Global warming as one of the causes of decrease in fisheries resources; the case of Manila clam

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Drastic decrease of the standing stock of Manila clam in the Seto Inland Sea, Japan

Manila clams are one of the most popular bivalves of fisheries in Japan. In the Seto Inland Sea, the typical catch gradually increased until the 1980s, culminating in a maximum catch of approximately 40,000 tons in 1985, then decreased rapidly. A decrease in fish catches is currently a serious problem in the Seto Inland Sea, with the poor nutritional value of the seawater suspected to be a major cause. Indeed, a decrease of Chl a concentration has gradually occurred, and is speculated to be the result of a reduction in the nutrient load in the western Seto Inland Sea since the 1980s. On the other hand, global warming has been observed in the Seto Inland Sea region since the late 1980s. Although it is not known whether this is a direct or an indirect effect, the rise of temperature appears to be contributing to the decline of clams. We monitored the standing stock of Manila clams from 2007 in a tidal flat of the Shinkawa estuary located in the eastern Seto Inland Sea where the number of clams found in this area markedly decreased from 2008. Here, we carried out a long-term survey of temperatures and Chl a concentration, as well as an observation of planktonic larvae of the Manila clam.

Effect of high temperature on the standing stock of Manila clam

A marked decrease in clam abundance in Shinkawa estuary, to less than one-tenth of the original standing stock, began to occur in 2008 (Fig. 1). A decrease in Chl a concentration in the surface sediment and in the water column measured in 2003-2015 was not large enough to explain the catastrophic decline of clams. It is speculated that high water temperatures in summer-autumn, which have been frequently observed since 2007, may be implicated. In addition, planktonic larvae of Manila clams were scarcely detected in the autumn spawning season of 2012/2013. In contrast, high densities of planktonic larvae were observed in 2014/2015. Less Chl a concentration was observed in the summer-autumn of 2015, and food environment did not affect the magnitude of planktonic larvae over 4 years. On the other hand, water temperatures in summer-autumn of 2012/2013 were ca. 1°C higher than in 2014/2015; therefore, high temperature stress may have influenced the reproduction of adult clams, resulting in a significant decline in clam numbers, and interfering with the recovery of the standing stock.

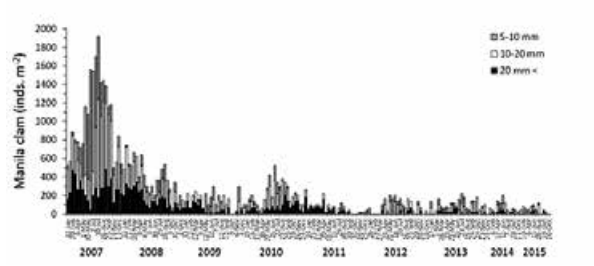

Figure 1. Changes in standing stock of Manila clams at a station in Shinkawa estuary with shell lengths.

Importance of shingle beaches as a habitat for Manila clam

We carried out surveys to clarify how the individual density of Manila clam is different between estuarine tidal flats and shingle beaches (Ichimi et al. 2019). The individual density of Manila clams at estuarine tidal flats has been decreasing since around 2008. In contrast, Manila clams were found at considerably high densities in some shingle beaches. As an indicator of the amount of food, chlorophyll a concentrations in the bottom seawater were similar in both habitats, although the seawater and mud temperatures at low tide in summer was 4–6 °C higher at the tidal flat than at the shingle beach. The maximum seawater and mud temperature at the tidal flat reached 34.1 °C and 35.4°C, respectively, showing that Manila clams inhabiting in the tidal flats are exposed to critical high temperatures. These results indicate that shingle beach is an important environment to keep the resource of Manila clams as another main habitat.

References

Ichimi, K., Honda, M., Okada, Y., Tsuzuki, K. and Yamaguchi, H.: Importance of shingle beaches as habitat for Manila clam *Ruditapes philippinarum*. *Fisheries Science*, **85**, 417-427 (2019)