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FIDDLER CRABS (CRUSTACEA : DECAPODA : OCYPODIDAE) OF TAIWAN[1]

JUNG-FU HUANG, HSIANG-PING YU and MASATSUNE TAKEDA*

Graduate School of Fisheries,
National Taiwan College of Marine Science and Technology
Keelung, 20224 Taiwan, Republic of China
and
** Department of Zoology, National Science Museum,*
Tokyo 169, Japan

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Jung-Fu Hang, Hsiang-Ping Yu and Masatsune Takeda (1989) Fiddler crabs (Crustacea : Decapoda : Ocypodidae) of Taiwan. *Bull. Inst. Zool., Academia Sinica* **28**(3): 191-209. The fiddler crabs of the genus *Uca* (family Ocypodidae) are represented by eight species in Taiwan, namely *U. arcuata* (De Haan, 1835), *U. coarctata* (H. Milne Edwards, 1852), *U. dussumieri* (H. Milne Edwards, 1852), *U. borealis* Crane, 1975, *U. formosensis* Rathbun, 1921, *U. lactea* (De Haan, 1835), *U. triangularis* (A. Milne Edwards, 1873), and *U. crassipes* (Adams et White, 1848). They are mostly collected in sandy and muddy areas around the mangrove and river mouths of the Tan-Shui River, I-Lan River, Pao-Lih Creek and various other creeks in western Taiwan, with the last two species usually living in dryer areas. *U. triangularis*, *U. coarctata* and *U. dussumieri* are very rare. Furthermore, the last two species only found in the Pao-Lih Creek of Ping-Tung County are new records from Taiwan. This paper reports the main morphological characteristics and habitats of these eight *Uca* species. A key and color illustrations are also provided.

Key words: Taiwan, Ocypodidae, *Uca*.

The habitats of fiddler crabs are generally around river-mouths, especially at estuarine mud flats. Since they live on organic debris in soils, mangrove swamps become their most preferred habitat as nutritions from animal and plant bodies are accumulated by tide actions. The presence of fiddler crab species may also be biological indicators of river pollutions. The records of the genus *Uca* in Taiwan have been found in some ecological (Chang, 1963; Su and Lue, 1984), and histological studies (Chang *et al.*, 1985). However, these studies focused mainly on the fiddler crabs of the Tan-Shui River in northern Taiwan and lacked a detailed account on their taxonomy. The sole taxonomic report on the fiddler crabs of Taiwan, which was provided by Maki and Tsuchiya (1923), only contained four species: *U. arcuata* (De Haan) *U. borealis* Crane, *U. formosensis* Rathbun and *U. lactea* (De Haan). Since then two more species *U. crassipes* (Adams and White) and *U. triangularis* (A. Milne Edwards) were found in Taiwan by Horikawa (1940) and Wang (1984) respectively. And now, two more species are added in the present paper, viz., *U. coarctata* (H. Milne Edwards) and *U.*

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dussumieri (H. Milne Edwards). Therefore, the Taiwanese *Uca* is now represented by eight species.

MATERIALS AND METHODS

The specimens examined were collected from various creeks or brooks. They are deposited at the Fisheries Department of National Taiwan College of Marine Science and Technology (NTCMST), with their specimen code number corresponding to its labelled species name and collection date, eg. *Uca coarctata* NTCMST 1988 10 12-01, *Uca coarctata* NTCMST 1988 10 12-02, etc.

The terms used in describing the various parts of the body of fiddler crabs are mainly adopted from George and Jones (1982). The measurements stated follow Crane (1975).

Carapace length (cl.) is the distance between the front and the posterior border.

Carapace width (cw.) is the distance between the tips of the anterolateral angles of both sides.

Dactylus length is the maximum distance between the tip and the base of the movable finger.

Manus and pollex length is the maximum distance between the tip of immovable finger and the base of manus.

RESULTS

Key to the Taiwanese *Uca* species

1. Distal end of gonopod with an elongated chitinous terminal tube....2
— Distal end of gonopod blunt, with a short chitinous terminal tube 3
2. Long thumb juxtaposed with gonopod. Base of outer surface of major pollex flattened .... *Uca triangularis*
— Short thumb spaced wide apart from gonopod. Base of outer surface of major pollex with small but distinct triangular depression .... *Uca crassipes*
3. End of gonopod bluntly rounded, with thumb indistinct 4
— End of gonopod flattened and somewhat oblique, with thumb distinct 6
4. Chitinous terminal tube reached over flange base of gonopod. Orbital floor with a line of accessory granules behind suborbital crenellations ..... *Uca coarctata*
— Chitinous terminal tube not exceeded flange base of gonopod. Orbital floor without accessory granules behind suborbital crenellations...5
5. Posterior flange of gonopod moderately curved. Major dactylus with two long grooves on its outer surface..... *Uca dussumieri*
— Posterior flange of gonopod slightly curved. Major dactylus with one long groove or added with a short basal groove on its outer surface ..... *Uca arcuata*
6. Short thumb spaced wide apart from gonopod. Front broad... *Uca lactea*
— Long thumb juxtaposed with gonopod. Front narrow.....7
7. Chitinous terminal tube of gonopod slightly elongated. Base of outer surface of major pollex with triangular depression extended to palm ..... *Uca borealis*
— Chitinous terminal tube of gonopod morderately broad. Base of outer surface of major pollex flattened.. ..... *Uca formosensis*

SYSTEMATIC ACCOUNT

Uca triangularis (A. Milne Edwards, 1873)

(Pl. 1, A-D; Fig. 1)

Gelasimus triangularis A. Milne Edwards, 1873: 275; de Man, 1892: 307; 1895: 577; Gordon, 1934: 11.

Gelasimus triangularis var. *variabilis* De Man, 1891: 47.
Uca triangularis, Estampador, 1937: 543; 1959: 100.
Uca novaeguineae, Sakai, 1936: 171; Miyake, 1938: 110; 110; 1939: 223.
Gelasimus triangularis variabilis, Tweedie, 1937: 144.
Uca triangularis variabilis, Tweedie, 1950: 357.
Uca (*Celuca*) *triangularis triangularis*, Crane, 1975: 290; Sakai, 1976: 607; Wang, 1987: 42; Dai *et al.*, 1986: 427.

Materials: 2 ♂, cl. 5 mm, cw. 9 mm, 1 ♀, cl. 5 mm, cw. 10 mm, 12 Oct. 1988, Pao-Lih Creek, Pin-Tong County.

Diagnosis: Front broad. Frontorbital margin strongly oblique. Anterolateral angle of carapace acuminate, remarkably produced and directed anterolaterally. Anterolateral margin of carapace short, decorated with fine granules. Posterolateral margin of carapace strongly converged, making anterior half of carapace distinctly arched. Eyestalk thick. Upper margin of orbit provided with microscopic beading. Lower margin of orbit with fine granules extending through two thirds. Suborbital crenellations widely separated and truncated. Orbital floor with a line of accessory granules behind suborbital crenellations. Pterygostomian region sparsely covered with setae. Major dactylus with weak long groove and short basal groove. Posterior surface of merus of minor chela with a row of strong tubercles, which is sharply turned distally. Gonopod with tip of terminal tube extremely narrow, elongated and slightly curved. Thumb blunt and long, slightly juxtaposed with gonopod and reached its basal margin.

Coloration: Carapace white, or anterior two thirds of carapace white and pale orange, covered with bistre brown spots, posterior one third of carapace sepia and marked with pale orange spots. Color of ambulatory legs similar to that of anterior part of carapace.

Habitat: This species lives in muds at slope and scarcely brackish creek banks.

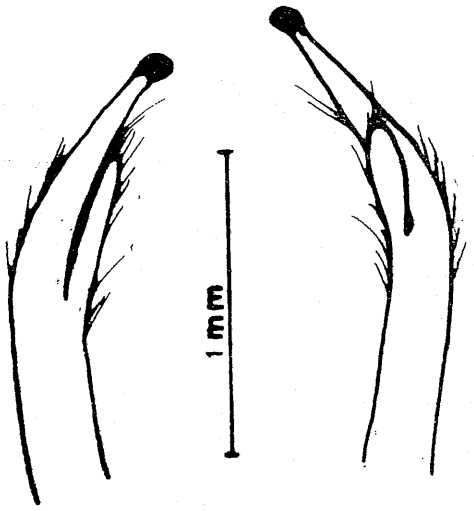

Fig. 1. Distal portion of gonopod of *Uca triangularis*. (A. Milne Edwards, 1873)

Uca crassipes can be found at the same regions.

Distribution: The range of distribution of this species is from the Ryukyu Islands through Taiwan, the Philippines, the Palau Islands, Yap Island, Indonesia and New Guinea to New Caledonia.

Remarks: This species is small form and only found in the Pao-Lih Creek at Ping-Dong County.

Uca crassipes (Adams and White, 1848)

(Pl. 1, E-G; Fig. 2)

Gelasimus crassipes Adams and White, 1848: 49.
Gelasimus gaimardi H. Milne Edwards, 1852: 114; Heller, 1865: 38; de Man, 1891: 39; Sakai, 1939: 617; Shen, 1940: 232; Lin, 1949: 26.
Gelasimus latreillei H. Milne Edwards, 1852: 114; A. Milne Edwards, 1373: 274; Ortmann, 1894: 757; Balss, 1922: 142; Estamdador, 1937: 545.
Gelasimus splendidus Stimpson, 1858: 99; 1907: 106.
Gelasimus pulchellus Stimpson, 1858: 100; 1907: 107.
Gelasimus chlorophthalmus, de Man, 1891: 41; 1902: 484.
Uca gaimardi, Nobili, 1907: 408; Rathbun, 197: 26; Pesta, 1911: 55; Tesch, 1918: 39; Sendler, 1923: 22; Miyake, 1939: 222, 241; Forest and Guinat, 1961: 140.
Uca chlorophthalmus, Nobili, 1907: 408.
Uca novaeguineae, Rathbun, 1913: 617.

Uca pulchella, Parisi, 1918: 93.
Uca latreillei, Balss, 1922: 142; Estampador, 1959: 103.
Uca (*Amphiuca*) *chlorophthalmus crassipes*, Crane, 1975: 101; Sakai, 1976: 606; Dai *et al.*, 1986: 428.
Uca (*Paraleptuca*) *chlorophthalmus crassipes*, Takeda and Nunomura, 1976: 80.

Materials: 1 ♂, cl. 10 mm, cw. 16 mm, 24 Oct. 1987, Dong-Wei, Peng-Hu County. 3 ♂♂, cl. 9–10 mm, cw. 14–16 mm, 3 ♀♀, cl. 10–11 mm, cw. 15–17 mm, 24 June 1988, Pao-Lih Creek, Pin-Tong County. 3 ♂♂, cl. 9–10 mm, cw. 14–16 mm, 2 ♀♀, cl. 10 and 11 mm, cw. 15 and 17 mm, 1 July 1988, Jin-Miann Creek, I-Lan County.

Diagnosis: Front broad. Frontorbital margin strongly oblique. Anterolateral angle of carapace acute and directed forward. Anterolateral margin of carapace short, while posterolateral margin is strongly converged. Anterior part of carapace broad and strongly arched. Posterolateral stria represented by line of elevated granules. Upper margin of eyebrow appeared to be smooth. Suborbital crenellation extending across entire orbit, with crenellation at outer half truncated and well separated. Pterygostomian region densely covered with setae. Dactylus and pollex slender, longer than manus. Two enlarged teeth at the edge of major dactylus and one enlarged tooth at the edge of major pollex. A small but distinct triangular depression present near base of pollex. Oblique ridge of palm moderately low and consisted of similar sized tubercles. Meri of ambulatory legs slender, and their dorsal and ventral surfaces marked with columns of granules. Gonopod distally tapered, tubed, lateral margin covered with setae. Thumb short, well seperated from gonopod, and covered with setae.

Coloration: Color of lateral and posterior surfaces of carapace varied from red-black to red, more often bearing deep carmine red and drab transverse bands. Outer major surfaces of palm and dactylus vermilion.

Habitat: Lives in muddy sand from flat areas nearby high-tide levels of creek to slope of bank, mostly living parallel to *Uca lactea* and *U. triangularis*, but sometimes *Uca arcuata* may also present in the same areas.

Distribution: Western and central Pacific: Ryukyu Islands, Taiwan, Philippines, Malaysia and Indonesia.

Remarks: This species is rather small in size and similar to *U. lactea* in its appearance. This species can easily be seperated from the other Taiwanese species by having a small triangular depression at the base of the major pollex and the carapace being reddish to blackish or carmine red with drab transverse bands.

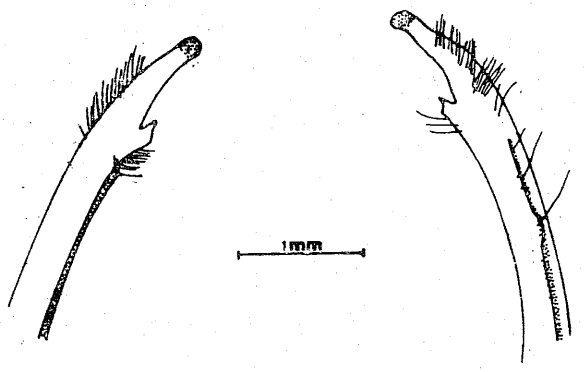

Fig. 2. Distal portion of gonopod of *Uca crassipes*. (Adams et White, 1848)

Uca coarctata (H. Milne Edwards, 1852)

(Pl. 2, A-D; Fig. 3)

Gelasimus coarctatus H. Milne Edwards, 1892: 146; A. Milne Edwards, 1873: 272; Haswell, 1882: 93; de Man, 1891: 31; 1892: 308; Tweedie, 1937: 143.
Uca arcuata, Grant and McCulloch, 1906: 20.
Uca rathbunae Pearse, 1912: 91.
Uca mearnsi Rathbun, 1913: 616.
Uca coarctata, Gordon, 1934: 11; George and Jones, 1982: 37.
Uca ischnodactylus Nemec, 1939: 107.
Uca (*Deltuca*) *coarctata coarctata*, Crane, 1975: 57; Sakai, 1976: 603.

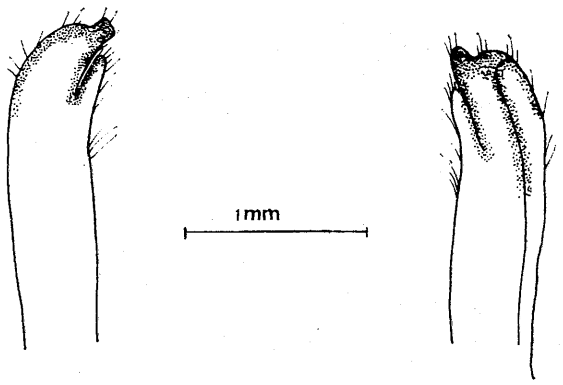

Fig. 3. Distal portion of gonopod of *Uca coarctata.* (H. Milne Edwards, 1852)

Materials: 1 ♂, cl. 15 mm, cw. 25 mm; 1 ♀, cl. 16 mm, cw. 22 mm, 12 Oct. 1988, Pao-Lih Creek, Ping-Tung County.

Diagnosis: Front narrow. Upper margin of eyebrow and anterolateral margin of carapace marked with microscopic beady-granules. Anterolateral angle of carapace extremely acute and directed anterolaterally. Anterolateral margin of carapace short and almost absent, dorsolateral margin strongly convergent at epibranchial regions, while posterolateral margins of both sides become to be parallel. Orbital floor with a line of accessory granules behind suborbital crenellation. Suborbital crenellation low, with rounded granule. Pterygostomian region setose. Outer surfaces of major dactylus and pollex with along groove extending to tip. Gape of major dactylus with an enlarged tooth at distal one third. Inner dorsal margin of merus of major chela with a morderately large bi-cuspid tubercle, while venteral surface provided with three or four tubercles. Meri of ambulatory legs slender, their dorsal margins convex and marked with fine granules. Gonopod bluntly rounded, with a chitinous terminal tube distally. Thumb close to, but shorter than tube.

Coloration: Carapace black, with milky white at anteromedian region. Lower outer part of major palm deep carmine red. Dull orange at proximal half of pollex, Upper outer surface of major palm and outer surface of dactylus mostly greyish cream. Ambulatory legs greyish brown, but proximal two thirds of merus of last ambulatory leg milky white.

Habitat: This species lives in the same areas with *U. dussumieri.*

Distribution: This species is found in the Fiji Islands, New Guinea, New Caledonia, Sumatra, Indonesia, western Australia, Philippines, Taiwan and Ishigaki Island, Japan.

Remarks: This species was recorded as new to Taiwan. It is rare and only found in the Pao-Lih Creek at Ping-Tung County. This species differs from *U. arcuata* and *U. dussumieri* in having a line of accessory granules at the orbital floor and the special whitish markings on the carapace and the merus of last ambulatory leg.

Uca dussumieri (H. Milne Edwards, 1852)

(Pl. 2, E-H; Fig. 4)

Gelasimus dussumieri H. Milne Edwards, 1852: 148; A. Milne Edwards, 1873: 274; de Man, 1892: 306; 1895: 576; Ortmann, 1894: 755; Gordon, 1934: 12.

Gelasimus dubius Stimpson, 1858, 99; 1907: 104; Sakai, 1939: 621.

Uca dussumieri, Schenkel 1902 578; Nobili, 1903: 22; Grant and McCulloch, 1906: 20; Roux, 1917: 614; Estampador, 1937: 543; 1959: 100; George and Jones, 1982: 31.

Uca dubia, Sakai, 1936, 170; Miyake, 1936: 511; 1938: 109; 1939: 222.

Uca dussumieri dussumieri, Miyake, 1963: 70.

Uca (*Deltuca*) *dussumieri dussumieri*, Crane, 1975: 37; Sakai, 1976: 602; Dai *et al.*, 1986: 421.

Materials: 1 ♂, cl. 16 mm, cw. 27 mm, 12 Oct. 1988, Pao-Lih Creek, Ping-Tung County.

Diagnosis: Front narrow. Fronotorbital margin slightly oblique, with flattened granules. Anterolateral angle of carapace acute and directed slightly forward. Anterolateral margin of carapace

short, while dorsolateral margin convergent posteriorly. Branchial and gastric regions seperated by deep groove. Suborbital crenellation low, truncate, distinctly seperated, and slightly larger toward anterolateral angle. Pterygostomian region densely covered with state. Dactylus of major chela markedly longer than palm. Outer surfaces of major dactylus and pollex with two long grooves. Gape at anterior one third of major dactylus armed with four enlarged teeth. Inner dorsal margin of merus of major chela provided with enlarged bi-cuspid tubercles. Merus of last ambulatory leg slender and almost straight. Gonopod bluntly rounded and well covered with setae. Apex of gonopod with an indistinct chitinous terminal tube.

Coloration: Carapace black. Lower surface of major palm reddish orange and becoming orange at posterior two thirds of pollex. Ambulatory legs greyish brown.

Habitat: Lives at muddy and almost flattened areas where is usually at the lowest high tidal level. *U. coarctata* and *U. arcuata* may also occur in the same areas.

Distribution: The distribution of this species is from eastern Australia through New Guinea, Indonesia, the Palau Islands and Taiwan to Okinawa.

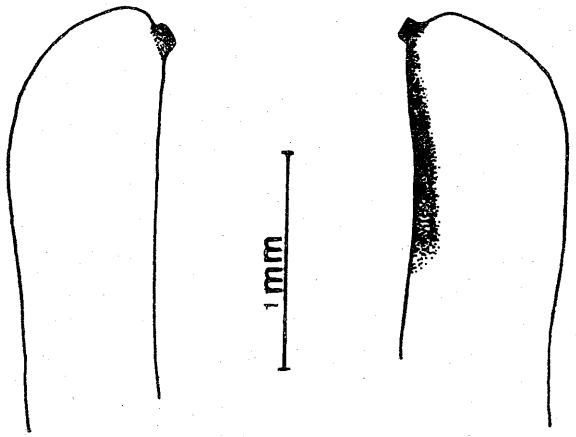

Fig. 4. Distal portion of gonopod of *Uca dussumieri*. (H. Milne Edwards, 1852)

Remarks: This species was recorded from Taiwan for the first time. It closely resembles *U. coarctata*, but can be distinguished from the latter by lacking a line of accessory granules at the orbital floor and with two long grooves on the outer surface of major dactylus. Additionally, these two species can be sepearted from *U. arcuata*, which lives in the same areas, by the slenderer and straight merus of last ambulatory leg.

Uca arcuata (De Haan, 1835)

(Pl. 3, A-C; Fig. 5)

Ocypode (*Gelasimus*) *arcuata* De Haan, 1835: 53.
Gelasimus arcuatus, H. Milne Edwards, 1852: 146; Miers, 1880: 309; de Man, 1891: 28; Ortmann, 1894: 755; Sakai, 1939: 619; Shen, 1940: 231; Horikawa, 1940: 28; Lin, 1949: 26.
Gelasimus brevipis H. Milne Edwards, 1852: 146.
Uca arcuata, Parisi, 1918: 93; Balss, 1922: 143; Maki and Tsuchiya, 1923: 209; Shen, 1932: 273; Sakai, 1943: 320.
Uca (*Deltuca*) *arcuata*, Crane, 1975: 44; Sakai, 1976: 601; Wang, 1984: 42; Su and Lue, 1984: 63; Dai *et al.*, 1986: 420.

Materials: 1 ♂, cl. 18 mm, cw. 30 mm; 1 ♀, cl. 9 mm, cw. 14 mm, 25 Mar. 1984, Tan-Shui River, Tai-Pei County. 4 ♂♂, cl. 19–22 mm, cw. 31–34 mm, 26 Sep. 1987, San-Sin-Chao, Tsin-Chu County. 2 ♂♂, cl. 19–20 mm, cw. 31–32 mm, 1 ♀, cl. 9 mm, cw. 14 mm, 29 Mar. 1988, Wu-Chi, Tai-Chung County. 1 ♂, cl. 19 mm, cw. 30 mm, 22 Apr. 1988, Tai-Shi, Yun-Lin County. 1 ♂, cl. 13 mm, cw. 21 mm; 2 ♀♀, cl. 7 and 9 mm, cw. 16 and 17 mm, 31 Jan. 1988, Buh-Dai, Jia-Yi County. 3 ♂♂, cl. 12–16 mm, cw. 19–24 mm; 1 ♀, cl. 18 mm, cw. 30 mm, 31 Jan. 1988, Chi-Guw, Tai-Nan County. 1 ♂, cl. 22 mm, cw. 35 mm; 1 ♀, cl. 15 mm, cw. 24 mm, 24 Jun. 1988, Pao-Lih Creek, Pin-Tong County. 1 ♂, cl. 18 mm, cw. 30 mm, 1 Jul. 1988, Lan-Yang Creek, I-Lan County.

Diagnosis: Front narrow. Carapace with long anterolateral margins. Anterolateral angle of carapace acute and

projected laterally. Upper and lower margins of eyebrow decorated with granules. Pterygostomian region densely covered with setae. Meri of ambulatory legs moderately broad, with dorsal margins serrated. Major chela of male with outer surface of dactylus and pollex having a long groove (sometimes indefinite) and proximal ridge composed of 9–12 tubercles. Outer surface of major palm rude and provided with distinct tubercles and with a distinct dorsal groove. Inner dorsal margin of major merus with 3 or 4 granules. Distal part of gonopod bluntly rounded, with thumb closely juxtaposed with basal edge.

Coloration: Anterior part of carapace brown-ochre and posterior blackish lilac, sometimes whole carapace blackish. Major chela brown-ochre or with palm and proximal pollex orange-red, while pollex tip and dactylus are whitish.

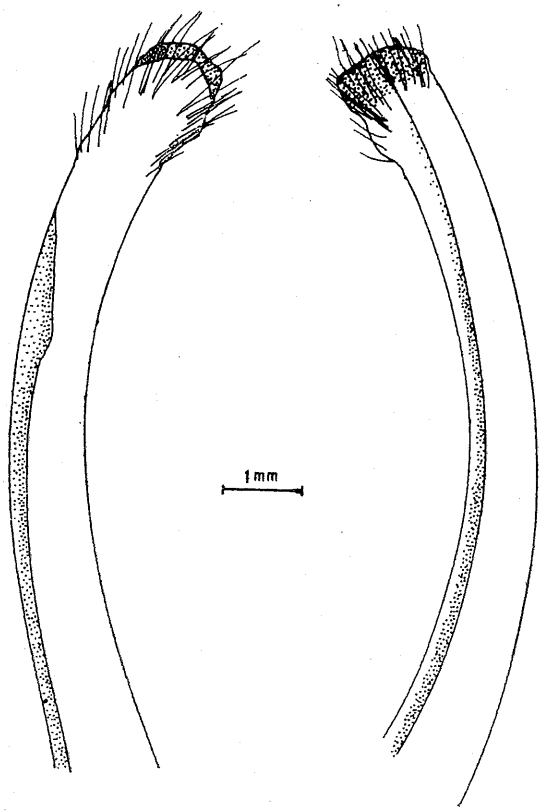

Fig. 5. Distal portion of gonopod of *Uca arcuata.* (De Haan, 1835)

Habitat: Muddy upper shoulder at slowly declined humid creeks, living below *U. formosensis* and *U. lactea.*

Distribution: This species has been recorded in Japan, Korea, eastern mainland China, Taiwan and Hong Kong.

Remarks: The soil around the holes of this species is always humid and sometimes spread out like a fan. When disturbed during sampling, large male crabs which fail to return to their large holes always stop moving in an attempt to camouflage themselves. *Chasmagnathus convexus, Uca formosensis* and *U. lactea* can also be found within the region where the present species lives.

Uca lactea (De Haan, 1835)

(Pl. 3, D-F; Fig. 6)

Ocypode (*Gelasimus*) *lactea* De Haan, 1835: 54.

Gelasimus lacteus, H. Milne Edwards, 1852: 150; Stimpson, 1858: 100; 1907: 108; Miers, 1879: 36; Sakai, 1939: 618; Shen, 1940: 231; Lin, 1949: 26.

Uca lactea, Parisi, 1918: 92; Sakai, 1934, 1934: 320; Kamita, 1941: 161; Kim, 1973: 431.

Uca (*Celuca*) *lactea lactea*, Crane, 1975: 300; Sakai, 1976: 608; Wang, 1984: 42; Dai *et al.*, 1986: 425.

Uca (*Celuca*) *lactea*, Su and Lue, 1984: 63.

Materials: 3 ♂♂, cl. 7–11 mm, cw. 11–18 mm; 2 ♀♀, cl. 8 and 9 mm, cw. 12 and 14 mm, 18 Oct. 1987, Tan-Shui River, Tai-Pei County. 11 ♂♂, cl. 8–11 mm, cw. 12–19 mm; 2 ♀♀, cl. 8 and 10 mm, cw. 13–15 mm, 4 Apr. 1984, Lan-Yan Creek, I-Lan County. 3 ♂♂, cl. 10–11 mm, cw. 15–18 mm, 29 Mar. 1988, San-Shin-Chao, Tsin-Chu County. 3 ♂♂, cl. 8–9 mm, cw. 13–14 mm, 29 Mar. 1988, Wu-Chi, Tai-Chung County. 5 ♂♂, cl. 10–11 mm, cw. 15–19 mm; 1 ♀, cl. 10 mm, cw. 15 mm, 22 Apr. 1988, Taishi, Yun-Lin County. 24 ♂♂, cl. 7–12 mm, cw. 11–19 mm; 19 ♀♀, cl. 8–10 mm, cw. 13–15 mm, 23 Nov. 1984, Wun-Kang, Jia-Yi County. 5 ♂♂, cl. 7–8 mm, cw. 10–12 mm; 1 ♀, cl. 7 mm, cw. 12

mm, 31 Jan. 1988, Chi-Guw, Tai-Nan County. 2 ♂♂, cl. 8 and 9 mm, cw. 13 and 14 mm, 24 Jun. 1988, Pao-Lih Creek, Pin-Tung County.

Diagnosis: Front broad. Frontorbital margin slightly oblique. Anterolateral angle of carapace short but acute, directed anterolaterally. Anterolateral margin of carapace short and almost straight. Eyestalk thick. Eyebrow with upper margin of eyebrow smooth and lacking lower margin. Suborbital crenellation well developed and almost along entire width of orbit. Pterygostomian region sparsely covered with setae. Outer surfaces of major pollex and dactylus lacking distinct median groove. Inner edge of minor chela without enlarged tooth. Meri of ambulatory legs slender. Dorsal margin of last ambulatory leg not convex. Gonopod with slight torsion. Thumb reaching beyond gonopod.

Coloration: Carapace white or grey-black. Dactylus and palm of major chela white.

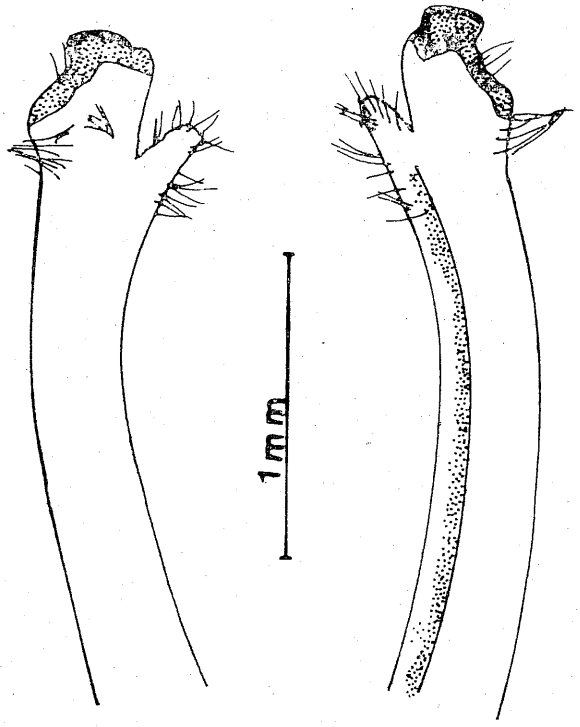

Fig. 6. Distal portion of gonopod of *Uca lactea.* (De Haan, 1835)

Habitat: Muddy sand nearby high tidal level of open creeks. Mostly living parallel to *Mictyris brevidactylus* and above *Uca borealis* and *U. arcuata.*

Distribution: This species has been known from Japan, Taiwan, eastern mainland China and Hong Kong.

Remarks: This species usually lives in rather dry muddy-sand beaches of creeks. Around their living holes there is generally a radiation of small rounded soils. Sometimes a volcano-like soil mass is constructed above their holes.

Uca borealis (Crane, 1975)

(Pl. 4, A-C; Fig. 7)

Gelasimus marionis, Shen, 1940: 232.
Gelasimus marionis, nitidus: Shen, 1940: 232; Lin, 1949: 27.
Uca marionis, Maki and Tsuchiya, 1923: 207.
Uca (*Thalassuca*) *vocans borealis* Crane, 1975: 90; Su and Lue, 1984: 63; Dai *et al.*, 1986: 424.

Materials: 16 ♂♂, cl. 9–14 mm, cw. 14–20 mm; 6 ♀♀, cl. 10–13 mm, cw. 14–18 mm, 25 Mar. 1984, Tan-Shui River, Tai-Pei County. 14 ♂♂, cl. 8–13 mm, cw. 12–19 mm; 7 ♀♀, cl. 9–10 mm, cw. 12–14 mm, 2 Apr. 1984, Lan-Yan Creek, I-Lan County. 5 ♂♂, cl. 14–20 mm, cw. 22–30 mm; 2 ♀♀, cl. 13 mm, cw. 19 and 20 mm, 6 Apr. 1988, Wu-Chi, Tai-Chung County. 2 ♂♂, cl. 10 and 13 mm, cw. 14 and 19 mm; 1 ♀, cl. 16 mm; cw. 22 mm, 23 Nov. 1984, Wun-Kang, Jai-Yi County. 5 ♂♂ cl. 12–16 mm cw. 17–22 mm, 2 ♀♀ cl. 10 and 11 mm cw. 15 and 16 mm, 31 Jan. 1988, Chi-Guw, Tai-Nan County. 7 ♂♂ cl. 10–13 mm cw. 14–19 mm; 1 ♀, cl. 10 mm, cw. 14 mm, 5 Apr. 1988, Wu-Chiou Island. 4 ♂♂, cl. 12–14 mm, cw. 18–22 mm; 1 ♀, cl. 16 mm, cw. 22 mm, 23 May 1988, Jin-Miann Island.

Diagnosis: Front narrow. Upper margin of eyebrow appeared to be smooth. Anterolateral angle of carapace extremely acute and slightly directed forward.

Anterolateral margin short and posterolateral margin scarcely convergent. Suborbital crenellation rounded but distinct. Pterygostomian region sparsely covered with setae. Outer surface of major dactylus with long median groove. Outer surface of major pollex with long groove composed of continued pits and with base having triangular depression. Proximal half in gape at major pollex concave and with an enlarged tooth at proximal base. Inner dorsal margin of merus of major chela with an enlarged sharp tooth. Meri of ambulatory legs slender, with dorsal margins covered with setae. Gonopod distally rounded, with a short chitinous tube. Thumb short, closely juxtaposed with gonopod, but not reached its basal margin. Inner proccess small and covered with setae.

Coloration: Carapace bistre brown to black. Outer surface of major dactylus white. Outer surface of major pollex and palm entirely orange yellow.

Habitat: Muddy areas along or above the lowest tidal levels of steep creeks and drain-off. Living below *U. lactea.*

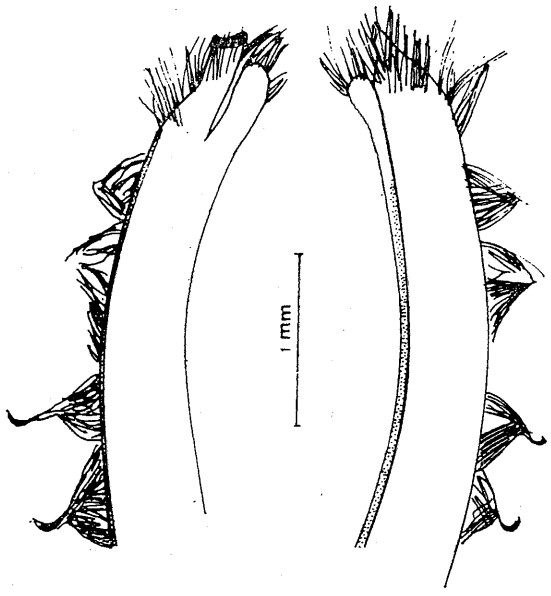

Fig. 7. Distal portion of gonopod of *Uca borealis.* (Crane, 1975)

Distribution: This species have been recorded in northeastern mainland China. Taiwan and Hong Kong.

Remarks: This species has been reported to occur in northeastern Taiwan, mainly in the Tan-Shui River (Su and Lue, 1984) and some collections of this species in NTCMST with a I-Lan Creek label. However, no specimen of this species have been found by the authors in the above areas for last two years despite of an extensive effort for collection. In the slightly wetted muddy areas where the present species lives, *Uca lactea* and *Mictyris brevidactylus* can also be found.

Uca formosensis Rathbun, 1921

(Pl. 4, D-F; Fig. 8)

Uca formosensis: Rathbun, 1921 155; Maki and Tsuchiya, 1923: 205.

Gelasimus formosensis, Sakai, 1939: 620; Lin, 1949: 26.

Uca (*Thalassuca*) *formosensis*, Crane, 1975: 83; Sakai, 1976: 604; Dai *et al.*, 1986: 425.

Materials: 1 ♂ cl. 13 mm cw. 23 mm, 4 Apr. 1984, Lan-Yan Creek, I-Lan County. 1 ♂, cl. 21 mm, cw. 32 mm, 29 Mar. 1988, Wu-Chi, Tai-Chung County. 2 ♂♂, cl. 16 and 17 mm, cw. 25 and 27 mm; 2 ♀♀, 10 and 14 mm, cw. 16 and 23 mm, 31 Jan. 1988, Chi-Guw, Tai-Nan County.

Diagnosis: Front narrow. Frontorbital margin scarcely oblique. Anterolateral angle of carapace acute, slightly protruded and directed forward. Anterolateral margin of carapace strongly developed. Eyebrow with upper margin smooth and lower margin indistinct or absent. Suborbital crenellation low, but sharp, without abrupt projection. Pterygostomian region sparsely covered with setae. Both outer surfaces of major dactylus and major pollex long and broad, without median groove and fruit-knife shaped. Outer surface of major pollex, with a median enlarged tooth, slightly longer and

broader than that of major dactylus. Distal half of gape almost close. Proximal ridge of major pollex distinct and provided with 5 or 6 tubercles. Outer surface of major palm covered with fine granules, and distinct tubercles above dorsal groove. Meri of first and last ambulatory legs moderately slender. Gonopod bluntly rounded, distal portion covered with setae. Thumb extending beyond gonopod.

Coloration: Carapace usually black. Carpus and merus of major chela orange-yellow. Dactylus pale white.

Habitat: This species is found living near high tidal levels in moderate open muddy areas above *Uca arcuata* and *Chasmagnathus convexus.*

Distribution: This species is only known from Taiwan.

Remarks: This species is an endemic species of Taiwan. It is very sensitive as compared to other Taiwanese fiddler crabs, being recorded from the Tan-Shui River (Su and Lne, 1984), San-Sin-Chao of Tsin-Chu County, Fan-Yun of Jang-Huah County, Tong-Shyr of Jia-Yi County (Chang, 1973) and I-Lan Creek (unpublished collection). However, no specimen has been sampled during last two years by the authors. The present species is very similar to *Uca arcuata* and their major morphological differences are given in Table 1.

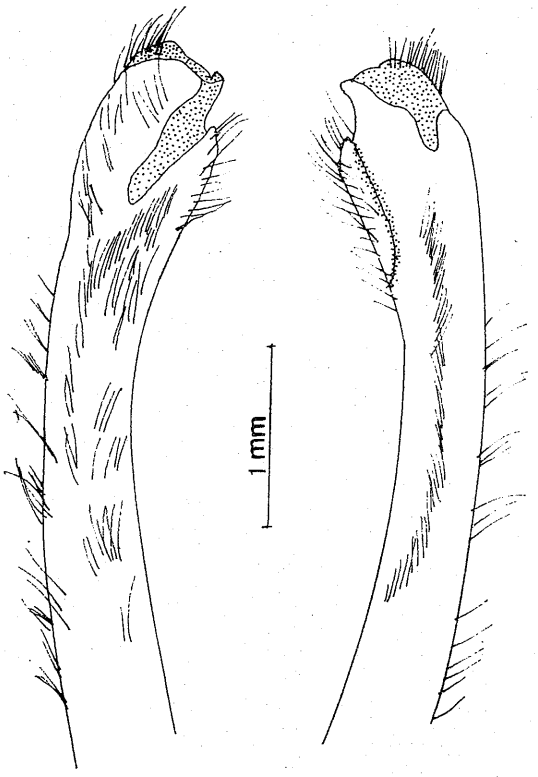

Fig. 8. Distal portion of gonopod of *Uca formosensis.* (Rathbun, 1921)

Table 1
Morphological differences between *Uca arcuata* and *U. formosensis*

Main characteristics	Species	
	U. arcuata	*U. formosensis*
Upper margin of eyebrow	with microscopic granules	entirely smooth
Lower margin of eyebrow	with microscopic granules	absent or indistinct
Anterolateral angle of carapace	directed anterolaterally	directed forward
Outer surface of major dactylus	both dactylus and pollex with long groove	no groove at both dactylus and pollex
Proximal ridge at major chela composed of:	9-12 tubercles	5-6 tubercles
Outer surface of major palm	coarse and covered with tubercles	finely granulated
Meri of ambulatory legs	broad	I and IV slender, II and III broad
Color of carapace	blackish or brown ochre with blackish lilac	black

Table 2
Main characteristics of the Taiwanese fiddler crabs (Genus *Uca*)

Species	Main characteristics			
	Front	Groove/s on outer surface of major dactylus	Groove/s on outer surface of major pollex	Dentition in gape of female chela
U. dussumieri	narrow;	two;	two;	one enlarged tooth at dactylus and pollex (from Crane);
	short, almost straight	slender	rounded, with indistinct terminal tube	black and motted with white at anterior one third
U. coarctata	narrow;	one;	one;	one enlarged tooth at dactylus and pollex;
	short, almost straight	slender	rounded, with short terminal tube	black
U. arcuata	narrow;	one;	one;	one enlarged tooth at dactylus and pollex;
	long	broad	rounded	blackish or brown-ochre
U. borealis	narrow; short, almost straight	absent; slender	one; rounded, and with a chitinous tube	absent; bistre-brown to black
U. formosensis	narrow;	absent;	absent;	one big enlarged tooth at dactylus and pollex;
	long	I and IV slender, II and III broad	rounded	black
U. triangularis	broad;	two or (sometimes) indistinct;	absent;	absent;
	short but strongly oblique	I and IV slender; II and III broad	tapered tubed	white or anterior white and pale orange with bistre-brown spots; posterior sepia with pale orange spots
U. crassipes	broad; short, almost straight	absent; broad	absent; tapered tubed	absent; red-black to red with transverse deep carmine and drab band
U. lactea	broad;	absent;	absent;	only pollex with four enlarged teeth;
	short, almost straight	slender	blunt, with slightly torsion	white or sepia

DISCUSSION

As noted by Hagen (1976) and Manning and Holthuis (1981), and also by George and Jones (1982), 10 genera split from the old genus *Uca* by Bott (1973) do not coincide in many instances with 9 subgenera defined by Crane (1975). It is unfortunate that Bott's generic names published in a short, rather preliminary paper has the priority over Crane's subgeneric names well defined and exhaustively treated in an ideal way. Because of their being objective synonyms Crane's *Amphiuca*, *Thalassuca* and *Boboruca* are substituted by *Paraleptuca*, *Musuca* and *Planuca*, respectively, as rightly stated by Hagen (*op. cit*) and partly dealt with by Takeda and Nunomura (1976). In the present paper we follow Hagen's suggestion that the formal splitting of *Uca* into genera or subgenera appeares premature and causes unnecessary confusion not only for the taxonomists but also the ecologists. In addition, the present paper follows his advice in using the simple binomial because of the difficulty in considering the characters with subspecific or specific value.

In this paper we presented a clue to the identification of Taiwanese 8 species of *Uca*, 2 of which were newly added to the carcinological fauna. The Table 3 shows the distribution pattern of the *Uca* species in the Far East.

It is reasonable and not surprising that the Japanese mainland and Korea situated at high latitude are represented by only two spcies, *U. arcuata* and *U. lactea*, which are the northernmost distributed species in the genus *Uca*. These two species are also known from Taiwan and China, but not from the Ryukyu Islands. This fact indicates that the nature of *Uca* from the Ryukyu Islands is somewhat different from that of the surrounding areas. The occurrence of *U. perplexa* and *U. tetragonon*, and the absence of *U. borealis* in the Ryukyu Islands also support this suggestion. Contrary to this, it is highly remarkable that *U. formosensis*, considered as the northern allopatric species of *U. tetragonon* by Crane (1975), is endemic to Taiwan.

As a result it is definitely said that the Ryukyu Islands *Uca* is characterized by the occurrence of *U. perplexa*, *U. tetragonon* and *U. vocans* which may be "oceanic" in nature, and that the Taiwanese *Uca* is characterized by the

Table 3
Distribution of *Uca* spp. in the Far East

Species	Taiwan	China	Japan		Korea
			Ryukyus	Mainland	
Uca annulipes (H. Milne Edwards)		+			
U. arcuata (de Haan)	+	+		+	+
U. borealis Crane	+	+			
U. coarctata (H. Milne Edwards)	+		+		
U. crassipes (Adams et White)	+	+	+		
U. dussumieri (H. Milne Edwards)	+	+	+		
U. formosensis Rathbun	+				
U. lactea (de Haan)	+	+		+	+
U. perplexa (H. Milne Edwards)			+		
U. spinata Crane		+			
U. tetragonon (Herbst)			+		
U. triangularis (A. Milne Edwards)	+	+	+		
U. vocans (Linnaeus)		+	+		

occurrence of the substituted species' *U. lactea, U. formosensis* and *U. borealis*, and also by the northern distributed species, *U. arcuata*, all of which are rather "continental" in the Far East.

Acknowledgments: We gratefully appreciate the help of Mr. J.H. Wang of the Taiwan Mueum for providing us with valuable references and lending precious specimens. We also wish to express our heartful thanks to Mr. C.H. Pan and Miss. M.Y. Chi, students of the Aquaculture Department, and Miss. K.Y. Foo of the Graduate School of Fisheries at NTCMST for their help in collecting and drawing the crab specimens. Particular thanks are extending to Mr. T.Y. Chan of the Graduate School of Fisheries at NTCMST for reading the manuscript and giving valuable suggestions.

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臺灣產招潮蟹之研究

黃榮富　游祥平　武田正倫

本報告報導八種產於臺灣各河口之招潮蟹。分別爲：弧邊招潮蟹 *Uca arcuata* (De Haan, 1835)，北方呼喚招潮蟹 *U. borealis* Crane, 1975，臺灣招潮蟹 *U. formosensis* Rathbun, 1921，清白招潮蟹 *U. lactea* (De Haan, 1835)，粗腿綠眼招潮 *U. crassipes* (Adams et White, 1848)，三角招潮蟹 *U. triangularis* (A. Milne Edwards, 1873)，窄招潮蟹 *U. coarctata* (H. Milne Edwards, 1852)，屠氏招潮蟹 *U. dussumieri* (H. Milne Edwards, 1852)。其中後二種爲臺灣首次報告之種類。

本文除討論此八種招潮蟹之外部形態、體色等特徵外，並述及棲息場所環境，同時附檢索表及彩色圖片供爲查定種之依據。此外，對遠東地區招潮蟹的分佈狀況，臺灣及琉球列島在種構成上之顯著差異亦予論述。

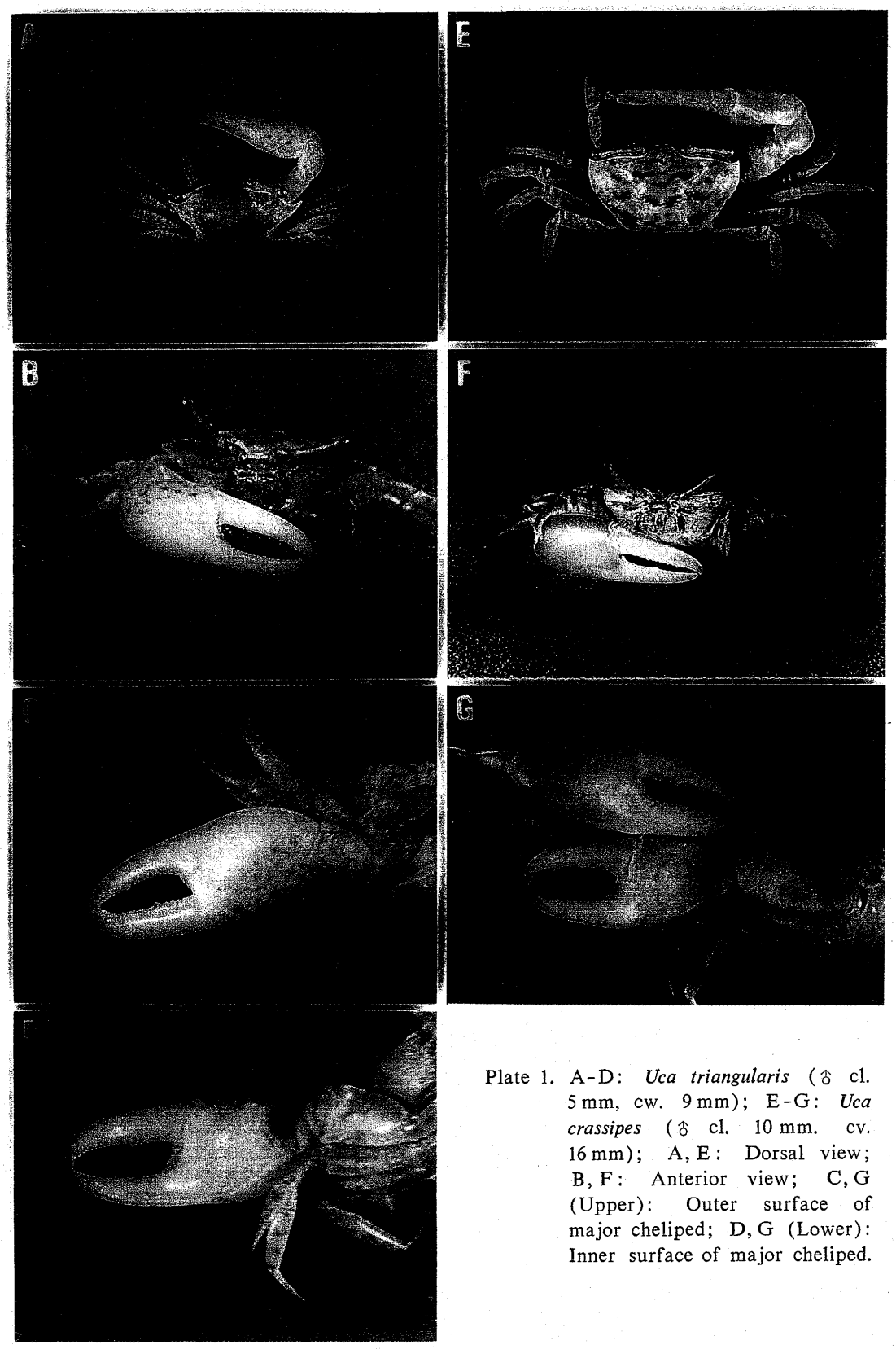

Plate 1. A-D: *Uca triangularis* (♂ cl. 5 mm, cw. 9 mm); E-G: *Uca crassipes* (♂ cl. 10 mm. cv. 16 mm); A, E: Dorsal view; B, F: Anterior view; C, G (Upper): Outer surface of major cheliped; D, G (Lower): Inner surface of major cheliped.

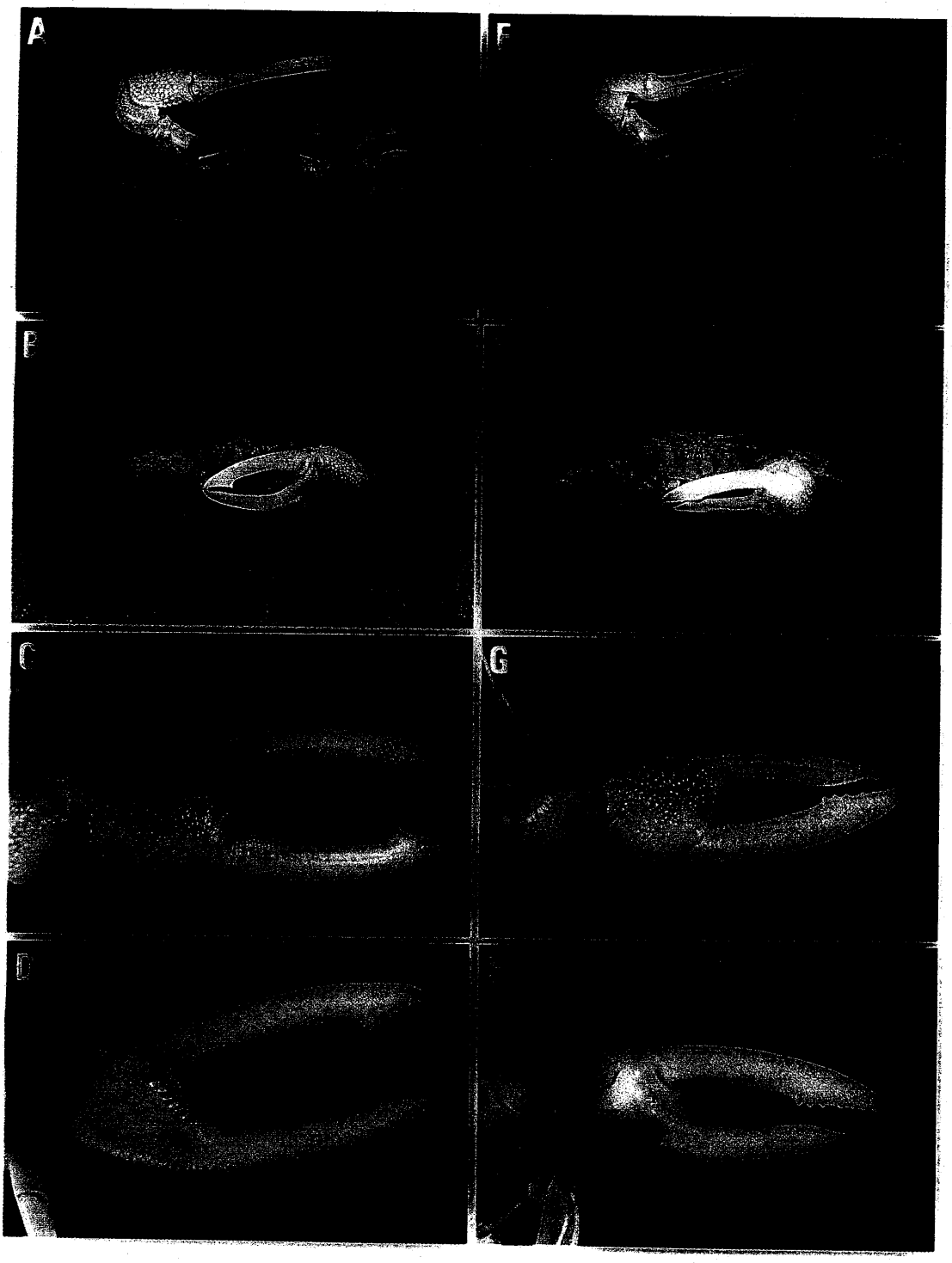

Plate 2. A-D: *Uca coarctata* (♂ cl. 16 mm, cw. 26 mm); E-H: *Uca dussumieri* (♂ cl. 17 mm, cw. 26 mm); A, E: Dorsal view; B, F: Anterior view; C, G: Outer surface of major cheliped; D, H: Inner surface of major cheliped.

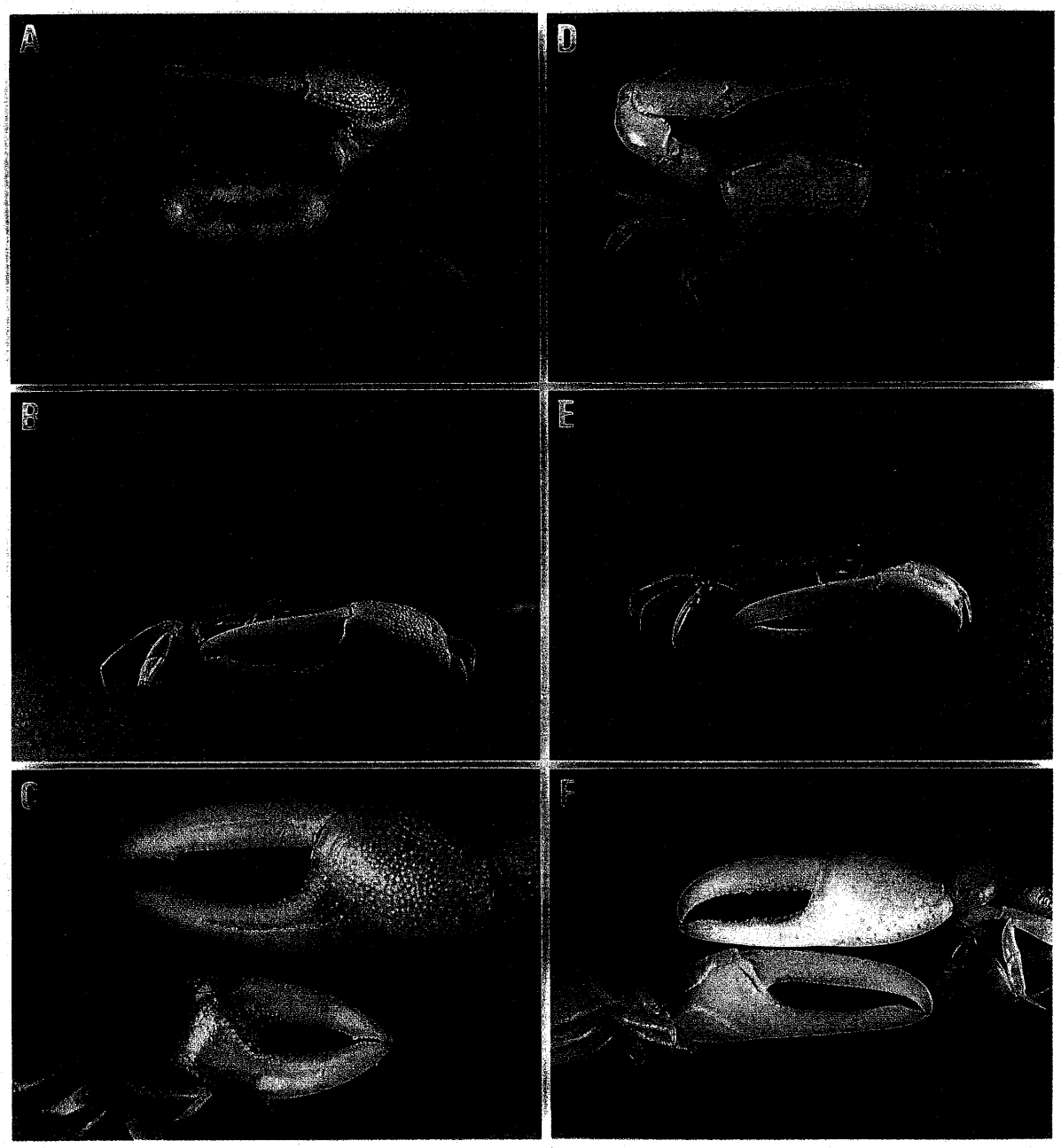

Plate 3. A-C: *Uca arcuata* (♂ cl. 20 mm, cw. 25 mm); D-F *Uca lactea* (♂ cl. 10 mm, cw. 15 mm); A, D: Dorsal view; B, E; Anterior view; C, F: Outer and inner surfaces of major cheliped.

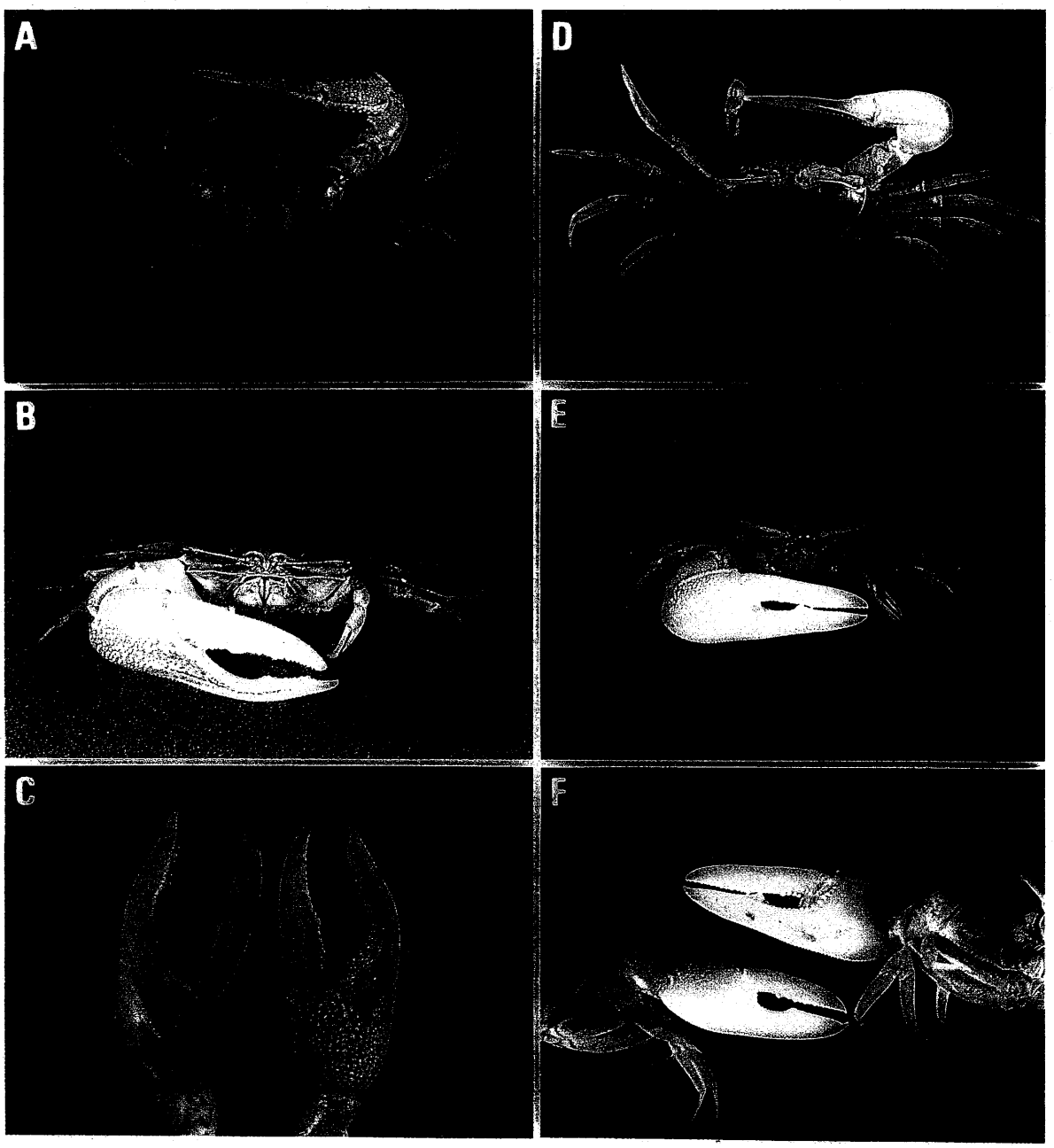

Plate 4. A-C: *Uca borealis* (♂ cl. 13 mm, cw. 19 mm); D-F: *Uca formosensis* (♂ cl. 14 mm, cw. 23 mm); A, D: Dorsal view; B, E: Anterior view; C (Left), F (Upper): Inner surface of major chelipped; C (Right), F (Lower): Outer surface of major cheliped.