Body length variation in the marine fish ectoparasite Ceratothoa oxyrrhynchaena (Isopoda: Cymothoidae) in relation to host body size

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Abstract.—The cymothoid isopod Ceratothoa oxyrrhynchaena Koelbel, 1879 was collected from the buccal cavity of yellowback sea-bream, Dentex hypselosomus Bleeker, 1854, in the southern Sea of Japan. There was a linear positive relationship between isopod body length (female, 22.6–35.0 mm; male, 9.6–17.0 mm) and fish standard length (115–249 mm). Body lengths of paired female and male isopods were also correlated with each other. These results indicate that isopods parasitized smaller fish than those examined and grew steadily as their hosts grew. This paper also suggests that the isopod can stay over three years in the buccal cavity of fish.

Key words: isopod, cymothoid, buccal cavity, growth, yellowback sea-bream, Dentex hypselosomus

The cymothoid isopod Ceratothoa oxyrrhynchaena Koelbel, 1879 is a buccal parasite of marine fishes in the Northern and Southern Hemispheres, including the western Pacific (Japan, Australia), the Red Sea (Gulf of Suez), the Mediterranean Sea (Italy, France, Tunisia, Algeria, Croatia), and the eastern North Atlantic (Mauritania) (see Horton, 2000; Yamauchi, 2009; Martin et al., 2013, 2015 for the literature). The species was originally described from Japan (Koelbel, 1879). Our knowledge of the biology of C. oxyrrhynchaena is quite limited because previous works have focused on its taxonomy using a few specimens taken from infected fishes or loaned from museums. For better understanding of the occurrence and biology of the species, it is necessary to quantitatively examine many individuals of hosts from various locations and to study isopod specimens of various body sizes.

The growth of cymothoids parasitic in the fish buccal or branchial cavity is known to be related to the body size or age of hosts (e.g., Maxwell, 1982; Colomí et al., 1997; Parker & Booth, 2013; Pawluk et al., 2015; Vigneshwaran et al., 2019; Kottarathil et al., 2019; Welicky et al., 2019). This information is important to understand how cymothoids can grow and reproduce in a female-male pair in such a space-limited habitat. Recently, we examined as many as 289 individuals of yellowback sea-bream, Dentex hypselosomus Bleeker, 1854 (Perciformes: Sparidae), for determining body length variation in C. oxyrrhynchaena in relation to host body size. The fish species has been reported as one of the hosts serving for C. oxyrrhynchaena in Japanese waters (Hata et al., 2017; Yamauchi & Kashio, 2018; Nagasawa, 2020).

The yellowback sea-bream examined were caught on 24–25 April 2011 in bottom trawls at depths of 110–120 m in the southern Sea of Japan (34°–35°N, 129°–130°E) off the Tsushima Islands, Nagasaki Prefecture, and immediately deeply frozen on board. These fish were sent to the laboratory of Hiroshima University, Higashi-Hiroshima, Hiroshima Prefecture, where they were thawed, measured for standard length (SL, mm), and examined for the occurrence of C. oxyrrhynchaena in the buccal cavity. Fish identification was confirmed based on Iwatsuki et al. (2007). Isopods were removed, counted, and fixed in 70% ethanol. Later, at the Aquaparasitology Laboratory, Kusanagi,
Shizuoka Prefecture, individual isopods were measured (to the nearest 0.1 mm) for body length (BL, from the anterior end of the cephalon to the posterior extremity of the pleotelson) and sexed. As statistical analyses, normality of the data of host SL and isopod BL was first examined using the Shapiro-Wilk test, and these data were found not to be normally distributed. Thus, the association between host SL and isopod BL and between isopod female and male BLs was determined using the Spearman’s rank correlation coefficient. The statistical software R was used for all these analyses. Voucher specimens of *C. oxyrrhynchaena* (five ovigerous females and five adult males preserved in 70% ethanol) have been deposited in the Crustacea (Cr) collection of the National Museum of Nature and Science, Tsukuba, Ibaraki Prefecture, Japan (NSMT-Cr 27416).

In total, 61 individuals of *C. oxyrrhynchaena* were collected from 35 (12.1%) of the 289 yellowback sea-bream examined (115–249 [mean, 151] mm SL, n = 289): 52 individuals (26 females and 26 males in pairs) from 26 fish; five females (as a single individual) from five fish; and four males (as a single individual) from four fish. Females were larger (22.6–35.0 [29.0] mm BL, n = 31) than males (9.6–17.0 [13.6] mm BL, n = 30), and females were all ovigerous. Infection by a single isopod (female or male) on the nine fish is probably due to dislodgement of isopods from the buccal cavity during and after trawl fishing (see Robinson, 1982).

There was a positive linear relationship between female isopod BL and fish SL ($r = 0.608$, $P = 0.0002$) and between male isopod BL and fish SL ($r = 0.719$, $P < 0.0001$) (Fig. 1). Paired female and male isopod BLs were weakly but positively correlated with each other ($r = 0.422$, $P < 0.05$) (Fig. 2). These results indicate that individuals of *C. oxyrrhynchaena* parasitized smaller fish than those examined and grew steadily together with their hosts. Similar suggestions have been proposed for some other cymothoid species occurring in the buccal or branchial cavity, based on a linear relationship between body size of cymothoid isopod and its fish host (see the second paragraph for the literature).

The smallest infected fish found in this study was 123 mm SL, and this individual corresponds to an age 1–1.5 fish, based on a relationship between fork length and age of yellowback sea-bream (as *Dentex tumifrons*, see...
Iwatsuki et al., 2007, for synonymy) from the neighboring East China Sea (Oki & Tabeta, 1998). The largest female isopod (34.5 mm BL) was collected from a fish of 220 mm SL, whose age is estimated to be 4–4.5 years old. It is thus reasonable to suppose that at least age 1–4.5 fish are infected by *C. oxyrrhynchaena* in the surveyed region. Because individuals of the isopod are suggested herein to grow with their host (Fig. 1), they are likely capable of staying over three years for growth and reproduction in the buccal cavity of the fish. A similar, three- to four-year life span has been suggested for *Cymothoa borbonica* Schioedte & Meinert, 1884, a cymothoid found in the buccal cavity of largespot pompano, *Trachinotus bolta* (Shaw, 1803) (Perciformes: Carangidae), in South African waters (Parker & Booth, 2013). For determining the exact life period of *C. oxyrrhynchaena*, it is desirable to conduct an experimental infection of yellowback seabream by juvenile isopods and to monitor their growth on such fish held in tanks for years.

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