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The Genera *Platorchestia* and *Demaorchestia* (Amphipoda, Talitridae, Talitriinae) from Seashores of Japan

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Abstract: Seventy-three male specimens of "*Platorchestia platensis*" from Japan were inspected on 13 morphological characters. Most characters revealed high variation. The coxa and propodus of gnathopod 2 and the carpus of pereopod 7 indicated that the specimens comprised two species: *Platorchestia pacifica* Miyamoto and Morino, 2004 and *Demaorchestia joi* (Stock and Biernbaum, 1994) sensu lato. Both species were rediagnosed. *Demaorchestia hatakejima* Lowry and Myers, 2022 was synonymized to *P. pacifica*. A key to allied species in *Platorchestia* and *Demaorchestia* from Japan and the surrounding countries was given.

Keywords: *Platorchestia; Demaorchestia;* intraspecific variation; Japan

1. Introduction

To provide the background of the present study, a brief history of the taxonomy on the sea-shore "*Platorchestia*" species from Japan and the surrounding countries are reviewed in the first place. Until the beginning of the 1980s, *Orchestia platensis* Krøyer, 1845 had been recognized as a common seashore talitrid species occurring worldwide[1–3]. In Japan, Iwasa [4] is the first which documented this species with description and illustrations based on specimen(s) from "Birô" (= Hiro'o) in Hokkaido, northern Japan. After that, Stephensen [5] studied amphipod specimens forwarded from a Japanese scientist for identification, and described specimens of *O. platensis* from the coast of Mie, central Japan. Morino [2] again described *O. platensis* with figures on the basis of specimens from Tanabe Bay, Wakayama, central Japan. He recorded this species from seashores throughout Japan, from Hokkaido to Okinawa.

Bousfield [6] revised the concept of the family Talitridae, as well as several component genera from the North Pacific region. He introduced new taxonomic characters to reflect natural (phyletic) species groupings and established new genera, one of which was the genus *Platorchestia.* This genus received six species of the genus *Orchestia* (*P. platensis, P. crassicornis* (Derzhavin, 1937), *P. pachypus* (Derzhavin, 1937), *P. japonica* (Tattersall, 1922), *P. zachsi* (Derzhavin, 1937), and a new species *P. chathamensis*). *Platorchestia crassicornis* was resurrected by Bousfield [6], which was originally described as a new species of the genus *Talorchestia* from Russian coast and had long been synonymized with *O. platensis* (see Bulycheva [7]). Bousfield [6] identified the Morino's specimens of *O. platensis* (from Wakayama) to *P. crassicornis,* though the diagnosis of *P. crassicornis* revised by Bousfield [6] was problematic, since it was not strictly concordant with the original description.

Jo [8] critically studied the specimens of the Talitridae from the Korean coasts and recognized four species; three of them belonged to *Platorchestia* (*P. crassicornis*, *P. pachypus*, and *P. munmui* new species). Jo [8] tackled with the taxonomic confusion between *P. crassicornis* and *P. platensis* by comparing specimens from the Korean coast (*P. crassicornis*) and those from the Atlantic coasts (*P. platensis*). He confirmed distinction between *P. crassicornis* and *P. platensis* and revised the diagnoses of both species. Jo [8] identified all the specimens of *O. platensis* described by Iwasa [4], Stephensen [5] and Morino [2] to *P. crassicornis*, and regarded *P. platensis* as a species geographically restricted to the Atlantic coasts.

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Miyamoto and Morino [9], in a study of the Talitridae from Taiwan, revised the genus *Platorchestia*, proposing three subgroups defined by the degree of sexual dimorphism. They described a new species from the seashore with the name of *Platorchestia pacifica*, and redescribed *P. joi* (Stock and Biernbaum, 1994)(= proposed name for homonymous *P. crassicornis* (Derzhavin, 1937)). These two species, together with *P. platensis*, *P. pachypus* and *P. munmui* composed one of the three subgroups, suggesting close relationships among the five species. Miyamoto and Morino [9] identified Morino's specimens to *P. pacifica* and Iwasa's specimens to *P. joi.*

Serejo and Lowry [10] described a new species, *Platorchestia paraplatensis*, from the Southwestern Australia. They compared the new species with *P. platensis* (the paralectotypes from Uruguay) and *P. pacifica* (original description), and summarized characters to discriminate the three species. Serejo and Lowry [10] pointed out the possibility that specimens of *P. platensis* from European coasts (studied by Jo [8] and Miyamoto and Morino [9]) belong to a different species than that from Uruguay.

Kim and Min [11] recorded *Platorchestia monodi* (Mateus, Mateus and Afonso, 1986) from the seashore and river mouth of Korea. This species was originally described from the Azores in the North Atlantic. Recently Lowry and Myers [12] recognized the Korean material of *P. monodi* as a distinct species, for which they erected a new species, *Platorchestia koreaensis*.

Kim, Jung and Min [13] described a new species, *Platorchestia parapacifica*, based on specimens collected from the beaches in Korea, which resembled *P. pacifica, P. platensis* and *P paraplatensis*. Kim, Jung and Min [13] gave a morphological character matrix to distinguish eight *Platorchestia* species (*P. parapacifica, P. pacifica, P. joi, P. munmui, P. platensis,P. paraplatensis, P. ashmoleorum,* and *P. monodi* (= *koreaensis*)).

Lowry and Myers [12] established the subfamily Platorchestiinae to accommodate 15 genera, including *Platorchestia*. This treatment is a follow-up of Myers and Lowry [14], in which they performed a morphological cladistical analysis and proposed new categories at family level (epifamilies and subfamilies) to classify 117 genera of the Talitridae. Lowry and Myers [12] also instituted three new genera (*Cocorchestia, Demaorchestia, Insularorchestia*) in the Platorchestiinae. *Demaorchestia* Lowry and Myers, 2022 consists of five species (*D. parapacifica*, *D. hatakejima* new species, *D. mie* new species, *D. joi* and *D. pseudojoi* new species). Among these five species, the following three species are based on the descriptions of specimens from Japan or Taiwan. *Demaorchestia hatakejima* Lowry and Myers, 2022 is based on the description of *O. platensis* from Wakayama by Morino [2]; *D. mie* Lowry and Myers, 2022 is of *O. platensis* from Mie by Stephensen [5]; and *D. pseudojoi* is of *Platorchestia joi* from Taiwan by Miyamoto and Morino [9].

Myers and Lowry [19] revisited the genus *Platorchestia* based on the species documented from beaches on Atlantic Ocean and the associated seas. They described five species, among which four are new to science.

In summing up these references, two species of *Platorchestia* (*P. pacifica* and *P. pachypus*) and three species of *Demaorchestia* (*D. hatakejima, D. joi,* and *D. mie*) are recorded in the seashore of Japan. Judging from their geographical affinity, *Platorchetia munmui* (Korea), *P. koreaensis* (Korea), *Demaorchestia pseudojoi* (Taiwan), and *D. parapacifica* (Korea) retain possibilities to be found from Japan. However, no rigorous treatment with the current concepts on the "*Platorchestia platensis*" species group has so far been conducted on specimens from Japan (see Morino [15]).

As mentioned above, drastic revisions of the Talitridae were initiated by Bousfield [1], whose material were mainly from the North Pacific, and were most recently done by Lowry and Myers [12] on the extensive data base. These revisions were performed often through utilization of newly introduced morphological characters. Some taxonomical judgements in these revisions were based on the description and illustrations published in those days of previous concepts. This method of iconography is inevitable in comprehensive taxonomical review works. Therefore, as a next step to these reviews, their conclusions are to be confirmed based on the specimens. Secondly, size-dependent characters have been adopted in these studies, e.g., antennal incrassation and the shape of the palm on male gnathopod 2. These characters will be more reliable if the character states are

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informed with the body size (see Myers and Lowry [19]). Also, the indication of the range of variation in diagnostic characters will be helpful to discriminate closely related species.

In this paper, specimens of "*Platorchestia platensis*" species group from the seashore of Japan are examined morphologically to identify to species and the variation of selected diagnostic characters are documented to evaluate their reliability.

2. Materials and Methods

Seventy-three male specimens of "*Platorchestia platensis*" from 31 localities, covering from Hokkaido to Okinawa, were analyzed (Table 1). Nine specimens from three consequent seasons were examined in the collection from Hatakejima Island, Wakayama (#19–#21 in Table 1), since from this collection the type specimens of *P. hatakejima* were selected (Lowry and Myers [12]; pers comm.). These nine specimens are parts of the year-round samples of "*Orchestia platensis*", which were ecologically treated in Morino [16]. For each of the other localities, one to four specimens were inspected. All of the specimens are deposited in the collection of the National Museum of Nature and Science, Tsukuba (NSMT-Cr).

Table 1. List of specimens for the present study. All of the specimens are deposited in the collection of the National Museum of Science and Nature, Tsukuba (NSMT-Cr).

#	Locality	Sampling date	Sample size	Specimen #-#: Body length (NSMT-Cr XXXXX)	Collector	Remarks
1	Sakanoshita, Wakkanai, Hokkaido	24 Jun. 1971	3	1-1: 8.8 mm (27043); 1-2: 11.5 mm (27042); 1-3: 12.5 mm (27041)	H. Morino	seashore
2	Lake Abashiri, Abashiri, Hokkaido	18 May 2004	2	2-1: 9.2 mm (27268); 2-2: 10.2 mm (27269)	K. Wada	brackish lake
3	Aikappu, Akkeshi, Hokkaido	22 Jun. 1971	3	3-1: 10.6 mm (27033); 3-2: 11.3 mm (27034); 3-3: 12.0 mm (27032)	H. Morino	seashore
4	Esashi-oyama, Hokkaido	18 Jun. 1971	3	4-1: 9.0 mm (27024); 4-2: 11.0 mm (27026); 4-3: 12.0 mm (27025)	H. Morino	seashore
5	Torikarasuhama, Oshima-ohshima Is., Hokkaido	10 Oct. 1990	1	5-1: 11.2 mm (27226)	Y. Harada and K. Kuribayashi	seashore
6	Togahama, Oga, Akita	16 Jun. 1971	1	6-1: 10.8 mm (27017)	H. Morino	seashore
7	Takashiro-hama, Onagawa, Miyagi	27 Jun. 1971	3	7-1: 10.2 mm (27052); 7-2: 10.5 mm (27051); 7-3: 12.0 mm (27053)	H. Morino	seashore
8	Hiraiso, Hitachinaka, Ibaraki	5 Nov. 2015	3	8-1: 10.2 mm (27310); 8-2: 10.2 mm (27311); 8-3: 12.0 mm (27312)	H. Morino	seashore
9	Shinpo, Noto, Ishikawa	14 Jun. 1971	2	9-1: 10.8 mm (27011); 9-2; 12.0 mm (27012)	H. Morino	seashore
10	Akasaki, Tsuruga, Fukui	6 Jun. 1976	2	10-1: 11.0 mm (27314); 10-2: 13.0 mm (27315)	H. Miyamoto	Seashore
11	Saburi River, Ooi, Fukui	6 May 1977	2	11-1: 10.5 mm (27336); 11-2: 11.0 mm (27335)	H. Miyamoto	estuary

12	Takahama, Ooi, Fukui	24 May 1971	2	12-1: 10.4 mm (27003); 12-2: 12.2 mm (27004)	H. Morino	seashore
13	Daito Fisheries Port, Isumi, Chiba	23 Jun. 1994	2	13-1: 9.0 mm (27237); 13-2: 10.1 mm (27236)	H. Morino	seashore
14	Uchiura Bay, Amatsu-kominato, Chiba	29 Jun. 1971	3	14-1: 11.0 mm (27057); 14-2: 12.0 mm (27058); 14-3: 13.0 mm (27059)	H. Morino	seashore
15	Funemisaki, Torishima Is., Izu Tokyo	29 Jan. 2017	2	15-1: 10.2 mm (27353); 15-2: 11.0 mm (27352)	T. Torii	seashore
16	Minamijima Is., Ogasawara, Tokyo	13 Aug. 1989	1	16-1: 8.0 mm (27217)	H. Morino	seashore, (incl. slide mount)
17	Koajiro, Misaki, Kanagawa	30 Jun. 1971	3	17-1: 9.2 mm (27065); 17-2: 9.5 mm (27066); 17-3: 10.2 mm (27064)	H. Morino	seashore
18	Kawajiri River, Wachi, Tahara, Aichi	24 Nov. 1974	2	18-1: 11.0 mm (27323); 18-2: 12.0 mm (27322)	H. Miyamoto	estuary
19	Hatakejima Is., Tanabe Bay, Wakayama	13 Mar. 1972	3	19-1: 12.0 mm (27284); 19-2: 12.4 mm (27285); 19-3: 14.3 mm (27286)	H. Morino	seashore (Morino, 1978)
20	Hatakejima Is., Tanabe Bay, Wakayama	13 Aug. 1972	3	20-1: 7.8 mm (27298); 20-2: 8.0 mm (27296); 20-3: 8.0 mm (27297)	H. Morino	seashore (Morino, 1978)
21	Hatakejima Is., Tanabe Bay, Wakayama	13 Dec. 1972	3	21-1: 8.8 mm (27305); 21-2: 10.8 mm (27304); 21-3: 11.0 mm (27303)	H. Morino	seashore, (Morino, 1978)
22	Suetsune, Tottori	22 May 1971	4	22-1: 9.2 mm (26996); 22-2: 10.0 mm (26997); 22-3: 11.0 mm (26995); 22-4: 11.2 mm (26994)	H. Morino	seashore
23	Bentenzaki, Tamano, Okayama	24 Sept. 1971	1	23-1: 8.5 mm (27092)	H. Morino	seashore
24	Karakohama, Imabari, Ehime	25 Sept. 1971	3	24-1: 8.0 mm (27100), 24-2: 8.0 mm (27102); 24-3: 9.2 mm (27101)	H. Morino	seashore
25	Shigenobu River, Matsuyama, Ehime	19 Apr. 2004	1	25-1: 10.0 mm (27265)	K. Wada	estuary

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26	Urado, Higashi-minamiura, Kochi	30 Sept. 1971	2	26-1: 7.5 mm (27116); 26-2: 9.0 mm (27115)	H. Morino	seashore
27	Tsuyazaki, Fukuoka	12 May 1971	2	27-1: 10.8 mm (26979); 27-2: 12.5 mm (26980)	H. Morino	seashore
28	Sesegushi, Kagoshima	17 May 1971	3	28-1: 10.1 mm (26986); 28-2: 11.0 mm (26987); 28-3: 12.5 mm (26988)	H. Morino	seashore
29	Akaogi, Amami-Oshima Is., Kagoshima	30 Jul. 1971	3	29-1: 7.5 mm (27082); 29-2: 8.2 mm (27083); 29-3: 9.0 mm (27081)	H. Morino	seashore
30	Awase Port, Awase, Okinawa Is. Okinawa	27 Mar. 1975	2	30-1: 8.2 mm (27138); 30-2: 9.8 mm (27139)	H. Morino	seashore
31	Sonai, Iriomote Is., Okinawa	30 Mar. 1975	3	31-1: 8.8 mm (27146); 31-2: 9.2 mm (27145); 31-3: 11.1 mm (27144)	H. Morino	seashore
		Total	73			

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The following morphological characters were inspected for each specimen by use of a stereomicroscope or a light microscope. The body lengths (from the tip of the head to the tip of the telson along the straightened dorsal margin) were measured before the inspection.

(1) Antenna 1: the number of marginal robust setae on peduncular article 3

(2) Antenna 2: developmental stage of incrassation of peduncle

1. none (Figure 1A)
2. slight (Figure 1B)
3. distinct (Figure 1C)

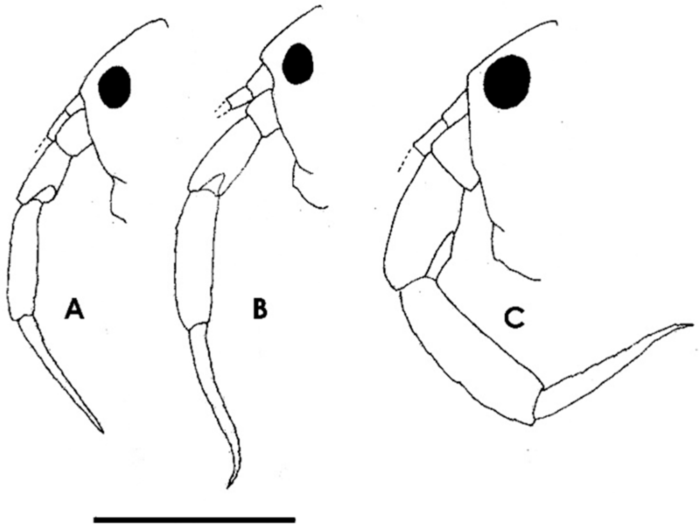

Figure 1. Antenna 2. Scale: 2 mm.

(3) Gnathopod 1: cusp on dactylus

1. none (Figure 2A)
2. rudimentary (Figure 2B)
3. distinct (Figure 2C)

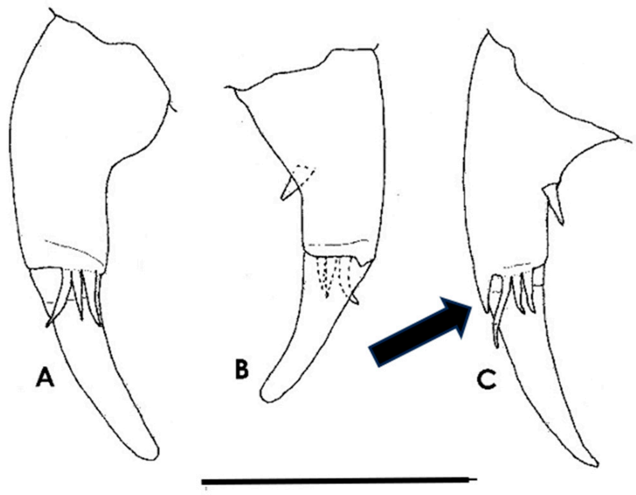

Figure 2. Dactylus of gnathopod 1. Arrow: cusp. Scale: 0.2 mm.

(4) Gnathopod 1: length ratio of propodus to carpus

(5) Gnathopod 2: posterior cusp on coxa

1. none (Figure 3A) or blunt (Figure 3B)

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2. medium
3. sharp (Figure 3C)

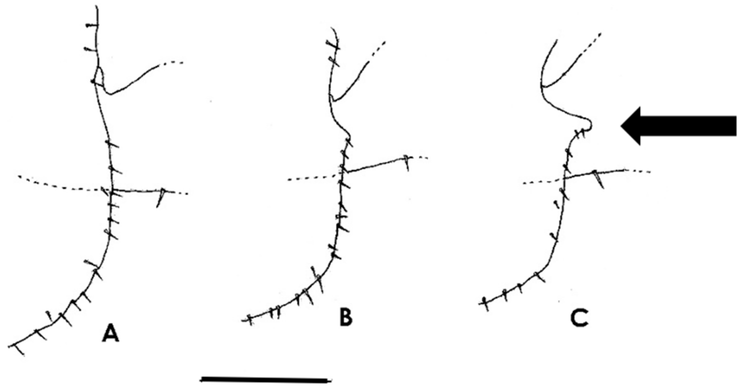

Figure 3. Posterior margin of coxa of gnathopod 2. Arrow: cusp. Scale: 0.4 mm.

(6) Gnathopod 2: developmental stage of mid-notch on palmar margin

1. none (Figure 4A)
2. slight (Figure 4B)
3. distinct (Figure 4C, white arrow)

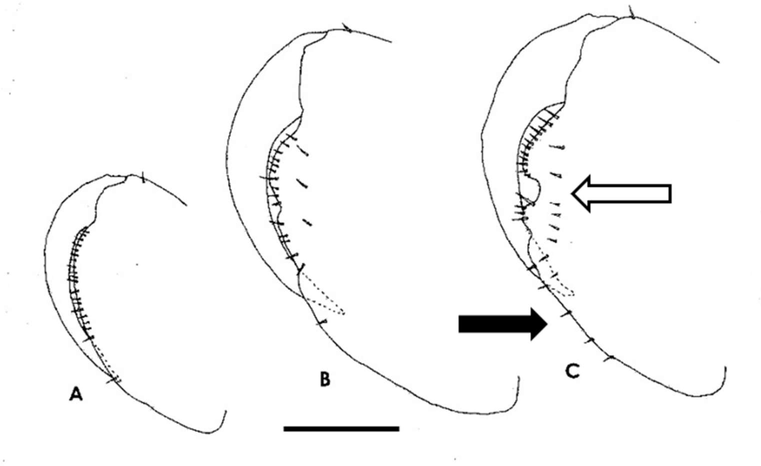

Figure 4. Propodus of gnathopod 2. White arrow: mid-notch; black arrow: marginal robust setae. Scale: 0.4 mm.

(7) Gnathopod 2: the number of robust setae on posterior margin of propodus (Figure 4C, black arrow)

(8) Pereopod 4: length ratio of carpus to width

(9) Pereopod 6: development of protrusion on posterior lobe of coxa

1. not protruded (right angled) (Figure 5A)
2. slightly protruded (Figure 5B)
3. distinctly protruded (Figure 5C)

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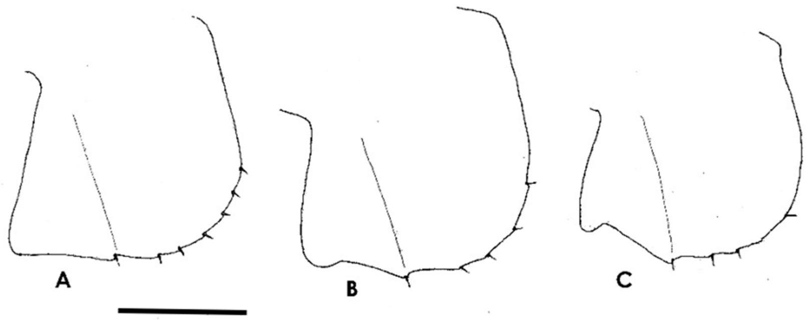

Figure 5. Posterior lobe of coxa of pereopod 6. Scale: 0.4 mm.

(10) Pereopod 7: developmental stage of incrassation of carpus

1. none (Figure 6A)
2. slight (Figure 6B)
3. distinct (Figure 6C)

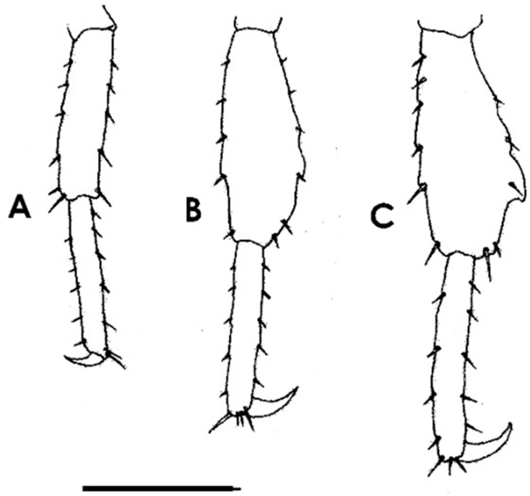

Figure 6. Carpus of pereopod 7. Scale: 1 mm.

(11) Pleopods 2 and 3: the number of robust setae on outer margin of peduncle

Serejo and Lowry [10] have referred to the position of the group of marginal robust setae on pleopod peduncles (e.g., medial or proximal). In the present analysis, the total number of the robust setae was counted since the positioning of setae groups was often not possible.

(12) Telson: the number of robust setae per lobe

Kim, Jung and Min [13] discriminated three states in the number of setae groups on the telson (one, two or three groups). However, the recognition of the group was often difficult so that herein the total number of the robust setae was counted on the left lobe of telson.

The analyses of the results proceeded with three steps. First, the specimens examined were tentatively identified to species following the diagnoses given by Miyamoto and Morino [9], that is, *Platorchestia pacifica* (P-type) or *Platorchestia joi* (J-type). In this process, the number of marginal setae on the posterior margin of propodus of the gnathopod 2 was given priority, since this is one of the meristic characters and thus practical to discriminate as compared to gradual, size-dependent ones, such as incrassation of appendages, also they showed a trend of two clusters. Secondly, character states or measurements in each of the other characters were separated into P- or J-type to be compared

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between both types to confirm the species identity and to delimit the variation. Lastly the revised characters of each type were compared with the descriptions of species known from Japan and the adjacent regions. Statistical tests were performed with the Microsoft Excel 2021 (ver. 2309).

3. Results

The results are put in order according to their diagnostic values.

3.1. The number of marginal robust setae on propodus of gnathopod 2 (Figure 7)

The number of the setae varies from 0 to 7, exhibiting two clusters, 0–2 and 4–7 with the intermediate 3 (2 specimens). The first cluster shows normal distribution with the mode of 1 seta, and suggests size-dependency. While the second cluster shows much higher variation and no trend with respect to the body size. The first cluster coincides with the diagnosis of *Platorchestia pacifica* (sensu Miyamoto and Morino, 2004) and the second one with that of *P. joi* (sensu Miyamoto and Morino, 2004). Although Miyamoto and Morino [9] mentioned of this character for *P. joi* as 3 or more (3–5), here the intermediate two specimens are allocated to *P. pacifica*. Hereafter, specimens with 3 or less marginal setae are allotted to P-type, and those with 4 or more setae are to J-type. Figure 8 gives the size frequency distribution of specimens of P- and J- types. The two distributions are not different with each other but the number of specimens of both types is disproportionate: that of P-type is as five times higher than that of J-type.

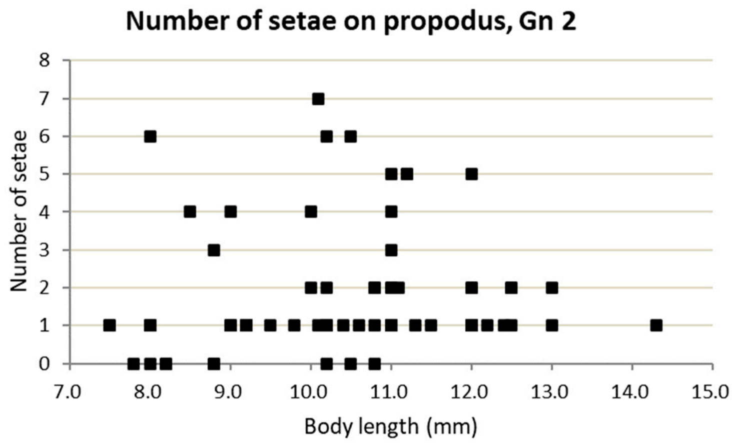

Figure 7. Scatterplot of setae number against body length.

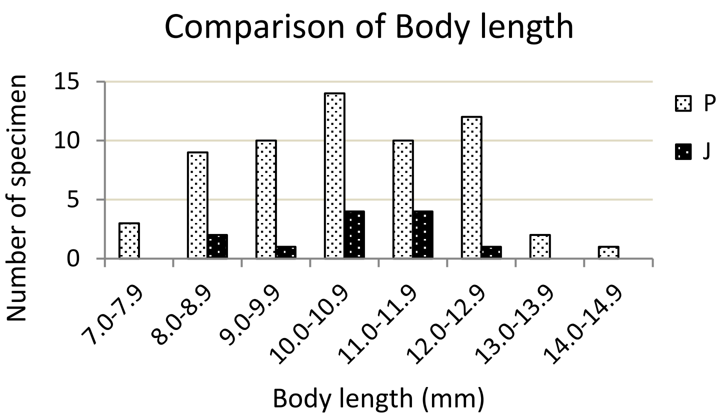

Figure 8. Frequency distribution of body length. P: P-type, J: J-type.

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3.2. Posterior cusp on coxa of gnathopod 2 (Figure 9)

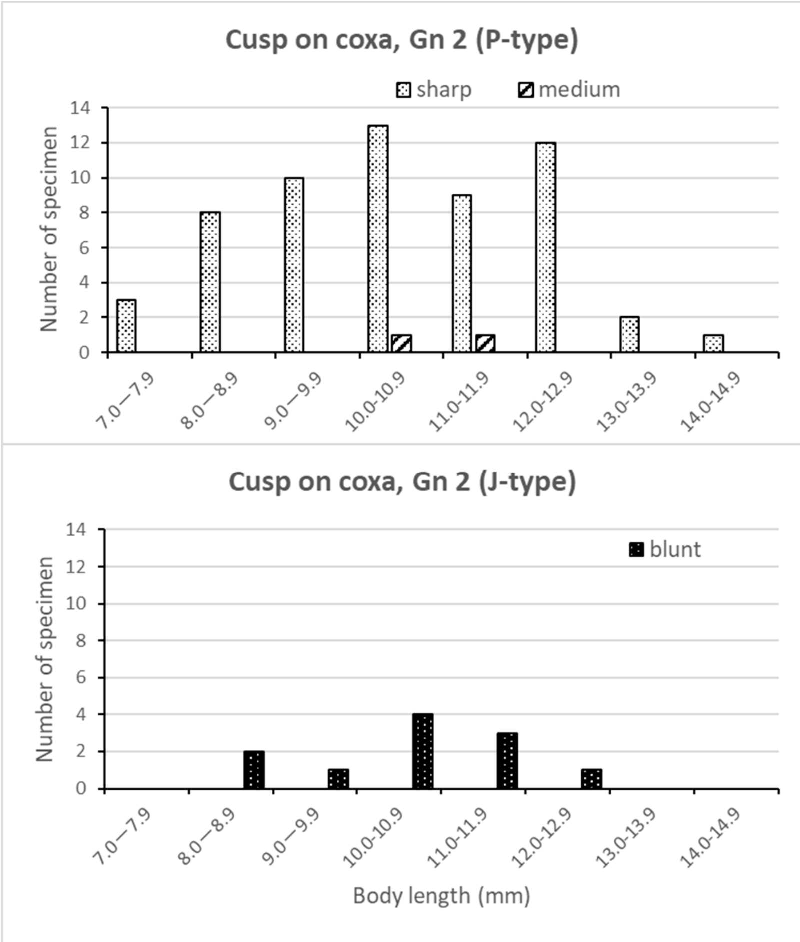

Figure 9. Frequency distribution of developmental states of cusp against body length. Upper: P-type; lower: J-type.

P-type specimens show sharp or rarely medium cusp, while those of J-type show blunt ones. Clear difference is admitted between both types with respect to this character.

3.3. Incrassation of carpus of pereopod 7 (Figure 10)

P-type specimens show all of the three stages of incrassation, from none to distinct, which show size-dependent trend. Most of large males (larger than 11 mm) shows incrassation. J-type specimens, on the other hand, show no sign of incrassation, except one specimen. For large males, there is a clear difference between both types.

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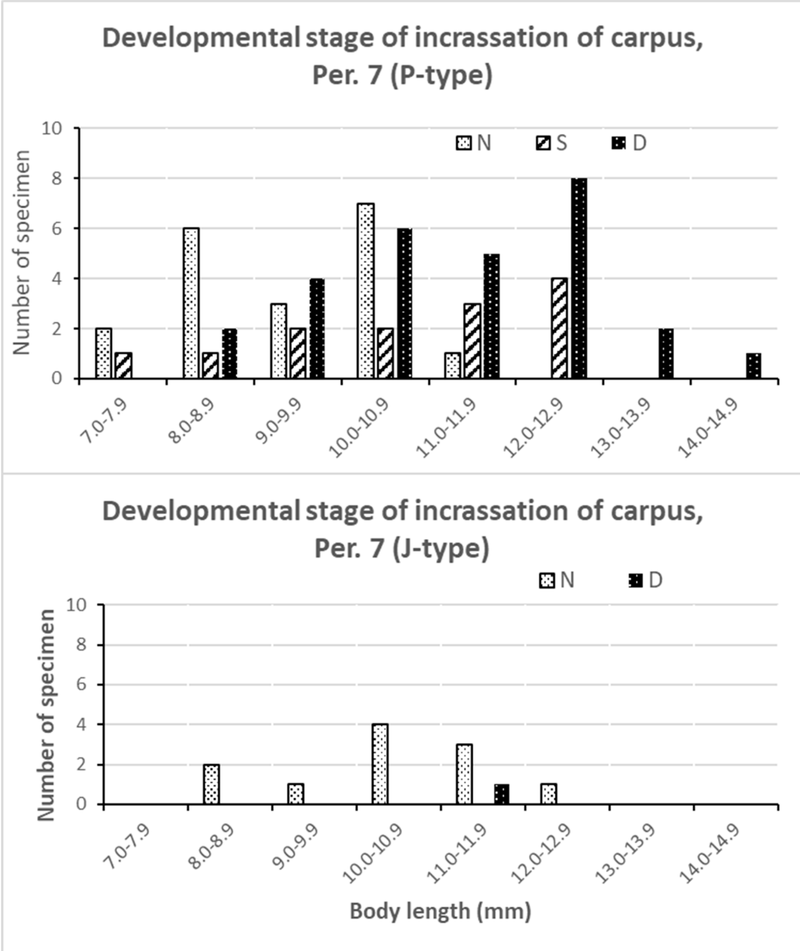

Figure 10. Frequency distribution of developmental stages of incrassation against body length. N: none, S: slight, D: distinct. Upper: P-type, lower: J-type.

3.4. Cusp on dactylus of gnathopod 1 (Figure 11)

P-type specimens show all the three states, from none to distinct cusp, in this character for almost all size classes. On the other hand, all the J-type specimens display none-cuspate dactylus . As discussed later, high variation of this character in P-type casts problem to the generic position of P-type.

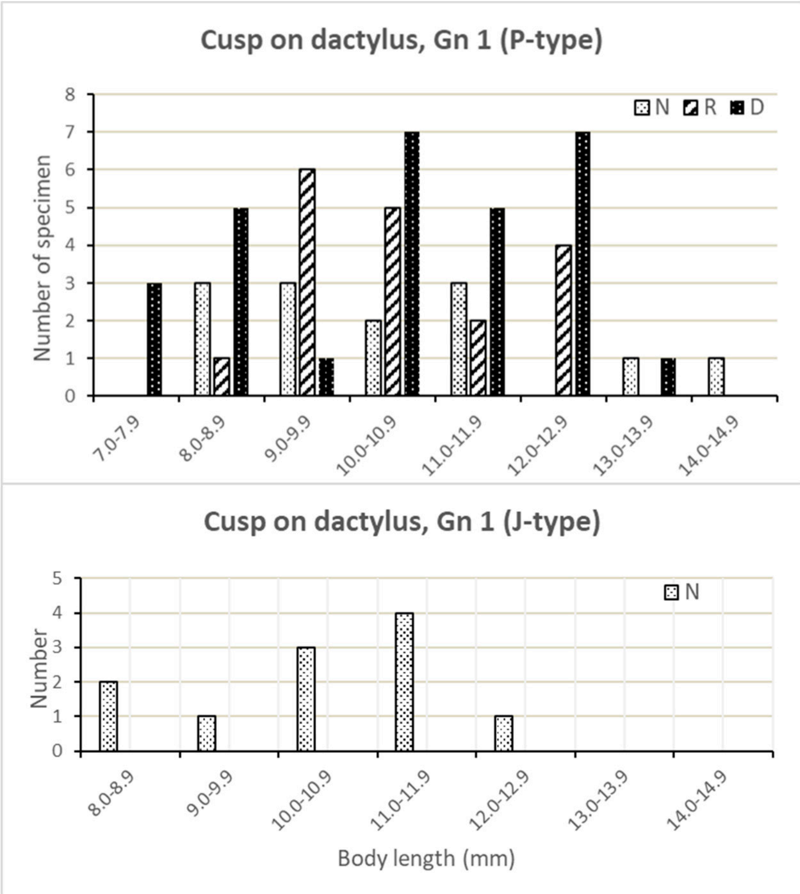

Figure 11. Frequency distribution of developmental states of cusp against body length. N: none, R: rudimentary, D: distinct. Upper: P-type, lower: J-type.

3.5. The number of marginal robust setae on peduncular article 3 of antenna 1 (Figure 12)

P-type specimens show from 1 to 4 setae, with the mode 2–3, whereas J-type specimens lower number, namely, 1 or 2 setae, both shows size dependency ($p<0.01$; P-type: $r = 0.680$, J-type: $r = 0.769$).

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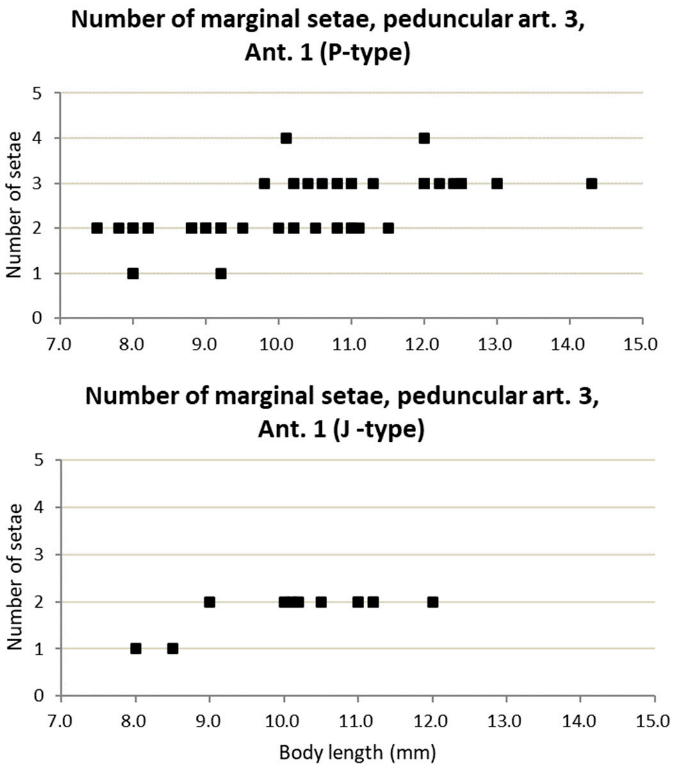

Figure 12. Scatterplot of setae number against body length. Upper: P-type, lower: J-type.

3.6. Incrassation of peduncle of antenna 2 (Figure 13)

In both types, small specimens (9 mm) show all the stages, and large ones (more than 11 mm) display distinctly incrassate peduncle (size-dependent in P-type, $p<0.01$; $r = 0.527$).

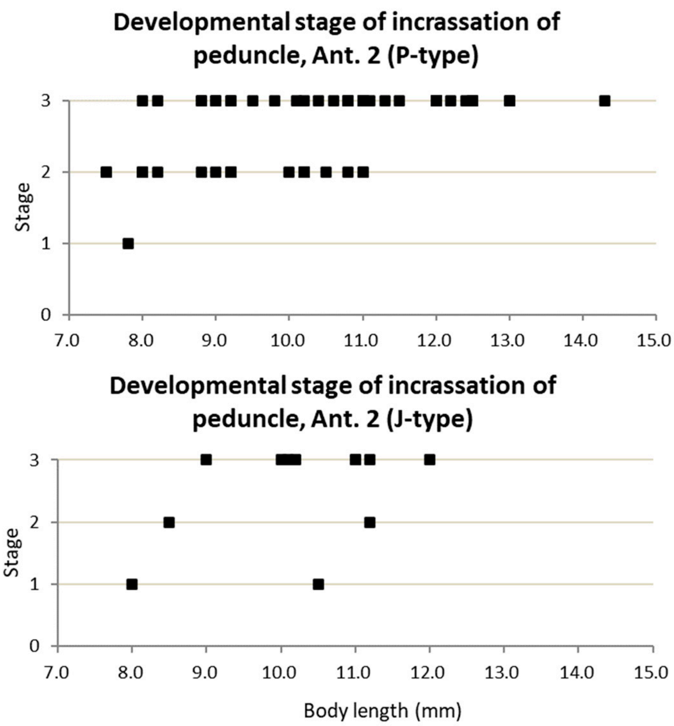

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Figure 13. Scatterplot of developmental stages of incrassation against body length. Upper: P-type, lower: J-type.

3.7. Length ratio of propodus to carpus of gnathopod 1 (Figure 14)

These ratios show no size-dependency (p>0.05). P-type specimens show the range 0.58─0.74 with the mode 0.65─0.68, while those of J-type are 0.57─0.68 with the mode 0.63─0.68. There is no difference between both types.

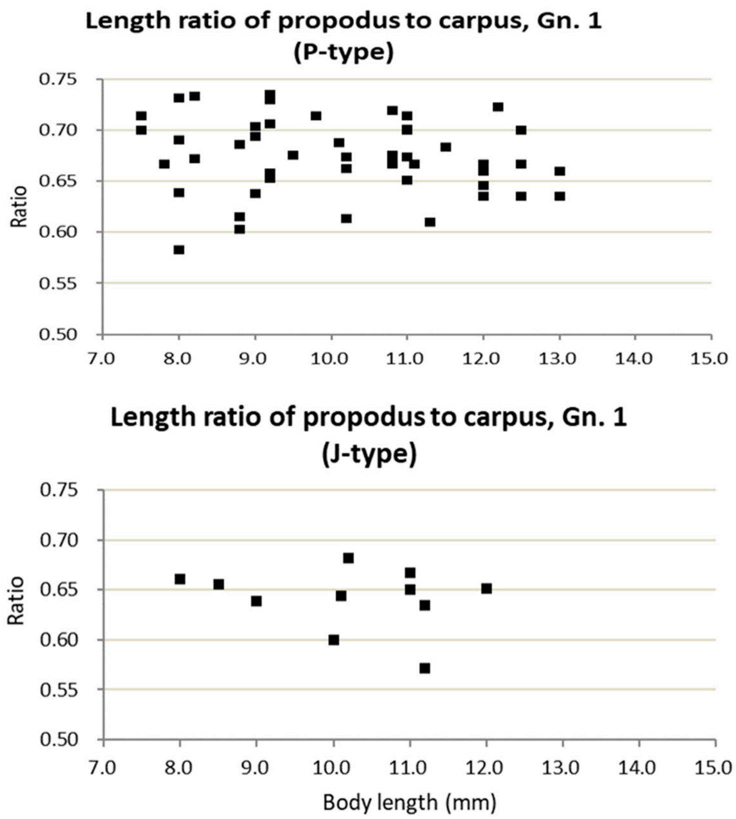

Figure 14. Scatterplot of ratio against body length. Upper: P-type, lower: J-type.

3.8. Mid-notch on palm of gnathopod 2 (Figure 15)

Specimens of both types exhibit the similar pattern. Larger males show more developed stages (P-type, p<0.01; r = 0.655), though smaller specimens show variable developmental stages in P-type. Most of the larger males (more than 11mm) shows distinctly developed stage.

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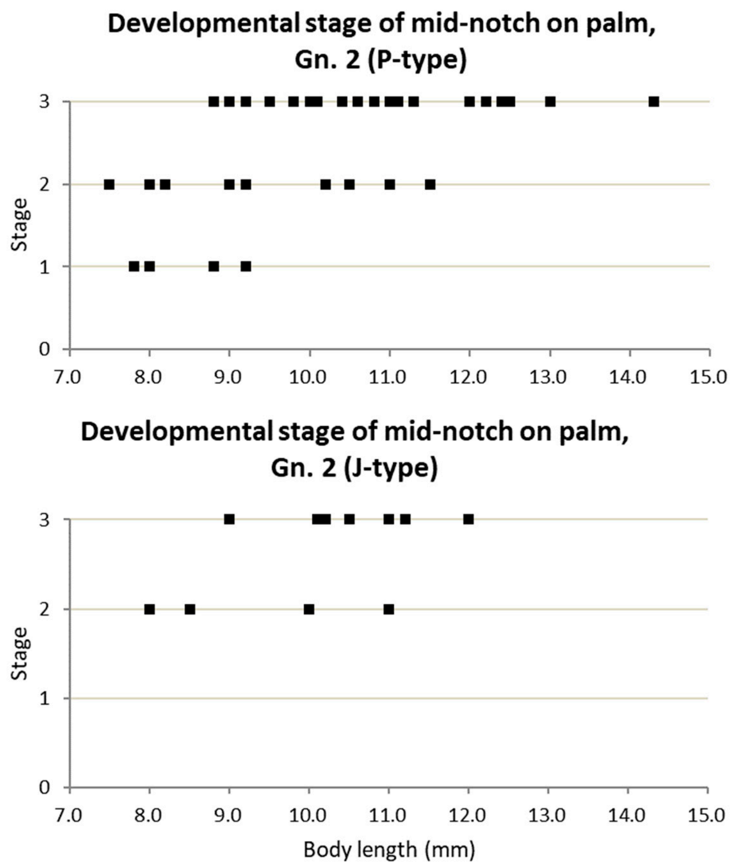

Figure 15. Scatterplot of developmental stages of mid-notch against body length. Upper: P-type, lower: J-type.

3.9. Length ratio of carpus to width of pereopod 4 (Figure 16)

These ratios show no size-dependency (p>0.05). P-type specimens show the range 1.13–1.78 with the mode 1.40–1.49. While those of J-type specimens are 1.33–1.71 with the mode 1.30–1.39. There are no differences between two types.

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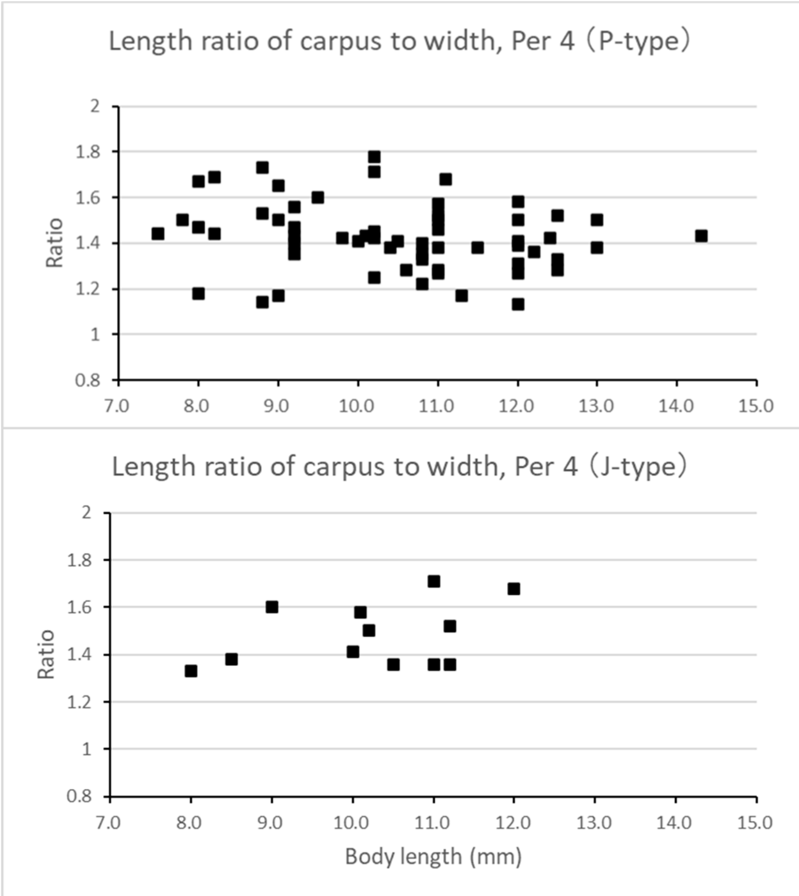

Figure 16. Scatterplot of ratio against body length. Upper: P-type, lower: J-type.

3.10. Protrusion on coxa of pereopod 6 (Figure 17)

P-type specimens show high variation, thus most of the size classes exhibit all of the three states of development. In J-type specimens, larger males tend to have less protruded state, though it is not significant ($p>0.05$).

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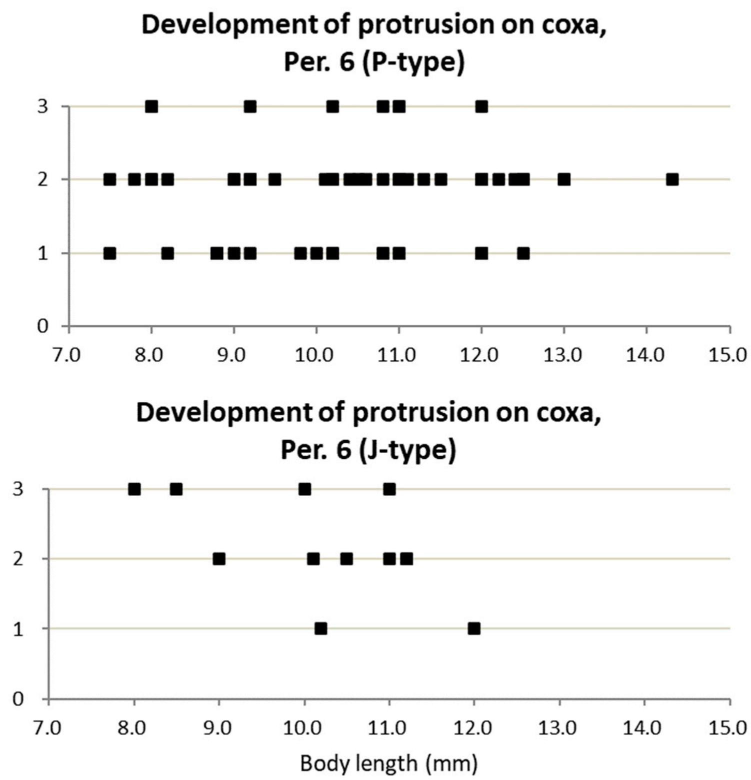

Figure 17. Scatterplot of developmental states of protrusion against body length. Upper: P-type, lower: J-type.

3.11. The number of marginal robust setae on peduncle of pleopod 2 (Figure 18) and pleopod 3 (Figure 19)

These values show high variation. For pleopod 2, P-type specimens exhibit from 3 to 15 setae with the mode 8, which correlates to the body length ($p<0.01$; $r = 0.708$), while J-type specimens with 6–17 setae, with the mode 11. The number in J-type tend to higher than that of P-type. The same trend is demonstrated in those of pleopod 3. P-type specimens have the range 2–13, with the mode 9; J-type specimens with the range 6–16 and with the mode 11–12.

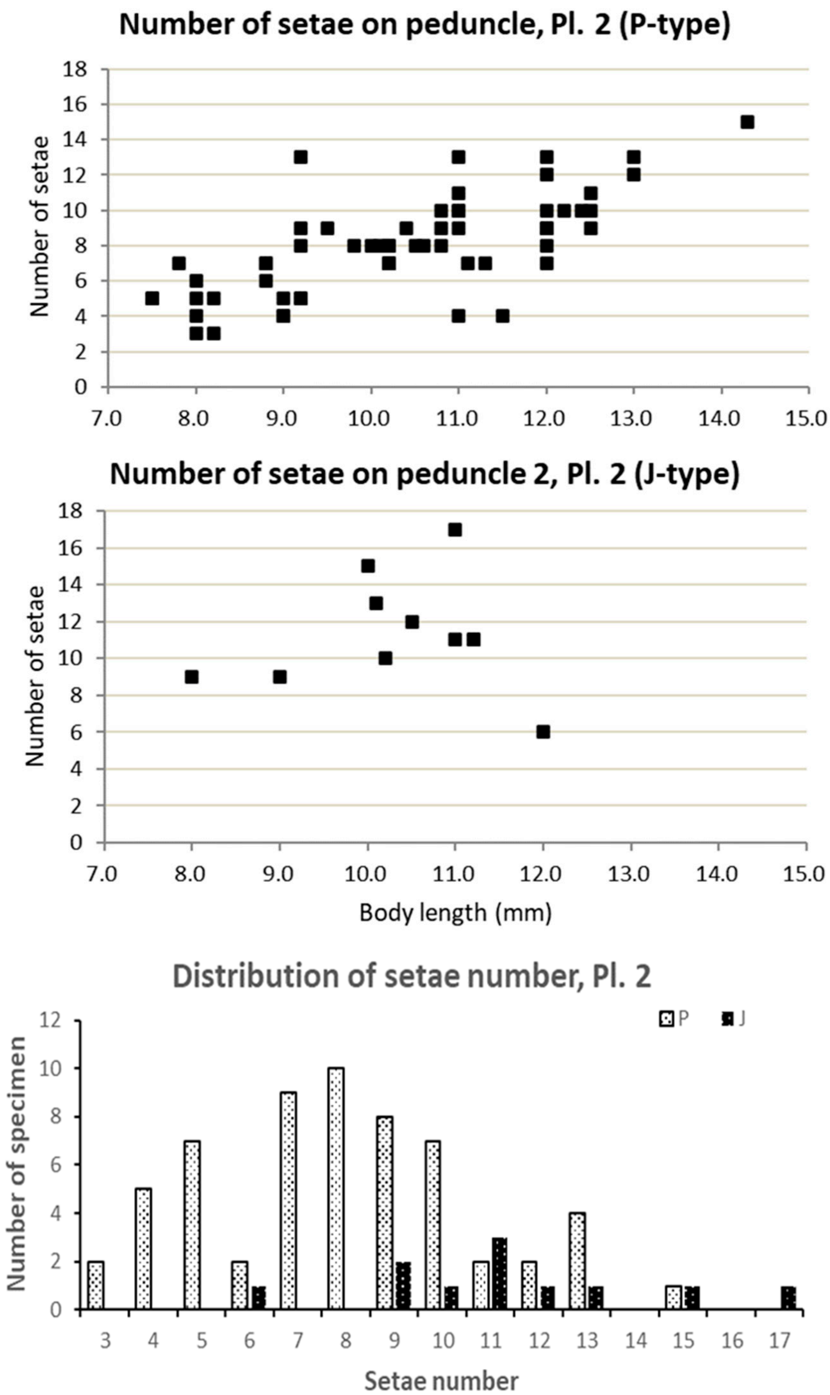

Figure 18. Upper and middle: scatterplot of setae number on pleopod 2 against body length; upper: P-type, middle: J-type. Lower: frequency distribution of setae number on pleopod 2. P: P-type, J: J-type.

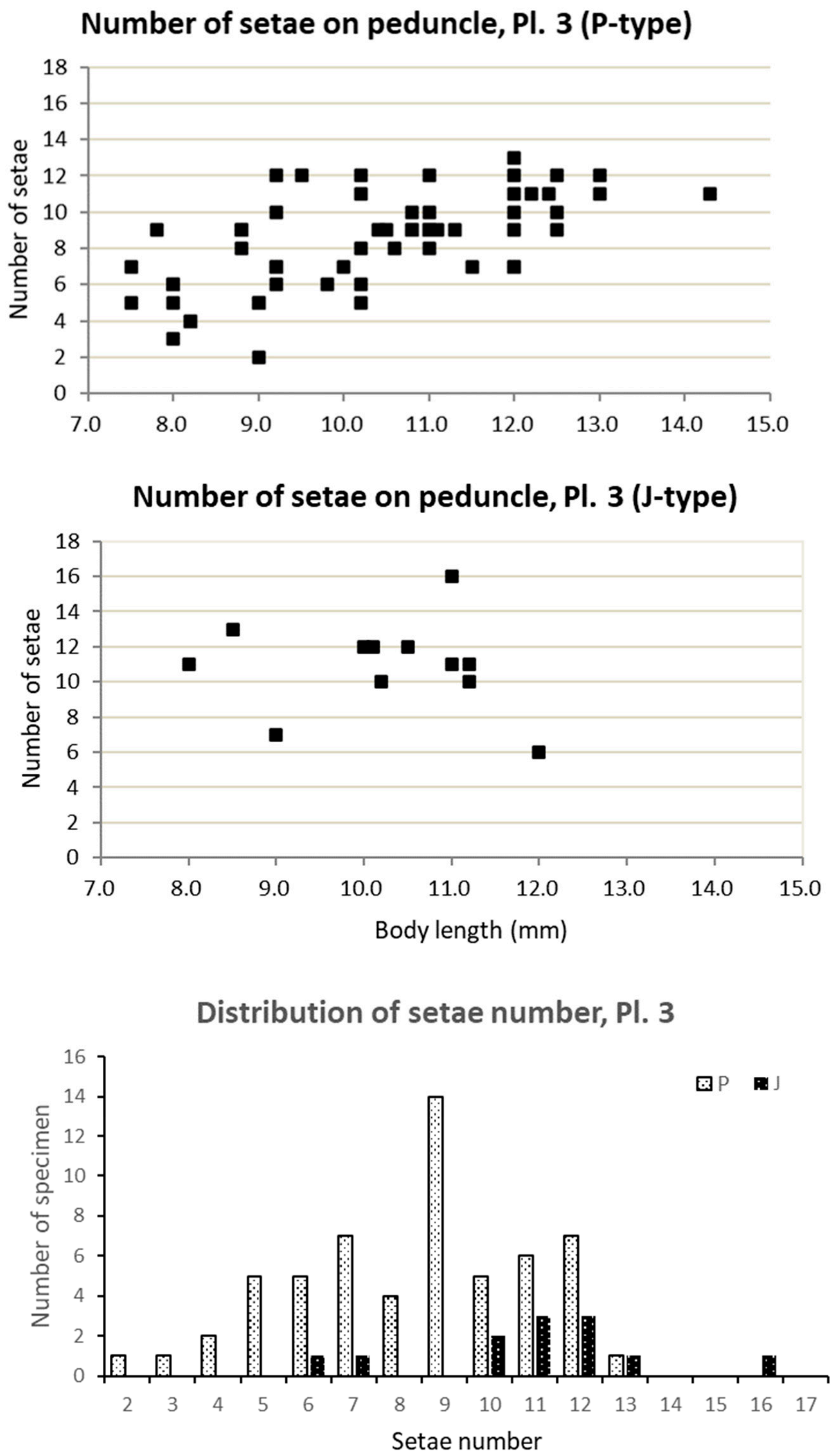

Figure 19. Upper and middle: scatterplot of setae number on pleopod 3 against body length; upper: P-type, middle: J-type. Lower: frequency distribution of setae number on pleopod 3. P: P-type, J: J-type.

3.12. The number of robust setae on left lobe of telson (Figure 20)

P-type specimens show the range 5–13 with the mode 7, and J-type specimens 8–12 with the mode 9. This number in J-type tends to be higher than that of P-type, though the former is included within the range of the latter.

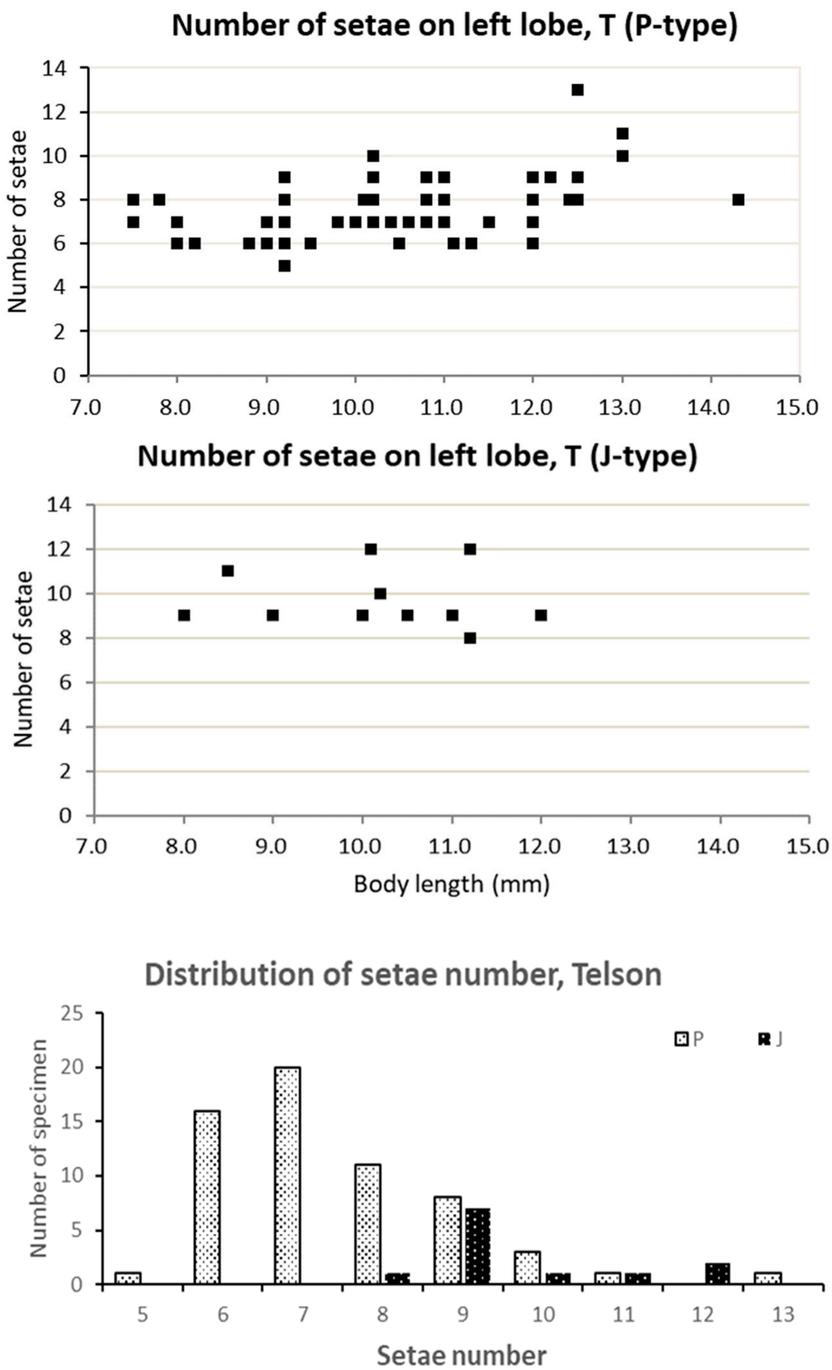

Figure 20. Upper and middle: scatterplot of setae number on telson against body length. Lower: frequency distribution of setae number; P: P-type, J: J-type.

The results of these analyses on P- and J-type specimens are summarized in Table 2, together with the information cited from the descriptions of species in question.4. Discussion and conclusions

Most of the characters treated here display rather high degree of variation, especially the number of robust setae on pleopods 2 and 3, and the telson lobe. Length ratio of the propodus on gnathopod 1 to the carpus was previously introduced by Bousfield [6] to distinguish *P. crassicornis* from *P. platensis*, though it shows no significant differences among specimens of both types and the species cited in Table 2. Development of protrusion on the anteroventral corner on posterior lobe of the pereopod 6 coxa has been adopted to discriminate species [10,12,13,19]. However, the present study

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indicates that all the states of the protrusion, from none to distinctive, appear in all size classes in both types, evincing its unstableness. It is advisable for other species to be examined the variation in these characters.

Cusps on the dactylus of gnathopod 1 display also variation in P-type specimens from none to distinctively cuspate state, but is stably non-cuspate (simplidactylate) in J-type ones. This character is employed to establish the genus *Demaorchestia* Lowry and Myers, 2022, which is defined by having the non-cuspate dactylus, and thus to differentiate it from cuspidactylate *Platorchestia* sensu Lowry and Myers, 2022. However, as far as the P-type specimens are concerned, this concept is hard to accept. High variation of the dactylar states may make the generic separation of *Demaorchestia* unreliable. As an alternative solution, the concept of the genus *Platorchestia* is expanded to encompass the variation of P-type. Until the variation of this character is examined for other *Platorchestia* species, the latter treatment is adopted here. Accordingly, P-type specimens are provisionally allotted to the genus *Platorchestia*.

In character states of the gnathopod 2 (cusp on coxa and marginal robust setae) and the pereopod 7 (incrassation on carpus), P-type specimens also agree with *P. pacifica* Miyamoto and Morino, 2004, and J-type specimens with *Demaorchestia joi* (Stock and Biernbaum, 1994) sensu of Miyamoto and Morino, 2004 (see Table 2).

Table 2. Characters and the states for examined specimens and species of *Platorchestia* and *Demaorchestia*.

	Specimen or species	P-type	J-type	*P. crassicornis*	*P. joi*	*P. pacifica*	*P. parapacifica*	*P. munmui*	*P. monodi*
	Referred author(s)	present paper	present paper	Jo [8]	Miyamoto & Morino [9]	Miyamoto & Morino [9]	Kim et al. [13]	Jo [8]	Kim & Min [11]
	Body length (mm)	7.5–14.3	8.0–12.0	12.5	8–11	10	19.2	13.2	9.3
	Taxonomic opinions of Lowry & Myers, 2022 [12]			*D. joi*	*D. pseudojoi*	*D. pacifica* (?*D. mie* & ?D. hatakejima)	*D. parapacifica*		*P. koreaensis*
	Characters								
1	Gn 2, number of setae on propodus	0–3(1)	4–7 (4–6)	7 (fig), several (text)	3–5	0	1 (fig), bare (text)	1	1 (fig), bare (text)
2	Gn 2, cusp on coxa	S (rarely M)	B	B or M	B	S	S	S	S (fig), obtuse (text)
3	Per 7, incrassation of carpus	D*, S, N	N (rarely D)	N or S	N or S	D	D	D	N
4	Gn 1, cusp on dactylus	D, R, N	N	N	N	D, R	N	D	D
5	Ant 1, number of setae on peduncular article 3	1–4 (2, 3)**	1–2*	2 (Kim et al, 2013)	0	1, 2	4	1, 2	1 (Kim et al. 2013)
6	Ant 2, incrassation of peduncle	2, 3 (rarely 1)**	1–3	3	2, 3	3	3	3	2
7	Gn 1, length ratio of propodus to carpus	0.58–0.74 (0.65–0.68)	0.57–0.68 (0.63-0.68)	0.63	0,71 (fig), ca 0.6 (text)	0.71 (fig), ca 0.6 (text)	0.66 (fig), 0.63 (text)	0.73	0.69 (fig), 0.63 (text)

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8	Gn 2, mid-notch on palm	1–3**	2, 3	3	2	1, 2	3	3	2
9	Per 4, length ratio of carpus to width	1.13–1.78 (1.40-1.49)	1.33–1.71 (1.30–1.39)	1.48	1.69	1.64	1.31	1.09 (fig), ca 1.0 (text)	1.77
10	Per 6, protrusion of lobe on coxa	1–3	1–3	1 or 2	1, 2	3	2, 3	1	1
11	Pl 2, number of setae on peduncle	3–15 (8)**	6-17 (11)	10~	4 (fig), several (text	3	7	5	1
12	Pl 3, number of setae on peduncle	2–13 (9)**	6–16 (11–12)	10~	8	9	9	9	2
13	T, number of setae on left lobe	5–13 (7)**	8–12 (9)	8	8	6	10	8	5

Parentheses after ranges mean mode values.; Asterisks mean size-dependency. Double asterisks means significant ones.; In the case that measured values or expressions are different between the texts and figures in literatures, each case is shown.

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In what follows, revised diagnoses of *Platorchestia pacifica* and *Demaorchestia joi* are given.

Platorchestia pacifica Miyamoto and Morino, 2004

(Japanese name: Taiheiyo-himehamatobimushi)

Miyamoto and Morino, 2004, pp.76-83, Figures 4–7, Table 1.

Orchestia platensis: Morino, 1975, pp. 172—175, Figures 1–3.

Demaorchestia hatakejima Lowry and Myers, 2022, pp. 11–12, Figure 5.

Diagnosis (Large males mean larger than 11 mm boy length)

Body size medium (up to 15 mm). Antenna 1 short, not reaching end of peduncular article 4 of antenna 2; peduncular article 3 with 2-3 (rarely 1 or 4) marginal robust setae. Antenna 2, peduncle longer than flagellum, peduncular article 3 without ventral plate; peduncular articles 4-5 slightly to distinctly (large males) incrassate in males. Mandible left lacinia 5-dentate. Maxilliped, outer margin of precoxa not stepped, palp article 2 with distomedial lobe; article 4 reduced, masked by apical robust setae. Gnathopod 1 sexually dimorphic, dactylus cusp varied: lacking, rudimentary or distinct; in males, propodus strongly subchelate, carpus and propodus with dome-shaped pellucid lobes; in females, shallowly subchelate, lacking pellucid lobe. Gnathopod 2 in males powerfully subchelate, coxa with sharp cusp on posterior margin, propodus posterior margin with 0—2, rarely 3 robust setae, palmar margin with U-shaped mid-notch in large males; in females, mitten-shaped, basis anteroproximally expanded. Pereopods 3—7 bi-cuspidactylate, propodus locking robust setae well-developed. Pereopod 4, coxa wider than deep, length ratio of carpus to width ca. 1.4 (1.13—1.78), dactylus base weakly concaved. Pereopod 6, protrusion of posterior lobe of coxa varied: from none to distinctly developed. Pereopod 7, carpus incrassate in large males. Coxal gill of pereopod 2 V-shaped, gills of pereopods 3-6 convoluted. Pleopods well-developed; peduncles of pleopods 2-3, outer margin robust-setose. Uropod 1, peduncle distolateral robust seta shorter than subdistal one; inner ramus with outer and inner marginal robust setae, outer ramus marginally bare. Telson with apical and marginal robust setae, 7 (5—13) in number.

Remarks

Relationships of *P. pacifica* with allied species are discussed in the order of geographical affinity.

Demaorchestia hatakejima Lowry and Myers, 2022 was instituted with the type specimens selected from the specimens of *P. pacifica* (Hatakejima Island, Wakayama in Japan). The original description was based on the illustration and description by Morino [2]. Since these were not prepared under the current concept, nine specimens from the same collection (#19—#21 in Table 2) were carefully examined in this study, which revealed three states (N, R, D) in the dactylation of gnathopod 1 among them, and no difference was found which separated any of them from the other *P. pacifica* specimens. This result demonstrates that the new species is not tenable.

Demaorchestia mie Lowry and Myers, 2022 from Mie in Japan is diagnosed by: (1) apically pinched dactylus of gnathopod 2, (2) basis of pereopod 7 lacking posterodistal lobe, and (3) strongly serrated posterior margins of epimera (Lowry and Myers, 2022). One or two specimens selected from each locality of "P-type" were examined with respect to these three characters. All of them showed apically pinched (strongly or smooth elongate) dactylus of the gnathopod 2, the pereopod 7 with posterodistal lobe, and the epimera with shallowly (not strongly) serrated posterior margins. Thus, no specimens of "P-type" fit into *D. mie*.

Platorchestia munmui and *Demaorchestia parapacifica* described from Korean coasts are very close to *Platorchestia pacifica. Platorchestia munmui* is separated from *P. pacifica* by the significantlylower ratio of carpus length to the width of pereopod 4 (see Table 2). *D. parapacifica* is separable from *P. pacifica* by the number of marginal setae on the peduncular article 3 of antenna 1 (*P. pacifica* with 1—3 (rarely 4); *P. parapacifica* with 4 setae) . The type of *D. parapacifica* could represent a largest specimen of *P. pacifica*. The population analysis of *D. parapacifica* should be performed to settle this possibility.

Myers and Lowry [19] enumerated 11 species in the genus *Platorchestia*, among which *P. munmui* and *P. pachypus* are treated above or below, respectively. The following six species: *Platorchestia ano* Lowry and Bopiah, 2013, *P. exter* Myers and Lowry, 2023, *P. negevensis* Myers and Lowry, 2023, *P. griffithsi* Myers and Lowry, 2023, *P. platensis* (Krøyer, 1845), and *P. smithi* Lowry 2012, are distinguished from *P. pacifica* by having the palmar margin of gnathopod 2 with shallow or weak

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mid-notch (vs. distinctly U-shaped mid-notch). *Platorchestia oliveirae* Myers and Lowry, 2023 differs from *P. pacifica* by the V-shaped mid-notch on the gnathopod palm and weakly incrassate pereopod 7(vs. U-shaped mid-notch and distinctly incrassate pereopod 7). *Platorchestia paraplatensis* Serejo and Lowry, 2008 has elongate propodus on pereopod 7 (1.4 X carpus), while *P. pacifica* has the propodus subequal to carpus in length.

Distribution: Japan (see Appendix), Taiwan, Vietnam (not published)

Demaorchestia joi (Stock and Biernbaum, 1994)

(Japanese name: Kushi-himehamatobimushi new)

Talorchestia crassicornis Derzhavin, 1937, pp.108—109, Pl. 3, 1.

Orchestia platensis: Iwasa, 1939, pp. 275—261, figs 1–3, Pl. IX.

Platorchestia crassicornis: Jo, 1988, pp.161—167, figs 5–9.

Platorchestia joi Stock and Bienbaum, 1994, pp.800 (proposed name for homonymous *crassicornis*); Miyamoto and Morino, 2004, pp.70—76, figs 1–3.

Demaorchestia joi: Lowry and Myers, 2022, pp.11 (comb. nov.)

Diagnosis

As *Platorchestia pacifica* except the followings:

Body size medium (up to 13 mm). Antenna 1, peduncular article 3 with 1 or 2 marginal robust setae. Gnathopod 1, dactylus not cuspate. Gnathopod 2, coxa posterior margin with blunt cusp; in males, propteodus posterior margin with 4-7 robust setae. Pereopod 7, carpus not incrassate. Telson with 9 (8–12) robust setae, apically and marginally.

Remarks

The characters in the male gnathopod 2, namely, robust setose posterior margin of the propodus, and blunt cusp of the coxa of gnathopod 2 are unique to *Demaorchestia jo*i and *D. pseudojoi* Lowry and Myers, 2022 among *Platorchestia* and *Demaorchestia* species. The former species is distinguished from the latter by: (1) labium with vestigial inner lobe, (2) elongate carpus of gnathopod 1 (more than 2 X width, and (3) shape of dactylus of pereopod 4 (Lowry and Myers, 2022). Since the carpus shape is clearest among these characters, all the J-type specimens were inspected for the carpus of gnathopod 1. The measurement reveals that the ratio of the carpus length to the width has the range 1.85–2.31, the mean value 2.05, and the mode 1.91—2.00. Thus, it is not possible to separate *Demaorchestia pseudojoi* from *D. joi* based on this character in our J-type specimens.

Distribution: Japan (see Appendix), Russia, Korea, and Taiwan.

A key to species of the genera *Platorchestia* and *Demaorchestia* from seashores of Japan and Korea are given below (based on matured males). *Demaorchestia mie* is tentatively placed in the key.

1. Propodus palmar margin of gnathopod 2 sigmoid; carpus of pereopod 7 sexually dimorphic, oar-shaped. ----- *P. pachypus* (Derzhavin, 1937)

--. Propodus palmar margin of gnathopod 2 with mid-notch; carpus of pereopod 7 incrassated or not sexually dimorphic. ----- 2

2. Carpus of pereopod 7 incrassated (larger than 11 mm B.L.). ----- 3

--, Carpus of pereopod 7 not sexually dimorphic. ----- 6

3. Length of carpus of pereopod 4 subequal to width. ----- *P. munmui* Jo, 1988

--. Length of carpus of pereopod 4 is 1.3—1.5 times as long as width. ----- 4

4. Number of marginal setae on peduncular article 3 of antenna 1 is 4; dactylar cusp on gnathopod 1 distinct. ----- *P. parapacifica* Kim, Jung and Min, 2013

--. Number of marginal setae on peduncular article 3 of antenna 1 is 1—3 (rarely 4); dactylar cusp on gnathopod 1 lacking, rudimentary or distinct. ----- 5

5. Basis of pereopod 7 lacking posteroventral lobe, epimera posterior margins strongly serrated (after Lowry and Myers, 2022). ----- *Demaorchestia mie* Lowry and Myers, 2022

--, Basis of pereopod 7 with posteroventral lobe, epimera posterior margins not-strongly serrated. ------- *P. pacifica* Miyamoto and Morino, 2004 (synonym: *P. hatakejima* Lowry and Myers, 2022) [Japanese name: Taiheiyo-himehamatobimushi]

6. Number of setae on propodus posterior margin on gnathopod 2, 4—7; posterior cusp of coxa on gnathopod 2 blunt. ----- *Demaorchestia joi* (Stock and Biernbaum, 1994) sensu lato

--. Number of setae on propodus posterior margin on gnathopod 2, 1; posterior cusp of coxa on gnathopod 2 distinct. ----- *P. koreaensis* Lowry and Myers, 2022.

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Conflicts of Interest: The author declares no conflict of interest.

Appendix

Geographical information on *Platorchestia pacifica* and *Demaorchestia joi*. Specimens inspected are classified into species; specimen numbers (Table 1) are shown in parentheses after the name of prefectures

Platorchesstia pacifica: Hokkaido (#1-1, 2, 3; #2-1; #3-1, 2, 3; #4-1, 2, 3); Akita (#6-1); Miyagi (#7-1, 2, 3); Ibaraki (#8-1, 2, 3); Ishikawa (#9-1, 2); Fukui (#10-2; #11-2; #12-1, 2); Chiba (#14-1, 2, 3); Tokyo (#15-1, 2; #16-1); Kanagawa (#17-1, 2, 3); Wakayama (#19-1, 2, 3; #20-1, 2, 3; #21-1, 2, 3); Tottori (#22-1, 2, 3); Ehime (#24-2, 3); Kochi (#26-1, 2); Fukuoka (#27-1,2); Kagoshima (#28-1, 2, 3; #29-1, 2, 3); Okinawa (#30-1, 2; #31-1, 2, 3)

Demaorchestia joi: Hokkaido (#2-2; #5-1); Fukui (#10-1; #11-1); Chiba (#13-1, 2); Aichi (#18-1, 2); Tottori (#22-4); Okayama (#23-1); Ehime (#24-1; #25-1)

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