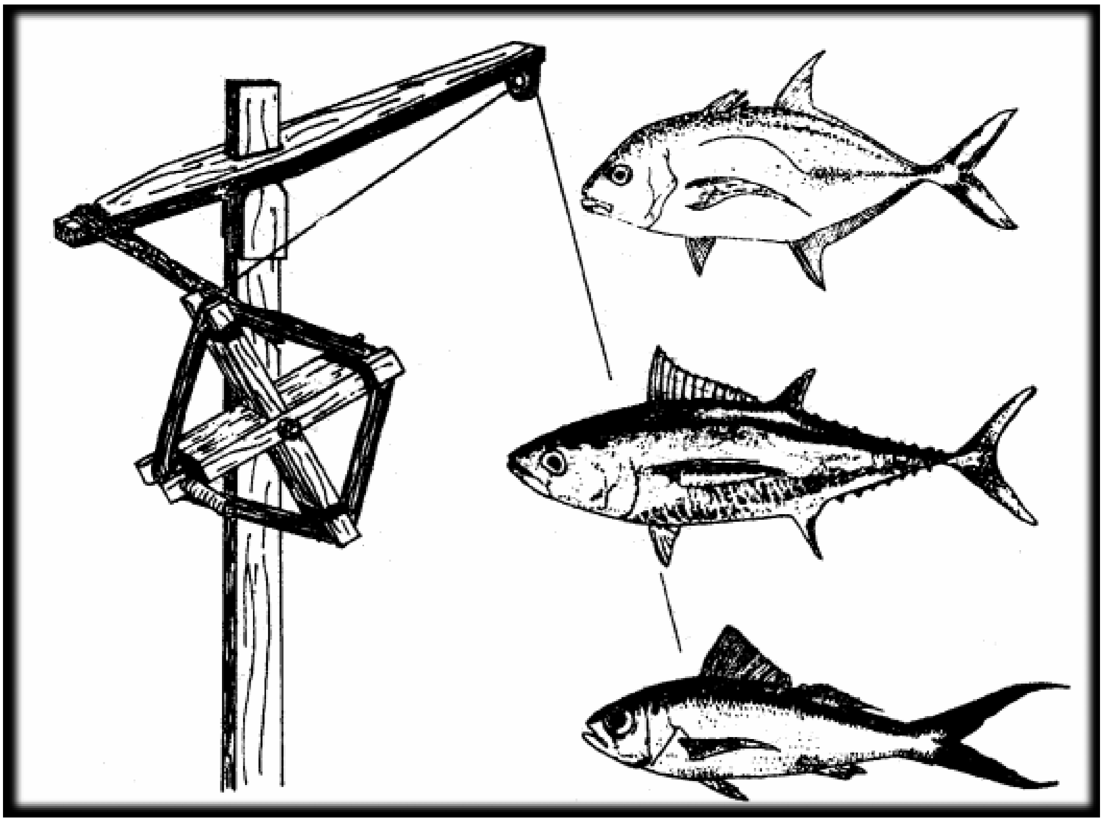
DEEP SEA FISHERIES DEVELOPMENT PROJECT

Report Visit to

COOK ISLANDS

10 September 1981 — 29 March 1982



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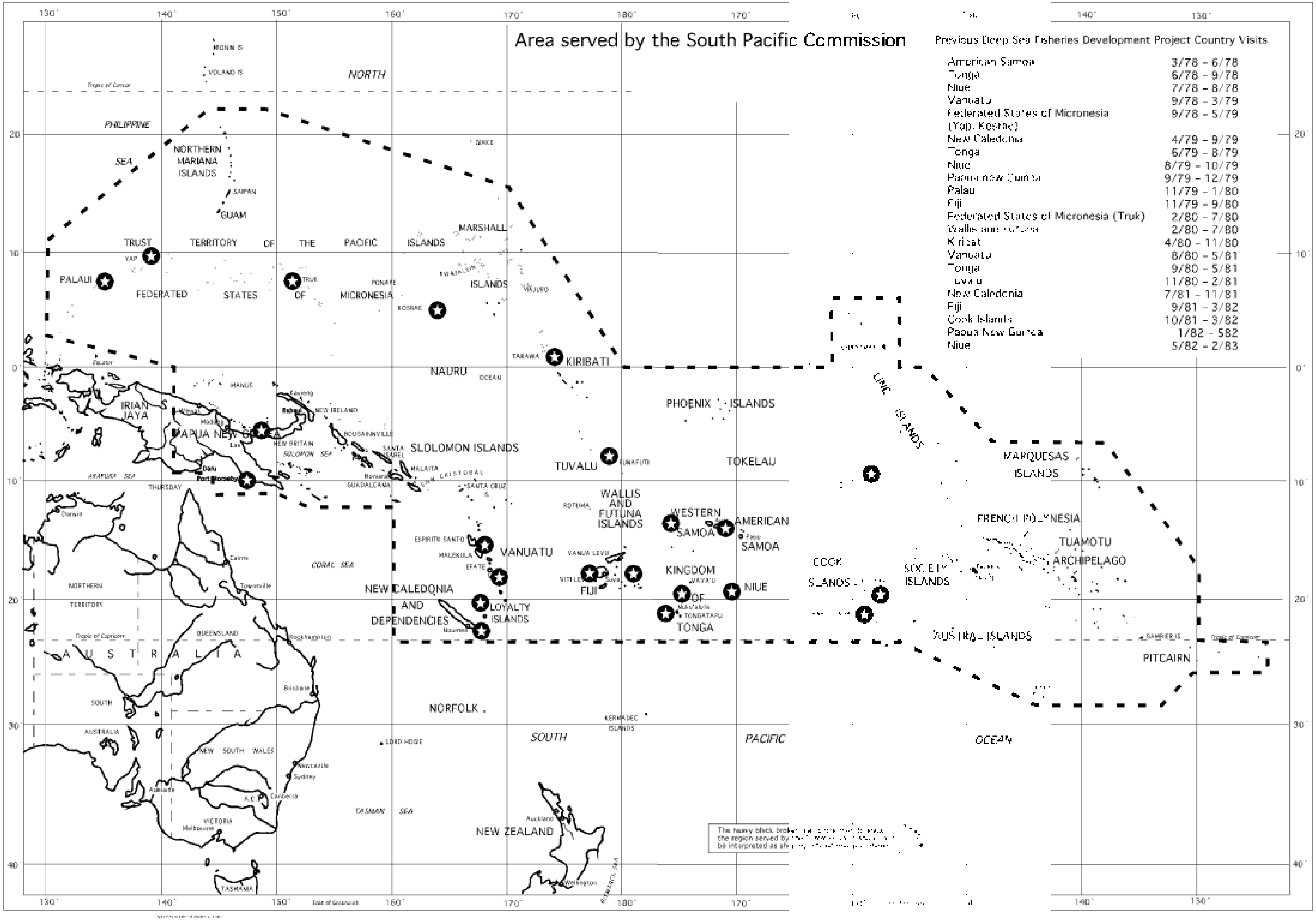

Previous Deep Sea Fisheries Development Project Country Visits

American Samoa	3/78 - 6/78
Tonga	6/78 - 9/78
Niue	7/78 - 8/78
Vanuatu	9/78 - 3/79
Federated States of Micronesia (Yap, Kosrae)	9/78 - 5/79
New Caledonia	4/79 - 9/79
Tonga	6/79 - 8/79
Niue	8/79 - 10/79
Papua New Guinea	9/79 - 12/79
Palau	11/79 - 1/80
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Federated States of Micronesia (Truk)	2/80 - 7/80
Wallis and Futuna	2/80 - 7/80
Kiribati	4/80 - 11/80
Vanuatu	8/80 - 5/81
Tonga	9/80 - 5/81
Tuvalu	11/80 - 2/81
New Caledonia	7/81 - 11/81
Fiji	9/81 - 3/82
Cook Islands	10/81 - 3/82
Papua New Guinea	1/82 - 582
Niue	5/82 - 2/83

SOUTH PACIFIC COMMISSION

Deep Sea Fisheries Development Project

Report of visit to

COOK ISLANDS

10 September 1981 to 29 March 1982

by

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and

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SUMMARY

The South Pacific Commission's Deep Sea Fisheries Development, Project operated in the Cook Islands for approximately 7 months between 10 September 1981 and 29 March 1982, under the supervision of SPC Master Fisherman Pale Taumaia. The main objectives of the visit were to conduct preliminary assessments of the deep-bottom fish resources, evaluate the potential for commercial deep-bottom dropline fishing operations, and provide training to Government and private fishermen in this fishing technique, at two islands: Rarotonga, the administrative centre of the group, in the south, and Penrhyn, a remote atoll in the north.

Twenty-five fishing trips were completed and a total of 2,855 kg of fish caught by the two principal fishing methods, deep-bottom droplining and trolling.

The results of the Project's fishing activities suggest that the deep-bottom fish resource around Rarotonga is impoverished and unlikely to support commercial small-boat fishing activites at the present time. In contrast, the resource at Penrhyn is highly productive but the local market is limiting and commercial fishing activities are unlikely to flourish unless the catch can be transported to Rarotonga or other areas where much higher prices prevail.

1. INTRODUCTION

The South Pacific Commission's Deep Sea Fisheries Development (DSFD) Project is a mobile village level rural development project which operates in Pacific Island nations at specific Government request, and which has the following broad objectives:

– to promote the development or expansion of artisanal fisheries throughout the region based on fishery resources which are at present underutilised, and in particular the deep bottom resources of the outer reef slope;

– to develop and evaluate new simple technology, fishing gear and techniques suitable for use by village fishermen, which will enable fishermen to substantially increase catches while reducing dependence on costly imported fuels;

– to provide practical training in appropriate fishing techniques to local fishermen and government fisheries extension workers.

The DSFD Project in 1978 superseded the SPC Outer Reef Artisanal Fisheries Development (ORAFD) Project, which visited the Cook Islands in 1975/76. The results of survey work carried out during this visit indicated the presence of a sizeable deep bottom resource at Aitutaki, but concluded that a fishery based on this resource would not be economically viable (Hume, 1976). However, subsequent experience suggested that the ORAFD Project results from Aitutaki may not be representative of the Cook Islands as a whole, and that further investigation in other locations was justified.

At the request of the Cook Islands Government, the Deep Sea Fisheries Development project, under the direction of SPC Master Fisherman Mr Pale Taumaia, spent just under seven months in the Cook Islands, from 10 September 1981 to 29 March 1982, working on both Rarotonga and Penrhyn. The fisheries situation is quite different at each of the two islands, and specific aims were identified for each location as follows:

a) Both islands:

   i) to survey available or accessible fishing grounds and provide a preliminary assessment of the deep bottom fish resources of the islands;

   ii) to evaluate the potential for commercial exploitation of the deep bottom resource;

   iii) to train a counterpart fisheries officer in appropriate fishing techniques and extension methods to enable him to conduct training programmes in deep-bottom fishing on other islands;

b) Rarotonga:

   iv) to train a government demonstration team in the techniques of deep-bottom fishing;

c) Penrhyn:

v) to stimulate interest in the exploitation of deep-bottom resources through the demonstration of simple, inexpensive gears and techniques, and to provide practical training in deep-bottom fishing techniques to interested fishermen.

2. BACKGROUND

2.1 General

The Cook Islands archipelago (figure 1) comprises two distinct groups, the Northern and the Southern, spread out over an area extending from 8 degrees S to 23 degrees S latitude, and from 156 degrees W to 167 degrees W longitude. The Southern Group contains eight islands or island clusters including Rarotonga, where the administrative headquarters of Avarua is located, and the Northern Group seven such clusters. In fact the true number of islands is much greater than these 15, since some clusters such as Manihiki and Penrhyn contain more than 20 islands and islets. Some of the islands are of volcanic origin, others are parts of atolls, and their total combined land area is approximately 240 square kilometres (Anon, 1981). However, because the islands are so widely scattered, the Cook Islands 200-mile exclusive economic zone of 1,969,448 square kilometres (SPC estimate) is the sixth largest in the SPC area.

The Cook Islands lie within the hurricane belt but hurricanes are not frequent (Anon, 1969). Throughout the archipelago easterly winds blow roughly 60% of the time from April to November. From December to March northeasterly winds prevail at least 50% of the time (Van Pel, 1955). Mean monthly wind speeds are all between 5 and 8 knots (Anon, 1969).

The population of the Cook Islands was estimated from a limited survey carried out in early July 1981 to number 17,695 (Turua, 1982). This represents a decline on the earlier census figures of 18,127 in 1976, and 21,323 in 1971, which is largely attributable to the continuing emigration of Cook Islanders to New Zealand (Anon, 1981). Of the 1981 population, 9,477 (52%) were estimated to be resident on Rarotonga.

The local economy is heavily dependent on imported foods, raw materials and most other commodities. Imports to the end of December 1981 were valued at NZ$28,735,000, of which NZ$6,009,000 were foodstuffs (Turua, 1983). Exports in the same year valued NZ$5,014,000, of which clothing, citrus juice and bananas were the main items, with tourism also playing an important part in generating foreign revenue (Turua, 1982). Exports of fishery products were restricted to NZ$322,700 worth of pearl shell and NZ$8,100 worth of shell handicrafts.

2.2 Fisheries

In general, fishing activity is at subsistence level throughout the archipelago, the main artisanal fishing methods being netting, handlining and spear fishing (Brown, 1981). The annual artisanal catch in the Southern Group (Rarotonga, Aitutaki, Mangaia, Atiu, Mauke, Manuae, Takutea and Mitiaro) has been estimated to be between 800 and 1,000 tonnes, comprising about 70% reef fish, 10% ‘ocean fish’ and 20% ‘miscellaneous’ fish, including sharks (Anon, 1980). Midwater handlining or ‘down fishing’ for yellowfin has been an important traditional fishing method in the past, but the Cook Islanders do not have a tradition of fishing the outer reef slope (Brown, 1981).

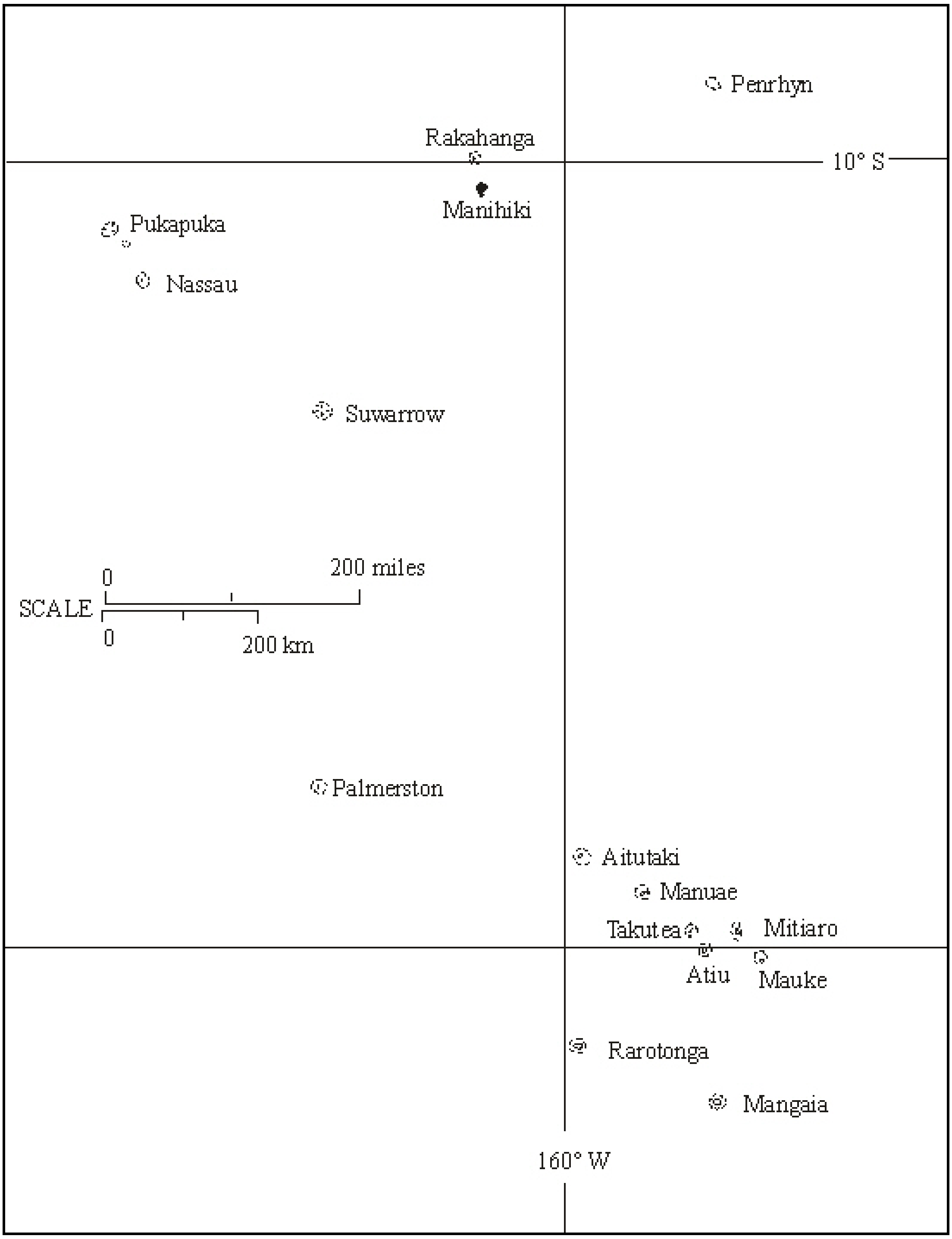

Figure 1: The Cook Islands

Only at Rarotonga is an exception to the general pattern of subsistence fishing activity found. Here, the population has increased due to migration from the outer islands, an increasing number of people are in salaried employment, and the supply of local fish falls far short of demand (Anon, undated). A number of plans have been put forward proposing ways in which outer island fishermen could ‘export’ their produce to Rarotonga to take, advantage of this demand. Hinds (1970) recommended that this should be done through a government-assisted fishermen’s co-operative society, but subsequent attempts to establish such a society failed (Marsters, 1975). More successful was a scheme in which the Government Fishing Vessel ‘Ravakai’ was used to collect fish and agricultural produce from some outer islands. In 1975, Marsters reported that a ‘small unit programme’ had been in operation on Palmerston for the past three years. Island fishermen stored their catch in a 2.5-tonne freezer provided by the Fisheries Department, and this was collected once or, occasionally twice a month. Since the required payload was 4 tonnes, it was usually necessary for the vessel to wait at the island for a few days while fishermen caught additional fish to make up the quantity. Although this collection system ran at a loss, the establishment of a fish transport infrastructure is seen by the government as an essential first step to the development of outer island fisheries. At the time of this Project visit a UNDP programme was under way to establish freezer facilities in Penrhyn, and thus enable a fish storage and collection operation along the lines of that described for Palmerston.

As well as the development of a fish marketing infrastructure, a number of other projects have also been implemented to enhance outer island fisheries. Notable among these was the introduction in 1956 of the topshell *Trochus niloticus* to Aitutaki. In 1970, Hinds reported that this population was very well established, and subsequent seedings have taken place on other islands in the group, using the Aitutaki stock. The shells are used for subsistence consumption, handicrafts and export.

The Fisheries Division has also concerned itself with the development of the pelagic resource. At the time of this Project visit, a number of fish aggregation devices had been deployed in various sites, and further deployments were anticipated.

2.3 Rarotonga

Rarotonga (figure 2) is the largest island in the group with a land area of 67 square kilometres. In most places the fringing reef is close to shore and the lagoon is narrow and shallow. The land, of volcanic origin, is fertile, and is used for growing food crops and commercial citrus plantations. The use of fertilisers is relatively heavy and there is considerable agricultural runoff into the sea via numerous freshwater creeks. Most local subsistence fishing activities take place on the reef, and include the use of spears, scoop-nets, surround nets, pens, rod and line, and hand collection.

The small size of the resource available to the relatively large population makes overfishing almost inevitable. Even in 1955, Van Pel reported that giant clams (family *Tridacnidae*) were collected when only three inches (7 cm) long, and “that the use of explosives and fishing poisons have done much harm”. The resources of the outer reef-slope, too, are reported to be relatively impoverished, although this appears to be undocumented. The SPC Outer Reef Artisanal Fisheries Development Project team, in their 1975/76 visit to the Cook Islands, deliberately chose not to operate on Rarotonga because the island “was reputed to have a dearth of bottom fish” (Hume, 1976).

The Cook Islands Government Fisheries Division headquarters is located on Rarotonga, and at the time of the Project visit was equipped with two cold stores, one 10-tonne blast freezer and one 3-tonne holding freezer, which were used for the freezing and retail of local fish produce. The Department also retailed ice to local fishermen, from a Northstar 0.5 tonne/24 hours ice machine. Nevertheless, the extent of true commercial fishing on Rarotonga is limited, with most operators being involved only on a part-time basis. In a survey conducted in 1979 (Anon, 1980) only one person was considered to be a full-time commercial fisherman.

2.4 Penrhyn

Penrhyn (figure 3), with a population of 608 people (Turua, 1982), is one of the largest atolls in the Pacific, having a reef/lagoon area of about 280 square kilometres. Over 20 islands, with a combined land area of some 6 square kilometres, stud the reef belt, but many of these carry little vegetation. The lagoon is deep, more than 60 metres for over half of its area and, with Suwarrow, is one of only two coral atolls in the Cook Islands where reasonably large vessels are able to enter the lagoon, which has three entrances. In 1955, Van Pel wrote: “This atoll is the best fishing place I have seen in the Cook Islands, both for lagoon fishing and deep sea fishing outside the western passage”.

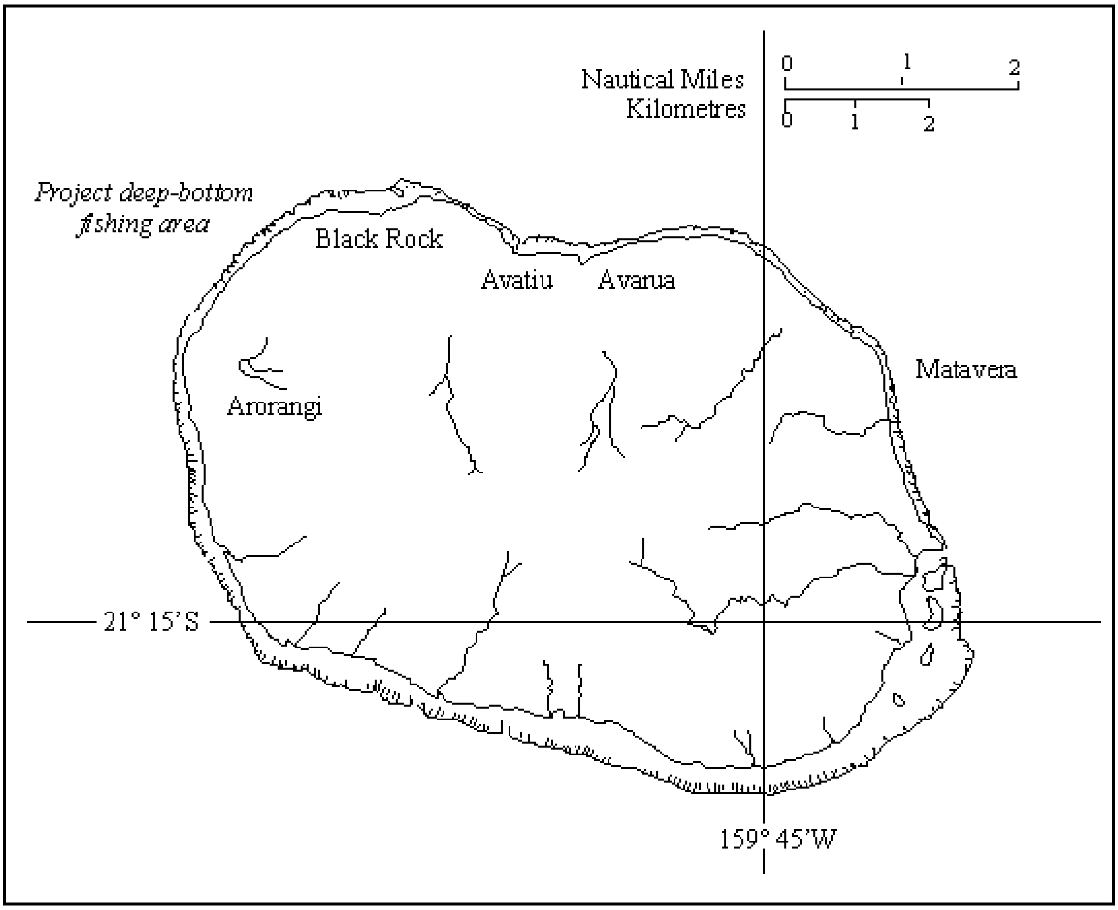

Figure 2: Rarotonga

Until recent years, the only commercial fishing activity on Penrhyn was the collection and sale of pearl oysters (*Pinctada* spp.), which are abundant in the lagoon. However at the time of this Project visit, the Food and Agriculture Organisation (FAO) of the United Nations Project RAS/73/025 were in the process of establishing a Seafarer TE 2 flake ice machine producing 2 tonnes of ice per day, and a blast/holding freezer with 16 tonnes storage capacity. These were intended for use in stockpiling marine produce for subsequent shipment to Rarotonga, but were not yet operational during the master fisherman's stay.

An unusual feature of Penrhyn is the presence of several natural brackish water ponds, which are connected with the sea only at extremely high tides, and which are heavily populated by adult milkfish (*Chanos chanos*). Van Pel reports that in the years up to 1955 these ponds were

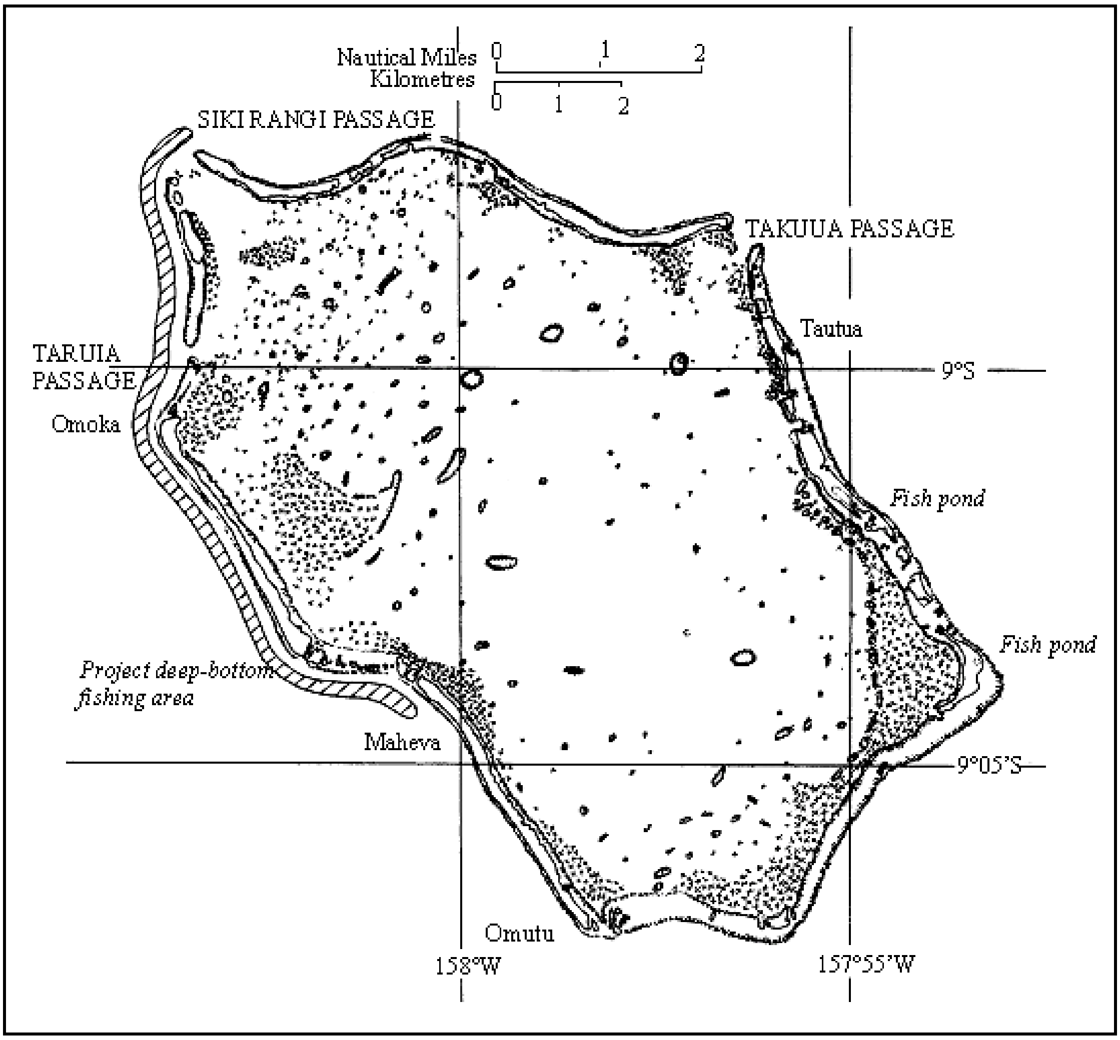

Figure 3: Penrhyn

harvested annually for a ceremonial feast, and re-stocked shortly afterwards (Van Pel, 1955). However, information collected during the Project visit by the master fisherman indicated that recruitment to the ponds occurred naturally at flood tides. Whichever the case, the ponds were a valuable source of bait for Project fishing activities when the preferred bait of tuna was in short supply. Normally harvesting from the ponds is prohibited, except for special community occasions, but a dispensation to net limited amounts of milkfish there was granted by the customary authorities, to help overcome problems of bait supply for the Project.

3. PROJECT OPERATIONS

3.1 General

The Project operated in Rarotonga during two separate periods: from 10 September to 7 October 1981, and subsequently from 1 January to 29 March 1982. The period in between, 27 October to 31 December 1981, was spent in Penrhyn, or in transit. Travel between the two islands was by cargo boat, and took about a week.

During the first period spent in Rarotonga the Project operated from a 28-foot aluminium *alia* catamaran, built in Western Samoa and belonging to the Fisheries Department Five fishing trips were completed, during which the master fisherman's counterpart officer Mr Sema Robati, a two-man government demonstration team, and two private fishermen, participated in the training programme.

The *alia* catamaran was shipped as deck cargo to Penrhyn where it was used as the main project vessel there. Initially, local fishermen were suspicious of the project and only two were keen to participate in fishing activities. The master fisherman thus concentrated on assisting one of these two to rig his boat correctly, and on training them and the counterpart officer in bottom fishing techniques. Once the project began to land good catches, the interest of other fishermen grew and four regularly joined the Project vessel for fishing trips. In the final week spent in Penrhyn, the master fisherman conducted a one-week intensive training course, using both the project vessel and a local boat, in which 32 fishermen participated. A total of 18 fishing trips were completed in Penrhyn. The *alia* catamaran was subsequently left behind, for use by the local Fisheries Division staff, when the project returned to Rarotonga.

Christmas and New Year festivities, during which no fishermen were available to fish with the project, led to the loss of several weeks work. More time was lost during the second period spent in Rarotonga due to a number of factors. Unforeseen delays with customs clearance formalities made the second Project vessel, a newly imported 18-foot aluminium 'Flying Fish' runabout, unavailable for use until 19 January, following which over three weeks had to be spent in preparing the boat for sea and rigging the fishing gear. At this time a period of bad weather set in, preventing fishing and culminating, on 27 February, in major damage to the vessel's engines when it dragged its mooring in Rarotonga harbour. The 'Flying Fish' was therefore never used by the Project, which transferred to a second aluminium *alia* catamaran. This again required substantial work prior to its use for fishing, and only three fishing trips could be carried out before the master fisherman's scheduled departure on 29 March.

Table 1 overleaf summarises the master fisherman's main activities and movements.

Table 1: Summary of activities during the DSFD project visit to the Cook Islands

10 September 1981	Master fisherman P. Taumaia arrives Rarotonga.
11 — 16 September	Preparation of fishing gear and first *alia* catamaran.
17 September — 25 October	Fishing from *alia* with counterpart officer. Training of government demonstration team. Five fishing trips completed.
26 October	Travel by freighter to Penrhyn, carrying *alia* as deck cargo.
27 October — 18 December	Fishing from *alia* with counterpart officer and local fishermen. Seventeen fishing trips completed. Assisting in rigging vessel for local fisherman. One week intensive training course in aspects of deep bottom fishing given to local fishermen.
18 December 1981— 10 January 1982	Packing gear. No fishing possible due to Christmas festivities. Travel to Rarotonga. No fishing possible due to New Year festivities.
11 — 19 January	Repair and replacement of fishing gear while awaiting customs clearance for new project vessel 'Flying Fish'.
20 January — 15 February	Preparation of new 'Flying Fish'.
16 — 26 February	Bad weather.
27 February	Project vessel engines damaged while at mooring.
28 February — 25 March	Rigging and using second *alia* catamaran. Three fishing trips completed.
26 — 28 March	Packing gear.
29 March	Master fisherman departs Cook Islands.

3.2 Boats and equipment

The master fisherman worked on the preparation of three different Project vessels, but only two were subsequently used for fishing, for reasons already described. These were both 28-foot aluminium *alia* catamarans, built in Western Samoa and purchased by the Cook Islands Government for use by the Fisheries Department. The *alias* were almost identical in the equipment they carried and in their deck arrangements, illustrated in figure 4. Each was powered by a 40 h.p. Evinrude outboard motor, and each had a 12 h.p. Evinrude motor as a spare or safety engine.

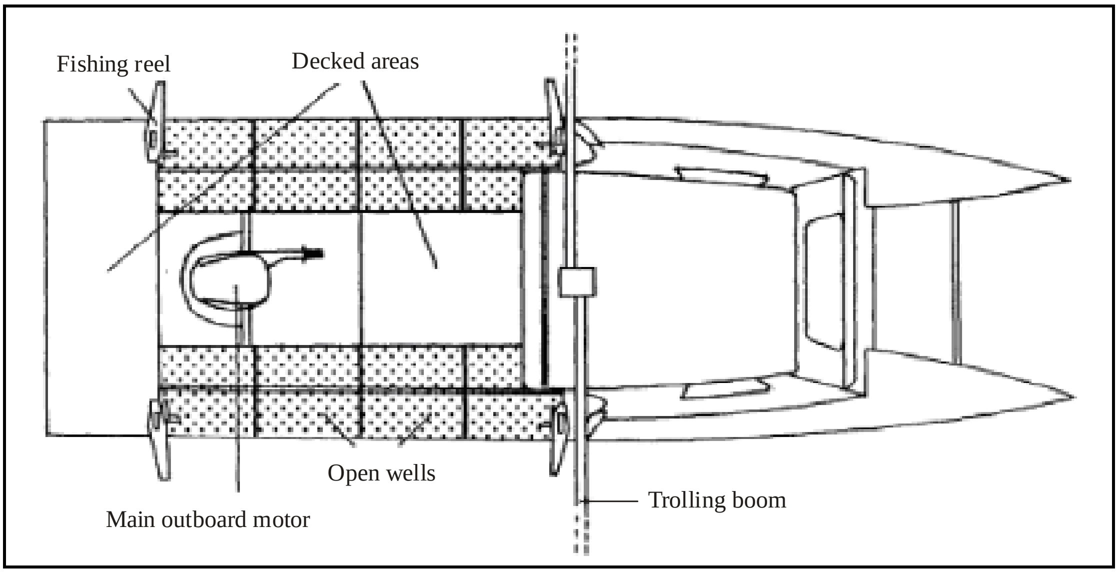

Figure 4: Typical* alia *fishing arrangement

Both *alias* were fitted with two 3-metre wooden trolling booms, allowing a total of four lines to be trolled, and with four of the wooden handreels used as standard equipment by the Project (figure 5). These each bore 500 metres of 114 kg test nylon monofilament fishing line, and were used both for trolling and bottom fishing. For the latter activity, a wire terminal rig bearing three tuna circle hooks (figure 6) was attached to the end of the line. Four wooden handcasting reels were also carried, for use when fishing in shallow waters. These each held 200 metres of 40 or 45 kg test nylon monofilament fishing line, and a similar but lighter terminal rig to that shown in figure 6, made of nylon monofilament rather than wire.

The third Project vessel, an l8-foot aluminium 'Flying Fish' runabout, was rigged for fishing but, as noted, was never used. Since the vessel was imported as a bare hull, it was necessary for the master fisherman and his team to fit plywood floors, decking and a hatch, build the cabin and install the steering system prior to rigging the fishing equipment, which consisted of two trolling booms and two wooden handreels.

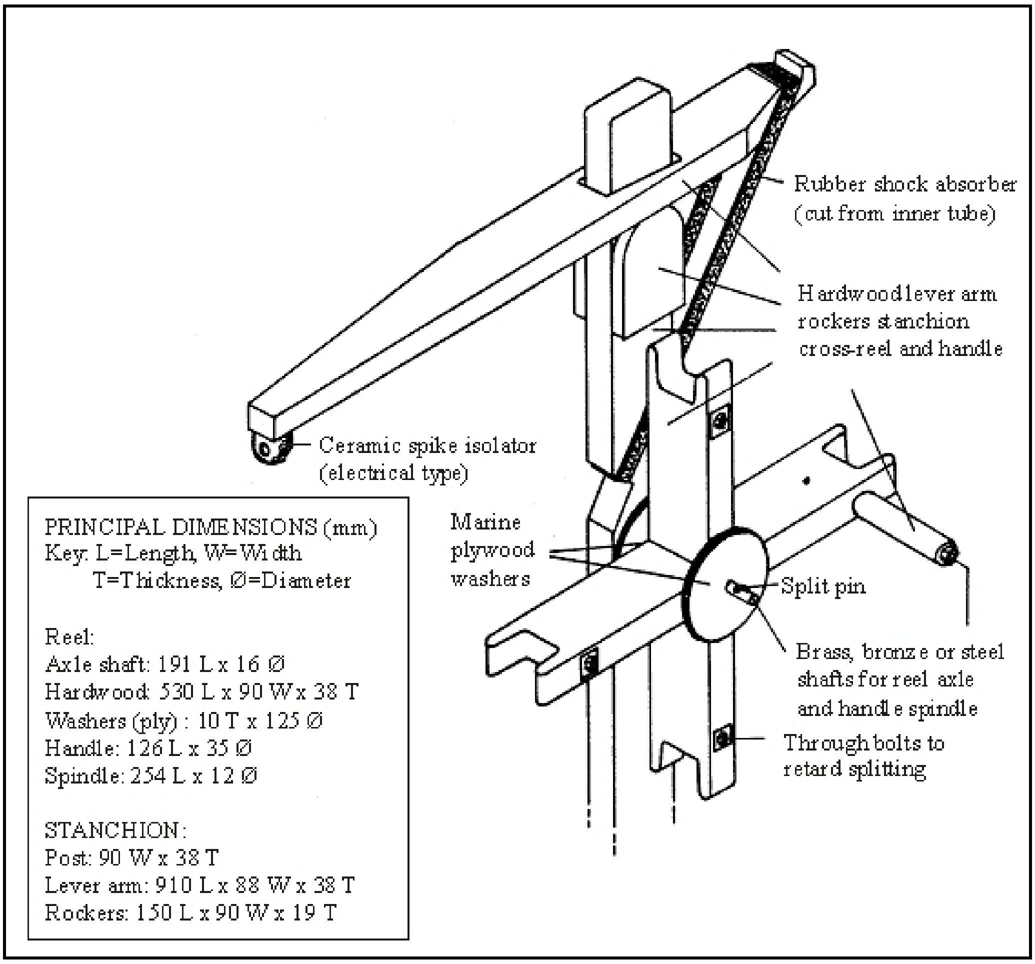

Figure 5: The Western Samoan handreel used by the Project

A 16-foot flat-bottomed plywood skiff belonging to a private fisherman in Penrhyn also participated in, and contributed to, project activities. The master fisherman spent several days assisting the owner of the boat in the construction and fitting of two wooden handreels. Subsequently, this boat was used alongside the *alia* during training sessions when there were more trainees than the *alia* could accommodate.

The anchor gear used while fishing was similar for all vessels, and is illustrated in figure 7. The anchor was a simple grapnel, constructed from two 3-metre lengths of 8 mm or 10 mm diameter reinforcing bar bent into the appropriate shape. These were held together by welding, lashing with strong wire, or by inserting them through a length of galvanised steel pipe prior to bending, and driving a wooden spike up the centre. A 5—6 metre length of 8—10 mm chain, or, if chain was not available, 4 — 5 mm galvanised fence wire, was used as a connection between the grapnel and the anchor rope. The rope itself was of polypropylene, 400 metres long and 10 — 12 mm in diameter. A 72-inch circumference inflatable polyethylene balloon buoy was also carried and used when hauling the anchor, as described in section 3.3.

The other main item of gear carried at all times was a portable echo-sounder, belonging to the project, which was used to locate areas of suitable depths and bottom profile for deep bottom fishing. A Furuno model FG-11, with a range of 0 — 360 fathoms, was used until the master fisherman returned from Penrhyn to Rarotonga, at which time it was replaced by a new JMC model F-400E with a range of 0 — 400 fathoms.

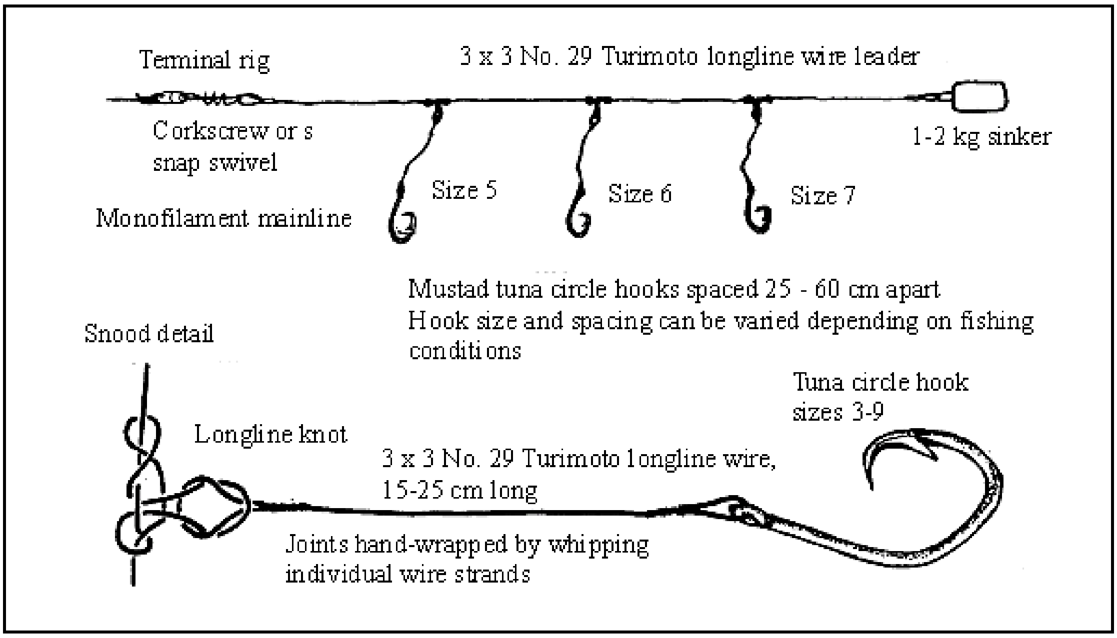

Figure 6: Typical terminal gear for bottom fishing

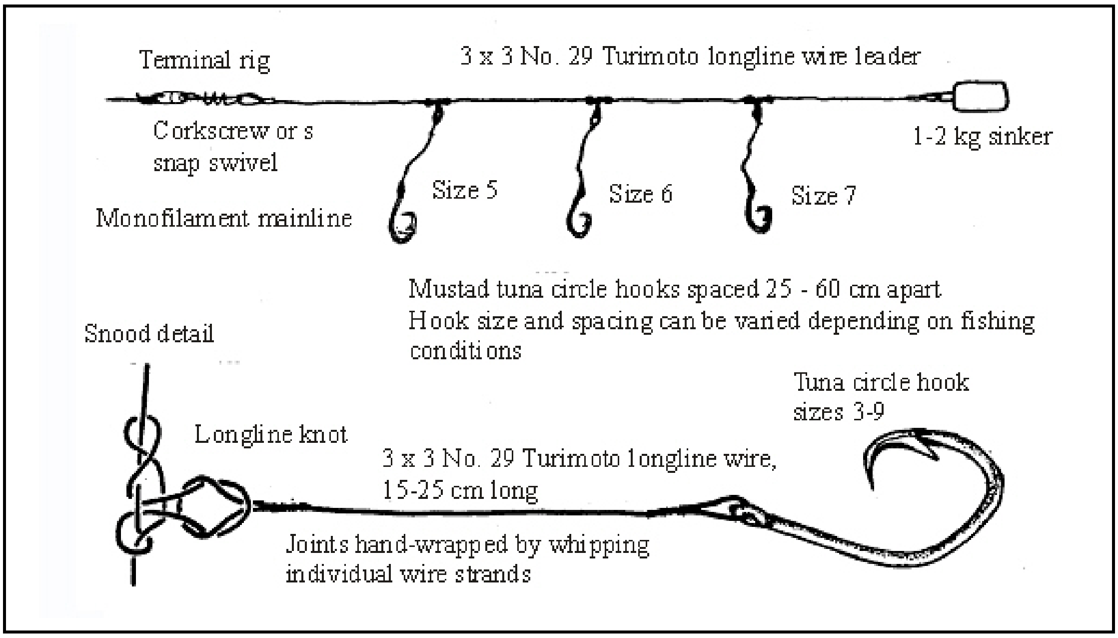

Figure 7: 'Self-hauling' anchor gear

A complete list of the basic fishing gear recommended by the project for use in deep-bottom fishing can be found at Appendix 1.

3.3 Fishing methods

Deep-bottom dropline fishing using the wooden handreels is the Project's standard fishing method. Suitable fishing areas were located using the echo-sounder, target depths being around 200 m. Where possible, the anchor was dropped in waters shallower than those of the chosen fishing spot, in a position selected so that the prevailing winds and current would carry the boat back over the deeper areas as the anchor warp was paid out. In calm weather it was necessary to drop the anchor in the same depth as the area selected for fishing. Once the boat was resting at anchor, bottom fishing was conducted using the handreels fitted with a terminal rig as described and a 1 — 2 kg sinker. The sinker was lowered to the bottom and there after the line was kept tight by hand, to allow the fisherman to respond to bites by striking, and to reduce the possibility of tangling with other lines. Because of the length and elastic properties of the line, which make rapid striking difficult, much reliance is placed on the effectiveness of the tuna circle hooks used.

The preferred bait for deep-bottom fishing is skipjack, and trolling was carried out in order to obtain this or other tunas on all fishing trips while traveling to the bottom fishing grounds. Short periods of time were also occasionally spent trolling around two fish aggregation devices anchored off Rarotonga and one off Penrhyn, again with the aim of catching tuna for bait.

Additional bait catching activities were required at both islands as trolling alone did not produce enough. At both Rarotonga and Penrhyn some scoop-netting for flying fish was practised using a light at night. At Penrhyn, gill-netting for milkfish was carried out in one of the natural milkfish ponds on the atoll. Together these combined bait catching activities generally yielded enough bait for the days fishing, although it was not always of the most favoured types.

Fishing was mostly carried out during daylight hours. Fishing trips were of limited duration, usually 6 — 8 hours (but occasionally up to 16) at both islands, because of difficulties in preserving the catch. Ice for this purpose was available at Rarotonga, but the project vessel was equipped with only very limited ice carrying facilities which were inadequate to hold the fish caught. At Penrhyn no ice was available.

At Rarotonga, fishing trips commenced either at about 0800 hours, or at midday. At Penrhyn, trips generally commenced at about 0700 hours, and tended to be slightly longer due to the time spent in gill-netting bait prior to departure for the bottom fishing grounds.

A simple technique was used to retrieve the anchor after fishing, greatly reducing the effort involved in hauling. By motoring rapidly forwards the anchor was broken out and towed until it streamed behind the boat. Still under way, a free-running buoy shackled on the line and released would be forced back along the rope until, close to the anchor, it was trapped by a 'no-return' wire barb whipped onto the line (see figure 7). The anchor thus remained suspended by the buoy at the sea surface. The boat could then he motored slowly back to the buoy, and the anchor line and anchor easily recovered.

The weather during the Project visit was generally calm, but with several periods of strong winds and rough seas which prevented fishing. The wind direction was always north-east, east or south-east.

3.4 Data collection

SPC master fishermen use a standard data form, shown at Appendix 5 to maintain detailed records of each fishing trip. During this project visit, data collected on each trip included: time spent steaming, anchoring and fishing; fishing area; fishing depth or depth range; number of crew; quantity and type of gear, fuel and bait used; the specific identification of each fish caught, where this could be determined; and the total number and weight of each species taken.

3.5 Training

Mr Sema Robati of the Cook Islands Fisheries Department trained as counterpart officer to the master fisherman during the entire Project visit. At Rarotonga, two other Fisheries Division staff, Mr Onio Terakia and Mr Ruru Moate, also regularly joined the project vessel for training to enable them to continue demonstration of bottom fishing techniques after the master fisherman's departure.

At Penrhyn a number of private fishermen were trained by the Project. In particular Mr Tata Tonita and Mr Taraa Ford spent extensive periods of time with the master fisherman, and subsequently assisted in demonstrations and training sessions for others, the former generously allowing the Project the use of his boat when required. Four fishermen from Te Tautua village joined the project vessel for a number of trips, and 32 fishermen from different parts of the island attended an intensive training course held in the last week of the Project's stay in Penrhyn.

In addition to practical instruction in deep-bottom dropline fishing techniques, subjects covered during the various training activities included aspects of basic small-boat seamanship and safety at sea, vessel and engine maintenance and repair, and preparation and care of fishing gear. Full details are contained in Appendix 2.

3.6 Handling and preservation of the catch

Fish caught by the project were not gilled or gutted but were landed whole, as Cook Islanders greatly prefer their fish in this form. As described earlier, ice was not available at Penrhyn and only limited quantities could be carried at Rarotonga. In general, therefore, with the exception of the first few fish caught on each trip from Rarotonga, the catch was not iced but was sold immediately on landing. Section 4.2 details the way in which the catch was disposed of.

4. RESULTS

4.1 General

During this project visit the wind always blew from the eastern quadrant. Deep-bottom fishing was thus carried out on the western or lee sides of the two islands visited. At Rarotonga the reef slope from Arorangi to Avarua harbour was fished (figure 2) while at Penrhyn fishing was conducted between Siki Rangi passage and Maheva (figure 3). Fishing trips were not numerous enough to allow the identification of particularly productive areas. Trolling was genera1ly carried out in the same areas, mostly while traveling to and from the bottom fishing grounds.

Twenty-five fishing trips were completed, eight in Rarotonga and 17 in Penrhyn, during which 195 hours were spent at sea. Deep-bottom fishing and trolling together occupied 115.5 hours, and produced a total catch of 2,855 kg (round weight). Other fishing methods (flying fish scooping and milkfish netting) were carried out principally to catch bait, but as neither the time they occupied nor the catch they produced were significant proportions of the totals, they are not included in the discussions which follow.

4.2 Disposal of the catch

All the fish caught trolling and most of the dropline catch were of types readily acceptable to the Cook Islanders, the only exceptions being sharks, and the red seabass *Lutjanusbohar*, which is reputedly ciguatoxic. 625 kg of unsaleable fish, mostly sharks, were caught droplining, all at Penrhyn, and these were rejected at sea after measuring, or, in the case of large sharks, estimating, their weights.

Sale or distribution of the acceptable part of the catch was the responsibility of the Cook Islands Fisheries Department and was administered by the master fisherman's counterpart officer. At Rarotonga, most of the catch was sold via the Government retail outlet at an average price of NZ$2.00/kg. At Penrhyn, half the catch, after deduction of operating expenses, was distributed among participating fishermen, and the rest sold for NZ 40 cents/kg.

4.3 Catches and catch rates

Deep-bottom droplining was the main fishing method practised and contributed 2,646 kg, or 93%, to the total catch weight of 2,855 kg. 625 kg were unsaleable and were rejected at sea as described above. Trolling yielded 209 kg, of which about 131 kg was used as bait. Thus only 78 kg of the troll catch was landed, although in principle all of it was saleable. Total landings were therefore 2,099 kg, or about 73% of the total catch; 96% of landings came from dropline fishing.

Catches and catch rates are summarised in table 2 below. Individual trip records can be found at Appendix 3.

Table 2: Catches and catch rates by major fishing methods

Fishing method	Fishing hours	Fishing effort (line-hours)	Catch (kg)		Catch/Unit of effort (kg/line-hour)	
			Total	Landed	Total	Landed
Droplining	96.0	310	2 646	2 021	8.5	6.5
Trolling	19.5	66	209	78	3.2	1.2
Total	**115.5**	**—**	**2 855**	**2 099**	**—**	**—**

The overall catch per unit of effort (cpue) values for droplining were good, and for trolling, moderate. Table 3 shows dropline catch rates obtained in other Pacific countries where the Project has operated. Unless otherwise stated, the catch rates include species which are considered unsaleable or unacceptable in some localities. This is necessary in order to allow realistic comparison of the productivity of the different locations. As can be seen, catch rates obtained during this visit compared well with those from other countries.

Table 3: Catch rates obtained by the Deep Sea Fisheries Development Project in selected Pacific Island locations

Country	Year of visit	Dropline Catch rate (kg/reel-hour) Total	Excluding sharks
Niue — Niue Island	1979	8.5	7.0
Niue — Beveridge Reef	1979	6.1	5.6
Tonga	1978	—	3.6*
Tonga	1979	7.6	5.7
American Samoa	1978	—	4.9
Tuvalu	1980	11.1	8.0
Kiribati	1980	8.8	7.2
Cook Islands (this visit)	1981/2	8.5	6.7

* Estimate only, excludes *Lutjanus bohar*

The overall figures do, however, mask a very marked difference in the productiveness of fishing operations at the two islands visited. Catches and catch rates for both fishing methods were far better at Penrhyn than they were at Rarotonga, as can be seen from table 4.

Table 4: Comparison of catches and catch rates at Rarotonga and Penrhyn

	Number of trips	Fishing hours	Fishing effort (line-hour)	Catch (kg) Total	Catch (kg) Landed	C.p.u.e. (kg/line-hour) Total	C.p.u.e. (kg/line-hour) Landed
a) *Rarotonga*							
Droplining	8	30	88	166	166	1.9	1.9
Trolling	8	8	32	20	0	0.6	—
Total	**8**	**38**	**—**	**186**	**166**	**—**	**—**
b) *Penrhyn*							
Droplining	17	66	222	2480	1855	11.2	8.4
Trolling	9	11.5	34	189	78	5.6	2.3
Total	**17**	**77.5**	**—**	**2669**	**1933**	**—**	**—**

The total catch rate by trolling at Penrhyn was some nine times higher than at Rarotonga, where the only three fish taken were caught on fish aggregation devices. Troll catches are particularly susceptible to seasonal and local variations and the difference in catch rates may prove not to be significant in the long term.

Dropline catches are generally more consistent and the great difference in catch rates obtained at the two islands by this fishing method probably gives a true picture of the likely relative productivity of sustained fishing operations. The catch rates obtained at Penrhyn were extremely good, among the highest ever achieved by the Project. Conversely, those from Rarotonga are the lowest recorded for any project visit. The catch rates may have been influenced to some extent by the generally shallower waters fished at Rarotonga (usually 150—175 metres, maximum 320 metres, as compared to usually 200—300 metres, maximum 480 metres, at Penrhyn). However, the presence of *Etelis* and other deep-living species in the catch (see next section) suggests that depth alone does not adequately account for the dramatic disparity between catch rates.

Although not as marked as the difference in catch rates, total hook rates (i.e. number of fish caught per unit of effort, were also higher at Penrhyn (3.3 fish/reel-hour) than at Rarotonga (1.6 fish/reel-hour). Catch rate is a function of hook rate and the average size of the fish caught: hence these figures also indicate that the dropline-caught fish tended to be larger at Penrhyn than at Rarotonga, as discussed in the next section.

4.4 Composition of the dropline catch

In addition to different catch rates, the catches from the two islands fished displayed strikingly different species and size compositions and it is of more value to compare these than to attempt to combine them.

The dropline catch at Rarotonga comprised only ten species, as compared to 38 at Penrhyn. Two species of deep-water snappers, *Etelis carbunculus* and *Pristipomoides zonatus*, were common in bath localities, but to different extents. Numerically *E. carbunculus* comprised 71% of the Rarotonga catch and 15% of the catch at Penrhyn where it was overshadowed by the very numerous *Pristipomoides zonatus* (36% numerically). *P. zonatus* also made up 8% of the catch numbers at Rarotonga. The gold-tailed jobfish *Pristipomoides auricilla* also occurred in small numbers at both localities. No other deep-water snappers were caught at Rarotonga, although three other species (*Etelis coruscans*, *Pristipomoides filamentosus* and *Aphareus rutilans*) occurred at Penrhyn.

Figures 8a and 8b graphically present the catch composition by number at both locations, mainly using broad species groupings of which details can be found at Appendix 4. Catch composition by weight at the two islands presented in figures 8c and 3d using the same groupings.

All fish in the Rarotonga catch were of small and consistent size (between 1 and 1.5 kg —see Appendix 4) and the overall pictures of species composition by weight and by number thus appear much the same. At Penrhyn the individuals caught varied considerably in size, and some of the numerically important but general1y small species such as *Pristipomoides zonatus* made a much smaller contribution to the total weight. Conversely, sharks, which were numerically unimportant, made a disproportionately high contribution to the total weight because of their generally large size.

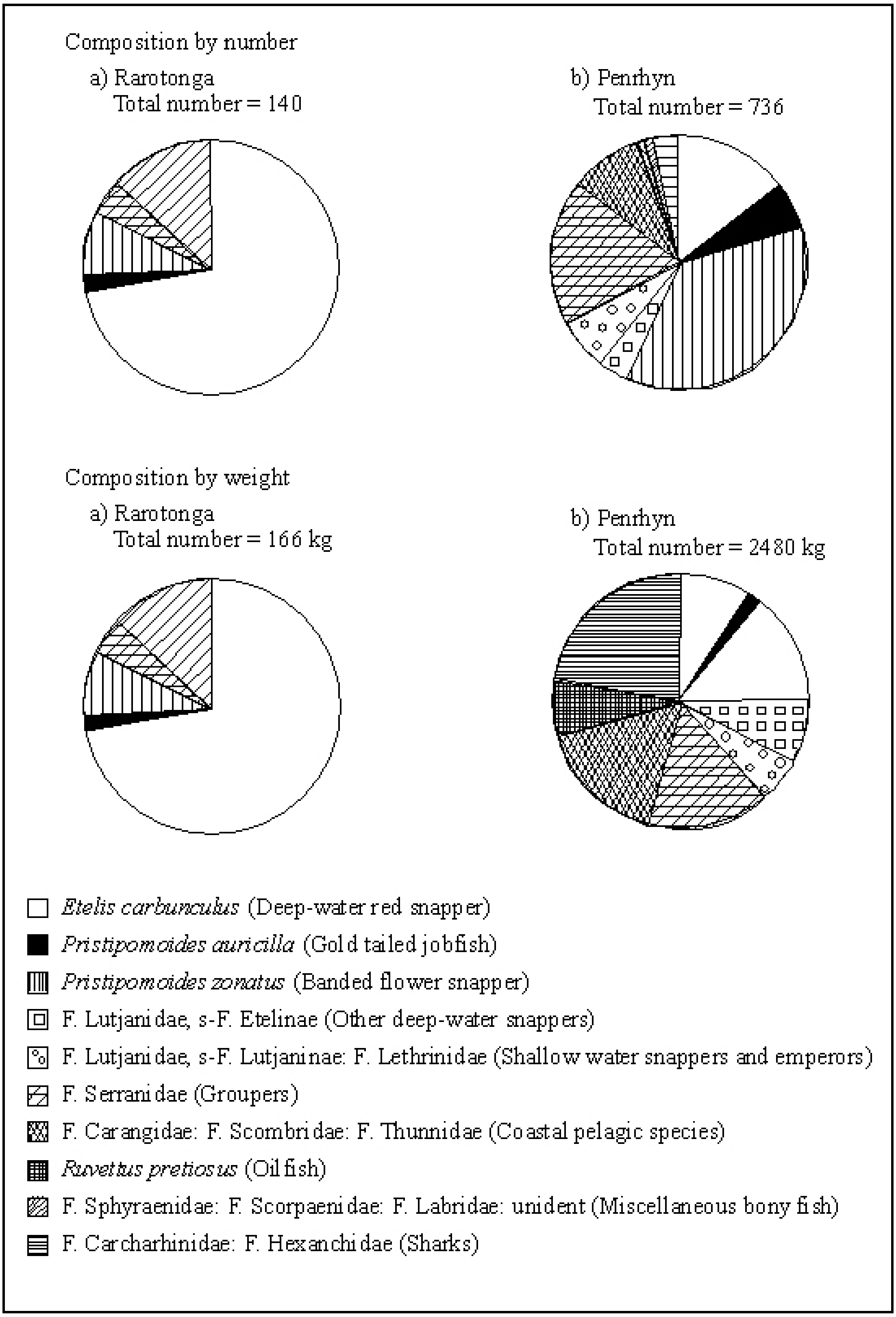

Figure 8: Dropline catch species composition by number and by weight at Rarotonga and Penrhyn

The dropline-caught fish from Rarotonga averaged only 1.3 kg in weight, as compared with 3.4 kg at Penrhyn, or, more realistically, 2.7 kg if sharks are excluded. Large numbers of *Pristipomoides zonatus*, a species which seldom exceeds 2 kg in weight, were taken at Penrhyn and this feature tends to mask the differences in average sizes between the other species taken at the two localities. In particular *Etelis carbunculus* (the short-tailed red snapper), a species whose individuals are known to grow to large sizes (occasionally over 30 kg) occurred in substantial numbers at both islands. Average sizes for this species were 1.6 kg at Penrhyn and 1.2 kg at Rarotonga, but 18 good sized individuals (5 — 15 kg, average 6.6 kg) were caught at Penrhyn, whereas none over 2 kg were taken at Rarotonga.

A low species diversity and an absence of large individuals are thus two characteristics of the deep-bottom fish community at Rarotonga. These features add weight to indications given by low catch rates and hook rates that the deep-bottom resource is unproductive compared to those of Penrhyn and other Pacific locations.

4.5 Fishing economics

From the results obtained during this Project visit it is possible to estimate the likely profitability of fishing operations based on the main fishing method used droplining, both at Rarotonga and Penrhyn. Table 5 shows itemised breakdowns of the estimated revenue and expenditure anticipated for a small commercial fishing concern, based on the following assumptions:

i) that a Western Samoan-built *alia* catamaran is purchased, fully equipped with handreels, 25 hp main outboard motor, spare 7 hp outboard motor, and basic safety equipment, for a total cost of NZ$7000;
ii) that a development bank loan, repayable over 5 years, for 90% of this capital is taken out at an annual interest of 6%;
iii) that the 10% remaining capital is provided by the buyer and depreciated over 5 years;
iv) that three trips per wee k, forty weeks a year, are achieved, each of 4 fishing hours, with three handreels in use;
v) that two crew are employed by an owner-skipper or manager-skipper, each of these three receiving 15% of the catch value as wages;
vi) that catch rates, fuel usage and other expenditure are typical of those experienced during this Project visit.

As can be seen, the economics of fishing in the two islands are somewhat different, but under the assumptions made here neither operation would be able to generate a profit, because of low catch rates in the case of Rarotonga and low local prices in the case of Penrhyn. An improvement in the sale price of the Penrhyn catch, such as would accrue, for instance, if a periodic shipment of fish to Rarotonga (for sale at NZ$2.00/kg) could be arranged, may render the operation feasible. In the example above, it would be necessary to ship between 2,000 and 3,000 kg annually (depending on freight costs) to break even. However, at the time of the Project visit, the infrastructure required to enable shipment s of this nature did not exist.

The simplistic approach taken above does not account for many other factors which would bear on commercial operations, such as difficulties in obtaining bait, or time spent waiting for the delivery of spare engine parts or replacement fishing gear. Development of a truly commercial deep-bottom fishery therefore does not appear possible in Rarotonga because of the limitations of the resource itself. In Penrhyn, commercial fishing for export is economically feasible but would require greatly improved infrastructure (storage and transport facilities).

Table 5: Estimated commercial bottom fishing income and expenditure

	Rarotonga	Penrhyn
Number of trips/year	120	120
Saleable catch/reel-hour (kg)	1.9	8.4
Saleable catch/year (kg)	2 736	12 096
Local sale value (NZ$/kg)	2.0	0.4
Annual income (NZ$)	5 472	4 838
Fuel cost (NZ$/US gallon)	4.0	4.0
Fuel used/trip (US gallon)	4	6
Fuel cost/year (NZ$)	1 920	2 880
Annual loan repayment (NZ$)	1 495	1495
Depreciation of owner’s capital (NZ$)	140	140
Engine maintenance and repair (NZ$)	750	750
Fishing gear replacement (NZ$)	300	300
Wages (NZ$)	2 462	2 117
Annual expenditure (NZ$)	7 067	7 682
Balance (NZ$)	–1 595	–2 844

5. DISCUSSION AND CONCLUSIONS

The main conclusion to be drawn from the results of this Project visit is that, due to a variety of factors, true commercial deep-bottom dropline fishing activities by small-scale operators are not currently feasible in either of the locations fished. At Rarotonga, this situation is unlikely to improve significantly as a result of development work because the resource itself is the factor limiting the profitability of fishing operations. At Penrhyn, however, the establishment of freezer facilities, which had already commenced at the time of the Project’s work there, may enable entrepreneurs to operate viable commercial fishing concerns, providing that substantial proportions of their catch can be ‘exported’ to Rarotonga or elsewhere and that they can be offered a better price for their fish than at present.

In considering frozen storage and transport of fish, it should be noted that the current practices of landing fish in the round (i.e. not gutted or gilled) and of not carrying ice on board the fishing vessel both contribute greatly to the rapid spoilage of the catch. If an export-based fishery is to be developed in Penrhyn it will be necessary to improve on-board handling techniques to the point where fish are iced at sea, preferably gutted and gilled, if excessive loss of stock while in frozen storage is to be avoided. Improving the on-board handling of the catch in this way may have the added benefit of improving the economics of small boat fishing operations, if the vessels are able to stay at sea for longer periods of time as a result.

Despite the uncertain economics of commercial operations, local fishermen who joined the project both at Penrhyn and Rarotonga were generally enthusiastic and quick to learn the techniques of deep-bottom dropline fishing. Whether or not a commercial fishery develops at Penrhyn, this fishing method could contribute substantially to subsistence fish catches there, and it would be worthwhile for the Cook Islands Government to encourage this by establishing a retail outlet to make available basic fishing gear and other items appropriate to the needs of small-boat fishermen. At Rarotonga, the returns on deep-bottom fishing operations were not encouraging and it would be more appropriate for further development work to be directed towards alternative fishing methods, and in particular small-scale techniques to enable the harvesting of fish associated with fish aggregation devices.

The following recommendations are formulated to reflect these conclusions.

6. RECOMMENDATIONS

1) That a retail outlet be established at Penrhyn to supply fishermen with items of basic fishing gear (such as those listed in Appendix 1), outboard motor spare parts and other supplies (paint, glue, etc.) required for the maintenance of small fishing boats and their equipment. This facility should initially be designed to support subsistence fishing activities only, but should be expanded to carry a larger and more comprehensive stock if commercial activities develop to any degree.

2) That with the completion of freezer storage facilities in Penrhyn, the Cook Islands Government encourage or assist in the trial shipment of frozen fish to Rarotonga to assess the practicality of this activity on a regular or repeatable basis.

3) That improved handling practices of fish intended for freezer storage be encouraged. These fish should be iced at sea, preferably gutted and gilled, and only fish treated this way and in good condition should be accepted for freezing. Incentives to good handling, such as a tiered system of buying prices for fish of varying quality, free or subsidised ice, etc., should be considered.

4) That, at Rarotonga, emphasis be placed on developing fishing methods other than deep-bottom droplining, in particular small-scale techniques to enable the harvesting of fish associated with fish aggregation devices.

7. ACKNOWLEDGEMENTS

The South Pacific Commission acknowledges with gratitude the friendly support and assistance afforded the master fisherman by the many individuals associated with the Deep Sea Fisheries Development Project while in the Cook Islands. Particular thanks are due to Chief Fisheries Officer Julian Dashwood, Principal Fisheries Officer (Northern) Chris Friberg, and Fisheries Department staff James Rima, Onio Rerekia, Ruru Moate and Sema Robati. The success of the Project visit was due in large part to their enthusiasm and help.

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Appendix 1

Basic equipment for deep bottom fishing

1. Western Samoan-type wooden handreels
2. 115 kg or 130 kg test monofilament, 500 m per reel
3. Turimoto No. 29 longline wire or equivalent (3 x 3 braided, 120 kg test)
4. Sizes 3 — 9 Mustad 399608T tuna circle hooks
5. Size 4/0 Berkeley-McMahon swivels or equivalent
6. Size 4/0 Kelux stainless lockfast swivels or equivalent
7. 1 kg and 2 kg sinkers
8. 400 — 500 m polypropylene anchor rope, diameter appropriate to boat size
9. Grapnel anchor and chain or wire
10. Large buoy for anchor retrieval
11. Standard pliers
12. Side cutting pliers
13. Crimping pliers
14. 15 cm bait knife.

Appendix 2

Topics covered in the Project's training programme

1. Handling of a fishing boat

    (a) Safety at sea
    (b) Knots and splices for mooring and anchor lines
    (c) Making a grapnel anchor
    (d) Use of equipment checklist before departure
    (e) Anchoring in order to fish at the right depth
    (f) Compass use
    (g) Marking of good fishing areas by landmarks or compass bearings
    (h) Simple method of anchor retrieval
    (i) Boat care and maintenance.

2. Handling equipment and fishing gear

    (a) Personal safety during fishing operations
    (b) Use of Western Samoan handreels
    (c) Use of handcasting reel
    (d) Knots and rigs for monofilament line, Wire leader and traces
    (e) Techniques for handling large fish
    (f) Operation of the echo-sounder
    (g) Care of gear and rust prevention
    (h) Rigging of gear in tackle-balance (appropriate matching of hooks, line and swivels).

3. Handling an outboard motor

    (a) Starting procedures
    (b) Fuel mixture
    (c) Emergency spares and tool kit
    (d) General care and maintenance procedures
    (e) Lay-up procedure
    (f) Treatment for engine accidentally dropped in sea.

Appendix 3a

Summary of operational aspects of fishing trips

Trip No.	Hours at sea	Engine hours*	Fishing hours*	Total catch** (kg)	Unsaleable catch (kg)	Bait used (kg)	Fuel used (USgall.)	No. of crew/ trainees
a)	*Rarotonga*							
1	6	2	5	30	0	4	2	2
2	6	2	5	21	0	5	2	2
3	7	2	6	29	0	7	2	2
4	7	3	5	28	0	8	3	4
5	5	2	4	15	0	8	4	2
23	6	3	4	31	0	3	4	1
24	8	5	4	12	0	1	7	2
25	7	3	5	20	0	3	7	2
Total	**52**	**22**	**38**	**186**	**0**	**39**	**31**	**—**
b)	*Penrhyn*							
6	7	3	5	165	58	4	4	3
7	7	4	4	181	93	4	5	3
8	5	2	3	81	13	9	4	3
9	9	4	3	215	151	6	4	6
10	9	5	4	164	55	14	15	5
11	9	6	3	84	0	6	7	4
12	10	6	3	54	0	3	7	4
13	8	5	4.5	154	0	12	4	4
14	6	3	3	55	0	3	4	3
15	16	4	8	480	214	15	8	3
16	8	4	3	84	0	8	4	3
17	5	2	3	33	0	2	5	3
18	10	4	7	208	10	14	8	3
19	8	3	5	160	10	10	7	7
20	10	5	8	150	4	8	8	7
21	8	4	5	234	17	12	7	6
22	8	3	6	167	0	10	8	4
Total	**143**	**67**	**77.5**	**2 669**	**625**	**140**	**109**	**—**
Grand Total	**195**	**89**	**115.5**	**2 855**	**625**	**179**	**140**	**—**

* Trolling constitutes both fishing time and engine time and is included in both categories.
** Includes bottom fish and trolled fish but not those caught by other methods.

Appendix 3b

Catch and effort summary by trip

Trip No.	Catch (number/ weight) (kg)	Dropline Fishing hours	Effort (reel hours)	Catch (number/ weight) (kg)	Troll Fishing hours	Effort (line hours)	Total Catch (number/weight) (kg)
a)	*Rarotonga*						
1	21/30	4	8	21/30	1	4	—
2	18/21	4	8	18/21	1	4	—
3	23/29	5	15	23/29	1	4	—
4	27/28	4	12	27/28	1	4	—
5	13/15	3	9	13/15	1	4	—
23	14/17	3	12	16/31	1	4	2/14
24	6/6	3	12	7/12	1	4	1/6
25	19/20	4	12	19/20	1	4	—
Total	**140/166**	**30**	**88**	**143/186**	**8**	**32**	**3/20**
b)	*Penrhyn*						
6	30/161	4	8	2/4	1	2	32/165
7	30/166	3	9	5/15	1	3	35/181
8	23/81	3	9	—	—	—	23/81
9	54/215	3	9	—	—	—	54/215
10	34/139	3	9	9/25	1	2	43/164
11	33/84	3	9	—	—	—	33/84
12	30/54	3	9	—	—	—	30/54
13	74/149	4	16	4/5	0.5	1	78/154
14	26/55	3	9	—	—	—	26/55
15	35/445	6	18	10/35	2	8	45/480
16	28/84	3	12	—	—	—	28/84
17	25/33	3	9	—	—	—	25/33
18	83/184	6	24	15/24	1	2	98/208
19	68/160	5	25	—	—	—	68/160
20	46/105	5	15	36/45	3	12	82/150
21	58/215	4	12	10/19	1	2	68/234
22	59/150	5	20	7/17	1	2	66/167
Total	**736/2480**	**66**	**222**	**98/189**	**11.5**	**34**	**834/2669**
Grand Total	**876/2646**	**96**	**310**	**101/209**	**19.5**	**66**	**977/2855**

Appendix 4a

Species composition of dropline catch

All weights are whole weights (not gutted or gilled) Classification of Lutjanidae and Lethrinidae follows Johnson, G.D., (1980).

Family/Species **English name, Cook Islands name (where known)**	**Catch (number/weight (kg))** **Rarotonga**	 **Penrhyn**	 **Total**
Family *Lutjanidae*, sub-family *Etelinae*			
Aphareus rutilans Small-tooth jobfish, paru tarakii	—	1/7	1/7
Etelis carbuncu1us Short-tailed red snapper, parumarau	101/117	108/226	209/343
Etelis coruscans Ribbon-tailed red snapper, parumarau	—	26/188	26/188
Pristipomoides filamentosus Rosy jobfish, paru tarakii		2/5	2/5
Pristipomoides auricilla Gold-tailed jobfish, paru tarakii	2/3	41/45	43/48
Pristipomoides zonatus Banded flower snapper, parurenga	12/14	268/341	280/355
Family *Lutjanidae*, sub-family *Lutjaninae*			
Lutjanus bohar* Red bass, angamea	—	18/80	18/80
Lutjanus gibbus Paddletail, angamea	—	4/5	4/5
Lutjanus sebae/malabaricus Scarlet sea-perch, angamea	—	4/4	4/4
Family *Lethrinidae*			
Lethrinus miniatus Long-nosed emperor, mu	—	14/40	14/40
Lethrinus variegatus Variegated emperor, mu	—	5/5	5/5
Lethrinus kallopterus Yellow-spotted emperor, mu	—	2/4	2/4
Lethrinus xanthochi1us Emperor, mu	—	1/4	1/4

Appendix 4a: (cont.)

Fami1y/Species	Catch (number/weight (kg)) Rarotonga	Penrhyn	Total
Eng1ish name, Cook Islands name (where known)			
Family *Serranidae*			
Epinephelus fasciatus	3/3	—	3/3
Black-tipped grouper			
Epinephelus dictyophorus	—	23/22	23/22
Grouper, agatara			
Epinephelus megachir	—	5/6	5/6
Epinephelus morrhua	3/5	57/298	60/303
Curve-banded grouper, apuku/ mataroa			
Cephalopholis sexmacu1atus	—	3/4	3/4
Rock-cod			
Cephalopholis igarasiensis	—	1/2	1/2
Cephalopholis aurantias	—	1/1	1/1
Orange rock-cod, rarx			
Variola louti	—	44/49	44/49
Lunar-tailed cod, oka			
Family *Carangidae*			
Caranx melampygus	—	3/6	3/6
Bluefin trevally			
Caranx lugubris	—	35/105	35/105
Black trevally, urua			
Caranx ferdau	—	4/8	4/8
Seriola rivoliana	—	13/142	13/142
Deepwater amberjack, palumata			
Seriola purpuras cens	—	2/29	2/29
Amberjack, palumata			
Family *Thunnidae*			
Thunnus albacares	—	2/23	2/23
Yellowfin tuna, tuava			
Thunnus obesus	—	5/47	5/47
Bigeye tuna			
Family *Scombridae*			
Gymnosarda unicolor	—	1/26	1/26
Dogtooth tuna, varu			
Acanthocybium solandri	—	2/30	2/30
Wahoo, paara			

Appendix 4a: (cont.)

Family/Species	**Catch (number/weight (kg))** Rarotonga	Penrhyn	Total
English name, Cook Islands name (where known)			
Family *Sphyraenidae*			
Sphyraena picuda	—	1/2	1/2
Barracuda, ono			
Family *Labridae*		1/9	1/9
Cheilinus undulatus	—		
Family *Scorpaenidae*			
Pontinus macrocephalis	10/14	3/3	13/17
Family *Gempylidae*			
Ruvettus pretiosus	—	8/169	8/169
Oilfish, vena			
Undentified species (3)	9/10	—	9/10
Family *Carcharchinidae*			
Carcharchinus amblyrhynchos*	—	17/249	17/249
Grey reef shark			
Carcharchinus falciformes*	—	4/58	4/58
Silky shark			
Triaenodon obesus	—	6/98	6/98
White-tip reef shark			
Family *Hexanchidae*			
Hexanchus griseus*	—	1/140	1/140
SALEABLE CATCH	**140/166**	**682/1855**	**822/2021**
UNSALEABL E C ATCH	**—**	**54/625**	**54/625**
TOTAL CATCH	**140/166**	**736/2480**	**876/2646**

* Unsaleable

Appendix 4b

Species composition of troll catch

Family/Species		**Catch (number/weight (kg))**	
	Rarotonga	**Penrhyn**	**Total**
English name, Cook Islands name (where known)			
Family *Thunnidae*			
Katsuwonus pelamis	—	85/146	85/146
Skipjack tuna, oopu			
Euthynnus affinis	—	2/5	2/5
Thunnus obesus	3/20	5/25	8/45
Bigeye tuna, aai			
Family *Carangidae*			
Elegatis bipinnulata	—	5/11	5/11
Rainbow runner			
Alectis ciliaris		1/2	1/2
Total	**3/20**	**98/189**	**101/209**

Appendix 5

STANDARD FORM FOR DATA COLLECTION

LOCATION:		Trip number:		Departure time:		Fishing area:		Boat:		Fuel:	
				Return time:				Skipper:		Amount:	

DATE	TIME	00 01	01 02	02 03	03 04	04 05	05 06	06 07	07 08	08 09	09 10	10 11	11 12	12 13	13 14	14 15	15 16	16 17	17 18	18 19	19 20	20 21	21 22	22 23	23 24	00 01	01 02	02 03	03 04	04 05	05 06	06 07	07 08	08 09	09 10	10 11	11 12	12 13	13 14	14 15	15 16	16 17	17 18	18 19	19 20	20 21	21 22	22 23	23 24
ENGINE HOURS																																																	
METHODS: Trolling																																																	
METHODS: Bottom fishing	Handreel																																																
METHODS: Bottom fishing	Handline																																																
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FISHING DEPTH (m)																																																	
CATCH RATE	Numbers																																																
CATCH RATE	Weight (kg)																																																

WEATHER		CREW (Names):	BAIT		FISHING EFFORT	
WIND			Type	Wt (kg)	No. of trolling lines	
SEA					No. of handreels	
CURRENT		No. of trainees:			No. of handlines	

BOTTOM CATCHES (including sharks)		
Species	No.	Wt (kg)
TOTALS		

TROLL CATCHES		
Species	No.	Wt (kg)
TOTALS:		

CATCHES OTHER METHODS		
TOTALS		

REMARKS:

TOTAL CATCH PER TRIP	No.	Wt (kg):