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A New Species of *Macrophthalmus* Closely Related to *M. japonicus* (DE HAAN)

(Crustacea: Decapoda: Ocypodidae).

With 7 Text-Figures and 3 Tables.

KEIJI WADA & KATSUSHI SAKAI.

Abstract.

[WADA, K. & SAKAI, K. (1989): A new species of *Macrophthalmus* closely related to *M. japonicus* (DE HAAN) (Crustacea: Decapoda: Ocypodidae). — Senckenbergiana marit., 20 (3/4): 131-146, 7 figs., 3 tabs.; Frankfurt a. M.]

One of WADA (1978)'s two forms of *Macrophthalmus japonicus* (DE HAAN) is described as a new species on the basis of its morphology and the characteristic males' display. Some traits distinguishing the new species from *M. japonicus* are also summarized and a lectotype for *M. japonicus* is designated. The two subspecies, *M. japonicus frequens* and *M. japonicus japonicus,* reported by DAY & SONG (1984) are considered to correspond to *M. japonicus* and the present new species, respectively.

Kurzfassung.

[WADA, K. & SAKAI, K. (1989): Eine neue mit *M. japonicus* (DE HAAN) nahe verwandte *Macrophthalmus*-Art (Crustacea: Decapoda: Ocypodidae). — Senckenbergiana marit., 20 (3/4): 131-146, 7 Abb., 3 Tab.; Frankfurt a. M.]

Eine der von WADA (1978) erkannten Formen von *Macrophthalmus japonicus* wird aufgrund morphologischer Besonderheiten und des charakteristischen Verhaltens der Männchen als neue Art eingeführt. Unterscheidungsmerkmale zu *M. japonicus* werden angegeben und für letztere Art ein Lectotypus designiert. Die zwei von DAI & SONG (1984) beschriebenen Unterarten *M. japonicus frequens* und *M. japonicus japonicus* werden als Synonyme von *M. japonicus* und der hier eingeführten neuen Art betrachtet.

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Introduction.

The ocypodid crab *Macrophthalmus (Mareotis) japonicus* (DE HAAN) has been known to consist of two forms (Forms V and L) differring in male's waving display and in some morphological traits (WADA 1978). WADA (1984) observed that where these two forms occurred sympatrically, pair formation was confined to members of the same form. Further, WADA (1989) has given details of experimental results showing that even when the two forms are forced to pair, they are reproductively isolated from each other.

By referring to some morphological traits (relative carapace length to carapace width and setae on propodus and carpus of the 3rd leg), it seems that type series of *M. japonicus,* reported in DE HAAN (1835) and in TESCH (1915), corresponds to WADA's Form V, but not to Form L. This has been confirmed by the examination of type specimens of *M. japonicus* deposited in the Rijksmuseum van Natuurlijke Historie, Leiden. The subgenus *Mareotis* is known to contain, besides *M. japonicus,* the following 12 species: *M. abercrombiei, M. boteltobagoe, M. crinitus, M. darwinensis, M. definitus, M. depressus, M. erato, M. pacificus, M. quadratus, M. setosus, M. teschi* and *M. tomentosus* (BARNES 1977). WADA's Form L could not be assigned to any of these from their morphology described by KEMP (1919), SAKAI (1939) and BARNES (1966, 1967, 1970, 1971, 1977). In this paper, WADA's Form L of *M. japonicus* is reported as a new species and its morphology and waving display are compared with those of *M. japonicus.*

Material and Methods.

Most of the specimens used in this study were collected at Samusaura and Tachigatani, Shirahama, Wakayama, Japan (33°41'N 135°22'E). Other specimens were supplied from a further locality in Japan, 2 localities in Korea and 1 locality in Hong Kong. The collected specimens have been deposited in Seto Marine Biological Laboratory, Kyoto University, Wakayama (SMBL), Biological Laboratory, Shikoku Women's University, Tokushima (BLT), National Museum of Natural History, Smithsonian Institution, Washington D. C. (USNM), British Museum (Natural History) in London (BM), Museum national d'Histoire naturelle in Paris (MP), Rijksmuseum van Natuurlijke Historie in Leiden (RML), Senckenberg-Museum in Frankfurt am Main (SMF), and Australian Museum in Sydney (AMS). Preserved specimens were borrowed from BM, RML and SMF.

Biometrical data were taken in order to demonstrate differences and similarities between the species. Carapace length (CL) was measured along the median line, from anterior to posterior margin. Carapace widths were taken in two positions, i. e. between the second anterolateral teeth (CW) (the widest part of carapace) and between the external orbital angles (CW'). Merus length of the 3rd ambulatory leg was measured between the ends of the anterior margin, and merus width was obtained from the widest part. Length of the female's last abdominal segment was measured along the median line, and width of it was along the proximal margin.

Waving displays by male crabs with mature-shaped chelae were recorded in the field (Samusaura, Shirahama, Wakayama, Japan) using an 8 mm movie camera on Aug. 24 and 25, 1984, where ambient temperatures ranged 26-32°C. General wave form and temporal components of the display were determined by frame analysis. Since this behavior was recorded at 18 frames per second, estimates of temporal

characteristics were determined by multiplying the number of frames involved by 0.056 seconds for respective recording speeds. The mean duration of each component of the display was obtained by averaging the mean values of respective crabs.

Macrophthalmus (Mareotis) banzai n. sp.

[Japanese name: Hime-yamato-osagani].

Figs. 1-2.

1932 *Macrophthalmus japonicus,* — SHEN, Zool. sin., **9**: 215 [part.], Fig. 134b [non *Ocypode (Macrophthalmus) japonica* DE HAAN 1835].

1978 *Macrophthalmus japonicus* "Form L", — WADA, Publ. Seto mar. biol. Lab., **24**: 327, Figs. 1-8. [non *Ocypode (Macrophthalmus) japonica* DE HAAN 1835].

1984 *Macrophthalmus (Mareotis) japonicus japonicus,* — DAI & SONG, Crustaceana, **46**: 77, Fig. 3d [non *Ocypode (Macrophthalmus) japonicus* DE HAAN 1835].

Holotype (Fig. 1): ♂ (SMF 17923 CW 21.6 mm CL 13.5 mm), Japan, Wakayama, Shirahama, Samusaura, 19. VI. 1977, leg. K. WADA.

Paratypes: Japan: 1 ♀ (SMF 17924 CW 20.3 mm CL 12.7 mm), 9 ♀ (SMBL TYPE 341, CW 15.3-20.0 mm CL 9.9-12.5 mm) 3 ♂ (SMBL TYPE 342, CW 15.8-20.2 mm CL 10.5-13.8 mm) 1 ♂ (SMBL TYPE 343, CW 20.8 mm CL 13.4 mm) 1 ♀ (SMBL TYPE 344, CW 17.3 mm CL 11.7 mm), same locality, 31. VII. 1981, leg. K. WADA. — 2 ♂ (SMBL TYPE 340, CW 16.9-17.0 mm CL 10.3-10.8 mm); 1 ♂ (USNM 240217, CW 18.6 mm CL 12.0 mm); 1 ♂ (MP B20516, CW 20.0 mm CL 12.4 mm); 1 ♂ (RML D-37405, CW 17.7 mm CL 11.0 mm); 1 ♂ (BM 1988.235, CW 17.5 mm CL 11.0 mm); 1 ♂ (AMS P 38644, CW 16.5 mm CL 10.7 mm), same locality, 26. VII. 1976, leg. K. WADA. — 1 ♂ (SMF 17724, CW 16.3 mm CL 10.6 mm), same locality, 19. VI. 1977, leg. K. WADA.

Material examined: Japan: 3 ♀ (SMF 17925, CL 11.7-16.4 mm), leg REIN [det as *M. japonicus*]; 2 ♂ (SMF 17681, CL 10.65-13.5 mm), 1 ♀ (SMF 17681, CL 10.0 mm), Shikoku, Kochi-Ken, Usa-Inoshiri, small creek towards harbour, V. 1979, leg. K. SAKAI, [det as *M. japonicus*]; 111 ♂ (SMBL KW1, 5.05-15.8 mm), Honshu, Wakayama, Shirahama, Samusaura, 18. V., 24/26. VII., 24/25. VIII. 1976, 19. VI. 1977 and 31. VII. 1981, leg. K. WADA; 34 ♀ (SMBL KW2, CL 5.45-13.1 mm), same locality, 26. VII. 1976 and 31. VII. 1981, leg. K. WADA. — Korea: 4 ♂ (SMBL KW3, CL 16.95-23.8 mm), Kunsan, 15. VII. 1986, leg. B. L. CHOE. — China: 3 ♂ (BM 1874: 2, CW 14.8-21.5 mm CL 9.7-13.8 mm), 1 ♂ (BM 1874: 2, CW 19.2 mm CL 12.4 mm), Shandong Peninsula, Chefoo, Mr. SWINHOE vend., [det as *M. japonicus*]; 1 ♂ (SMF 17683, CL 13.0 mm), 2 ♀ (SMF 17683, CL 9.0-10.0 mm), Shandong, Qingdao, Xuejidao, tidal flat, 28. VIII. 1987, leg. M. TÜRKAY. — Hong Kong: 2 ♀ (SMBL KW4, Cl 14.35-15.0 mm), New Territory, Mai Po Marshes, 23. III. 1988, leg. R. K. C. CHOI.

Etymology: Named *banzai* from Japanese in reference to the waving display of this species which resembles a "banzai" posture.

Diagnosis: Male: Cheliped stout, cutting edge of movable finger with large quadrangular proximal tooth close to base and denticulated in distal three-fourth. Carpus and propodus of ambulatory leg 3 provided with tuft of setae on anterior half of ventral surface. Terminal process of gonopod lengthened, with tip convex. — Female: Distal margin of last abdominal segment gently-sloping. Operculum of genital organ oval, provided with collar in anteromedial part.

Description: Carapace 1.6 times as broad as long; gastric region demarcated distinctly by deep, setae containing furrow, smooth, except granulate marginal area; branchial region studded with granules; lateral margins with granules and row of

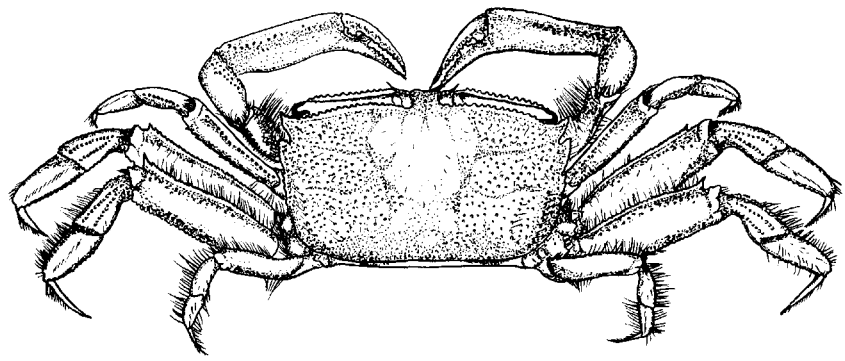


Fig. 1. *Macrophthalmus banzai* n. sp., holotype, male.

Abb. 1. *Macrophthalmus banzai* n. sp., Holotypus, Männchen.

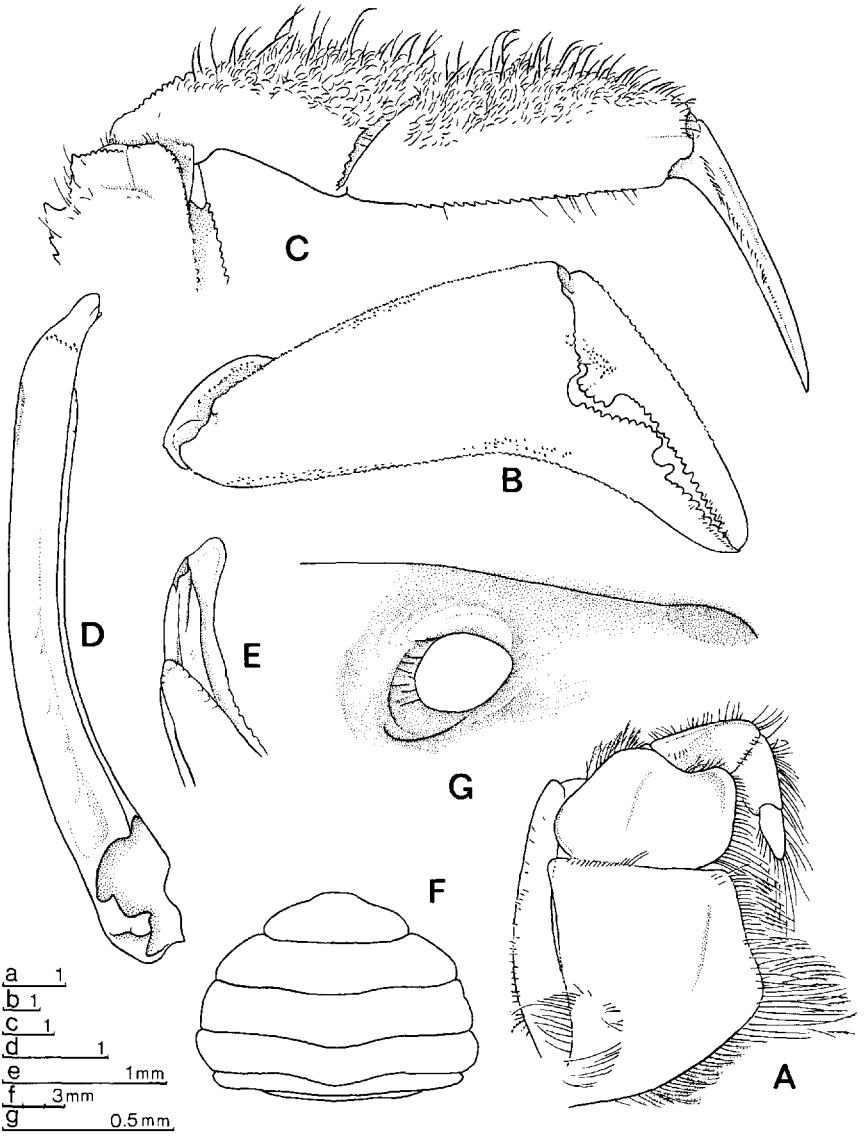
setae. Front distally broadened and medially grooved; with smooth margins and granular surface. Upper and lower orbital margins beaded with tubercles. External orbital angle large, triangular, pointed antero-laterally; separated from second tooth by wide incision; second tooth projecting slightly beyond first one; third tooth very small; greatest carapace width across second lateral teeth. Epistome narrow, central region distinctly concave, smooth on upper and indistinctly granular on lower margin. Lateral region of carapace with two deep transverse furrows from level of two incisions between three anterolateral teeth, and posteriorly with two longitudinal granular and setose rows. Ocular peduncles long and narrow; cornea extending to base of external orbital angle. Ischium of maxilliped 3 (Fig. 2A) concave on

▶

Fig. 2. *Macrophthalmus banzai* n. sp. — A. Right maxilliped 3, outer face. B. Chela of right cheliped, outer face. C. Left ambulatory leg 3, ventral face. D. right gonopod, outer face. E. terminal process of right gonopod, inner face. F. female abdomen, outer face. G. female genital organ with suture between thoracic sternites II and III. — A-E. ♂, SMBL TYPE 343. F. ♀, SMF 17924, G. ♀, SMBL TYPE 344; a = articulation; c = collar; s = suture; go = genital opening; op = operculum; su = suture between thoracic sternites II and III; tp = terminal process.

Abb. 2. *Macrophthalmus banzai* n. sp. — A. Rechter 3. Maxilliped, Außenfläche. B. Rechte Schere, Außenfläche. C. Linker 3. Pereiopod, Ventralfläche. D. Rechter 1. Gonopod, Außenfläche. E. Terminalanhang des rechten 1. Gonopoden, Innenfläche. F. Weiblicher Hinterleib, Außenfläche. G. Weibliche Geschlechtsöffnung und Segmentgrenze zwischen den Thorakalsterniten II und III. — A-E. ♂, SMBL TYPE 343. F. ♀, SMF 17924. G. ♀, SMBL TYPE 344; a = Gelenk; c = Kragen um das Operkulum; s = Sutur; go = Geschlechtsöffnung; op = Operkulum; su = Segmentgrenze zwischen Thorakalsternit II und III; tp = Terminalanhang.

internal margin, almost straight on external margin; merus largely concave in distal margin, almost straight on internal margin and convex on postero-external margin. Cheliped of male short or long according to age; inner and lower surfaces of merus heavily setose; carpus comparatively small, oblong, 1.9 times (holotype) as long as broad; chela (Fig. 2B) strong in larger males; upper margin of palm with row of tubercles; outer surface of palm finely granular, while inner surface heavily granu-



lar, with scattered setae, faintly marked with a longitudinal row of granules near to upper margin; cutting edge of movable finger proximally with large rectangular crenulated tooth close to base, denticulated on distal three-fourths; cutting edge of immovable finger with large wedge-shaped, crenulated tooth proximally, roughly denticulate on distal half; outer and inner surfaces of both fingers with distal setae. Chela of female weak. Ambulatory legs comparatively slender, merus of legs 2 and 3 slender, studded with granules on anterior and posterior margins, subdistal teeth directed forward; carpus and propodus of leg 3 of male (Fig. 2C) provided with tuft of setae on anterior half of ventral surface, while same part of female less setose. Distal margin of last abdominal segment of female (Fig. 2F) gently sloping. Terminal process of male gonopod (Fig. 2D, E) lengthened, with tip convex. Female genital organ opening on thoracic sternite 3 situated apart from suture between thoracic sternites 2 and 3; operculum (Fig. 2G) oval, collar surrounding operculum distinctly convex on antero-median half; suture between thoracic sternites 2 and 3 terminated medially in rounded transparent structure.

Macrophthalmus (Mareotis) japonicus (DE HAAN 1835).

[Japanese name: Yamato-osagani].

Figs. 3-4.

Restricted synonymy:

1833 *Ocypode (Macrophthalmus) depressa*, — DE HAAN, Fauna japon., Crust.: expl. of pl. 7 fig. 1. [non *Macrophthalmus depressus* RÜPPELL 1830].
1835 *Ocypode (Macrophthalmus) japonica* DE HAAN, Fauna japon., Crust.: 54, pl. 15 fig. 2.
1915 *Macrophthalmus japonicus*, — TESCH, Zool. Meded., **1**: 200, pl. 9 fig. 14.
1932 *Macrophthalmus japonicus*, — SHEN, Zool. Sin., **9**: 215 [part.], figs. 132-134 (134b = *M. banzai*).
1967 *Macrophthalmus japonicus*, — BARNES, Trans. zool. Soc. London, **31**: 224, fig. 8, pl. 2.
1973 *Macrophthalmus japonicus*, — KIM, Encycl. Fauna Flora Korea, **14**: 450, fig. 191.
1978 *Macrophthalmus japonicus*, — WADA, Publ. Seto mar. biol. Lab., **24**: 327 (as Form V), figs. 1-8.
1987 *Macrophthalmus japonicus*, — SAKAI, Bull. Shikoku Women's Univ., **7**: 49, fig. 1 pl. 1.
1984 *Macrophthalmus (Mareotis) japonicus frequens* DAI & SONG, Crustaceana, **46**: 76, figs. 1-3.

Lectotype (Fig. 3): ♂ (RML 297, CW 31.9 mm CL 21.0 mm), Japan, leg. P. F. VON SIEBOLD.

Paralectotypes: 1 ♂ (RML 37362), 1 ♀ (RML 37363), 1 ♂ (RML 37364), 1 ♂ (RML 37365), 1 ♂ (RML 37366), 1 ♂ (BM 1961.1.3.20.2, CW 24.2 mm CL 15.6 mm), same data.

Material examined: Japan: 3 ♂ (SMF 5430, CW 18.7-27.5 mm CL 12.3-17.35 mm), leg. REIN; 4 ♂ (SMBL KW5, CW 20.2-27.2 mm CL 13.5-18.0 mm), 1 ♀ (SMBL KW6, CW 25.6 mm CL 16.5 mm), 37 ♀ (SMBL KW9, CL 6.3-19.4 mm), Honshu, Wakayama, Shirahama, Samusaura, 31. VII. 1981, leg. K. WADA; 62 ♂ (SMBL KW7, CL 6.8-20.7 mm), same locality, 24. VII., 24.-26. VIII. 1976 and 31. VII. 1981, leg. K. WADA; 1 ♂ (SMBL KW8, CW 36.2 mm CL 23.2 mm), same locality, 18. VI. 1977, leg. T. KUWAMURA; 1 ♂ (SMBL KW10, CW 45.8 mm CL 28.2 mm), Honshu, Wakayama, Shirahama, Tachigatani, leg. K. WADA; 1 ♀ (SMBL KW11, CW 35.0 mm CL 22.45 mm), same locality, 17. V. 1976, leg. K. WADA; 1 ♂ (BLT 5610, CW 25.0 mm CL 16.2 mm), 1 ♀ (BLT 5611, CW 27.1 mm CL 17.6 mm), Tokushima, Hichiken-bara, Yoshinogawa, 28. IX. 1982, leg. K. SAKAI; 1 ♂ (SMF 7761, CW 35.35 mm CL 22.95 mm), 1 ♀ (SMF 7761, CW 23.7 mm CL 15.6 mm), Tokyo-

Fig. 3. *Macrophthalmus japonicus,* lectotype, male.

Abb. 3. *Macrophthalmus japonicus,* Lectotypus, Männchen.

Bay; 1 ♂ (SMF 13234, CW 32.9 mm CL 22.05 mm), 3 ♂ (SMF 17682, CW 18.4-26.3 mm CL 12.25-16.95 mm), 5 ♀ (SMF 17682, CW 17.85-24.25 mm CL 11.75-15.9 mm), 3 juv. (SMF 17682), Kyushu, Fukuoka-Ken, Fukuoka, Tatara-gawa estuary (33°27.6′N 130°23.7′E), intertidal mud., 6. XI. 1979, leg. M. Türkay. — Korea: 3 ♂ (SMBL KW12, CL 19.7-21.4 mm), Kunsan, 25. VII. 1986, leg. B. L. Choe; 2 ♂ (SMBL KW13, CL 20.0-26.25 mm), Anmyun Is., 29. V. 1987, leg. B. L. Choe; 1 ♂ (SMF 6698, CW 38.15 mm CL 23.9 mm), Seoul, 1970-1971, leg. H. S. Kim. — China: 1 ♂ (SMF 13234, CW 32.9 mm CL 22.05 mm), 1 ♀ (SMF 13234, CW 23.75 mm CL 15.5 mm), Shandong, Quingdao, 12. VIII. 1957, leg. H. L. Chen.

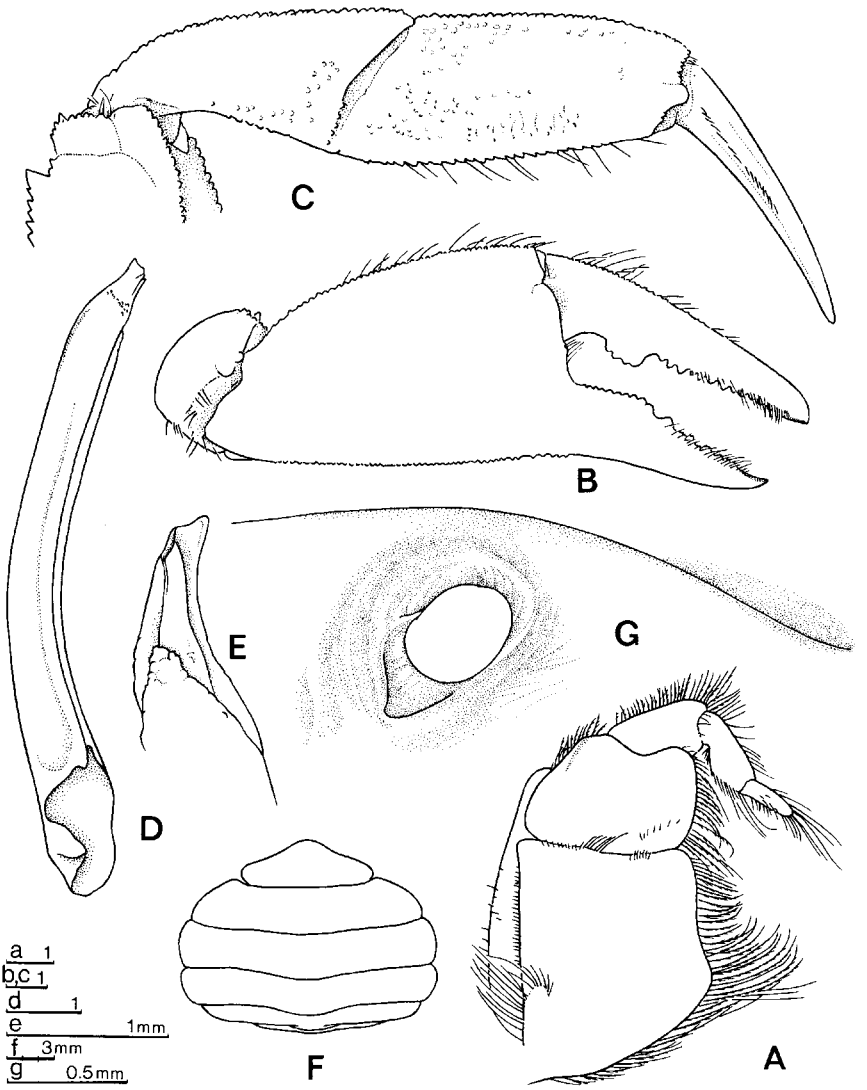


Fig. 4. *Macrophthalmus japonicus.* — A. Right maxilliped 3, outer face. B. Chela of right cheliped, outer face. C. Left ambulatory leg 3, ventral face. D. Right gonopod, outer face. E. Terminal process of right gonopod, inner face. F. Female abdomen, outer face. G. Female genital organ with suture between thoracic sternites II and III. — A-E. ♂, BLT 5610. F. ♀, SMBL KW6. G. ♀, BLT 5611.

Abb. 4. *Macrophthalmus japonicus.* — A. Rechter 3. Maxilliped, Außenfläche. B. Rechte Schere, Außenfläche. C. Linker 3. Pereiopod, Ventralfläche. D. Rechter 1. Gonopod, Außenfläche. E. Terminalanhang des rechten 1. Gonopoden, Innenfläche. F. Weiblicher Hinterleib, Außenfläche. G. Weibliche Geschlechtsöffnung und Segmentgrenze zwischen Thorakalsterniten II und III. — A-E. ♂, BLT 5610. F. ♀, SMBL KW6; ♀, BLT 5611.

Designation of Lectotype: Type specimens of *Macrophthalmus japonicus* deposited in RML were examined by one of the authors (K. SAKAI), and a specimen preserved in alcohol selected among them was designated as lectotype.

Diagnosis: Carapace 1.5 times as broad as long; gastric region smooth, with marginal area granulate; branchial regions studded with granules. External orbital angle less pointed laterally than in *M. banzai*. Maxilliped 3 (Fig. 4A) similar to that of *M. banzai*. Merus of ambulatory legs 2 and 3 stout; subditstal tooth on anterior margin of merus of leg 3 less distinct than in *M. banzai*. — Male: Cheliped (Fig. 4B) stout; palm length relative to carapace size shorter than in *M. banzai*; tubercles on upper margin of palm larger than in *M. banzai;* cutting edge of movable finger with large rectangular proximal tooth one fourth of distance from base, distal two-thirds denticulated. Carpus and propodus of ambulatory leg 3 (Fig. 4C) without tuft of setae on ventral surface. Terminal process of gonopod (Figs. 4D, E) short, with tip truncate. — Female: Terminal margin of last abdominal segment (Fig. 4F) more projecting than in *M. banzai*. Operculum of genital organ (Fig. 4G) rounded, surrounded by collar in medial part.

Male Waving Display.

Waving displays of *Macrophthalmus banzai* and *M. japonicus* are distinct, and individuals of each species can be easily identified on the basis of these movements (Fig. 5). In *M. banzai,* the both chelipeds at the beginning remain flexed in front of the buccal region and are raised up to a level near the front of the carapace, then unflexed to the upper-lateral side. At this maximum elevation of chelipeds, the body

Table 1. Temporal patterns of waving displays in *Macrophthalmus banzai* and *M. japonicus* from Shirahama, Japan. — Data are shown separately for the waves observed when no other crabs were near (A) and those with approach of other crabs (B).

Tabelle 1. Dauer der Winkbewegungen bei *Macrophthalmus banzai* und *M. japonicus*-Exemplaren von Shirahama, Japan. — Die Werte sind für Winkbewegungen in Abwesenheit (A) und Annäherung (B) von Artgenossen getrennt angegeben.

Species		Sample size	Mean duration ± SD (sec) Initial - final	Initial - apex	Apex - final
M. banzai	A	22 males (63 waves)	1.34 ± 0.28	0.69 ± 0.12	0.65 ± 0.19
	B	18 males (37 waves)	1.15 ± 0.17	0.63 ± 0.11	0.52 ± 0.10
M. japonicus	A	14 males (54 waves)	0.84 ± 0.12	0.52 ± 0.09	0.32 ± 0.05
	B	11 males (40 waves)	0.84 ± 0.11	0.54 ± 0.10	0.29 ± 0.04

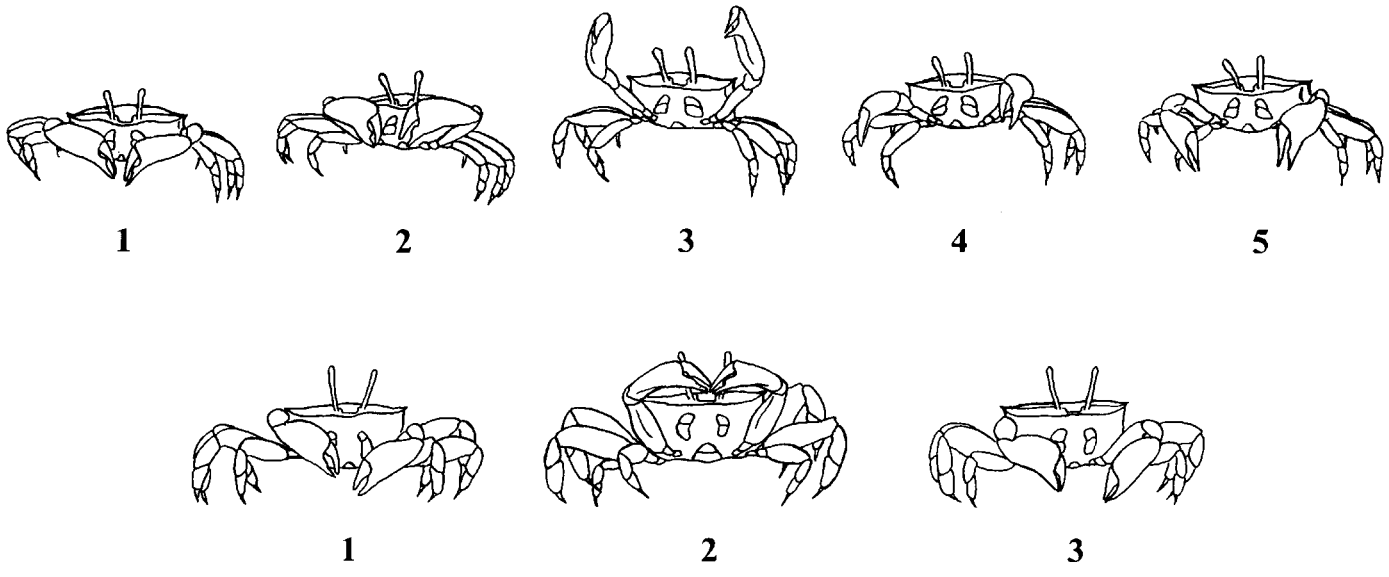


Fig. 5. Successive postures of waving displays by *Macrophthalmus banzai* (upper) and *M. japonicus* (lower).

Abb. 5. Aufeinanderfolgende Phasen der Winkbewegung von *Macrophthalmus banzai* (oben) und *M. japonicus* (unten).

is also raised up on the extended ambulatory legs, and sometimes the 4th legs are lifted off the ground. Finally the chelipeds are slightly flexed and lowered frontally. The chelipeds at the final position are flexed to less extent than at the initial position. The duration of the wave component from the initial to the apex (the maximum elevation of the body) was similar to that from the apex to the final position, and both components were slightly shortened with the approach of other crabs (Tab. 1).

In contrast to *M. banzai*, waving in *M. japonicus* does not involve unflexing of chelipeds. Both chelipeds of *M. japonicus* at the beginning are kept in front of the buccal region, and raised up to a level just above the front of the carapace without unflexing. Subsequently, the body is raised up, keeping the chelipeds in the same position, by extending ambulatory legs, when the 3rd legs are sometimes lifted off the ground. Finally the chelipeds are lowered back to the initial position in the same plane in which they are elevated. The duration of wave component from the initial to the apex was longer than that from the apex to the final position, and the duration of both components was shorter than those of *M. banzai* (Tab. 1). The wave durations were almost identical comparing occasions when no other crabs were near to ones when other crabs approached.

Morphological Differences and Taxonomic Considerations.

Morphological differences between *Macrophthalmus banzai* and *M. japonicus* can be summarized as follows: 1) the maximum size of *M. banzai* is smaller than that of *M. japonicus* (Tab. 2); 2) the ratio of carapace length relative to carapace width in *M. banzai* is smaller than that in *M. japonicus* (Tab. 3); 3) the external orbital angle of *M. banzai* is more pointed laterally than that of *M. japonicus*; 4) male *M. banzai* have a longer propodus of cheliped in relation to carapace width than male *M. japonicus*, which is exemplified in WADA (1978) as a difference between Form V (= *M. japonicus*) and Form L (= *M. banzai*) of *M. japonicus;* 5) the tubercles on the upper margin of male palm are smaller in *M. banzai* than in *M. japonicus;* 6) the large blunt tooth on the cutting edge of the male movable finger is located more closely to

Table 2. CL (mm) of the largest individual among the specimens of *Macrophthalmus banzai* and *M. japonicus* collected at Shirahama, Japan. — Number of specimens examined is shown in parenthesis.

Tabelle 2. CL (mm) der größten in Shirahama (Japan) gesammelten Exemplare von *Macrophthalmus banzai* und *M. japonicus*. — Die Anzahl der untersuchten Exemplare ist in Klammern angegeben.

	Male	Female
M. banzai	15.8 (124)	13.1 (45)
M. japonicus	28.2 (68)	19.4 (38)

Table 3. Relationships between CL (y in mm) and CW′ (x in mm) in *Macrophthalmus banzai* and *M. japonicus* collected at Samusaura, Shirahama, Japan.

Tabelle 3. Beziehungen zwischen CL (y in mm) und CW′ (x in mm) bei *Macrophthalmus banzai* und *M. japonicus*. — Alle Daten wurden an Exemplaren aus Samusaura, Shirahama, Japan erarbeitet.

	N	Range (x)	Regression equation	r
M. banzai				
Male	82	7.05 - 23.05	y = 0.805 + 0.610x	0.994
Female	39	7.45 - 20.15	y = 0.758 + 0.619x	0.996
M. japonicus				
Male	66	9.95 - 31.10	y = 0.483 + 0.661x	0.997
Female	36	8.90 - 28.35	y = 0.419 + 0.663x	0.998

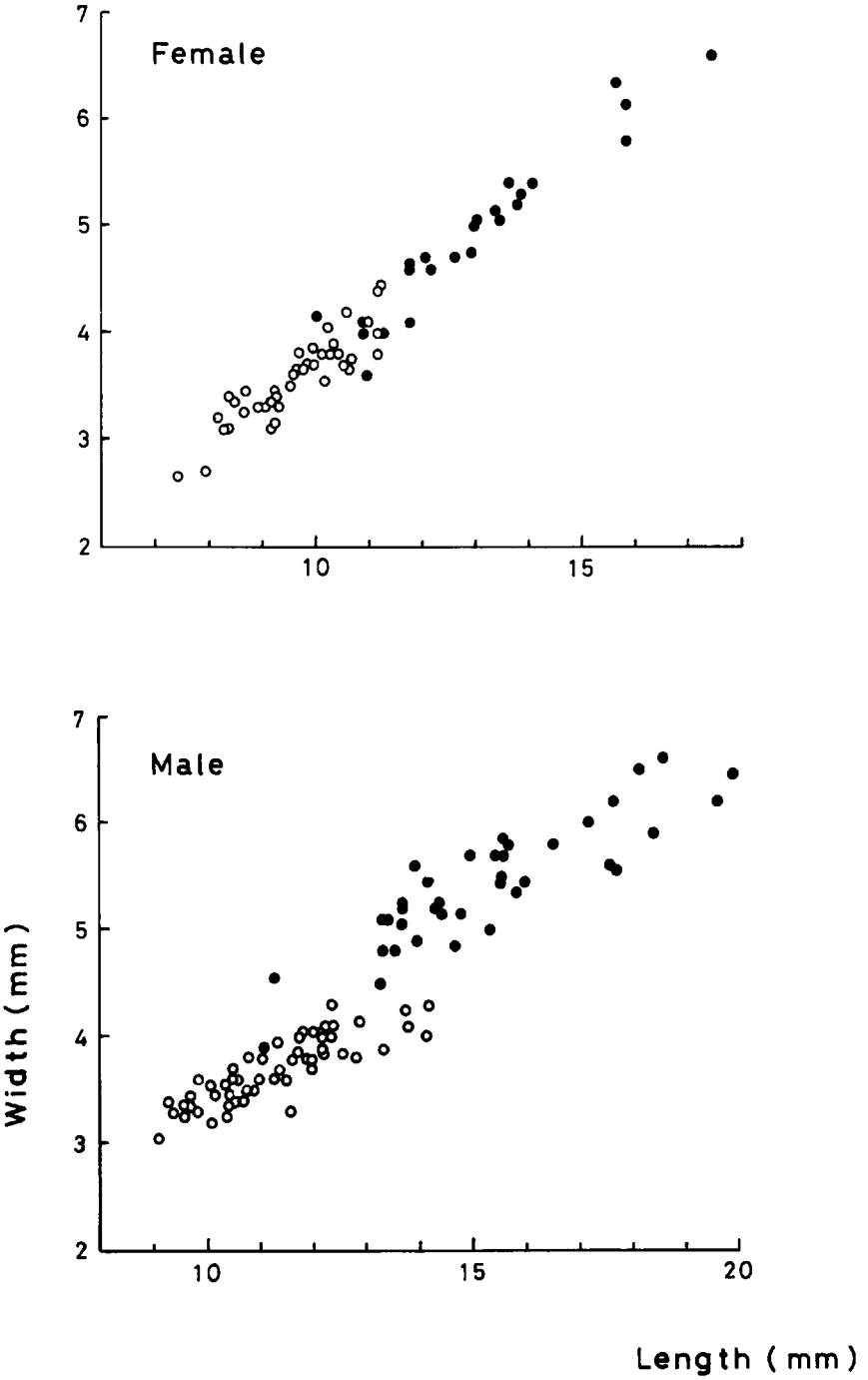
the base in *M. banzai* than in *M. japonicus;* 7) the anterior half of the ventral surface of carpus and propodus of the 3rd leg bears a tuft of setae in male *M. banzai,* while no setae are present on the same part of male *M. japonicus;* 8) the merus of the 3rd leg in male *M. banzai* is more slender than in male *M. japonicus* (Fig. 6); 9) the subdistal tooth on anterior margin of the merus of the 3rd leg is more distinct in *M. banzai* than in *M. japonicus;* 10) the terminal process of male gonopod is lengthened in *M. banzai,* while short in *M. japonicus,* and its tip is convex in the former, while truncate in the latter; 11) the terminal margin of the last abdominal segment of female *M. banzai* is less projecting than that of female *M. japonicus,* and the length of the segment relative to its width in the former is shorter than in the latter (Fig. 7); 12) the collar of female genital organ in *M. banzai* is more evidently convex on anteromedian part than in *M. japonicus.*

Recently, Dai & Song (1984) reported a new subspecies, *M. japonicus frequens* from northern China. According to their description, morphological characteristics

▶

Fig. 6. Diagram showing the relation between width of merus of the ambulatory leg 3 and corresponding length in *Macrophthalmus banzai* (open circle) and *M. japonicus* (solid circle) collected at Shirahama, Japan. — Covariance analysis shows that the regression lines in males are significantly different between the two species (slope: $P < 0.05$; elevation: $P < 0.01$), while those in females are not (slope: $P > 0.25$; elevation $P > 0.1$).

Abb. 6. Beziehung zwischen Länge und Breite des Merus des dritten Pereiopoden bei *Macrophthalmus banzai* (unausgefüllte Kreise) und *M. japonicus* (ausgefüllte Kreise) aus Shirahama (Japan). — Die Kovarianzanalyse zeigt, daß die Regressionsgeraden für Männchen der beiden Arten signifikant unterschieden sind (Steigung: $P < 0.05$; y-Achsen-Abschnitt: $P < 0.01$), bei den Weibchen ist dies nicht der Fall (Steigung: $P > 0.25$; y-Achsen-Abschnitt: $P > 0.1$).


Female
Male
Width (mm)
Length (mm)
2
3
4
5
6
7
10
15
20

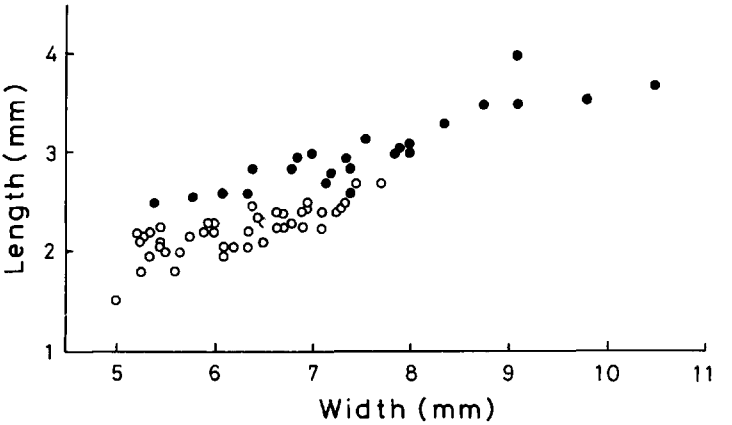


Fig. 7. Diagram showing the relation between length of the last abdominal segment and corresponding width in females of *Macrophthalmus banzai* (open circle) and *M. japonicus* (solid circle) collected at Shirahama, Japan. — Covariance analysis shows that slopes of the regression lines are not significantly different ($P > 0.25$) between the two species, but the elevations are significantly different ($P < 0.01$).

Abb. 7. Beziehung zwischen Länge und Breite des letzten Hinterleibssegmentes der Weibchen von *Macrophthalmus banzai* (unausgefüllte Kreise) und *M. japonicus* (ausgefüllte Kreise) aus Shirahama (Japan). — Die Kovarianzanalyse zeigt, daß die Steigungen der Regressionsgeraden nicht signifikant unterschieden sind ($P > 0.25$). Dies ist jedoch bei den y-Achsen-Abschnitten der Fall ($P < 0.01$).

of *M. japonicus frequens* distinguishing it from *M. japonicus japonicus* are 1) the broader merus and 2) the finer serrations on anterior and posterior margins of the 2nd and 3rd legs, 3) the relatively indistinct subdistal tooth on the 3rd leg, 4) the truncate tip of male gonopod process, and 5) the relatively narrower last segment of female abdomen. All the above characteristics, excluding 2), which could not be distinguished between *M. banzai* and *M. japonicus*, are included in those of *M. japonicus* distinguishing it from *M. banzai*. In addition, the following two characteristics of *M. japonicus frequens* are also applicable to *M. japonicus*, but not to *M. banzai*: 1) carapace is 1.5 times as broad as long, and 2) the blunt tooth on the inner margin of male movable finger is located at one fourth of distance from the base. We could not examine the type specimens of *M. japonicus frequens* but could obtain the information that in specimens of *M. japonicus frequens* the upper margin of carpus and propodus of the 3rd leg is less setose, the male chela is smaller, and the tubercles on the upper margin of the male palm are larger than in specimens of DAI & SONG's *M. japonicus japonicus* (DAI, personal communication). From all these facts it can be concluded that DAI and SONG's two subspecies *M. japonicus japonicus* and *M. japonicus frequens* correspond to *M. banzai* and *M. japonicus* respectively. However, their new subspecies is not, as shown above, identical with the new species described here but with *japonicus* proper.

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References.

BARNES, R. S. K. (1966): A new species of the genus *Macrophthalmus* LATREILLE, 1829 (Decapoda: Brachyura: Ocypodidae) from the Gulf of Carpentaria, Queensland. — Proc. roy. Soc. Qd., **78**: 43-47; Brisbane.

— — — (1967): The Macrophthalminae of Australasia: with a review of the evolution and morphological diversity of the type genus *Macrophthalmus* (Crustacea: Brachyura). — Trans. zool. Soc. London, **31**: 195-262; London.

— — — (1970): The species of *Macrophthalmus* (Crustacea: Brachyura) in the collections of the British Museum (Natural History). — Bull. Brit. Mus. nat. Hist. (Zool.), **20**: 205-251; London.

— — — (1971): Biological results of the Snellius Expedition. XXIII. The genus *Macrophthalmus* (Crustacea: Brachyura). — Zool. Verh., **115**: 1-40; Leiden.

— — — (1977): Concluding contribution towards a revision of, and a key to, the genus *Macrophthalmus* (Crustacea: Brachyura). — J. Zool., **182**: 267-280; London.

DAI, A.-Y. & SONG, Y.-Z. (1984): *Macrophthalmus* (Decapoda, Brachyura) of the seas of China. — Crustaceana, **46**: 76-86; Leiden.

HAAN, W. DE (1833-1850): Crustacea. In: SIEBOLD, P. F. VON [Ed.]: Fauna japonica sine descriptio animalium, quae in itinere per Japoniam jussu et auspiciis superiorum, qui summum in India Batava Imperium tenent, suscepto, annis 1823-1830 collegit, notis observationibus et adumbrationibus illustravit, I-XVII, I-XXXI, IX-XVI, 1-243, pls A-J, L-Q, 1-55, circ. tab. 2; Amsterdam (J. Müller & Sons).

KEMP, S. (1919): Notes on the Crustacea Decapoda in the Indian Museum, No. 13. The Indian species of *Macrophthalmus*. — Rec. indian Mus., **16**: 383-394; Calcutta.

KIM, H. S. (1973): Illustrated encyclopedea of fauna & flora of Korea Vol. 14 Anomura Brachyura. 694 pp., 112 pls.; Seoul (Minist. Educ.).

SAKAI, K. (1987): Two species of the genus *Macrophthalmus* (Crustacea: Brachyura), *M. (Macrophthalmus) dilatatus dilatatus* and *M. (Mareotis) japonicus*, at the estuary of the Yoshino-gawa, Tokushima, Japan. — Bull. Shikoku Women's Univ., 7: 49-51, pl. 1; Tokushima.

SAKAI, T. (1939): Studies of the crabs of Japan. IV. Brachygnatha, Brachyrhyncha: 365-741 + 23 pp., pls. 42-111; Tokyo (Yokendo).

SHEN, C. J. (1932): Brachyuran Crustacea of north China. — Zool. Sinica, **9**: 1-320, 1 map, 10 pls.; Peiping.

TESCH, J. J. (1915): The catometopus genus *Macrophthalmus* as represented in the collection of the Leiden Museum. — Zool. Meded., **1**: 149-204; Leiden.

WADA, K. (1978): Two forms of *Macrophthalmus japonicus* DE HAAN (Crustacea: Brachyura). — Publ. Seto Mar. Biol. Lab., **24**: 327-340; Shirahama.

— — — (1984): Pair formation in the two forms of *Macrophthalmus japonicus* DE HAAN (Crustacea: Brachyura) at a co-occurring area. — J. Ethol., **2**: 7-10; Kyoto.

— — — (1989): Interbreeding experiments of the two forms of *Macrophthalmus japonicus* (Crustacea: Brachyura: Ocypodidae). — Zool. Sci., **6**: 181-184; Tokyo.