NOTE ON CRABS OF THE GENUS *ECHINŒCUS* RATHBUN LIVING COMMENSALLY WITH ECHINOIDS (PARTHENOPIDAE, EUMEDONINAE)

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NOTE ON CRABS OF THE GENUS ECHINŒCUS RATHBUN LIVING COMMENSALLY WITH ECHINOIDS (PARTHENOPIDAE, EUMEDONINAE)[1]

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THREE TEXT-FIGURES

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Echinœcus is a genus established by Rathbun in 1894, but no carcinologist, except Ward, has since accepted the genus as valid. It is closely related to *Eumedonus* in morphological characters. They differ however from each other in three respects. The rostrum is single-lobed in *Echinœcus*, while it is divided into two lobes in *Eumedonus*. The antero-lateral angle in *Echinœcus* is not produced, but in *Eumedonus* it is produced strongly. The eyes of *Echinœcus* are small whereas *Eumedonus* has large eyes. Bouvier, Seurat and Gravier have all suggested that *Eumedonus* should be divided into two groups on the basis of morphological characters.

Moreover, most of the members of the genus *Echinœcus* have been found in association with Echinoids. Though this character appears to me to possess little generic importance I regard *Echinœcus* as a distinct genus from all the other genera of the subfamily Eumedoninae in the characteristics enumerated above.

As to the condition of the association which will be described in this paper I have attempted to divide it into two groups. In one group females usually live alone in the anal tube of Echinoids protected from any outside danger. They are well supplied with food through the activities of their host. The males probably swim freely, as Bouvier and Seurat pointed out. Those of the other group live among spines of Echinoids. The commensalism in the former case may be called semiparasitic, whereas in the latter the crabs doubtless take advantage of shelter among the spines.

I wish to express my hearty thanks to Prof. Hiroshi Ohshima, who

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kindly revised the manuscript. I am also indebted very much to prof. H. Ohshima, Mr. Hayato Ikeda and Mr. Koichiro Yasumoto, for their kind assistance in getting type specimens of *E. petiti nipponicus* nom. nov. My thanks are specially due to Mr. H. Ikeda who kindly collected for me the topotype specimen of *E. rathbunæ* nom. nov.; and the Echinoids dealt with in the present paper have been identified by him. Furthermore I am greatly obliged to Messrs. Tadao Hama, Ituo Kubo and Tune Sakai for their kind hels in the matter of literature.

I. SYNOPSIS OF ALL THE SPECIES OF *ECHINŒCUS*

1. *Echinœcus pentagonus* (A. Milne-Edwards)

Eumedon pentagonus A. Milne-Edwards 1879, pp. 104–105—Mauritius (Type-locality).
Eumedon pentagonus Bouvier et Seurat 1905, pp. 629–631—New Guinea.
Eumedonus pentagonus Gravier 1922, pp. 484–486—No new locality.

1. Carapace including rostrum longer than broad.
2. Apex of rostrum slightly emarginated.
3. Carapace ornamented with regional grooves slightly.
4. It is not known whether the eyes are concealed or not by the carapace; as nothing is mentioned of it in the original paper.
5. Distal margin of merus of the ambulatory leg produced much above the upper margin.
6. Dactylus of the ambulatory legs furnished with hairs on the posterior margin.
7. Host and habitat unknown.
8. Colours or marks on the carapace are not described.

2. *Echinœcus rathbunæ* nom. nov.

I shall describe this species in detail later on.

3. *Echinœcus rathbunæ convictor* (Bouvier et Seurat)

Eumedon convictor Bouvier et Seurat 1905, pp. 629–631—Gambier Island (Type-locality).
Eumedon convictor Gravier 1922, pp. 484–486—No new locality.

1. Measurements of the carapace not given.
2. Apex of rostrum not emarginated.
3. Carapace smooth and has branchial regions with irregular depressions.
4. Eyes concealed by the carapace.
5. Distal margin of merus of the ambulatory legs normal and not produced.
6. Dactylus of the ambulatory legs without hairs.

7. Host: *Echinothrix diadema* (Linnaeus) [=*Echinothrix turcarum*]. Female of this species lives alone in the anal tube of the named sea-urchin. Male unknown.

8. Surface of the carapace is of a dark violet colour uniformly. *Remarks*: This form differs from *E. rathbunae* in one respect only (§ 5). This difference appears to me as a mere local or individual variation.

4. *Echinoecus petiti* (Gravier)

Eumedonus petiti Gravier 1922, pp, 484-486—Madagascar (Type-locality).

1. Measurements of carapace unknown.
2. Apex of rostrum not emarginated.
3. Surface of the carpace smooth, without regional groove.
4. Eyes visible from above in the male, but concealed by the carapace in the female.
5. Distal margin of merus of legs produced much above the upper margin.
6. Dactylus of the ambulatory legs furnished with hairs on posterior margin.
7. Host: Diadematidae. Both sexes of this species live commensally with the Echinoids of the family just mentioned; they live free-swimming sheltered among spines of the sea-urchins.
8. In the male the dorsal surface of the carapace is marked longitudinally with subparallel bands which are convergent anteriorly. In the female besides these bands the carapace is margined with a whitish stripe on the anterior border.

5. *Echinoecus klunzingeri* nom. nov.

Liomedon pentagonus Klunzinger 1906, p. 57, Pl. 2, figs. 1 1a-d—Red Sea (Type-locality).

1. Carapace including rostrum longer than broad.
2. Apex of rostrum not emarginated.
3. Carapace smooth, without regional groove.
4. Eyes scarcely visible from above.
5. Distal margin of merus of the ambulatory legs normal, not produced.
6. Dactylus of the ambulatory legs furnished with hairs on the posterior margin.
7. Host and habitat unknown (not described).
8. This species has the same patterns as the female of *E. petiti* has on the carapace.

6. *Echinœcus petiti nipponicus* nom. nov.

This form is described in detail in the following pages.

II. NOTE ON SYNONYMY OF THE GENUS *ECHINŒCUS* RATHBUN

Echinoecus Rathbun 1894, p. 66; 1906, p. 880; Ward 1934, p. 7.
Eumedon A. Milne-Edwards 1879, p. 104; Bouvier et Seurat 1905, p. 629.
Liomedon Klunzinger 1906, p. 57.
Eumedonus Balss 1922, p. 137; Gravier 1922, p. 484; Flipse 1930, p. 98; Sakai 1936, p. 113; 1938, p. 249; Miyake 1937, p. 29.

The name *Echinœcus* was established by Rathbun, and the diagnosis of the genus she gives is as follows:

"Carapace subpentagonal, very convex in the antero-posterior direction. Rostrum triangular, flattened horizontally, strongly deflexed. Eyes small, in circular orbits, concealed by the carapace and situated at the indentation formed by the meeting of the anterolateral and rostral margin. Antennæ very small, covered by the rostrum, the basal segment narrow. Maxillipeds with the merus notched at its antero-internal angle. Abdomen of female with seven segments. Legs short."

A. Milne-Edwards described *Eumedon pentagonus* which doubtless belongs to *Echinœcus*. But the name of *Eumedon* is obviously synonymous with *Eumedonus* H. Milne-Edwards (1834, p. 349).

Bouvier et Seurat described a specimen from Gambier Island under the name of *Eumedon convictor*. This form is closely related to *Echinœcus rathbunæ* nom. nov. [=*Echinœcus pentagonus* Rathbun 1894] by the following characters.

1. Par son rostre plus étroit et totalement dépourve d'échancrure terminale.

2. Par sa carapace un peu convexe dorsalement, assez irrégulière, à peu près lisse, et dépourve en tout cas des ponctuations nombreuses et fortes qui caractérisent l'*E. penctagonus* [=*Echinœcus pentagonus* (A. Milne-Edwards)].

3. Par la position de ses pédoncules oculaires qui, au lieu d'atteindre les bords de la carapace, sont francement ventraux et absolument cachés quand on examine le Crabe par la face dorsale.

4. Par ses pattes ambulatoires fort peu comprimées, dépourvues d'angle saillant sur le bord antériur du méropodite et à peu près démunies de poils dans toute leur étendue, même sur la région des doigts.

Eumedon convictor is distinguished from *Echinœcus rathbunæ* in only one respect which is mentioned by Bouvier et Seurat in the article 4 cited above. The dactylus of the ambulatory legs in *Eumedon con-*

victor is not furnished with hairs, but in *Echinœcus rathbunæ* it is furnished with hairs thickly. This character appears to me to possess no specific importance, so that I regard the former as a subspecies (*Echinœcus rathbunæ convictor* new combination) of the latter.

Liomedon pentagonus klunzinger is also to be included in the genus of *Echinœcus* judging by his original description and accurate figures.

Gravier regarded his *Eumedonus petiti* (*Echinœcus petiti* new combination) as a species distinct from *Echinœcus pentagonus* (A. Milne-Edwards).

Balss and Flipse have transferred the genus to *Eumedonus*, but so far as I know, they have not explained in detail their reasons for doing so.

Ward recently described the genus *Prœchinœcus*. It is allied to the genus in question, but is readily distinguishable from the latter by the following characters as he pointed out:

1. Carapace flat. 2. Rostrum broadly triangulate, concave horizontally; not strongly deflexed. 3. Eyes of normal size; not concealed by the carapace. 4. The lateral margins and the rostral margins are broken by the orbit but the broadly triangulate outline of the carapace is retained.

In my previous paper I identified the specimen from Danjo Islands with Rathbun's species *Eumedonus pentagonus*. But after careful re-examination I am now convinced that the Japanese specimens are not identical with Rathbun's but are to be regarded as a subspecies of *Echinœcus petiti* (*Echinœcus petiti nipponicus* nom. nov.).

Echinœcus is distinguished from *Eumedonus* by the following characters:—

Carapace subpentagonal, convex from front to back. Antero-lateral angle not prolonged. Rostrum triangular. The tip of rostrum not divergent. Eyes very small.

Thus I deem it quite safe to regard *Echinœcus* as a distinct genus from the other genera in the Eumedoninae.

Genotype: *Echinœcus rathbunæ* nom. nov. (*Echinœcus pentagonus* Rathbun 1894, p. 66).

III. KEY TO THE SPECIES OF THE GENUS *ECHINŒCUS*

A. Eyes concealed by the carapace. Distal margin of merus of the ambulatory legs normal, not produced.

B. Branchial regions of the carapace ornamented with irregular

depressions. Upper surface of the carapace of uniform dark colour. Female lives alone in the anal tube of Echinoids.

C. Dactylus of the ambulatory legs furnished thickly with short hairs.....*E. rathbunae* nom. nov.

C'. Dactylus of ambulatory legs without hairs.....*E. rathbunae convictor*

B'. Carapace glabrous, without regional groove and ornamented with peculiar patterns on the upper surface...*E. klunzingeri* nom. nov.

A'. Eyes visible from above. Distal margin of the ambulatory legs produced much above the upper margin. Dactylus of the ambulatory legs furnished thickly with short hairs.

D. Upper surface of the carapace ornamented with regional groove slightly, without coloured marks. Carapace longer than broad .....*E. pentagonus*

D'. Upper surface of the carapace glabrous, without regional groove. Carapace ornamented with the said patterns on the upper surface.

E. Eyes concealed by the carapace in female only. The patterns of the carapace differ from each other in both sexes...*E. petiti*

E'. Eyes can be seen from above in both sexes. The said patterns of the carapace are the same in both sexes. Carapace broader than long (seldom equal).....*E. petiti nipponicus* nom. nov.

IV. DESCRIPTIONS OF THE JAPANESE SPESIES OF *ECHINOECUS*

1. *Echinoecus rathbunae* nom. nov.

Text-fig. 1. A; 2. A_{1-2}; 3. A_{1-2}.

Echinoecus pentagonus Rathbun 1894, p. 66—Port Lloyed, Bonin Islands (Type-locality).
Echinoecus pentagonus Rathbun 1906, p. 880, text-fig. 37—Modu Mann, Hawaii Islands.
Eumedonus pentagonus Balss 1922, p. 137—No new locality.
Eumedonus pentagonus Flipse 1930, p. 98—No new locality.

Material examined. One female; Hutami Harbour, Ogasawara Islands; living commensally in the anal region of *Phyllacanthus dubius* Brandt, about 100 fathoms deep; collected by Mr. H. Ikeda, in August 1936.

Description of topotype. Carapace subpentagonal, longer than broad including the rostrum, and convex from front to back. Antero-lateral angle rounded. Postero-lateral margin straight, forming oblique angles. Upper surface of the carapace appears to be smooth and glossy to the

naked eye, but punctate under a magnifying lens. Rostrum triangular forming a concavity on the upper surface. There is no groove delineating the regions. There is an irregular depression in the metabranchial region. A few tubercles are elevated in that area. According to Rathbun there are in the holotype seven or eight small tubercles on the cardiac region, but in our specimen there is no tubercle. Eyes very small; orbits rounded. Ventral surface punctate.

A B

Text-fig. 1.—A. *Echinœcus rathbunæ*, female in dorsal view, ×2.
B. *Echinœcus petiti nipponicus*, female in dorsal view, ×2.

Chelipeds equal; ischium armed with one blunt, thin-edged tooth on the antero-internal angle. Merus trigonal, widened distally. Merus furnished with two teeth. One of them small, acute on distal edge of the inner margin, the other blunt but stout on subdistal edge of the upper margin. There are two teeth on wrist; one on subdistal edge of the inner margin, the other on subproximal edge of upper margin. Palm compressed, widened distally; distal end of upper margin produced much above the dactylus. The fingers small and stout. There is no gap between them. Two or three smooth edges are to be seen on outer surface of the fingers.

Ambulatory legs unarmed and slightly compressed. Distal end of merus not produced on upper margin. Dactylus furnished with thick short hairs. Tips of dactylus curved, horny and exceedingly acute.

Colour in life. Carapace is uniformly of a dark violet colour on both dorsal and ventral sides. Abdominal surface is pale brown with a brown stripe running transversely on each segment. The dorsal surface of the cheliped and legs are blackish violet. Ventral face of pale brown colour.

Measurements (in mm).

Length of carapace	11.0
Maximum width of carapace (at antero-lateral angle)	9.7

Posterior width of carapace	6.5
Width at orbits	4.0
Length of rostrum	3.0
Length of cheliped	11.5
Lower margin of propodus	5.3
Greatest depth of propodus	3.0
Length of first ambulatory leg	11.0
Length of second ambulatory leg	11.0
Length of third ambulatory leg	10.5
Length of fourth ambulatory leg	10.5

Habitat. The female of this species is commensal, living in the anal region of *Phyllacanthus dubius* Brandt. Rathbun described in her original paper that the female was found in the anal tube of *Echinothrix calamaris* (Pallas). According to Mr. Ikeda's observation made during his Ogasawara Expedition in 1935 a female of this species was found, living in the anal tube of *Echinothrix calamaris.*

Distribution. Ogasawara Islands [=Bonin Islands] (Rathbun, Miyake); Hawaii (Rathbun).

2. *Echinoecus petiti nipponicus* nom. nov.

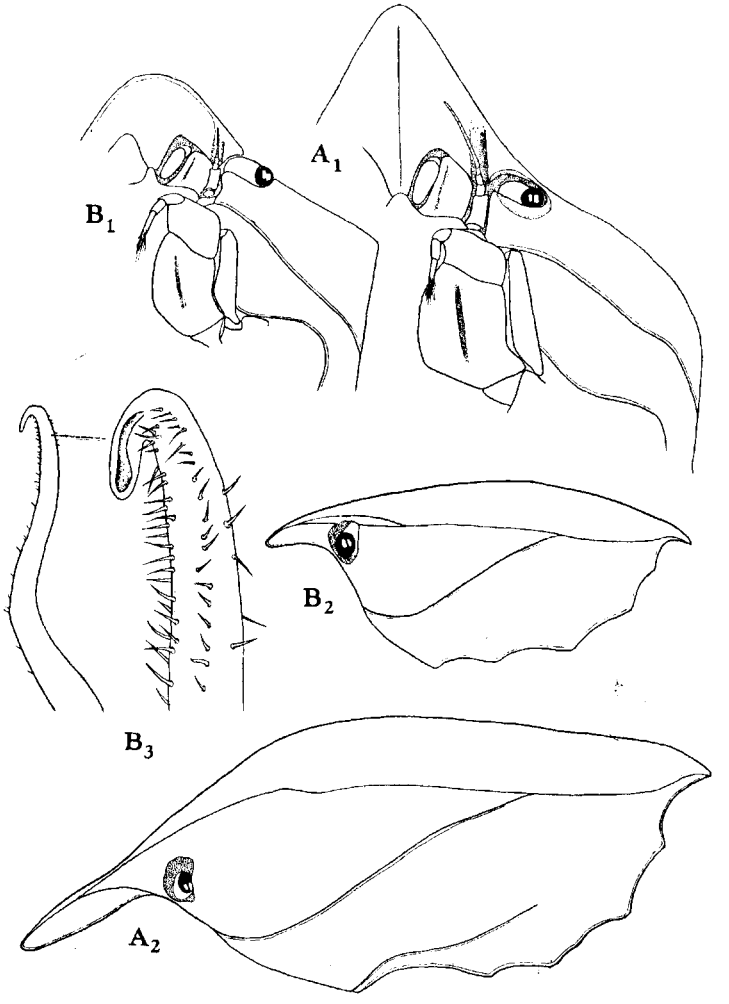
Text-fig. 1. B; 2. B$_{1-2}$; 3. B$_{1-3}$.

Eumedonus pentagonus Sakai 1936, p. 113, Pl. 30, fig. 2—Simoda.
—— Miyake 1937, p. 29, text-fig. 3—Mesima, Danjo Islands.
—— Sakai 1938, p. 349, Pl. 33, fig. 3—No new locality.

Types. Holotype, male; allotype, female; two paratypes, females; collected at Okinosima (Long. 130°06′ E, Lat. 34°15′ N) by the Second Okinosima Expedition during May 19–29, 1933. These type specimens are all deposited in the Zoological Laboratory, Kyūsyū Imperial University, Hukuoka.

Description. Carapace including rostrum subpentagonal, broader than long. Dorsal surface of carapace slightly convex longitudinally and appears as glabrous to the naked eye, but punctate when magnified. Rostrum short, triangular with apex rounded, slightly deflexed downward. The antero-lateral angle formed by the meeting of antero-lateral and postero-lateral margins sharp or angular. Postero-lateral margins slightly convergent distally. Eyes very small, but can be seen entirely from above. Antenna very short and concealed by rostrum.

Chelipeds equal, short and punctate; ischium with a minute tooth on inner margin; merus trigonal, widened distally, with two stout teeth on subdistal margin. One is on inner margin, the other on upper margin. Wrist with two teeth, one is on inner margin, the other on upper margin. Palm deep; its distal end of upper margin produced much above the dactylus. Fingers short, without gap between them. Ambulatory legs compressed; distal end of merus produced much



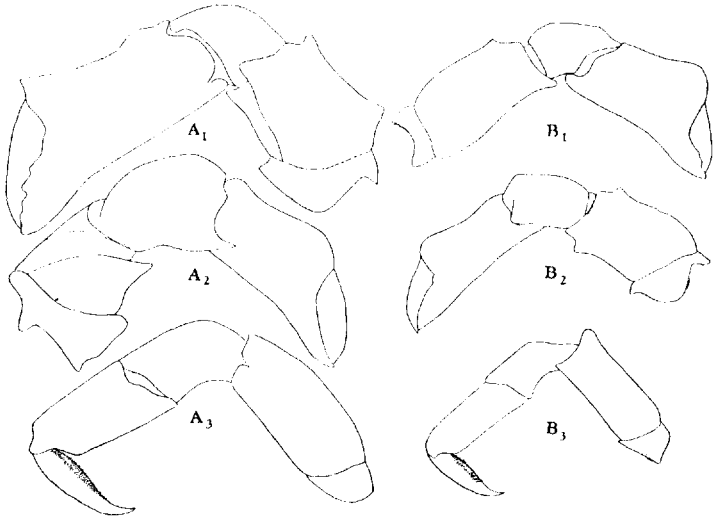
Text-fig. 2.—A. *Echinœcus rathbunæ*, female. 1. ventral view of anterior half, ×18. 2. lateral view of carapace, ×18. B. *Echinœcus petiti nipponicus*, male. 1. ventral view of anterior half, ×18. 2. lateral view of carapace, ×18. 3. anterior appendage and apex of the same, further enlarged, ×13.3 and 60.

above the upper margin. Dactylus hairy beneath, terminating in a single claw.

Abdomen in both sexes with seven segments.

Remarks. This species is allied to the preceding species, but they differ from each other in the following characters.

E. Rathbunae	*E. petiti nipponicus*
1. Eyes concealed by rostrum.	1. Eyes visible from above.
2. Antero-lateral angle of carapace rounded.	2. Angular.
3. Carapace longer than broad.	3. Carapace broader than long.
4. Rostrum long.	4. Rostrum short.
5. Distal margin of merus of ambulatory legs normal.	5. Distal margin produced much above upper margin
6. Carapace without marks on upper surface, but of a uniform colour.	6. Transverse band present on anterior margin and two longitudinal bands in posterior half.



Text-fig. 3.—A. *Echinœcus rathbunæ*, female. 1. lower surface of left cheliped. 2. upper surface of the same. 3. lower surface of first ambulatory leg. B. *Echinœcus petiti nipponicus*, female. 1. lower surface of right cheliped. 2. upper surface of the same. 3. upper surface of first ambulatory leg (all×9).

Colour in life. Dorsal surface of carapace dark violet, ornamented with whitish peculiar patterns. Carapace margined by a stripe on the anterior border; two logitudinal bands run parallel with each other to become convergent anteriorly in posterior half of the carapace. Ventral surface whitish.

Measurements of types (in mm). No. 1, male (holotype), No. 2, female (allotype), Nos. 3-4, females.

	1	2	3	4
Length of carapace including rostrum...	6.4	7.0	6.8	5.2
Width of carapace	6.7	7.3	7.0	5.4
Width of orbits	3.6	3.9	4.0	3.0

Habitat. Found free-swimming at rocky shores at Okinosima and Mesima. According to Mr. Sakai this species lives commensally with *Heliocidaris crassispina* (A. Agassiz) [=*Acanthocidaris crassispina*] at Simoda, Prov. Izu. The commensalism in this spcies seems to me to be in such an extent that the crabs only obtain the benifit of shelter.

Distribution. Japan: Simoda, Prov. Izu (Sakai); Okinosima, Hukuoka-Ken (new record); Mesima, Danjo Islands, Nagasaki-Ken (Miyake).

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