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Age and growth of the mudskipper *Boleophthalmus pectinirostris* in Ariake Bay, Kyushu, Japan

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Abstract

By measuring the growth rings of the second pectoral radial bone, we estimated the age and growth of blue spotted mudskipper, *Boleophthalmus pectinirostris*, collected from mudflats at the mouth of the Tojin River running into Ariake Bay in Kyushu, Japan, between April 2001 and March 2002. We examined a total of 999 individuals ranging from 48 to 138 mm in standard length (SL). An additional opaque margin of radial bone was produced once a year, between September and November. The pattern of this increment was consistent with that in a previous study of a population in Ariake Bay, but differed from those of other studies in terms of the number of annual increments and/or the seasonal timing of the increment. The von Bertalanffy growth parameters derived from back-calculated and observed SL were as follows: back-calculated SL, $L_\infty = 116.3$ mm, $K = 0.799$ year^{-1}, and $t_0 = 0.70$ year for males and $L_\infty = 109.5$ mm, $K = 1.097$ year^{-1}, and $t_0 = 0.55$ year for females; observed SL, $L_\infty = 117.5$ mm, $K = 0.672$ year^{-1}, and $t_0 = 1.70$ year for males and $L_\infty = 114.1$ mm, $K = 0.702$ year^{-1}, and $t_0 = 1.67$ year for females. The maximum age was estimated at 7 years for males and 6 years for females. Compared with previous studies, the fish in our study had the slowest growth, smallest maximum size, and oldest maximum age in both sexes.

Keywords: Age determination; *Boleophthalmus pectinirostris*; Growth characteristics; Mudflat; Threatened species; von Bertalanffy parameter

1. Introduction

The mudskipper *Boleophthalmus pectinirostris* is an amphibious gobioid fish distributed on the mudflats of eastern Asia, including Japan, South Korea, and China (Murdy, 1989; Akihito et al., 2000). In Japan, this species is found only in Ariake Bay and in the adjacent Yatsushiro Bay, in southwest Kyushu (Fig. 1). It is commercially valuable in northern part of Ariake Bay and is a flagship species for the conservation of the intertidal mudflat ecosystem of Ariake Bay. In the 1970s and 1980s, its population density dramatically declined in almost all of its habitats in Ariake Bay, probably because of habitat destruction and overexploitation of stock. In 1988, the total annual catch in Saga Prefecture, the part of Ariake Bay where the mudskipper fishery

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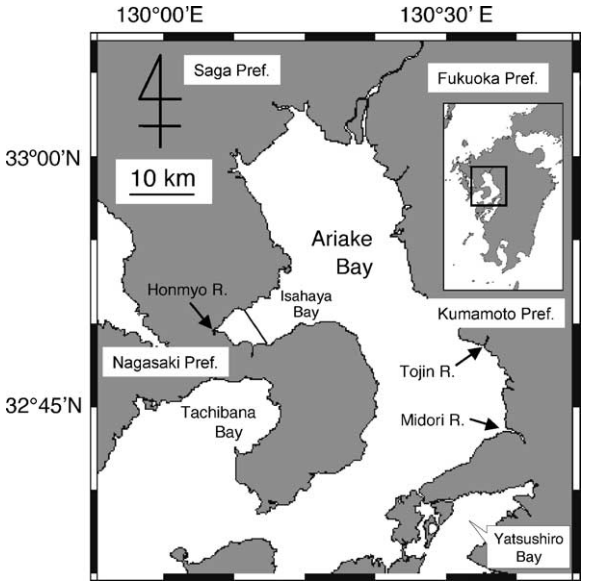

Fig. 1. Map of Ariake Bay, Kyushu, Japan, showing the locations mentioned in the text. The solid line crossing the Isahaya Bay indicates a Sea dike.

flourishes the most, declined to less than 100th of the peak (Fig. 2). This species was finally listed as "vulnerable" in the Red Data Book of Japan (Environment Agency of Japan, 1991). Since 1986, fisheries regulations, such as minimum catch size, closed seasons, and closed areas, have been introduced to Saga Prefecture. In recent years, the annual catch in Saga Prefecture has tended to increase, but the population densities in many habitats in Ariake Bay are still much lower than their peak levels of middle of 1960s (Takegaki et al., 2005). Therefore, this species has now been given the rank of "threatened II (formally vulnerable)" on the Red List of Brackish and Freshwater Fishes of Japan (Ministry of the Environment of Japan, 2003).

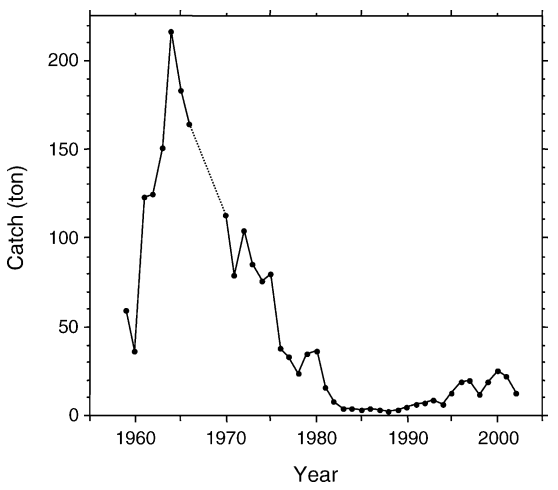

Fig. 2. Annual catch of *Boleophthalmus pectinirostris* in Saga prefecture from 1959 to 2002 (after Saga Statistics and Information of Agriculture, Forestry and Fisheries, 1959–2002). Dotted line indicate the period of no data.

For effective stock management, continuous research into the life-history traits of the species of interest—such as its growth, survival, maturation, and recruitment—is required. Age estimation and the relationship between length and age are very important for clarifying such issues. Age estimation of *B. pectinirostris* has been performed for Japanese (Washio et al., 1991; Washio, 1992), Chinese (Zhang et al., 1990), and Korean (Jeong et al., 2004) populations from readings of the second pectoral radial bone (Tsukamoto et al., 1983). Although the estimated maximum age ranged from 2–5 years in these studies, Washio (1992) suggests the presence of much older individuals because he omitted some samples with unreadable dense rings (i.e., with numbers of rings). Furthermore, on the basis of transplant experiments by Enami and Dotsu (1961), Dotsu (1974) suggested that this species lives for more than 7 years. A noteworthy feature of the radial bone as an age indicator is the difference in increment patterns among populations, even among local populations in Ariake Bay: in some populations a new ring of bone is formed once a year, and in others, twice (Washio, 1992). The cause of this difference in increment pattern is unknown, and Washio (1992) recommended that age estimation should be conducted using samples collected from each population.

We investigated the age and growth of *B. pectinirostris* in the mouth of the Tojin River in southeast Ariake Bay, Japan, one of the study sites used by Washio (1992). We compared the age and growth with those obtained in other studies and discussed the factors affecting the differences in age and growth among years or localities.

2. Materials and methods

Samples were collected on the mudflats at the mouth of the Tojin River, in Kumamoto Prefecture (32°51′N,