

## **Description of *Daphnia obtusa* Kurz (Branchiopoda, Anomopoda, Daphniidae) in Korea, with Notes on Distribution and Ecology**

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### **ABSTRACT**

The specimens of *Daphnia obtusa* collected from various freshwater habitats at 13 localities in South Korea during the period from May 1980 to May 1996 were examined. In this paper *D. obtusa* in Korea is described and figured, and discussed with distribution and ecology.

Key words: Description, *Daphnia obtusa*, Daphniidae, Anomopoda, Branchiopoda, Korea

### **INTRODUCTION**

Species in the genus *Daphnia* are notoriously difficult to delimit, and for many years various names were used extensively to describe the variability in shape often apparent in *Daphnia* populations (Brooks, 1957; Hebert, 1977). It has been known that the body shape of many *Daphnia* species is affected by environmental conditions, and populations often consist of several species linked by individuals of intermediate appearance due to introgressive hybridization (Brooks, 1957).

Four species of *Daphnia* belonging to the *pulex*-group, characterized by possessing true combs (pectens) on the postabdominal claw (Scourfield and Harding, 1966), have been reported from the Far East so far (Chiang and Du, 1979; Tanaka and Tominaga, 1986; Tanaka and Shigaki, 1987; Yoon and Kim, 1987; Kim, 1988; Mizuno and Takahashi, 1991; *D. pulex* Leydig, *D. obtusa* Kurz,

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*D. curvirostris* Eylmann, and *D. biwaensis* Ueno. Among them *D. biwaensis* seems to be confined to Lake Biwa-ike of Honshu, Japan (Mizuno and Takahashi, 1991). *D. curvirostris*, which had been confused with *D. ambigua* Scourfield in Japan, was reported from the lakes and ponds of high mountain in central Japan (Tanaka and Tominaga, 1986). *D. pulex* is known to be one of the common and widespread species in the Far East. It has been recorded from almost all regions of three countries, Korea, China and Japan (Ching and Du, 1979; Yoon and Kim, 1987; Mizuno and Takahashi, 1993). *D. obtusa* seems to be another common species in this region though its records are rare (Benzie, 1987). Presently *D. obtusa* is taxonomically recorded from China (Chiang and Du, 1979) and Japan (Tanaka and Shigaki, 1987), but its reality is still not clear in Korea.

*D. obtusa* was first separated as a new species from *D. pulex* by Kurz (1874), but many investigators had considered it as a variety or subspecies of *D. pulex* (Lilljeborg, 1901; Keilhack, 1909; Ueno, 1927; Kiser, 1950; Manujlova, 1964). It had long been confused with *D. pulex* owing to the morphological similarities, and might have been misidentified as *D. pulex* in a quite frequency (see Benzie, 1987). Presently the informations concerning *D. obtusa* such as geographical variations, variations within or between populations according to age or environmental conditions, and geographical distribution including relative occurrence compared to related species are quite a few. This is being a difficulty in the taxonomy of the species.

While the first author have surveyed the daphniid cladoceran fauna of Korea, he found several populations of *D. obtusa*. In this paper, *D. obtusa* from Korea is described and discussed with the morphological characteristics. Also the distribution and some ecological features of the species are examined.

## MATERIALS AND METHODS

Materials were collected from the various freshwater habitats such as ricefields, pools, bogs, and reservoirs at 13 localities in South Korea during the period from May 1980 to May 1996 (Fig. 1). Collections were made with a conical plankton net and a dipnet (both 155 m in mesh size). Samples were fixed with 10% formalin and preserved in 4% formalin. Environmental factors such as water temperature, pH, concentration of dissolved oxygen (DO), and conductivity were measured with pH meter (Toa, HM-10P), DO meter (Toa, DO-11P), and conductivity · salinity meter (Orion, model 140) in the field.

The samples were inventoried to determine the presence and the reproductive state of the species under a Nikon stereomicroscope. Each specimen was removed to a drop of glycerol in a reversed slide for subsequent study. Temporary mounts of whole specimens in glycerol were used for the measurements and drawings on intact animals and their parts. Whole bodies were dissected with tungsten needles for investigating antennules, antennae, trunk limbs, postabdomens, postabdominal claws, and other parts. Drawing and measuring were made with a Nikon compound microscope attaching a drawing tube system. All specimens examined are deposited in the first author's collection. An abbreviation 'ephi' in the 'Material examined' section means ephippial female.

Terminology follows that given by McLaughlin (1980).

## RESULTS

### Description of species

#### ***Daphnia obtusa* Kurz, 1874** 몽당물벼룩 (Figs. 2-5)

*Daphnia obtusa* Kurz, 1874, p. 22; Sramek-Husek *et al.*, 1962, p. 206, Figs. 71, 72; Scourfield and Harding, 1966, p. 17, fig. 29; Flössner, 1972, p. 118, Fig. 53; Chiang and Du, 1979, p. 112, Fig. 74; Negrea, 1983, p. 109, Fig. 41; Margaritora, 1983, p. 64, Fig. 40; Tanaka and Shigaki, 1987, p. 111, Figs. 1, 2; Michael and Sharma, 1988, p. 69, Fig. 19.

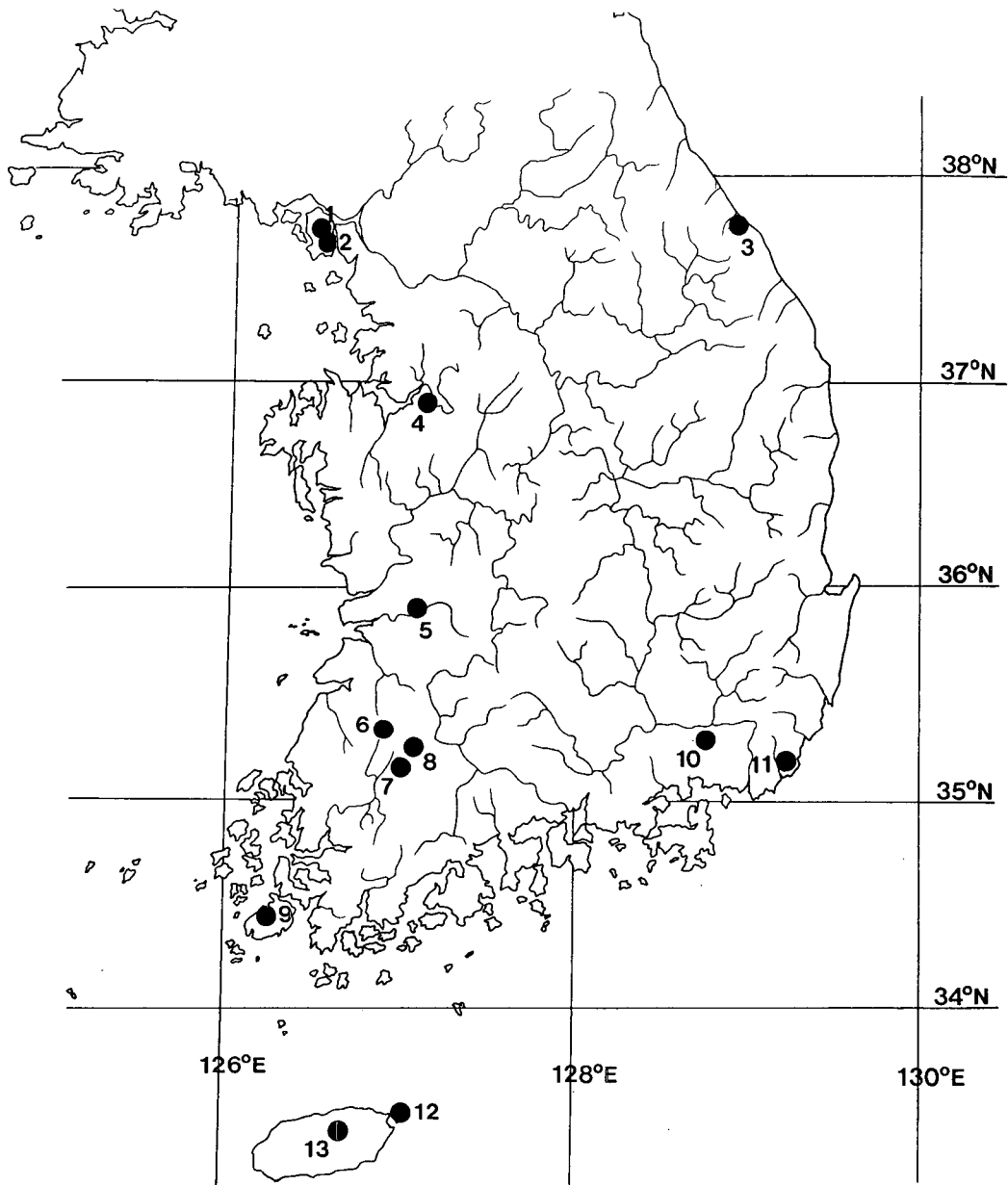
*Daphnia pulex* var. *obtusa*: Lilljeborg, 1901, p. 89, Tab. 11, figs. 3, 11, Tab. 12, fig. 1; Keilhack, 1909, p. 21, fig. 34; Ueno, 1927, p. 279, Pl. 23, figs. 7, 7a-7f.

*Daphnia pulex obtusa* Kiser, 1950, p. 12, Pl. 1, figs. 8-10; Manujlova, 1964, p. 121, figs. 34-4, 34-5.

**Material examined:** 19 ♀ ♀ (6 ephi.), 4 ♂ ♂, from ricefields at Sinjōng-ri, Kanghwado Is., 24 Apr. 1991, leg. Shin and Kong; 11 ♀ ♀, from ricefields at Tōkchin-ri, Kanghwado Is., 24 Apr. 1991, leg. Shin and Kong; 16 ♀ ♀ (5 ephi.), 3 ♂ ♂, from ricefields at Ch'odang-ri, Kangrung, 18 May 1980, leg. Kim; 17 ♀ ♀, from ricefields at Sōnghwan, 28 Apr. 1996, leg. Yoon; 4 ♀ ♀, from Chugyo Reservoir at Onsu-ri, Iksan, 3 May 1988, leg. Chang; 17 ♀ ♀, 22 ♀ ♀ (4 ephi.), from ricefields at Punhyang-ri, Changsōng, 24 Apr. and 18 May 1996, leg. Yoon; 15 ♀ ♀, 18 ♀ ♀, from a pool at Ch'ōngok-dong, Kwangju, 17 Apr. and 15 May 1996, leg. Yoon; 11 ♀ ♀ (3 ephi.), from ricefields at Sōgyo-ri, Tamyang, 17 Apr. 1996, leg. Yoon; 13 ♀ ♀, from a bog at Samdang-ri, Chindo Is., 2 Nov. 1994, leg. Yoon and Kim; 18 ♀ ♀ (5 ephi.), from ricefields at Mangch'ōn-ri, Kimhae, 29 May 1991, leg. Yoon; 19 ♀ ♀, from a ditch of ricefield at Songjōng-dong, Pusan, 3 Apr. 1994, leg. Kim; 16 ♀ ♀ (6 ephi.), 3 ♂ ♂, from a pool in Udo Is., 24 Mar. 1988, leg. Min; 2 ♀ ♀, from a swamp of streamlet near Kaewōlorūm in Mt. Hallasan, 25 Aug. 1984, leg. Ham.

**Parthenogenetic female:** *General shape* (Fig. 2a). Body bilaterally compressed, almost oval in outline of lateral view. In lateral view, head short and wide, separated from body by very weak indentation at dorsocephalic suture; ventral margin deeply concave. Dorsal and ventral margins of carapace evenly curved; curvature of ventral margin quite more than that of dorsal margin. Posterior shell spine usually very short. Color yellowish or red-brown.

*Carapace* (Figs. 2a-b). Surface with distinct reticulation, subrectangular or irregular polygonal. Dorsal margin without carina, spinose from about midline to posterior shell spine; spines fine and irregularly spaced. Ventral margin spinose on posterior half; spines fine but distinct, even, widely spaced; inner lip of middle part more or less concave or straight, with row of plumose setae decreasing in length posteriorly, followed by row of fine spinules widely spaced toward posterior shell spine (Fig. 2b). Posterior shell spine spinose and short, occasionally rudimentary; length usually less than one-tenth of carapace length in mature female, but sometimes longer than one-fourth of carapace length in egg-carrying female.



**Fig. 1.** Localities from which the specimens were collected. 1, Sinjŏng-ri, Kanghwado Is.; 2, Tŏkchin-ri, Kanghwado Is.; 3, Ch'odang-ri, Kangrung-shi; 4, Sŏnghwan-p; 5, Onsu-ri, Wanggung-myŏn, Iksan-gun; 6, Punhyang-ri, Nam-myŏn, Changsŏng-gun; 7, Ch'ŏngok-dong, Tong-gu, Kwangju-shi; 8, Sŏgyo-ri, Kosŏ-myŏn, Tamyang-gun; 9, Samdang-ri, Chisan-myŏn, Chindo-gun; 10, Mangch'ŏn-ri, Hanrim-myŏn, Kimhae-shi; 11, Songjong-dong, Haeundae-gu, Pusan-shi; 12, Udo Is., Pukcheju-gun, Cheju-do; 13, Kaewŏlorŭm in Mt. Hallasan, Cheju-do.

*Head* (Figs. 2a, 2c). Relatively short and wide, broadly rounded; length about one-fourth of carapace length; width at base about three-fifths of carapace width and about twice head length. Cephalic shield moderately penetrating carapace dorsally as broad wedge. Surface on ventral part with reticulation of polygons. Carina absent. Dorsal margin evenly curved to anterior margin while anterodorsal margin somewhat straight. Ventral margin deeply concave behind eye. Fornix rounded and well developed. Eye large, filling apart in short distance from anteroventral margin. Ocellus conspicuous, moderate in size, and situated behind eye. Rostrum short and bluntly pointed at tip.

*Antennule* (Figs. 1a, 2c). Short and immobile, locating on strong rostral ridge having large and protuberant tip under posterior margin of head; width/length ratio about 1.0. Nine apical sensory aesthetascs unequal in length; longest aesthetasc nearly as long as antennule; almost all aesthetascs projecting slightly beyond tip of rostrum.

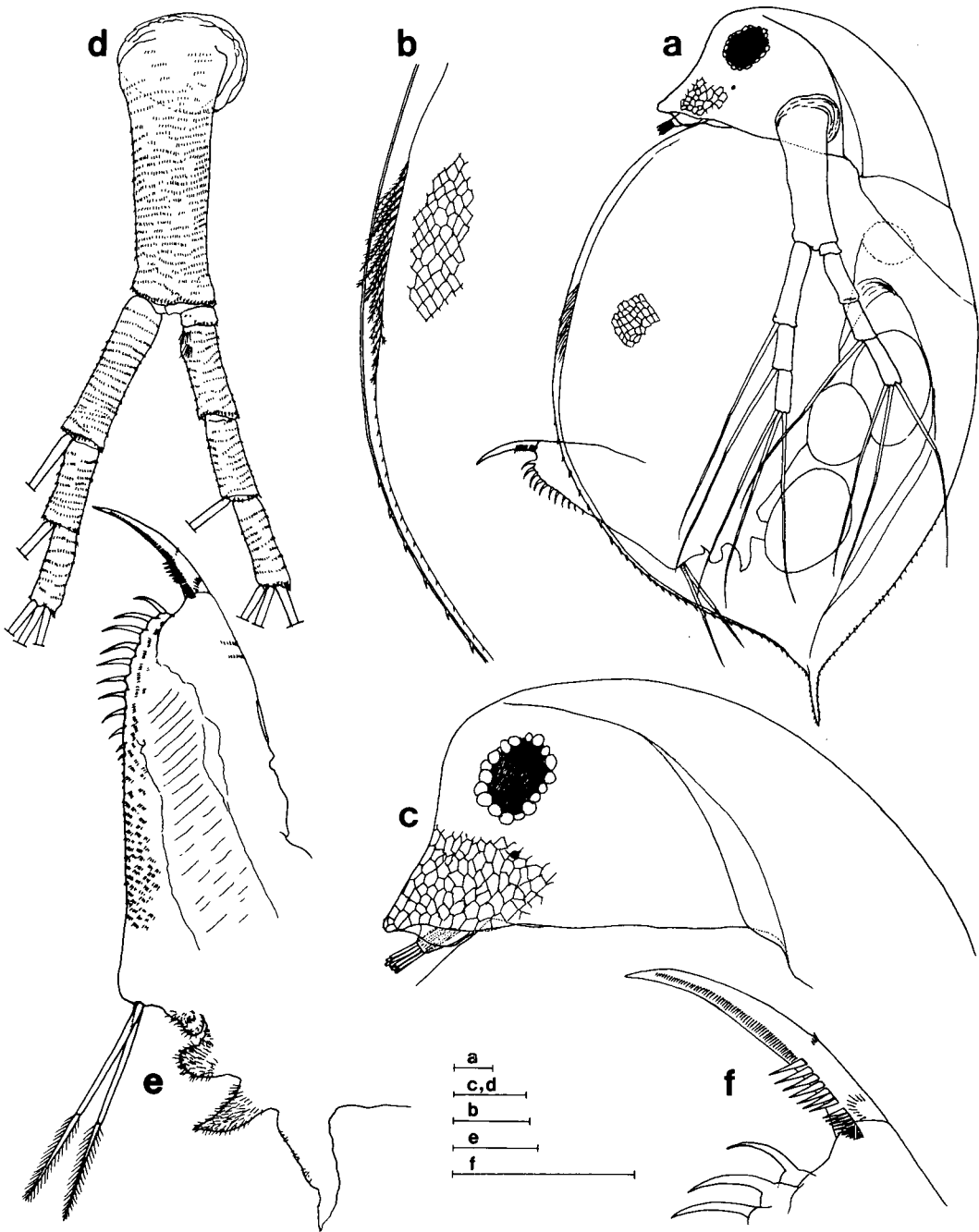
*Antenna* (Fig. 2d). Slightly shorter than two-thirds of carapace length. Antennal formula 0-0-1-3/1-1-3; terminal setae shorter than non-terminal setae; approximate length ratios of exopod segments relative to basipod length 0.1, 0.4, 0.4, and 0.4, endopod segments 0.6, 0.3, and 0.3, approximate width/length ratios of each segments 0.28 in basipod, 1.75, 0.35, 0.40, and 0.28 in exopod, 0.25, 0.38, and 0.35 in endopod. Surface covered with transverse rows of fine spinules along whole length. All segments with transverse row of small spines at distal ends. Second exopod segment with 2 clumps of setae on inner surface proximally.

*Trunk limb I* (Fig. 3a). Epipod subovoid to subrectangular. Two ejector hooks of unequal size, each finely serrated on distal half of concave margin, arising from anterior surface of protopod. Exopod with 1 long seta finely serrated distally. Endopod with 5 endites; proximal endite with 4 long plumose setae and 1 short, finely serrated seta; second endite with 2 long plumose setae and 1 short, finely serrated seta; third endite with 2 long plumose setae and 1 finely serrated seta, much larger than setae in other endites; fourth and distal endites each with 1 seta on distal end; seta on distal endite very short and nearly naked while seta on fourth endite long and finely serrated distally. Anterior surface with 8-10 transverse rows or clusters of hairs.

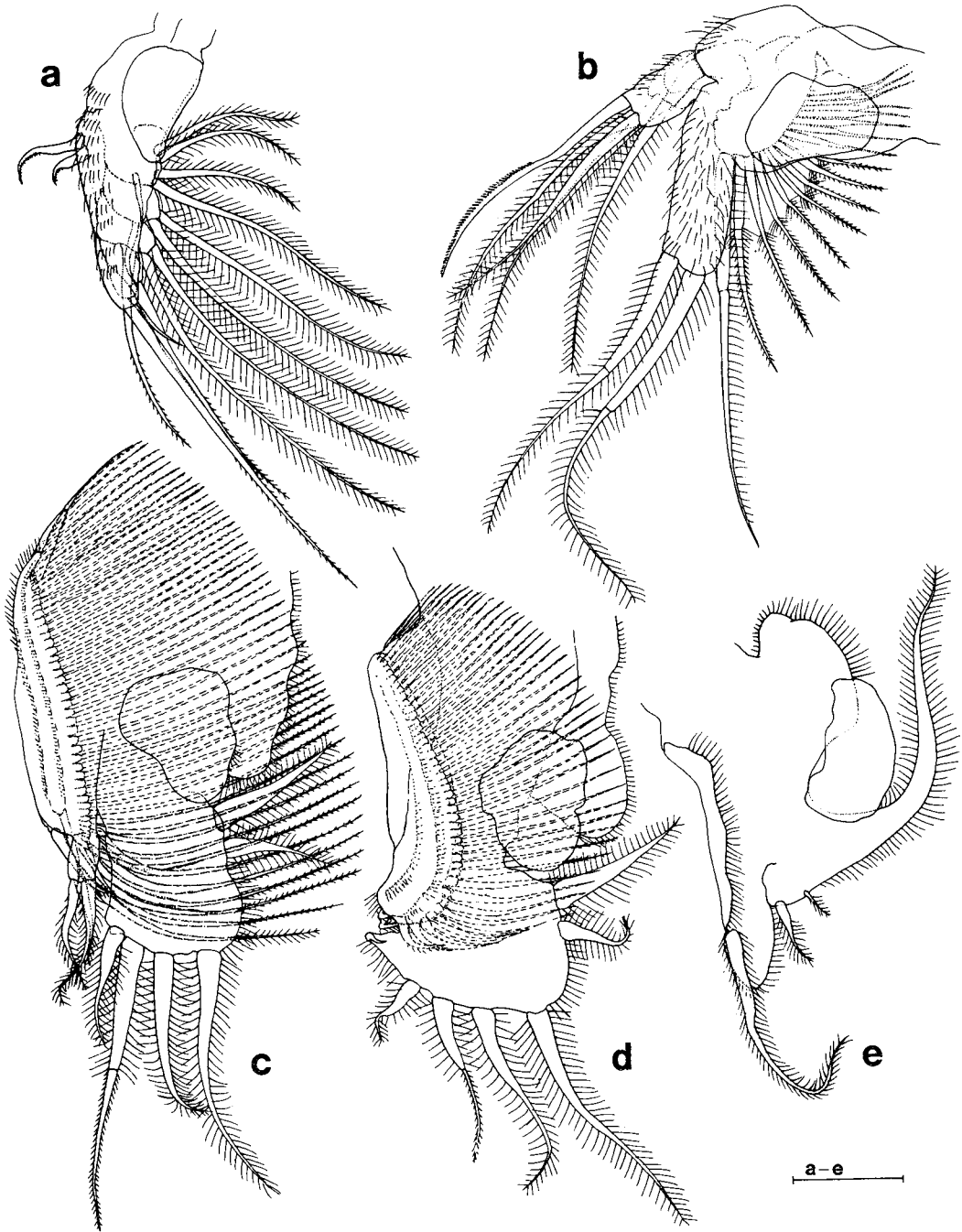
*Trunk limb II* (Fig. 3b). Epipod subovoid to subhexagonal. Exopod elongate, with 2 long plumose seta at tip; external surface covered with setules. Endopod with 5 endites; proximal endites flate, with 15 spinose setae, 1 densely papose seta, and 1 feathered seta having hairs on one margin; second endite with 1 long plumose seta; third endite without seta; fourth endite with 1 long plumose seta; distal endite with 2 long plumose setae and 1 serrate seta; anterior surface of each endopodites with clusters of hairs.

*Trunk limbs III* (Fig. 3c). Epipod semispherical, inserted between setulose preepipod and exopod. Exopod flabelliform, with 5 stout plumose setae and 1 proximally plumose, distally serrate seta; external margin fringed with fine setules. Endopod with 2 endites; proximal endite elongate and flat, with 3 short and stout setae distally, and fringed with about 50 long, tapering, biserrate setae, and with 2 rows of fine setules parallel to fringed margin submarginally; distal endite with 3 stout plumose setae on distal end.

*Trunk limbs IV* (Fig. 3d). Epipod semispherical, inserted between setulose preepipod and exopod. Exopod flabelliform, with 5 stout plumose setae and 1 proximally plumose, distally serrate seta; external margin fringed with fine setules; internal margin fringed with fine setules, and with small accessory seta proximally. Endopod with 1 endite; endite elongate and flat, with 2 short plumose



**Fig. 2.** *Daphnia obtusa* Kurz, lateral view of parthenogenetic female: a, habitus; b, middle part of ventral margin of carapace; c, head; d, left antenna; e, postabdomen; f, postabdominal claw. (Scales: a-f = 0.1 mm).



**Fig. 3.** *Daphnia obtusa* Kurz, outer view of left trunk limbs of parthenogenetic female: a, limb I; b, limb II; c, limb III; d, limb IV; e, limb V. (Scale: a-e = 0.1 mm).

seta at tip; external surface covered with setules. Endopod with 5 endites; proximal endite flate, with 15 spinose setae, 1 densely papose seta, and 1 feathered seta having hairs on one margin; second endite with 1 long plumose seta; third endite without seta; fourth endite with 1 long plumose seta; distal endite with 2 long plumose setae and 1 serrate seta; anterior surface of each endites with clusters of hairs.

*Trunk limbs III* (Fig. 3c). Epipod semispherical, inserted between setulose preepipod and exopod. Exopod flabelliform, with 5 stout plumose setae and 1 proximally plumose, distally serrate seta; external margin fringed with fine setules. Endopod with 2 endites; proximal endite elongate and flat, with 3 short and stout setae distally, and fringed with about 50 long, tapering, biserrate setae, and with 2 rows of fine setules parallel to fringed margin submarginally; distal endite with 3 stout plumose setae on distal end.

*Trunk limbs IV* (Fig. 3d). Epipod semispherical, inserted between setulose preepipod and exopod. Exopod flabelliform, with 5 stout plumose setae and 1 proximally plumose, distally serrate seta; external margin fringed with fine setules; internal margin fringed with fine setules, and with small accessory seta proximally. Endopod with 1 endite; endite elongate and flat, with 2 short plumose setae distally, and fringed with about 45 long, tapering, biserrate setae, and with 2 rows of fine setules parallel to fringed margin submarginally.

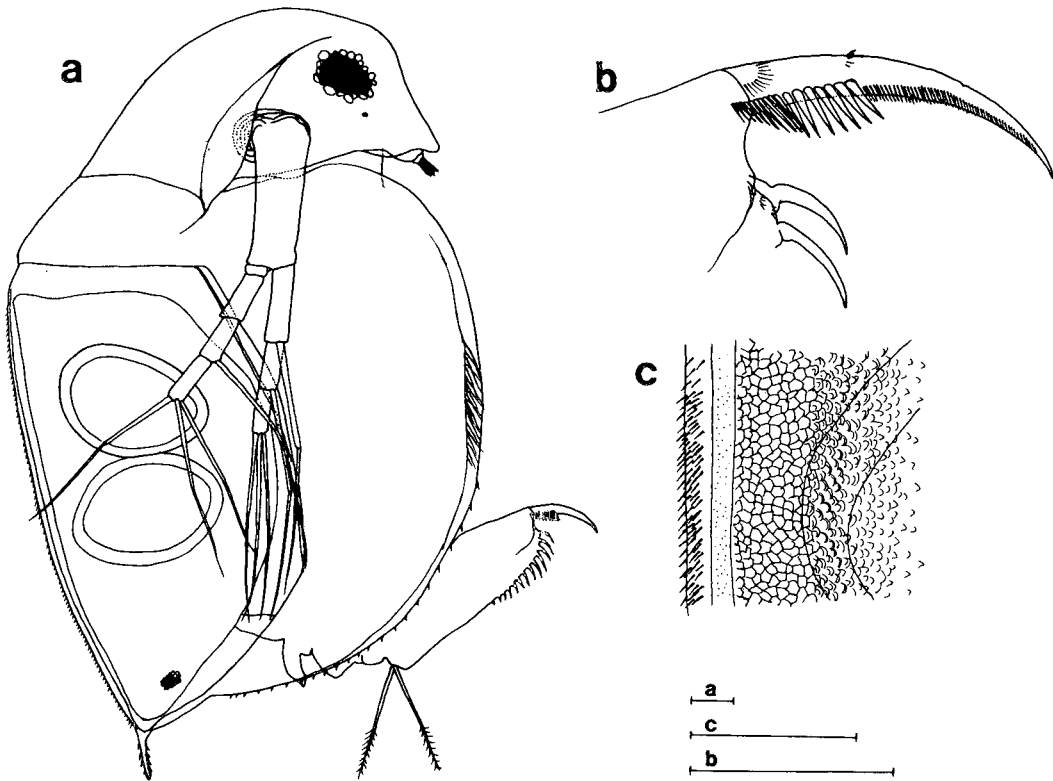
*Trunk limbs V* (Fig. 3e). Epipod semispherical. Margin of preepipod densely setulose. Exopod terminated by large plumose seta; internal margin finely setulose, with very reduced seta followed by small plumose seta near base of endopod endite. Endopod composed of 2 endites; external endite flaplike and setulose, other endite smaller, with setulose internal margin and terminated by large recurved plumose seta.

*Postabdomen* (Fig. 2e). Long and slightly tapering; length about 2.6 times of height. Abdominal processes 4 in number; first and second processes large, third and fourth processes strongly reduced; length ratios for first, second, third and fourth about 4.5: 2.6: 1.4: 1; first process nearly naked while other processes setulosed. Abdominal setae as long as preanal margin, arising near anterodorsal corner forming right angle. Dorsal margin very weakly sinuate with anal region slightly expanded, provided with 10-13 slightly curved anal spines more or less increasing in size distally; anterior 1-2 anal spines located on preanal region accompanied anteriorly by 3-4 spinules. Dorsal surface with clusters of fine hairs, which located near bases of anal spines on distal part and scattered irregularly on proximal part except on region near anterodorsal corner. Ventral margin nearly straight, with 2 clusters of fine hairs near distal quarter.

*Postabdominal claw* (Fig. 2f). Slightly curved, with 2 pectens of large and stout spinules extending to base proximally, and with long row of minute and fine spinules arranged along concave margin from pectens to tip of claw; spinules on proximal pecten 5-10 in number, relatively shorter and slender, increasing in size distally, spinules on subproximal pecten 5-8 in number, somewhat larger distally. Ventral surface with semicircular row of fine spinules near base and cluster of fine setules on midway from base to tip.

**Ephippial female:** Except for showing partial differences on general shape and carapace owing to having ephippium, indistinguishable from parthenogenetic female in general form (Fig. 4).





**Fig. 4.** *Daphnia obtusa* Kurz, lateral view of ephippial female: a, habitus; b, postabdominal claw; c, middle part of dorsal margin of ephippium. (Scales: a-c = 0.1 mm).

Body (Fig. 4a) expanded dorsally owing to having ephippium; dorsal margin of region placing ephippium with slight indentation anteriorly.

Ephippium (Figs. 4a, 4c) broad and subtrapezoid, containing 2 eggs, right brown in color; dorsal, ventral and posterior margins slightly curved, anterior margin nearly straight; dorsal margin covered with fine spinules along its whole length (Fig. 4c). Posterior shell spine spinose. Surface rugged, with distinct reticulation of irregular polygons and semicircles; ruggedness increasing from margins to central eggs.

**Male:** *General shape* (Fig. 5a). Small and slender. Body bilaterally compressed, oblong and narrow in outline of lateral view. In lateral view, head short and wide, separated from body by very weak indentation at dorsocephalic suture; ventral margin nearly straight. Dorsal margin of carapace somewhat straight, while ventral margin curved; anterior half of ventral margin weakly sinuated, with distinct indentation near anteroventral corner, and posterior half evenly curved. Posterior shell spine short. Color yellowish.

*Carapace* (Figs. 5b-c). Surface with distinct subrectangular reticulation. Dorsal margin without carina, spinose along almost whole length; spines fine and irregularly spaced. Ventral margin spinose on posterior half; spines fine but distinct, even, widely spaced; inner lip sinuated, with row of plumose setae decreasing in length posteriorly on anterior half, followed by row of groups of fine spinule and minute setules along posterior half (Fig. 5c). Posterior shell spine spinose and short, but always relatively longer than that in female; length about one-fifth of carapace length in mature male.

*Head* (Fig. 5a). Relatively short and wide, broadly rounded; length about one-fourth of carapace length; width at base slightly shorter than carapace width and longer than twice head length. Cephalic shield moderately penetrating carapace dorsally as broad wedge as in female. Carina absent. Dorsal margin evenly curved to anterior margin while ventral margin nearly straight; posteroventral corner distinctly indented. Fornix rounded and well developed, reaching to eye. Eye large, filling apart in short distance from antero-ventral margin. Ocellus conspicuous, moderate in size, and situated behind eye. Rostrum absent.

*Antennule* (Fig. 5d). Cylindrical, long and curved, mobile, and arising from ventral margin of head near indentation at posteroventral corner; width/length ratio about 0.3. Lateral surface with 10-12 clusters of setules forming transverse rows along antennular length. Anterior margin with sensory seta arising from small protuberance at about one-seventh antennular length distally. Nine apical sensory aesthetascs of unequal length, situated on circular end plate. Terminal seta long and curved, tapering, rising from cylindrical mound on end plate opposite to apical sensory aesthetascs; tip spatulate, not terminating to point; anterior margin with 2 small protuberances on about one-third setal length proximally, and with extremely minute teeth distally.

*Antenna*. Identical in general form with that of female.

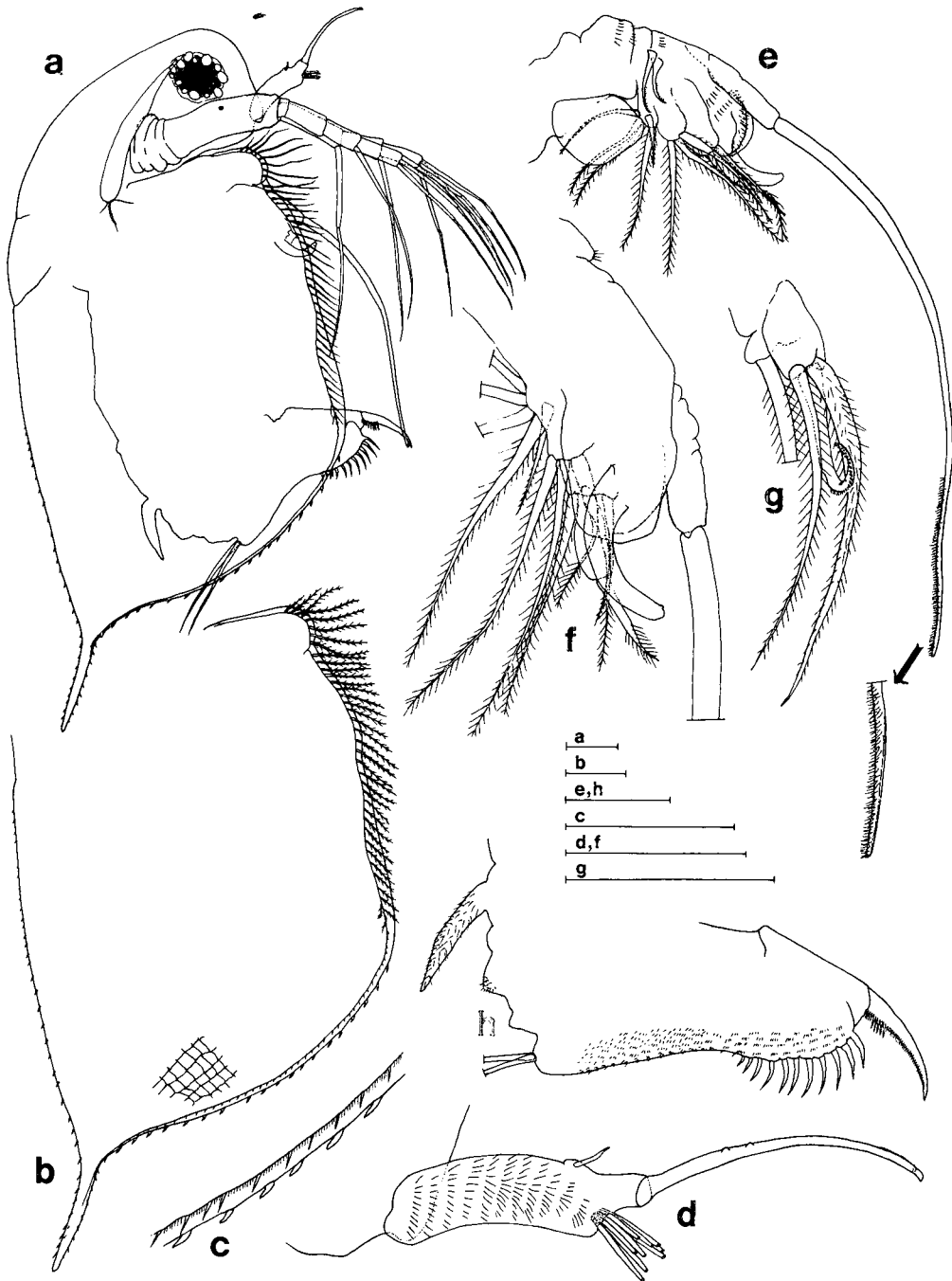
*Trunk limb I* (Figs. 5e-f). Epipod subovoid to subrectangular. Two ejector hooks of unequal size, each finely serrated on distal half of concave margin, arising from anterior surface of protopod. Exopod narrow and elongate, with 1 long curved seta on distal end; seta more than twice limb in length, somewhat spatulate at tip, and with fine hairs on about distal one-third of posterior surface (Fig. 5e). Endopod composed of 5 endites; proximal endite with 4 long plumose setae and 1 short, finely serrated seta; second endite with 3 long plumose setae; third endite with 2 long plumose setae and 1 finely serrated seta; fourth endite elongate, with 1 stout setulose seta on distal end; distal endite of large lobe, with 1 strong hooked spine (male hook). Anterior surface with clusters of hairs.

*Trunk limb II*. Identical in general form with that of female. Distal endite of endopod with 2 long plumose setae and 1 serrate seta as in female, but distal portion of serrate seta usually rolled up while nearly straight in female (Figs. 3b, 5g).

*Trunk limbs III-V*. Identical in general form with those of female.

*Postabdomen* (Fig. 5h). Similar in general form to that of female. Long and slightly tapering; length about 3.0 times of height. Abdominal processes 4 in number; first process large and setulose; second, third and fourth processes strongly reduced; length ratios for first, second, third and fourth about 10: 0.3: 1: 1. Dorsal margin sinuate. Ventral margin nearly straight. Anal spines 11-12 in number.

*Postabdominal claw*. Identical in general form with that of female.



**Fig. 5.** *Daphnia obtusa* Kurz, male: a, habitus, lateral view; b, carapace, lateral view; c, posterior part of ventral margin of carapace, lateral view; d, right antennule, lateral view; e, right trunk limb I, outer view; f, part of right trunk limb I, inner view; g, postabdomen, lateral view. (Scales: a-g = 0.1 mm).

**Size:** Length range (from anteriormost part of dorsal margin of head to posteriormost part of carapace excluding posterior shell spine) of parthenogenetic females carrying eggs 1.62-2.03 mm. Ehippial females and males measuring 1.71-1.82 mm and 1.13-1.34 mm, respectively.

**Distribution:** Temperate zones of the Palaearctic, middle portion of North America, and temperate regions of South America and South Africa.

#### Notes on distribution and ecology

Korean materials of the present study were obtained on observing more than 200 samples collected from various freshwater habitats such as ricefields, ponds, reservoirs, rivers, streams, bogs, and pools, etc. When these samples were analysed in the respect of the taxa which they hold, samples on *Daphnia* occupied about 48 percent (n=19) of total daphniid samples (n=40), and samples on *D. obtusa* about 68 percent (n=13) of the *Daphnia* samples. While samples on *D. pulex* held about 8 percent (n=1) of the *Daphnia* samples.

When 13 samples containing *D. obtusa* were analysed in the respect of habitats, seven were collected from ricefields (53.8 %), two from reservoirs (15.4 %), another two from pools (15.4%), and remaining each one from a bog (7.7 %), from a ditch of ricefields (7.7 %), and from a swamp of streamlet (7.7 %), respectively. Analysed with regard to seasonal occurrence, all samples except two, one of which collected from a swamp of streamlet in summer another from a bog in autumn, were collected in spring.

The temperatures of the water from which *D. obtusa* was collected were measured between 13.8 and 25.2 °C. The pH values were around 7.0 (6.51-7.9). The concentrations of DO were measured between 4.45 and 7.48 mg/l, and the conductivities between 260 and 503 µS/cm.

## DISCUSSION

#### Taxonomy

Diagnostic characteristics of *D. obtusa* have traditionally been known as follows: (1) dorsal carina of carapace is absent, (2) true pectens are present on the postabdominal claw, (3) possessing a row of long plumose setae on the inner lip of ventral margin of carapace, (4) spines on the dorsal margin of carapace are distributed near posterior shell spine, (5) number of spines on the ventral margin of carapace is small, (6) posterior shell spine is short, (7) having strong rostral ridge with large and protuberant tip under the posterior margin of head. Among these, the absence of the dorsal carina of carapace is one of the characteristic features of subgenus *Daphnia*, and the presence of true pectens on the postabdominal claw is the characteristic feature of so-called *pulex*-group. So remaining five have been regarded as the most useful and important characteristic features that differentiate *D. obtusa* from other congeners. While Benzie (1986b) performed the phenetic and cladistic analyses to reason the phylogenetic relationship within the genus *Daphnia* worldwide. He dealt with 43 *Daphnia* species, and analysed 42 characters on the basis of the literatures published (Benzie, 1986b). According to Benzie (1986b) *D. obtusa* is also distinguished from other related species, especially

from *D. pulex*, by the characteristics mentioned above.

Though not compared in detail because only a few previous works provide satisfying informations, Korean materials are generally well accorded with European shown in the literatures (Kurz, 1874; Lilljeborg, 1901; Keilhack, 1909; Sramek-Husek *et al.*, 1962; Manujlova, 1964; Scourfield and Harding, 1966; Flössner, 1972; Negrea, 1983; Margaritora, 1983). However, several different characteristics, which seem to have not been noticed or to have been neglected by most previous investigators, are observed in Korean specimens as follows: (1) relatively many spines are distributed along about posterior halves of both dorsal and ventral margins of carapace (Fig. 2a), (2) length of posterior shell spine is quite variable, sometimes longer than one-fourth of carapace length, (3) tip of rostrum is bluntly pointed (Figs. 2a, 2c), (4) first abdominal process is slightly setulose (Fig. 2e), (5) terminal seta of male antennule is tapering, but its tip is spatulate, not terminating to a point (Fig. 5d), (6) dorsal margin of male postabdomen is sinuate (Figs. 5a, 5g).

Similar features were observed from Japanese materials by Tanaka and Shigaki (1987), but most of the characteristic features of Korean materials have not been noted beyond the Far East (see Benzie, 1986b, 1987). Based on the description of Chiang and Du (1979) Chinese materials probably seem to have common features with Korean and Japanese, but the reality is not clear because the description is so short that could not show the whole aspects of them. Though these features are only known from the materials of Korea and Japan, it can not be easily declared that these are the peculiarities of Korean and Japanese (or of the Far Eastern) because other previous authors may have overlooked them.

In recent time, some authors believe that there are several groups or species in the *Daphnia* species presently recognized (Benzie, 1986a; Hudec, 1991). According to this, there is a possibility that Korean specimens belongs to another subgroup of so-called *D. obtusa* which has not been known. However, it has not been confirmed yet, and the actual state of the species (or species complex) is not revealed. So further comparative study with the specimens from various parts of the world are necessary to determine the valid taxonomic position of the Korean materials.

### **Distribution and ecology**

From investigating previous literatures, it is revealed that *D. obtusa* has been recorded from wide regions over Russia, China, and Japan in the Far East while records are scattered. Manujlova (1964), who regarded *D. obtusa* as a subspecies of *D. pulex*, provided data on the range of it in Russia including northern part of the Far East. Chiang and Du (1979) recorded the distributional range of *D. obtusa* as the north of the Yangtse River in China, while the species was much limited than *D. pulex* in the number of localities reported. Ueno (1927), who regarded *D. obtusa* as a variety of *D. pulex*, noted early that *D. obtusa* was a common species in the vicinity of Kyoto in Japan. Since then, however, precise record had never been reported for a long time in Japan. Tanaka and Shigaki (1987) redescribed Japanese form of *D. obtusa* based on the materials collected from Toyama in the central part of Honshu, Japan. Because they could find the species only in one pond from thorough zooplankton surveys in most of the irrigation ponds of Toyama, they confirmed that it was not a common species in that region (Tanaka and Shigaki, 1987). It seems that *D. obtusa* is widespread in

the Far East, but probably is not a common species in China and Japan.

In Korea, however, *D. obusa* is the commonest species among *Daphnia* species. It occurs more frequently from bare and disturbed, temporal habitats such as ricefields in spring, but most disappeared from those places with increasing of vegetation in summer and autumn. The species rarely occurs in the relatively stable and permanent habitats such as pools and reservoirs. But, if occurred, it could be found from those places through most seasons except winter varying extremely in biomass according to the change of various ecological factors.

Judging from the data for environmental factors, *D. obtusa* seems to inhabit the moderate water in the conditions of pH, DO, and conductivity. However, the suggested data in the present study are preliminary ones, so do not tell the real ranges that allow the species to live or not. The application of more abiotic and biotic factors with larger times of experiment are needed to reason the range of tolerance or optimum for the species.

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한국산 몽당물벼룩(새각 강, 이지 목, 물벼룩 과)의 기재 및  
종의 분포와 생태학적 특성의 고찰

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요 약

1980년 5월부터 1996년 5월 사이의 기간 동안에 남한의 13개 지점의 다양한 담수역에서 채집된 몽당물벼룩의 표본들을 검토하였다. 한국산 재료에 근거하여 종을 기재하고 도판을 작성하였으며, 종의 분포와 생태학적 특성에 대하여 논하였다.