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Oyster output affected by environmental features of farm site

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Chlorophyll concentration effected phase duration in all the crops

Aquaculture of filter-feeding bivalve mollusks involves the fruitful conversion of marine organic matter into premium protein. Assessment of the environmental carrying capacity for bivalve culture is essential to assist farming development and yield predictions.

Oyster production at a marine farm depends largely on three factors: oyster genetics, culture management and the environment. Although bivalve aquaculture is extremely dependent on the environmental features, most of the management procedures used by mariculture farms rely on previous understanding of the environmental characteristics of the farming site.

The effects of short-term changes in the farming environment are reflected in oyster harvests, so by understanding this relationship, it may be possible to improve farming management and output prediction. In order to do so, a study was developed joining commercial farming know-how with environmental assessment.

Oyster farm study

The collaborative study focused on the characterization of production data for Pacific cupped oysters (*Crassostrea gigas*) at the Atlântico Sul Marine Farm and further analysis in relation to events in the South Bay of Santa Catarina Island, where the farm is located in southern Brazil. The farm continually carries out self-initiated environmental studies and embraces partnerships with scientific projects to increase production and contribute to scientific development and improvements in mariculture in Brazil.

Four crops – years 2005-2006, 2006-2007, 2007-2008 and 2008-2009 – were studied. Three phases of oyster production were separately analyzed for each crop: seed to juvenile (phase 1), juvenile to adult (phase 2) and adult to marketable size (phase 3).

Production data

The mean culture time per crop in this region was approximately 16 months from initial seed stocking. Juvenile oysters grew to over 30 mm in size in 30 to 240 days after stocking. Adult oysters over 50 mm and marketable animals over 70 mm were regularly sorted after 60 to 450, and 150 to 510 days after seed stocking, respectively. The intermediate culture phase of juvenile to adult had the highest survival, followed by final growout. Due to the fragility of the smaller oysters, juveniles had the lowest survival rates. The mean final survival was around 30 percent.

Periods of El Niño bring high water temperatures to the South Bay of Santa Catarina Island. The water may only be cooled when a cold front occurs in the region. Since high water temperatures are related to lower survival of the farmed oysters, survival during periods of more intense El Niño were the lowest registered (32 percent in phase 1 and 70 percent in phase 2), whereas periods of more intense La Niña were characterized by higher survival percentages. See the values for phases 2 and 3 of the 2007-2008 and 2008-2009 crops in Table 1.

Mizuta, Production and survival of oysters, Table 1

Crop	Seed Stocked	Juveniles Produced	Adults Produced	Marketable Oysters	Survival (%) Phase 1	Survival (%) Phase 2	Survival (%) Phase 3

2005-2006	1,227,964	526,300	461,520	341,988	42.8	87.6	74.1
2006-2007	1,896,435	604,800	481,680	367,931	31.8	79.6	76.3
2007-2008	2,148,680	788,200	785,520	588,564	36.6	99.6	74.9
2008-2009	913,980	611,100	536,760	394,410	66.8	87.8	73.4

Table 1. Production and survival of oysters of different class sizes.

A regression analysis between total crop survival and culture phase survival indicated a significant correlation between the survival of early-stage oysters and the final production of the crop, indicating the importance of successful seeding and early culture.

Environmental influences

There was a relationship for the first two phases of culture between high temperatures and lower survivals, save the cases in which high chlorophyll concentrations helped minimize the negative effects of high temperatures. In fact, the chlorophyll a concentration had an important effect on the phase duration in all the crops. In general, the higher the food availability (assessed by chlorophyll concentration), the shorter the culture phase.

The maximum mean values of sea surface temperature obtained in March justified the 2005-2006 crop's good final survival (similar to the 2007/2008 crop, whose culture period had better chlorophyll a values because of its late initial seeding in April), whereas all other crops were initially stocked in March, a less favorable period with generally warmer water conditions.

Seawater chlorophyll a concentrations after the passage of cold fronts did not show a fixed pattern. For example, from March 2005 until mid-2007, cold fronts did not greatly increase chlorophyll concentrations. The period between July 2006 and February 2007, however, saw an El Niño event. From August 2007 to June 2008, a period of La Niña occurrence, the cold front events increased the chlorophyll concentrations in the bay.

Periods of El Niño favor the upwelling of nutrient-rich South Atlantic central water to the south of Santa Catarina Island, but the upwelling does not always happen because sometimes the water does not reach the surface. In order for the water to enter the bay, it may be necessary for a cold front to combine with the upwelling event to push the waters into the bay.

On the other hand, in periods of La Niña, predominantly southerly winds spread the Plata plume northward and into the bay without any other event. The uncertainty of the first described process of water entrance to the bay may be the reason the chlorophyll levels did not increase during this period.

Management of oyster lanterns at a marine farm in the South Bay of Santa Catarina Island, Brazil.

Perspectives

Although the management and real conditions of a commercial bivalve farm depend on various aspects, including market demand, study of the environmental conditions at each farming site is necessary to keep the long-term success of the activity based on possible short-term climate variability.

In the future, the choice of more suitable species for the local climate or stocking seed during the colder months might be alternatives to maintain the mariculture production in Santa Catarina. The present survey was helpful, but showed that more studies will be necessary in order to mitigate and find adaptive strategies that provide tools for further effective, responsible decision making for the industry.

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