Semi-culture Feasibility of the Caribbean lobster

Factibilidad del Semi Cultivo de la Langosta del Caribe

Feasibility de Culture Semi du Homard des Caraïbes

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ABSTRACT

Based on the fact that wild spiny lobster stocks have attained their maximum capacity of exploitation, the spiny lobster semi culture is seen as a good candidate for cultivation. It has a high potential in the Caribbean waters, because of its high demand, high commercial value and its feasibility to be grown in floating cages. However, post larval availability seems to be a bottleneck constraining this activity. Few species have been grown in four south East Asian countries, particularly in Viet Nam where up to 1,500 tons are produced in cages. None of the research and development programs addressed to the lobster cultivation, apart from those already mentioned, has attained success. Therefore, in this paper a numerical model was developed with the intention to evaluate the feasibility of a semi-culture. Results confirm the expectations, meaning that it is viable; however, the following weak point could be identified as the main aspects constraining the activity: low density of post-larvae caught in collectors imposing the need to deploy a high number of collectors and a large number of cages imposing high costs of maintenance. These two aspects imply high labor costs leading to a non-profitable activity. In conclusion, the semi-culture of the Caribbean spiny lobster is feasible but with the current operational costs it is not economically viable.

KEYWORDS. Caribbean lobster, semi-culture, cages, economic feasibility

INTRODUCTION

Caribbean lobster fisheries have been heavily exploited in all of the Caribbean countries for long time, leading to a condition of over-exploitation in some of them. The catch landings of this fishery in 2004 by the whole Caribbean fisheries amounted to 37,600 tons, profiting USD$168.9 Million (Chávez 2008). According to this, none of these fisheries seemed to have the possibility of further increases in their production by the traditional exploitation of wild stocks. Therefore, non-conventional approaches have been attempted as a means to increase catch, including the adoption of artificial shelters, with not much success. The main constraint for this seems to be in the limited carrying capacity of coral reef environments, which sets limits to biomass production, whose production/consumption ratio approaches one, limiting the chance of developing fisheries (Odum 1971, Opitz 1993, Christensen and Pauly 1993). For this reason, it was considered convenient to explore the possibility of developing a spiny lobster semi-culture by trapping post-larval stages, then transferring them to floating cages, and evaluating its economic feasibility.

The cage culture of spiny lobster was first developed in Vietnam in 1992, and since then it was maintained producing 1,500 tons yearly. The method was also applied in other countries of southeast Asia (FAO 2011-2016). In recent years in Australia, the scientists have focused in the technology of incubation which seems to be ready for commercialization (Barnard et al. 2011).

METHODS

The biomass of a stock has been monitored for > 10 years, and a simulation model was developed, which follows every step of the culture with the number of survivals and costs over time. The general steps of this semi-culture are described in Table 1 and were adopted from the FAO paper. At the end, the commercial value of the harvest is discounted from the accumulated costs of its culture.

Table 1. Semi-culture of spiny lobster starting from collection of post-larvae. Since the age of three months, the same density should be maintained.

TIME	STAGES
Initial	Post larval catch by-monthly or monthly
2 days	When they attain 30 g, Transference of post-larvae to baskets
3 ? months	When they grow to 100 g, Transference of juveniles to cages
9 to 12 months	Reduction of numbers to keep a constant density adding more
To 15 months	Further reduction of numbers adding more cages
To 18 months	Further reduction of numbers adding more cages
To 21 months	Further reduction of numbers adding more cages
To 2 years	Harvest and shipment of lobsters alive, to the market

RESULTS

The Spiny Lobster Fishery (*P. argus*)

An assessment of a lobster fishery was taken of the stock exploited in the nearby area where the semi-culture is proposed to develop (Ley-Cooper and Chavez 2009), and served as a basis for the examination of the semi-culture problem in the conditions of southeastern Mexico under the light of its population dynamics. Likewise, the description of the spiny lobster semi-culture in Vietnam (FAO 2011-2016) was made; the process described herein was followed and adapted to the Caribbean lobster fishery.

Current Age Structure

To estimate the number of recruits per year, plus the other age groups needed to harvest 10,000 kg, two and the twentieth month after collecting post-larvae, when they attain the commercial size, at a length of 13.5 cm and a weight of 259 g per lobster, which corresponds to the legal size of those from the wild stock. Parameter values chosen to estimate the harvest are described in Table 1. After this, in Figure 1, the survival of 174,785 puerulus post-larvae required for a harvest of 10,000 kg is described; here a natural mortality value of $M = 0.36$ was adopted. The parameters of the von Bertalanffy growth equation and those of the length-weight relationship were borrowed from Ley-Cooper and Chavez (2009) and used to estimate individual growth and the expected harvest. According to this, at the moment of the harvest, after twenty months, 38,656 lobsters would survive, with a weight of 258 g each and a length of 13.6 cm.

As a product of the numbers of lobsters surviving, multiplied by their increasing weight as consequence of growth, the animals displayed an increase from 2.7 g the first month, reaching 259 g at the end of the twentieth month, the harvest time. In this time, the weight of all animals is 10,000 kg (Figure 2).

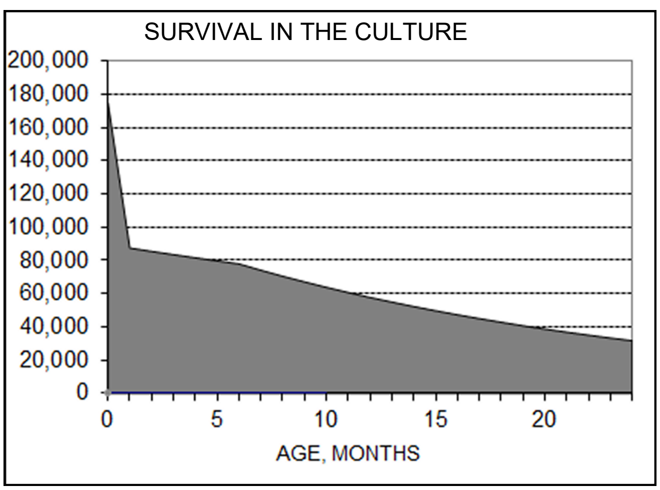

Figure 1. Lobster survival in the culture, numbers. There is an initial abrupt decrease of the early stages. After the third month, juveniles are moved to cages and from this moment, a constant density is maintained, with a significant reduction of mortality.

Respecting to the food provided, it was considered that a daily ration of 4% of the weight, would provide all the nutrients required for adequate health and growth. Therefore, the amount of food was estimated as a constant proportion of total weight of all lobsters in the cages (Figure 2). The cost per kg was US$1.3, and it was assumed constant.

The culture time appears to be too long for economic viability, and for this reason, the deployment of monthly batches of lobster post-larvae is advised.

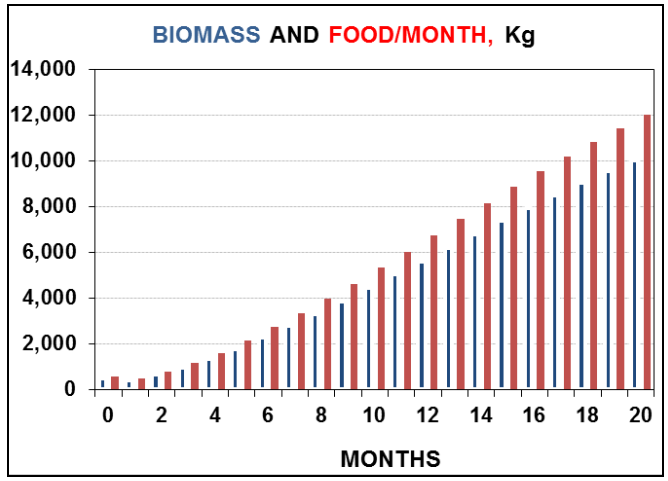

Figure 2. Increase in lobster biomass in the cages (thin bars) and the food provided (thick bars) over time for twenty months until the harvest time.

Economic Flow

Based on the circumstance that the lobster growth in cages takes at least twenty months, it looks like it's too long of a starting period; for this reason, it is convenient to deploy new sets of post-larvae every month, although this might be a constraining situation, because despite lobster spawns year-round, the intensity of this process displays a clearly defined seasonal variation. However, it is assumed that this may be a minor problem that could be overcome, and the post-larval supply will be enough to provide sufficient numbers for the baskets. In the following paragraphs, the requirements for a single batch will be described.

As was mentioned in former paragraphs, there are at least two steps in the logistics of lobster growth; so, there would be required baskets to deploy the post-larvae collected in the 8,739 Gusi type collectors, with a cost of US$9.00 per collector. The post-larvae are transferred to 3496 Niester type baskets, at a cost of US$79.25 each and these values are maintained constant, with a monthly replacing rate of 5%, where they kept during three months. At the fourth month, juveniles are transferred to 462 cages, whose number is gradually increased to maintain a constant density, until harvest time, where there would be 1,667 cages (Figure 3). There are two times in the process when the cost increases suddenly, in Figure 3 it is evident that there are two times when sudden costs are displayed, the initial time, and at the seventh month.

Finally, in Figure 4, a display of balance of costs, value, and profits over time for a single batch is shown. From here, it is evident that since the first twelve months, there will be no profits, only costs derived from the growth process in the cages. It is pertinent to say that the profits are very low compared to costs, during the first six months of the second year, followed by a steady increase, with more than US$3M at the end.

FINAL CONSIDERATIONS

It is important to keep in mind that this is a numerical exercise, based on information available. It is expected, however, that this may serve as a tool that can be addressed to test its applicability in real conditions, such that some aspects can be refined, as well as detailed costs, and other variables that may have not been taken into account. In addition, the hatchery production of spiny lobster (Barnard et al. 2011), is an activity that looks very promising, and it would be like a natural consequence to adopt in Caribbean waters, complementary to the cage culture of juveniles, where growth could be enhanced with artificial diets.

Constrains and Risks

i) *Hurricanes and storms* — These events might destroy the cages and all the investment could be lost.

ii) *Cost of materials* — This aspect includes the risk of sudden changes in their commercial value.

iii) *Hand labor* — The number of employees and their salaries may impose severe constrain to the culture.

iv) *Availability of post larvae* — The collectors are very inefficient, at a maximum rate of 5 post larvae/collector /week (Rosario and Figuerola 2005, Wehrtmann 2004, González and Wehrtmann 2011). It is evident that new collectors must be developed and new areas with high concentration of post-larvae be found.

v) *Water quality* — The experience in Vietnam (FAO 2011-2016) evidences the need to keep the areas where the cages are deployed, be clean of the excess of organic matter, to avoid problems of reduction in growth, pests and infections, etc.

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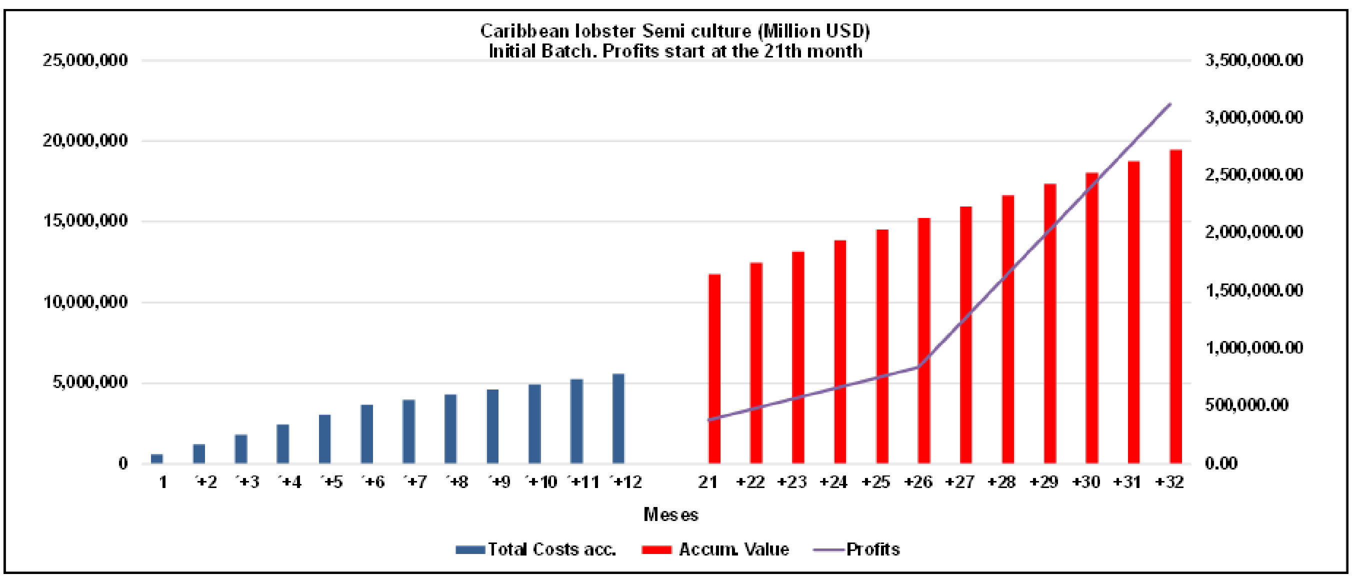

Figure 4. Caribbean lobster semi-culture (USD). Twelve monthly batches. Profits of the first one shown in red bars, start at the 21th month.