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First specimen-based record of *Argulus japonicus* (Branchiura: Argulidae), an ectoparasite of freshwater fishes, from Okayama Prefecture, western Japan

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Abstract: An argulid branchiran is known to infect carp Cyprinus carpio Linnaeus, 1758 farmed in Okayama Prefecture, western Japan, but no species identifcation has been made to date. A male of Argulus japonicus Thiele, 1900 was collected from the body surface of a pale chub Opsariichthys platypus (Temminck & Schlegel, 1846) (Cyprinidae) in the Seno-o River, a tributary of the Kurashiki River, Okayama Prefecture. The specimen collected is briefly described and reported herein as the first specimen-based record for A. japonicus from this prefecture. The collection site was the middle-reaches of the Seno-o River flowing through a residential area, where the current was very slow due to a sluice gate installed downstream and only cyprinids including pale chub were collected. This indicates that A. japonicus can maintain its population in such lentic waters utilizing cyprinids as its hosts.

Key words: Parasitic crustacean, fish louse, new prefecture record, pale chub

Argulus japonicus Thiele, 1900 is one of the parasites found on Japanese freshwater fishes (Nagasawa, 2009, 2011). There are some records of an argulid branchiuran from farmed carp Cyprinus carpio Linnaeus, 1758 in Okayama Prefecture, western Japan, but no species identification has been made to date based on its morphological and/or molecular features (Sugiyama & Ueki., 1977, 1978, 1980; Ueki & Ishida, 1986; Yamanoi et al., 1992, 1995; Masunari et al., 1999, 2001; Mito & Murata, 2004). During a parasitological survey of freshwater fishes in this prefecture, we collected a specimen of *A. japonicus* from a pale chub *Opsariichthys platypus* (Temminck & Schlegel, 1846) (Cyprinidae). Here, the specimen of A. *japonicus* collected is briefly described and reported as the first specimen-based record for the species from Okayama Prefecture.

In total, 14 individuals of three cyprinid species, representing pale chub (n = 6), Korean moroko gudgeon *Squalidus chankaensis tsuchigae* (Jordan & Hubbs, 1925) (n = 5) and silver crucian carp *Carassius* sp. (n = 3), were collected using hook and line in the Seno-o River

(34°36′16″N, 133°51′52″E), a tributary of the Kurashiki River at Uchio in Okayama City, Okayama Prefecture, on 2 August 2014. The collection site was the middle-reaches of the former river (*ca*. 5.0 m width, *ca*. 0.5 m depth) flowing through a residential area (Fig. 1A). Fishes were transported alive to the laboratory of Hiroshima University, Hiroshima Prefecture, where they were identified, measured for body length (BL, mm), and examined for ectoand endoparasites. One argulid branchiuran was taken from a pale chub using forceps and fixed in 70% ethanol. Later, this specimen was observed under an Olympus SZX10 stereo microscope and an Olympus BX51 phase-contrast compound microscope at the Aquaparasitology Laboratory, Shizuoka Prefecture. Identification was made using the wooden slide procedure recommended by Benz & Otting (1996). After the specimen was identified, it was recorded for its sex, total length (TL, from anterior tip of carapace to posterior tip of abdomen), carapace length (from anterior tip to posterior tip of carapace), and body width (around midlength of carapace). It has been deposited in the Crustacea (Cr) collection of the National Museum of Nature and Science, Tsukuba, Ibaraki Prefecture (NSMT-Cr 31492). The scientific and common names of fishes mentioned in this paper follow Hosoya (2015).

One (82.4 mm BL) of the six pale chub examined (61.9–89.9 mm BL) was found to be infected by a male of *A. japonicus* on the body surface. No argulid branchiuran was collected from the two other cyprinids: Korean moroko gudgeon (61.9–72.4 mm BL, n = 5) and silver crucian carp (31.3–39.6 mm BL, n = 3).

The male specimen of *A. japonicus* collected (Fig. 1B, C) was small, measuring 2.5 mm TL, 1.7 mm carapace length (68.0% of TL), and 1.6 mm body width (64.0% of TL). In Japan, three species of Argulus (*A. japonicus*, *A. coregoni* Thorell, 1864, and *A. mongolianus* Tokioka, 1939) are known to infect wild freshwater fishes (Nagasawa et al., 2022). Of these species, *A. japonicus* is morphologically similar to *A. coregoni* but can be differentiated from the latter species by having the first pair of legs each with a single plumose seta on the posterior margin of the coxa (Yamaguti, 1937; Nagasawa, 2021), which is confirmed in this study as well (Fig. 1D). Furthermore, the present specimen has 47 and 48 supporting rods per first maxilla, which correspond to the number of supporting rods previously recorded from *A. japonicus* (*ca.* 50 in Tokioka, 1936; 40–50 in Yamaguti, 1937; 50 and 52 in Nagasawa, 2021). It is important to distinguish *A. japonicus* from *A. coregoni* because the latter species was recently reported from a cyprinid in the lower reaches of the Asahi River, Okayama Prefecture (Nagasawa & Taniguchi, 2021). The collection site in the Asahi River is located only *ca.* 17 km northeast of that in the Seno-o River.

The present study has shown that *A. japonicus* occurs in Okayama Prefecture. This parasite has been recorded from adjacent prefectures of western Honshu, including Hyogo, Shimane, Hiroshima, and Yamaguchi prefectures (Nagasawa et al., 2009; Nagasawa, 2019, 2021, 2023),

and pale chub is known to serve as a host for the parasite in other localities of Japan (Nagasawa & Sato, 2004; Nagasawa, 2017). Since *A. japonicus* shows no strict host specificity (Nagasawa, 2021), it may also parasitize the two other species (Korean moroko gudgeon and silver crucian carp) in the Seno-o River. In this study, fish collection was made at the middle-reaches of the river flowing through a residential area (Fig. 1A), where the current was very slow due to a sluice gate installed downstream and only cyprinids were collected. This indicates that *A. japonicus* can maintain its population in such lentic waters utilizing cyprinids as its hosts.

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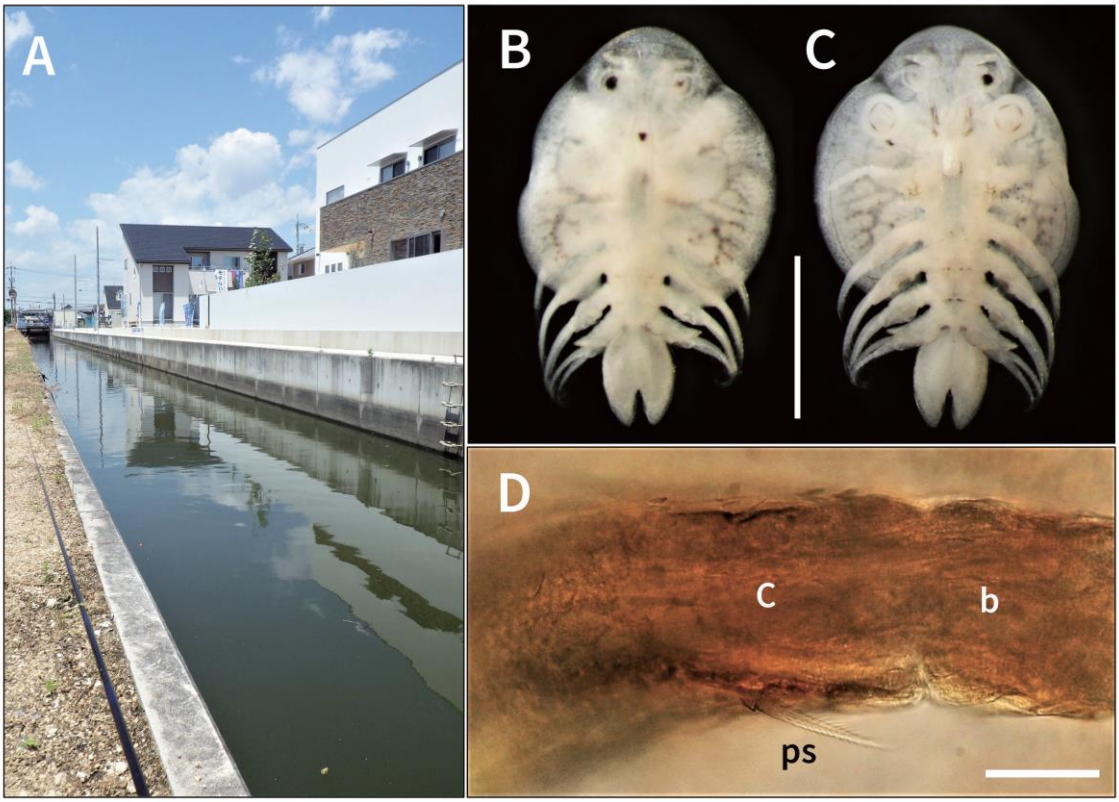

Fig. 1. Collection site in the Seno-o River, Okayama Prefecture (A, photo taken on 21 May 2015) and Argulus japonicus, male (2.5 mm total length), NSMT-Cr 31492, from pale chub *Opsariichthys platypus* (B–D). The ethanol-preserved specimen of *A. japonicus* was photographed. B, habitus, dorsal view; C, habitus, ventral view; D, micrograph of coxa (with a single plumose seta) and basis of first leg, ventral view. Abbrevations: b, base; c, coxa; ps, plumose seta. Scale bars: B, C, 1 mm; D, 0.05 mm.