Development and Management of Artisanal Fishery for Yellow Clam *Mesodesma mactroides* in Uruguay

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Introduction

Since 1974, when Uruguay's National Plan for Fisheries Development went into effect, the landings of traditional (mainly demersal species) by the commercial fleet have increased nearly tenfold. Also, various mechanisms have been put in place which aim at sound resources management.

The situation is different for the artisanal fisheries, presently open-access system, whose resource base has not been studied in depth, but whose catches, although small in absolute terms, turn out to be important when the employment and other social benefits they provide are taken into account.

The Uruguayan fisheries for the yellow clam *Mesodesma mactroides* (Deshayes 1854), conducted on 22 km of beaches between the resorts of La Coronilla and Barra de Chuy (Fig. 1) is a largely unmanaged artisanal fishery such as mentioned above. It differs from some similar fisheries, however, in that it has been studied, since 1983, by the Benthic Resources Department of Uruguay's National Institute of Fisheries (INAPE) with emphasis on the interactions between biological and socio-economic factors.

Description of the Fishery

Mesodesma mactroides is one of the main malacological resources of the Atlantic coast of South America. In Uruguay, it is second among exploited invertebrates, the first place in terms of catches being held by the mussel *Mytilus edulis platensis*.

The clams are gathered by means of simple implements such as shovels, put in bags and kept in nearby storehouses after they have been checked by the administrative officer of the regional Sub-prefecture in charge of weight and size control of the harvest. The region Sub-prefecture also grants transport permits which allow the fishermen or traders to carry the catch to the point of sale.

The clams are marketed either for bait or for human consumption, in which case the live clams are cleaned in tanks or basins filled with sea water and located close to the beach. The cleaned clams are then sold to restaurants along the coast during the tourist season. Some attempts have been made to export canned clam meat, but the lack of processing technology and of infrastructure have precluded

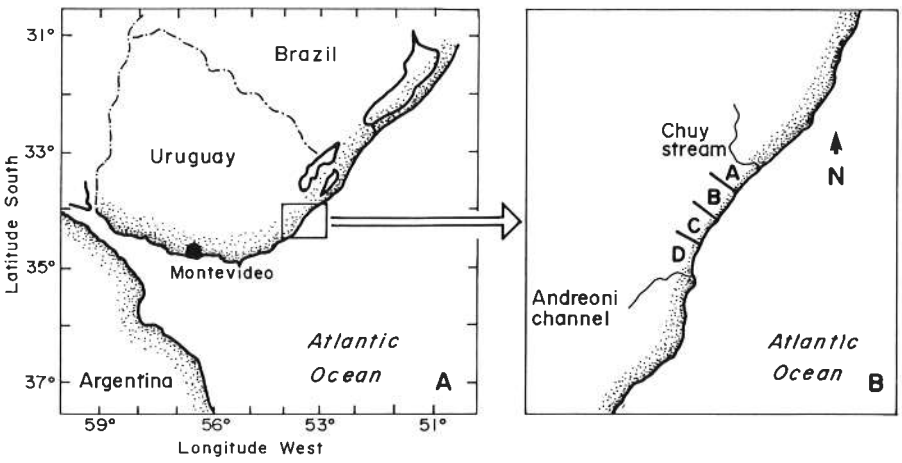

Fig. 1. Left: Uruguayan Coast, South-eastern South America. Right: 22 km stretch of coast supporting the yellow clam fishery discussed in the text.

successes, as has the fact that the entire production can be absorbed by the domestic market.

The fishery has a strong seasonal component. Catches and fishing effort increase between December and March (Fig. 2) as a result of a higher demand for the product for human consumption. Between April and November, there is a period of reduced fishing pressure and the catches diminish. This is due both to a decline in demand and to a reduced availability of the resource because of downward migration towards the infralittoral (Defeo et al. 1986).

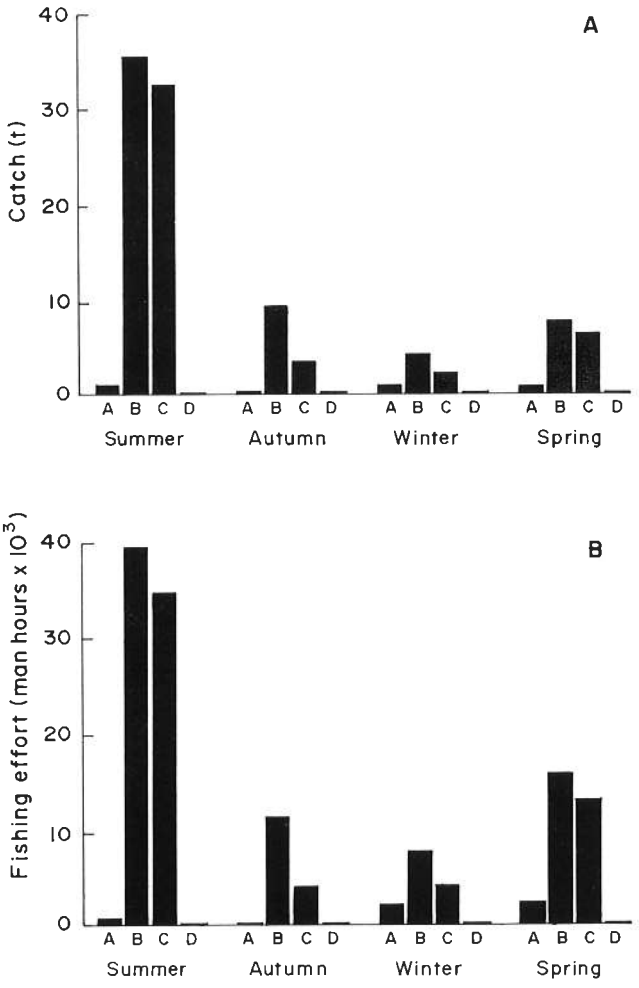

Fig. 2. Catch and effort data on the yellow clam fishery, by areas (A-D) and seasons, in 1986.
A. Catch; B. Effort.

Fishermen Characteristics

Given the marked seasonality of the demand for clams, there is an increase in the entry of temporary fishermen during the period of heavy harvesting. Seasonal fishermen, who may amount to 50% of the total workforce in the fishery, come from various coastal sites, some as far as 200 km from the fishing grounds. On the other hand, the "permanent fishermen" who reside in the area, often work in other coastal fisheries or harvest rice in nearby farms during the slack season.

Fishermen are usually freelance workers. Fluctuations in the demand for clams and the availability of some alternative employment in adjacent urban centers cause the fishermen settlements to be highly variable, both in size and structure. This instability, coupled with the lack of cooperative behaviour, led to the failure of previous attempts to create permanent fishermen associations.

Up to the middle 1980's, the monopoly for the transport and marketing of the clams was held by middlemen. The concentration of the demand in the hands of big traders gave rise to frequent conflicts in the fishery, resulting from unsuccessful attempts by the small producers to free themselves from the big ones. Since then, some measures (to be discussed further below) were implemented by INAPE which favored the small producers.

As for the clam fishermen, the instability and uncertainty associated with their activity account for their poverty, both absolute and when compared (as suggested by Panayotou 1983) with similar socio-economic groups including, in this case, rural workers and farmers.

Elements of Research

Up to 1983, the Uruguayan yellow clam was an "open-access common property," and only monthly catch data records and a directory of active fishermen were kept by INAPE. Biological studies and research on the general features of the fishery were initiated in 1983 by INAPE, in response to the large increase both of the catch and of the demand for fishing licenses.

For the purpose of recording spatial and temporal variations in the abundance of the resource and in the fishing effort exerted, the fishing ground was divided into four sections of similar size (A, B, C and D, see Fig. 1) with the boundaries set at right angles to the coastal line (Defeo et al. 1986).

The analysis of the fishery included the reproductive biology, ecology and population dynamics of the yellow clam as well as data on catches from the different sections of the beach. On the other hand, market price data were recorded for different product forms from fishermen, middlemen, traders, and consumers.

Management Strategies

Fishing effort and catch control

Open access

In open-access fisheries, the fishermen tend to expand fishing effort as long as there is any profit to be made. In the case under consideration, from 1983 onwards, there was, during the summer months, an uncontrolled entry of workers into the fishery which led to a significant increase in the catch (Fig. 3). The causes can be identified as the lack of alternative employment and enhanced demand for the clams, mainly during the summer months. This unstable situation resulted in the concentration of the product in the hands of a few middlemen with access to important assets (e.g., refrigerator trucks and cold storage rooms) to the detriment of small freelance producers, who were forced to sell their catch to the former at low prices.

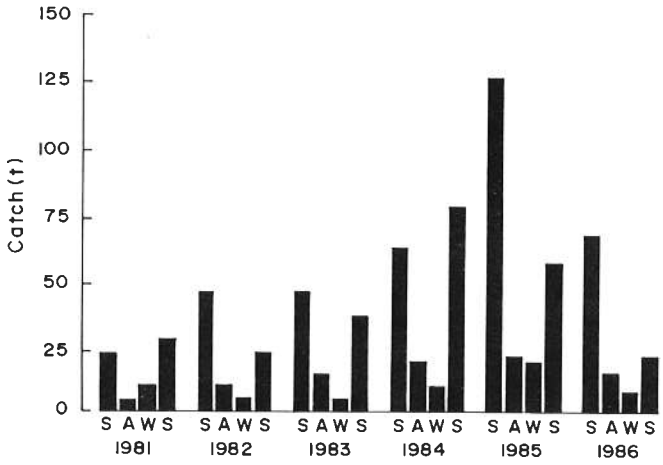

Fig. 3, Time series of yellow clam catches, by seasons, 1981 to 1986.

Overall catch quotas

The implementation of catch quotas by INAPE was a complete failure, for it gave rise to a phenomenon whereby the overall quota was reached in a very short time. This resulted in the deterioration of product quality due to the lack of appropriate cold-storage rooms to keep the clams in good condition. In addition, the quotas were to the advantage of the fishermen who owned infrastructure assets, since those who had no storage rooms or facilities were forced to sell their catches to the former at a low cost.

On the whole, catch quotas did not achieve their objective, as they did not bring about any increase of economic surpluses or a more even distribution of incomes. The only benefit recorded arose from some competition between large traders for the catches of small producers. However, a subsequent (informal) agreement between the former large traders gradually emerged which had the result that the fishermen were left in an unfavorable position, facing the free forces of supply and demand. Had the catch quotas continued to be in force, they would have probably caused the exit of many fishermen from the fishery.

Allocation of catch quotas by fishermen settlements

This measure implies assigning differential catch quotas to fishermen's settlements, as identified through catch statistics. Larger catch quotas are granted to those groups whose activity appeared as more permanent in the catch records and who reside in the region, the intention being to give them priority over fishermen coming from other regions during the period of higher demand for the product. Monthly total allowed catch is allocated proportionally to the settlements in accordance with the number of fishermen per settlement.

The opportunity was given, however, to transfer measure lies in the variations over time of the number and size of settlements, and thus partial quotas assigned can be under- or overestimated. Consequently, the enforcement of this measure calls for a dynamic process to monitor the evolution of the settlements.

The opportunity was given, however, to transfer quotas between settlements. The need to sell the quotas derived from reductions in the number of workers or the impossibility of the quota sellers to market their product.

The measure was successful with regard to its enforcement, for the assigned quotas were previously discussed during workshops with the fishermen. It appears that small producers benefited from this measure in that the assigned quota ensured the marketing of their catch. Moreover, the body in charge of controlling the catch per settlement (i.e., the Sub-prefecture) carried out this task efficiently.

Minimum catch volume per fisherman

This management measure which has not yet been implemented, can only be effective if accurate data from stock assessments as well as on the number of fishermen who participate in the fishery are available. Should a reduction of the fishing effort

appear necessary, catch per fisherman is considered to set the limit to the fishery. Priority is given to those fishermen with longer activity in the fishery.

As a rough estimate, and given the low incomes of the fishermen and the scarce labor opportunities in the area, net benefits equivalent to two times the national minimum wages seem to be a reasonable benchmark. Therefore, the number of fishermen who should participate in the fishery can be estimated as the ratio between the net value of the seasonal catch (quota) and two times the minimum wages.

Differential fishing quotas per season

Owing to the increase of fishing effort during the summer, together with a higher demand for the product and a greater availability of the resource, two seasons can be defined differently: a period of reduced fishing pressure, between April and November; and the harvesting season, from December to March. The management strategy in this case implies setting differential catch quotas according to demand. During the first stages, and due to the lack of time series and of an accurate measure of the size of the fishery, quotas were assigned by means of trial-and-error techniques. In the future, the continuing study of the resource will allow to set more accurate quotas, taking into account stock size estimates, number of fishermen per season, the national minimum wage and the amount of complementary employment in rural areas. Consequently, this strategy and the one mentioned above could be applied jointly for managing the fishery. Preliminary trials to apply this measure were successful, even though only stock size estimates and number of fishermen per season were considered when the settlement-specific quotas were assigned.

Spatial management and optimum rotation of areas

Given that the *M. mactroides* population is subject to spatial and temporal variations of its distribution and abundance (Fig. 4) and that fishing effort varies similarly, spatio-temporal factors are relevant to the management of the yellow clam fishery. The differences, abundance, catch and effort between areas in the amount of catch and fishing effort (Figs. 2 and 4), the marked seasonality of the fishery, and the greater availability and abundance of yellow clam in summer suggested that spatial management based upon an optimum rotation of fishing areas

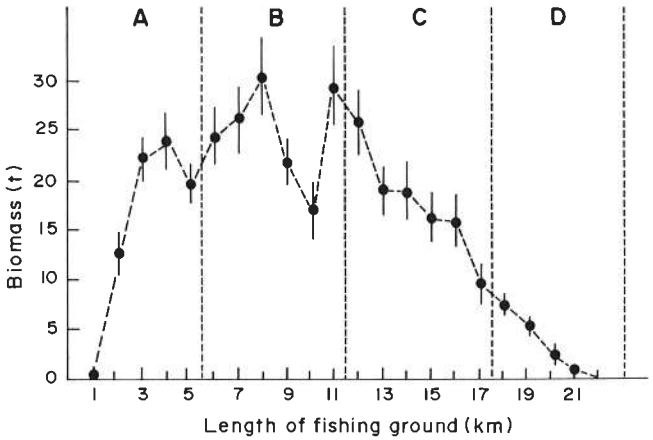

Fig. 4. Mean estimated biomass (± st. dev.) of yellow clams in 1984, in the 22 km stretch of coast along areas A-D.

could be a feasible option to manage the fishery. To this end, the fishing grounds were divided into subsections to be exploited as independent units. At the same time, the population was regarded as if consisting of discrete subpopulations even though it is continuous along the 22 km of beach considered here.

The technique of optimum rotation proposed also enables balancing socio-economic and biological factors, for it considers interactions between cycles of fishing activity, habitat quality and population structure during various periods, as well as market fluctuations particularly with respect to changes in the interest rate (Hall 1983).

Given this working scheme and taking into account the heterogenous conditions already described, sections A and D were selected as exploitation units for periods of low demand for clams (April to October). This would allow to preserve the richest sections (B and C) for periods of higher demand, of greater availability and consequently, of larger labor opportunities. This measure was welcomed by the fishermen.

Alternatively, the spatial-management scheme could be designed with regard to the spatial variation in the magnitude of recruitment so as to protect certain areas where and when recruits are dominant (Fig. 5).

Prospects

Frequently, because of easy access to the resource, co-existence of commercial and recreational fishing and lack of local centers for product processing and marketing, regulatory efforts turn out to be expensive and ineffective. Notwithstanding the abovementioned problems, in the case of the

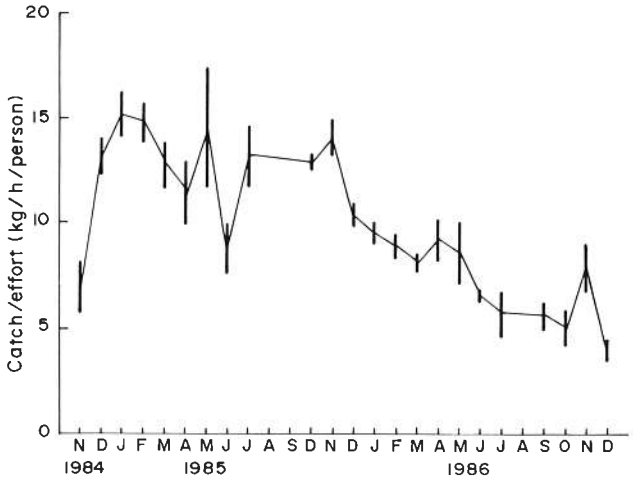

Fig. 5. Time series of catch/effort of yellow clam (± st. dev.) November 1984 and December 1986.

Uruguayan yellow clam fishery, the limited area along which the resource is distributed simplifies the identification and enforcement of low-cost management measures. This makes this fishery an attractive experimental unit to analyze the impact of different management schemes.

Without prejudice to the management issues discussed above, the increase in demand from the domestic and the potential of foreign markets make it necessary to initiate restocking experiments - either by "sowing" or colonization (*sensu* Castilla 1987) - in appropriate areas along the Uruguayan Atlantic coast. Indeed, spontaneous clam restocking activities carried out by fishermen in Uruguayan beaches have been successful.

The present state of the resource suggests that there is presently no need to improve the harvesting technology (Defeo, in press). On the other hand, improving the hygienic and sanitary conditions of post-harvest processing would result in greater value added, which would directly benefit the artisanal fishing community.

Bearing the above considerations in mind, improvements in clam processing and marketing techniques should be promoted both for the present fishery and for newly stocked area within the context of a policy aimed at the development of organized artisanal fishery community centers.

References

Castilla, J.C. 1987. La problemática de la repoblación de mariscos en Chile: diagnóstico, estrategias y ejemplos. Simposio "Presente y Futuro de la repoblación de recursos marinos en Chile", Ancud, Chile, 26-29 de Octubre, 1987. mimeo.

Defeo, O. Consideraciones sobre la ordenación de una pesqueria en pequeña escala. Biología Pesquera (Chile). in press.

Defeo, O., C. Layerle and A. Masello. 1986. Spatial and temporal structure of the yellow clam *Mesodesma mactroides* (Deshayes 1854) in Uruguay. Medio Ambiente (Chile) 8(1): 48-57.

Hall, M. 1983. A spatial approach to the population dynamics of the Manila clam (*Tapes philippianarum*). Ph.D. thesis, Univ. of Washington, U.S.A. 224 p.

Panayotou, T. 1983. Conceptos de la ordenación para las pequerias en pequeña escala: aspectos económicos y sociales. FAO, Documento Técnico de Pesca 228. 60 p.

Computer-Aided Approaches to Identification II. Numerical Taxonomy

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Introduction

This is the second in a series of three Fishbyte articles dealing with computer-based methods to facilitate identification of aquatic organisms. In the preceding article (Froese et al. 1989), IDEXSYS, an IDentification EXpert SYStem for fish larvae of the Northeast Atlantic. IDEXSYS was presented which relies on a text-based approach and which, apart from the fact that it is very comfortable to use and easy to update, functions as would a printed key.

Morphometric measurements in combination with discriminant analysis have been successfully used to identify and separate stocks (Ihssen et al. 1981; Meng and Stocker 1983; Misra and Ni 1983; Misra 1985; Maccrimmon and Claytor 1986; Reddin 1986). This led to the idea of using morphometric measurements and discriminant analysis to build a numerical identification key.