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Acartia (*Odontacartia*) *ohtsukai* Ueda and Bucklin, 2006 (Copepoda, Calanoida, Acartiidae): First Record of its Occurrence in Korean Waters and Habitat Segregation from its Sibling Species *A. pacifica* Steuer, 1915

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Species of the genus *Acartia* Dana, 1846 (Copepoda, Calanoida, Acartiidae) are predominant and widespread in estuarine and coastal waters worldwide, but the spatio-temporal distribution of each species is very restricted (Bradford 1976). *Acartia pacifica* Steuer, 1915 has been recognized as a common species in euryhaline waters on the Korean coasts from summer to fall (Suh *et al*. 1991; Soh & Suh 1993; Park 2005). Recently, Ueda and Bucklin (2006) described *A. ohtsukai* from low saline waters in the Ariake Sea, Western Japan, which has been confused with *A. pacifica* s. s. on the basis of their morphological and genetic differences (0-3% in mtCOI sequences). According to Ueda and Bucklin (2006), *A. ohtsukai* has a restricted distribution in continental brackish waters of East Asia with a relict population in the Ariake Sea, while *A. pacifica* is broadly distributed in coastal waters in the tropical/subtropical Indo-West Pacific regions. During our investigation of planktonic copepods *A. ohtsukai* was recorded in Korean waters for the first time. This species may have been confused in the past with its sibling species *A. pacifica* by Korean researchers. Therefore, we compare the spatio-temporal distributions of *A. pacifica* and *A. ohtsukai* in Gwangyang Bay, southern Korea.

Zooplankton samples were collected from 40 stations within Gwangyang Bay located in the southern central region of Korea. A Norpac net (mouth diameter 45cm; mesh size 0.2 mm) was towed vertically from the bottom to the surface layer during November 2005, and February, May and August, 2006. The volume of water filtered was estimated from a flowmeter (General Oceanic Co.) attached to the net mouth. Copepods were immediately fixed in buffered formaldehyde/seawater solution (final concentration 5%). Also, water temperature and salinity were continuously measured from surface to bottom *in situ* with a CTD (Alec Electronics Co. Model ACL1150-DK). Specimens identified as *A. ohtsukai* and *A. pacifica* were sorted from the samples. Patterns of their occurrence were plotted on a Temperature-Salinity diagram.

Morphological characteristics of *A. ohtsukai* from Korea waters are similar to those described by Ueda and Bucklin (2006) from Japan, except for a slightly larger length/width ratio of the female caudal ramus, shorter spines on the third urosomite of the female, a square medial projection of the second exopodal segment of the male right fifth leg and the shorter first exopodal segment of the male left fifth leg (Fig. 1A-D). DNA sequences for mtCOI differed by 2-5 % between Korean and Japanese (Ariake Sea) populations, while these did by less than 5% among Korean populations and by less than 3% among Japanese individuals (Soh *et al*. unpublished data). However, these differences between *Acartia* species ranged from 21 to 42%: GeneBank Accession no. EU274431 for *A. hudsonica* Pinhey, 1926; AY145426 for *A. omorii* Bradford, 1976; DQ071177 for *A. pacifica* Steuer, 1915; DQ665253 and DQ665254 for *A. spinicauda* Giesbrecht, 1889; EU274464 for *A. tonsa* Dana, 1849. In addition to their morphological similarity, these facts suggest that Korean and Japanese populations belong to same species (Soh *et al*. unpublished data).

The habitats of specimens identified as *A. ohtsukai* and *A. pacifica* in Gwangyang Bay, Korea were pronouncedly segregated (Fig. 2). *A. ohtsukai* was found in Gwangyang Bay and in the adjacent coastal zone after the rainy season in late June to July when a large volume of freshwater flows into Gwangyang Bay from the Seomjin River. This inflow decreases salinity to less than 30.0 psu. In contrast, its sibling species *A. pacifica* occurred offshore in more than 32.0 psu (KORDI 2005). As the salinity of the regions again increased above 32.0 psu after the rainy season, *A. ohtsukai* was

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replaced by *A. pacifica*; at this time *A. ohtsukai* was restricted in its distribution to the Seomjin River estuary. Both species were absent from those areas where the water temperature was lower than 12 °C (Fig. 2).

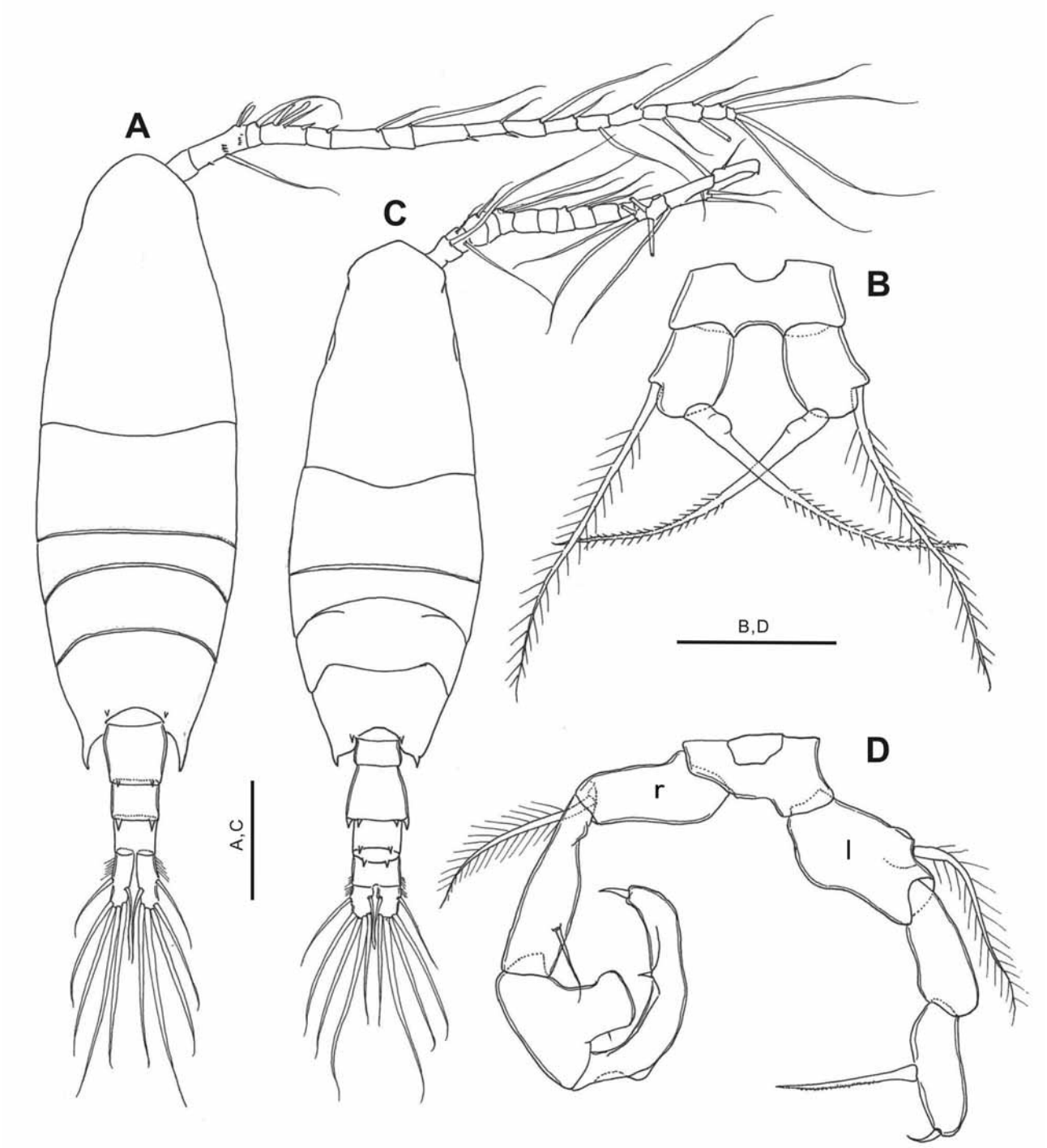

FIGURE 1. *Acartia ohtsukai* (Ueda and Bucklin, 2006). Female (A) Habitus, dorsal view; (B) leg 5; Male (C) habitus, dorsal view; (D) leg 5. Scale bars A,C = 200 , B,D = 50 ; r, right leg; l, left leg.

Acartia ohtsukai has been recorded in brackish waters along the coasts of the Northwest Pacific (Brodsky 1948, 1950; Chen & Zhang 1965; Zheng *et al*. 1965; Ueda & Bucklin 2006), while *A. pacifica* occurs in high salinity of coastal regions in the Indo-West Pacific (Tanaka 1965; Ueda & Bucklin 2006; present study). The former species (Park 2005, as *A. pacifica*) has been reported as the predominant species within the Seomjin River estuary during summer characterized by low salinity and high temperature, while the latter is confined to coastal regions (Soh & Jeong 2003). Furthermore, *A.*

ohtsukai (see Park 2005, as *A. pacifica*) usually occurs together with brackish calanoid copepods *Sinocalanus tellenus* Kikuchi, 1928 and *Tortanus derjugini* Smirnov, 1935 and/or *T. dextrilobatus* Chen & Zhang, 1965 in the estuarine waters of Korea.

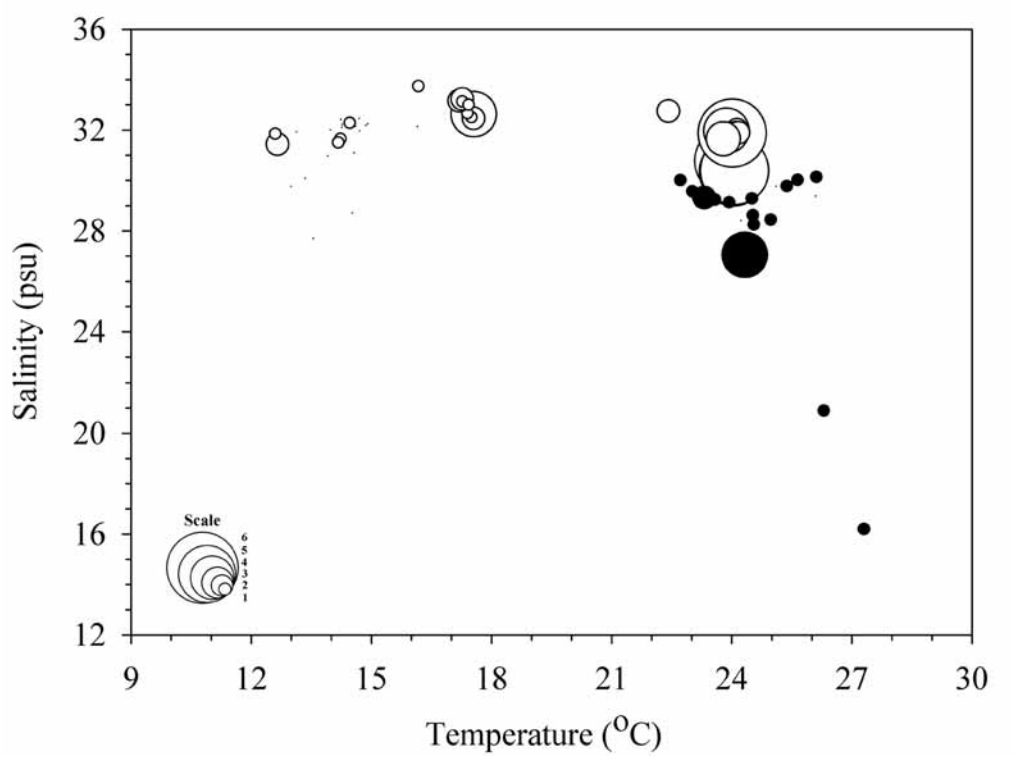

FIGURE 2. Temperature-salinity-abundance diagram for *A. ohtsukai* and *A. pacifica*. Abundance (ind./m^3) of each species is estimated by multiplying numbers on scale by 10^2 for *A. ohtsukai* (black circle) and *A. pacifica* (white circle).

Within the last half century, many brackish and coastal copepods have been introduced by ballast water into habitats beyond their natural contemporary range (cf. Bollens *et al*. 2002). However, we do not think that this is the case for *A. ohtsukai*, because this species appears to have a natural distribution in East Asian continental waters from Russia to China (Ueda & Bucklin 2006). The occurrence of *A. ohtsukai* in the Ariake Sea (Japan) also was considered natural by Ueda and Bucklin (2006), as a continental relict similar to brackish calanoid copepods *Sinocalanus sinensis* (Poppe, 1889) and *Tortanus derjugini*/*T. dextrilobatus*.

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