Preliminary Results on Spat Collection and Growth of the Catarina Scallop, Argopecten circularis, in Bacochibampo Bay, Guaymas, Sonora, Mexico

CARLOS F. REYES
Escuela de Ciencias Maritimas y Tecnologia de Alimentos
Instituto Tecnologico y de Estudios Superiores de Monterey
(ITESM), Guaymas, Sonora, Mexico

RESUMEN

El objetivo de esta investigacion fue obtener datos biologicos sobre la fijacion y el crecimiento de la semilla de escalopa catarina, Argopecten circularis, en la Bahia de Bacochibampo, Guaymas, Sonora, Mexico. Este estudio fue realizado durante el periodo de julio de 1983 a julio de 1984. El crecimiento fue observado desde septiembre a diciembre 1983, usando semilla obtenida a mediados del mes de septiembre de ese ano. La fijacion de la semilla se registro durante todo el ano. La abundancia y el tamano de la semilla variaron mensualmente. Se encontro una relacion significativa entre abundancia y profundidad. El crecimiento promedio mensual durante el periodo de estudio fue aproximadamente de 10mm.

INTRODUCTION

Scallops of the family Pectinidae support important fisheries in several countries around the world. Catches of scallops have been increasing in recent years, however, due to natural fluctuations of scallop populations, many countries have experienced disastrous collapses after making considerable investments in gear and processing facilities. Many countries which fish scallops, such as France, Canada, Spain, U.S.A. the United Kingdom, and Australia have been involved in research to adapt, for their own situations, the scallop culture methods developed in Japan which have been demonstrated as being very successful in increasing scallop production and "re-stocking" (Wood, 1978).

Scallops in Mexico are fished and consumed locally mainly in the Mexican Pacific and throughout the Gulf of California. Scallop fisheries in Mexico are artisanal and are also part of the bycatch of shrimp trawlers. Some scallop grounds have been destroyed by overfishing and in some cases by a combination of high fishing pressure and development of tourist resorts (Yoshida, personal communications). Research on scallop culture is just starting in Mexico (Baqueiro, 1984).

This paper reports preliminary results of a study to determine the suitability of a modified Japanese spat collection system to obtain wild spat, which could be the basis of commercial scallop culture operations on the Pacific coast of Mexico.

STUDY AREA

Bacochibampo Bay is located on the east side of the Gulf of California in the coast of the state of Sonora near the city of Guaymas (Figure 1). Annual sea surface temperatures range from 10° C up to 33° C. Upwelling of deep cold water along the coast maintains relatively low sea temperatures (16 - 18° C) throughout the winter and early spring (Thomson et al., 1979). There is little seasonal variations of salinity, the range being from 35.0 ppt to 35.8 ppt. Tidal amplitude is small, and tidal currents are less important than wind-driven currents. In winter the wind is reversed and is believed to cause upwelling in the Guaymas area (Maluf, 1983). Water is clear and the rocky shoreline found along the coast is steep. Average depth of the bay is about 10 m. However, there is an abrupt change from the relatively shallow basin of the bay moving out to the open sea. Sandy, rocky and silt bottoms are found throughout the bay. Walker (1960), based on the fish distribution, included the Guaymas area in the Central Gulf of California. The Central Gulf is characterized by a very rich biota dominated by species charcteristic of the Central American Pacific coast, the "Panamic" biogeography province (Maluf, 1983).

MATERIALS AND METHODS

Four areas were chosen as collection stations near the ITESM (Instituto Tecnologico y de Estudios Superiores de Monterrey), taking into account the main circulation of the currents in Bacochibampo Bay. Four sampling stations (Fig. 2) based on the Japanese long line system, were constructed for this study. Location of the stations are shown in Figure 1. Using a Furuno Echo Sounder, depth for each station was obtained to calculate the material required to construct each station. Depths at these collection stations were: station A - 6 m, station B - 30 m, station C - 15 m, station D - 17 m.

Each collection station was anchored perpendicular to prevailing surface currents with eight concrete blocks, each weighing approximately 60 kg and having dimensions of 30 x 30 x 30 cm. A handle bar of corrugated steel (3/8" diameter) was placed on the top of each block to provide an attachment point to tie the anchor lines. However, these blocks were too light for the deepest station, and old tires filled with concrete with four corrugated steel bars of 40 x 125 cm diameter were placed in the bottom of the tire to provide better anchorage. This type of anchor weighed around 100 kg and replaced the concrete blocks on station B. The concrete mix used was 2 parts of gravel, 1 part of cement and 3 parts of sand, giving a density of about 2.2 ton/m. In addition, 16 small weights (10 x 10 x 10 cm.) were made with the same mix ratio to provide vertical positioning for the sampling lines. Iron anchors were used on station D, fastened to the concrete block, because strong bottom currents moved the blocks from their original positions. Subsequently, the blocks were again placed in their original position and the anchors were fastened to the concrete

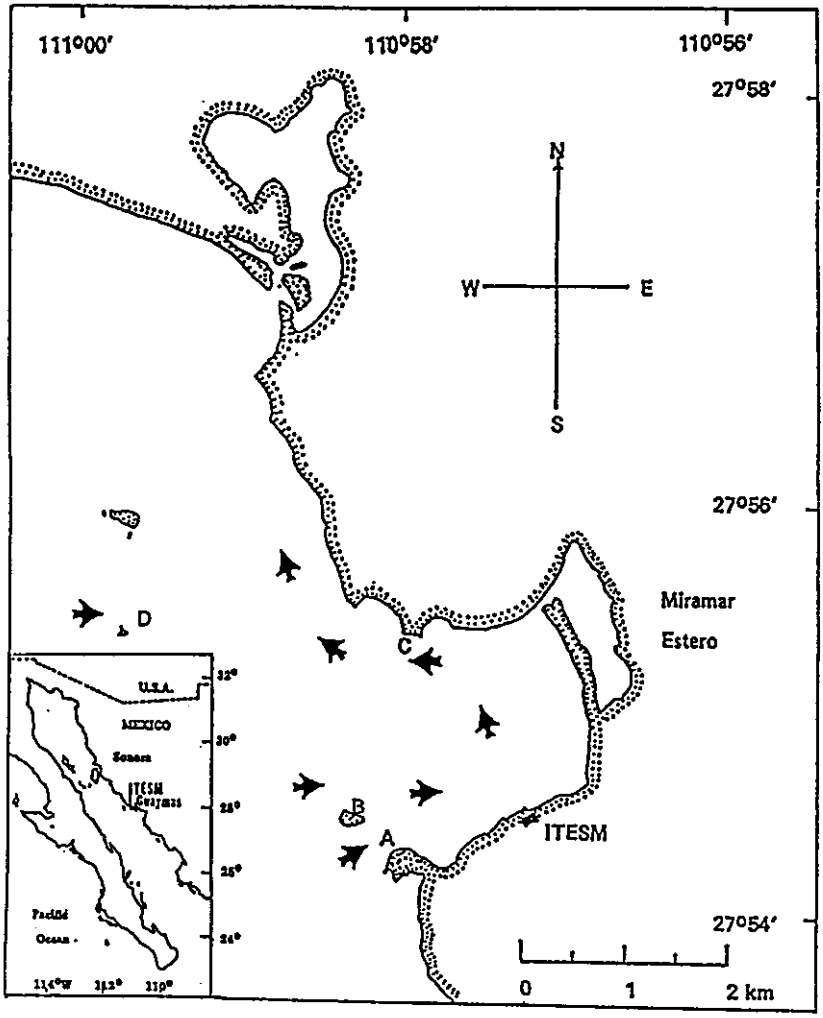

Figure 1. General location of study area in the Gulf of California, Pacific Coast of Mexico and of the Instituto Tecnologico y de Estudios Superiores de Monterrey (ITESM). Dark arrows show the general circulation pattern of surface waters; A-D are the locations of the experimental scallop spat collectors.

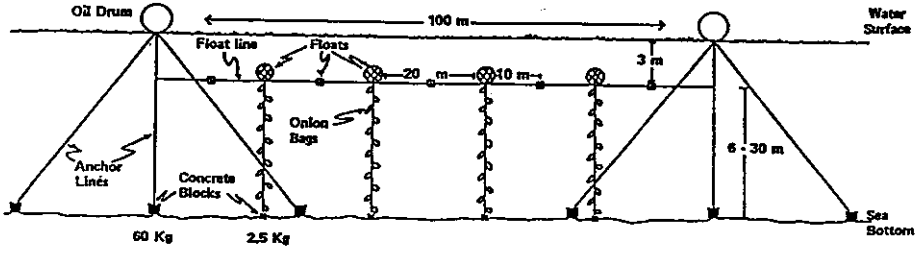

Figure 2. Details of spat collecting station.

block with shackles, and two meters of 1/4" chain were used between the anchor and the concrete blocks.

Polypropylene ropes (3/8") were used as anchors lines. The ratio between depth and length of the anchor lines was 4:1. For instance, at station A, recorded depth was 6 m so 20 m of polypropylene plus 4 m of chain, 2 m at each end, gave a total length for the anchor line of 24 m. Chain was used to prevent the ropes from cutting off with the handle bar of the concrete blocks and swivel of the buoy. Shackles were used to fasten the chains to the handle bar, and galvanized screws were used to fasten the chain to the swivel. At the deepest station, a 5:1 ratio was used to give better anchoring, because this station was located in open sea conditions. Eyed sinkers were placed on the anchor lines to prevent them from floating at low tide.

Oil drums of 200 liters were used as buoys. They were cleaned and painted, and a belt of iron plate of 1.8 m x 5 cm x 0.6 cm was attached to the drum. A swivel (3/8") was soldered to the belt and to this was attached the anchor line which allows the drum (float) to orientate with the wind and currents.

The float lines were also made with 3/8" polypropylene rope; each was 100 m long with four buoys of 30 cm in diameter attached every 20 m to give positive flotation to the line, as the sampling lines were hooked at these points. In order to give extra flotation, 10 buoys of 10cm in diameter were placed every 10m in sets of two. Float lines, tied to the central anchor lines, were placed 3 m below the sea surface to prevent navigation problems.

Sampling lines were made of ¼" polypropylene rope. A snap was fastened at one end, and a small concrete block at the other using an eye splice knot. Sampling lines, cut in different lengths depending on the depth of the sampling area, were used to tie the spat collectors. The snap was used to hook the sampling line to the float line and the concrete block, in combination with the buoys of the float line, gave vertical positon to the sampling line. Butterfly knots were made every two meters to tie on the spat collectors except at station A where the knots were tied every meter because of the reduced depth.

Spat collectors were made using plastic onion bags of 40 x 60 cm, packed with one square meter of worn out monofilament gill net. Each onion bag was tied at the middle with a piece of cord, reducing the surface area by one half. The cord was used to tie the spat collector to the sampling line.

Labels were made using plastic letters strips (Dymo system). A small hole was punched at one end and a piece of cord was used to tie it to the bag. Each label had a code to identify the station, site on the station and water depth. For instance, 1A3, means station A, first sampling line, 3 m depth.

Collection of the bags was made monthly. All bags were replaced the same day. The bags were kept in running sea water by submerging them at the ITESM dock in order to maintain the spat alive and preventing separation of the valves which makes

examination of the bags more difficult. Each bag was opened on a table, after turning inside out and removing the gill netting for inspection. After careful examination, the spat were removed from the bag and gill net. Subsequently, the bag and gill net were washed gently in a bucket and the water then drained through a fine sieve (1 mm). In this way most of the small spat were collected. Spat were separated from the accompanying fauna and then counted and shell length and height measured. When the abundance of spat was high, collectors were frozen and the spat were collected by washing the collector in a bucket and draining the water through sieves of different mesh sizes (4, 2, 1mm). All spat were counted and a subsample was taken from each sieve for measurements. The data were recorded on data sheets for each bag. Shell measurements were made to 0.01 mm using an Ohaus caliper. Spat that fell out of the the bag and those which adhered to the outside of the bag were neither counted nor measured. Species of scallops were counted and measured separately to determine the dominant species.

Surface water temperature was recorded daily from the ITESM dock using a Taylor thermometer (-10° to 50° C ± 1° C) at the upper value. Recordings were made for the period July 1983 to July 1984. There are no significant diurnal fluctuations in water temperature and obsevations were made at noon.

Part of the spat collected in September was used in the growth experiment. Spat were measured and counted and placed in growth modules which were made of 3 mm plastic net (Vexar netting). The modules were placed 2 m below the water surface near the ITESM dock. Seed spat were individually measured and cleaned weekly during the study.

Data were analyzed using analysis of variance, contrast and regression analysis.

RESULTS AND DISCUSSIONS

Scallop spat settled in the collectors throughout the year, with three peaks in abundance in November 1983, February and May 1984 (Figure 3). Linear regression analysis showed that scallop spat abundance and mean monthly surface water temperatures correlate significantly ($r = 0.9638$) from December to June when spat settlement increased as surface water temperature increased. Spat settlement peaks in February and May were removed from the analysis to eliminate variations caused by the intense settlement during those months. The mean shell height correlated significantly ($r = 0.80$) with mean monthly water temperatures. Analyses of variance showed that there was no general pattern between spat abundance and water depth, but that there were differences in spat abundance between stations. Contrast analysis showed that spat were most abundant at station B (Figure 1). Growth of scallops during the 14 week experiment was linear (Figure 4), and appeared to be independent of decreasing water temperature down to 21°C, below which growth slowed down considerably.

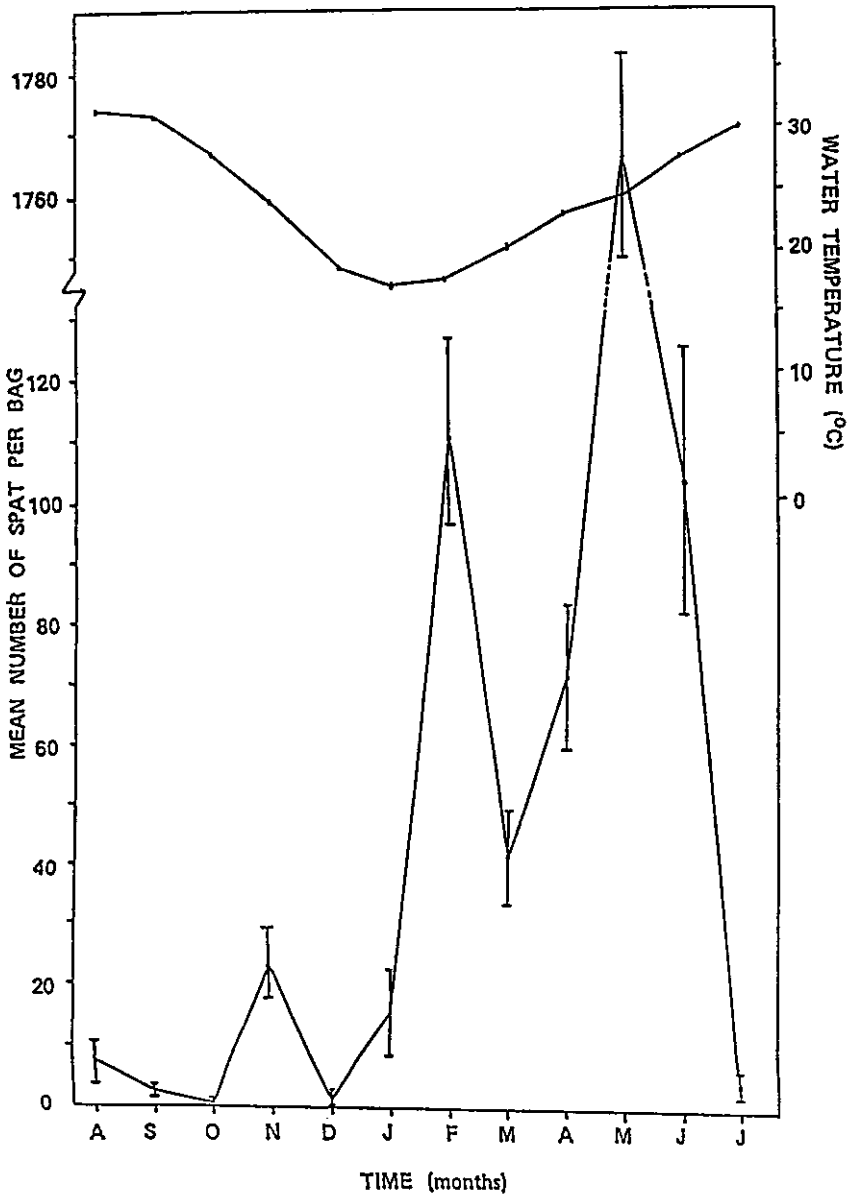

Figure 3. Monthly variation in mean number of spat collected per bag and surface water temperature.

Scallops in the study area appear to reproduce continually, since spat was collected throughout the year. This would be advantageous for commercial operations of scallop culture, because it would allow for continued seeding and harvesting. The three peaks in abundance appear to be due to a factor, or factors, other than water temperature, such as currents bringing the pelagic larvae from other areas.

Station B, where spat were most abundant during the study, was located in a high energy area with strong currents. This implies that spat collection can be optimized by strategic positioning of the collectors.

Scallop growth appears to slow down during the winter months (December to March), when surface water temperature decreases below 21°C due to nearby seasonal upwelling. This reduced growth period does not appear to be a significant obstacle to commercial culture of scallops in the area, due to the high growth rates observed at higher water temperatures that prevail during the rest of the year.

In conclusion, scallop spat appear to be abundant enough to support commercial culture operations in the study area. Observed growth rates should produce market-size scallops in 6 -8 months after spat is collected. The modified spat collectors worked adequately, and after the one-year study were still functional. A detailed study of the currents should determine the most productive areas in which to locate collectors. Ongoing growout studies will provide the remaining data needed for the final economic feasability analysis.

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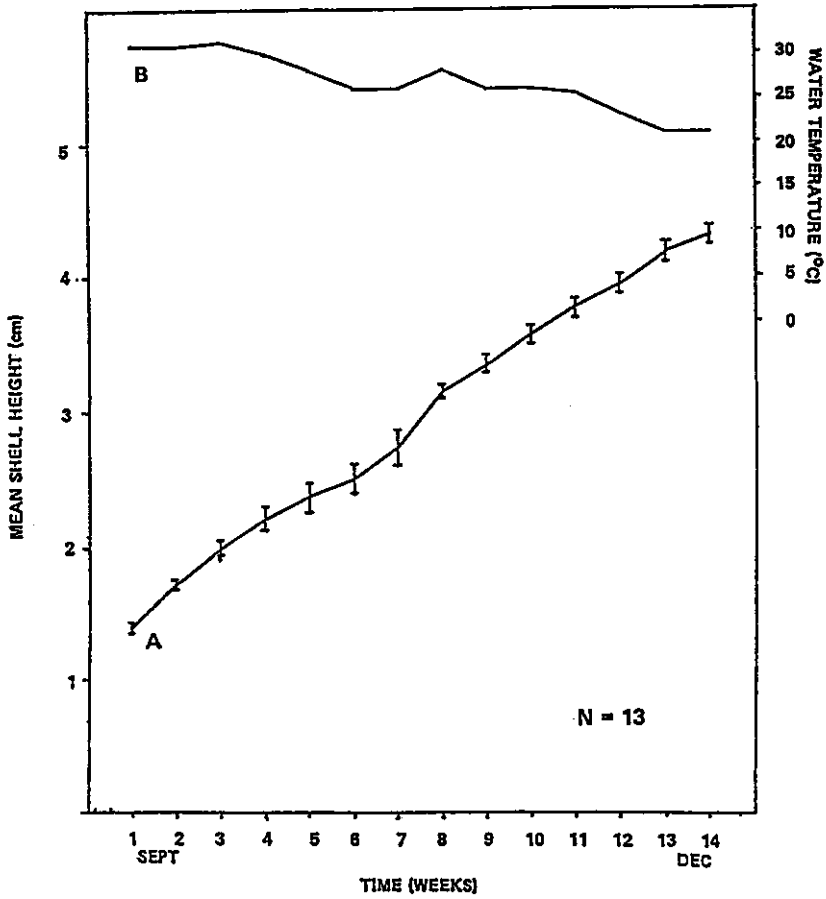

Figure 4. A) Weekly shell height increase (cm). Bars are 95% confidence limits. B) Weekly mean seawater surface temperature (°C).