



REPORT ON THE SOUTH PACIFIC COMMISSION

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OUTER REEF FISHERIES PROJECT IN THE COOK ISLANDS
(1 December 1975 — 31 May 1976)

by

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Project Manager

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SUMMARY

The Project arrived in Aitutaki, Cook Islands, in late November. Supply logistics limited the choice for a site of operations to either Rarotonga or Aitutaki, with the latter chosen as it was reputed to have larger stocks of outer reef fish.

As the main local fishing effort at Aitutaki is netting inside the lagoon and “fishing down” outside the main reef passage for yellowfin tuna, the Project concentrated on bottom fishing outside the reef, both day and night, and trolling and poling for schools of tuna and for barracuda and wahoo.

Bottom fishing at night, using electric reels with stainless steel lines in depths of 100 to 400 metres proved the most successful method of fishing throughout the period. Trolling for pelagic schools of yellowfin and skipjack tuna produced a smaller value of fish for a larger expenditure in fuel costs, making this latter type of fishing a marginally economic proposition. Night fishing close to the reef is strenuous and skilled work.

Average catches over the six-month period were 71.4 kg (157 lb) for night bottom fishing, 29.0 kg (63.7 lb) for day bottom fishing and 25.9 kg (57.0 lb) for trolling. A simulated commercial fishing effort for one month produced an average of 85.5 kg (188 lb) for overnight bottom fishing, and 29.0 kg (63.7 lb) for trolling.

Surplus fish, especially the larger fish, were frozen and air-freighted to Rarotonga to be sold through the Government freezer there. A buying, processing and marketing system to transfer excess Aitutakiaa fish to Rarotonga should be established. This might be operated by a Fishermen’s Co-operative, the Government or a local trader.

It has been demonstrated that Aitutaki can supply the Rarotongan market with limited quantities of high quality fish and it is recommended that every encouragement be given to the continuation and increase of catching and marketing such fish.

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INTRODUCTION

1. The South Pacific Commission Outer Reef Artisanal Fishing Project arrived [n Rarotonga, Cook Islands, in mid-November, the move from Asau, Western Samoa, having been delayed when the vessel chartered for the move went on the reef outside Suva Harbour. All equipment was off-loaded at Rarotonga while the *Manuvai* was despatched to Mangaia to collect a load of pineapples during peak season, re-loaded a week later and finally arrived at Aitutaki at the end of November.
2. The aims of the Project were to survey local resources at Aitutaki and assess the economic feasibility of fishing there commercially, to determine and demonstrate fishing techniques suitable to the area, and to train local fishermen.

AREA OF OPERATIONS

3. Manihiki, Penrhyn and Palmerston islands were originally considered as sites for the Project in the Cook Islands, as they were thought to have more abundant stocks of bottom fish than the islands of the southern group. However, a shipping frequency between the northern group and Rarotonga of one visit every six weeks to two months would have made the logistics of spare parts and replace-merit equipment too uncertain. Also the small populations on these islands and the very limited freezer capacities would have meant that much of the fish caught would have been wasted.
4. As Rarotonga was reputed to have a dearth of bottom fish. Aitutaki was chosen as the Project site since logistic support could be maintained with a regular air service from Rarotonga.
5. Aitutaki is 140 miles north-east of Rarotonga. It is a volcanic island situated at the northern apex of a large coral lagoon 14 km long with a maximum width of ii kin. The outer slope of the reef drops away rapidly “into deep water. Project boats were based at the Arutanga harbour basin with good shoreside facilities. The Arutanga boat passage, the only navigable entrance to the lagoon, is in the lee of the prevailing south-east trade winds but [s open to westerly and north-westerly winds which render the passage unusable about ten per cent of the time.
6. Bottom fishing was carried out mainly around the south-east and southwest corners of the lagoon where the reef shelved out 200 to 300 yards. Some bottom fishing areas were worked on the eastern side of the reef, but these were in the main too exposed to the trade winds. The trolling areas extended to 15 miles offshore.

PROJECT PERSONNEL

7. The Project team consisted of Project Manager, H.R. Hume; Mat Fisherman, R. Eginton; Boat Skipper/Fishermen, P.D. Mead and C.B. Scott and Marine Mechanic. N. Nicoll. Five Aitutakians were recruited through the Department of Agriculture and trained as fishermen.

BOATS AND EQUIPMENT

8. Boats used by the Project in Aitutaki were a New Zealand-built 2 aluminium boat, the *Norman Kirk*, driven by a 70 h.p. Nissan Datsun diesel and a Hamilton 1011 jet unit. This boat was underpowered and too slow for trolling for fast-moving schools of tuna, but proved a satisfactory platform for bottom fishing where the fishing grounds were within a short range of base. *Norman Kirk* also proved a good boat for bait trips within the Aitutaki lagoon with its many shallow coral heads. For the first time since the commencement of the Project the aluminium hull therefore had an opportunity to prove its strength and durability.
9. The Project's second Pago Pago-built 'Oregon dory', the 24 ft plywood *Tangaroa*, driven by a 70 h.p. Chrysler-Nissan diesel engine with a conventional shaft and propeller, was used for both bottom fishing and trolling and proved a sound boat.
10. The third fishing vessel used was a 28 ft. Apia-built *Viking* based on a modified FAO design with an inboard 33 h.p. Perkins diesel engine. It was the prototype for a series of inboard diesel boats to be built in Western Samoa for artisanal outer reef fishing and had some of the minor problems normally associated with prototypes, but shows promise of being a good low-cost design suitable for village-level fishing in the South Pacific.
11. Kept in reserve but not used in Aitutaki was the Project's original Pago Pago dory, the *Manulele*, powered by a 135 h.p. Lees Marine Ford Falcon petrol engine and a Hamilton 750 jet unit.
12. A Resco block icemaker, driven by a 5 h.p. 440 volt 3 phase electric motor, with a capacity of 1,000 lbs ice/12 hours, was used throughout and proved invaluable.
13. The 18 cubic metre Soconair modular freezer was not used in Aitutaki as local walk-in freezers were available. The Project's domestic 22 cu. ft freeze unit was used for bait and short-term stowage of fish caught.
14. An assortment of fishing equipment from the United States, Japan, Australia and New Zealand was carried. A list of basic equipment for the FAO-designed vessel is included as Appendix III to this report.

POISONOUS FISH

15. Ciguatera poisoning is rare in the Aitutaki region. Both rock cod and a small species of surgeon fish have been known to be poisonous at times and as a result are not sold locally.
16. On a recent visit to the Northern Cooks, Mr D.J. Brandon, SPC Biologist in charge of the Cook Island Turtle Project, gathered information on ciguatera poisoning on Penrhyn Island where there has been a noticeable increase in toxicity in recent years. The results of this study are given in Appendix IV to this report.

TRAINING

17. Five men were trained by the Project in Aitutaki, three from the Department of agriculture and two more recruited through the Department. They were trained in all aspects of bottom fishing and trolling, care and handling of fish, rigging, preparation of gear including net mending, and boat handling.
18. Regrettably no further volunteers for training were available. Approaches were made to the acting Headmaster of the Aitutaki Junior High School and to the Director of Secondary Education for the Cook Islands, who was provided with a proposed training syllabus for pupils leaving school, but no candidates were forthcoming.
19. The five men trained were all energetic and keen to learn and proved competent to handle and fish the Project boats.

FISHING EFFORT

20. The main local fishing effort at Aitutaki is concentrated on netting inside the lagoon for bonefish, goatfish, mullet and akule (purse-eyed scad), often a village co-operative effort; and on a yellowfin season lasting from February to May, when up to 40 canoes a day 'fish down' outside the main Arutanga passage where the yellowfin feed at depth on the organic debris that is swept out of the lagoon. The Project effort was devoted mainly to deep bottom fishing, both night and day, outside the reef, and to trolling outside the reef for yellowfin, skipjack tuna, barracuda and wahoo.
21. Bottom fishing was carried out mainly around the south-east and south-west corners of the atoll where the reef shelved out 200 to 300 yds. Some fishing areas were worked on the eastern side of the reef but these were in the main too exposed to the trade winds. The major species caught were castor oil fish, snake mackerel, red snapper, rosy job fish and cod.

22. Catch totals for overnight bottom fishing for six months were 1,493.2 kg or 3,285.0 lbs, averaging 59.7 kg or 131.4 lbs per trip. If pelagic fish trolled on the way to and from the fishing grounds are included, these figures increase to a total of 1,784.8 kg or 3,926.6 lbs, averaging 71.4 kg or 157.1 lbs per trip. For day bottom fishing 463.5 kg or 1,019.7 lbs of fish were caught, averaging 29.0 kg or 63.7 lbs per trip. In general, the largest catches, between 100 and 200 kgs, were taken at night, using tuna bait. Night fishing, particularly on dark moonless nights, while definitely more productive, requires experienced fishermen and boat handlers who are prepared to work and arduous hours in close proximity to the reef area.
23. The limiting factor in bottom fishing in Aitutaki is the narrow area of outer reef area that could be fished to a maximum depth of 200 fathoms 400 metres.
24. Schools of yellowfin and skipjack tuna, both separate and mixed, were seen infrequently and proved difficult to troll as they were often moving faster than the Project's boats could travel. Trolling catches by the Project totalled 1,216.8 kg or 2,676.9 lbs averaging 25.9 kg or 57.0 lbs per trip. Apart from a few local expatriates, very few of the local fishermen attempt trolling out: the reef as the running costs are too high for the meagre returns. An exception to this generalization is said to be during the period July to October when large wahoo are reputed to be plentiful. This period was, however, outside the Project's term in Aitutaki.
25. The March figures for catches from the boat skippered by P, Me were considered as a simulated commercial fishing exercise. During this period a total of 768 kg or 1,689.6 lbs of fish was caught, averaging 54.9 kg or 120.69 lbs per trip. Overnight bottom fishing figures (including fish trolled the way to and from the fishing grounds) totalled 513 kg or 1,128.6 lbs, averaging 85.5 kg or 188.1 lbs per trip for six trips, while the trolling total was 289.0 kg or 637.3 lbs averaging 29.0 kg or 63.7 lbs per trip.
26. One of the main requirements for the best possible returns at Aitutaki is flexibility. Each fishing vessel should be rigged and equipped for bottom fishing and trolling, with a good selection of lures, in order to take advantage of whatever opportunities are available.
27. Unsuitable weather (west and north-west winds) made the Arutang passage unworkable between five and ten per cent of the time. The south-east trades made bottom fishing on the eastern side of the lagoon impossible about 50 per cent of the time and trolling in the eastern sector was impossible about 25 to 30 per cent of the time.
28. It must be emphasised that the catch rates quoted are based on a relatively light fishing effort over a comparatively short period. The magnitude the stocks cannot therefore be adequately assessed. A heavy fishing effort over a sustained period could well result in a reduced catch rate, where stocks are small, on the limited outer reef fishing grounds available.

MARKETING¹

29. Fish caught were either sold locally in Aitutaki or flown to Rarotonga for sale. The monies received from the sale of fish were paid to the Department of Agriculture. The selling price in Aitutaki was 30 cents per lb of green fish. Local preference was for tuna and the smaller specimens of the bottom snapper, rosy job fish, cod, savane and snake mackerel.
30. The larger snapper, castor oil fish and yellowfin were often too large to be sold whole in Aitutaki, and they were frozen, packed in plastic bags and airfreighted to Rarotonga by Cook Islands Airways Islander aircraft. Arrangements were made the previous day for the plane to be met on arrival at Rarotonga and the fish was taken to the Government Freezer where it was usually sold within the hour. The selling price in Rarotonga was approximately 45 cents per lb, which included 11 cents for air freight and five cents for the Government Freezer handling commission.
31. The Rarotonga market has the capacity to absorb large quantities of both frozen and fresh fish and it is considered that local Aitutakian fishermen could readily adopt this marketing procedure to sell surplus fish, especially during the yellowfin season, providing the Government Freezers in Aitutaki could be made available on a regular basis.
32. The present return for Aitutakian fish sold in Rarotonga is 29 cents/lb. This does not include costs for ice, freezer facilities or transport from the freezer to the airfield in Aitutaki. If these extra costs are to be considered then the return to the fisherman is depressed further, providing little if any, incentive for him to provide fish for the Rarotongan market.
33. Shipping as an alternative method of transport proved unsatisfactory during the six months the Project was in Aitutaki; the *Ravakai* was rarely very available, the *Manuvai* does not have refrigerated stowage, and the condition of the walk-in freezers in Aitutaki made it risky to stockpile large quantities of fish awaiting shipping.
34. To provide good quality chilled or frozen fish from Aitutaki for the Rarotongan market, some further incentive must be offered the local fisherman. This could be either a Government subsidy if it was intended to keep the price down in Rarotonga, or a premium price placed on quality fish flown from Aitutaki.
35. Deep water shark were caught during bottom fishing at night. There was no market for shark meat in Aitutaki, and as species caught lacked the normal odour associated with shark flesh, three consignments were flown to Rarotonga for trial. After some initial publicity and sales, buyer resistance to shark re-asserted itself and further supply of this meat was therefore stopped.

¹ All prices in this and the following sections are expressed in New Zealand dollars.

ECONOMICS OF FISHING IN THE AITUTAKI AREA

36. The following average values of catches were obtained for bottom fishing and trolling:

I. **Overnight Bottom Fishing**

(with trolling to and from the fishing ground)

Average hours underway per trip	4.42
Average diesel consumption per trip	8.84 galls.
Average cost of fuel per trip (diesel at 67 c/gall.)	\$5.92
Average catch per trip	157.06 lb
Value of catch at 30 c/lb	\$47.12
Average return per trip	\$41.20

II. **Day Bottom Fishing**

Average hours underway	3.23
Average diesel consumption	6.46 galls.
Average cost of fuel per trip	\$4.33
Average catch per trip	63.72 lb
Average value of catch	\$19.12
Average return per trip	\$14.79

III. **Trolling**

Average hours underway	6.8
Average diesel consumption	13.6 galls.
Average cost of fuel per trip	\$9.11
Average catch per trip	56.96 lb
Average value of catch at 30 c/lb	\$17.09
Average return per trip	\$7.97

37. For the simulated commercial fishing exercise for March the total value of the catch was \$506.88. Fuel consumption was 171.6 galls, at \$0.67/gall. totalling \$114.97. Hence returns for the month were \$391.91.
38. The above figures do not allow for crew wages, boat depreciation, lubricant or ice costs.

39. From these figures it becomes apparent that a fishing operation based on trolling would be uneconomic, the possible exception being during the wahoo season mentioned in the previous section. Day bottom fishing also provides a meagre return. This leaves overnight bottom fishing, Where reasonable returns might be expected for two or possibly three boats with a crew of two mounting two mechanical reels each. This requires skilled and hard-working personnel.
40. The other potentially economic fishery is for yellowfin. (Information below was kindly provided by Mr Rio Ngere, a leading Aitutaki fisherman). This season, although short, proved productive this year with average daily catches of between 30 and 50 fish, and maximum total daily catches in the region of 100 fish a day. The largest one-man catch was 13 fish, with most tuna weighing between 30 and 40 lbs and a few weighing up to 70 lbs. This is a labour-intensive type of fishing with few overheads, as most of the boats used are outrigger canoes paddled to and from the fishing grounds. The hours are long, with most of the boats fishing eight to ten hours per day. Most boats are fished single-handed.
41. Although efforts have been made in the past to ship yellowfin, to Rarotonga, this was not done in 1976 as there was a lack of local shipping between Aitutaki and Rarotonga and the Government freezers in Aitutaki were not always operational.

FOLLOW-UP OPERATIONS

42. To encourage overnight bottom fishing it is essential that ice be available so fishermen at a nominal cost. The SPC ice-making plant must leave Aitutaki with the Project as it will be needed at the next area of operation. The housing structure however, will remain and makes a good site for a replacement ice-maker.
43. The provision of ice allows the local fisherman to fish longer hours without fear of his fish going bad and permits him some choice in where and when to sell his catch on return to harbour after a night's fishing. Block makers of the type used by the Project would be suitable, for Aitutaki. It is recommended that Government or aid funds be Sought to provide a block ice- maker.
44. Three walk-in Government freezers are situated at Arutanga. However, one of these is currently out of action, and another only operating down to 0°C. There is a need for these freezers to be made available for local fishermen on a regular and organised basis. It is also recommended that someone from Aitutaki be sent to New Zealand for a course in refrigeration equipment repair and maintenance.

45. If fish surplus to Aitutaki's needs are to be provided for the Rarotongan market, the local fishermen require a marketing organisation to collect, process, handle and transport fish from the arrival of the catch in harbour to delivery to the Government Freezer in Rarotonga. The following types of organisation might be considered:
- a) a Fisherman's Co-operative Society;
 - b) Government buying of fish in Aitutaki;
 - c) a local trader or entrepreneur buying fish direct from the fishermen in Aitutaki.
46. Although co-operatives do not appear to have much support in Aitutaki, the establishment of one locally would reduce the need to pay the commission that a local trader or storekeeper (with freezer space) would require. If the Government were to undertake the buying of local fish, it would need to appoint a Fisheries Officer or representative in Aitutaki who could also promote local fishing ventures and give technical advice.
47. To provide an incentive for Aitutakian fishermen to sell their surplus catch in the capital, it would be necessary for the Government to subsidize the sale of fish or for the Government Freezer to provide a premium price for quality fish. The already low return to the fishermen of 29 c/lb would be still further reduced by additional commissions or handling charges.
48. The fishermen trained by the Project are all competent to fish their own boats but lack the funds necessary to finance themselves. It is recommended that consideration be given to providing loans to fishermen for the purchase of low-cost fishing vessels, reels and equipment. In Western Samoa such aid has been provided by DANIDA, a Danish Government Aid Scheme, through the Western Samoan Development Bank. Low cost loans are made available to *bona fide* fishermen at the village level, often with little security. If the loans are repaid in six months a 20 per cent discount is offered; the discount is 10 per cent if repayment is made within the first year. If the loan is repaid within two years there is no discount and thereafter increasing interest rates are charged.
49. The remarks in the above section apply to Aitutaki but could equally well apply to the other outer islands as assessed by the Director of Marine Resources, Mr T. Marsters, and the FAO Fisheries Advisor, Mr C. Edwards. Aitutaki's main asset, however, is its regular air service with Rarotonga providing for the rapid transportation of good quality fish.

SUMMARY OF RECOMMENDATIONS

1. It is recommended that a block ice-maker with a capacity of approximately one ton per day be installed at Aitutaki.
2. It is recommended that the three Government walk-in freezers be made available on a regular and organised basis to all fishermen.
3. It is recommended that someone from Aitutaki be selected to undergo a refrigeration maintenance and repair course in New Zealand and on return be responsible for the upkeep and operation of the Government freezers.
4. It is recommended that an organisation responsible for the buying, processing, transportation and marketing of fish be set up in Aitutaki; this organisation to take the form of a Fisherman's Co-operative, direct Government buying or a local merchant/trader operation.
5. It is recommended that the Government consider subsidising the sale of Aitutakian fish sold in Rarotonga or alternatively that a premium price be placed on high-quality fish sold through the Government Freezer as an incentive for the larger consignments of Aitutakian fish to be flown to the Rarotongaa market.
6. It is recommended that interest-free or low-interest loans be made available to *bona fide* fishermen in Aitutaki to purchase low-cost local-design fishing vessels, reels and equipment.
7. It is recommended that aid funds be sought to implement recommendations 1, 3 and 6 above.
8. It is recommended that every encouragement be given to increasing the volume of fish transported from Aitutaki to Rarotonga, in order to assist in reducing the amount of frozen and canned fish imported from overseas.

APPENDIX I

FISH SPECIES CAUGHT

by
R. Eginton
SPC Master Fisherman

Scientific Name	English Name
<i>Etelis carbunculus</i>	Red snapper
<i>Aphareus rutilans</i> Cuvier	Small tooth jobfish
<i>Apion microlepis</i>	Bleeker Rosy job fish
<i>Tropidinius zonatus</i>	Snapper?, savane
<i>Ruvettus pretiosus</i>	Castor oil fish
<i>Gempylus serpens.</i>	Snake mackerel
Epinephelidae	Cod, Groper
Carangidae	Trevally
<i>Seriola purpurascens</i>	Amberjack
<i>Lujanus bohar</i>	Red bass
<i>Katsuwonus pelamis</i>	Skipjack tuna
<i>Neothunnus macropterus</i>	Yellowfin tuna
<i>Gymnosarda nuda</i>	Dogtooth tuna
<i>Coryphaena hippurus</i>	Dolphin fish
<i>Acanthocybium solandri</i>	Wahoo
<i>Sphyrnaenidae</i>	Barracudas
<i>Selar crumenophthalmus</i>	Purse-eyed scad
<i>Variola louti</i>	Lunar-tailed cod
<i>Muraenidae</i>	Moray eel
<i>Pontinus macrocephalus</i>	?
<i>Hexanchus griseus</i>	Six gill shark
<i>Pristipomoides</i> sp.	Job fish

Notes:

1. One species of *Pristipomoides* could not be identified. A specimen has been forwarded to the Australian Museum, Sydney, for identification.
2. No *Lutjanus malabaricus* (Scarlet sea perch) were caught at Aitutaki. This species comprised a large percentage of the catch in both Western Samoa and the New Hebrides.

FISHING METHODS

by
R. Eginton
SPC Master Fisherman
and
P. Mead
SPC Fisherman

The Project concentrated on deep water demersal line fishing outside the reef, using "Electric Snapper" reels (winch type). The reels were used both electrically and manually.

The fishing tackle was basically the same as that used previously in Western Samoa and the New Hebrides, and consisted of: the main line of 2,000 ft of flexible multistrand stainless steel wire of 3/64 inch diameter, with a breaking strain of 275 lbs; a leader, 10 to 15 fathoms long, of 250 lbs breaking strain monofilament was used instead of the usual rubber snubber. The leader was necessary to provide spring or stretch to the steel line.

A size 7 or 9 bronze torpedo-type swivel was attached to the end of the stainless steel main line. Bronze sleeves and crimping pliers were used to form the loop to take the swivel, and also to join the main line when it became necessary to cut out sections of frayed or broken line.

A McMahon Snap swivel, size No. 4, was used on the end of the nylon leader; the wire terminal leader and hooks then being simply clipped to the swivel.

It was necessary to use wire terminal gear and hook traces because otherwise fish and gear were lost.

Japanese long line galvanised wire was used to make the terminal and hook traces. Tuna circle hooks were used entirely when bottom fishing; the sizes ranged from No. 7, the smallest, to No. 3.

Three hooks per line were usually fished, more hooks causing tangles in the deep water. The hooks were spaced approximately two feet apart on the terminal trace with hook traces of 12 inches, the sinker was spaced one to three feet lower than the bottom hook of the rig.

The "Electric Snapper" reels used were efficient. They were operated from a bank of twelve volt batteries and had an amperage draw of 30 amps with a moderate load and of 20 amps running free. The reels will fish to a depth of 300 fathoms and the line recovery rate is approximately 55 fathoms per minute. The reels can be used manually; in fact, when a large fish is hooked it is necessary to operate the reels manually until the fish is played out.

Two “Electric” reels were fitted to each boat.

The *Viking*, the 28-foot boat built in Apia, could fish three reels.

The reef drops away steeply outside the lagoon of Aitutaki. There are only two small banks, one off Maina Islet at the south-west point of the lagoon, and the other off Motukitui Islet at the south-east point. Even these banks only extend for 100 to 200 yards from the outer edge of the barrier reef. They proved to be the most productive areas for demersal fish.

Because of the steep gradient of the reef it was impossible to obtain any satisfactory echo sounder traces of the bottom deeper than 20 fathoms. No sharp peaks or trenches, where fish are more likely to school, could be identified.

The wind dictated the area that could be fished. The boats had to anchor on the ledge before the drop-off, and then pay out sufficient anchor warp to fish in the depths desired. The drop-off was too steep for the anchor to hold, and a sudden change of wind during the night could swing the boats on to the reef amongst the breakers.

Fishing at night, especially on moonless nights, yielded more than day fishing. The depths fished ranged from 40 fathoms to 200 fathoms; no fish were taken over 180 fathoms. The main species caught were normally taken in the following depths:

<i>Pristipomoides</i> sp.)	
<i>Aphareus rutilant</i>)	70 to 120 fathoms
<i>Aprion microlepi</i>)	
<i>Etelis carbunculus</i>	120 to 150 fathoms
<i>Epinephelidae</i> sp.	50 to 150 fathoms
<i>Tropidinius zonatus</i>	100 to 150 fathoms
<i>Ruvettus pretiosus</i>)	
<i>Gempylus serpens</i>)	Over 150 fathoms

Several *R. pretiosus* were caught off the bottom at 40 to 50 fathoms when the boat was anchored in 00 fathoms.

G. serpens were also caught at the Same depth when drifting off the reef and with no bottom trace showing on the sounders at 480 fathoms. *R. pretiosus* weighing 103 pounds and *S. serpens* weighing 50 pounds were caught.

A number of very large *E. carbunculus* weighing up to 80 pounds were taken, but the average size was only two pounds, whereas in Western Samoa the average size was 40 pounds and the largest taken there weighed 60 pounds The best bait again proved to be skipjack.

Trolling was not very productive. Schools of rana, both yellowfin and skipjack, were fished at times. Occasionally they bit well, but quite often the schools were travelling so fast that the boats could not keep up with the fish. The appearance of the schools was very irregular; one day a fair catch would be made. then the schools would not be sighted again for several weeks.

Wahoo, barracuda and dogtooth tuna were occasionally caught close to the reef.

Four lines were usually trolled, two from outriggers made up of 250 lb test monofilament nylon with a backing of 5 mm Polypropelene rope, and two stainless steel line from the "Electric" reels. The "Electric" reels were excellent for trolling, especially for landing large fish. Trolling was also carried out by the boats on their way to and from the bottom fishing grounds.

A variety of lures were trolled. Yellowfin were taken on large feather, squid and spoon lures. Skipjack showed a preference for 1/4 to 1/2 oz. feather lures with a pearl shell head. Very large red squid lures were best for wahoo.

When trolling for yellowfin the boat's speed was reduced to about four knots when amongst the school, but with skipjack the speed was kept at eight to ten knots. A number of lures available are effective in attracting fish, but because of the poor quality of hooks fitted to them by the manufacturers over hall the fish hooked are lost. A double hook, forged and bronzed, was found to be the best type. These hooks are difficult to obtain in the area fished by the Project but are obtainable from Norway.

During the mouths of January and February the tuna were feeding on juvenile surgeon fish. These juvenile fish. which were opaque, later entered the lagoon and changed colour to black after a few days. The Aitutakians say that the small fish drive the larger surgeon and parrot fish from the lagoon. This did indeed occur and a large quantity of big fish leaving the lagoon by shallow passages were netted. The Aitutakians can predict several weeks in advance when the main run of large fish will leave the lagoon.

APPENDIX III

LIST OF BASIC FISHING EQUIPMENT FOR AN FAO 28 FT. FISHING VESSEL

by
R. Eginton
SPC Master Fisherman

	A\$
2 manual snapper winch reels (or 2 electric snapper winch reels — \$590)	260
4 x 1000 ft 3/64" stainless steel wire (sufficient wire for reels to fish in depths to 200 fathoms or 400 metres)	250
1 No. 00 hand sweet	
200 3/64" copper cable connectors	18
6 rubber snubbers	
1 x 6 lb tube 150 lb test mono filament line	65
1 x 6 lb tube 250 lb test mono filament line	65
100 No. 6 tuna circle hooks	12
100 No. 7 tuna circle hooks	12
100 No. 8 tuna circle hooks	12
24 Kelux stainless steel Lockfast swivels	
200 ft. stainless steel 200 lb test trace wire	20
Anchors)	
Ropes)	as required
Sinkers)	

APPENDIX IV

POISONOUS FISHES OF PENRHYN

by
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SPC Turtle Project Biologist

The Maori names of fishes given in this list were supplied by Dr R. Woonton, until recently Medical Officer, Penrhyn. The English common names and scientific names were supplied by Messrs Ron Powell, Tekaki Williams and Tom Marsters with reference to the SPC publication Fish Poisoning in the South Pacific.

The scientific names may not all be exact but will suffice to give an idea of the kind of fish involved.

There is a belief in Penrhyn that the recent increase in cases of fish poisoning is related to the nuclear bomb blasts at Mururoa atoll. A much more likely reason for the increase in ichthyosarcotoxism, however, is a hurricane which struck Penrhyn five years ago and caused widespread damage to the reef coral. A rapid increase in new corals in the reformation of the destroyed sections of the reef could initiate the sudden increase in the occurrence of ciguatera poisoning. This theory is partially supported by the fact that the incidence rate of fish poisoning has declined markedly with time following a peak shortly after the hurricane.

Maori Name (Penrhyn)	English Name	Scientific Name
Taiva	Snapper	<i>Lutjanus bohar</i> *
Roi	Coral cod	<i>Cephalopholis miniatus</i>
Tonu	Grouper	...
Haroa	Snapper	<i>Lutjanus vaigiensis</i>
Pusi	Moray eel	<i>Gymnothorax</i> *
Hangamea	Red Emperor	<i>Lethrinus</i> *
Rahl	White Parrot	<i>Scaridae</i> *
Maratea	Wrasse	<i>Cheilinus undulates</i> *
Maito	Surgeon Fish	<i>Ctenochaetus striatus</i> *

* relatively accurate description.

The maito and rahi are nearly always poisonous in one particular area of the reef; no reason for this was discovered.

APPENDIX V

AVERAGE CATCH COMPARISONS: NEW HEBRIDES, WESTERN SAMOA AND COOK ISLANDS

1.	All fishing	kg	lb
	New Hebrides	53.4	117.48
	Western Samoa	71. 61	157.53
	Cook Islands	37.22	81.89
2.	Night bottom fishing		
	New Hebrides	71.1	156.42
	Western Samoa	82.73	182.0
	Cook Islands	71.39	157.06
3.	Day bottom fishing		
	New Hebrides	42.2	92.84
	Western Samoa		
	Cook Islands	28.97	63.73
4.	Trolling		
	New Hebrides	57, 6	126.72
	Western Samoa.	27.73	61.0
	Cook Islands	25.89	56.96
5.	Simulated commercial fishing		
	Western Samoa:		
	Bottom fishing	63.95	140.7
	Trolling	81.64	179.6
	Cook islands :		
	Bottom fishing	85.5	188.1
	Trolling	28.97	63.73

Note:

It is relevant that the Project has improved its equipment, techniques and experience since the early days in the New Hebrides.