Status of Populations and Fisheries of *Strombus gigas* in Cuba, with some Results of Juvenile Rearing in Pens

LUIS MUNOZ[1], PEDRO ALCOLADO[2], ILEANA FRAGA[2] and PEDRO LLORENTE[3]

[1]Centro de Investigaciones Pesqueras
Ministerio de la Industria Pesqueras
Avenida 1ra y 26, Mirama
La Habana, Cuba

[2]Instituto de Oceanologia
Academia de Ciencias de Cuba
Avenida 1ra, No. 18406
Playa La Habana, Cuba

[3]Empresa Combinado
Pesquero Industrial de Matanzas
Matanzas, Cuba

ABSTRACT

A general history of queen conch (*Strombus gigas*, Linne) fisheries in Cuba is presented. Fisheries activities, together with indiscriminate collection of conchs by tourists and divers and the use of conch meat as bait for snappers and other fishes, led to great drops in population densities in many parts of the country. For conservation and management, there was established a closed season and the application of catch quotas. Nevertheless, population rebuilding was not achieved, due to excessive, illegal harvesting which escaped control, and maybe also to a drop in larval recruitment. Preliminary results are given on rearing of 2 year old conch in pens at a density of 0.5 individual/m^2, for one year. Growth rates between reared and wild juveniles were not significantly different, but mortality rate was markedly lower in reared conch. Development of conch shell lip was studied for one year. Some alternative strategies for future juvenile rearing are discussed.

INTRODUCTION

The large gastropod, *Strombus gigas*, has constituted an important food source for West Indian and Central American inhabitants. Furthermore, its shell has been used for many purposes. This fact, summed with ease of capture, led the conch to occupy an important place as a sea product in the Caribbean, together with lobsters and fin fishes. This situation was maintained until 1980 when a great drop in capture levels due to overfishing was observed (Brownell and Stevely, 1981). As this was also the case with Cuban conch populations, the Ministry of Fishery Industry, by means of the National Commission on Mariculture, started experimental rearing of two year old juvenile conch in pens, as one possible way to develop a

methodology which would permit obtaining large quantities of adult conch by avoiding mortality. The aim of juvenile rearing was directed both to obtaining conchs for trade and for restoring their populations. This paper offers a brief account of the Cuban conch fishery, as well as some preliminary results obtained during one year of experimentation.

CUBAN CONCH FISHERY

Cuban aborigines were classified in two different cultural groups; the ceramists and the non-ceramists. The latter used gastropod shells for making several kinds of devices, such as plates, scrapers, hammers, vessels, etc., and consumed the conch meat as food. Among gastropods used by early natives, the queen conch was most important, as can be deduced from the great amount of shell fragments found in aboriginal homes (Rivero, 1966). For a long time, consumption of conch meat in Cuba was limited to inhabitants in the most easterly parts of the island. After beginning the official fishery of conch in 1969, people all around Cuba began to include this food in their diet.

According to Baisre (manuscript), annual capture was very unstable, with a maximum value in 1977 of 2,353 tons (Fig. 1). After this, conch populations were so depleted that a closed season of 4 years was decreed. The conch fishery recommenced in 1982, with a catch quota of 555 tons, rising to 780 tons in 1984. Only adult conch were permitted to be caught. Unfortunately, there are no fishing effort data on S. gigas for analyzing yields. In spite of the establishment of catch quotas and the ban on fishing of juvenile conch, populations are still decreasing at an alarming rate (Grau and Alcolado, manuscript). Among factors affecting the conch populations are illegal collections by tourists and divers, and the use of conch meat as bait by fishermen, none of which is registered in official statistics. It is probable that assigned catch quotas are still higher than they should be.

This fishery situation is being analyzed, and several measures, such as a new closed season, introduction of conch culture techniques, or very low quotas, are being discussed. Not only is overfishing affecting conch populations, but also a possible drop in larval recruitment from native, and even foreign populations, from the Caribbean as can be inferred from Berg (1985).

EXPERIMENTS ON JUVENILE REARING

Rearing experiments were carried out in the Province of Matanzas, at the entrance to the Bay of Cardenas, near Point Hicacos ($23^{\circ}07N$, $81^{\circ}08W$). Average depth is 1.5 m, water is transparent, and there is an active water exchange with the open sea. The bottom is a medium dense Thalassia grass bed, with muddy sand sediment of low organic content. The site is subject to strong tidal currents.

An area of 5000, m^2 was enclosed with chicken wire fencing of one inch diameter mesh. Juveniles of about 2 years old (mode)

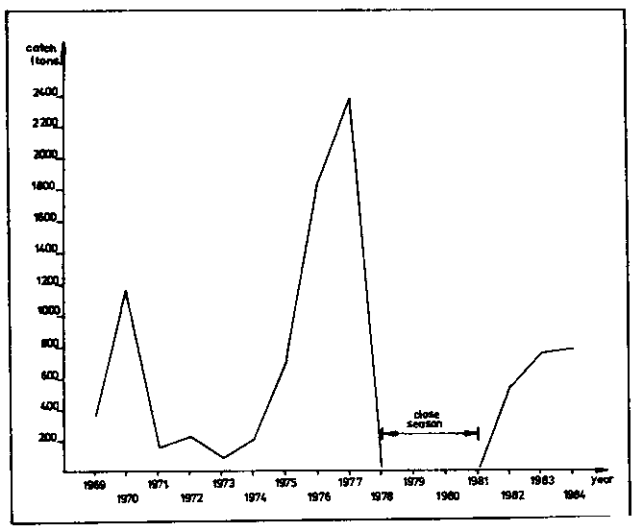

Figure 1. Annual catch of conch (wet weight of shelled conch).

were seeded at the beginning of April 1984 at a density of 0.4-0.5 conchs per square meter.

The juvenile conchs were brought on the deck of a boat from a place near Cruz del Padre Cay, where depth is about 5 m and the bottom is similar to that in the pen, and seeded about 20 hours after being captured. There was no mortality during the process.

Immediately after seeding, conchs tended to group at the fence where they fed on algae growing on the wire and on shells of other conchs. They were not observed burying in the sand. Apparently they acclimated well to the change in habitat to which they were subjected.

Growth in Pen and Original Habitat

The growth study began in April 1984 when 105 conchs were tagged. These conchs were recaptured and measured monthly until April 1985. Conchs grew fast during the period April 20-July 23, at an individual average rate of 0.83 cm/month, due to high temperatures (28-30°C) and an abundance of benthic plant material. From July 1984 to April 1985, growth was very slow with an average size increase of 0.2 cm. The overall average increase in size of conch during one year in the pen was 2.7 cm. Figure 2 shows the evolution of the size mode.

When comparing the modal size of two year old juveniles in the natural population (17.3 cm) in April 1984, with the median size of adults (20.3 cm) achieved when they are 3 years old, we obtain a size increase of 3 cm, very similar to the growth rate observed in the pen. Furthermore, the median size of adult reared conch was 20.1 cm, and thus we can conclude that growth to maximum size was not significantly affected in the pen.

Mortality

The measurement of mortality within the pen began in May 1984 when the total number of seeded conchs was 3200. At the end of the period May 1984-April 1985, a total of 243 empty shells had been noted during frequent inspections of the pen, and a total of 2365 conchs remained alive.

Mortality was calculated by the equation:

$$N_t = N_o e^{-Zt}$$

where:

N_t = Number of live conchs at the end of period t (2365 units).

N_o = Initial number of conchs (3200 units)

Z = Instantaneous rate of total mortality

t = Time period (one year).

Total mortality (Z) had a value of 0.30, that evidently is low.

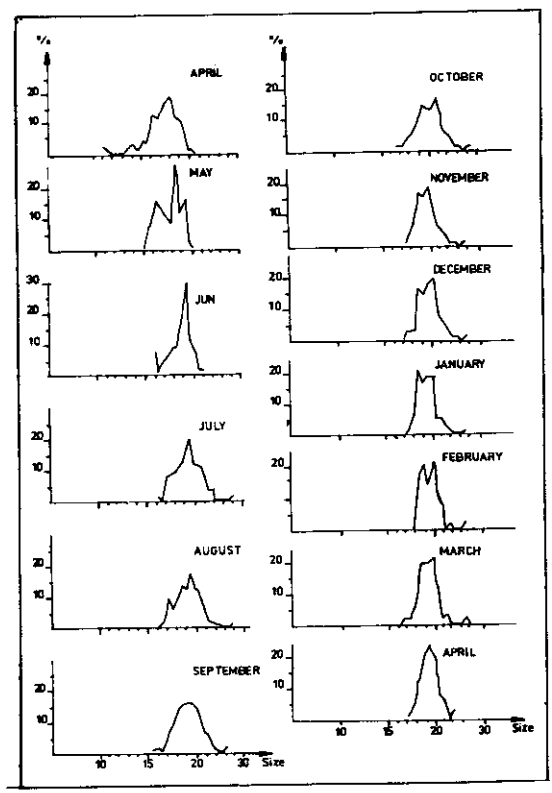

Figure 2. Monthly length-frequency distribution of S. gigas in pens.

Natural mortality (M), is even lower, since during the experiment conchs that disappeared due to different causes (escape, theft) were considered as dead.

For calculating total mortality in the natural population, 500 conchs were sampled, weight modes were separated by Battacharya's method (FAO, 1982) obtaining the weights at different consecutive ages. For calculating Z, we obtained the catch curve whose slope is -Z (Pauly, 1983). For this purpose we plotted naperian logarithms of the number of conchs with age T, against t (Fig. 3). The slope of the obtained regression gives a total mortality of 1.82, six times higher than mortality in the pen. Total mortalities found by other authors are also higher, for example, 3.0 in Puerto Rico (Berg, 1976), 7.3 also in Puerto Rico (Appeldoorn and Ballantine, 1983) and from 1.06 to 3.18 in Cuba (Alcolado, 1976).

It can be concluded that enclosures diminish conch mortality, provided the pens are inspected regularly to avoid conch escape, and predators entering the pen are removed periodically.

In future experiments it will be necessary to improve the quality of the fence, and to select a shallower area (less than one meter), for preventing the entrance of swimming predators during high tides, for making pen inspections and predation control easier, for economics reasons, and for improving conch growth rates. If all these conditions are fulfilled during the experiment (no escape, no theft, no fence breakage), total mortality could be even lower.

Outer Lip Expansion Rate

Every month a sample of the pen population was observed so as to determine the degree of development or expansion of the outer lip as an indicator of the onset of maturation. In April 1984 all seeded conchs were immature without any expansion of the outer lip. By November 1984, only 6% began to expand the lip or had the lip already expanded. There was then a rapid increase in the process and by September 1985, 5% of the conchs had begun to form a lip or had a fully formed shell lip (Fig. 4). The remaining conchs stayed in the juvenile stage, perhaps because they were less than 2 years old at the time of collection (those represented by part of the left side of the mode of two year olds). It is advisable, therefore, to collect and seed juveniles with sizes equal to, or above, the mode of two year olds in order to obtain a full population of adult conchs in the next summer.

It was observed during the experiment that full development of the outer lip takes about 6 months after it begins to expand, agreeing with observations of Katherine Orr (pers. comm.).

Other Comments

Our results with growth and mortality in a pen show that juvenile rearing is feasible, and together with culture from conch eggs, may contribute to restoration of populations. Juvenile rearing may be carried out for two main purposes; (1)

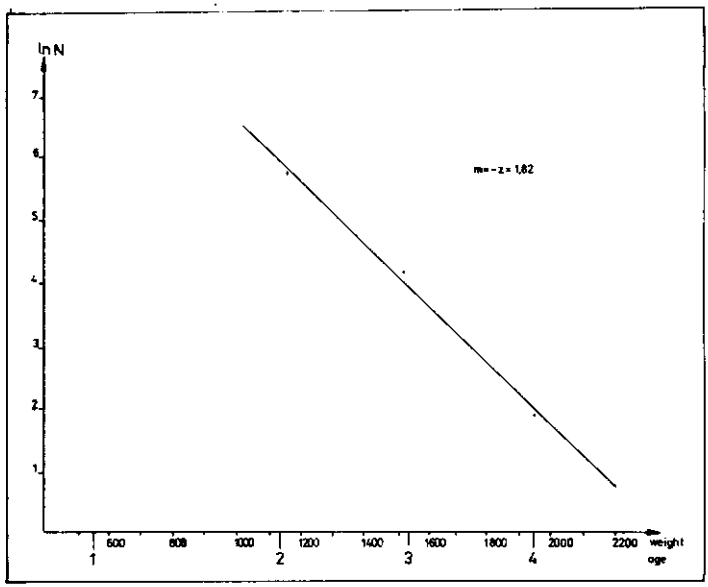

Figure 3. Monthly curve of S. gigas in the natural population.

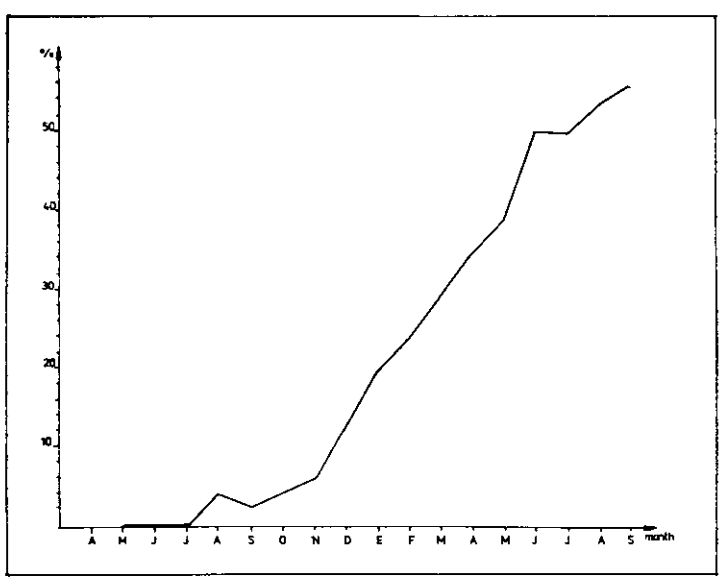

Figure 4. Trend of percent of non juvenile conch during the experiment.

for conservation and (2) for conservation and exploitation.

(1) For Conservation. For this purpose, all adult conchs obtained by juvenile rearing are transplanted to conch reserves or protected zones, where exploitation is prohibited. This practice can be complemented by importing adult conchs from other natural populations into the reserve. In this way, both juveniles and adults are protected to a certain degree from different kinds of mortality and the reserve acts as a larval source through reproduction.

(2) For Conservation and Exploitation. For this purpose, we can test different alternatives. We propose as examples:

(a) All pen reared adults are exploited once the period of reproduction is over (about September or October). It should only be done provided that ecological conditions in the pen permit plentiful egg laying and that all adults be capable of reproducing just after the full development of the outer lip - which seems unlikely.

(b) As above, except that not all conchs are harvested, but only a quanitity equivalent to the number of conchs that would die if not protected by the pen. It would require the same conditions mentioned above. The remaining conchs would be carried to a conservation area.

(c) If the above mentioned conditions are not fulfilled, a quantity of adult conch, equivalent to the number that would die if not protected by the pen, could be sacrificed without the need for reproduction. The remaining ones would be carried to a conch reserve.

Other alternatives could be suggested and tested in the future.

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