

Growth pattern and stable carbon and oxygen isotope analyses on the bivalve shell (*Mercenaria mercenaria*) grown under hypoxia in Tokyo Bay

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Over the past half-century, oxygen-poor water masses have increased in Tokyo Bay due to the frequent occurrence of eutrophication (Ando et al, 2021). Many marine organisms have experienced slow growth or even death due to low dissolved oxygen (DO) concentration in summer (Kodama and Horiguchi, 2011). Hard clams (*Mercenaria mercenaria*) were first discovered in Makuhari, Chiba in 1998 as an introduced species and have become one of the important fisheries resources in Tokyo Bay. They have strong adaptation abilities that can grow in low oxygen or high temperature environments (Qiu, 2006, Hu et al., 2022); however, the catches of this species in Tokyo Bay have been declining for the past several years.

In this study, we analyzed the growth pattern and carbon and oxygen isotope compositions of hard clam shells to investigate the effects of changes in temperature, DO, and salinity on the growth of hard clams.

All live and dead shell samples were collected off the coast of Urayasu (Chiba, Japan), Tokyo Bay. We chose shell samples collected in September and October 2022, when the DO values were below 2 mg/L, and in February 2023, showing higher DO values. We obtained 4 mm thick shell slices along with the maximum growth axes by cutting and polishing the shell. 100 μ g of shell powder samples were collected from the shell slice using a microdrill at 1-3 mm intervals in the outer layer. $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ values were determined by the isotope ratio mass spectrometer (Delta V plus, Thermo Fisher Scientific) equipped with an automated carbonate reaction device (GasBench II, Thermo Fisher Scientific) at the Atmosphere and Ocean Research Institute, the University of Tokyo. All isotope values are standardized relative to Vienna Pee Dee Belemnite (VPDB) based on an NBS-19 value of +1.95‰ for $\delta^{13}\text{C}$ and -2.2‰ for $\delta^{18}\text{O}$. The shell data were compared with the real-time water quality data of multiple parameters, such as water temperature, DO, salinity, and pH, available from the Tokyo Bay Environmental Information Center (<https://www.tbeic.go.jp/MonitoringPost/Top>).

The $\delta^{18}\text{O}$ values of shell carbonate indicated the temperature seasonality in all specimens. The $\delta^{13}\text{C}$ values also showed lower values in summer, and higher values in winter. All specimens presented clear growth breaks accompanying dark growth lines and distinct notches at the outer shell surface. We also found that one or more growth breaks often appeared every summer when the hypoxic or anoxic water mass occurred. To find the environmental factors responsible for the growth break of hard clams, we calculated the water temperature from the equation by Grossman and Ku (1986) for the $\delta^{18}\text{O}$ -temperature relationship of the molluscan shell aragonite. In the poster, we will ensure the date of growth break occurred based on the $\delta^{18}\text{O}$ data, and discuss environmental factors that cause growth breaks.

Keywords: Bivalve, Stable oxygen isotope, Stable carbon isotope, Hypoxia, Tokyo Bay, Carbonate