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Problems and perspectives of the pearl oyster aquaculture in French Polynesia

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Abstract — *The first attempt to obtain artificial pearls from the black-lip pearl oyster *Pinctada margaritifera* in French Polynesia dates back 1963. The pearl oyster culture has grown quickly especially since the eighties. This industry is now the first exportation in value of French Polynesia. 19 atolls of the Tuamotu islands have at this time one or more farms and this activity become more and more attractiveness. The rise of this industry has consequently a lot of socio-economical repercussions on these atolls. However, as a young industry, the technics and the development are not always controlled and a lot of problems appeared these last years :*

- + *overfishing and depletion of broodstocks in some lagoons,*
- + *mass mortalities of cultured oysters,*
- + *large occupation of the lagoons by long lines and galvanised structures,*
- ...

It is now time for the management of the resource and the environment. Actually, some measures have been applied :

- + *the development of spat collection technics,*
- + *the control of the farms,*
- + *the estimation of the natural stocks in some exploited lagoons,*
- + *experiments on the artificial reproduction and culture of spat in hatchery.*

As the management of the lagoons might be very complex, a multidisciplinary research program will started next year to provide datas on the diseases and the impact of the pearl oyster culture on the ecosystem.

INTRODUCTION

Unlike most of the aquaculture production concerning the Pacific region, the Pearl oyster culture distinguishes itself by the magic of the final product, the pearl.

Dressed up in so many and marvelous term for centuries, the mystery and charm which exist around pearls have contributed, to some degree, to the development of this activity.

But it is mainly the high value of these uncommon black pearls that lead so many Polynesians to work on this field as the present situation might be compared with a kind of « gold rush ».

However, despite and because of the rise of this aquaculture in so few years, some problems appeared recently and we have to be extremely careful for the future.

A BRIEF HISTORICAL REVIEW

In French Polynesia, the fishing and use of mother of pearl as an ornament was a traditional activity which was followed by the commercial fishing and diving of shells for ornaments, studs and natural pearls. (Reed, 1973). Nevertheless, this fishery was very fluctuating and, with the exhaustion of some lagoons and the massive use of plastics, has resulted in the decline of this industry in the fifties/sixties (Intes, 1984).

It is approximately at the same time, under the incitement of the local Fishery Service, that some attempt were done to graft black-lip pearl oysters by Japanese technicians, according to their techniques in Japan.

Despite the harvest of some beautiful black pearls, it was necessary to wait 10 years before some private companies tried again to obtain round pearls in order to complete the production of half pearl, the so-called « mabe », for which the commercial market was increasing rapidly. During all those years, the first pearls produced were not sold for a long time and consequently slowed down the attractiveness of this new activity, and, above all, it seems that no Polynesian was able to master the grafting technique.

In the seventies, from a few pioneer farms, the situation has quickly evolved. Japanese technicians have decided to try the experience with some privates and the Fishery Service. They took a great part in the establishment and improvement of the first techniques to culture and graft black-lip in the lagoons of the Tuamotu atolls.

Because of the marketable value of the produced pearls, the local government has simultaneously encouraged the creation of Cooperatives in the Tuamotu islands where the broodstock was still important.

THE PEARL OYSTER CULTURE IN FRENCH POLYNESIA

Oyster supply

The supply of oysters for the graft operation has evolved in the past few years. Originally, all the oysters were fished by diving. They were usually big and old shells but, as some lagoons were exhausted (Intes and Coeroli, 1985), the lack of oysters came a great problem for the growing farms.

Although experiments to collect pearl oyster spat have been done in many countries for a long time (Cabral *et al.*, 1985; Victor and *al.*, 1987), the improvement and success of the spat collection techniques in some lagoons by EVAAM have been realized since 1977 (Coeroli *et al.*, 1984). The collectors, attached on long lines immersed at 3 metres depth, were first made of natural bushes or coconut train but now almost everybody use artificial polypropylene ribbons. Of course, the results differ greatly between islands and over the years however several millions of spats are collected every year. The main problem is the high mortality among the young oysters less than six months old.

To protect the broodstocks, the fishing of shells is now forbidden except in some cases; so the fishery is strictly controlled. Now the majority of grafted shells come from spat collection as they are also preferred by the farmers because the shells are younger and seem to produce more beautiful pearls.

Rearing techniques

The culture areas are only in the lagoons, never offshore, often near the villages. Scuba diving is necessary to build the growing structures, the spat collectors stations or check the oysters as most of the farms have underwater structures, between 3 and 15 metres.

The young shells often grow directly on the spat collectors. Some harvest them when they are 6-8 months old. There are several hanging methods, similar to those used in Japan (Kafuku and Ikenoue, 1983) : the pocket baskets, the boxes made of plastic or wood, the lantern baskets and the ear hang method. Galvanized rafts and long lines are mostly used as hanging structures.

At the opposite of Japanese and Indian techniques, (Cahn, 1949; Chellam *et al.*, 1987), surface rafts are rarely used, only in shallow water or to prepare the shells before the operation near the graftlab.

Graft operation and harvest

Two to three years are needed to have ready-to-graft oysters. The grafting technique is always monopolized in great part by Japanese technicians but a few locals have good results too, since a few years. However, because of the characteristic of the black-lip pearl oyster, experiments are done to improve the pearl quality (Coeroli and Mizuno, 1985).

Usually, the number of pearls produced is between 20 and 30 % of operated oysters but many factors might influence these results such as the experience of the graft technician, the health condition of the oysters but also the type of nucleus, the part of the mantle introduced with the nucleus and the high mortalities in some lagoons.

Less than two years are necessary to obtain a good size pearl and sufficient mother of pearl layer around the nucleus. The harvested shells are usually killed to take the pearl out of the gonad, but since a few years,

the best shells are kept alive for a new operation, a few months after the harvest.

THE ACTUAL SITUATION

Over 15 years, the rise of this activity has been exceptional for the local economy (Coeroli, 1983). From 1975 to 1987, the number of cooperatives has grown from 7 to 103 and, in 1985, a new type of company was created called « family company ». They were constituted by a few members of the same family and due to their flexibility, these companies have had immediate great success and their numbers have risen immediately (Fig. 1).

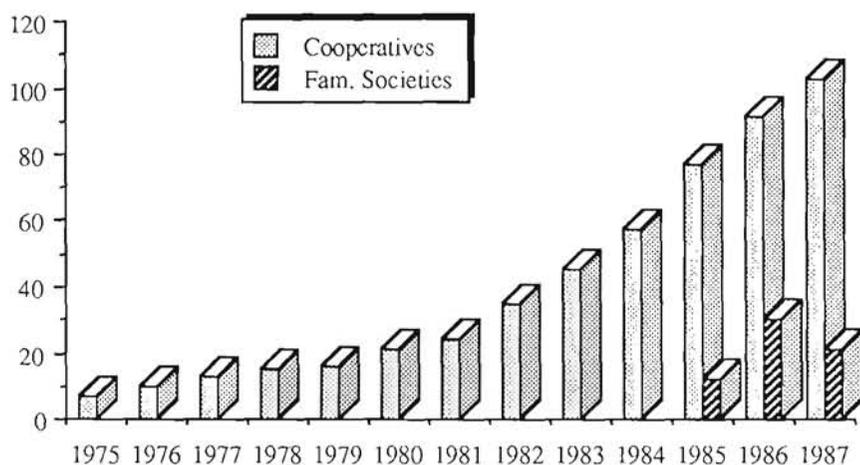


Fig. 1. — Evolution of Cooperatives and family societies (1975-1987).

All these companies are managed by the G.I.E. *Poe Rava Nui* which is an organization that takes care, with the help of EVAAM of their loans, contacts and chooses the graft technicians, harvests and expertises their pearls and organizes the sales of the pearls and shells.

The number of private companies has also quickly grown to 24 big farms and numerous small scale enterprises. They sell their product directly in Tahiti or export it. Some of them run also a local jeweller in Tahiti. The size of the farms varies from 5 000 cultured oysters to nearly one million oysters composed of juveniles and grafted oysters.

The number of atolls exploited is growing every year. Today, more than 37 atolls have a pearl oyster culture activity, eg. spat collection, rearing of juveniles or grafted oysters. 25 atolls dispersed in all the Tuamotu. For their produce pearls, they are chosen natural broodstocks available, communication with Tahiti and above all, local inhabitants who are the first concerned and able to manage this activity so far from any urban center.

The success of the pearl oyster culture in the Tuamotu with its consequences, large income, new jobs and a pause in the rural depopulation lead other archipelagos of French Polynesia and particularly the Society islands (Tahaa, Bora Bora, Huahine...) to try the experience too. The lack of numerous oysters in these islands however slowed down these projects.

Presently, the number of pearl oysters licences is very important (table 1), and each year, several licence requests are rejected in the areas where they are already too numerous. In fact, even if these licences are controlled and compulsory to establish a culture ground, there are also numerous of unknown or under-estimated farms, so it is quite difficult to appreciate exactly the number of farms and their importance in all these isolated atolls.

Tab. 1. -- Distribution of Pearl oyster licences in the Tuamotu in 1989.

Authorized Licences for 1988 in 28 Islands		
SPAT COLLECTIONS 105	JUVENILES 90	GRAFTED OYSTERS 35

THE ECONOMICAL CONSEQUENCES

For these last years, the pearls have become the first exportation in value in French Polynesia, well over the coprah. The main part is due to the private farms and particularly one or two of them. The part of the cooperatives varies between 10 to 20 %.

Tab. 2. -- Export statistics and mean price of the black pearls in French Polynesia.

Years	Exported value Pacific Francs × 1 000	Mean price of black pearls Pacific Francs
1972	300	214
1973	2 000	2 517
1974	13 400	3 454
1975	8 900	569
1976	14 700	2 413
1977	18 200	2 975
1978	128 700	2 575
1979	158 100	1 836
1980	101 800	1 836
1981	404 800	4 678
1982	98 700	3 055
1983	711 700	5 088
1984	441 300	3 933
1985	1 392 500	6 744
1986	997 800	9 584
1987	2 251 500	5 523
1988	2 514 000	5 901

For 1988, the export value was 25 million U.S. \$. This is mainly the result of the increase of the production, as the mean price of the pearl has greatly fluctuated over the years (Table 2).

All these results have involved a lot of socio-economic changes in these isolated islands. The main consequence is the return of local people to their islands and the development of a new micro-economy with sometimes good standard of living. About 3000 people work directly in the pearl oyster industry in the Tuamotu atolls.

Of course, even if the Pearl oyster culture seems in good health, there are some problems occurring in many fields of this industry. The present results do not have to hide that. For the cooperatives for example, according to the number of operated oysters each year, the results might be about twice the actual production (Table 3).

Tab. 3. — Production results of the cooperatives.

Years	Grafted Oysters	Harvested Oysters
1979	48 118	—
1980	59 920	—
1981	97 787	33 012
1982	97 211	36 034
1983	116 837	67 356
1984	156 208	64 809
1985	186 357	76 603
1986	156 982	72 052
1987	—	63 998
1988	—	61 341

THE MAIN PROBLEMS

— The mass mortalities which appeared in 1985

In some lagoons, 50 to 80 % of cultured oysters died and no explanation was found. Grafted oysters as spats and juveniles have been attacked.

The general symptoms of the disease seemed quite similar in many islands with mantle lesions, absence of growth and hypersecretion of mucus. None infectious pathogens were observed on the diseased oysters but more studies are necessary before any conclusion today.

Today, the mortality is ever high in some islands, particularly on the grafted oysters, and this situation really compromises the future of many farms.

The overdensity of cultured shells and some inadequate culture techniques might be greatly involved in the mortalities. In this way, much stress occurs during the four or five years of cultivation such as bad rearing techniques, repeated washing of shells against high biofouling, as grafting operation.

— The oyster supply

In some lagoons, the spat collection is not sufficient to supply ready-to-graft oysters, and farms in these areas need oysters from other islands. But, to avoid any propagation of an enigmatic infectious agent, transfers of oysters were forbidden in all the lagoons, since early as 1985. The main consequence was a lack of ready-to-graft oysters these last years and a tendency to fish natural stocks. In 1988, numerous of transfers were authorized as the mortalities seemed less important. However we have to be extremely careful about these practises as most of the time, there is no selection on the transferred oysters.

— The large occupation of lagoons

There are farms which often use much more area than allowed by their licenses. In some lagoons, there are sometimes too many farms with extensive cultured areas. Small houses built on the lagoons, primarily as graft labs but often used as domestic houses also contribute to water pollution around the cultured areas.

Presently, the rules to define the cultivation areas are not restrictive enough, and very often, the situation is very confused. With the development of tourism, it will soon be necessary to plan the distribution of cultured areas in order to protect both activities.

— The lack of knowledge on basic biology of *Pinctada margaritifera*

To master the farming of such a species, we need a lot of information on several parts of its biology. However, except old works (Seurat, 1904; Ranson, 1952 and 1955), studies on the biology of *Pinctada margaritifera* in French Polynesia focus only on some aspects of the natural stocks (Intes, 1982; Intes et al., 1986) and on the genetics of this species (Blanc, 1983; Blanc et al., 1985). Elsewhere, studies have been made on the reproduction of this species in Australia (Tranter, 1958) but these data cannot be easily reliable to the particular Polynesian lagoonal ecosystem.

— The organization of the farms, especially the cooperatives

These companies are greatly helped every year by interesting loans but only a few of them have good results. It seems that these loans are more or less like subsidies for some of them and this situation does not encourage these farms to be competitive.

— The monopoly of Japanese graft technicians

The dependency over Japanese technicians for most of the farms contributes to rise the cost of the operation. Today, the grafting is the most expensive cost for the farms, and only enough competent local technicians would change this situation.

— The market, still very restricted

The monopoly of Japanese jeweller's in the black-lip pearl oyster market has to be broken to avoid great surprise in the future. Today, more than 60 % of the market is under their control with consequences on the prices. As a matter of fact, the development of the black pearl market supposes an international audience for this high price product (Table 4).

Tab. 4. — % of Black Pearl export in value by countries.

Countries	% exported Pearls in value
W. GERMANY	0,6
N. CALEDONIA	0,3
AUSTRALIA	0,1
SPAIN	0,01
FRANCE	0,8
HONG KONG	1,2
SWITZERLAND	7,0
U.S.A.	20,0
JAPAN	69,2

THE FUTURE

In this near future, it seems very important to develop the following points :

- to improve the general cultivation techniques and discover the reasons of the high mortalities,
- to improve the control of the farms to avoid heavy problems in and with the ecosystem,
- to improve our knowledges on the relationship between cultivation grounds and evolution of the environment of the lagoons, and consequently to improve our knowledge on the general biology of this species,
- to manage the stocks by the limitation of broodstock harvest, by the improvement of spat collectors and artificial breeding techniques in hatchery to restock exhausted lagoons,
- to develop the Pearl oyster culture in other sites, other lagoons but respect the other activities like fishing and tourism,
- to improve the quality of pearls instead of the quantity,
- to develop the market in countries other than Japan and U.S., to promote the product and maintain actual prices.

Some of these points are already implemented :

- artificial breeding experiments have been done by EVAAM in the atoll of Rangiroa where a hatchery was built two years ago; for

the moment, the larvae culture is not really mastered but some spat have been obtained; the production of artificially produced spat to restock some exhausted lagoons is hoped for the next years.

- a pearl oyster culture school will open soon in the atoll of Rangiroa; this will allow young Polynesians to learn many aspects of the culture techniques, as spat collection and graft operation, but also the management of the farms and the commercial aspect of this industry.
- recent efforts for the promotion of black pearls all over the world and the creation of a technical international laboratory to expertise the black pearls might contribute to the development of an international market.

Other points need to start quickly such as a research programme on the mortalities, the biology of the oysters and better understanding of the relationship between pearl oyster culture grounds and lagoons.

CONCLUSION

Pearl oyster culture has risen very quickly and sometimes with anarchical tendency in French Polynesia. It was a gold mine due to the quite simple techniques : everything was happening in the natural conditions, the oysters seemed to be numerous and to support the cultivation techniques.

With the multiplication of farms, of cultured areas, of high mortalities and the problems of pearl quality, the pearl oyster culture enters a second phase.

Now is the time to manage the activity if we want to succeed in this aquaculture experience. We have to remember that after the gold rush, many ghost cities appeared.

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