Socio-economic Assessment for the Management of the Caribbean Spiny Lobster

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ABSTRACT

The spiny lobster (*Panulirus argus*) tails catch of the Caribbean countries accounts for more than 11,000 tones, with a value of 286 Million USD; it provides jobs to 32,000 fishers, and yearly profits approach 169 Million USD. A biological and socio-economic assessment was made in the whole spiny lobster catch records. Diagnosis made on the condition of the stocks suggests that overfishing has been the main cause of decrease in biomass, profits, and social benefits. Then, optimum socio-economic harvesting strategies were explored with the aid of a simulation model, and pros and contras of social and economic benefits compared under three scenarios were examined as possible targets of the fisheries. Social and economical importance of the spiny lobster fisheries in the Caribbean justifies the creation of an institution devoted as a main goal, to monitoring the state of stocks to provide advice to the fisheries industry for ensuring the optimum sustainable exploitation of lobster stocks.

KEY WORDS. Spiny lobster, fisheries, Caribbean, management, optimum harvesting strategies

Evaluacion Socio-economica para el Menejo de las Pesqueritas de Langosta del Caribe

La captura anual de colas de langosta del Caribe (*Panulirus argus*), supera las 11,000 t con un valor de 286 millones de dólares; provee de empleo a 32,000 pescadores y genera utilidades por unos 169 millones de dólares. Se hizo una evaluación socio-económica de todas las pesquerías basada los datos estadísticos de la FAO. Un diagnóstico de la condición de estas pesquerías sugiere que la presión de pesca excesiva ha sido la causa principal de los decrementos en la biomasa, en las utilidades y en los beneficios sociales. Se exploraron las estrategias socio-económicas óptimas de pesca con ayuda de un modelo de simulación en tres escenarios como posibles objetivos de manejo. La importancia económica y social de las pesquerías de langosta del Caribe justificaría la creación de una institución dedicada esencialmente a la evaluación constante de las existencias para un manejo informado que garantice la explotación óptima de las pesquerías de langosta en el largo plazo.

PALABRAS CLAVES: Langosta del Caribe, pesquería, Caribe, manejo, estrategias óptimas de pesca

NTRODUCTION

Spiny lobster (*Panulirus argus*) is the main fishery of the Caribbean countries; regional importance of scientific research addressed to evaluation of these stocks is far of being satisfactory. Overexploitation of stocks lead to socio economic crisis in some regions of the Caribbean (Memorando de Nicaragua 2005), motivated by the economic pressure on a fishery rather than on advice scientifically supported. Most spiny lobster harvested by the Caribbean countries is exported to the USA.

Fisheries of the Caribbean were evaluated from the biological and socio-economic viewpoints. This assessment allowed to evaluate the potential production of the whole stocks, and to provide a baseline for optimizing the fisheries.

METHODS

Catch of all 25 countries exploiting spiny lobster was examined by adding all the catch records contained in the FAO statistics. Population parameter values were taken from González-Cano (1991) and De León (2005). Equations for conversion as required were taken from the compilation by FAO (1998). Data were transformed into tail weights.

A great variety of fishing methods are in use, like traps, hookah, and free diving. Therefore, it is assumed that all fisheries were using the same method and referring the analysis to data of a bioeconomic assessment of a spiny lobster fishery of Chinchorro bank on the Caribbean coast of Mexico, transforming data of all the Caribbean spiny lobster fisheries into the same scheme of exploitation. In the Chinchorro Bank fishery the mean catch per fisher during a fishing season is 315 kg, and they sell their landed lobster tails to $27.8 USD per kg; there are 98 fishers getting an income of $4,000.00 USD per season.

The age-structured simulation model FISMO (Chávez 2005) was used; here the age of first capture was three and was maintained constant; this way the condition of the constrain imposed in recent years by the American government to the importation of lobster tails, fixed in 5 ounces as minimum, was fulfilled.

The exploitation rate E as F/(M+F)) was used as a criterion for the diagnosis of the fishery. The optimum E value at FMSY, was E = 0.28 and was used as a reference for diagnosis of the fishery; and was applied through the fifteen years of data. Other outputs are the number of fishers and the B/C ratio under F values used as fishing scenario.

RESULTS

Socio-economic Condition of the Caribbean Fisheries

Spiny lobster catch and estimations of the profits obtained by the main Caribbean lobster fisheries for the year 2004 are shown in Figure 1; in the year 2004 the Caribbean fisheries produced 37,632 tonnes of live weight, profiting $ 168.9 million USD.

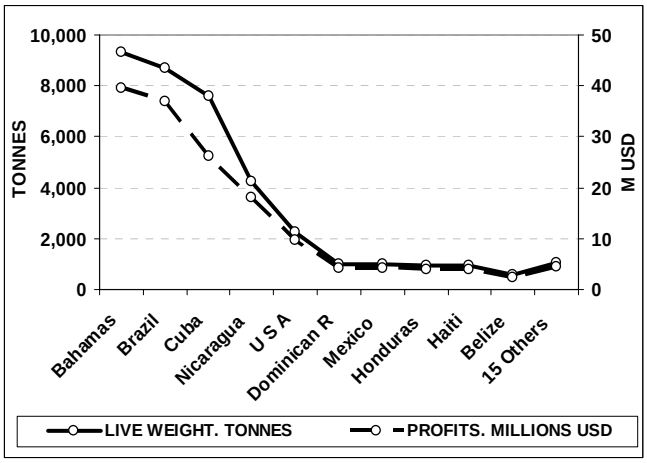

Figure 1. Relative contribution of the Caribbean countries exploiting spiny lobster. Catch is expressed as live weight (tonnes), and profits in Millions of USD.

Biological assessments were made previously (Chávez Unpubl.), such that they are the basis for the socio-economic descriptions made here. The model provides a stock response whose tendency depends on input values, as shown in Figure 2, where important biological, social and economic reference points of each fishery important for decision-making and useful for planning purposes are indicated. In that figure, the condition of the Caribbean fisheries is indicated on the catch line; here, the fisheries show a slight condition of over exploitation, with an F value higher than the one producing the maximum sustainable yield (F_{MSY}). The maximum social benefit this is, the number of jobs, is reached at the same F value as the one required for the F_{MSY}. By contrast, the maximum economic level, this is, the profits or maximum economic yield (MEY) is found at a lower F value than that required for the MSY. By observing the tendency of all these curves, it is evident that maximizing the economic benefit implies a significant reduction of the number of direct jobs, as compared to the current yield or the MSY levels, but a fishing strategy pursuing this target may produce significantly more economic benefits, more than twice the profits that other options could provide and may allow the possibility of producing marginal investments and creating jobs in other activities apart from the fishery.

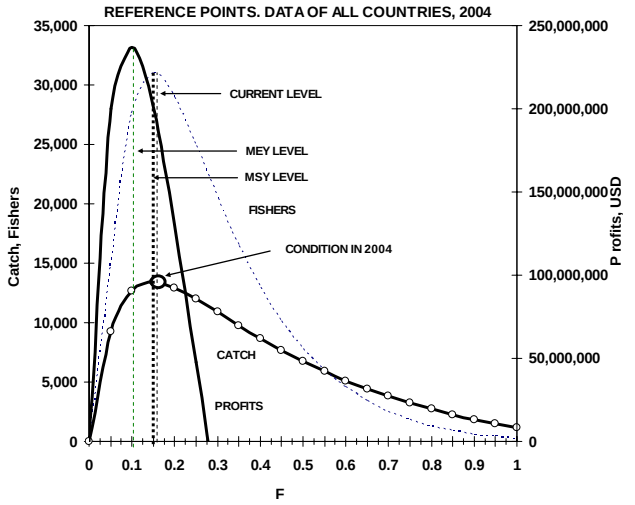

Figure 2. Biological and socio-economic reference points of the Caribbean lobster fisheries. Catch data for all the fisheries was used.

The socio-economic condition of the Caribbean lobster fisheries, Figure 3 shows the profits and the Benefit/Cost (B/C) ratio, one is the line describing the relative economic efficiency of the fishery observed each one of the years analyzed, and a horizontal dotted line indicates the economic equilibrium level, showing the limit of a profitable activity.

By examining the assessment, the evidence shows a condition of overexploitation for 13 out of the 15 years of data, with a harvest ranging around 13,000 tonnes of lobster tails. The socio-economic condition of these fisheries data suggest a very convenient picture, because the profits have been stable with slight decrease over time, with profits ranging from $140 to >$160 M USD and a rather constant economic efficiency, usually B/C > 1.75 (Figure 3).

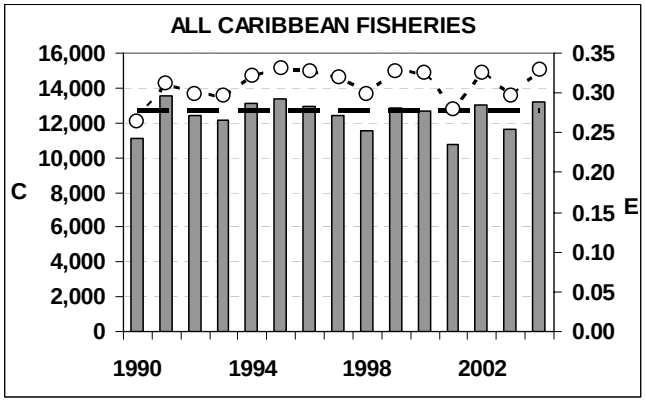

Figure 3. Tendencies of economic benefits (bars) and the Benefit/Cost ratio (dotted lines) of the spiny lobster Caribbean fisheries. Horizontal dotted line shows the B/C at the economic equilibrium level, such that values below this line indicate that the fishery would be not profitable.

DISCUSSION

A comprehensive assessment of the lobster fisheries of all the Caribbean countries, or a socio-economic analysis as presented in this paper has not been attempted before. Former research experience in the region is scarce; for instance, Barnutty-Navarro 2003, states that Nicaraguan stock is over exploited; in Belize, Carcamo (2003) mentioned that "the lobster fishery may be fully exploited"; in Brazil, Martins de Castro e Silva (2003), point out that there is an excess of exploitation, which is supported by the reported decline in landings (Gittens and Braynen 2003) showing significant increasing and decreasing (Martins de Castro e Silva *et al.* 2003). By contrast, Aguilar *et al.* (2003), state that yield in Mexico is much below the MSY. Puga and de León (2003), report a 44% reduction respecting to Cuban captures recorded in the middle eighties; more recently, Puga *et al.* (2005), recommend that the fishery should pursue the exploitation level at the maximum economic yield. At the southeastern USA, the fishery seems to be in a healthy condition, exploiting the stock slightly below the MSY (SEDAR 80).

This approach should be considered as a baseline and helpful for more accurate and updated evaluations. As it is advised in fisheries management, and with the possible exception of the option addressed to maximize the number of jobs, decisions on the convenience of adopting the economic efficiency or the economic benefit per fisher, have to rely on the fisheries authorities, who should know which are the most convenient policies to adopt in each case over time. The first step to be done is exploiting the stocks below the F_{MSY} in ; this is, exploiting the fisheries to make them sustainable; then maximizing the social benefit below the F_{MSY} level or at the F_{MEY} to maximize the profits and the economic efficiency would be the next step. By choosing the maximum social benefit at the F_{MSY} level has another major inconvenience, because its value corresponds to the threshold of overfishing and is very easy to surpass it, as occurred with many fisheries in recent times; for this reason it is not advised to be adopted as target for any fishery.

These results provide the basis for devising a management strategy, based on three possible targets; the first one is addressed towards an optimization of the social benefits, this is, the maximum number of fishers; the second one pursues the economic efficiency, based on maximizing the B/C ratio. The third target of the fisheries was finding the maximum economic benefit expressed as profits per fisher. These options were evaluated by comparing their values respecting to the current condition of the fisheries, this is, the state variables found in the year 2004; the other two were the economic efficiency as the B/C ratio, and the income, or profits per fisher. The first option corresponds to the current condition. The second management option was finding the F values corresponding to the $F_{MEY} = 0.1$. Finally, the third management option was the condition of catch, B/C, and profits per fisher at the F_{MSY} level, this is at the $F_{MSY} = 0.15$. Comparison of these management options was made such way that differences shown in graphic results were easy to perceive (Figures 4 A, B, C).

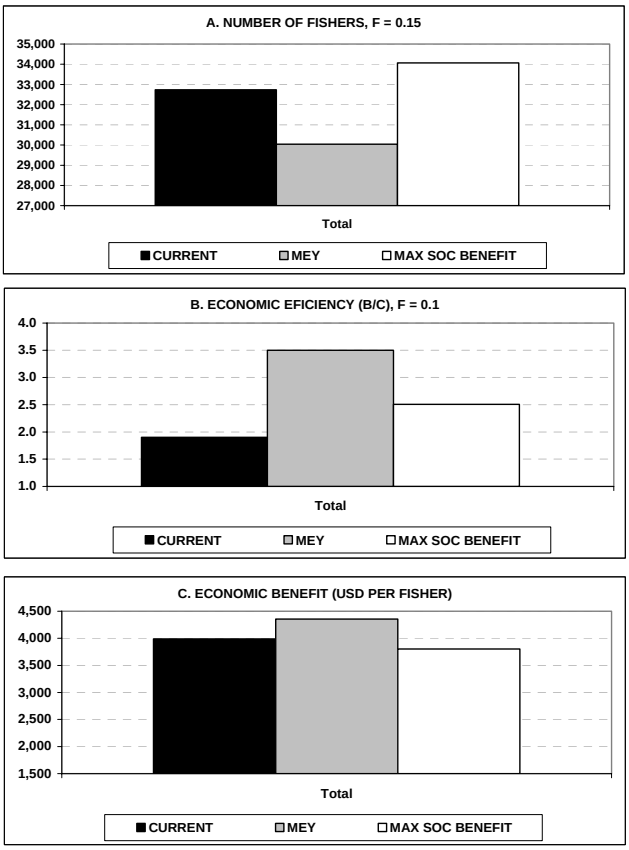

Figure 4. Options for management of the Caribbean spiny lobster fisheries by comparing three scenarios. Black bars show the current condition of the fisheries; the maximum social benefit at F_{MSY} is indicated with grey bars; white bars indicate the maximum economic benefit. **A.** Optimization of the maximum social benefit, as number of fishers. **B.** Optimization of the maximum economic efficiency, as the Benefit/Cost ratio (B/C). **C.** Optimization of the economic benefit as USD per fisher.

On examining Figure 4A, it is evident that the maximum social benefit is accomplished at the F_{MSY} level in all cases, which represents a better option than the current one where the fisheries are over exploited. This option has the inconvenience of being the threshold of overfishing and for this reason it is a risky option and not recommended.

The option pursuing maximum economic efficiency, another view of the economic benefit, is related to a perspective of the capital owner, where maximum benefits can be obtained under the criterion of maximum profits at the F_{MEY} level (Figure 4B).

The Maximum economic benefit per fisher is the most convenient management target from the viewpoint of the social benefit, because combines the economic efficiency

with the benefits addressed directly to the fishers and the sustainability of the fishery is ensured. Here, economic benefits at F_{MEY} are much higher than the two other options and for this reason it is very appealing (Figure 4 C).

Social and economical importance of the spiny lobster fisheries in the Caribbean justifies the creation of an institution devoted, as a main goal, to monitoring the state of stocks to provide advice to the fisheries industry for ensuring the optimum sustainable exploitation of lobster stocks.

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