AN ESTIMATION TO CALCULATE THE RATE OF GROWTH OF THE CLAM, *Rangia cuneata* AT THE SOUTHEAST OF MEXICO

NOTA CIENTIFICA

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ABSTRACT

At the southeast of Mexico, the marine Lagoon Pom, Campeche, in 2 years sampling a total of 4,514 raw clams, *Rangia cuneata* were trawled by a 2.5 cm mesh net Nasal. The highest, medium, and lowest monthly rate of growth were calculated by the Petersen method as a basis. Mean water temperature was 28° C, salinity 2.4‰, depth 2.7 m, and transparency 0.75 m. There are 2 spawning periods: February to June and September to November which coincides with a salinity of 4‰. Medium growth rate of the 1st period was given by the following von Bertalanffy equation: LTOTcm = 4.104(1-eEXP-0.2554(t+0.4004)),and LTOTcm = 4.462(1-eEXP-0.2146(t + 0.3545)) for the 2nd one. Where LTOT: total length; t: time in months. In one year clams grow to a commercial size. Over the years of 1983 to 1986 clams reached an annual peak production of 1,800 m.t. which was about 1,280 clams/m^2/year from an6 area of about 50 km^2. Production of 1990 was scantly, 420 m.t.

RESUMEN

En la Laguna marina Pom en el sureste de México, Campeche se realizaron dos años de muestreo de 4,514 almejas, *Rangia cuneata* por media de una “cuchara o nasa” con malla de 2.5 cm de luz. Utilizando el método de Petersen, como base, se calculó la tasa de crecimiento alta, media y baja. La temperatura media del agua fue de 28 °C, la salinidad fue de 2.4‰, la profundidad fue de 2.7 m y la transparencia fue de 0.75 m. Hay 2 periodos de desove principales: febrero a junio y septiembre a noviembre los cuales coinciden con una salinidad de 4‰. La tasa media de crecimiento del primer periodo se representan por las siguientes ecuaciones de von Bertalanffy: LTOTcm = 4.104 (1-eEXP-0.2554(t +0.4004)) el primero, y LTOTcm = 4.462(1-eEXP-0.2146(t +0.3545)) para el segundo. Donde LTOT: longitud total; t: tiempo en meses. Las almejas crecen a un tamaño comercial en 1 año. Durante los años de 1983 a 1986 las almejas alcanzaron la producción anual más alta con 1,800 toneladas métricas, lo que representa 1,280 almejas/m^2/año en una área de alrededor de 50km^2. La producción en 1990 fue tan solo de 420t.m.

INTRODUCTION

The brackish water clam, *Rangia cuneata* is found in many areas of the Atlantic Ocean where salinity varies up to 15 ‰, from Chesapeake Bay, U.S.A. to Mexico (Hopkins *et al*., 1973). This clam was harvested commercially in the southeast of Mexico around 1960's where it reached almost 1,800 m.t. from an area of 5.2 ha between 1983 and 1986 (Escamero-Figueroa, 1989).

Wolfe and Petteway (1968) showed that a 60 mm long clam was reached in 8 years in the Trent River east of North Carolina. Tenore *et al*. (1968) found that in the Pamlico River, North Carolina, clams grew bigger in the sand sediments with high concentrations of organic matter than those grown in the clay-silt sediments.

Regarding to mexican weather conditions, there is no published information about clam's growth. So this paper deals with the calculation of clams growth over the spawning period using Petersen method as a basis. It will also shows the main hydrological conditions.

STUDIED AREA

Pom Lagoon is situated between 18º 30' and 18º 38' N. and 92º 19' W. It is part of the Atasta-Pom system at the southwest of Términos lagoon. It is about 7 km wide and 10 km long with an average depth of 2.7 m.

Climate is Amw"ig (García, 1973) which is warm-humid with 2 rainy periods, a short one in summer (June-September) and a long one in winter (December-March). Mean air temperature is 28ºC. Annual rain is 1,500 mm and evaporation is 1,400 mm. Salinity in the lagoon is between 0 and 12‰. Oxygen is 6-7 ppm primary production varies between 0.12 - 0.31 g C/m^3/day. Main mangrove are *Rhizophora mangle* and *Avicennia germinans*. Sediments are sand-silt and silt-clay.

MATERIALS AND METHODS

From 1973 to 1975, every 15 days, a total of 4,514 raw clams were trawled using a 2.5 cm mesh net "nasa" or "cuchara" attached to a 50 cm rim which is joined to a 4 m wood stick. A 5 m long boat with a 40 HP out-board motor was used. These data were also compared to fishing production from 1983 to 1990.

Water temperature was measured with a 0-50 °C thermometer adapted to a van Dorn bottle, salinity with an AO refractometer, extinction of light with a Secchi disc, and depth with a plummet. Each clam was weighed with a scale, and total length measured to the nearest 0.1 mm with a Vernier.

A file of 4,514 clam records were processed by a B7800 computer from the UNAM. A statistical package (SPSS) was also used.

Due to, small variation from year to year in this area, data of two years sampling were mixed into one year. Then, Petersen method was applied for the WTOT (total weight) as a basis, to see the behaviour of the rate of growth.

According to two spawning periods per year, the highest and lowest growth lines were drawn by eye. These lines were the basis to calculate LTOT (total length) per month according to WTOT-LTOT relationship. Then von Bertalanffy method was used to calculate the highest and lowest rate of growth (Gulland, 1971) using Ortega-Salas (1981 and low) Basic programs on growth. Finally, an average of these rates gave the medium rate of growth.

Mean clam weight will be used to estimate density of clam production from 1983 to 1986.

RESULTS

Main hydrological results were taken from the northwest part of the Pom Lagoon. These results appear in table 1.

Annual mean depth was 2.7 m, minimum 2.2 m in December (winter), and maximum 3.7 m in May (spring). Annual mean temperature was 28.4º C, minimum 22.8º C in December (winter), and maximum 38.6º C in September (summer). Annual mean Salinity was 2.4 ‰ minimum 0‰ between October and March (end of autumn-winter), and maximum 12 ‰ in May (spring).

Two spawning periods, February to June and September to November were caracterized because temperature was over 28º C and salinity was around 3-4‰. This happened when the rain period was beginning and ending.

Most sediments were found to be silt-clay with organic matter which was also favorable for the dams growth.

All these hydrological parameters (table 1) were considered ideal for clam's growth mainly because stability of high temperature, low salinity, and low transparency values (0.75 m), which could means food for clam due to microorganisms living in the water.

The WTOT (total weight) - LTOT (total length) relationship gave the following equation:

$WTOTg = 0.002682\ (LTOTmm^{24967})$

n = 4,516 r = 0.87

This equation considers total dams collected in two years.

TABLE 1

MAIN HYDROLOGICAL DATA SHOWING MONTH OF REGISTER

	DEPTH m	TEMP ºC	SALINITY ‰	TRANSPARENC m
Annual				
Mean	2.7	28.4	2.4	0.75
Min	2.2 DEC	22.8 DEC	0 OCT-MAR	0.25 SEP
Max	3.7 MAY	38.6 SEP	12 MAY	1.60 APR

Average length found was 34.2 mm, range varied between 25 mm and 47 mm. Average weight was 18.5 g, range varied between 8.2 g and 41.6 g.

As it was explained above, the WTOT-LTOT relationship was used to calculate LTOT at each monthly spawning period. These LTOT data were the basis to calculate the van Bertalanffy equation (Gulland, 1971) which results appear in table 2.

The WTOTg = 0.002682 (LTOTmm EXP 2.4967) equation was used to calculate the rate of total length and total weight growth with the von Bertalanffy equation given the medium rate growth of:

$LTOT = 4.1(1-e^{-0.25(t+0.40)})$

for SEP-NOV spawning period, and

$LTOT = 4.4(1-e^{-0.21(t+0.35)})$

for FEB-NOV spawning period.

From these rates of total growth in length, it was possible to calculate the highest, medium, and the lowest total length and total weight of the clam as shown in table 3.

So, if 27 g is considered an average weight (table 3: 25.1-29.2 g) per clam caught, and 1,800 m.t. were fished yearly, between 1983 and 1986, it gave more than 66.6 million of clams per year which divided by 5.2 ha the Pom Lagoon gives more than 1,280 clams/m^2/year. Unfortunately production is decreasing year by year. In 1987 it was 932 m.t. which was half of the peak production reached in previous years. In 1990 roughly 420 m.t were caught.

If the same rate of exploitation continues, this natural clam resource will be lost. Probably, no *Polymesoda carolineana* but *R. flexuosa* (which also inhabits the same Lagoon) will occupy *R. cuneata* habitat because this species is smaller than *P. carolineana* and *R. cuneata* and consequently the fishing net is almost Enable to catch it. In January of 1989, the inhabitat relation between these species was *R. cuneata* 62 %, *R. flexuosa* 25 %, and *P. carolineana* 13%. Later in July 1992 this proportion was *R. cuneata* 20%, *R. flexuosa* 71 % and *P. carolineana* 9 % which shows clearly that *P. flexuosa* will dominate Pom Lagoon. This last species is not commercially important.

DISCUSSION

Several authors such as Fairbanks (1963), Pfitzenmeyer and Drobeck (1964) and Peddicord (1976) mentioned that physical and chemical parameters such as sediments, salinity and temperature have a straight influence on growth, distribution, and abundance of *R. cuneata*.

TABLE 2

ACCORDING TO THE SPAWNING PERIOD. THE HIGHEST, MEDIUM, AND THE LOWEST MONTHLY RATE OF TOTAL LENGTH GROWTH OF VON BERTALANFFY PARAMETERS TOTAL LENGTH (cm)

SPAWNING	SEP-NOV			FEB-JUN		
	T_0	K	L¥	T_0	K	L¥
Highest	-0.896	0.2418	5.109	-0.2194	0.1968	5.203
Medium	-0.4004	0.2554	4.1048	-0.3545	0.2146	4.462
Lowest	0.953	0.269	3.1001	-0.4895	0.2324	3.722.

TABLE 3

ACCORDING TO THE SPAWNING PERIOD.THE HIGHEST, MEDIUM, AND

LOWEST RATE OF TOTAL LENGTH AND TOTAL WEIGHT GROWTH WAS

CALCULATED AT 6 AND 12 MONTHS OF AGE

TOTAL LENGTH (cm) SPAWNING	SEP - NOV		FEB - JUN	
Months	6	12	6	12
Highest	4.14	4.88	3.67	4.77
Medium	3.30	4.14	3.32	3.90
Lowest	2.29	2.97	2.89	3.44
Total Weigth (g)				
Highest	29.2	44.0	21.6	41.6
Medium	16.3	29.2	16.8	25.1
Lowest	7.9	12.7	11.9	18.4

Fairbanks (1963) found two spawning periods for *R. cuneata* in one year, from March to May (spring), and during the end of November. This was similar to Pom Lagoon, reported by Rogers and García-Cubas (1981).

In this area there is no restriction for fishermen to catch shellfish even during the spawning time. At the moment there are four Cooperatives with about 70 members each. They allow them to fish a certain quantity per week.

Clam's spawning periods in this area are from February to June and September to November (Rogers and García-Cubas, 1981). It coincides with a mean temperature of over 28 °C and salinity around 3-4 ‰ at the beginning and at the end of the rain season.

Tenore, *et al.* (1968) in Chesapeake Bay and Parker (1966) informed that clay-silt sediments were inadequate for *R. cuneata* growth. On the contrary in Pom Lagoon where most of the sediments are clay-silt with dead shells have provided an extraordinary inhabitat for *R. cuneata* growth.

Pfitzenmeyer and Drobeck (1964) in Potomac River, Maryland and Gunter (1961) observed that clams grew twice as big in fresh water (‰) than those grown in brackishwater (11‰) In Pom Lagoon the mean water salinity was around 4 ‰.

Fairbanks (1963), in Pontchartrain Lake observed that at lower temperature of 9 °C the clam's growth stopped. In Chesapeake Bay winter temperature killed clams. Klein (1981) in upper Chesapeake Bay found that growth was due to an increase of temperature. In Pom Lagoon most of the time temperature was above 28º C.

Tenore *et al*. (1968) and Fairbanks (1963) reported that high concentrations of organic matter were lethal in the water for clams which also diminished their growth. In Pom Lagoon average transparency of 0.75 m was an index of this organic matter. But here was considered to be good for clams growth.

From January 1980 to April 1981 Klein (1981) found that, clams grew bigger in summer, June to October (8 mm - 14 mm to 32 mm - 40 mm) than from October to April. Andersen and Bilger (1977) in Potomac River found that in Maryland *R. cuneata* grew from 23 mm to 41 mm in 277 days. Fairbanks (1963) in Pontchartrain Lake, Louisiana found that differences in sizes and growth of *R. cuneata* were due to physical and chemical properties of sediments. In sand areas clams grew from 15 mm to 20 mm in the first year, 15 mm to 20 mm in the second year, and 4 mm to 5 mm in the third year. Wolfe and Petteway (1968)

in Trent River, eastern part of North Carolina, estimated that *R. cuneata* reached 75 mm in 10 years. The same estimation of growth was found by Pfitzenmeyer and Drobeck (1964), and Hopkins and Andrews (1970) in Texas. In Pom Lagoon *R. cuneata* reached 40 mm in one year.

Fishermen said that in previous years each pair of them could fish 200 kg in 4 furs. In 1989, they spent 2 to 3 days to catch less than 180 kg. They said that fishing clams nowadays is no longer a business. They were selling a kilogram of clam at $ 6,000 pesos ($ 2.7 USA dollars) to the Cooperative. So 2 fisherman could make around $ 1.08 million pesos ($ 480. USA dollars) per month.

CONCLUSIONS

Pom Lagoon was considered to be an ideal natural environment for the clam, *R. cuneata* to live in.

Mean temperature was 28.4 °C, salinity 2.4 ‰, water transparency 0.75 m, and depth 2.7 m.

The spawning periods: FEB-JUN and SEP-NOV where characteristic because temperature was over 28 °C and salinity 3-4 ‰. During the first period rain was beginning, and during the second period it was ending.

The WTOT - LTOT relationship was given by the following equation:

$$WTOT = 0.002682(LTOT^{2.4967}).$$

The rate of total length growth considering the first spawning period was as follows:

$$LTOT = 4.104((1-e^{-0.2554(t+0.4004)}),$$

and for the second period

$$LTOT = 4.462((1-e^{-0\ 2146(t+°\ 3545)}).$$

An average clam of 40 mm and 27 g was reached in one year.

Unless the rate of clam, *R. cuneata* exploitation diminishes in Pom Lagoon, this fishing resource will be lost in few years. Nothing important is being done to look after this resource.

ACKNOWLEDGEMENTS

I thank A. Toledano Granados for collecting, identifying and measuring most of the clams used in this study. I also thank C. Bannister (MAFF) for his comments.

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III. Trabajo recibido 26, 2, 1993; aceptado 11, 3, 1993