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ON THE JAPANESE ATYID SHRIMPS

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I. Introductory

The Japanese atyid shrimps have been studied by many investigators, namely, de HAAN (1849), STIMPSON (1860), ORTMANN, (1890~91), DOFLEIN (1902), RATHBUN (1902), BOUVIER (1906), de MAN (1908), BALSS (1914), KEMP (1918), UÉNO (1935), and others. But inasmuch as they are variable in several characters, their taxonomy is of no easy task.

I had of late opportunity to examine a considerable number of specimens of atyid shrimps collected from Japan and adjacent regions. Of the systematic categories hitherto proposed, four species, viz., *Caridina acuminata*, *C. brevisrostris*, *C. harmandi* and *C. multidentata*, are not represented in the material at my disposal. The scrutiny of the material with special reference to the features of pleopods, however, enabled me to make emendations and additions in regard to atyid taxonomy. In the present paper are given erection of a new genus *Neocaridina*, to which *Caridina denticulata* of de HAAN and a new subspecies, *Caridina denticulata koreana*, are referred, emendation of the characters of three genera *Caridina*, *Atya* and *Paratya*, creation of another new subspecies *Caridina japonica sikokuensis*, and addition of *C. serratirostris* to the Japanese fauna. A general consideration of the family in question is also dealt with in this paper on the basis of the features of the pleopods and some others.

Before proceeding any farther, I take this opportunity of expressing my warmest gratitude to Professor Arata TERAO for his kind supervision under which the present work was carried out. My best thanks are due to Dr. Yaitirô OKADA and Dr. Densaburô MIYADI for kindly placing the material from Formosa and Liu-Kiu at my disposal.

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I am also indebted to Mr. Sigeru KIMURA for the favour of the specimens from Shanghai, to Mr. Hiroshi YOSIDA for a loan of Korean ones, and to Dr. Masuzô UÉNO, Mr. Densaburô INABA, Mr. Tûne SAKAI, Mr. Masao KATAYAMA, Mr. Heiji IKEDA, Mr. Kazuïti MORI, Mr. Kiyomatsu MATSUBARA, Mr. Genkiti ABE, Mr. Kazuo KôBA, Mr. Yuichi ITO, Mr. Isao MATUÏ and other gentlemen for the collection of the material from various parts of Japan.

II. Descriptive

Family *Atyidae* KINGSLEY

Key to the Japanese genera of Atyidae

- a. With exopodite on all legs; supraorbital spine present *Paratya*.
- a₁. Without exopodite on all legs; supraorbital spine absent.
 - b. Pairs of chelipeds not similar, carpus of first pair short, its distal margin more or less concave.
 - c. Endopodite of first abdominal appendage enlarged, pear-shaped, without lobe-like protuberance at antero-outer angle of endopodite of first maxilliped *Neocaridina*, n. g.
 - c₁. Endopodite of first abdominal appendage normal, endopodite of first maxilliped carries a lobe-like process at antero-outer angle ... *Caridina*.
 - b₁. Pairs of chelipeds quite similar, carpus greatly concave on distal border *Atya*.

Genus *Paratya* MIERS

Paratya MIERS, 1882, p. 195; KEMP, 1917, p. 293; ROUX, 1926, p. 238.

Xiphocaridina, BALSS, 1914, p. 23; KEMP, 1912, p. 113.

Key to the species of *Paratya*

- a. Upper border of rostrum with 16~25 spines, of which the posterior 2~3 situated on median ridge of carapace *P. compressa*.
- a₁. Upper border of rostrum serrated with 6~20 spines, the serration commencing from corneal region of rostrum (no spine on median ridge of carapace) *P. improvisa*.

Paratya compressa (de HAAN)

Ephyra compressa de HAAN, 1849, p. 186, Pl. 46.

Xiphocaris compressa, DOFLEN, 1902, p. 631; RATHBUN, 1902, p. 49; BOUVIER, 1905, p. 62.

Xiphocaridina compressa, KEMP, 1912, p. 114; BALSS, 1914, p. 23.

Paratya compressa KEMP, 1917, pp. 296~299, fig. 1, a~f; 1918, p. 293.

Table 1

	Species	Lot	Range	Mean	S.D.	C.V.
Upper rostr. spine	<i>P. compressa</i>	C	16~25	20.7±0.04	1.02±0.02	4.93±0.26
		B	7~19	12.1±0.07	2.29±0.05	18.38±0.92
	<i>P. improvisa</i>	A	6~20	12.2±0.08	2.44±0.05	20.07±0.95
Lower rostr. spine	<i>P. compressa</i>	C	1~5	2.4±0.06	0.78±0.04	31.99±1.87
		B	0~4	2.3±0.00	0.69±0.00	28.92±0.12
	<i>P. improvisa</i>	A	1~4	2.3±0.02	0.76±0.01	33.25±1.58

A. Female, 100 specimens obtained from Kasumi-ga-ura. B. Male, 100, locality same as in A. C. Female and male, specimens 70 in number, secured from various other places of Japan.

Carapace with supraorbital and antennal spines. Pterygostomian angle not spiniform. Rostrum almost horizontal but slightly convex

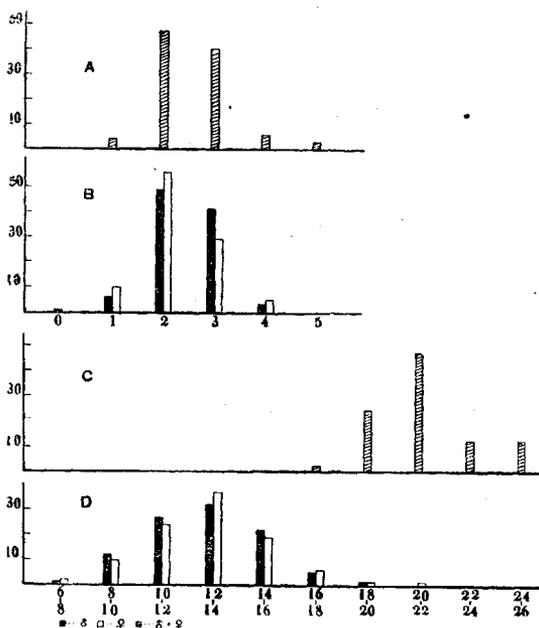


Fig. 1. Frequency histogram of rostral spine number.

A. upper one, B. lower one of *P. compressa*;

C. upper one, D. lower one of *P. improvisa*.

at base (Fig. 2, A), with 16~25 spines (mostly 20~22) on upper and 1~5 spines (mostly 2~3) on lower border near the middle (Table 1 and Fig. 1), well beyond the antennular peduncle; it is feebler in male than in female. Telson subquadrate, armed on each posterior half of dorso-lateral border with 2 pairs of spinules, with about ten or more bristles on terminal margin (Fig. 2, B). Mandible without palp, somewhat Y-shaped, both the molar and incisor processes equally short (Fig. 3, A and A'). Palp of maxilla rudimentary

(Fig. 3, C). Endopodite of first maxilliped densely fringed with distally

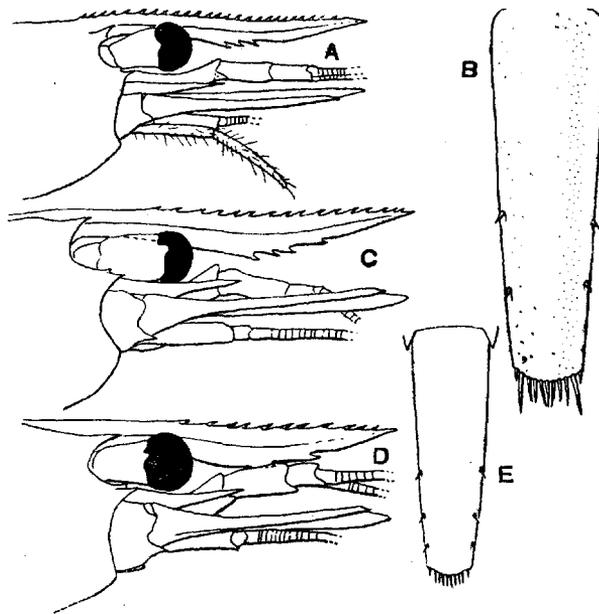


Fig. 2. *A*, Frontal aspect, of *P. compressa*, obtained from Kasumi-ga-ura, ♂, $\times 7.5$; *B*, telson of the same specimen, $\times 15$; *C* and *D*, *P. improvisa*, obtained from the same locality, $\times 7.5$; *E*, telson of the same as in *E* $\times 7.5$.

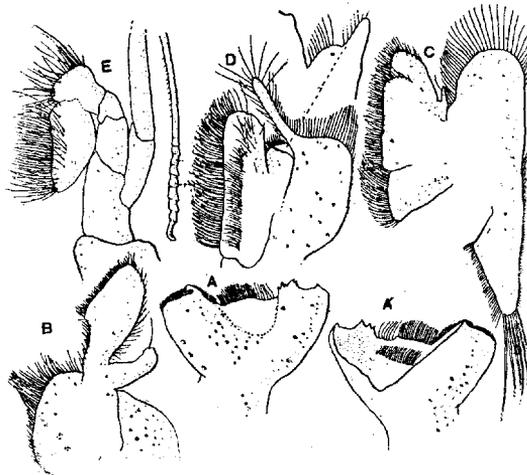


Fig. 3. Mouth parts of *P. compressa* except third maxilliped. *A*, mandible, outer view, \times ca. 23; *A'*, same, inner view; *B*, first maxilla, \times ca. 16; *C*, second maxilla, \times ca. 13; *D*, first maxilliped, \times ca. 13; *E*, second maxilliped, \times ca. 16.

jointed hairs on inner margin of its inner lobe, provided with a lobe-like protuberance at antero-outer angle (Fig. 3, *D*).

Endopodite of first abdominal appendage greatly differs in both sexes: in male, leaf-shaped, with its distal and inner corner elongated in the form of a stripe bearing a tuft of minute curled hairs near its apex, in female, simple, almost linear, acuminate at tip.

	<i>h</i>	<i>i</i>	<i>k</i>	<i>l</i>	<i>m</i>	<i>n</i>	<i>o</i>
Pleurobranchiae	—	—	1	1	1	1	1
Arthrobranchiae	—	1?	—	—	—	—	—
Podobranchiae	—	—	—	—	—	—	—
Mastigobranchiae	1	1	1	1	1	1	—
Exopodites	1	1	1	1	1	1	1

Localities: Itiki (Yuda), Kagosima Pref.; Hukuoka; Iwakuni River, Yamaguti Pref.; Kawasima, Tokusima Pref.; Kobata-numa, Kyôto Pref.; Gokasyo, Mie Pref.; Hukamizo, Miya, Katahara, Aiti Pref.; Toyama; Simoda, Yosida, Siduoka Pref.; Kasumi-ga-ura, Ibaraki Pref.; Murakami, Niigata Pref.; Nobezi, Aomori Pref.

Distribution: Main Island of Japan, Korea (RATHBUN).

Note: The specimens at my disposal agree well with the description of de HAAN of the present species, although his figure is not so confirmative. KEMP's account stands in complete harmony with my material with respect to several morphological characters, but his limitation of the distribution of this species as north as Lake Biwa should be lifted since I have obtained specimens even from the northern end of the Main Island of Japan as already given in the list of localities.

Paratya compressa improvisa KEMP

Paratya compressa improvisa KEMP, 1917, p. 299, fig. 2 (a~f) and fig. 3; 1918, p. 293.

Carapace provided with supraorbital and antennal spines, pterygostomian angle rounded. Rostrum almost horizontally straight, with 7~19 spines on upper from corneal region distad in male but 6~20 ones in female, with 0~4 spines on lower distal half in male but 1~4 in female (Fig. 1, *B* and *D*), reaching beyond antennular peduncle by about one-fourth of its length (Fig. 2, *C* and *D*). Telson subquadrate, armed with two or three pairs of spinules on distal half of dorso-lateral border fringed with ten spinules on terminal border

(Fig. 2, *E*). Mouth-parts entirely same as in the previous species in general aspects. Endopodite of first abdominal appendage leaf-shaped, usually with serrations and comparatively short bristles on inner margin but long ones on outer margin, provided with a bar-shaped elongation at distal inner angle, giving off minute curled hairs at tip. (Fig. 4).

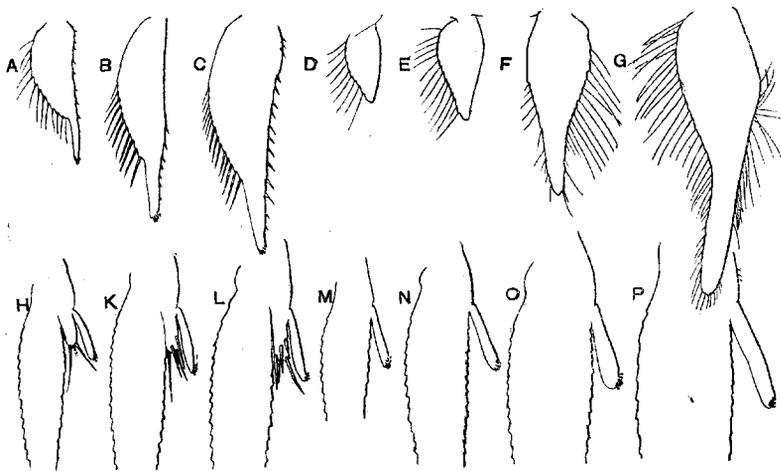


Fig. 4. Upper series: endopodite of first abdominal appendage, lower series: that of second abdominal appendage; each figure with $\times 24$; numerals representing body length in mm. *A*, 13.0, ♂; *B*, 15.0, ♂; *C*, 18.5, ♂; *D*, 14.0, ♀; *E*, 17.0, ♀; *F*, 21.0, ♀; *G*, 24.0, ♀; *H*, 13.0, ♂; *K*, 15.0, ♂; *L*, 18.5, ♂; *M*, 14.0, ♀; *N*, 17.0, ♀; *O*, 21.0, ♀; *P*, 24.0, ♀.

Endopodite of second abdominal appendage carries stylamblys and appendix masculina which is provided with a tuft of setae at apex in male (Fig. 4, *H*~*L*), but with stylamblys only in female as shown in Fig. 4, *M*~*P*.

Localities: Yosida, Siduoka Pref.; Lake Suwa, Nagano Pref.; Lake Kawaguti, Yamanashi Pref.; Yamaguti, Saitama Pref.; Urayasu, Tega-numa, Tiba Pref.; Kasumi-ga-ura, Ibaraki Pref.; Aidu, Hukusima Pref.; Murakami, Niigata Pref.; Kinomata and Ôsida, Yamagata Pref.; Aisaka, Aomori Pref.

Note: The correlation coefficients between body length (1), rostral length (2), upper rostral spine number (3), and lower rostral one (4) were computed, and as shown in the following table no correlation was found to exist between rostral length and rostral spines, although a

significant correlation was observed to occur between body length and rostral length.

Sex	No. of specimens	r_{1-2}	r_{2-3}	r_{2-4}	r_{3-4}
♂	100	0.54±0.04	0.05±0.06	0.32±0.06	0.29±0.06
♀	100	0.73±0.03	0.19±0.06	0.04±0.06	0.31±0.06

Sexual dimorphism is evident in the present species in body length, and features of endopodites of first and second abdominal appendages. Males are much smaller than female as shown in the following table:—

Sex	No. of specimens	Range (mm)	Mean	S.D.	C.V.
♂	100	16.0~21.0	18.73±0.08	1.29±0.08	13.77±0.66
♀	100	19.0~28.5	23.57±0.06	1.02±0.04	8.66±0.41

The reader is referred to the accompanying figures (Fig. 4, *A~P*) for the differences in both sexes in regard to the endopodites of first and second abdominal appendages. The differentiation is observable even in such small specimens as 10 mm long (without rostrum).

Remarkable as they are, the appendages in question do not serve to distinguish *P. compressa improvisa* from the typical form of *P. compressa*. The differences between the two are, as already pointed out by KEMP, to be seen in the number of upper rostral spines and situation of the hindmost upper rostral spine.

Genus *Neocaridina* gen. nov.

Body smooth. Carapace with rostrum and antennal spine, without supraorbital one, antero-lateral border spiniform. Mandible carries no palp. Endopodite of first maxilliped provided with no process on the distal outer border. Two pairs of chelipeds not similar, the second much longer than the first. Frontal border of carpus of the first thoracic legs more or less excavated. Endopodite of first abdominal appendage pear-shaped and greatly enlarged in male, subtriangularly elongated in female. Appendix masculina of second abdominal appendage much enlarged and covered with thickly set

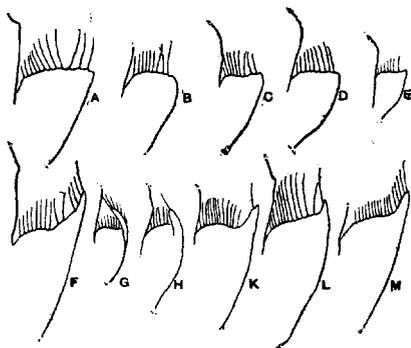


Fig. 5. Endopodite of first maxilliped.

A, *N. denticulata* (collected from Unzen, Nagasaki Prefecture), $\times 35$; B, *N. dent. sinensis* (Shanghai, China), $\times 35$; C, *N. dent. koreana* (Huzan, Korea), $\times 35$; D, *N. denticulata* (Yaidu, Siduoka Prof.), $\times 35$; E, *N. denticulata* (Hukuyama, Hiroshima Pref.), $\times 20$; F, *C. japonica sikokuensis*, $\times 35$. G, *C. japonica*, $\times 20$; H, *C. serratirostris*, $\times 50$; K, *C. leucosticta*, $\times 35$; L, *C. grandirostris*, $\times 50$; M, *C. typus*, $\times 35$.

stout setae in male.

The present genus is closely allied to the genus *Caridina* but differs from it by the following important characters:— (1) Endopodite of first maxilliped without protuberance on its distal outer margin (Fig. 5); (2) endopodite of first pleopod greatly enlarged and pear-shaped in male, subtriangularly elongated in female; (3) appendix masculina of second abdominal appendage much enlarged, thickened and densely covered with setae.

Type species: *Neocaridina denticulata* (de HAAN) = *Caridina denticulata* de HAAN.

Key to the species of *Neocaridina*.

- a. Endopodite of first abdominal appendage greatly dilated in the distal half, the proportion between length and width (in the widest region) about 1: 1.2 in full grown specimen.
- b. Rostrum much beyond the antennular peduncle*N. denticulata*.
- b₁. Rostrum not beyond the antennular peduncle*N. denticulata sinensis*.
- a₁. Endopodite of first pleopod pear-shaped, not so much dilated in its distal half, with the proportions: length 1.7, breadth (in the widest region) 1.
-*N. denticulata koreana*, subsp. nov.

Neocaridina denticulata (de HAAN)

Caridina denticulata de HAAN, 1849, p. 186, Taf. 45, fig. 8; DOFLEIN, 1902, p. 632, Text fig. D; RATHBUN, 1902, p. 49; BALSS, 1914, p. 24; KEMP, 1918, p. 286, Text fig. 11.

Carapace with almost horizontally straight rostrum, antennal spine, but without supraorbitale one, anterolateral margin spiniform. Rostrum feebler in male than in female (Fig. 6, A & B), reaching to or well beyond

the tip of antennular peduncle (Fig. 7, *A~F*), armed with 10~20 spines on upper, (Table, 2.) the posterior 3 or 4 spines of which situated on carapace, without spines on distal two-fifths, with 0~7 spines on

Table, 2.

	Locality	No.	Range	Mode	Mean	S. D.	C. V.
No. of upper rostral spine	Shanghai	41	8~19	16~18	15.8±0.11	2.16±0.08	13.6±1.03
	Huzan (Korea)	131	12~20	16~18	15.6±0.06	2.07±0.04	13.2±0.56
	Hukuyama	83	10~20	16~18	15.4±0.07	1.99±0.05	12.9±0.68
No. of lower rostral spine	Shanghai	41	1~9	4~6	4.7±0.07	1.50±0.05	31.9±2.61
	Huzan (Korea)	131	2~10	4~6	5.6±0.04	1.48±0.03	26.4±1.17
	Hukuyama	83	0~7	4~6	4.7±0.04	1.29±0.03	27.1±1.52
Length of rostrum (mm)	Shanghai	41	2.5~4.6	3.0~3.5	3.4±0.09	0.46±0.06	13.7±1.04
	Huzan	131	2.5~5.0	3.5~4.0	3.7±0.05	0.49±0.04	12.9±0.54
	Hukuyama	83	3.9~6.0	4.5~5.0	4.7±0.07	0.48±0.05	10.2±0.54

Shanghai..... *Neocaridina denticulata sinensis*. Huzan..... *N. dent. koreana*. Hukuyama (Hirosima Prefecture)..... *N. denticulata*.

rather anterior half of the lower (Table, 2.). Telson ornamented with three or four pairs of spinules on dorsal distal two-thirds, each pair at nearly the same intervals, convex on terminal margin which bears 12~14 spinules (Fig. 6, *F~G*). Mandible without palp. Endopodite of first maxilliped comparatively broad, inner margin of the lobe of the maxilliped densely set with proximally simple and distally jointed long setae, without lobe-like process at distal and outer corner (Fig. 8, *D*). First cheliped short, with the proportions against the finger: meropodite 2.6, carpopodite ca. 1.8, palm ca. 0.9; anterior distal margin of carpopodite somewhat excavated. Second cheliped more slender and much longer than the first one, the proportions: meropodite about 3.3, carpopodite ca. 2.5, palm 0.96. Third leg longer than second one, proportions against dactylus: merus 4.2, carpus 3, propodus 3.8; merus ornamented on the posterior margin with one distal largest spine and three proximal smaller spines situated at equal intervals, carpus with a rather large spine near distal border on the outer side, propodus carries many spinules on posterior border; dactylus provided with six spinules on posterior border (Fig. 6, *E*).

Endopodite of the first abdominal appendage in male inverted

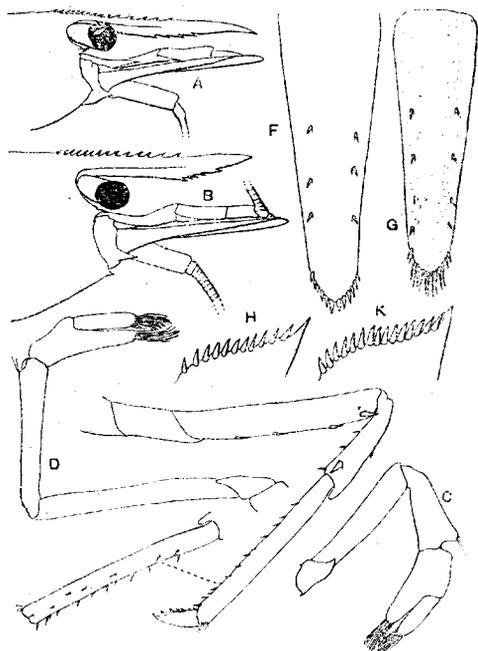


Fig. 6. *A*, Frontal aspect of *N. denticulata* secured from Kobata-ike, Kyoto Prefecture, ♂, ×5; *B*, same as in *A*, ♀, ×5; *C*, first cheliped of same specimen, ×10; *D*, second cheliped, ×10; *E*, third pereopod, ×10; *F*, telson, ×10; *G*, telson (specimen obtained from Hukuyama, Hiroshima Pref.), ×10; *H*, uropodal spine (Hukuyama), ♂ ca. 33; *K*, same as in *H*, ♀, × ca. 33.

pear-shaped and greatly enlarged in its distal half, ratio of length to greatest breadth: 1.2 (Fig. 9, *A-C*), carrying a stylamblys on the inner border, distal peripheral region densely covered with spinules; the same in female elongated subtriangular in shape, fringed with hairs on outer margin, covered with a thicket of short spinules near the middle of inner margin (Fig. 9, *K*, *M*, and *O*). Appendix masculina of second pleopod much enlarged and thickened, much longer than stylamblys, covered with densely set setae in its distal half.

Localities: — Beppu, Ôita Pref.; Nagasaki, Unzen, Nagasaki Pref.; Hukuoka; Hukuyama, Hiroshima Pref.; Kobata-ike, Kyôto Pref.; Yaidu, Siduoka Pref.

Distributions: Main Island of Japan (de HAAN); Peking (DOFLEIN); Hikone, Japan (KEMP).

Branchial formula:

	<i>h</i>	<i>i</i>	<i>k</i>	<i>l</i>	<i>m</i>	<i>n</i>	<i>o</i>
Pleurobranchiae	—	<i>r</i>	1	1	1	1	1
Arthrobranchiae	—	1	1	—	—	—	—
Podobranchiae	1	—	—	—	—	—	—
Mastigobranchiae	—	1	1	1	1	1	—
Exopodite	1	1	—	—	—	—	—

Note: Endopodite of the first pleopod greatly characterized in male as previously mentioned, but it is not so much enlarged in its

immature stage (about 10 mm in body length without rostrum), viz., the proportions of the length against the breadth: 2 (Fig. 9, D). Appendix masculina unusually enlarged in full grown male, but not in the specimens of about 10 mm and downwards in body length

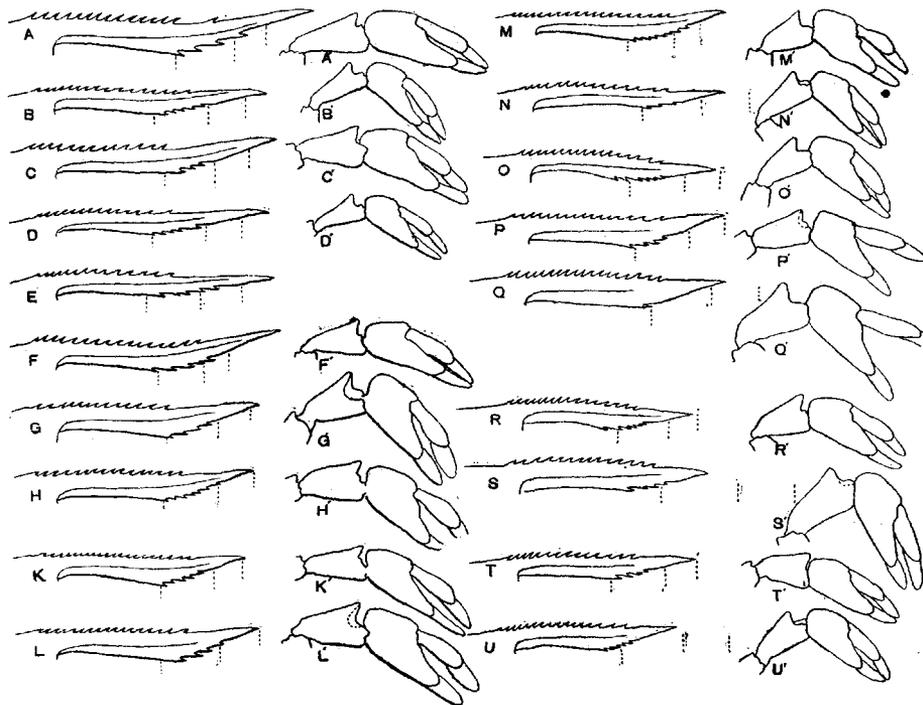


Fig. 7. Rostrum, magnified 7 times (dotted lines indicating terminal end of each segment of antennular peduncle) and distal three joints of first cheliped magnified 10 times respectively. A~F and A'~F', *N. denticulata* secured from Hukuyama, 3 ♂, 3 ♀; G~M and G'~M', *N. dent. coreana* from Huzan, 2 ♂, 3 ♀; N~U, *N. dent. sinensis* from Shanghai, 2 ♂, 8 ♀.

excluding rostrum, being somewhat larger than stylamblys (Fig. 9, H).

Although imperfectly illustrated in his figure, de HAAN's description of *Caridina denticulata* tallies completely with the specimens at my disposal. It seems to me highly probable that the lack of the elongation of the distal outer angle of the endopodite of first maxilliped and the enlargement of the endopodites of first and second abdominal appendages were overlooked by de HAAN. It follows therefore that de Haan's

C. denticulata should be included in the newly created genus.

Neocaridina denticulata sinensis (KEMP)

Caridina denticulata sinensis KEMP, 1918, p. 287, text-fig. 11 (c, d); UENO, 1935, p. 270, fig. 1 (A~G).

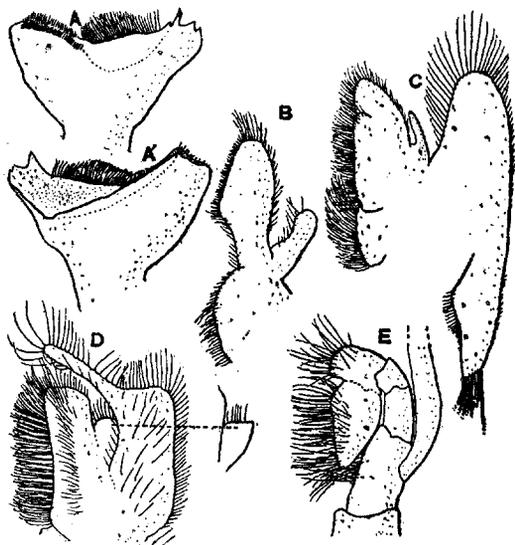


Fig. 8. Mouth parts of *N. denticulata*. A. mandible, outer view, $\times 28$. A'. inner aspect of mandible, $\times 28$. B. maxillula, $\times 20$. C. maxilla, $\times 28$. D. first maxilliped, $\times 16$. E. second maxilliped, $\times 20$.

Rostrum horizontal, not surpassing antennular peduncle, armed with a rather sparse series of 8~19 spines (mostly 16~18, 15.8 on the average) extending over one-third from tip proximad to the median ridge on the carapace (spines on the ridge 2~4), provided with 1~9 spines on lower border (mostly 4~6, 4.7 on the average) (Fig. 7, N~U). Carapace moderately compressed, antennal spine present, supraorbital one absent, pterygostomian angle pointed. Mouth-parts entirely the same as in *N. denticulata*. First cheliped short, palm 0.8 times, carpus about 1.4

times as long as movable finger, excavated on anterior border (Fig. 7, N~U'). Second cheliped much longer than first one, proportions of its distal three segments against finger: palm 0.7, carpus 1.8. Third and fourth thoracic legs similarly slender; third one with proportions against dactylus: propodus 3, carpus 2, merus 4; dactylus usually with five spinules on inner margin, the propodus provided with about 15 spines on posterior border. Fifth leg a little shorter than the previous two, with dactylus bearing stout bristles on inner margin. Endopodite of first and second pleopods similar in both sexes, quite resembles that of *N. denticulata*.

Localities: — Uzantô, Rigyo-ti (Formosa), Isigaki-Zima (Liu-Kiu).

Shanghai.

Distribution: Peking (KEMP).

Note: The present subspecies is closely allied to the typical form of *N. denticulata* (de HAAN), but was separated from it by KEMP (29) by the following two characters: (1) Both upper and lower rostral spines

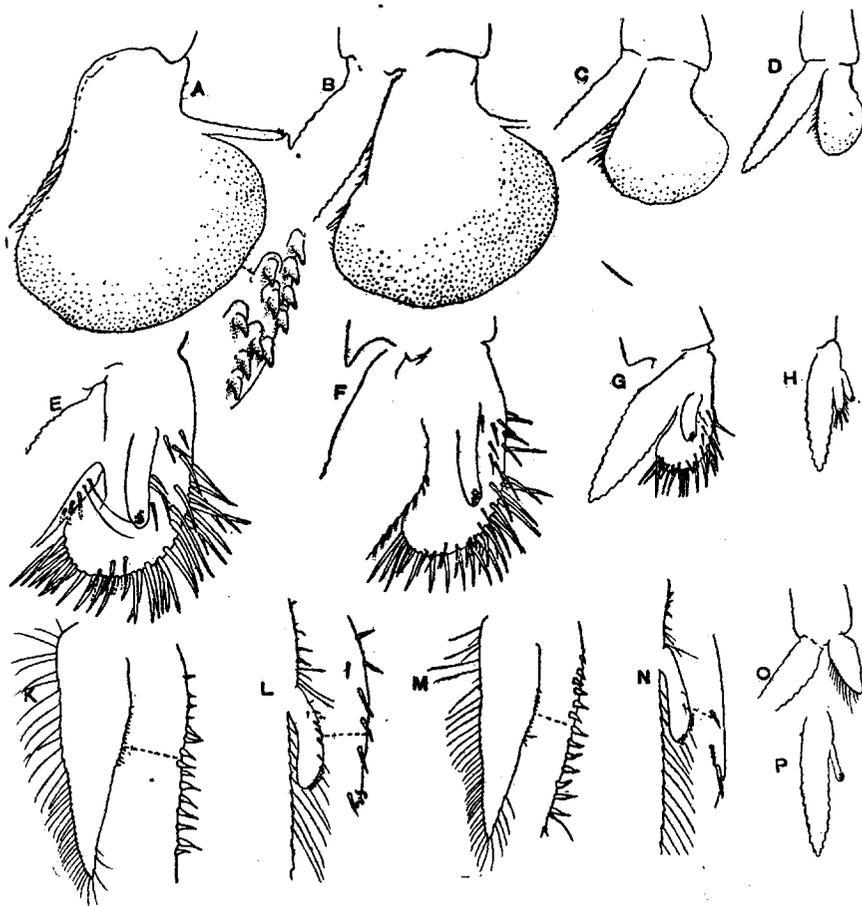


Fig. 9. A, Endopodite of *N. denticulata* of first pleopod in male, body length, 19 mm; B, same as in A, 16 mm; C, same as in A, 11 mm; D, same as in A, 10 mm; E, endopodite of second pleopod in male, 19 mm; F, same as in E, 16 mm; G, same as in E, 11 mm; H, same as in E, 10 mm; I, endopodite of first pleopod in female, 23 mm; J, inner border of second pleopod of female, 23 mm; K, same as in I, 20 mm; L, same as in J, 20 mm; M, same as in K, 20 mm; N, same as in L, 20 mm; O, first pleopod of female, 10 mm; P, endopodite of second pleopod, 10 mm; (each figure magnified 28 times).

rather numerous, varying from 14 to 22 on upper margin and 3 to 8

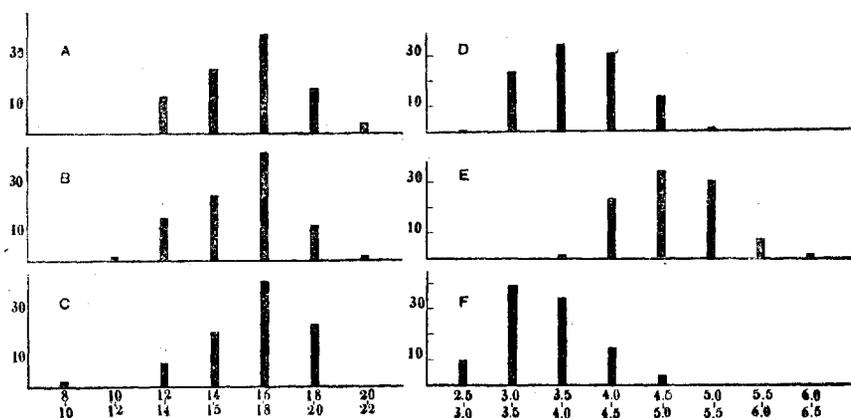


Fig. 10. Frequency histogram. *A*, upper rostral spine number of *N. dent. koreana* collected from Huzan; *B*, same as in *A*, *N. denticulata* from Hukuyama; *C*, same as in *A*, *N. dent. sinensis* from Shanghai; *D*, length of rostrum, *N. dent. koreana*; *E*, same as in *D*, *N. denticulata*; *F*, same as in *D*, *N. dent. sinensis*.

on lower one; (2) anterior border of carpus of first thoracic leg more deeply excavated than that of the typical form of *N. denticulata*.

But my observations on the specimens from Formosa and Shanghai do not warrant one to separate the two forms on the basis of the characters in question (Figs. 7, 10 and 11). It may be mentioned that the rostrum is much shorter in my specimens than that of the typical form and this character may be utilized to distinguish the present subspecies from the latter (Table 2, Figs. 7, 10 and 11). Of the caridid species studied by Bouvier, *Caridina davidi* (1905, p. 83) stands most closely to *N. denticulata sinensis* KEMP in morphological characters and in the locality as well. The absence of spiniform pterygostomial angle, however, separates Bouvier's form from KEMP's.

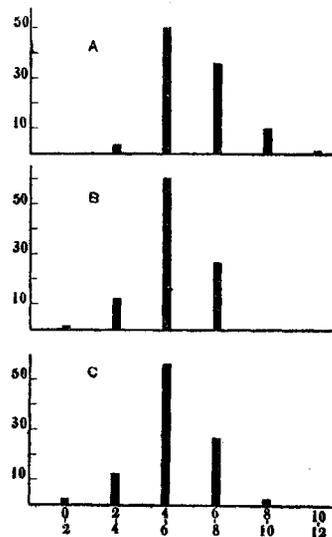


Fig. 11. Frequency histogram of lower rostral spine number. *A*, *N. dent. koreana*; *B*, *N. denticulata*; *C*, *N. dent. sinensis*.

Neocaridina denticulata koreana, subs p. nov.

Carapace about 1.5 times as long as rostrum, with no supra-orbital and antennal spines, pterygostomian margin spiniform. Rostrum almost horizontally straight, almost reaches to or slightly beyond the apex of antennal peduncle (Figs. 7 and 10), with 12~20 spines on upper border (mostly 4~6, 5.6 on the average) (Table 2, Figs. 10 and 11). Mandible without palp. Endopodite of first maxilliped without process at the distal outer angle (Fig. 5, C). First cheliped rather short, with proportions against finger: palm 0.9, carpus 1.2, merus 1.4; moderately excavated on anterior distal border. Second cheliped much longer than first, ratios to finger: palm 0.9, merus 2.0. Last three pairs of legs with regularly set longitudinal spinules on lower border, 3 on merus, 3 or 4 on carpus, about 15 on propodus. Branchial arrangement entirely the same as in *N. denticulata*. Endopodite of first pleopod pear-shaped, length about 1.7 times as long as breadth in male, it is lobular in female, elongated subtriangular in shape, provided with long hairs on outer margin, with a thicket of short setae near the middle region of the inner margin (Fig. 12, E~K). Endopodite of second abdominal appendage with stylamblys and much longer appendix masculina,

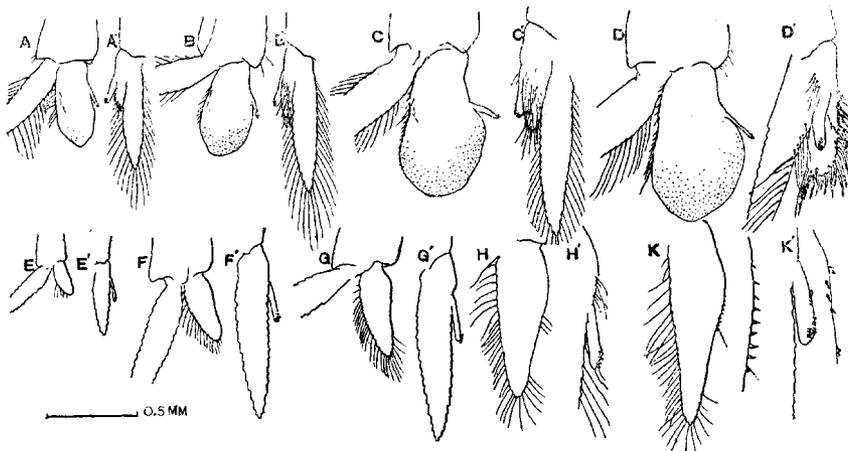


Fig. 12. Endopodite of first (simple letter) and second pleopod (dashed letter) of *N. dent. koreana*; upper series, male, lower series, female; magnification about 23. A, A', body length 10.0 mm, B, B', 12.4 mm. C, C', 15.0 mm. D, D', 19.0 mm; E, E', 5.5 mm; F, F', 13.0 mm; G, G', 15.0 mm; H, H', 20.5 mm; K, K', 23.0 mm.

which is fringed with comparatively long setae on inner and distal margins in male (Fig. 12, *A'~D'*), but with stylumblyls only in female (Fig. 12, *E'~K'*).

The above mentioned description is based on 66 male specimens, ranging 10~20 mm in body length without rostrum and 65 female specimens, ranging 10~24 mm in body length. These specimens were secured from Huzan fish market by Mr. Hiroshi YOSIDA.

Type locality: Huzan (Korea).

Note: Rostral length does not correlate with rostral spines on upper and lower borders, since the correlation coefficient with upper ones is 0.47 ± 0.04 and with lower ones 0.04 ± 0.05 .

Endopodite of first pleopod in younger male about 10 mm in body length excluding rostrum lobe-shaped, the ratio of the length to the breadth about 2.4.

The present subspecies is closely allied to the typical form of *N. denticulata* (de HAAN) and to another subspecies *N. denticulata sinensis* (KEMP), but it is easily distinguishable from them in having endopodite of first abdominal appendage as well as appendix masculina of second pleopod in grown up male smaller than those of the males of the latter two forms. These criteria do not hold true in the three forms when they are younger (Figs. 9 and 11).

Genus *Caridina* MILNE-EDWARDS, emend.

Caridina MILNE-EDWARDS, 1837. p. 362; BATE, 1888, p. 702; de MAN, 1892, p. 363; KEMP, 1918, p. 274; BLANCO, 1935, p. 31.

Carapace acuminate at rostrum and antennal spine. Pterygostomian angle rounded. Mandible without palp. Endopodite of first maxilliped provided with a lobe-like protuberance at outer angle. First shorter and second longer pairs of thoracic legs chelate, chela with a tuft of hairs at apex. First cheliped with carpus moderately excavated on distal border. Branchial formula runs as follows:—

	<i>h</i>	<i>i</i>	<i>k</i>	<i>l</i>	<i>m</i>	<i>n</i>	<i>o</i>
Pleurobranchiae	—	r	1	1	1	1	1
Arthrobranchiae	—	1	1	—	—	—	—
Podobranchiae	1	—	—	—	—	—	—
Mastigobranchiae	—	1	1	1	1	1	—

Exopodite absent on all thoracic legs.

Key to the species of the genus *Caridina*

- a. Without spines on upper border of rostrum*C. typus*.
- a₁. With spines on upper border of rostrum
 - b. With several terminal spines on rostrum
 - c. Rostrum remarkably long, surpasses antennular peduncle by half, dorsal spineless portion covering a distal half or so. Endopodite of first pleopod with stylumblys in male.*C. grandirostris*.
 - c₁. Rostrum not so long, slightly beyond apex of the antennular peduncle, spineless along distal one-fourth of dorsal. Endopodite of the first pleopod without stylumblys*C. leucosticta*.
 - b₁. Without terminal spines on rostrum
 - d. Dorsal median ridge of carapace without spines behind the level of the orbital notch
 - e. Rostrum rather long almost horizontal or slightly directed downwards, almost reaching to or well beyond the second segment of antennular peduncle.*C. japonica*.
 - e₁. Rostrum short, directed obliquely down-wards, not surpassing the first joint of antennular peduncle....*C. japonica sikokuensis* subsp. nov.
 - d₁. Dorsal median ridge of carapace with many spines behind the level of the orbital notch.*C. serratirostris*.

Caridina typus MILNE-EDWARDS

- Caridina typus* MILNE-EDWARDS, 1837, T. II, p. 363, pl. 25, figs. 4 and 5.
 BATE, 1888, p. 704, pl. 119, fig. 3; BOUVIER, 1904, p. 134; 1905, p. 88, fig. 10; ROUX, 1929, p. 235; 1904, p. 552; EDMONDSON, 1935, p. 14, fig. 2, g-1; de MAN, 1892, p. 367, Taf. 21, fig. 22.
C. exilirostris STIMPSON, 1860, p. 30.

Rostrum short, reaching to about the middle of penultimate segment of antennular peduncle, directed somewhat downwards, distal portion lanceolated, upper border without spine, but lower one with 0-4 spines. Supraorbital spine absent and antennal one present. Pterygostomian angle rounded (Fig. 13, A). Telson subrectangular, length about 3.4 times as long as the breadth of distal border, dorsally ornamented with 6 pairs of spinules in the distal two-thirds, distal margin convex and armed with 14 setae (Fig. 13, F). Outer margin of antennal scale ends in a spine which stretches to the level of the apex of the antennular peduncle. Mandible without palp. Endopodite of first maxilliped bears a process at outer angle (Fig. 5, M). First cheliped the shortest of all legs, proportions against finger: palm 1.1, carpus 1.5, merus 1.7; carpus more or less excavated on distal border.

Second cheliped slender and longer than the first one, ratios to finger : palm 0.73, carpopodite 2.2, meropodite 2.1, ischiopodite 1.1. Third pereopod stouter and longer than the second, dactylus with 6 spines on its inner border; propodus armed with many spinules on posterior surface; carpus about 0.6 times as long as propodus, with a stout spine near distal posterior; merus about 1.5 times as long as propodus, with one terminal and other three spinules set at equal intervals on posterior

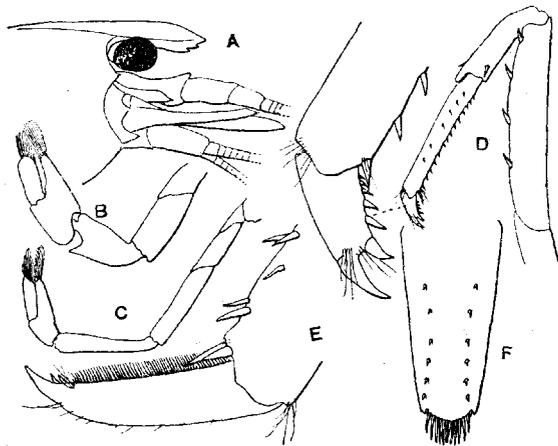


Fig. 13. *A*, Frontal aspect of *C. typus*, ♀, ×4; *B*, first cheliped, ×8; *C*, second cheliped, ×6; *D*, third leg, ×6; *E*, tip of fifth leg, ×40; *F*, telson, ×ca. 8.

border (Fig. 13, *D*). Fifth leg longer than fourth, dactylus with about 60 setae on the inner margin (Fig. 13, *E*).

The above description is based on numerous adult and young specimens from 11 to 30 mm in body length.

Localities: Simoda, Yaidu, Siduoka Pref.; Yuda (Itiki), Kagosima Pref.; Okinawa, Miyakozima, Iriomote-zima (Liu-kiu Island)

Distributions: Flores, Saleyer, Celebes (de MAN); Suva (EDMONDSON); Lombok (ROUX).

Note: Endopodite of first abdominal appendage

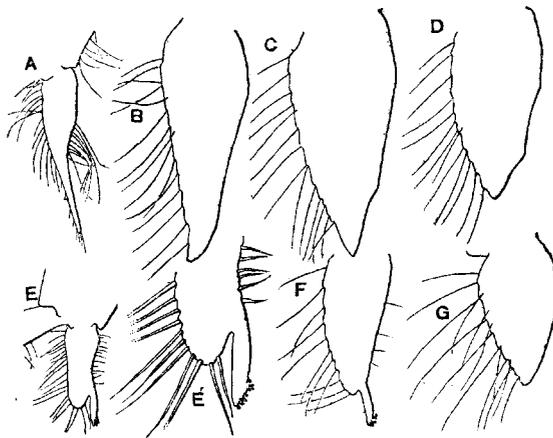


Fig. 14. Endopodite of first pleopod of *C. typus*, upper series: female, lower series: male. *A*, ovigerous, body length, 30.0mm, ×12; *B*, 17 mm, ×60; *C*, 14 mm, ×80; *D*, 13 mm, ×80; *E*, 22 mm, ×16; *E'*, same as in *E*, ×40; *F*, 13 mm, ×80; *G*, 11 mm, ×80.

at first makes its appearance as a small oval lobe in both sexes at a stage about 11 mm in body length without rostrum (Fig. 14, *G*). In male stylamblys buds out its inner terminal margin when the animal is about 12 mm long without rostrum (Fig. 14, *F*), whilst the opposite distal outer angle assumes an auricular shape when mature. Female lacks stylamblys in the appendage in question which is acuminate at tip.

Presence or absence of spines on rostrum appears to be one of the most important criteria to distinguish *C. typus* MILNE-EDWARDS from *C. acuminata* STIMPSON. As already remarked by de MAN, such character, however, falls within the range of individual variations of my specimens. But BALSS's (1914) specimens of *C. acuminata* obtained from Ito, Prov. Idu show discrepancy to the material at my disposal in having 7 spinules (instead of 60 setae) on the posterior border of fifth leg. His description and figure leave much to be desired from the viewpoint of taxonomy so that we are not in a position to decide between the alternatives whether or not *C. acuminata* of his is identical with *C. typus* MILNE-EDWARDS.

Caridina grandirostris STIMPSON

Caridina grandirostris STIMPSON, 1860, p. 28.

Carapace with antennal spine, but without supraorbital one, pterygostomial angle rounded. Rostrum somewhat longer than carapace, mostly with 14 spines (ranging from 14 to 22) arranged from the middle of upper border proximad to the median ridge, on which 2 of the spines are situated, with 2 or 3 spines at apex, and with mostly 18 (ranging from 10 to 20) overlapping spines on inferior border (Fig. 15, *A*). Telson slender, with five short pairs of spinules on dorso-lateral sides, with four pairs of longer spinules on obtusely pointed distal border (Fig. 15, *L*). Uropods with 11 spines as shown in Fig. 15, *M*. Antennal scale extending beyond the distal end of antennular peduncle. Mandible without palp. Endopodite of first maxilliped provided with a rather small lobe-like process at distal outer angle (Fig. 5, *L*). First pereopod with proportions against finger: palm 1.1, carpus 1.9, merus 1.9; carpus moderately excavated on distal anterior border. Second leg much longer than first, with ratios to finger: palm 0.7, carpus 2.2, merus 2. Third stouter than second. Fourth as stout

as third, dactylus with 7 spinules on posterior border; propodus armed with 15 setae on its posterior border, length about 15.5 times the breadth; carpus about 0.5 times as long as propodus, with 3 feeble spines, 1 very stout almost terminal one on posterior border; merus about 1.2 times as long as propodus with 3 spines on posterior border (Fig. 15, *D*). Fifth pair similar to preceding two, dactylus with about 50 spines on posterior border (Fig. 15, *E*). Endopodite of first pleopod leaf-shaped, giving off a stylamblys at distal inner angle in grown-up male (Fig. 15, *G*), but simply elongated in full grown female (Fig. 15, *K*).

Localities: Izumi, Kimmura, Nakizin, Tengagawa (Okinawa-zima).

Distribution: Liu-Kiu (STIMPSON).

Note: Stylamblys of first pleopod is not yet present in an immature male about 13 mm in body length without rostrum (Fig. 15, *F*). Endopodite of first pleopod of an immature female about 13 mm

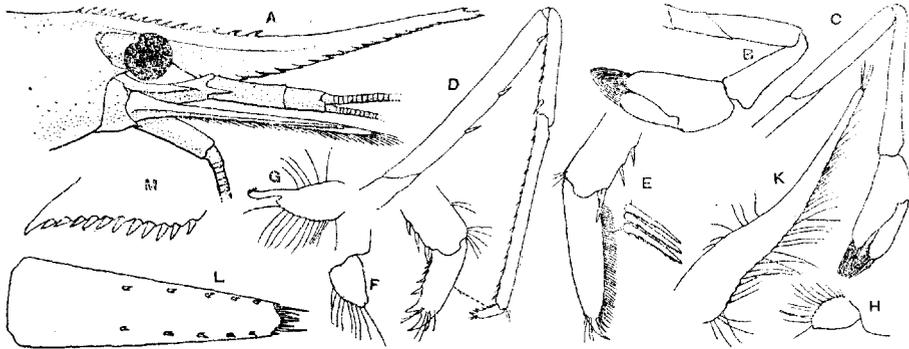


Fig. 15. *A*, Frontal aspect of *C. grandirostris*, ♀, $\times 7$; *B*, first pereopod, \times ca. 13; *C*, second pereopod, $\times 10$; *D*, fourth pereopod, $\times 10$; *E*, ultimate segment of fifth leg, \times ca. 33; *F*, endopodite of first pleopod of male body length 13.2 mm, \times ca. 33; *G*, same as in *F*, body length 15.5 mm; *H*, same as in *F*, female, 13.0 mm, \times ca. 33; *K*, same as in *H*, 22.0 mm, \times ca. 33; *L*, telson, $\times 10$; *M*, uropodal spine, \times ca. 33.

in body length excluding rostrum, somewhat oval in outline just like that of immature male (Fig. 15, *F*).

In his description of *C. grandirostris*, STIMPSON puts: "Rostrum carapace vix brevius, ...crista dorsali supra oculos fere recta et denticulis minutis ab 20 serrata, denticulo postico supra basim pedunculorum oculorum sito; cristae parte quarta anteriore edentula, denticulo uno mediano et duobus apicalibus exceptis; rostri margine inferiore obscure

8—10-denticulato." It may be mentioned that my specimens stand at variance with his account in having (1) rostrum not shorter than carapace; (2) upper rostral spines 14 to 22 and lower ones 10~20; (3) upper border of rostrum unarmed in distal half.

Caridina leucosticta STIMPSON

Caridina leucosticta STIMPSON, 1860, p. 28; RATHBUN, 1902, p. 49.

Caridina nilotica gracilipes, UÉNO, 1935, p. 272, Fig. 2.

Carapace with antennal spine, but without supraorbital spine, anterolateral margin rounded. Rostrum as long as carapace, subhorizontal but slightly concave near the middle of the upper border, passing proximally into a low and short ridge on carapace, dorsally with 15~23 (mostly 20, 19.8 on average) spines, 2 or 3 of which are placed on the ridge, with 1~3 (mostly 1, 1.5 on average) isolated spines at tip and ventrally with 6~22 (mostly 12, 10.3 on average) spines. (See below).

	Range	Mean	C. D.	C. V.
Upper	15~23	19.8±0.23	2.08±0.19	10.5±0.84
Tip	1~3	1.5±0.08	0.06±0.05	4.3±0.39
Lower	6~22	10.3±0.46	0.41±0.33	3.9±0.31

(Specimens, 59).

Telson slender, three times as long as wide (proximally), ratio of proximal border to distal border 5:2, dorsally armed with three pairs of spinules, terminally with 9 setae (Fig. 16, *K*). Antennal peduncle shorter than rostrum. Antennal scale somewhat extending beyond tip of rostrum. Mandible without palp. Endopodite of first maxilliped with a lobe-like protuberance at outer distal angle (Fig. 5, *K*). First leg the shortest of all; ratios to finger: palm 1, carpus 1.5, merus 1.7; carpus somewhat excavated on distal border. Second leg much longer than first, ratios to finger: palm 0.7, carpus 1.8, merus 1.7; merus about 5 times as long as wide. Third leg much longer than second cheliped; dactylus about one-fourth the length of propodus, with 6~7 spines on posterior border, propodus 12.5 times as long as wide, with terminal one pair of longer setae and many shorter irregularly set setae on its posterior border, carpus about 0.6 times as long as propodus; merus somewhat longer and stouter than propodus, with a spine on posterior border. Fifth leg fringed with about 50~60 setae on posterior border of dactylus (Fig. 16, *E*). Endopodite of first pleo-

pod without stylamblys in full grown male specimens (Fig. 16, *G* and *H*), but much longer than female, ending very acutely (Fig. 16, *F*).

Localities: Yuda (Itiki), Kagosima Pref.; Midori-kawa, Kumamoto Pref.; Nagasaki; Kurume, Yukuhasi, Hukuoka Pref.; Yosino-gawa, Tokushima Pref.; Miya, Aiti Pref.; Yaidu, Simoda, Siduoka Pref.; Murakami, Niigata Pref.

Distributions: Liu-Kiu (STIMPSON); Kurume (RATHBUN).

Note: The present species is closely allied to, if not identical with, the typical form of *C. nilotica* ROUX and its subspecies especially *C. nilotica gracilipes* de MAN. It may be mentioned that the Formosan specimens which Dr. UENO (1935) had referred to *C. nilotica gracilipes* were kindly placed by him at my disposal and they revealed nothing different from the specimens from other places of Japan which

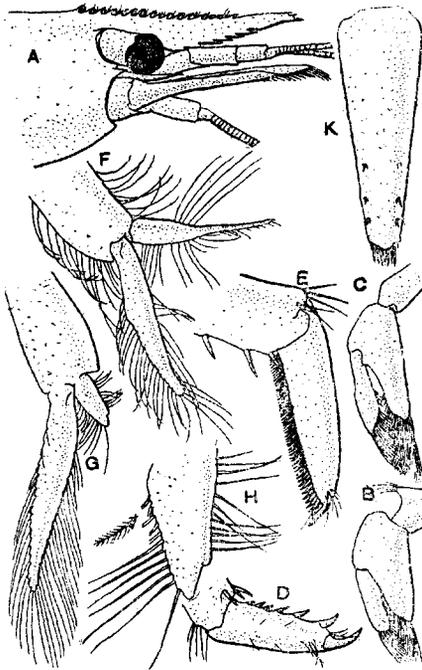


Fig. 16. *A*, Frontal aspect of *C. leucosticta*, ♀; *B*, chela of first leg; *C*, chela of second leg; *D*, terminal segment of third leg; *E*, dactylus of fifth leg; *F*, first pleopod; *G*, second pleopod; *H*, endopodite of second pleopod.

Species	Size of egg (mm)		Investigator	Locality
	length	breadth		
<i>C. nilotica</i>	0.70~0.86	0.42~0.48	de Man	Cairo.
<i>C. nil. natalensis</i>	0.42~0.46	0.24~0.29	"	Natal.
<i>C. nil. paucipara</i>	0.96~1.10	0.55~0.67	"	"
<i>C. nil. longirostris</i>	0.33~0.39	0.21~0.26	"	Macta, near Oran.
<i>C. nil. bengalensis</i>	0.42~0.49	0.25~0.30	"	Bengal.
<i>C. nil. brachydactyla</i>	0.39~0.49	0.22~0.25	"	Celebes, Saleyer, Flores.
<i>C. nil. gracilipes</i>	0.35		"	Celebes, Saleyer.
" "	0.50~0.52	0.31~0.32	Kemp	Shanghai.
<i>C. nil. minahassa</i>	0.55		de Man	Minahassa, Saleyer.
<i>C. leucosticta</i>	0.60~0.50	0.30~0.37	Kubo	Kotōsi (Formosá).
" "	0.35~0.48	0.20~0.29	"	Miya (Aiti Prefecture).

are referred to *C. leucosticta* in the preceding paragraphs. The egg size has been utilized, amongst others, to distinguish *C. leucosticta* from *C. nilotica* and its subspecies. But as shown in the preceding table, no decided differences could be found, not to mention that the apparent differences in egg size might be due to differences in developmental stages.

Caridina japonica de MAN

Caridina japonica de MAN, 1892, P. 261, Taf. 9, Fig. 7; BALSS, 1914, P. 25.

Rostrum about 0.6 times as long as carapace, a little ascending at base but otherwise stretching almost horizontally, serrated with 13~25

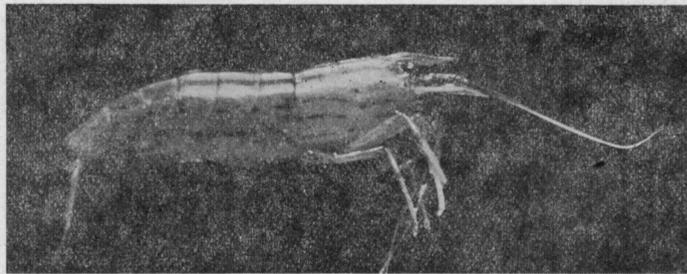


Fig. 17. *Caridina japonica* de MAN, ♀, ×1.2.

spines on dorsal except its anterior one-third, with 4~14 spines on ventral. Antennal spine present but supraorbital one absent, antero-

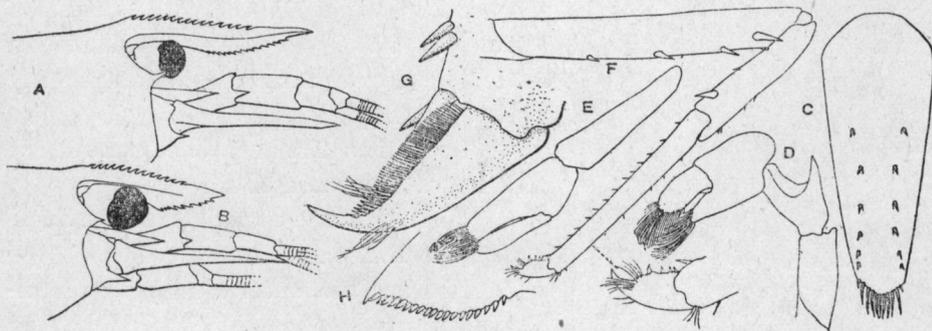


Fig. 18. A, Frontal aspect of *C. japonica*, ♀, ×4; B, same as in A, (variety), ×4; C, telson, ×7; D, first cheliped, ×7; E, terminal three joints of second cheliped, ×7; third leg, ×7; G, dactylopodite of fifth leg, ×ca. 33; H, uropodal spines, ×ca. 13.

lateral margin not spiniform. Mandible without palp. Endopodite of first maxilliped with a lobe-like process at the distal outer angle (Fig. 5, *G*). Telson with 6 pairs of spinules in distal three-fifths, with 11 spinules on obtusely convex terminal margin (Fig. 18, *C*). First cheliped the shortest of all thoracic legs, with palm 1.5, carpus 1.5 and merus 1.9 in finger, carpus excavated anteriorly (Fig. 18, *D*). Second cheliped much longer than the first one, palm about 0.7, carpus 1.7, times as long as dactylus (Fig. 18, *E*). Third leg shorter and much longer than second one; dactylus with 4, propodus with 14 spinules on each posterior border; carpus about 0.6 times as long as propodus, with subterminal spine on posterior border; merus about 1.5 times the length of propodus, with 4 spines on posterior border (Fig. 18, *F*). The remaining two pairs of pereiopods similar, except dactylus of the fifth

leg mostly subtriangular, fringed with 54 spinules on the posterior border, and with a recurved hook at tip (Fig. 18, *G*). Endopodite of the first pleopod of male with rounded apex which is surpassed by a long protuberance growing from distal inner angle (Fig. 19, *A*), same of female acuminate at tip without any protuberance (Fig. 19, *C*). Endopodite of second pleopod provided in male with bar-shaped stylamblys and appendix masculina which is twice as long as stylamblys and armed with a tuft of setae at apex (Fig. 19, *B*), same in female with a longer stylamblys only (Fig. 19, *D*).

Localities: Tanabe, Wakayama Pref.; Okinawa-zima (Liu-Kiu).

Distributions: Japan (de MAN), Sagami Bay (BALSS).

Note: This species may be distinguished from *C. weberi*⁽³³⁾ by having dactylopodite of fifth leg subtriangular in outline and from *C. laevis*⁽³³⁾ by having such a characteristic form of dactylopo-

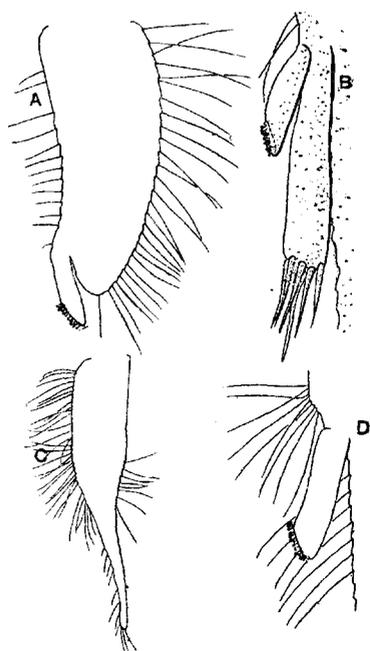


Fig. 19. *A*, Endopodite of first pleopod of *C. japonica*, ♂, ×40; *B*, stylamblys and appendix masculina, ×40; *C*, same as in *A*, ♀, ×16; *D*, stylamblys of second pleopod, ♀, ×28.

dite of the appendage in question but no spine on median ridge of carapace.

Caridina japonica sikokuensis subsp. nov.

Carapace about 4 times as long as rostrum. Rostrum short, not reaching to the distal border of the basal segment of antennular peduncle, directed strongly downwards, armed with 21 spines on almost whole dorsal border, with 13 spines on subterminal portion of lower border (Fig. 20, *A* and *B*). Antennal spine present, pterygostomial angle rounded. Telson much shorter than uropods, with a longitudinal series of 6 pairs of spinules toward dorsal end, with 7 long, 2 short setae on rectangularly pointed terminal margin (Fig. 20, *C*). Mandible

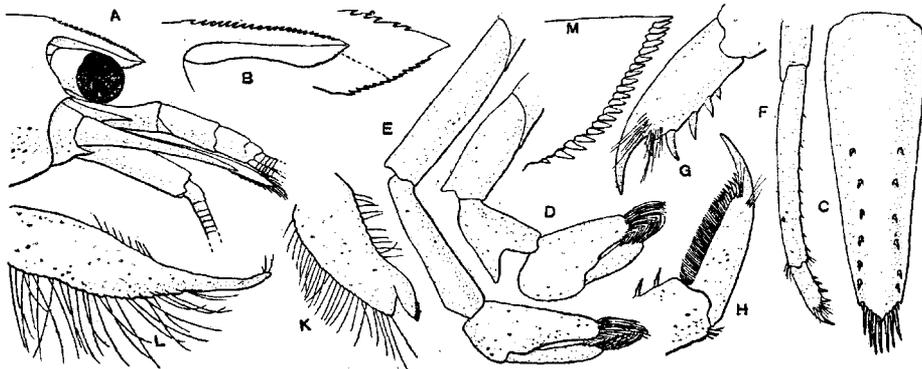


Fig. 20. *A*, Frontal aspect of *C. japonica sikokuensis*, ♂, ×7; *B*, rostrum and its tip, ×ca. 13; *C*, telson, ×ca. 13; *D*, first thoracic leg, ×10; *E*, second thoracic leg, ×10; *F*, distal two segments of third leg, ×10; *G*, dactylus of third leg, ×ca. 33; *H*, dactylus of fifth leg, ×ca. 33; *K*, endopodite of first abdominal appendage, ♂, ×ca. 23; *L*, same as in *K*, ♀, ×ca. 23; *M*, uropodal spines, ×ca. 13.

without palp. Endopodite of first maxilliped with a papilliform protuberance projecting from the distal outer angle (Fig. 5, *F*). First cheliped the shortest, palm 0.9, carpus 1.2, merus 1.7 in finger, carpus excavated on anterior border. Second cheliped a little longer than 1.5 times the length of the first one, palm in finger 0.6, carpus 1.6, merus 1.9. Third leg slightly longer than 1.4 times the length of the second; dactylus with 5 spinules on posterior border; propodus about thrice as long as dactylus, with 9 spinular setae on posterior border (Fig. 20, *F* and *G*). Fourth leg almost the same as the third leg in

shape and size. Dactylus of fifth leg fringed with 56 long setae on the posterior border (Fig. 20, *H*). Endopodite of first abdominal appendage lobe-like, provided in male with a stylamblys at distal inner angle (Fig. 20, *K*), but simply lanceolate in female (Fig. 20, *L*).

The description given above is based on a male specimen of 29.5 mm, and a female ovigerous specimen of 30.5 mm in body length from posterior margin of orbital notch to tip of telson.

The present subspecies is closely allied to the typical form of *Caridina japonica* de MAN, but it is easily distinguished from it by having rostrum exceedingly short and directed strongly downwards.

Type locality: Ryûgadô, Kôti Prefecture (Mr. K. MORI).

Caridina serratiostris de MAN

Caridina serratiostris de MAN, 1892, p. 382, Pl. 23, Figs. 28 and 28 (a-h).

EDMONDSON, 1935, p. 8, Fig. 2 (g-l).

Carapace with antennal spine, without supraorbital one, pterygostomian angle not spiniform. Rostrum almost horizontal, but slightly descending distally, about 0.5 times as long as carapace, with 23 spines on upper border and median ridge of carapace, with 5 spines on lower

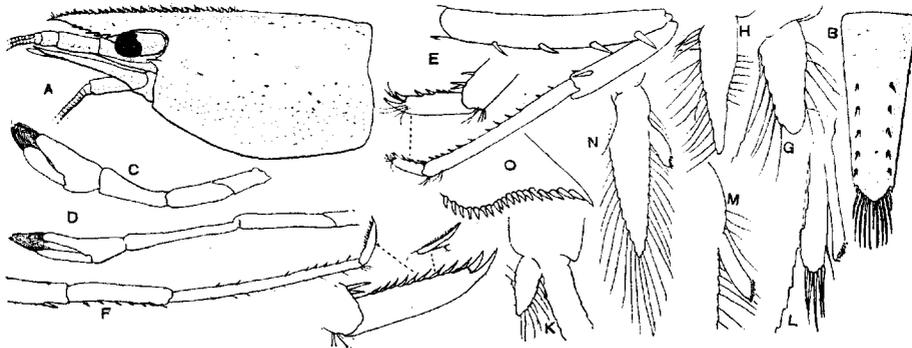


Fig. 21. *A*. Profile of cephalo-thorax of *C. serratiostris*, body length 14 mm, ♀, ×7; *B*, telson, ×ca. 13; *C*, first cheliped ×ca. 13; *D*, second cheliped, ×10; *E*, third thoracic leg, ×ca. 16; *F*, terminal three segments of fifth leg (×ca. 16) and its dactylus (×ca. 66); *G*, endopodite of first abdominal appendage, ♂, ×ca. 66; *H*, same as in *G*, ♀, ×ca. 33; *K*, same as in *H*, body length, 10.5 mm, ×ca. 33; *L*, stylamblys and appendix masculina of ♂, 9 mm in body length, ×ca. 66; *M*, stylamblys of second pleopod in female, ×ca. 33; *N*, endopodite of second abdominal appendage of 10.5 mm in body length, ♀, ×ca. 33; *O*, uropodal spines, ×ca. 33.

border (Fig. 21, *A*). Telson dorsally armed with a longitudinal series of 5 pairs of spinules, and with 11 long, 2 short spinular setae on convex distal border (Fig. 21, *B*). Antennular peduncle extends slightly beyond tip of rostrum; stylocerite overlapping second joint of antennular peduncle by one-fourth. Mandible without palp. Endopodite of first maxilliped with a lobe-like process at distal outer angle (Fig. 5, *H*). First cheliped the shortest of all pereopods; palm in finger 0.6, carpus 1.2, merus 1.2, ischium 0.7; carpus not excavated on distal border (Fig. 21, *C*). Second cheliped slender, much longer than first, palm in finger 0.6, carpus 2, merus 1.7 (Fig. 21, *D*). Third leg stouter than second one; dactylus about one-fourth the length of propodus, with 6 spinules on posterior border; propodus with 13 spinules on posterior; carpus about two-thirds the length of propodus, with a subterminal spinular seta; merus about 1.3 times as long as propodus, with four spinules on posterior border (Fig. 21, *E*). Fourth leg much resembles third one. Fifth leg somewhat slenderer than previous two pairs of legs, dactylus about one-fourth the length of propodus, with 10 spinules on posterior border (Fig. 21, *F*), dactylus about one-fourth the length of propodus, with 10 spinules on posterior border (Fig. 21, *F*). Endopodite of first pleopod lobular, rounded at tip in male (Fig. 21, *G*), but pointed in female (Fig. 21, *H*). Endopodite of second pleopod armed in male with stylamblys and equally long appendix masculina which is furnished with a tuft of long setae at apex, but in female with stylamblys only (Fig. 21, *M* and *N*). Uropods with 19 spinules in both sexes (Fig. 21, *O*).

Locality: Okinawa-zima (Liu-Kiu), Dr. Yaitirô OKADA.

Distributions: Saleyer, Flores (de MAN); Jacquinet Bay, Mélanésienne; Queensland (ROUX).

Note: Remarkably enough, posterior border of dactylus of fifth leg is furnished with 10 spinules in the present species instead of 30~65 spinules as in other species belonging to genera, *Paratya*, *Caridina*, *Neocaridina* and *Atya*.

Genus *Atya* LEACH, emend.

Atya LEACH, 1815, p. 345; NEWPORT, 1847, p. 158; de HAAN, 1849, p. 185; BATE, 1888, p. 691; de MAN, 1892, p. 355; 1915, p. 407; BLANCO, 1935, p. 30.

Antennal spine present, supraorbital one absent. Mandible without palp. Endopodite of first maxilliped provided with a lobe-like protu-

berance at distal outer angle. Both first and second chelipeds quite similar in general aspects, carpus crescent-form, chela composed of two similar fingers which are provided with a tuft of long hairs on the distal border.

Atya moluccensis de HAAN

Atya moluccensis de HAAN, 1849, p. 186; MIERS, 1880, p. 382, Pl. 15, figs. 3 and 4; de MAN, 1892, p. 357, pl. 21, fig. 20; 1915, p. 407, Taf. 28, figs. 5 and 5a~d; BOUVIER, 1904, p. 137; BALSS, 1914, p. 26; BLANCO, 1935, p. 30.

Body large, entirely covered with fine spinules. Rostrum rather short, triangular in upper aspects, more or less deflexed, slightly shorter than 0.4 times the length of carapace, not reaching to the ter-

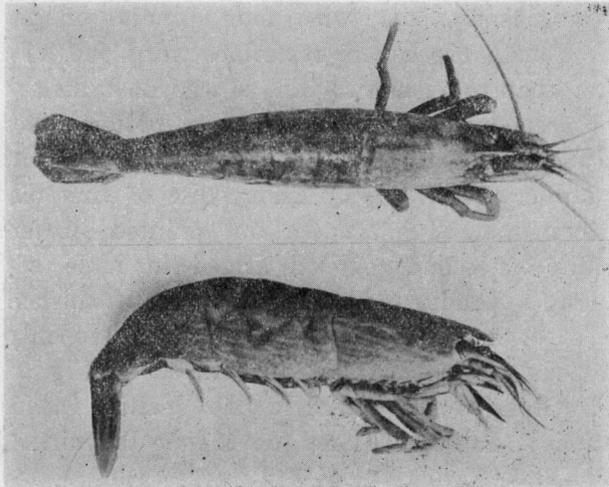


Fig. 22. *Atya moluccensis* de HAAN, ♀, × ca. 1.2.

minal margin of penultimate article of antennular peduncle, dorsal carina extending backwards to post-orbital region (Fig. 22), spineless dorsally, but with 8 spines ventrally (see below).

Number of lower rostral spines	3	4	5	6	7	8
Frequency	2	5	7	2	2	2

Infraorbital and pterygostomian angles each end in an acute spine (Fig. 23, A). Telson shorter than uropods, with two longitudinal series of 6~7 spinules on dorsal with a median and two marginal processes on distal convex border which bears several bristles (Fig. 23, B).

Mandible without palp (Fig. 23, *C* and *D*). Endopodite of first maxiliped with a lobular triangular process at distal angle. Chelipeds. quite similar in size and general aspects, carpus deeply excavated on anterior border, fingers similar (Fig. 23, *E* and *F*). Third to fifth pairs of legs much alike, densely covered with setae all over. Third leg stoutest of all walking legs, propodus in dactylus about 2.8, carpus 2, merus 6; carpus with a subterminal spine on the posterior border,

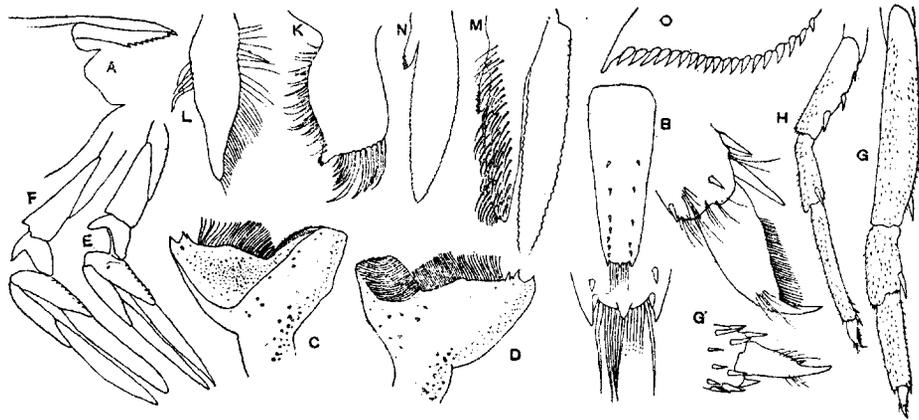


Fig. 23. *A*, Frontal region of carapace of *A. moluccensis*, ♀, ×4; *B*, telson, ×4; *C*, inner view of mandible, ×ca. 16; *D*, outer view of mandible, ×ca. 16; *E*, first leg, ×4; *F*, second leg, ×4; *G*, third leg, ×4; *G'*, dactylus of third leg, ×ca. 13; *H*, fifth leg, ×4; *H'*, dactylus of fifth leg, ×ca. 23; *K*, endopodite of first pleopod in male, ×ca. 13; *L*, same as in *K* in female, ×ca. 16; *M*, endopodite of second pleopod in male with stylamblys and appendix masculina, ×ca. 13; *N*, endopodite of second pleopod in female with stylamblys, ×7; *O*, uropodal spines, ×ca. 13.

merus with one small spinules and one large spine on the posterior border (Fig. 23, *G*). Fifth leg smaller and shorter (about 0.8 times) than third and fourth ones, propodus in dactylus 4, carpus 2, merus 3; dactylus armed with 32 setae in distal two-thirds of the posterior border except apical claw, carpus with a subterminal spinule on postero-lateral side, merus furnished with 3 spinules on posterior border (Fig. 23, *H*).

Definite branchiae two in number.

	<i>h</i>	<i>i</i>	<i>k</i>	<i>l</i>	<i>m</i>	<i>n</i>	<i>o</i>
Pleurobranchiae	—	r	1	1	1	1	1
Arthrobranchiae	—	1	1	—	—	—	—
Podobranchiae	—	—	—	—	—	—	—
Mastigobranchiae		r?	r	r	—	—	—
Exopodite	1	1	—	—	—	—	—

Endopodite of first pleopod resembles a sail of a boat in outline, with a short papilliform protuberance at inner distal corner, densely furnished with bristles on inner and terminal borders in male (Fig. 23, *K*), but in female, with long hairs on whole outer and central inner borders, both meeting acutely at tip (Fig. 23, *L*). Endopodite of second pleopod provided with a large appendix masculina as well as small stylamblys on its inner side, the former thickly set with setae (Fig. 23, *M*), but in female, with a stylamblys only (Fig. 23, *M*). Uropod with 19 spines (Fig. 23, *O*).

Above description is based on a male, 31 mm long, and an ovigerous female specimen, 51 mm in body length from posterior margin of orbital notch to the tip of telson.

Localities: Okinawa-zima, Miyako-zima, Isigaki-zima (Liu-kiu).

Distributions: Java; Sumatra; Celebes; Saley; Timor; Flores (de MAN); Philippine (BLANCO).

Note: According to MIER's⁽³⁷⁾ descriptions and illustrations which are based on an adult male from Java, "the third leg considerably dilated, and the merus armed below with a strong spine placed at some distance from the distal border of the segment". But my specimens have two unequal spinules instead of a strong spine in corresponding part of third leg which is not dilated.

III. General consideration

So far as my observations on the majority of the family Atyidae go, two modes of subdivisions may be recognized in this family, viz., geographical and morphological. The geographical distribution of the group warrants one to set five subgroups into which the group in question is divided, namely, (1) Korean, (2) All Japan, (3) Northern Japan, (4) Southern Japan, and (5) Subtropical and tropical Japan.

(1) Korean subgroup includes one which is endemic to Korea, *Neocaridina denticulata koreana*.

(2) All Japan subgroup covers the whole Japan in the extent of

distribution and is represented by *Caridina leucosticta*, *Paratya compressa* may also be said a member of this subgroup but it is not yet found more southern than Kyûsyû.

(3) Northern Japan subgroup extends from the latitude 35° northward to northern extremity of the Main Island of Japan in area and is inhabited by a subspecies of *P. compressa*, viz., *P. compressa improvisa*.

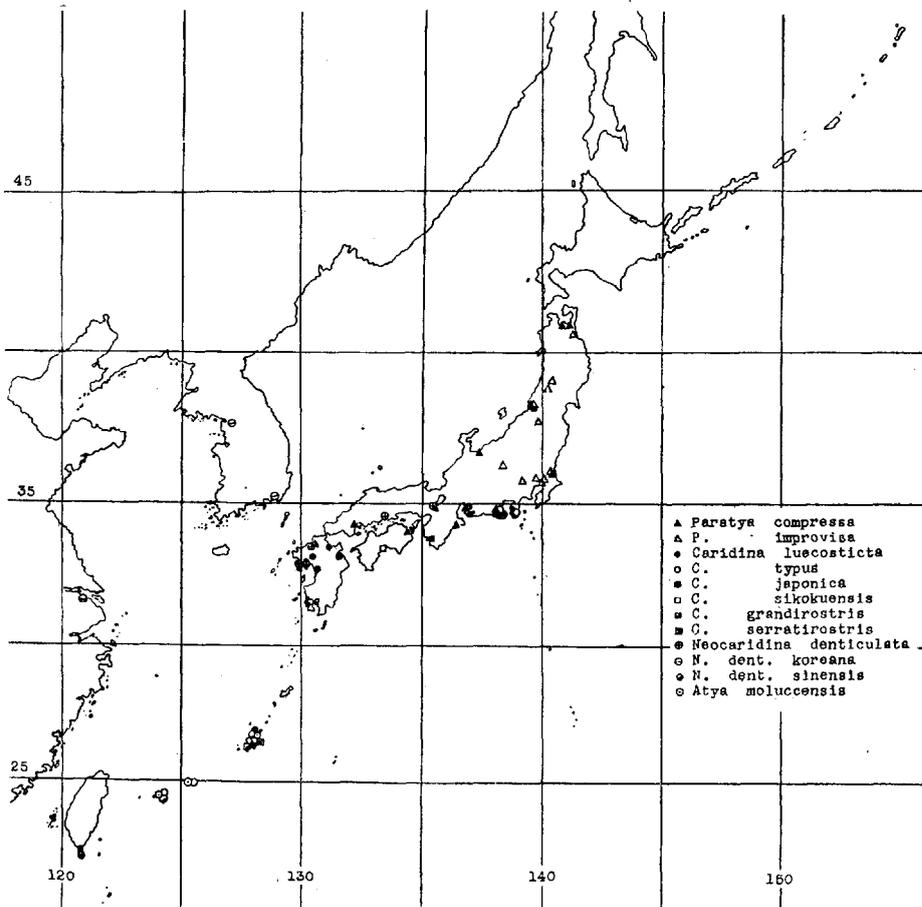


Fig. 24. Distribution of Japanese atyid shrimps.

(4) Southern Japan subgroup includes those which inhabit southern Japan, viz., *Caridina typus*, *C. japonica*, *C. japonica sikokuensis* and *Neocaridina denticulata*.

(5) Subtropical and tropical subgroup populates from Liu-kiu southward to Indian Ocean, including *Caridina grandirostris*, *C. serratirostris*, *Neocaridina denticulata sinensis*, and *Atya moluccensis*.

Of the morphological features which correspond to the geographical distribution of the specimens, mention should be made of the typical form of *Paratya compressa* and *P. comp. improvisa* on the one hand, and the typical form of *Neocaridina denticulata*, and its two subspecies *N. dent. koreana* and *N. dent. sinensis* on the other.

The two items do not go on all fours except the above mentioned examples. But I would like to call attention to the point that *Paratya compressa* stands far apart from all the rests in having exopodites on all pereopods. But *Atya* is rather near to *Caridina* with respect to the features of appendages. It may be mentioned that pleopods furnish conjectures as to the phylogeny of the group. I am inclined to set "leucosticta" form ancestral to two divergent stems "denticulata" and "typus" according to the features of pleopods. It is hoped, however, that careful examinations will throw some light on this problem.

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