

# Rehabilitation Of Pearl Oyster Beds In French Oceania



The author, with native assistant, preparing to shoot a plankton net in Hikueru Lagoon.

*Once rich in pearl oyster beds, many lagoons in French Oceania have become exhausted due to over-exploitation by man, and to natural causes. Practical measures to restore their productivity are detailed in this article.*

By GILBERT RANSON\*

The time of the year when the eggs are produced has been the subject of numerous observations which, however, do not agree with one another. In fact, the reproductive glands are only functional from October to February, that is, during the Austral summer. From March to September, the winter months, the glands contain only remnants of more or less degenerated sexual products.

When a favourable set of circumstances occurs, an astronomical number of eggs and spermatozoa are released by the female and male pearl oysters. They sink to the bottom or are carried away by the currents. The eggs are rapidly fertilized. Within 24 hours an egg of good conformation (only one-half to two-thirds are) is transformed into a small ciliate larva, capable of minute vertical movements, which remains near the surface of the sea. This larva is, however, unable to swim against the slightest current, which carries it away. It is part of the plankton. All marine animals from the fish down to the smallest crustaceans eat these larvae.

For 21 to 25 days, a plaything of the currents, it grows and undergoes many transformations. On the second day it is equipped with the embryo of a shell. Gradually its internal organs become complete and our larva, measuring about one-fiftieth of an inch on the 21st day, is near the end of its planktonic life. It is about to undergo an internal metamorphosis. It drops to the bottom and, provided it finds a suitable support on which to attach itself, it goes on living. Otherwise, it dies or becomes a prey to the innumerable enemies lying in wait. Myriads die in this way.

The young survivors still have to face many new dangers, including fish, crustaceans, molluscs and echinoderms. Again many will die. Very few will

**DURING** a mission to French Oceania I studied the conditions under which pearl oysters were living in the Hikueru and Takuma lagoons. Shorter visits were made to other islands—Kaukura, Apataki, Takapoto, Takaraoa, Raroia, and Fakarava. I went also to Niau and Makatea, where, although no oysters are to be found, I was able through observations to understand better the evolution of the other islands.

I recorded water temperatures and salinities, collected plankton, studied the growth of the pearl oyster at various depths, the nature and condition of bottoms, the direction of bottom and surface currents, and the evolution of the oyster's reproductive glands.

At the outset I found that 35 lagoons, previously prosperous, now produced only negligible quantities of pearl shell, or had completely stopped producing; 8 had still an appreciable yield, and only 6 were rich.

Let us examine the reasons for such an evolution, after briefly reviewing the

main points of the biology of the pearl oyster.

## Biology Of The Oyster

In pearl oysters the sexes are distinct. Male and female oysters can be differentiated. Japanese scientists have made very detailed studies of the Japanese and Celebes pearl oyster, and have found that they change sex from one year to the other. It is therefore impossible, from the mere examination of the shell, to say whether the specimen is male or female. To do that, it is necessary to examine the reproductive products of each under a microscope.

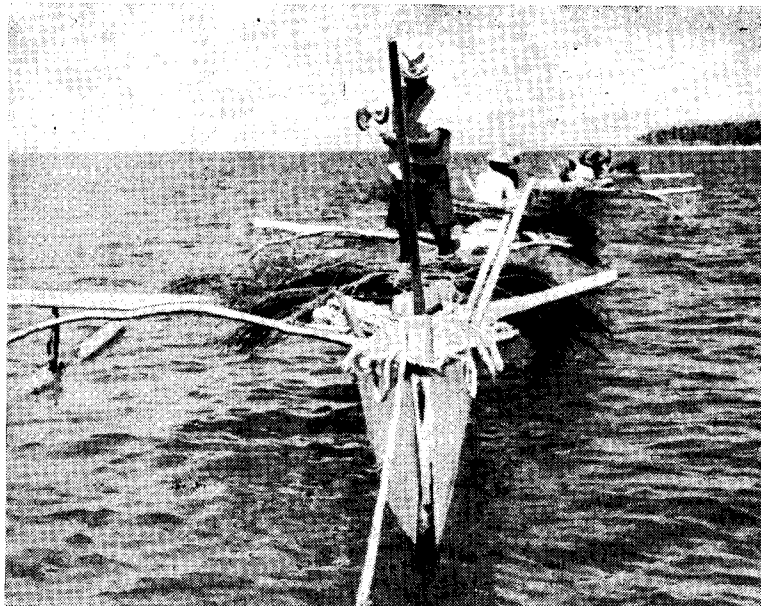
The ratio of male to female oysters is highly variable, according to localities. In the Hikueru lagoons I have observed a preponderance of males in some places, of females in others, and more or less equal numbers of each sex elsewhere.

A pearl oyster five to six years old can produce some tens of millions of eggs, while the number of spermatozoa emitted by a male is more than ten times greater.

When one year old the oyster already gives forth sexual products, but it is not certain that they are viable.

\* Professor Ranson is Deputy Director of the Laboratory of Malacology, National Museum of Natural History, Paris.

Setting out collectors of mikimiki wood in Hikueru Lagoon. Several months later it was observed that considerable quantities of young oysters—more than had been hoped for—had attached themselves to the collectors.



reach the adult stage. For each million eggs spawned, only from one to ten will go on to perpetuate the species. The number of parent oysters necessary to ensure the survival of the species in a given locality can now be gauged. When the breeding stock fall below a certain number the total extinction of the population will sooner or later become a fact.

The larvae, which have been dispersed by the currents, attach themselves anywhere, even in places where the adults will vegetate for the rest of their existence. The adult stages can withstand severe conditions. However, only those living under very favourable conditions will give birth to normal progeny; their eggs will be well constituted. The particular zone where these conditions obtain may be considered as the "nest of the species." If the breeding stock is taken away from it, the species ceases to be. In the case of the pearl oyster of French Oceania, these favourable conditions are found only in the deep parts of the lagoons.

### Reasons For Lagoon Exhaustion

In the light of these facts we are now in a position to understand what has happened in the course of time in the pearl-shell producing lagoons.

The evolution of the lagoons, with regard to the problem under review, results partly from the disorderly activities of the men who have exploited them, and partly from the combined action of natural phenomena over which these

men have no control. The former should be brought to a stop, and we should try and solve the difficulties caused by the latter.

Attempts have been made through successive regulations covering fishing operations, and also by a division of some lagoons into "sectors" (measures excellent in themselves), to minimize the effects of over-exploitation. But these steps were not sufficient. Nothing was attempted to obviate the untoward effects of the natural phenomena which hamper the reproduction of pearl oysters. The main points were overlooked.

I have mentioned that the spawning of pearl oysters in the Gambier and Tuamotu Islands takes place from October to February. The fishing season should not coincide with the breeding season. This problem is easy to solve in the Tuamotus, where the water is never very cold (79° to 86° F.). I have therefore proposed that in future the lagoons of this Group be opened for diving from April to July only.

In the Gambier Group the problem is more complicated, as the seasons are more definitely marked. In winter the water is colder and diving is not possible. After studying the question closely I have proposed that an open season be declared from January 1 to April 30 in all islands south of 20° S.

We have seen how, for every million eggs released, only one to ten will eventually become adult oysters. This is the most important factor affecting the prosperity of a lagoon. Tens of thousands of progenitors, concentrated over a comparatively small area, are necessary to ensure the continuity of the species. Over-fishing is fatal in that it decreases the stock in a dangerous manner.

There was over-fishing in the lagoons

long before 1900: in 1863, Bovis was already requesting regulation of the fishing.

All the steps taken since, such as dividing some lagoons into three areas which are each in turn opened to diving, and the opening of other lagoons in rotation, are excellent, and those at present in force will be maintained. They are aimed towards conserving pearl shell resources in the lagoons.

### Establishment Of Reserves Essential

However, these steps have not been sufficient. The main point has been overlooked; the establishment of "natural reserves" to assure, on a permanent basis, the necessary breeding stock.

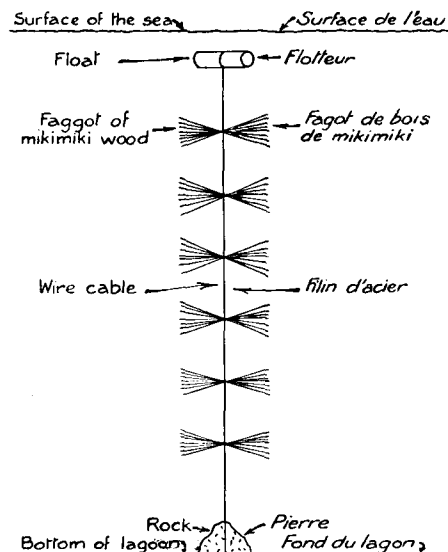
It might be assumed that the parts of the lagoons which are closed to fishing for two or three years contain enough progenitors, or that the fact that a lagoon is not open to diving for three or four years ensures its restocking.

This is not so. After the fishing season, pearl oysters are too few and too far apart in these areas. The few male or female oysters which have escaped the divers are often too far from each other. A large number of eggs is never fertilized.

In addition, almost all the old oysters are gathered, and there remain on the bottom only young oysters from one to three years old, which are probably not capable of releasing viable sexual products. In order to have progeny, one needs oysters four years old or more, in large numbers and concentrated on some favourable bottom.

The necessity for a reserve in each lagoon is obvious. From 50,000 to 100,000 mature pearl oysters, living under good conditions, would produce fabulous quantities of fertile eggs. In spite of the high mortality there would

SKETCH OF A FLOATING COLLECTOR  
SCHEMA D'UN COLLECTEUR MOBILE



still remain in the sea considerable numbers of larvae which, carried by the currents and wind, would go and attach themselves wherever suitable supports were to be found in the lagoon.

This proposal of mine is not so extraordinary. For quite some time the necessity for "game reserves" and "fish reserves" has been recognized. Natural sanctuaries have been established here and there around the world, in order to prevent man from driving into extinction some animal or plant species. The principle which actuates me in the case of pearl oysters is the same.

The first idea of Mikimoto, when he organized his scientific pearl farm in Japan, was to establish "natural beds", reserves of breeding stocks over which he kept a zealous watch, and which he never touched. He knew well that they were his most precious treasure.

In Hikueru and Takume, I have shown how these reserves should be established. At present, reserve areas have been surveyed in all pearl-shell producing lagoons.

Let us assume that we have our reserves of progenitors. These will produce thousands of millions of larvae. We have got to look after these, to make captive the greatest possible number. This is the second major problem of the oyster man.

As previously observed, the larva at the mercy of currents for 21 to 25 days will grow and undergo transformations. At the end of its planktonic life, it sinks to the bottom. If a suitable support is there on which it can attach itself it goes on living; otherwise it dies.

A few are distributed irregularly in the lagoon and drop to the bottom, to provide later the divers' catch. I said a few. Indeed, as the larvae live very near to the surface, winds and currents will carry the majority of them to the leeward side of the lagoon. Some will find supports there and vegetate, but by far the greatest bulk will die for lack of suitable supports. (From now on I will refer to these supports as "collectors", the name by which they are known among oyster men. Their importance can be appreciated.)

What can we do to collect the greatest possible number of these two lots of larvae?

For the larvae to establish themselves on the bottom of the lagoon, they need rocks or shells. Sand is fatal to them. These rocks or shells must be clean and free of any plant or animal life. An oyster larva cannot settle on a rock covered with living coral.

This is where the natural factors come in quite independently of the activities of man. In the course of time the sea slowly but relentlessly throws sand into the lagoon. Gradually the thickness and surface of the sand increase. The depth of the lagoon decreases. Shallow lagoons are threatened first. In the deeper ones, sand is found only on the bottom, be-

tween the rocks of various sizes, which may be small submarine hills or peaks.

When a shell or a piece of dead coral is found on a sandy bottom, it is uncommon not to find an oyster attached to it. It is easy to appreciate—and the pearl-shell diver is well aware of the fact—that if there were millions of clean shells or rocks on the sandy bottom of a lagoon there would also be approximately the same number of oysters.

The cyclone of 1906, which spread devastation in some islands, threw into the lagoons a large number of uprooted trees. These served as supports, or "collectors", and were rapidly covered with pearl oysters. A diver from Hikueru told me, emotionally: "At the bottom of the lagoon there were as many oysters on the dead tree as there are leaves on the living tree standing in front of us."

Takume, a second-rate lagoon before the hurricane, became afterwards a high-producing one.

This lesson, given to us by nature itself, should not be lost.

At present the oysters are mainly fixed on to the rocks which have not yet become covered by sand. They have, however, become progressively covered with various forms of life, and free space is scarce. It would be necessary to heap rocks and blocks of dead coral on the bottom of the lagoons to replace these natural collectors which have become unsuitable for the oysters.

#### Provision Of Collectors Essential

Thousands of tons of shells, wood and rocks are what a well-advised oyster man would put in the depths of the lagoons in order to harvest large quantities of oysters. The advice I gave to the islanders wherever I went was: "You must do as the hurricane did, and put in your lagoons everything you can in the way of shells, rocks and wood."

Other larvae, by the thousands of millions, are driven ashore or out to sea through the passes. Once the areas to which they are driven are known, suitable collectors should be placed there in order to intercept as many as possible. All round the world it is in such numbers that the larvae of edible oysters are thus captured. In the region of Marennes alone, in France, over 2,000 million attach themselves to the collectors prepared and staked out by the oyster farmers each year. From these, after five years, and in spite of losses amounting to 50% and over, come the 900 million oysters annually consumed in France. It is also in this way that Mikimoto collected his pearl oysters in Japan.

A great variety of materials are used for collectors, but rocks, shells and wood are the main ones.

Once the young oysters fixed on the collectors are three to four months old, they are spread out in depths of 60 to 80 feet, which are more suitable for

their growth. So you will see that after the collecting comes the farming.

The cycle is complete when the lagoon has been organized scientifically, and is ready to supply the required quantities of pearl shell. Each lagoon should have a reserve of progenitors, the various collectors and the farming areas.

In the Tuamotu Islands, I have carried out as a demonstration, a large-scale experiment. I had some 8,000 bundles or faggots of "Mikimiki" wood prepared in Hikueru, and 4,000 more in Takume. These represented respectively 1,000 and 500 collectors, at the rate of 8 faggots to each. For this work, we used 18½ miles of rope, 1,500 floats and 1,500 rocks or pieces of pig iron weighing over 65 lbs. each. These collectors were put in the water in October and November, 1952.

Because of the means of transport available and of the distances between the islands, great difficulties had to be overcome in order to carry out this experiment.

From a letter from Hikueru in February, 1953, I learned that considerable quantities of young oysters (more than we had hoped for) were fixed on the collectors. From the biologist's point of view, this is a demonstration. On the economic plane, its consequences will be of importance for French Oceania.

By the general application of such measures, large numbers of young pearl oysters can be caught in the lagoons of Oceania which are still producing. All the poor lagoons can be improved, and those which have been exhausted can be restocked.

#### Fishery Investigations In Papua And New Guinea

*(Continued from page 20)*

sels on fishing grounds beyond the coastal areas.

Developing methods of processing and marketing fish for both native and European consumption.

If the Goroka experiment on pond culture is successful, construction of inland fishing ponds to help meet the need for protein food and to reduce imported meat supplies for these areas.

The processing of unpalatable and wastefish into fishmeal for livestock and poultry. The Fisheries Division has processed a small quantity of fish meat at Port Moresby and although the quality was poor, the grade will be improved when better equipment is constructed.

It is emphasized that development of the territory's fishery resources could contribute materially towards raising the protein value of the native diet, which in many localities is below the desirable level for general health, despite the yearly importation of nearly £1,000,000 worth of canned meat.