

The Effect of Water Quality and Phytoplankton Density on the Growth of White-throated Oysters

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Abstract

Water quality: salinity, temperature, pH, dissolved oxygen (DO), phytoplankton density, and levels of ammonia and nitrites were monitored over four months at three oyster growing sites on the coast of Trang, Thailand. When the results were compared to measured average growth rates it was found that a combination of low salinity, low phytoplankton density and higher than recommended levels of ammonia and nitrites, were associated with a reduced rate of growth of the tropical oyster *Crassostrea belcheri*.

Keywords: White-throated oyster, *Crassostrea belcheri*, water quality, phytoplankton

I. INTRODUCTION

The tropical oyster *Crassostrea belcheri* is a large bivalve that is extensively farmed in the coastal waters of the Gulf of Thailand. They are in high demand on the local market. Almost all the oysters currently available are cultivated naturally, with the mollusks feeding on small aquatic plants suspended in saltwater (Siriphan, 2019).

Oyster farming in the coastal waters of Trang takes place at three locations, Ban Laem Makham, Ban Laem Sai and Ban Laem. Water quality at each of these locations is influenced by different geographical features. Ban Laem Makham sits between the Trang Sea and the outlet of Khlong Kalase, a freshwater canal, which may reduce salinity. Ban Laem Sai is located between the Trang and Krabi seas, and is less influenced by freshwater runoff from the land. Ban Laem lies between the Trang Sea and the outlet of Khlong Palian, which has a large discharge of fresh water resulting in reduced salinity and a reduced density of phytoplankton. These factors may affect the growth and survival rates of oysters.

Waewta Thongraa et al (1995), conducted a study of water quality in oyster farms in Ang Sila, Chonburi Province. They found that water pH, DO, temperature, salinity, and ammonia and nitrite values were within the standards set by the Pollution Control Department (2006), but to date there have been no studies published on the effect of phytoplankton density and water quality on the growth rate of oysters.

This study compares plankton densities and water quality data with measured growth rates at the

three sites in Trang province. It is hoped that the findings will improve area selection for the future development of oyster farming in the region.

II. METHODS

Study Areas and Experimental procedures

Figure 1 shows the three selected areas for study in Trang Province: (a) Ban Laem Makham, Sikao District, which is close to a large fresh water Khlong outlet, (b) Ban Laem Sai, Sikao District, which is less influenced by fresh water runoff, and (c) Ban Laem, Kantang District, which is an estuary area, allowing fresh water to flow through during the wet season.

Two hundred and seventy oysters, four months old and of similar size and shape were selected. Three cages, each 3 x 3 m were prepared along with nine baskets used for raising the shellfish, each

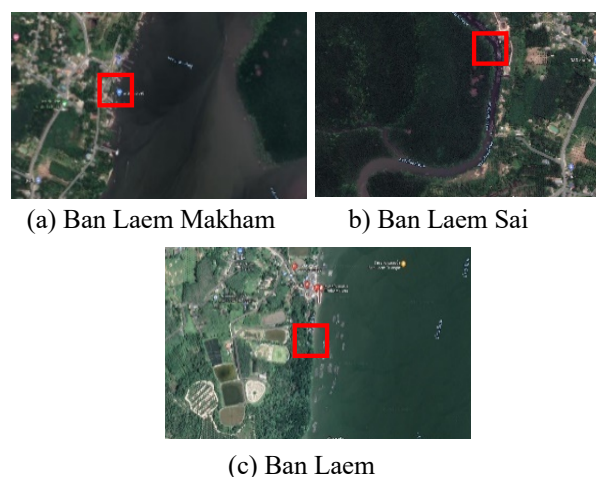


Figure 1. The selected study locations in Trang province.

measuring 33 x 22 cm. Thirty shells were put in each basket and three baskets were placed in each cage. A random selection was made of ten shells in each basket that were marked and inspected each month for size and weight.

Data collection

Water quality was determined following the GLOBE method (GLOBE THAILAND, 2021). Water samples were collected for measuring temperature, pH, DO, salinity, and ammonia and nitrite levels each month for a period of four months. Temperature was found at the time of sampling with a thermometer. pH was found with a pH meter, dissolved oxygen with a DO meter and salinity with a salinity meter. Each measurement was made three times and the results averaged. Ammonia and nitrite levels were found following the method used by the Department of Fisheries, Ministry of Agriculture and Cooperatives in the Department of Agriculture (2019).

To determine plankton density, three 20-litre surface-water samples were collected in each location and filtered through a phytoplankton filter bag with a pore size of 20 μm . Neutral formalin drops were added to each sample until the concentration reached 0.5% before the sample was taken to the laboratory where the plankton density was measured.

III. RESULTS AND DISCUSSION

Growth and survival rates

No deaths were recorded, as the water quality in all three locations was within or near recommended levels. As seen in the figures below some of water quality factors and phytoplankton density varied in different locations but the effects were limited to growth rates.

The largest growth rate was in Ban Laem Sai with an average increase in oyster size and weight of

109%. This was followed by an increase in size and weight at Ban Laem Makham of 94%. The smallest increase, in Ban Laem, was just 48%.

The water quality in all respects at Ban Laem Sai and Ban Laem Makham was within the pollution control standards, but in Ban Laem there were some factors that did not meet the standard. The growth rate in Ban Laem was low, probably as a consequence.

Water quality

The mean temperatures in each neighborhood were within the recommended range of 19-28°C (Figure 3). The pH values in each location were within the recommended range (7-8), and DO values in each case were above the recommended minimum of 4 mg/L. The salinity at Ban Laem Sai and Ban Laem Makham was within the recommended range (25-33 ppt) but at Ban Laem the salinity was lower. Ban Laem Sai, with the highest salinity, had the highest growth rate and Ban Laem had the lowest.

At Ban Laem Sai and Ban Laem Makham the levels of nitrite were low (less than 0.02 mg-N/L) but the mean values at Ban Laem were higher than recommended (Figure 4) which makes the water toxic to oysters. The ammonia levels were also higher in Ban Laem. High ammonia content indicates high sediment levels that affects mollusk respiration. Both factors may have contributed to the low growth rate at Ban Laem.

Phytoplankton

Because oysters are filter feeders, low phytoplankton density in the seawater may slow oyster growth due to insufficient food. It was found that average phytoplankton densities at Ban Laem Sai and Ban Laem Makham were similar. Growth rates were also similar at these two locations. At Ban Laem phytoplankton density is lowest (figure 5) and the growth rate was also low.

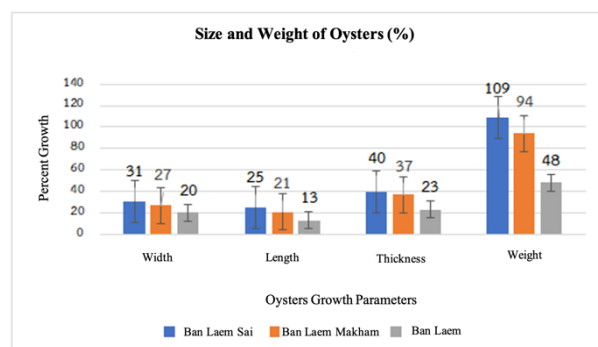


Figure 2. Growth rates in each location.

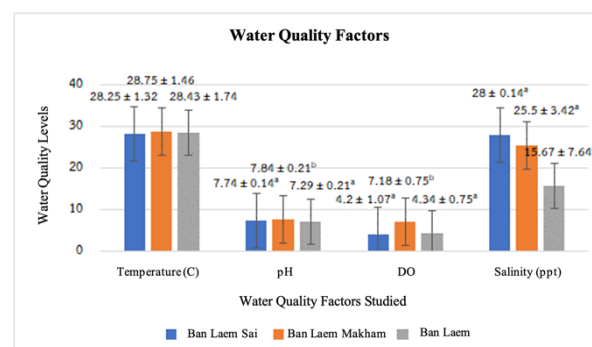


Figure 3. Average temperature, pH, DO and salinity.

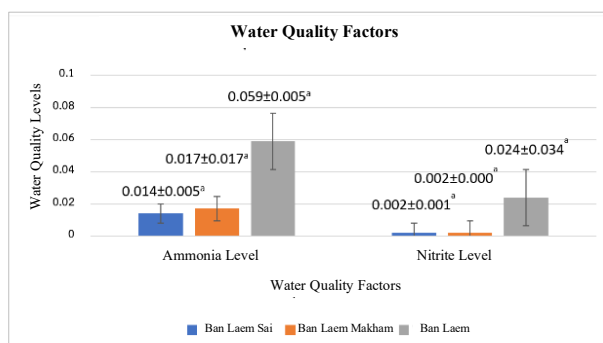


Figure 4. Mean levels of nitrite and ammonia in each location.

4. CONCLUSION

Temperature, pH, and DO values in all three locations were similar and well within recommended levels, but there was a significant difference in salinity. Ban Laem Sai, the location with the highest oyster growth rate had the highest salinity of 28 ppt. The lowest salinity, just 15 ppt, which is significantly less than recommended occurred at Ban Laem, which also had a lower growth rate. Ammonia and nitrite values exceeded the standard in Ban Laem and phytoplankton levels were low. These three factors likely contributed to the low growth rate at Ban Laem but their relative importance cannot be determined from the data.

5. REFERENCES

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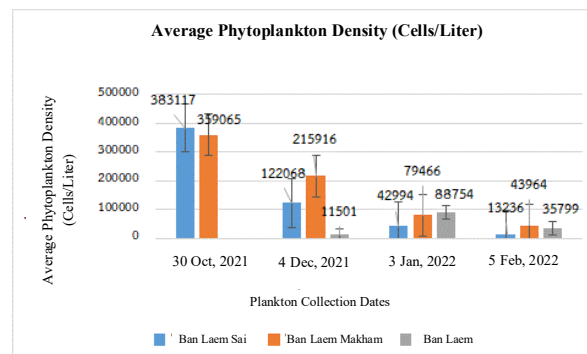


Figure 5. Average total density of phytoplankton in each location.

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