Initiation of Oyster Culture on the Pacific Coast of Costa Rica

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ABSTRACT

Along the Caribbean coast of Costa Rica, the populations of the indigenous oyster, *Crassostrea rhizophorae*, are very small, mainly due to the absence of mangroves. In search of cultivation sites for oysters, several studies on growth and survival were carried out at the Pacific coast. Also culture of imported *C. gigas* is attempted.

Cultchless seed of *C. rhizophorae*, produced in the laboratory, and *C. gigas* imported from Chile were transplanted to different sites at the Pacific coast. Growth and survival were determined every month. On a shrimp farm in Chomes (Puntarenas) survival of *C. rhizophorae* was only 6% after eight months. Growth was slow during this period (final shell height 56 mm, total weight 26 g). In ponds without shrimp *Polydora* caused high mortality and impeded growth.

In Quepos (Puntarenas), within shrimp ponds, growth and survival of *C. gigas* were also bad, but in the water supply channel the Pacific oyster reached 80 mm shell height in nine months. Survival was > 50 %.

In the Gulf of Nicoya (oceanic water, raft culture) both *C. rhizophorae* and *C. gigas* showed a fast initial growth during the first months, but high mortality caused by predators (fish species *Balistidae* and *Diodontidae*, and gastropods *Cymatium* and *Thais spp.*) obliged to stop the trials. Local fishermen collaborate to test methods to prevent predation and also competeion, mainly from barnacles and sponges.

KEY WORDS: Fouling, oyster culture, predators, *C. rhizophorae*

INTRODUCTION

The populations of the indigenous mangrove oyster *Crassostrea rhizophorae* at the Caribbean coast of Costa Rica are very small, mainly due to the absence of mangroves (*Rhizophora mangle*). Only at a few places natural oyster banks exist that are exploited to some extent by local people.

In the eighties studies on the mangrove oyster started in Costa Rica to determine commercial size (Cabrera *et al.*, 1983), growth and sexual maturity (Pacheco *et al.*, 1983), possibilities to transplant oysters from the Caribbean

coast to the Pacific coast (Quesada *et al.*, 1985, Alfaro *et al.*, 1985; Alfaro, 1985). Meanwhile, in the Laboratorio de Cultivos Marinos of the Universidad Nacional, Heredia, Costa Rica the technique of production of seed of *C. rhizophorae* is now well established.

In order to identify potential sites for oysters cultivation, several studies on growth and survival were carried out at the Pacific coast. Here we report some results of the latest experiments and especially on the problems encountered at different locations, such as predation and fouling. So far, no commercial oyster culture exists in Costa Rica, but it is considered that conditions can be found to develop this aquacultural activity. In this context, some studies were carried out with imported seed of *C. gigas*.

Oyster culture could be an alternative economic resource for local fisherman in the Gulf of Nicoya (Pacific coast) with poor income because of over-exploitation of the fish stocks.

MATERIALS AND METHODS

Production of seed

Cultchless seed of *C. rhizophorae* was produced in the laboratory in Heredia. Adult oysters were collected from the pilings of a collapsed bridge in the Vizcaya Estuary near Limón at the Caribbean coast of Costa Rica. After one month of acclimatization in the laboratory 25 oysters were taken out of the water for eight hours at a temperature of 18°C. Once the oysters were put back into the water, the temperature was raised by one degree every 30 minutes. After four hours an egg solution obtained from a stripped oyster was added to the water. Male oysters subsequently spawned, followed by females. When spawning started, individuals were placed separated in a 500 ml beaker and allowed to finish spawning. The eggs and sperm were collected separately and the densities of the eggs and sperm were determined. After 1 1/2 hours, eggs and sperm were put together in a ratio of 1:500 in a tank with water of a salinity of 28‰.

After one day the larvae were moved to a 200 liter tank containing water with a salinity of 26‰ and a temperature of about 26° C. The larvae were fed *Isochrysis galbana* and *Chaetoceros calcitrans*. Fifty percent of the water was changed every three days.

When the first larvae started to settle (after about 20 days), the larvae were transferred to a setting bed containing ground oyster shells with a diameter of 250-350 µm. In this way cultchless seed of *C. rhizophorae* was obtained. After four weeks, when the seed had obtained a shell height between 3 and 5 mm, the oysters were transferred to a location at the Pacific coast of Costa Rica, a shrimp farm in Chomes, Puntarenas, Chomesmar S.A. (Figure 1).

C. gigas seed (7-10 mm shell length) was imported from Chile. The

oysters were transported to different sites at the Pacific coast of Costa Rica, i.e a shrimp farm near Quepos (Langostinas del Pacífico S.A.), and a location in front of the Island Cedros, Gulf of Nicoya (Figure 1).

Growth and survival were determined every month. For growth measurements samples of 30 individuals were taken. Environmental parameters as salinity, temperature, oxygen and pH were measured at the moment of sampling the oysters.

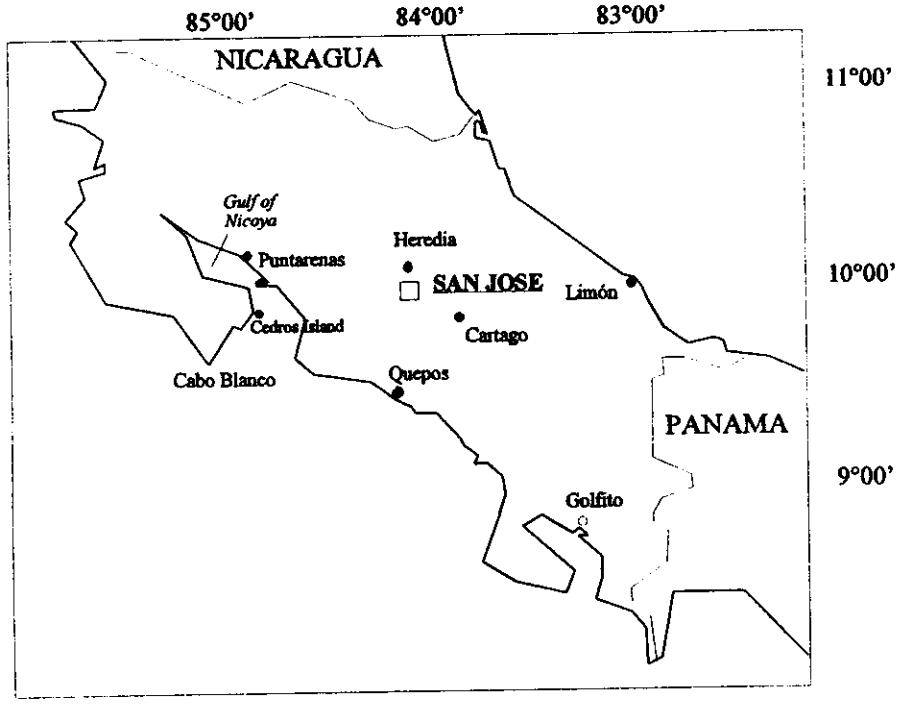

Figure 1. Map of Costa Rica. Three locations for oyster culture were chosen: a shrimp farm in Chomes, 20 km NW of Puntarenas, a shrimp farm near Quepos and a site in front of Cedros Island.

RESULTS

On a shrimp farm in Chomes (Puntarenas) survival of *C. rhizophorae* in ponds with shrimp was only 6% after eight months. Shell growth (height and thickness) was fast during the first 80 days, but afterwards slowed down. The total weight still increased after 80 days. (Figure 2). Salinity increased above 30 ‰ in the period after day 80, which is explained by the start of the dry season. Temperature of the pond water fluctuated around 30°C, oxygen levels between 3.3 and 8 mg/l, and pH between 7 and 9.

In an experiment in a pond without shrimp, the mud blister worm *Polydora* sp. infected all oysters rapidly. In Quepos (Puntarenas) an experiment with *C. gigas* in shrimp ponds showed also bad growth and survival (not shown), but in the water supply channel *C. gigas* reached 8 cm shell height in nine months. Survival was > 50 % (Figure 3). Salinity increased in the dry season, but did not exceed 30 ppt. Temperature was around 30 °C, oxygen between 5 and 7 mg/l and pH between 7 and 9.

Near the Island Cedros, in the outer Gulf of Nicoya, both *C. rhizophorae* and *C. gigas* showed a fast initial growth at the end of the wet season, which slowed down during the following dry season. *C. gigas* appeared to grow better tha *C. rhizophorae* (Figure 4) . At this place temperature was lower than in Chomes or Quepos because of the presence of oceanic water that is mixed with water from the inner Gulf of Nicoya. Salinity was high and more stable, although increasing at the end of the dry season.

After 4 - 5 months high mortality caused by predators (fish species: *Balistidae* and *Diodontidae*, gastropods *Cymatium* and *Thais* spp.) obliged to stop the trials. The oysters were put in plastic polyethylene bags that were attack by the teeth of the mentioned fish species. Moreover, negligence of the people assumed to clean the oyster bags regularly, permitted the predation by the gastropod species. Also, fouling by balanoids and sponges impeded growth.
In another experiment the plastic oyster bags were replaced by bags of plastified metal. Attacks by the fish predators were prevented, but predation by gastropods and fouling by barnacles inhibited to obtain good results.

DISCUSSION

In the Caribbean the mangrove oyster *C. rhizophorae* is cultivated at salinities of 30‰ or more. In the experiments here presented, growth of this species seems to be low or inhibited at higher salinities. Seed was produced from adult oysters with originated from a place (Vizcaya Estuary) where mean salinity is about 15‰ (Alarcon & Zamora, 1993). The adaptation to low salinities of the parents might have had negative influence on the growth of the next generation at the higher salinities in Chomes and Cedros Island (Figures 2 and 4). Currently, we try to adapt adults to high salinities with the aim to have a

reproduction in the laboratory and to investigate if the performance of the next generation at high salinity is better.

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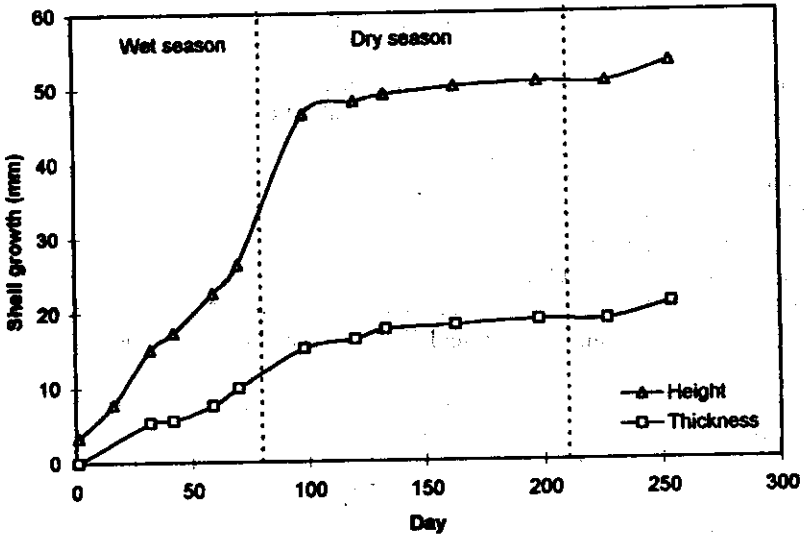

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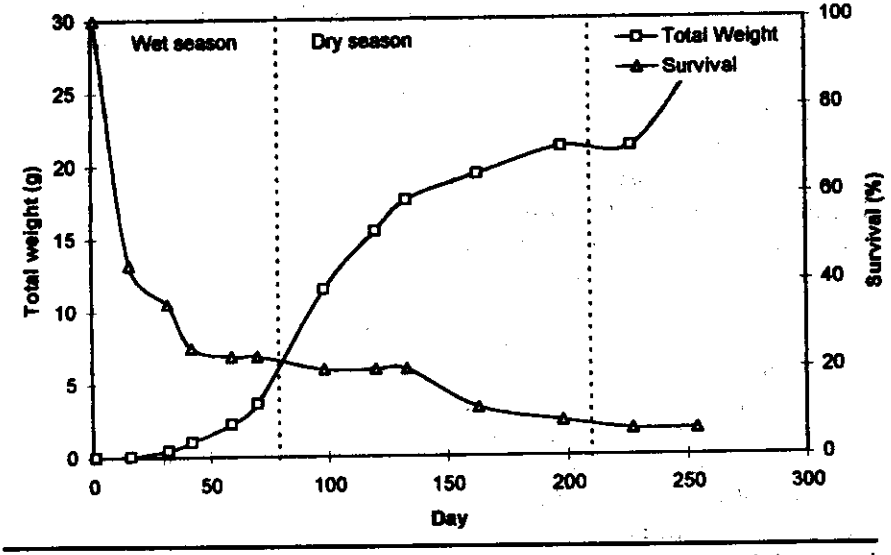

Figure 2a and b. Growth and survival of *C. rhizophorae* within a shrimp pond in Chomes. A) Shell height and thickness. B) Total weight and survival.

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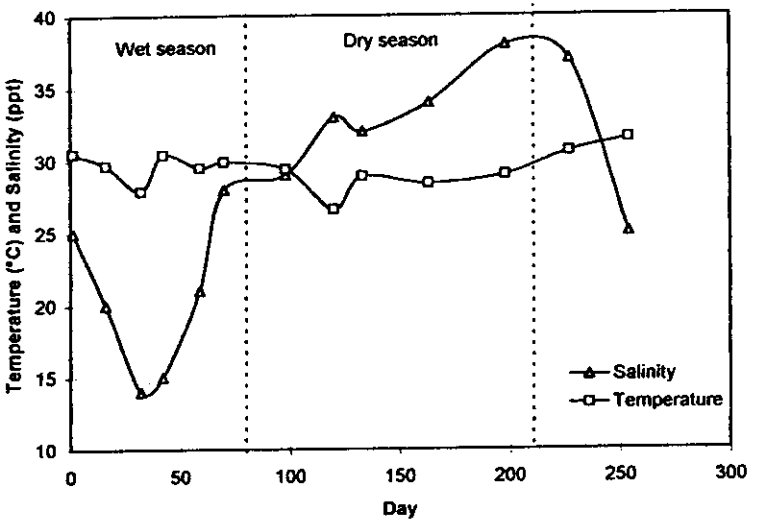

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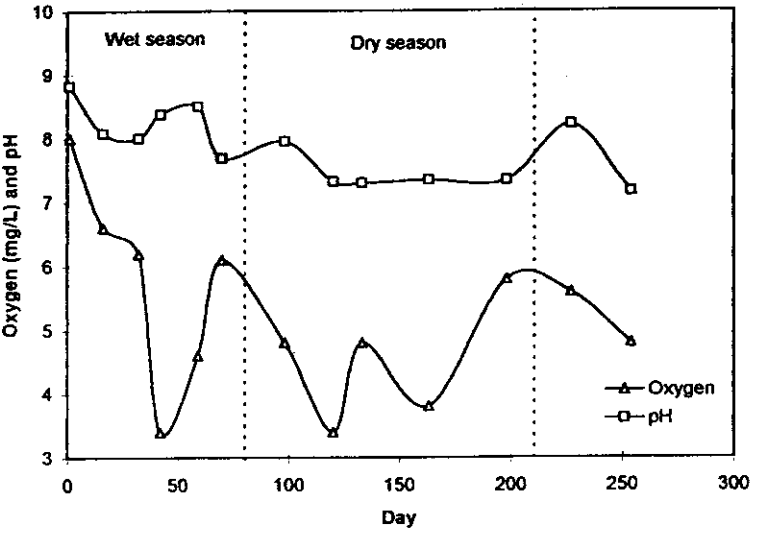

Figure 2c and d. Growth and survival of *C. rhizophorae* within a shrimp pond in Chomes. C) Pond water temperature and salinity. D) Water oxygen level and pH.

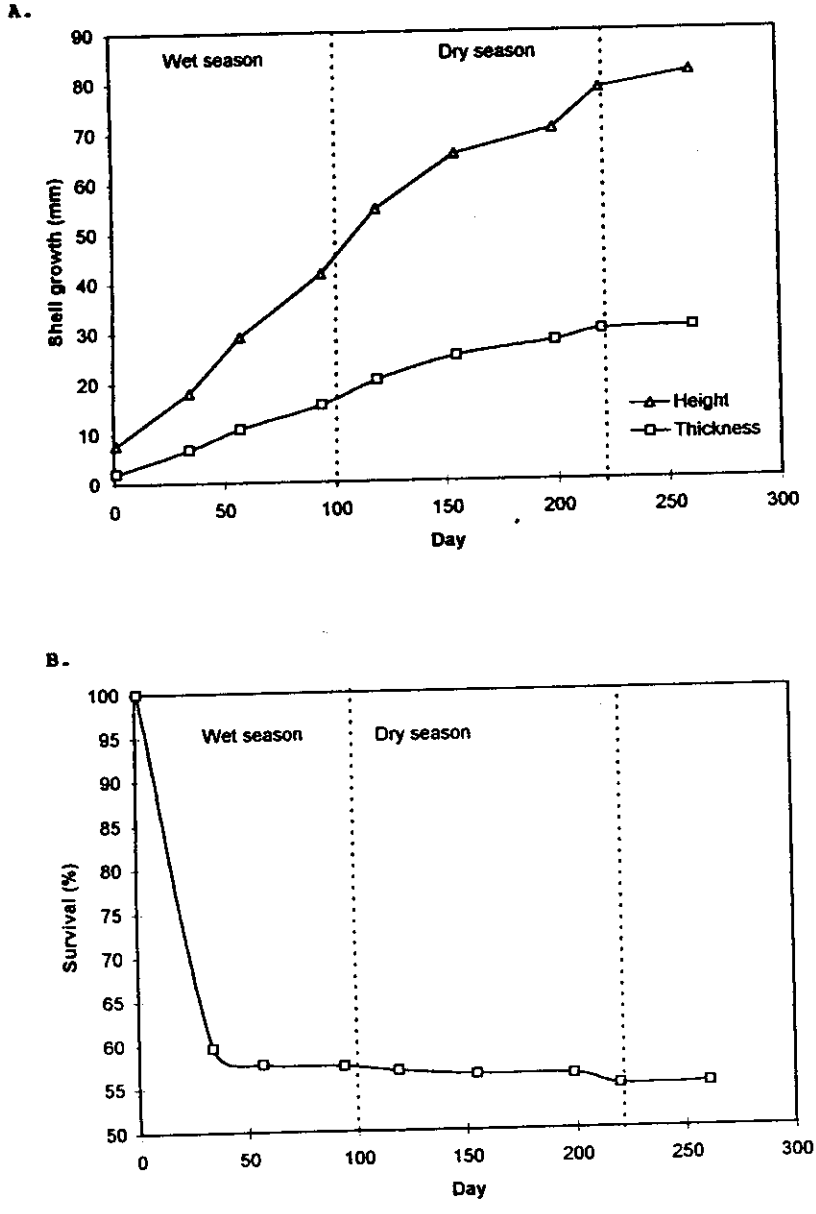

Figure 3a and b. *C. gigas* within the water supply channel of a shrimp farm near Quepos. A) Shell growth. B. Survival.

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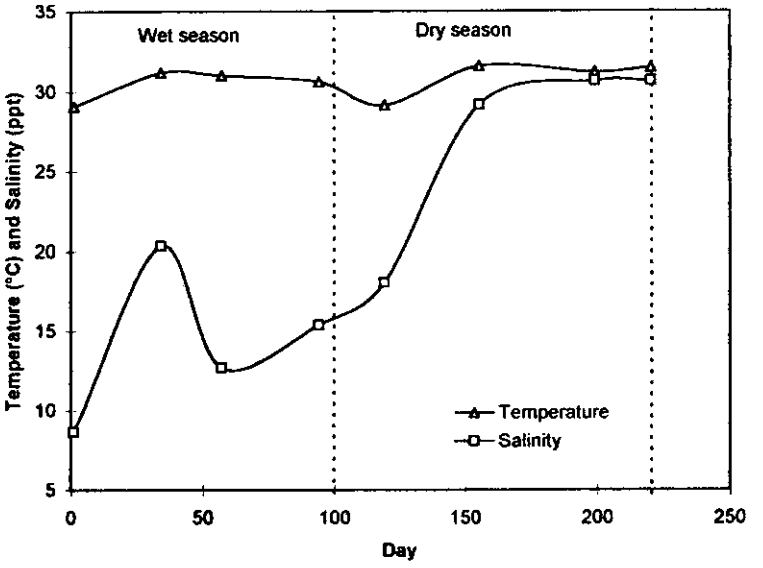

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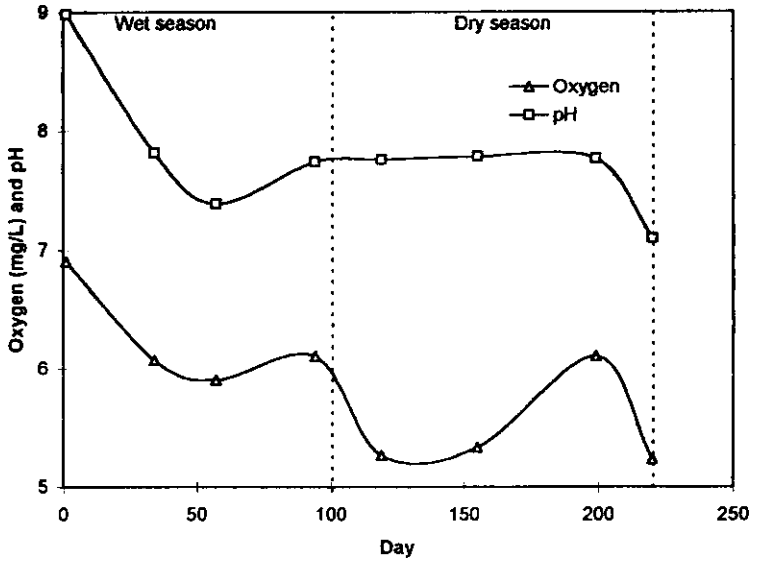

Figure 3c and d. *C. gigas* within the water supply channel of a shrimp farm near Quepos. C) Water temperature and salinity. D) Water oxygen level and pH

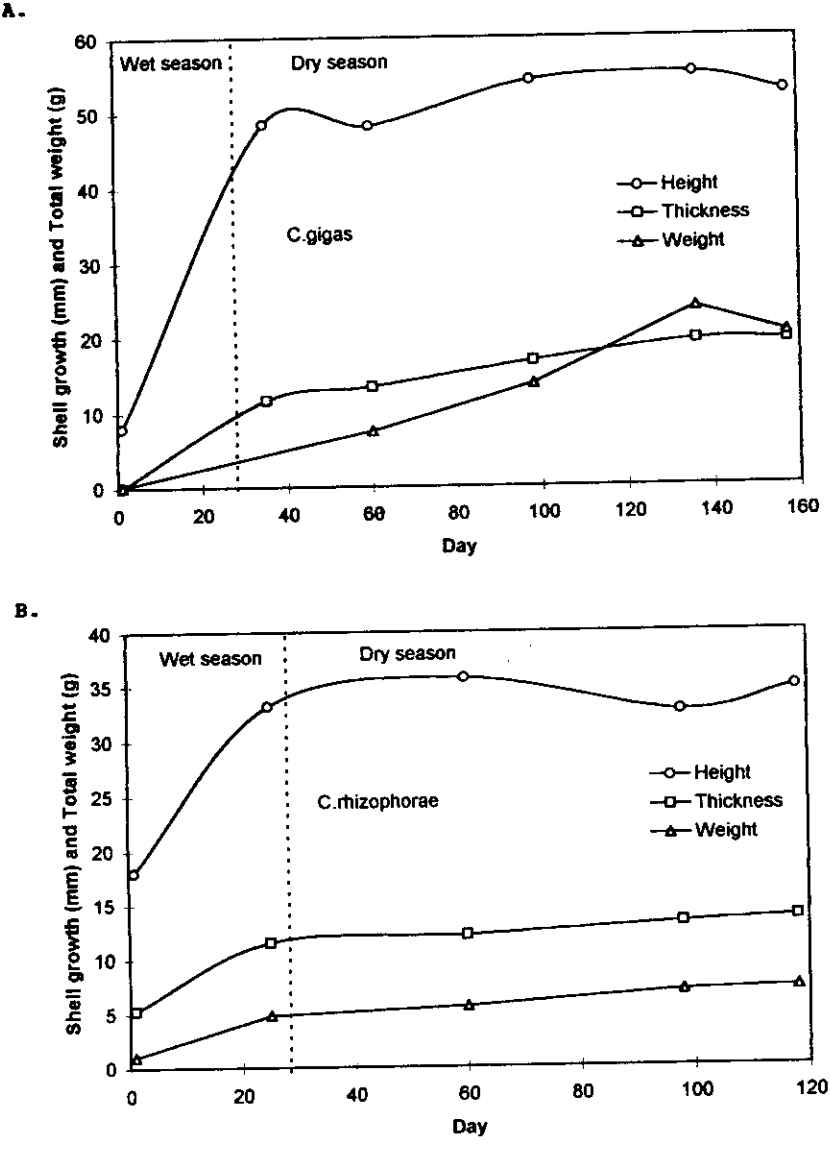

Figure 4a and b. Shell growth and total weight of oysters at a site in front of Cedros Island. A) *C. gigas.* B) *C. rhizophorae.*

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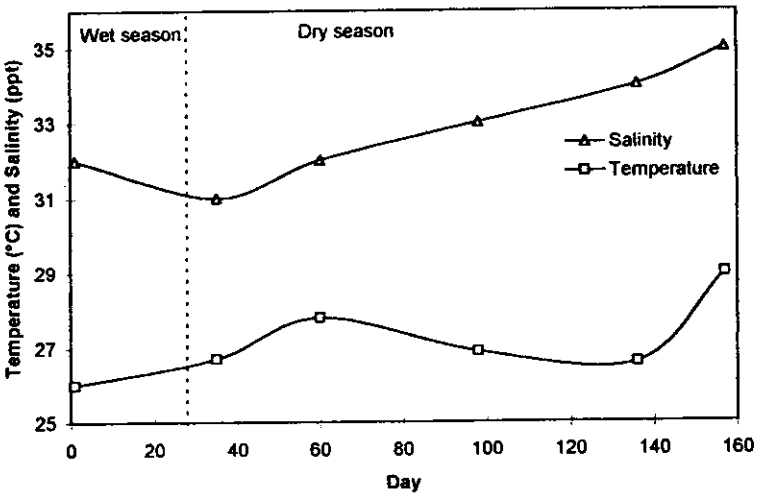

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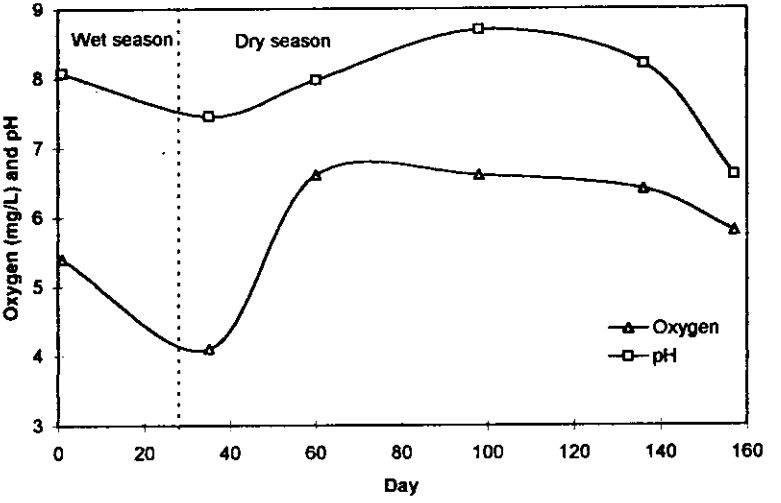

Figure 4c and d. Shell growth and total weight of oysters at a site in front of Cedros Island. C) Water temperature and salinity. D) Oxygen level and pH.

The Pacific oyster *C. gigas* with origin in sea water in Chile, showed better growth patterns at high salinities (Cedros Island, Figure 4), but did not seem to be affected by lower salinities in the wet season (Figure 3). Temperature, oxygen levels and pH were not too much different at the three locations to suggest effects on growth.

For the mangrove oyster it may be possible to start a culture at the end of the dry season to obtain individuals of commercial size (60 mm) at the end of the wet season. The predation problem by fish species can be prevented by using more solid material (plastified metal) for the oyster bags. At present, trials are carried out at another site in the inner Gulf of Nicoya, where the presence of these fish is not reported. Predation by *Cymatium* has been described by Littlewood (1989). Young tritons are supposed to enter the oyster bags as planctonic larvae as at the Cedros Island the oyster bags were hung off-bottom under a raft. Revising the bags regularly can be a method to prevent this predation. Local fishermen collaborate to test methods to prevent predation and fouling by frequent checking of the bags and by exposing them to the sun for different periods to kill ongrowing organisms.

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