

FISHERIES IN TONGA

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INTRODUCTION

My visit to the Tonga Group extended from November 24th to December 17th 1954. I made some all-day trips with the Fisheries Officer of the Kingdom of Tonga, Mr. W.A. Mackenzie and we also made a trip lasting one week with the Fisheries Research vessel "Alaimoana". Fishing experiments were made during all these trips and various areas were visited such as reefs, islands, a lake and some lagoons.

Courteous co-operation was extended by the Premier H.R.H. Prince Tungi, Mr. van der Molen, Acting Senior Agricultural Officer, Mr. W.A. Mackenzie, officials of the Administration, fishermen and private persons. Very valuable information was collected through their good offices.

Before the writing of this Report was commenced I had the opportunity of meeting Mr. W. Straatmans, Senior Agricultural Officer, Tonga, who was passing through Noumea, and we discussed some aspects of fisheries.

My visit and investigations covered only parts of the Tongatapu and Ha'apai Groups.

Three valuable Reports were made available to me, they were :

1. Preliminary report on a fisheries survey in Tonga, 1951, Vaea and Straatmans.
 2. Fishery Report, 1954, W.A. Mackenzie.
 3. Report on whales and whaling in Tonga, 1954, Dawbin.
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I LOCAL FISHERIES INDUSTRY

The Kingdom of Tonga includes a large number of islands and islets of which Tongatapu is the largest and most important. The population is about 54,000, of which 25,000 live on Tongatapu. My feeling is that there is a sufficient quantity of food for the population, although animal foods are insufficient. The main sources of animal food are fish and aquatic animals and pigs; there are also importations of such foods. In 1953 imported fish products reached a value of fT.14,334.

Real professional fishermen are few and most people fish occasionally. Fishing crafts consist mainly of canoes and small open sail boats. Shellfish gathering for food is actively practised at low tide on the reefs and along the lagoons. Many kinds of fishing methods are used in the Archipelago of which details can be found in the Report of Vaea and Straatmans mentioned. Most of these methods are simple, the most important being the fish fence made of sticks and wire netting, handline fishing, trolling, spear-fishing, throw nets, fish drives, barrage nets and whaling.

The use of poisons and explosives is also popular, although prohibited. Many of the reefs we visited were almost devoid of fish, especially the shallow ones. I feel that dynamiting has done great harm to both the flora and fauna of these reefs.

The surface schools of pelagic fish seen in the open waters were of small size, the largest did not total more than 500 lbs. Tonga fishermen considered it a big school.

There are still some reef fishes and spiny lobsters on the deeper reefs and small boats could do some commercial fishing in these areas. There seems to be more fish in the ocean, although they are not to be found near the surface. Near the coast mullets sometimes appeared in schools and are caught in fish fences, about June and July.

A large salt water lagoon called Fanga 'Uta is situated on Tongatapu. Some fish are caught in this lagoon but it is more famous for its shell-fish, including mussels. These latter are found in

quantity and have an excellent flavour. They are known under the local name of Kuku. This lagoon also contains some edible jelly-fish (Toka and Mahanu). It appears to be an excellent spawning place for fish.

Trochus shell and black-lipped pearl oysters (Pinctada Margaritifera) are found in the Tonga Group, the latter mainly in the Vava'U area. However, there is no trade in shells.

During the period from July to October, large numbers of hump-back whales move through the Tonga Archipelago. Mr. W.H. Dawbin, an expert on whales from Victoria University College, Wellington, New Zealand, states in his Report : "My general impression however, was that whales are as abundant in Tonga as in Cook Strait, New Zealand, where 100 per person are caught". It is possible that the humpbacks breed in or around the Tonga Archipelago and calves, sometimes reaching the size of 12 feet, are often seen with the females. A Mr. Cook of Tonga hunts the whales with his sons in a 30 ft. open sail boat. Last season he caught 18 of which 12 were brought ashore and 6 were lost, having sunk. Only as much meat is used as can be sold in one day to the population. The rest is thrown away in the sea being tainted after this period.

Milkfish (Chanos chanos Forsk) is also present among these islands. I saw specimens 23 inches long caught in the sea and some young ones about 8 inches swimming in Sapu. On Nomuka island there is a salt water lake called Ano Ava and milkfish, known by the local name of Ava are caught there in quantity.

The only instance of fish preservation I observed was the salting and drying of milkfish in Nomuka.

I was told that on Fanoi Fua Island fish are cooked in leaves and sent to Lifuka Island. There is no preservation and trade on a commercial level. In Nuku'alofa peddlers sometimes sell fish on a small scale.

II. FISHERIES RESEARCH

The Kingdom of Tonga has a fisheries section in the Department of Agriculture. This section is under the direction of Mr. W.A. Mackenzie and includes an establishment of about 20. Working headquarters are situated on Pangaimotu Island and there is a small office and a store in Nuku'alofa.

The Fisheries Section has a research vessel "Alaimoana" which is 47 ft. 6 inches long and is equipped with an 88 H.P. Kelvin engine. This vessel was purchased in New Zealand. A 22 feet work boat "Otule", with a 4 H.P. Stuart petrol engine was built in Tonga by Mr. Mackenzie. Six small dinghies were also built locally for lamp fishing.

Before the "Alaimoana" was available (mid 1954) Mr. Mackenzie attended to the erection of the necessary buildings, the building of boats and the establishment of a stock of fishing gear, and also started experimental fishing operations.

His intention was first to try pole fishing for Tuna with live bait. A beachseine was made for bait catching. The fish were attracted with lamps of 500 candle power. The species caught were mainly Caranx crumenoptalmus Bloch. Scomber kanagurta, Cuv., Caranx mate C.V., Decap-
terus macrosoma Blkr., and Clupeidae. Small fish suitable for fishing for Tuna were almost non-existent. Larger specimens of the abovementioned species suitable for long-line bait were only available in small quantities. The beachseine could not be used around the coast and Mr. Mackenzie found that the schools of Tuna move very fast. He continued with lamp fishing with the intention of developing bait fishing for a future long-line fishery, and another net more satisfactory than the beachseine was made for lamp fishing. This is a floating netroom. This net gave better results although not quite satisfactory.

With the present gear, Mr. Mackenzie has to fish in one well determined area. His intention is to make a small purse seine (150 yards) so as to gain freedom of movement. As soon as he receives glass floats from Japan, Mr. Mackenzie will try a small experimental long-line. This line is at present ready.

Handline and trolling have also been experimented with and

have provided valuable data on the marine fauna. The small motor boat "Otule", built in Tonga, is sometimes used for handline fishing, occasionally with good results. It is a very handy boat although a little too small for commercial operations. Handlining also gives good results when combined with lamp attraction. Surface trolling usually yielded poor catches, with an occasional good haul.

III. INVESTIGATIONS

The whole time spent in Tonga was devoted to the investigations. These covered local fisheries methods, the work of a fisheries section, the fauna of the sea and inland waters, local conditions, etc.

Investigations were carried out at sea with the boat "Alai-moana" and the "Otule". The former was used for a long field trip through the Tongatapu and Ha'apai Groups. During this particular trip observations were made on the following :

1. Surface trolling.
2. Depth trolling.
3. Hand line fishing.
4. Attraction of fish with lamps.
5. Lobster fishing.
6. Coral reefs.
7. Stomach contents of pelagic fishes.
8. Nomuka salt water lake (Milkfish)
9. Coconut frond lureline.
10. Beachseine.
11. Anchored fish-room and local fishing gear.
12. Dry salting and drying fish.
13. Local fish names.

Surface trolling

We fished with five surface lines, using both fresh baits and lures. Fresh bait consisted of mullet, or pieces of tuna mixed with feathers. The lures used included brown and white feathers, metal spoons, leaves, white cotton thread and mother of pearl shell.

The best conditions were found to be a speed of six knots, with a cloudy sky, working near islands or reefs.

Moderate catches of tunas, Spanish Mackerel, Barracuda and Dolphin were made (see list annexed).

Depth Trolling

A new method was experimented with and gave good results.

A wooden depth kite and a steel paravane had been made in Nuku'alofa for

this purpose. Both were good, but the former gave far better results.

In the first experimental operations, one depth line, connected either to the steel mainline or to the kite, caught the same quantity of fish as 15 surface lines.

Such a method can be of very great importance for Tonga. Details of the experiments will be found in the note on "Depth trolling" attached to this report.

Handline fishing

This type of fishing was undertaken with monofilament nylon lines and hard laid cotton lines. Nylon proved superior to cotton.

Some areas did not yield fish, but in the South of the Ha'apai Group there is a good fishing ground. The catches there included mostly Lutjanidae of various species, known locally as Koango, Tanu tanu and Manga.

Various species of Serranidae were also caught. They are called Tonu and Ngatella by the Tongans. A reddish species of Scaridae was caught and is named Meai tangasila.

Attraction of fish with lamps

While on our long trip in the Ha'apai Group, we tried every night to attract fish with a 500 candle-power kerosene pressure lamp. The results were poor. Some garfish, some small Stolephorus and some cuttlefish were seen. Mr. Mackenzie has always obtained his best results between Nuku'alofa and Pangaimotu Island.

Lobster fishing

Twelve spiny lobsters were caught by hand in two hours from holes in the reef walls off Kelelesia Island. There are plenty of lobsters, but the waves make it difficult to catch them.

Coral reefs

The shallow reefs are not rich in fish. The deeper reefs which we investigated have a better population. On many of the shallow reefs I missed the brilliant coral formation and the colourful fishes and some corals looked to me as if they were starving.

I am afraid that fishing with explosives has done much harm. In this connection I wish to advise the authorities to do all in their power to prevent this. I have personally seen some reefs elsewhere on which the population took from two to three years to become reestablished in normal numbers after dynamiting was stopped.

Stomach contents of pelagic fishes

In general, we found little food in the stomachs of pelagic fishes. However, the specimens caught between the Ha'apia and Tongatapu Groups contained mostly flying fish about 12 inches long and the same was true of the tunas.

Nomuka salt water lake (Milkfish)

On Nomuka Island there is a salt water lake covering 445 acres. A particularity of this lake is that the "Ava" (Chanos chanos Forskal) not only live in it but also spawn. So far as I am aware this is the first known case of milkfish breeding in enclosed waters. There are thousands of brackish water ponds in Java, Malaya, India, Thailand, and the Philippines, where milkfish are raised. These ponds must always be stocked with "Ava" fry taken from the sea. Scientists have been trying for years without success to determine why milkfish will not spawn in enclosed waters.

In this lake it has been happening year after year for a long time.

A peculiar thing is that this lake contains salt water although there is no inlet from the sea. Presumably the soil is porous; I cannot find any other explanation for it. At the time of my visit the salinity was lower than that of the sea, perhaps because heavy rains had been falling the previous week. However, local people say that the salinity is sometimes higher in the lake than in the sea.

The depth of the lake is from 4 to 5 feet. The bottom is of dark mud with a sulphurous smell. There is a heavy growth of algae providing food for the Ava. The water is turbid as in a fish pond. The water temperature with a cloudy sky and an air temperature of 28°C. was of 28°5°C. at 8.45 a.m. The temperature of sea water at 10.00 a.m. was of 26°5°C.

There was always Ava in the lake, but overfishing took place about 38 years ago and it was necessary to restock the lake with fry from a tidal creek in Tongatapu. Since then the fish have always been there.

The only difference between this lake and fishponds is that the former has a greater surface and depth than the latter.

It seems that once a year millions of fry are seen, after the rains at the end of the year. The lake yields thousands of full sized milkfish every year. The observations made in Nomuka have been written into an article for the South Pacific Commission Quarterly Bulletin.

The specimens of Ava I saw were 28 inches long. The District Officer, Mr. Williams, has been told how this fish can be smoked by simple means and made into a first-class food of excellent taste.

Coconut frond lureline

A lureline 18 fathoms long was anchored in 12 fathoms of water near Pangaimotu Island. Coconut leaves were attached to the line at 1 yard intervals. There was almost no current.

As a rule such lures are very efficient in attracting fish in any area. However, observations covering a period of 10 days did not disclose any sign of fish. It is possible that there were no fish in this area and I have asked Mr. Mackenzie to try the lure in another place to the north of the first one where there is more current.

Beachseine

Mr. Mackenzie has carried out trials with a straight beachseine (without bag). In most areas in the Tonga Archipelago the bottom is not suitable for this type of gear.

Some hauls were made in my presence and my feeling is that it would be better to abandon this net.

Anchored fish-room and local fishing gear

These have already been described in the reports of Vaea & Straatmans and Mackenzie (see introduction).

Dry salting and drying of fish

Part of the fish caught during experimental operations was

dry salted (three parts fish to one part salt). After one or two days the fish was washed in sea water and dried. All the fish thus prepared was acceptable for the market.

Local fish names

See Appendix. Identifications have not yet been made, so that the names given should not be entirely trusted.

Inland waters

In addition to the salt water lake of Nomuka Island, there is a fresh water lake on Vava'U. This latter has a surface of 840 acres and, as far as I know, has never been surveyed from the fisheries point of view. From information I gathered, it would be very advisable to use it for fish production. Unfortunately, I was unable to visit this lake. However, when Mr. Straatmans returns to Tonga, Mr. van der Molen will resume his duties as Agricultural Officer in Vava'U. He will be able to carry out preliminary investigations and will inform me of his findings. The following data are needed :

1. Are there already fish in the lake ? In the affirmative, what information is available about them and what knowledge is there among the population ? Are there any predatory fish ?
2. Could fish samples be sent to me in formalin ?
3. Is the water absolutely fresh ?
4. Is the water clear or turbid ?
5. What kind of soil is the bottom made of and what is the depth of the lake ? I would like to have a sketch of the lake with an indication of depth in feet and of the type of bottom.
6. Are there any other animals living in the lake besides fish (crabs, shrimps, etc) ?
7. Are there surface and bottom plants growing in the lake ?
8. From where does the water come ?
9. What is the temperature of the water at different places in the lake (please give the temperature of the air at the same place and time) ?
10. Is the water level constant ?

11. Is the population already fishing in this lake and if so, what type of fishing gear is used ?
12. I would like to know the composition of the water. The most important detail is the p.H.
13. Is the vicinity of the lake populated ?

An area of tidal flats of approximately one thousand acres at "Sopu" West of Nukualofa has been reclaimed for Agricultural purpose. It will not be used for the time being. In the course of my investigation it was actually a large swamp of fresh water with depths of one, two and three feet. At low tide, water from the swamp escapes to the sea through a 22 inch pipe and in the dry season there are still two fresh water ponds remaining which cannot be emptied because their bottom is at too low a level. If there was no outlet for water, the swamp might stay full for a great part of the year. This swamp is fed not only by rain water but also by springs.

At present this swamp contains Ava and Mullet which are unfortunately caught while still small. A large number of them also escape through the outlet pipe.

During my visit I advised that the pipe be closed and that water be let out only when the level becomes too high. A sieve should also be installed at the land end of the pipe. If it is possible to have water in this swamp for six to eight months on end, a reasonable yield of fish could be expected. Fishing should be allowed only when the swamp is drying up.

Three species of fish would be important in connection with this swamp : Milkfish, Mullet and Tilapia mossambica Peters. Ava and Mullet will not spawn in the swamp, so fry will have to be put in every year. It might be possible to bring Ava fry from Nomuka; Mullet fry is available nearby; Tilapia fry can be obtained from the Director of Agriculture, Fiji, and can easily be transported by air. Once this fish is established in the swamp there will always be fry available.

It will also be possible to build salt water fish ponds in this swamp. This would require the building of simple dykes and putting a sluice box of simple design in the dam. Ava and Mullet could be raised in such ponds.

IV. CONCLUSION AND RECOMMENDATIONS

Although I only stayed three weeks, I formed a sufficiently clear impression of fisheries and their possibilities in the Kingdom.

No rich fishing grounds will be found in depths under 30 fathoms. In depth over 30 fathoms greater quantities of fish will be found but they stay at least 50 feet down.

From the depth trolling experiments we gathered indications that there are fish in the depths. The data obtained from Japanese long-line fishing operations in this area coincides with this and their albacore catches were best in the vicinity of the Tonga Group. So far, the long-line has proved to be the best and practically the only efficient type of gear for use in the South Pacific. This fishing method requires :

1. Skilled fishermen.
2. Seaworthy fishing boats.
3. Bait.
4. Skilled workmen to handle the fish on shore.

In case Tonga is contemplating the development of a long-line fishery with local fishermen, I feel obliged to advise against it. The reason for my doing so is that not a single Tongan fisherman would welcome such heavy work on the open ocean where the weather is generally hard on fishing boats. Bait is not available in sufficient quantities for long-line fishing. There is no ice factory and no cold storage facilities to be found locally. The establishment of a long-line fishery in Tonga would be best left to an outside commercial organisation.

The species caught by means of the long-line can also be caught with depth trolling gear. This latter method appears to be more suitable for Tongan fishermen and is not as dependant on bait as the long-line. It should be tried and improved and it will still be necessary to find out whether it can be profitable.

The reefs in depths over 5 fathoms are not rich in fish but a reasonable catch of Lutjanidae can be obtained with hand lines or possibly with bottom traps. There are many sand bars studded with a few coral patches where quantities of fish pass at night. Nylon bottom gill nets set at night will possibly yield reasonable catches of bottom and reef.

species. A drawing of such a net can be made available by the South Pacific Commission.

There are spiny lobsters in the reefs, although they are not caught on a commercial scale. During our trip we caught twelve lobsters in a short time. If these lobsters will enter into lobster traps, this could become an important item. I feel that Mr. Mackenzie should make a trial with perforated oil drums fitted with a trap on one side and bait. If lobsters are caught in such drums, lobster traps can be made.

I did not see edible oysters but their establishment in Tonga would be worthwhile if an investigation disclosed satisfactory conditions.

An investigation should be made concerning sea shells, in particular :

1. The position in regard to trochus.
2. The position as regards mother of pearl oyster (Pinctada margaritifera).

I have seen trochus shell and mother of pearl oysters but I have no idea in what quantities they are to be found. Before the war, the Japanese used to do some trade in these islands. A market for these shells could possibly be found in Fiji, where a button industry is now established, and it is possible that other countries might also offer prospects.

The Report on whales and whaling in Tonga by Dawbin gives sufficient information for the development of the whaling industry. Large quantities of whale meat have been thrown away because it could not be sold before it spoilt and no cold storage facilities were available. I therefore advised Mr. Cook to boil the remaining meat in drums with water for one hour. The meat must then be cut, ground and dried. This gives an excellent human food and can also be used as pig and poultry feed.

An investigation of the factors which make it possible for milk-fish to spawn in Nomuka Island (Anc Ava Lake) while it does not do so in large ponds in other countries should be of the highest value. In this connection I would advise co-operating with any country prepared to send an expert.

Milk fish raising would offer many possibilities if a solution could be found to the breeding problem.

Attention should be given to inland waters and the possibility of using them for fish production.

The use of explosives in fishing should be stopped, if possible, immediately.

Recommendations

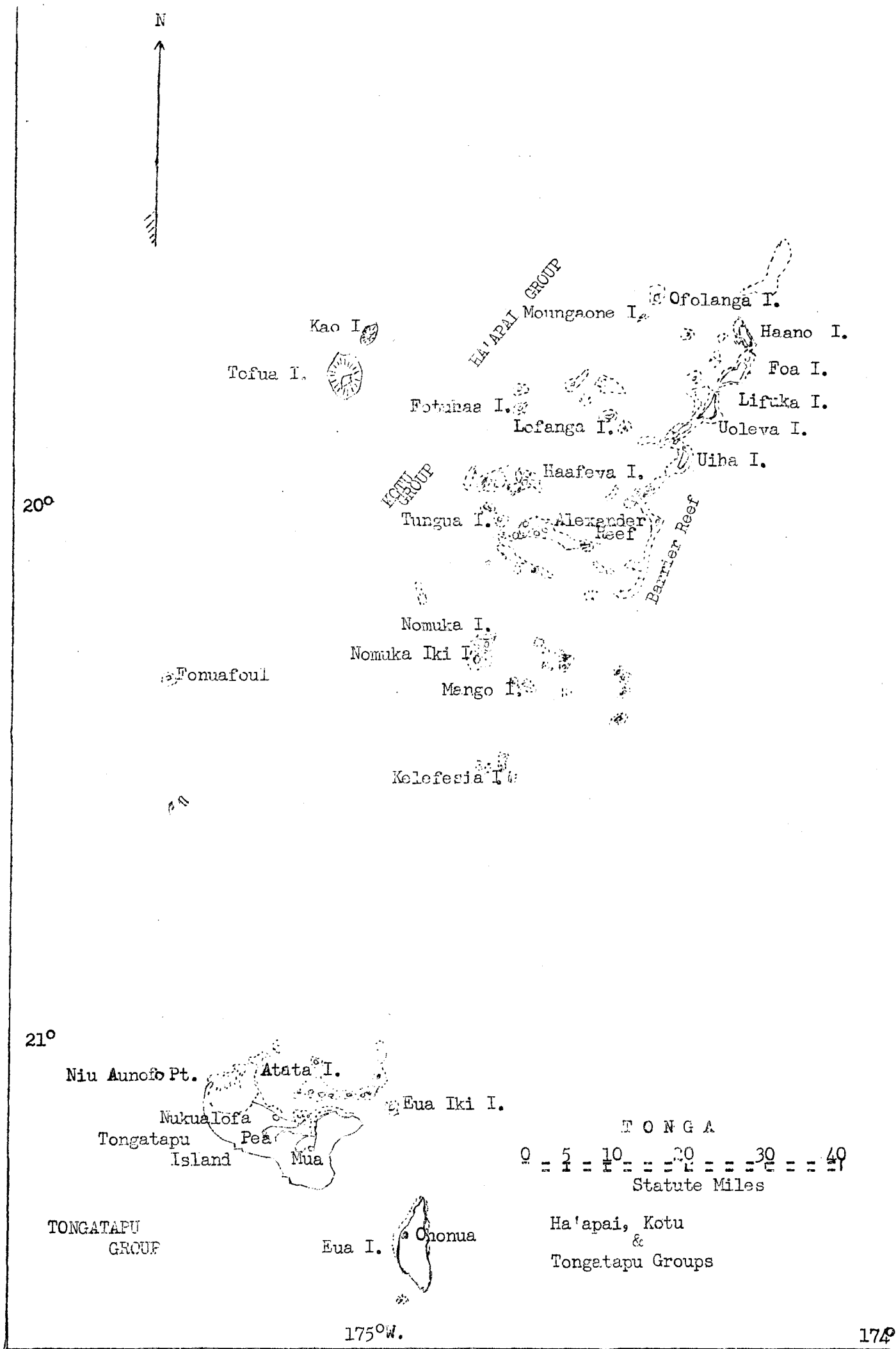
1. In the event that foreign concerns might wish to bring their tuna catches to Tonga for processing or storage, it would be advisable to permit this, provided that conditions are satisfactory.
2. Production of ice is necessary for the development of fisheries.
3. Experiments on depth trolling should be carried out as soon as possible and a complete record should be kept. The aim should be to determine "what is the smallest motor boat capable of carrying out depth trolling profitably with a native crew".
4. Fishing with handlines, fish traps and lobster traps should be experimented with. The aim should be to determine "what is the smallest motor boat capable of using these methods profitably with a native crew.
5. The same target as in 4 should be adopted in respect of nylon bottom gill nets. Experiments in this connection could be done with "Otule".
6. The transfer of edible oysters to Tonga for cultivation would be advisable.
7. An investigation of the position regarding trochus and mother of pearl shell appears to be necessary. The target should be the rehabilitation of the shell trade.
8. As long as no ice or cold storage facilities are available in Tonga, it would be advisable to encourage Mr. Cook to prepare his surplus whale meat as indicated in section IV.
9. An investigation of the biological cycle of the very valuable milkfish is advisable.
10. The inland waters (Vava'U lake and Sopa swamp) could be used for fish production.
11. The use of explosives to kill fish should be stopped immediately.

List of Fish Names

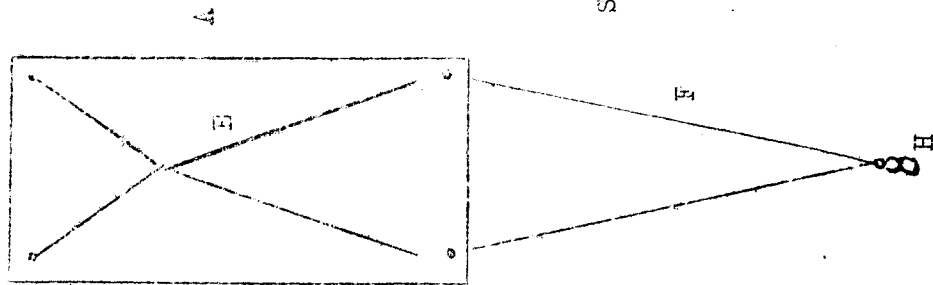
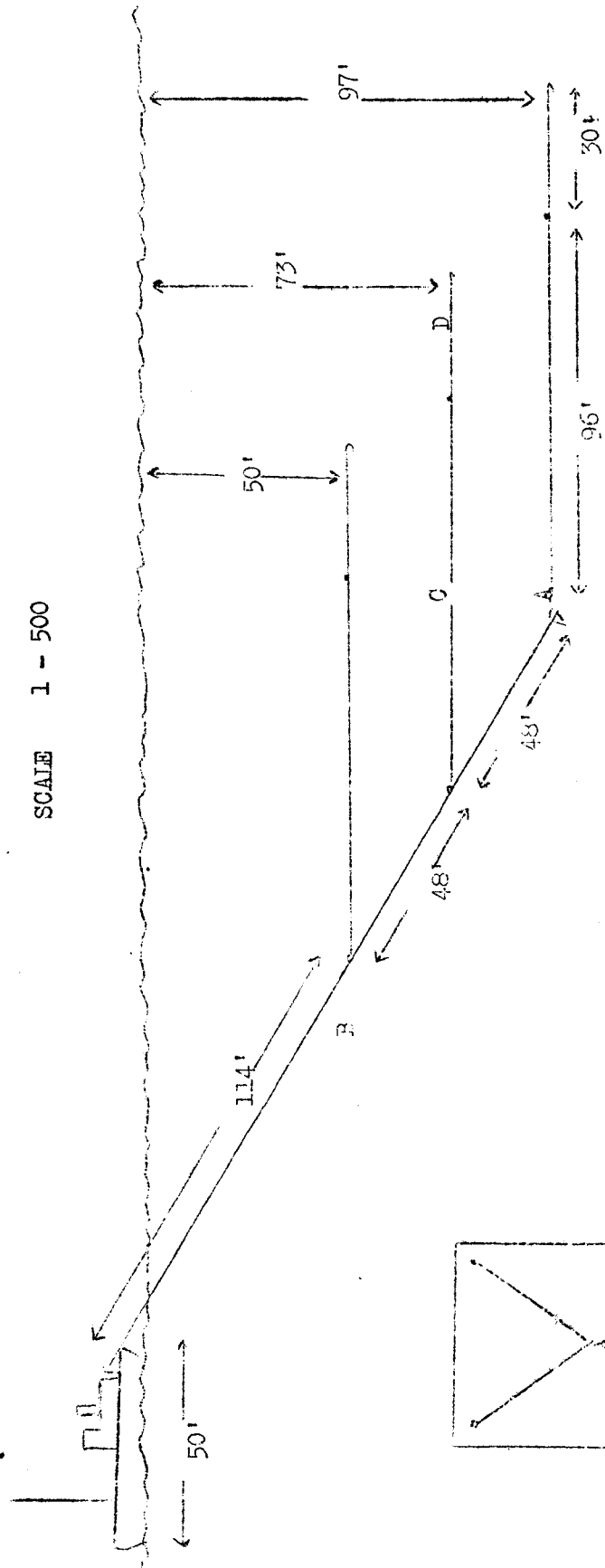
<u>Tongan</u>	<u>English</u>	<u>Scientific</u>
'Otule	Horse Mackerel	Caranx crumenophthalmus Bloch
Lemuru +	Herring	Clupea leiogaster C.V.
Palolo	Flying fish	Exocoetidae
Lajang +	Horse Mackerel	Decapterus macrosoma Blkr.
Ma'ava	x	Siganidae
Hu'ila	Halfbeak	Hemirhamphidae
Totao	Garfish	Belonidae
Fai	Ray	Myliobatidae
Valu	Spanish Mackerel	Cybiidae
Tonu	Rock cod	Serranidae
Takuo	Yellowfin tuna	Neothunnus macropterus
'Atu tonga	Dogtooth tuna	Gymnosarda nuda
Kanoe	Mullet	Mugilidae
'Ono	Barracuda	Sphyraenidae
Hapatu	Seapike	Sphyraenidae
Mata mea	x	Caranx mate C.V.
'Atu langi	x	Megalaspis cordyla L.
Meai tongasila	Parrotfish	Scaridae
Sipa sipa	x	Leiognathidae
Tanu tanu	Snapper	Lutjanidae
Manga	Snapper	Lutjanidae
Koango	Snapper	Lutjanidae
Vete	Surmullet	Mullidae
Mahi mahi	Dolphin	Coryphaenidae
Sifi sifi	Sailfish	Istiophoridae
Tafa'uli	Kingfish	Carangidae
Ava	Milkfish	Chanos chanos Forskal
Ngatala	Rock cod	Plectropoma maculatum Bloch
Kutu	Job fish	Aprion virescens Valenciennes
Nga'a	Mackerel	Scomber kanagurta Cuv.

x English name not known.

+ No local name, Indonesian name is mentioned



SCALE 1 - 500



SCALE 1 - 10

