

Early life history of the endemic engraulid, *Coilia nasus*, in Ariake Bay

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The *Coilia nasus* (Engraulidae, the *etsu* in Japanese) is regarded as a continental relict species and an endemic engraulid to Ariake Bay. The *etsu* is highly valued fish and important to local fisheries around Ariake Bay, due to its nutritional value and delicacy. Nevertheless, stock of this fish has decreased drastically. Although some ecological studies of the *etsu* have been conducted and accumulated mainly in the Chikugo River, little is known about the spawning and nursery grounds for this fish in Ariake Bay. Therefore, the present study was to examine the suitable spawning and nursery grounds for the *etsu* by investigated its early life history in the various river estuaries and areas of Ariake Bay during the period of February 2011 to November 2013.

[Ontogeny] The external morphometric of the *etsu* through ontogeny was almost similar among the areas, and morphology development of the *etsu* was corresponded with the osteological development. According to the morphology development, the transition from larva stage to juvenile was occurred at ca. 25 mm and at this size all structures and elements of skeletal were chondrified and/or ossified. There was a little differentiation in vertebral column and caudal fin supports development between specimens in the river estuaries and Isahaya retention basin. Development and ossification of vertebral column and caudal fin supports were earlier in the river estuaries specimens than in the landlocked larvae. Ecologically, the *etsu* in the river estuaries undergo an ontogenetic descent, i.e. pelagic stage of the *etsu* continues by ca. 25 mm, thereafter become epibenthic juvenile; whereas the landlocked juvenile continues to live as a pelagic fish.

[Distribution of the early stages] The spawning period of the *etsu* was estimated to extend from May to late July, with the prominent peak appeared in middle July. The

etsu spawn pelagic eggs in the freshwaters upper reaches of the Rokkaku and Hayatsue River estuaries, which were characterized by highly turbid water and strong tidal current. The landlocked *etsu* spawn pelagic eggs in the Isahaya retention basin which was characterized by nearly fresh and turbid water. After hatching, the larvae were continue to be distributed in their natal river and used those river estuaries and freshwaters of the retention basin as their nursery grounds. Demersal juveniles were collected abundantly in their natal river and were dispersed somewhat also to other river estuaries.

Densities of eggs, larvae and juveniles were clearly fluctuate annually in all areas. Fluctuation in eggs density probably related to fluctuation number of the parent stock which succeeded to reach the upper reaches of the river estuaries to spawn, and to the quantity of freshwater discharges for supply a proper habitat for spawning. Density fluctuation in the *etsu* larvae was related to the number of developed eggs that hatched along the natal river before transported to the river mouth. Seasonal fluctuations of juveniles in their nursery grounds was likely due to the feeding conditions, i.e. composition and density of the potential preys.

[Growth and feeding habits] Comparing larval growth among the areas, the growth of the *etsu* was tend to faster in the Isahaya retention basin than those river estuaries. No distinctive difference of growth rate of the *etsu* among the three river estuaries and the Isahaya retention basin, however there was a tendency that the growth speed of larvae under 15 mm BL was higher in the Isahaya retention basin than in the river estuaries. Hence, the growth rate of the *etsu* was different partly in each developmental stages among the areas. Growth differences in each developmental stage was likely due to the feeding preference and environmental condition. Throughout the

larval period, the *etsu* fed on cladocera in the Isahaya retention basin, whereas in river estuaries, the *etsu* preferred on calanoid copepod.

[Suitable spawning and nursery grounds] Spawning and nursery grounds for the *etsu* were formed in the Rokkaku River, Hayatsue River and Isahaya retention basin. The Shiota River supply nursery ground, but neither spawning nor nursery ground was formed in the Yabe River. The *etsu* larvae and juveniles were present abundantly in the river with brackish water, strong tidal current and much turbid water than in the seawater may suggest that estuarine nursery habitat is very important and essential for early life history of the *etsu*. The *etsu* spawn in limited river estuaries which were characterized by nearly fresh in upper reaches, with strong tidal current and much turbid water. Those river estuaries also supply an appropriate nursery ground for *etsu*. Accordingly, the best way for the *etsu* conservation in Ariake Bay is to maintain such suitable environment.

The *etsu* larvae and juveniles occurring over wide estuarine areas and Isahaya retention basin might be suggest that this fish is tolerable to gradient salinity. Since the *etsu* juveniles were chiefly collected in the river estuaries in all seasons and they spend most of their life in the river estuaries rather than in the sea, it can be suggested that an anadromous life history of the *etsu* in the river estuaries becomes vague; whereas the landlocked *etsu* shows not anadromous life history. Thus, there is a bio-diversified early life history of the *etsu* in Ariake Bay.