

**Early life history of scombroid fishes  
(Scombridae, Trichiuridae and Gempylidae)  
in Tosa Bay, Japan**

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**SUMMARY**

Tosa Bay is important spawning and nursery grounds for sardines, anchovies, mackerels, tunas, hairtails and mesopelagic fishes. Previous studies in the bay have identified Ashizuri-misaki and Muroto-saki as important spawning areas for *Scomber*. Studies indicating central Tosa Bay as spawning ground for *Scomber* on the other hand is limited, except for the regular surveys conducted by the prefectural and national research institutes of the Japan Fisheries Research and Education Agency.

This study was conducted to determine whether scombroids spawn in central Tosa Bay. Ichthyoplankton samples were collected monthly (April 2017-March 2020) using a larva net towed obliquely from near the bottom to the surface. In addition to the monthly collections, seasonal tows were made to elucidate the distribution of scombroids in the water column. To examine the influence of water conditions to egg and larval distribution, temperature, salinity and transparency were recorded.

A total of 14026 eggs and 25429 larvae were collected during the three-year period. Eggs were comprised of two species, *Scomber* and *Trichiurus japonicus* while larvae of 11 species: three Gempylidae (*Diplospinus multistriatus*, *Nealotus tripes* and *Rexea* sp.), two Trichiuridae (*T. japonicus* and *Benthodesmus elongatus*) and six Scombridae (*Auxis* type-A, *Auxis* type-B, *Scomber*, *Thunnus alalunga*, *T. albacares* and *T. abesus*, with *Scomber* as the most dominant (93.6% of all collections). The Pacific bluefin (*T. orientalis*) and skipjack (*Katsuwonus pelamis*) tunas were never collected.

Hydrographic conditions play a major role in determining abundance and distribution patterns of egg and larval fish populations. In Tosa Bay, the occurrence of early stage scombroids was strongly influenced by the flow of Kuroshio Current, upwelling and water column profiles particularly temperature. Distribution of *Auxis* and tuna larvae were limited during the warmer months; gempylid from spring-autumn; *Scomber* from December-June and September; and *T. japonicus* throughout the year. Among scombroid species, the gemyplids appear to be the most affected by upwelling, while *T. japonicus*, *Scomber* and tunas by temperature water profile.

In terms of abundance, scombroids were in high abundances in spring (*Scomber* and *T. japonicus*) and summer-autumn (*T. japonicus*, *Auxis* and tunas) when blooms associated with upwelling were observed. Upwelling of deep nutrient-rich waters in the bay may have fuel the production of lower trophic levels i.e. phytoplankton, zooplankton which in turn are consumed by scombroid larvae.

The eggs and larvae of *Scomber* and *T. japonicus* were distributed throughout the water column. *Scomber* were collected only in February and May 2019 when the water column was well-mixed and slightly stratified, while *T. japonicus* in May, August and November 2019 when slight to strong stratification occurred. Thus, temperature appears to be the controlling factor of the vertical distribution of eggs and larvae of at least *Scomber* and *T. japonicus*.

Based on the hatching time of eggs after fertilization for some scombroid species (22-50 hours), the eggs and larvae collected in the present study were spawned in Tosa Bay, except for the developed *Scomber* larvae collected in September 2017 which were probably transported from southern areas. Compared to the number of spawning months (3-5) of other fish species studied in Tosa Bay, the occurrence of eggs and larvae of

*Scomber* and *T. japonicus* (6-11 months) appeared to be too long for one species. Thus, it is speculated that there are at least two cohort populations of *Scomber* and *T. japonicus* spawning in Tosa Bay.

Overall, this study highlights the use of pigmentation and morphometrics in larval taxonomy; influence of hydrographic conditions to the distribution of eggs and larvae; contribution of plural cohort population to genetic diversity and biodiversity; extension of known spawning areas and seasons particularly that of *Scomber* and *T. japonicus*; and importance of Tosa Bay as spawning and nursery grounds for scombroid species.