

## **Aquaculture, restocking and stock enhancement as an answer to the scallop fisheries management crisis in the areas of Brest and Saint-Brieuc (Brittany)**

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**Mots-clefs** : aquaculture, licence de pêche, coquille Saint-Jacques, repeuplement, surpeuplement.

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### **Abstract**

Since the beginning of the century, scallop fisheries in France have known successive phases of expansion and recession. Although a system of fishing licences has been implemented, the number of fishermen involved in the scallop fishery has increased and huge investments have been made. The important fishing effort during this period has induced a serious stock depletion, and output has dropped to less than 2 000 m.t. per year since 1986. Hence, the remunerations of capital and labour have dramatically decreased. As early as 1973, attempts have been made to use aquaculture methods for the management of this stock, following the successful Japanese model. Because of insufficient amounts of spat available from the wild, hatchery and nursery techniques have been improved to support restocking operations in the harbour of Brest, stock enhancement on delimited areas in St Brieuc Bay and aquaculture on specialized leases involving fishermen or oyster-farmers. It is interesting to compare the advantages and the costs of these different approaches in France and to assess the difficulties of scallop aquaculture implementation.

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### **Aquaculture, repeuplement et surpeuplement comme solution à la crise des pêcheries de coquilles Saint-Jacques dans les régions de Brest et de Saint-Brieuc**

#### **Résumé**

Depuis le début du siècle, les pêcheries de coquilles Saint-Jacques en France ont connu des phases successives d'expansion et de récession. Malgré la mise en place d'un système de licences de pêche, le nombre de pêcheurs pratiquant cette activité a augmenté et d'importants investissements ont été effectués. L'augmentation de l'effort de pêche au cours de cette période a entraîné une sérieuse chute des stocks, avec une production tombée à moins de 2 000 tonnes par an depuis 1986. En conséquence, les rémunérations du capital et du travail ont considérablement chuté. Dès 1973, des tentatives ont été faites pour utiliser les méthodes d'aquaculture pour la gestion de ces stocks, en suivant le modèle japonais. A cause de l'insuffisance du captage naturel, des techniques d'écloserie et de nurserie ont été mises au point comme support à des opérations de repeuplement en rade de Brest, de surpeuplement sur certaines zones de la baie de Saint-Brieuc et d'aquaculture sur des concessions spécialisées pour des pêcheurs et des ostréiculteurs. Il est intéressant de comparer les avantages et les coûts de ces différentes approches et d'évaluer les difficultés à mettre en place une aquaculture de coquilles Saint-Jacques.

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#### **Introduction**

IFREMER has been carrying out an important research program in scallop aquaculture in France since 1973. We can now say that scallop cultivation is technically feasible, but practical development is still in embryo. This paper will try to define a global approach to the scallop production chain, to show how scallop aquaculture can be integrated into this chain, despite certain constraints and limiting factors. This kind of analysis has to take into account not only

the technical and economic aspects of the production sector but also the historical, sociological and marketing aspects. Here we present the first results of an investigation which will continue in the future, in order to help scallop aquaculture develop at minimum public expense.

### **Characterization of the production sector**

The fleet operating in the St Brieuc region is a small-scale fleet (Berthou *et al.*, 1990) characterized by heterogeneity in the types of boat and fishing gear; polyvalency of the fishing units; multispecificity of the resources and flexibility of the exploitation strategies.

At any time, the fishermen are free to choose a particular fishing technique and to look for certain species in one area or another. The principal fishing gear is the scallop drag-net, followed by the bottom trawl within the twelve-mile limit, the clam drag-net and lobster traps. Scallop dredging represents about 20 to 25 % of the fishermen's activity in St Brieuc Bay, but it is seasonal, carried out mainly in winter and strictly regulated as will be shown below. Trawling competes with dredging by damaging the young scallops (by the mechanical action of the trawl) or by illegal catches. The bay provides a little less than half the French scallop production and has yielded between 2 000 and 3 000 m.t. per year in recent years. The species concerned is *Pecten maximus*.

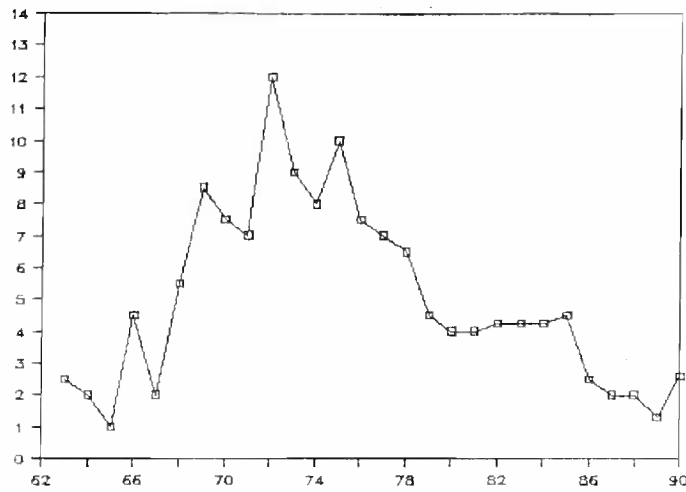
### **The history of scallop fisheries in Brittany**

#### *The evolution of the fleet and landings*

Like most scallop fisheries in the world, French fisheries of *Pecten maximus* have experienced successive phases of expansion and recession since the beginning of the century. Whereas the stocks disappeared in the Brest region in the late 1960s (after reaching a maximum of 20 000 m.t. in 1959), production in St Brieuc Bay increased until 1973, then slowed down, particularly after 1986 (Fig. 1). Nevertheless, 1990 was a little better and the two following years should be years of relative abundance. The annual value of the landings has followed the same pattern (Fig. 2), but the decrease was slightly less at the beginning of the 1980s, because the product reached higher prices. However, during the entire period under study, supply has had no direct effect on prices.

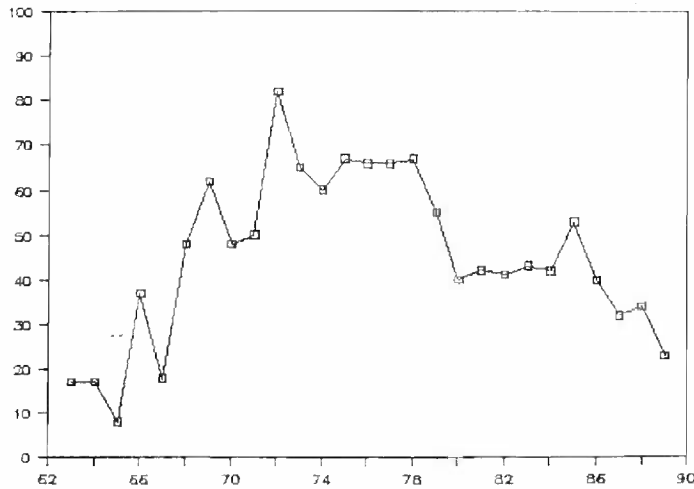
The total number of boats involved in this activity, coming from either St Brieuc Bay itself or elsewhere, increased until 1973 (Fig.3). During this early period, the average growth rate of the fleet was 20 % per year. The number of boats remained stable between 1973 and 1980, then began to decrease a few years after the decline in output, especially because of the departure of fishermen who came from elsewhere. From 1962 to 1973, the number of fishermen increased from 125 to 1000, the power of the boats from 25 hp to 100 hp, and the replacement value of the fleet from 10 to 175 MF (Meuriot *et al.*, 1987). With the reduction of the resources and the stable prices, landings per boat have decreased dramatically both in quantity (Fig. 4) and in value (Fig. 5).

Thanks to the flexibility of this multispecies-multigear fishery, most fishermen have concentrated their activity on other species and the importance of scallop dredging has been decreasing for several years, particularly since the serious depletion of the stock in the 1980s (Fig. 6). More recently, among the population of St Brieuc fishermen, scallop fishing activity



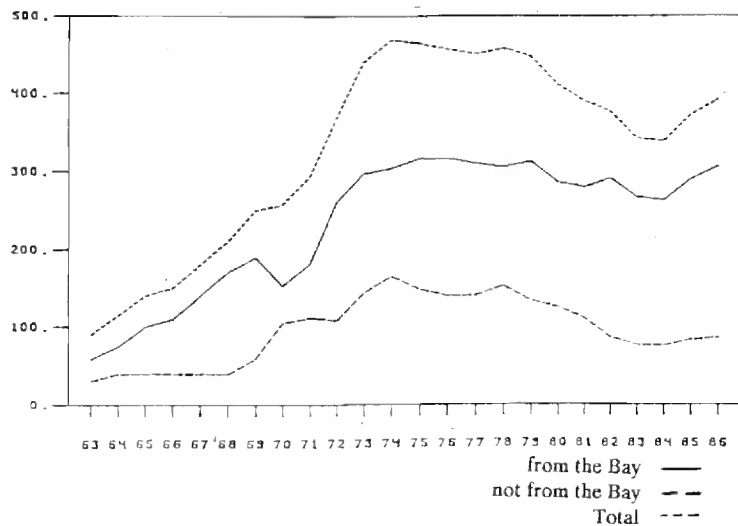
**Fig. 1** - Scallop (*Pecten maximus*) landings in St Brieuc Bay (1000 m.t.) (after Comité central des pêches maritimes).

-Quantité de coquilles St Jacques débarquées dans la baie de St Brieuc (en tonnes)- (Source : Comité central des pêches maritimes.)



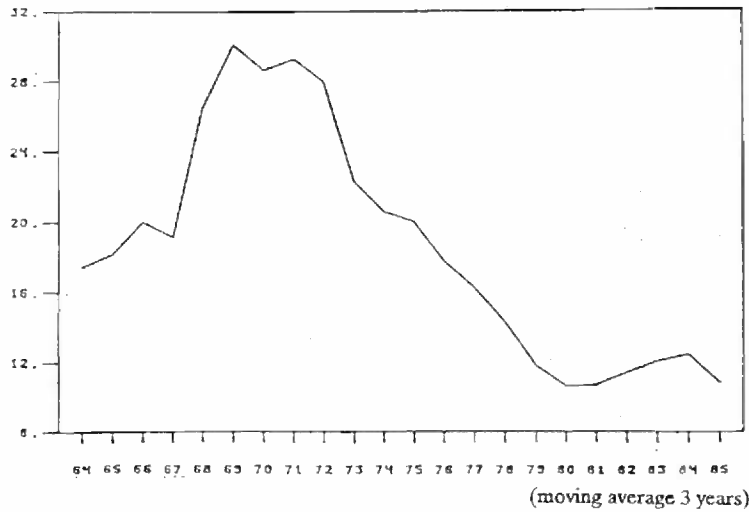
**Fig. 2** - Scallop (*Pecten maximus*) landings value in St Brieuc Bay (MF 89).

-Valeur des captures de coquilles Saint-Jacques (*Pecten maximus*) dans la baie de St Brieuc (MF 89). (Source : Comité central des pêches maritimes.)

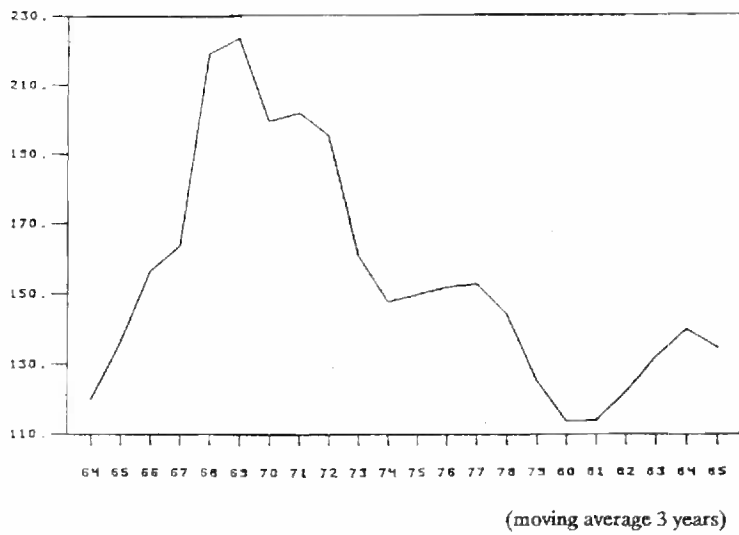


**Fig. 3** - Evolution of the number of boats (after Meuriot et al.)

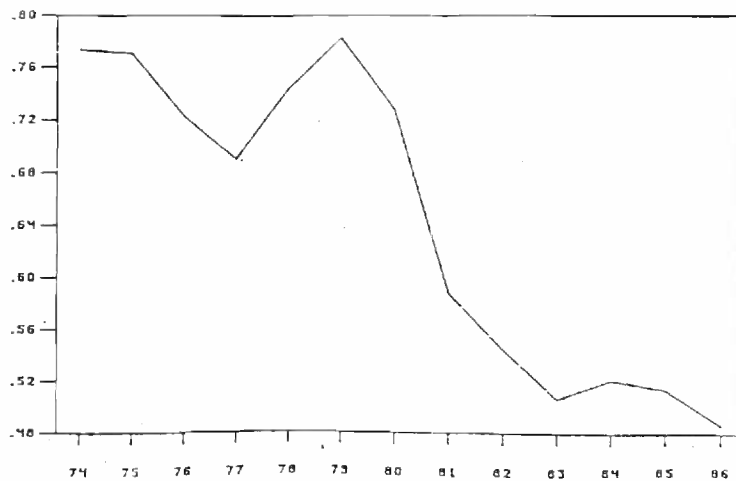
- Evolution du nombre des bateaux (d'après Meuriot et al.).



**Fig. 4** - Average landings per boat (m.t.) (after Meuriot *et al.*)  
- *Moyenne des captures par bateau (en tonnes) (d'après Meuriot et al.)*.



**Fig. 5** - Average landings value per boat (MF 87).  
- *Valeur moyenne des captures par bateau (MF 87) (after Meuriot et al.)*.



**Fig. 6** - Share of scallops in total landings value in St Brieuc Bay. (after Meuriot *et al.*).  
- *Part des coquilles Saint-Jacques dans la valeur totale des captures dans la baie de St Brieuc (d'après Meuriot et al.)*.

has been reduced by 16 % between 1986 and 1989 (Berthou *et al.*, 1990) while landings were down by 43 %.

*Scallop fisheries management : which measures have been taken and with what results ?*

As the resource is located within a well delimited area (St Brieuc Bay), it has been easy to define a management unit to which different regulatory measures can be applied. Until 1980, regulation sought to maintain the profitability of the activity (minimum efficiency criterion) and to keep fishermen from other locations from having access to the resources of the Bay (allocation criterion) by restricting the number of boats, the total investment and the fishing effort.

The first regulation affected the fishing time : every year, the number of months in the fishing season, the number of fishing days per week and the number of fishing hours per day are decided jointly by the administration and the profession. These numbers have been continually reduced (Fig. 7) which until 1973 made it possible to limit the global landings and to avoid lower prices, which was the aim at that time.

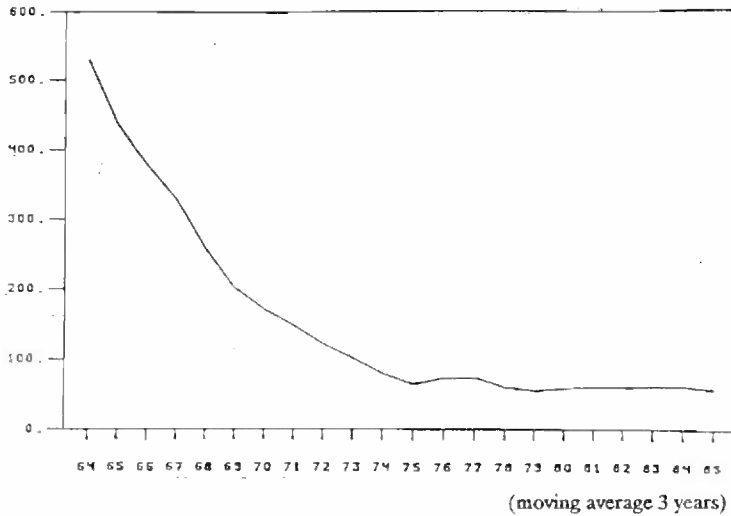
However, given a stable resource and no limit on fishing capacity, the main effect of this kind of measure was to induce the fishermen to maintain income by using more and more costly equipments during fewer and fewer fishing days. Huge investments have been made during the period of good catches and high earnings, because specific long-term loans were very attractive to fishermen (Fig. 8).

To try to restrict the number of boats, a system of fishing licences, attributed simultaneously to the boat and the captain, was introduced in St Brieuc Bay in 1973, but only for the scallop fishery. These licences have to be bought, and the money collected in this way is used by the local fishermen's organization for management and survey expenditures. This scheme has never been very constraining and the number of attributed licences has remained stable at about 400 (Meuriot *et al.*, 1987).

As for the restrictions concerning the technical characteristics of the boats, their aim was more the eviction of boats not belonging to the Bay than the limitation of the fishing capacity. Indeed, regulations imposed a maximum length of 16 metres, while the average boat measured only ten metres, and a maximum power of 400 hp, which was well above the average of 100 hp. Another reason for these flexible norms was to keep fishermen from becoming too specialized. Thus, in order to avoid some of the difficulties of the scallop fishery, several fishermen have been able to buy boats big enough for winter trawling, for instance.

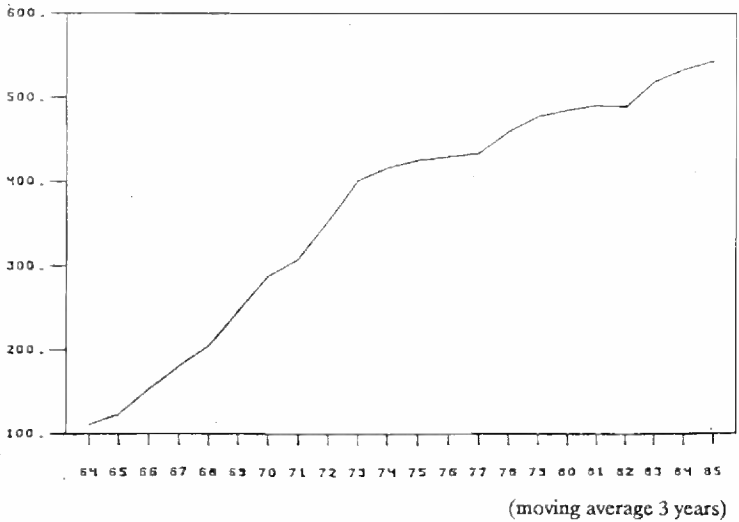
Although the licensing system kept the value of total output at a higher level until 1978-1979, the economic situation of the fishermen in St Brieuc Bay continued to decline even after the implementation of the licences. The falling return on capital investment can be illustrated by the decreasing ratio of the value of the landings to boat replacement value (Fig. 9). Even with the departure of some boats after 1981, this ratio remained very low, which indicates that only the old boats have been withdrawn. The labour costs has also decreased during the period but recovered after 1981, thanks to the departure of some boats (Fig. 10) (Meuriot *et al.*, 1987).

In fact, it is more the economic evolution of the fisheries than the regulation scheme which induced a reduction in the number of boats from 1979. After 1981, the decrease in the number of boats involved in this fishery has induced a recovery in the profitability of the activity. But it is mainly the possibility these fishermen have to carry on other kinds of fishing which has enabled them to improve their economic situation. The system of licences has not

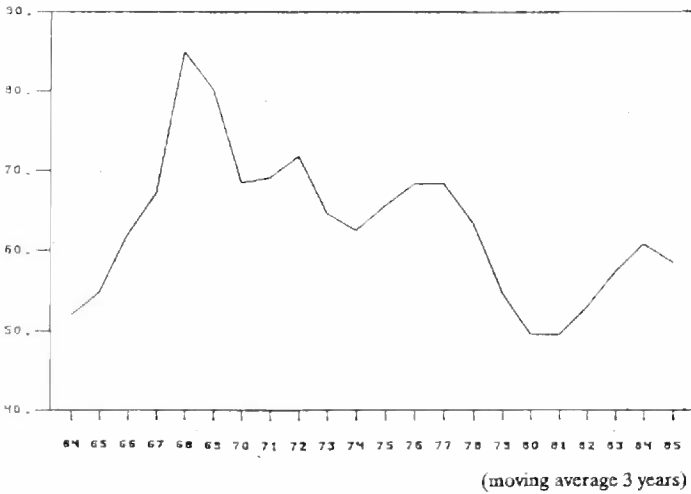


**Fig. 7** - Average yearly number of fishing days per boat (after Meuriot *et al.*).  
 - Moyenne annuelle des journées de pêche par bateau (d'après Meuriot *et al.*).

**Fig. 8** - Average boat replacement value (MF 87) (after Meuriot *et al.*).  
 - Valeur moyenne de remplacement des bateaux (MF 87) (d'après Meuriot *et al.*).



(moving average 3 years)



**Fig. 9** - Total scallop landings value versus fleet replacement value (after Meuriot *et al.*).  
 - Ratio de la valeur totale des captures de coquilles Saint-Jacques par rapport à la valeur de remplacement de la flotte (d'après Meuriot *et al.*).

(moving average 3 years)

played a role in the evolution of the global fishing effort and has not been able to adjust fishing capacity to the decrease in stock in St Brieuc Bay. Licences have only marginally reduced the entry of new fishermen.

In order to reduce the exploitation of the stock, some other measures have been adopted, but they have not prevented stock depletion : a global quota from 1978; a minimum size (10,2 cm); a new auction hall since 1977 and an immediate interruption of landings when the price is too low.

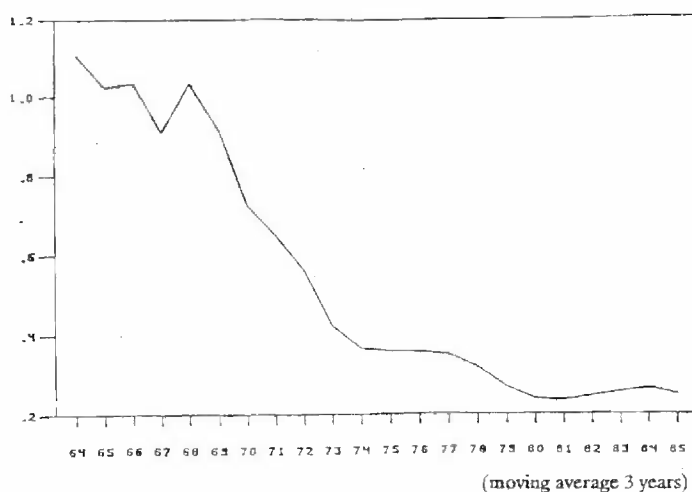


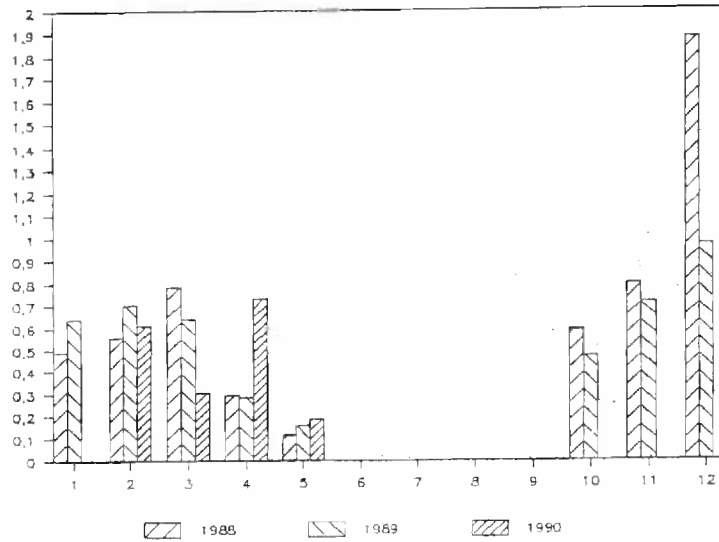
Fig. 10 - Average turnover per crew member (MF 87) (after Meuriot *et al.*).  
- Moyenne du chiffre d'affaires par membre d'équipage (MF 87) (d'après Meuriot *et al.*).

### Brief analysis of the French scallop market

First of all, the market for the scallops from French fisheries is characterized by distinct seasonality and by irregularity due to the regulation scheme and the fragility of the scallop in warm temperatures : there is no production at all from June through September and there is a peak in December due to traditional French consumer habits (Fig. 11).

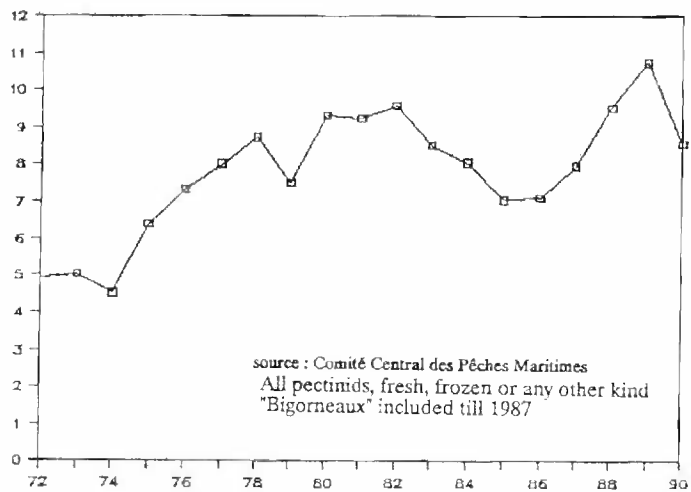
We do not however observe the usual rule of  $dQ/dP < 0$ . In May, for instance, the landings are very low and the prices too. On the other hand, both price and landings are high in December. In these conditions, we can reckon that supply is exogeneous, as a renewable resource, the catches being strictly regulated. The heavy restrictions on the number of fishing days have so disorganized the distribution channel that the market can now absorb only small quantities of scallops at any one time. Particularly at the beginning of the season, fishing often has to be interrupted when prices suddenly drop.

Among the bivalve molluscs, scallop has the particularity of being considered as an expensive, top quality sea-food in only a small number of countries which consume the bulk of the supply. France is one of these countries and individual consumption there reaches 150 g per year. Given the decrease in the domestic supply, there has been a regular increase in imports (Fig. 12), especially of frozen or shelled fresh meat from many countries (United Kingdom, Norway, New Zealand, Japan, Chile). The decrease in imports in 1990 is due to sanitary problems (PSP) concerning some imports from Japan. We can observe also a certain seasonality in the imports, with a maximum at the end of the year and a low consumption in January but there is no noticeable reduction in summer (Fig. 13).

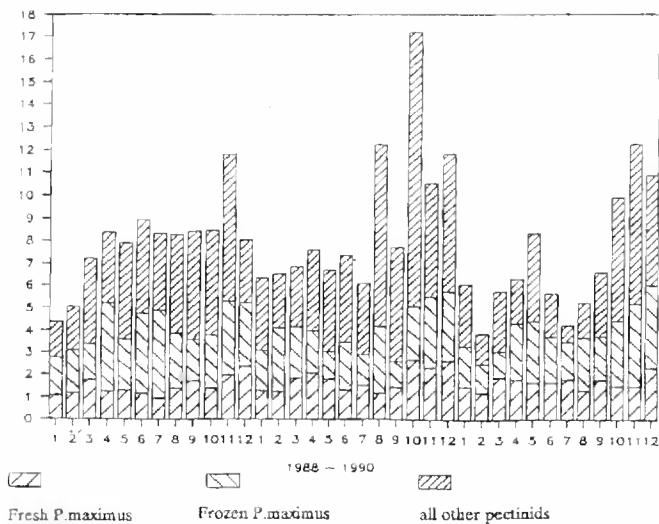


**Fig. 11** - Monthly French production of *Pecten maximus* (1000 m.t.). (From the Comité central des pêches maritimes.)  
 - Production mensuelle de *Pecten maximus* (en tonnes). (Source : Comité central des pêches maritimes.)

**Fig. 12** - Evolution of French scallop imports : meat weight (1000 m.t.). (From the Comité central des pêches maritimes.)  
 - Evolution des importations françaises de coquilles Saint-Jacques (1000 tonnes de chair).



source : Comité Central des Pêches Maritimes  
 All pectinids, fresh, frozen or any other kind  
 "Bigorneaux" included till 1987



**Fig. 13** - Monthly imports of scallops including all pectinid species (100 m.t.). (from the Service des Douanes.)  
 - Importations mensuelles de coquilles Saint-Jacques, incluant tous les pectinidés.



production	with shell		meat weight	
	6 000 m.t.	24 F/kg(1)	800 m.t.	185 F/kg
imports	65 000 m.t.	8 F/kg	8 000 m.t.	55 F/kg
exports	14 000 m.t.	(2)	1 800 m.t.	(2)

**Table 1** - French scallop market. (1) Average price : -30 F/kg for scallop with roe from Brest Bay; 18 F/kg for scallop without roe. (2) Unreliable data. (Data from the "Service statistique des douanes".)

- *Le marché français de la coquille Saint-Jacques. (1) Prix moyen : 30 F/kg pour les coquilles Saint-Jacques avec laitance, venant de la baie de Brest; 18 F/kg pour les coquilles Saint-Jacques sans laitance. (2) Données non fiables.*

The French market is influenced a great deal by international trade and can be considered as the hub for Southern Europe : part of the imports are re-exported to Spain or Italy (Table 1).

These figures are very difficult to read because the aggregate data do not distinguish clearly between species (*Pecten*, *Chlamys*, *Patinopecten*...) nor between meat with or without shell (depending on the origin). Furthermore, the price comparison between the French product and imports must take into account all the import expenses (taxes, transaction costs) and the differences in quality (degree of humidity, freshness) within the different origins.

Half the French production is consumed locally, and half goes to the national market in Paris. Only 2% of the production is processed, the bulk is sold fresh in the shell. Half of the production is sold through supermarkets, the other half by direct sale or wholesalers in the same proportion. About one third of the imports is for the processing industry.

### Aquaculture opportunities

Since their return from a study trip to Japan in 1973, where they discovered the successful results of scallop (*Patinopecten yessoensis*) aquaculture and fisheries management, French researchers from IFREMER (known as CNEXO until 1984) have tried to adapt these techniques to *Pecten maximus*. But it turned out to be impossible to rely on spat collecting from the wild, because the yield was too low and irregular (Dao 1986). However, all the work focused on natural reproduction has made it possible to enhance our knowledge of scallop population dynamics, to obtain indications on stock evolution and to help the management of the fishery through the implementation of an annual total quota in 1978 (Dao 1985).

Attempts to rear scallops in lantern-nets on long-lines have also been very disappointing and have been abandoned. Sea-bed sowing, in contrast, has been more successful and has contributed to the improvement of hatchery techniques and intermediate culture in bags, in order to produce 30 mm sized young scallops for sowing (CEREOPA, 1987).

### Aquaculture as a basis for restocking

The first way in which aquaculture methods were used in scallop fishery management was in the restocking of Brest Bay. The aim was the reconstitution of a depleted stock by sowing 1 to 2 million spats every year until a biomass of 500 m.t. adult animals was reached (Buestel *et al.*, 1987). Such a broodstock should have been able to sustain spat collecting, but this has not yet happened, even though the biomass is already more than 400 m.t. Indeed, the results of a national research program into recruitment determinism, carried out by IFREMER and universities, demonstrate that the biological phenomena determining the natural renewal of

the scallop resource are numerous and complex : 80 % of the recruitment variance is explained by weather conditions (temperature) during the maturation phase and just before spawning, while the role of the broodstock size is marginal (IFREMER, 1991).

### **Stock enhancement**

In the case of St Brieuc Bay where a scallop bed still exists, young scallops produced by aquaculture could be sown in some areas in order to increase the stock and hence the catches. The principal problems arising in the development of such a program are to know how to assess each fisherman's participation in the collective investment (hatchery, intermediate culture) and how to share out among fishermen the extra resource generated (Bailly, 1990). Stock enhancement has not yet proved profitable for this fishery without high public expenditure, mostly because of the difficulty of implementing a common management in the St Brieuc fishing community.

### **Scallop culture**

Although scallop culture is technically feasible, its development has to face many constraints due to the economic environment. Once the technical problems of hatchery have been solved, the first constraint in the rearing of scallops is the availability of sites. Indeed, sea-bed sowing requires specific areas chosen for depth, nature of the substrata and shelter from storms, and most often the attribution of leases for aquaculture has to be done at the expense of fishing spaces. For this reason, the profitability of scallop culture should be demonstrated in order to incite fishermen to invest in a hatchery and in specific equipment for aquaculture rather than in other fisheries. This is why it is important to have, on the one hand, a good knowledge of the current economic situation of the fishermen and, on the other hand, an appraisal of the profitability of the activity, in order to attract private and public investment as well as loans and grants. Additional aspects of common resource management have to be taken into account, like the need to buoy the culture areas and to take protective measures against theft, trawling or illegal dredging.

Other actors have expressed their interest in scallop culture : the French oyster farmers in Brittany who used to practice *Ostrea edulis* sea-bed sowing are looking for ways to diversify their activity, until now limited to *Ostrea gigas* which is difficult to market in France. They are all the more inclined to try mixed cultures of *Ostrea edulis* and *Pecten maximus* on part of their deep sea leases, as they already have the required boats and equipment at their disposal. As for the spat supply, it could be provided by the private mollusc hatcheries, operating in France at a fraction of their capacity because of the difficulties in the clam industry. In this case, too, an economic study is necessary to evaluate the opportunity cost of this new species both for oyster farmers and mollusc hatcheries. Conditions for a good transfer of technology and of technical assistance have to be planned.

Altogether, however scallop culture is carried out, there will be the problem of commercial outlets. Until now, the first aquaculture products have been sold through the fishery distribution chain at a good price (30 F/kg). But without a consolidation of this chain and without a strong marketing operation to promote and differentiate the species *Pecten maximus*, it will certainly be difficult to compete with imports. In the case of the development of the production by oyster farmers, the risks of competition with the traditional scallop fisheries also have to be evaluated.

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