TABLE SHOWING CHEMICAL COMPOSITION OF Ipomoea aquatica

COMPOSITION— 100 GRAMMES		EDIBLE PORTION	AS GATHERED
Refuse	%	0	19
Water	%	89.7	72.7
Food energy	Cal	29	23
Protein	gm	3.0	2.4
Fat	gm	0.3	0.2
Carbohydrate—			
total	gm	5.4	4.4
fibre	gm	1.1	0.9
Ash	gm	1.6	1.3
Calcium	mg	73	59
Phosphorus	mg	51	41
Iron	mg	2.5	2.0
Vitamin A value	I.U.	6,300	5,100
Thiamine	mg	0.07	0.06
Riboflavin	mg	0.12	0.10
Niacin value	mg	0.7	0.6
Ascorbic acid	mg	32	26

ficiencies which have sometimes been observed in the diet of the inhabitants.

Ipomoea aquatica is being grown at the Sigatoka Agricultural Station, Fiji, in an interesting experiment involving fish farming and green feed production in the same pond. The fish and vegetable matter produced are being used chiefly for pig feed.[1] The vegetable yield of this pond was the equivalent of 84 tons of wet material per acre in 9 months and, while the combination makes for a lower production of fish than could be expected in a normal pond, it is felt that this will be compensated for by the increased production of beef, milk and pork which can be expected from the use of *Ipomoea aquatica* as green feed.

—J.B.

1 cf. Payne W. J. A. et al. *Fish Farming*, Fiji Agricultural Journal, Vol. 25, Nos. 3-4, Dec., 1954, pp. 71-76, illus.

Fishery Investigations In Papua And New Guinea

By A. M. RAPSON*

A PRELIMINARY survey of the fishery resources of Papua is being undertaken with a 60-foot vessel from Mackay, under charter to the Administration. Tests are being made with small-mesh trawl nets, mesh nets, long horizontal lines, vertical lines and troll lines. Although it was expected that the lines would yield most valuable results, only sharks have been captured with this gear, and for successful line fishing a supply of good bait will be necessary.

Up to the time of writing (April, 1955) results from a 20-fathom small-mesh trawl net have shown that there are extensive areas of clear mud bottom. In 26 tests of 40 minutes with this net in water 4 to 17 fathoms deep, inconvenient quantities of timber were taken on only one occasion, viz., in a position 2½ miles off the east head of the Purari River mouth.

Six species of prawns were taken in the Western Gulf of Papua, and there is evidence that differences in prawn stock will be found in the Eastern Gulf. Samples are being prepared so that expert opinion on the commercial possibilities may be obtained. As the net is of small mesh, the fish caught are mainly under 4 inches in length. Principal groups obtained are as follows:— Clupeoids, anchovies, threadfins, catfish, jewfish, and silver perch; in the Western Gulf considerable numbers of *Harpodon* were taken in shoal areas off the river mouths in positions where the influence of freshwater is considerable.

Future plans for the Fisheries Division call for the purchase of a specially designed 60-foot vessel for general fishery survey work. Orders have already been placed for a 30-foot motor boat and another of 16-foot, the latter to be used as a tender to the survey ship. All three vessels will be powered by diesel motors. It is anticipated that the 16-foot and 30-foot craft will be delivered by June.

During the past year, experiments with different types of gear in Papuan waters have shown possibilities in the use of new fishing gear for natives who still regularly engage in fishing by traditional village methods. Some experiments have also been made on methods of preserving fish with the aim of improving these to the point where fish can be marketed over a wider area than at present and retained in storage for longer periods.

Considerable difficulty is expected in getting increased native production for trading purposes and any marked rise in output will come only through organised fishing and introduction of new methods of preserving the catch.

A pilot project on pond fisheries is being established at Goroka to ascertain the possibility of developing fish production for inland regions from pond culture. One pond has already been constructed and stocked with about 200 tilapia imported from Singapore. This species resembles perch, and has proved very suitable in Malaya for pond culture where under favourable conditions the fish reach a weight of nearly 2 lbs. in 12 months. The Goroka experiment will establish whether tilapia will breed and thrive in the Highlands, where the climate and altitude differ considerably from their natural habitat. Experiments in Malaya indicate that this species will thrive at altitudes up to 4,500 feet.

Ponds for fish culture are constructed along small watercourses in shallow valleys with a low watershed, the pond being formed by building an earthen dam with cement drains and gates.

The Goroka project will comprise three small ponds of about one acre each on a waterway near the town. It will be about two years before any positive results from the experiment can be expected. However, as marine fishing offers the quickest means of increasing fish supplies for the territory, priority in development will be given to this phase of survey work. The long-range plan for fishing development is as follows:—

Introduction of new methods among native fishermen.

Encouraging native fishermen to organize their activities for development of their local fishing grounds.

Promoting interest in fishing by established native co-operative societies both for village consumption and as a commercial venture.

Training native fishing crews on Fishery Division vessels with the object of establishing mechanized native fishing fleets and giving village fishermen first-hand experience in modern techniques adaptable to community fishing.

Ascertaining potential fishing grounds for commercial operators in areas where these will not conflict or reduce the catch upon which village communities are dependent for part of their normal food supplies.

Exploring and testing the potentialities for ocean fishing by mechanized ves-

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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, between 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

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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.