

Trochus Research In New Caledonia

In the early post-war years the trochus industry in New Caledonia flourished. The beds, closed during the war, were rich, and prices for shell were high. By the mid-1950's, however, evidence had appeared of serious over-fishing, even threatening extinction of the species. The French Institute of Oceania was asked to carry out a scientific survey and to propose regulations that would ensure a continuing and plentiful supply of shell. How this was done is related below . . .

By MICHEL ANGOT*

New Caledonians diving for trochus immediately outside the main reef, on which the rollers in the background are breaking.



MAN uses many kinds of mother-of-pearl shells, but among them the trochus (*Trochus niloticus*, Linné.) ranks first in importance. Because of the thickness and strength of its shell it is particularly sought after in the mother-of-pearl industry, main product of which is buttons used by shirt makers and fashion designers.

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In New Caledonia, collecting trochus quickly proved a profitable occupation. Various problems developed, however, which in recent years fishermen and government have combined to solve.

Scientific Research Entrusted To IFO

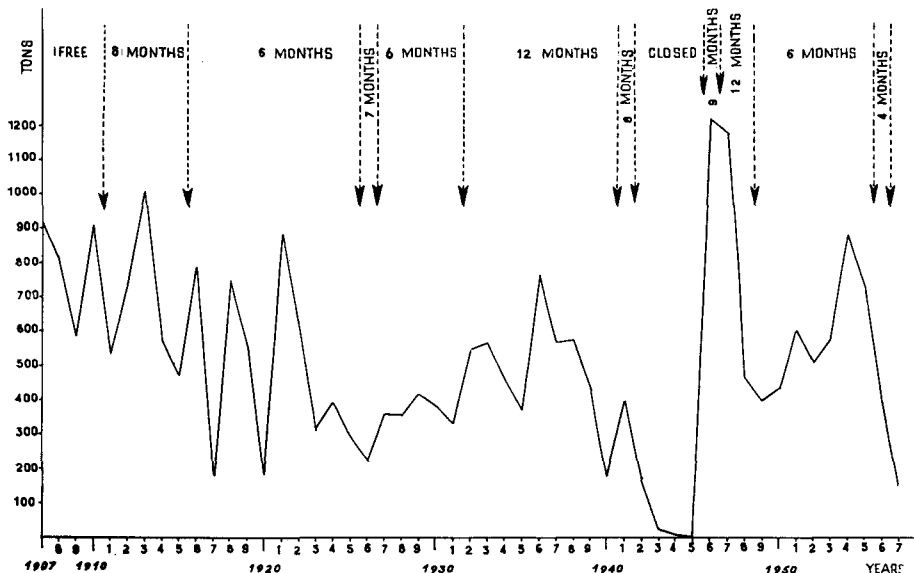
The scientific research involved was entrusted to the Marine Section of the *Institut Francais d'Océanie* in Nouméa. Work was carried out under the suc-

cessive direction of two biologists, Mr. R. Gail* and Mr. M. Angot, and with the continued assistance of Mr. J. Patterson. A large number of observations was made and their interpretation has enabled us to solve most of the problems hitherto unanswered.

But, first of all, how had these problems arisen? In fact, they appeared gradually as trochus fishing became more difficult and less rewarding. At its very beginning in New Caledonia, around 1907, it was a remarkably simple operation. All one had to do was to walk along the reef at low tide and pick up the shells crowding the surface. This could be done by hand or, in particularly good spots, even with a shovel.

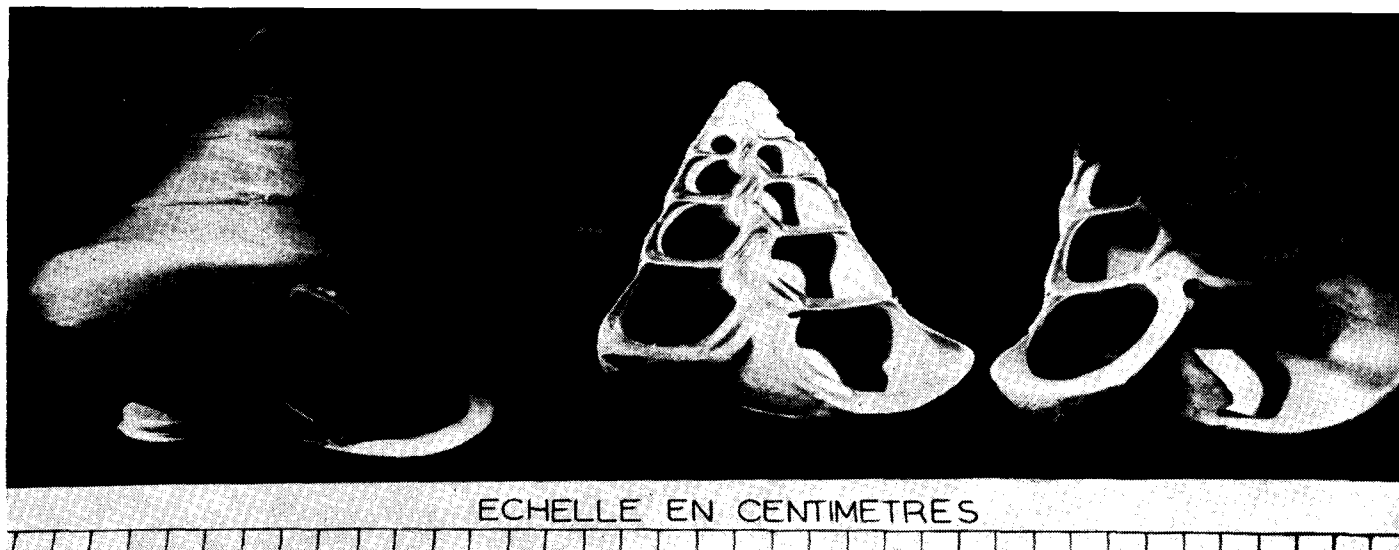
Such intensive gathering soon reduced the number of easily available trochus. They were no longer to be found on reefs uncovered at low water but went into hiding in the myriad crannies of the submerged reef. The method of fishing, perforce, had to change and thus was developed trochus diving, which is still a common practice. The diver—male or female—wears underwater goggles, swims along the reef and dives whenever a shell is seen.

When the new method was first used there was no need to go very deep, but soon divers were forced to go down further and further for good catches. Today the Caledonian diver frequently



Tonnages (in metric tons) of trochus fished during the last fifty years in New Caledonia. Above the graph, between the arrows, the number of months per year during which trochus fishing was open is indicated for each period. Since 1911 the minimum legal size has always been 8 cm., except in 1935, when it was raised to 9 cm., and in 1957 when new legislation brought it up to 10 cm.

* Mr. Gail lost his life on 10 January 1957 when diving near the New Caledonian reef in connection with his trochus research.



Because of the thickness and quality of its shell the trochus ranks first among mother-of-pearl species sought for commercial use.

goes down to 6 metres and often to 10 (sometimes even 14, but this is exceptional).

Steady Decline In Pre-War Yields

Trochus fishing has, therefore, become increasingly difficult, a fact well illustrated in the accompanying graph showing the weight of trochus collected annually in New Caledonia. Limiting ourselves to the pre-World War II period, we notice considerable fluctuations in tonnage, with an overall trend towards decline. As early as 1930, Risbec stressed the "steady decline in average yield". This is surprising, since, even then, trochus fishing was controlled; one of the main rules being that no shell under 8 cm. in diameter might be captured. (Another rule laid down that trochus fishing was to be open only for a given number of months each year, but this could not be enforced as it has never been possible to patrol all the reefs of New Caledonia.)

So, in spite of these regulations, trochus were unable to reproduce at a rate sufficient to keep up with shell taken, and, consequently, production steadily decreased.

During the war trochus fishing stopped. From 1943 to 1945 the animals lived and reproduced freely, and were again to be found in reef areas from which they had previously disappeared. Their colonies again formed one of the main components of animal life on the coral reefs.

Soon after the war the world market for mother-of-pearl revived. At first it was feared that there might be a slump in the prices paid to producers, chiefly because of the introduction of plastics in the button industry. But the genuine mother-of-pearl button retained its prestige, and prices rocketed. In 1948 a ton of shell was worth 28,000 Pacific francs; in 1955 the price went up to 53,000

and in 1956 it reached 63,636 Pacific francs.

The obvious result of such a strong demand was a corresponding increase in trochus fishing, as, quite naturally, divers were intent on making the most of this excellent opportunity.

Trochus Plentiful Following War Years

In 1946, 1221 tons of shell were taken and in 1947, 1178 tons. Trochus was so plentiful that fishermen were in high spirits and looked to the future with confidence. But optimism declined when, in 1948, the catch amounted to only 465 tons!

Facts to be faced: the abundance of shell due to non-interference during war years was no more. In two years only, fishing had depleted the extra stocks accumulated between 1943 and 1945, and conditions were back to the pre-1943 period, although the minimum legal size of shell was still 8 cm.

In spite of this the incentive of rising prices brought more fishermen into the industry. From 1,400 in 1954 their number increased to 2,004 in 1955, while the number of cutters and dinghies equipped for trochus fishing increased from 394 to 479.

At the same time the number of shells on the inside of the reef was declining steadily, and fishermen increasingly took the risk of diving on the ocean side, away from the shelter of the coral barrier. Thus trochus fishing became more and more hazardous, especially as depths of 8, 9 or 10 metres had to be reached in order to obtain shell.

Also, the trochus caught were mostly large ones and therefore old, and parasites had had time to attack their shells, which were thus pierced unevenly by tiny holes. This fact is responsible for the commercial grading of shells. The larger ones are so often damaged by

parasites that they fetch a lower price than the smaller.

The percentage of shells over 12 cm. fished in New Caledonia had remained in the vicinity of 5% until 1954, but it increased to slightly under 10% in 1954, then to 20% in 1955 and reached 30% in 1956.

Serious Production Decline

Producers now became seriously worried. The total catch for 1956 was only 402 tons, and, worse still, the percentage of inferior shells was increasing at an alarming rate. Why was this? And how could this state of affairs be remedied? Finding an answer to these questions was a matter of urgency.

The problem, primarily a commercial one but with a social aspect because so many people in New Caledonia derive their livelihood from the trochus, was tackled by Mr. R. Gail, who raised it to the scientific level by seeking its solution through research on trochus biology.

Undoubtedly, areas where trochus had hitherto flourished had been seriously depleted. However, one could have believed, as did many local fishermen, that shells were still abundant in deep water, out of man's reach, thus forming a reserve stock capable of replenishing the upper beds.

Further Research By IFO

Equipped with an aqua-lung Mr. Gail made many deep dives around New Caledonia from the Kuaré Pass to the Belep Islands on the west coast, and from Cape Chambéron to Balabio Island on the east. Everywhere his observations were identical. Trochus do not live below a depth of 15 metres. The few odd ones that were spotted at this depth were all old specimens with shells ranging between 12 and 15 cm. in diameter (the latter size is about the maximum

ever reached by the species in New Caledonian waters).

As skilled skin-divers can reach a depth of approximately 15 metres it was now proved that the entire trochus population is accessible to divers; there is no natural reserve, and no breeding trochus is beyond a possible capture.

Let us now consider the picture of trochus production at the close of the 1956 season.

The commercial aspect of the situation was not serious. Inflated prices were maintaining an artificial prosperity because, although tonnage was small, earnings were still considerable. Nevertheless, there was a risk of depreciation of New Caledonian trochus on the world market because of the high percentage of shells measuring 12 cm. and over. Though not desperate, the outlook was certainly bleak.

Need For Drastic Action

Biologically, according to the data available, the very survival of the species was doubtful. Not only had the shells within easy reach practically disappeared but even the more remote ones were becoming scarce, in spite of the fact that their commercial value was less than that of smaller shells. The species was in danger of extinction through intensive fishing, and rules and regulations were therefore absolutely necessary to preserve the species as well as to safeguard local trade. It was for the good of the fishermen themselves that drastic measures had to be taken at once.

First consideration was given to measures which would enable the trochus to breed, multiply and grow. It would, of course, have been easy to prohibit fishing altogether for a period of four years and then start it off again on a new basis: the war years had proved that the species was strong enough to recover. But this procedure would have had dire consequences for the fishermen, as some derived their entire livelihood from trochus diving. Another method



Holes being drilled in the living shells. When tagging is completed the animals will be immediately replaced whence they were caught.

had to be found, probably more protracted but achieving the same results.

The method, now officially enforced in New Caledonia, is based on the biological knowledge on *Trochus niloticus* acquired by Mr. Gail.

He found that the trochus starts spawning when it reaches approximately 7 cm. in diameter. At that stage it increases in size by 1.5 cm. a year. The rate of growth was ascertained by marking shells and following their development.

First a given trochus is measured. Then a hole is bored in the shell near the opening and a rivet inserted and clamped over a small coloured disc, a

different colour being used for each size. The animal is then released and at intervals, recaptured and measured; thus the rate of growth can be determined very accurately by comparing the original size with that at the last date of measuring.

A trochus of 7 cm. therefore increases by 1.5 cm. a year. Unfortunately, fishing was so intensive around 1956 that, in fact, the animal hardly had the chance to live for a year after reaching 7 cm. because as soon as it measured 8 cm., approximately eight months after the beginning of its breeding life, it was captured. Therefore, under the rules and regulations in force in 1956, a trochus



Four tagged shells. The third from the left has increased by one complete whorl since the marking date.



The two middle shells are "stunted" trochus. On either side is a normal trochus identical in diameter with its stunted neighbour.

could breed actively for only 8 months, or perhaps a year at the most. Moreover, the animal is then at the very beginning of its productive period when its breeding capacity is small—very much lower than it would become if man did not interfere.

One could compare a 7 cm. trochus to an 8-year-old coconut tree just coming to fruition. During the next 4 or 5 years yields are small; the tree bears fully only between 15 and 30-40 years of age. Similarly, the reproductive capacity of a trochus is small during the first year of its breeding life—the equivalent of the first 4 or 5 years of the coconut's fruitfulness—but after this it releases great quantities of spawn, the trochus of the future. Unfortunately, under the 1956 regulations a trochus was not allowed even a year in which to breed.

New Regulations For Trochus Conservation

Because of this serious flaw in a law which was meant to protect the species, but, in fact, did little but slow down the rate of its extinction, Mr. Gail made the following suggestions, which have since been adopted by the Government and are now enforced in New Caledonia.

To begin with, trochus fishing was forbidden altogether for one year, from 1 September 1956. The minimum legal size was then raised to 10 cm., measured at the maximum diameter of the shell. In this way, when the trochus has reached 7 cm. (and better still 8 cm.) it can breed until it measures 10 cm., the period during which it spawns most profusely.

It was further decided that there would be no closed season for trochus fishing. A closed season serves its purpose only if it can be properly enforced, and this has always been a delusion in New Caledonia because of the vast expanse of reefs and the paucity of means of control.

Such is the legislation which was passed towards the end of 1956. It came

into force on 1 September 1957, when fishing was declared open permanently. At that time shells over 10 cm. in diameter were scarce, and only 144 tons were fished during the last four months of the year. However, the 1958 catch, especially that of the last six months, should definitely show an improvement in the trochus production of New Caledonia.

In a few years' time there will be more 10 cm. shells than there were 8 cm. ones around 1950. The larger shell is heavier, and, consequently, of greater value. The advantages of the present legislation will then become obvious to the fishermen.

Occurrence Of Stunted Trochus

In the case of normal-sized trochus which are generally found on most New Caledonian reefs, these advantages are obvious to all. There are, however, two cases in which this may not be so; in the Balabio Island area north of New Caledonia; and Touaourou in the south. In both localities the trochus is stunted. The shells hardly ever exceed 8 cm. and therefore are no longer saleable.

The *Institut Français d'Océanie* decided to investigate the matter, and a large research station was established at Touaourou in November 1956. The local fishermen were most helpful, and agreed not to disturb the shells under regular observation. Work has progressed over a period of eighteen months, and we are now in a position accurately to define the problem of stunted trochus.

Risbec has already proved that a stunted trochus belongs to the same species (*Trochus niloticus*) as a normal one. The term "stunted" merely describes the fact that such shells grow more slowly than normal ones. A stunted 7 cm. shell increases by 0.5 cm. a year instead of 1.5 cm., but it is not correct to state that it will never exceed 8 cm. In fact it continues to grow, but slowly, which explains why in 1956 fishermen could find only a small number of 8 cm. shells. These, in turn, will take longer

to become 9 cm. trochus, and it is quite possible that all will not reach the 10 cm. mark if the time required to do so exceeds the life span of the species.

Yet another consequence of this slow growth is that the stunted shells were able to reproduce during longer periods than others before being caught, while the minimum legal size was 8 cm. Therefore, shells were much more plentiful in the stunted trochus areas than elsewhere.

Experimental Transplantings Successful

The next problem was to find out if stunted trochus remain so permanently. We collected shells and transferred them very carefully to areas where trochus grow normally. Each animal was placed apex upwards in its new habitat.

After an acclimatization period of 4 to 5 months the so-called stunted trochus started to grow quite normally. Most of them have now reached the 10 cm. mark.

Work at Touaourou is now ended, but the experience has been fruitful. The local fishermen who helped us and saw the results of our experiments are planning to carry on transplanting shells on their own.

Natural Shell Reserves

It could almost be said that stunted trochus areas serve as natural shell reserves. The animals remain small and therefore protected against fishing until they are transplanted to suitable spots where they can grow normally to 10 cm. or more.

It has been found that areas where trochus growth is impeded are characterized by low salt content in the water, i.e. near the mouths of rivers or, broadly speaking, on the axis of currents carrying fresh water onto a reef. Trochus do not develop well in even slightly brackish water; their ideal habitat being an ocean reef bathed by the pure salt water of the open sea. This is naturally

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Patients working in the light and airy kitchen.

community is made more easy, while everybody is aware of conditions in the leprosarium.

Encouraging Results

The results of this work show great hope for the control of leprosy in the whole coastal area. An attempt is now being made to examine, each year, the total population in all infected areas, in order to find the new patients in the early stages of the disease.

Though the people are not aware that patients even in an advanced stage of the disease can be cured, in some areas they are now convinced that the disease can be cured faster if treated at an early stage, and that the severe mutilations which have given the disease its bad reputation can, in many cases, be prevented.

The basis for a sound leprosy control has been laid. Yet other important problems still remain. New Guinea is a large country, with widely-scattered population groups often difficult to reach.

Papuans Being Trained In Leprosy Control

Until recently, the leprosy control work has been carried out almost entirely by European personnel. Papuans are now being trained in diagnosis, treatment and education of the people, and more frequent visits to rural areas will result.

In the leprosaria, patients are trained in nursing and laboratory work, and some will be kept working when cured.

The sulphones are powerful weapons in the eradication of leprosy, but treatment requires several years of careful attention.

In the central part of New Guinea there are still population groups exposed to leprosy infection who are not yet used to modern methods of treatment, and they follow with interest the investigations into the preventive value of the BCG vaccine in leprosy control.

During 1957 the people in one endemic area were vaccinated. This year BCG is being used in a second area.

SPC Plant Introduction Service

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SPC Plant Introduction Service, it must be kept in mind that its purpose is not to act as a seeds and plants concern, but to be a means of crop improvement.

As such, its activities have to be included in a general programme which must be constantly reviewed, to keep up-to-date with territorial research and development schemes. For instance, special attention is given to species and varieties which are of practical and immediate use to the economic development of the islands and the betterment of the crop concerned. Thus, a number of "Arabica" and "Robusta" coffee varieties have been introduced, for these two species are the only ones with commercial possibilities. Furthermore, an increasing number of South Pacific terri-

ories, in their efforts for cash crop diversification, are now including coffee in their agricultural development programmes.

As far as cacao is concerned, no introductions from overseas will be made through the Commission for the time being, firstly because the risks of introducing serious diseases or pests of this important crop are too great, while secondly, a wide range of excellent material is already available in the South Pacific region.

The outstanding results achieved in the field of cacao selection on the "Trinitarios," introduced long ago at Keravat Station, New Britain, show clearly that new introductions are not absolutely necessary. However, even in such a case, the SPC Plant Introduction Service has its importance in assisting inter-territorial exchange of plant material and, eventu-

ally, in locating in old plantations, material which could be worth propagating or including in collections established for selection purposes.

The coconut offers another example of this definite trend towards crop improvement. Research on the coconut is increasing in many territories such as Papua and New Guinea, French Polynesia and the Solomon Islands, selection and breeding of improved coconuts being a main objective.

Here again, introduction from overseas sources involves too many risks from a quarantine point of view, except perhaps for pollen, which could be imported for cross-breeding purposes. Instead, our main task is to survey the South Pacific varieties of this palm and use the material available in the area for the improvement of this basic cash crop. Our assistance in that field has already been requested by the Solomon Islands and French Polynesia.

An Enormous Task Ahead

These few examples show that selection work is now playing an important part in agricultural research schemes in the South Pacific region.

Until recently, we had to consider plant introduction mostly as a means of introducing already improved varieties. Now our programmes must include material for use by plant breeders. This will have to be obtained either by introduction from sources outside the South Pacific, or by exploration and collection.

An enormous task remains to be done to improve South Pacific crops, and the present agricultural research in our region is developing in this direction. The indications are that the Commission's plant exploration, collection and introduction activities will play an important part in this essential work.

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the most suitable location for transplanting. Great care must be taken in handling the shells to give them every possible chance of survival during the settling down period.

Once these principles are accepted by the Balabio and Touaourou fishermen (in the case of the latter, they are almost unanimously converted to the idea) the inhabitants of these areas will consider themselves the most fortunate among trochus fishermen.

Nature maintains for them a practically inexhaustible supply of shells; it is up to them to make the best of such favourable circumstances. With a little care and common sense their catches should always be plentiful.

REFERENCE

Selected Annotated Bibliography of Trochus, by R. Gail and L. Devambez. SPC Technical Paper No. 111, Nouméa, 1958.