult to distinguish the related *Pinnotheres* species only by the shape of the carapace, but the armature of the fourth ambulatory dactylus is useful as one of the distinguishing characters. In the systematics of the *Pinnotheres* species, otherwise, it is generally recognized that the relative length of the ambulatory dactyli is useful to distinguish the species from the others. Among the specimens at hand, however, there are some females having asymmetrical dactyli like the cases extensively discussed by GORDON (1936) and subsequently mentioned by SAKAI (1939), GRIFFIN and CAMPBELL (1969) and TAKEDA and NUNOMURA (1976). GRIFFIN and CAMPBELL mentioned an asymmetrical specimen of *P. spinidactylus*, each side of which was keyed out to a different species using the key constructed by TESCH (1918). In the specimens at hand the dactylus of the third pair is variable in the length, but fortunately, as already mentioned, always longer than that of the second pair and shorter than that of the fourth pair, so that there is no problem in using TESCH's key.

Host. In the rocky shore in front of the Mukaishima Marine Biological Station, Hiroshima University, *Mytilus edulis* (LINNAEUS) [Murasaki-igai] is commonly found, and many shells are inhabited by *Pinnotheres sinensis* SHEN [Ooshiro-pinno] or *P. pholadis* DE HAAN [Kagizume-pinno]. All the specimens recorded as *P. alcocki* in the present paper were found only in *Barbatia virescens* (REEVE) [Karigane-egai], and no specimen was obtained from *Mytilus*. SCHMITT *et al.* (1973) enumerated *Chlamys farreri* PRESTON [Azumanishiki], *Crassostrea gigas* (THUNBERG) [Magaki], *Meretrix lusoria* (RÖDING) [Hamaguri], *Modiolus auriculatus* (KRAUSS) [Hibarigai], *Mytilus coruscus* GOULD [Igai], *M. edulis*, *Ruditapes philippinarum* (A. ADAMS et REEVE) [Asari] and *R. variegatus* SOWERBY [Hime-asari] as the host bivalves of *P. sinensis*, and *Barnea manilensis* (PHILIPPI) [Niogai], *Chlamys farreri*, *C. nobilis* (REEVE) [Hiougi], *Crassostrea gigas*, *Mactra chinensis* PHILIPPI [Bakagai], *Meretrix lusoria*, *Mytilus edulis*, *Pecten albicans* (SCHRÖTER) [Itayagai], *Spisula sachalinensis* (SCHRENCK) [Ubagai] and *Ruditapes philippinarum* as the host bivalves of *P. pholadis*.

Distribution. This species has hitherto been known from the Mergui Archipelago, some localities in Indonesian waters, and Burias, the Philippines.

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