SOUTH PACIFIC COMMISSION

UNPUBLISHED REPORT No. 26

ON SECOND VISIT OF THE

DEEP SEA FISHERIES DEVELOPMENT

PROJECT TO THREE LOCATIONS

IN NEW CALEDONIA

20 July to 30 November 1981

by

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This unpublished report forms part of a series compiled by the Capture Section of the South Pacific Commission's Coastal Fisheries Programme. These reports have been produced as a record of individual project activities and country assignments, from materials held within the Section, with the aim of making this valuable information readily accessible. Each report in this series has been compiled within the Capture Section to a technical standard acceptable for release into the public arena. However, they have not been through the full South Pacific Commission editorial process.

This report has been produced in both French and English, with the numbering of the report being French unpublished report No. 5 and English unpublished report No. 26.

On 6 February 1998 the South Pacific Commission (SPC) became the **Pacific Community**. The Secretariat of the Pacific Community (retaining the acronym SPC) is now the name for the body which administers the work program of the **Pacific Community**. The names have changed, the organisation and the functions continue.

This report was prepared when the organisation was called the South Pacific Commission, and that is the name used in it. Please note that any reference to the South Pacific Commission, could refer to what is now the Secretariat of the Pacific Community, or, less likely, to the Pacific Community itself.

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SUMMARY

The South Pacific Commission's Deep Sea Fisheries Development Project (DSFDP) visited New Caledonia for the second time between 20 July and 30 November 1981, under the supervision of SPC Masterfisherman Tevita Fusimalohi.

The project was operated out of three locations: Doking, Lifou Island; Eni, Mare Island; and Noumea, for varying lengths of time. The primary fishing method used was deep-water handreeling, with trolling conducted on an opportunistic basis. Bottom longlining trials were originally planned as part of this project, however, this was not conducted due to no suitable hauling equipment being available.

The overall catch rate for deep-bottom fishing was 2.9 kg/line-hour when sharks were excluded from the catch. This was low when compared to other catch rates achieved around the region. It was also considerable lower that the previous catch rates achieved by the DSFDP in New Caledonia in 1979 (7.1–7.2 kg/line-hour when sharks excluded from the catch. The main reason given for the low catch rates achieved was the shortage of suitable bait, including the Projects own efforts to catch bait by trolling.

Deep-water snappers were the main group caught and made up one-third of the total catch, which was encouraging. Shallow-water snappers and emperors were the next most common species group in the catch.

Several restraints were identified as a result of the current Project. These include a coordinated training programme to introduce deep-water snapper fishing techniques to other locations around New Caledonia, the need for suitable vessels for this form of fishing and the availability of ice in locations where deep-bottom fishing activities are promoted.

CONTENTS

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 under-utilised, 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; and

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

The project has operated in New Caledonia on one previous occasion. The 1979 visit was based in Lifou, and Isle of Pines with a couple of fishing trips conducted out of Noumea (Fusimalohi & Grandperrin 1979). The objective of the visit was to encourage the exploitation of the deep-bottom fish resources which, up to that time, had remained virtually untapped. This objective was achieved through the introduction and demonstration of simple gear and techniques that were proven efficient in other parts of the tropical Pacific. Catch rates for the two main areas fished were encouraging at 7.5 kg/line-hour at Lifou and 7.8 kg/line-hour at Isle of Pines.

This current visit was set up in response to increased interest in the exploitation of the deep-water snapper resource in New Caledonia. The project operated out of three locations, Lifou, Mare and Noumea over a four month period from 20 July to 30 November 1981 under the supervision of SPC Masterfisherman, Tevita Fusimalohi. The objectives of this project were to:

– Conduct a 'refresher' training course for interested fishermen in the Lifou area, with particular emphasis on selection of fishing grounds and vessel anchoring techniques under different conditions;

– Demonstrate and train local fishermen in each area in the use of deep-water snapper fishing gear and techniques especially the wooden 'Samoan' handreel;

– Locate suitable fishing areas for deep-water snappers in each of the three project locations; and

– Conduct an advanced course in deep-water snapper fishing techniques in Noumea.

2. BACKGROUND

2.1 General

The French Overseas Territory of New Caledonia (Figure 1), which includes La Grande Terre, the Loyalty Islands, the Belep Islands, and the Isle of Pines, has a land area of some 19,103 sq km (Douglas & Douglas 1984). The geology of the mainland is old and complex and includes ancient volcanic tuffs and younger conglomerates, sandstones and shales. Large masses of ultrabasic igneous rocks are the origin of extensive nickel deposits. Structurally, the mainland is a narrowly compressed, strongly eroded mountain range. The Loyalty islands are uplifted coral atolls.

The wet east coast of the mainland has abundant evergreen forest, with conifers common at higher altitudes. On the drier west coast the vegetation is savannah with sparse tree cover. Mangrove swamps are common around the coast and in some areas are backed by coastal fresh water swamp forests. The Loyalty Islands have open forests with patches of grasslands, and coconut palms near the coast. Bananas, sugar cane, papaya, pines, banyans, and hardwoods grow inland.

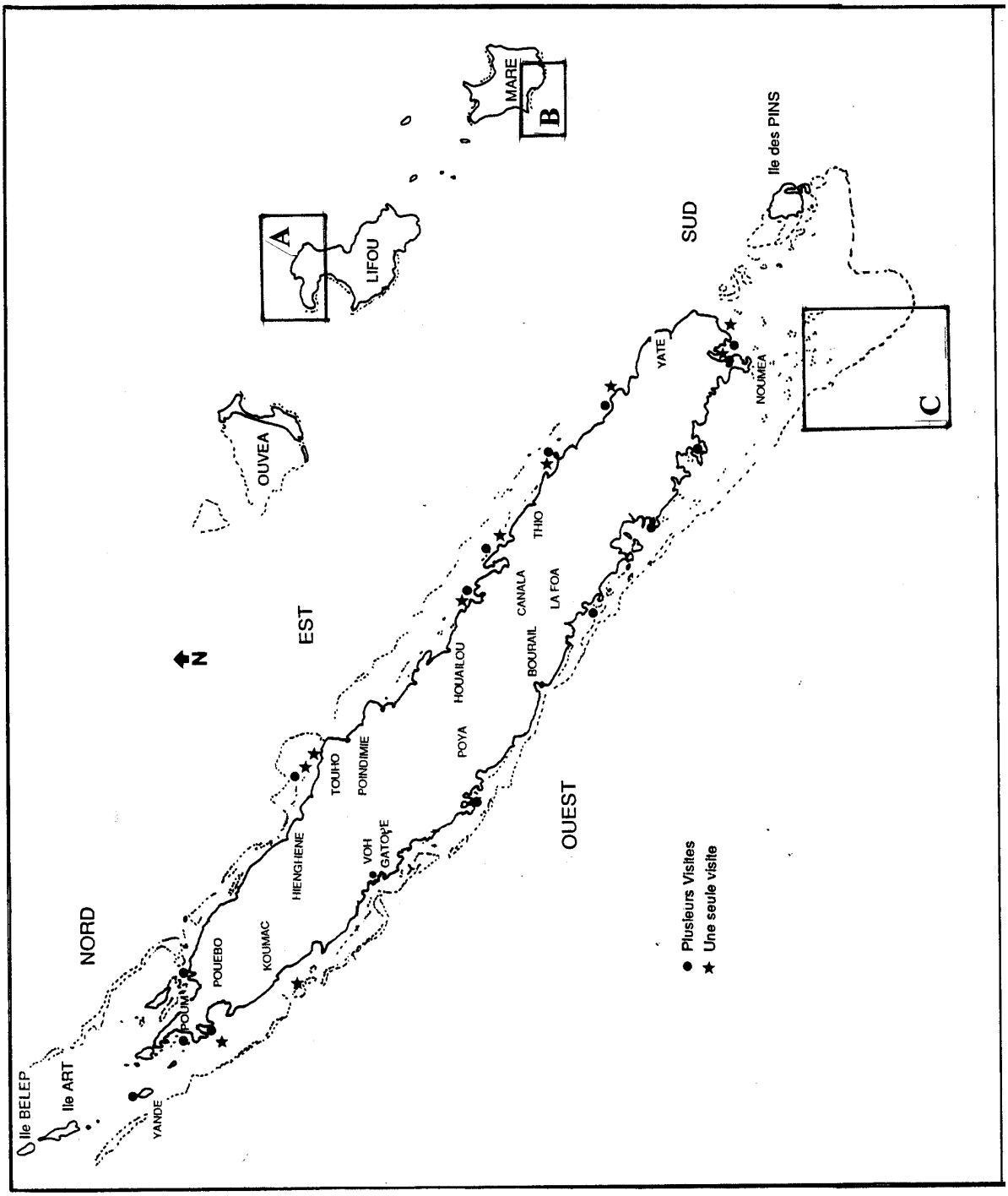

Figure 1: The Territory of New Caledonia showing the areas fished during this visit.

Only about 6 per cent of the land is cultivable, with about 416,000 ha under pasture, 6,000 ha commercially cultivated, and 250,000 ha containing forest. Mineral exploration and exploitation rights have been granted for some 466,000 ha. There are several forms of land ownership; native reserves belonging to the local tribes, private estates, and public land belonging to the Territorial authorities or to the French Government.

Although New Caledonia lies within the tropical belt, the climate is relatively cool because of the trade winds. Tropical cyclones occur between November and April. The average annual rainfall on the east coast is 2,300 mm and on the west 1,100 mm. There is a marked wet season from December to March and a dry season from September to November. Average annual temperature is 23°C (Douglas & Douglas 1984).

The population of around 146,000, more than 60,000 of whom live in the area of Noumea, is comprised of about 43 per cent Melanesians, 37 per cent Europeans (mainly French), and smaller components of Wallisians, Tahitians, Vietnamese and Indonesians. French is the official language but there are numerous Melanesian languages and dialects.

The nickel industry dominates the economy, generating 95 per cent of exports and employing about 20 per cent of the labour force. There is also a chlorine and oxygen plant, coffee processing mills, and a construction industry. Some meat is produced and there is small-scale forestry activity. Local fishing is on a limited scale only. Most rural Melanesians are engaged in subsistence agriculture. Although copra and coffee are exported, tourism is the second largest earner of foreign exchange. (Anon 1986).

The unit of currency is the French Pacific Franc (CFP).

2.2 Existing fisheries

Fisheries development in New Caledonia is the responsibility of the Territorial Department of the Merchant Navy and Sea Fisheries. Under this fisheries service's development strategy, lagoon waters and reef areas are reserved for village fisheries, stocks in these waters being regarded as too fragile to sustain larger scale exploitation. A variety of assistance schemes have been implemented to give coastal communities the opportunity to generate cash income through fisheries by supplying local markets, and possibly entering export markets for products such as trochus, beche-de-mer and corals. The main feature of this development programme has been the establishment of village fishing co-operatives and their provision with material and technical support. Nine of these co-operatives have been established in the Northern, Central, and Southern Regions, or the Loyalty Islands. The eventual aim is the establishment of 15 such co-operatives, which are expected to have a combined annual production of between 450 tonnes and 600 tonnes. The fisheries service also provides assistance for fishermen in geographically isolated settlements and for established commercial fishermen seeking help to improve their productivity.

Domestic offshore fisheries were established in 1981/82 with locally-commissioned pole-and-line and longline vessels, but poor catches and a decline in world prices for canning tuna had caused most of these operations to cease by 1985. There has been some investigation of longlining to supply the Japanese sashimi market.

Research into the raising of seawater shrimps was begun in the Territory in 1970 and continues with the assistance of the French Institute for Research on exploitation of the Oceans (IFREMER). Two artisanal shrimp farms are already in operation, as is the first phase of a 40 ha industrial-type farm designed to test, on full-scale size, the economic and technical feasibility of raising and marketing seawater shrimps.

3. PROJECT OPERATIONS

3.1 General

During the four months of this visit the Project operated at the three sites shown in Figure 1, for varying periods as detailed in Table 1.

Table 1: The movements of the project

Locality	Dates (1981)	Days spent at site
Noumea—project set-up	20–27 July	8
Doking—Lifou Island	28 July to 5 October	69
Eni—Mare Island	6 October to 6 November	31
Noumea	7–23 November	17
Noumea—writing report	24–30 November	7

Because of the distances between operational bases, the movement of the Project from site to site was effected by air transport with ground transport to get to specific locations. Little time was lost due to unfavourable weather as at all sites weather conditions were generally mild. During some rough periods fishing activities were restricted to sheltered waters or shore activities conducted.

At each operational base a vessel, complete with skipper and crew, was assigned to support the Project and fishing time was therefore maximised. Trainees were advised ahead of time of their scheduled training trips.

3.2 Boats and equipment

Different fishing craft were made available at each operational base as follows:

Doking—Lifou Island

A 6.4 m plywood 'Samson Express' design vessel (Figure 2) owned by Mr Pierre Wenisso was used by the project when fishing out of Doking, Lifou Island. This vessel was 1.5 years old and powered by a 12 HP Yanmar diesel engine. The vessel had two Samoan type handreels mounted on the starboard side, both fitted with very light monofilament line. Anchoring gear consisted of around 100 m of rope and the icechest was an old freezer with a maximum holding capacity of around 100 kg of iced fish.

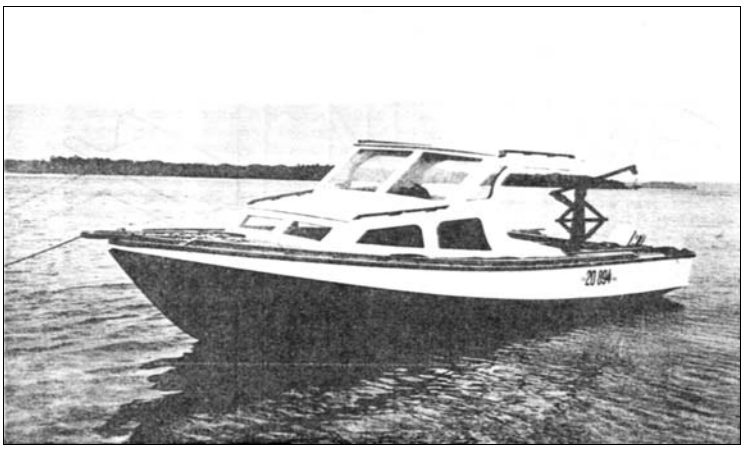

Figure 2: 'Samson Express' design vessel, similar to that used during the project in Lifou and Mare

The Masterfisherman mounted some of the project's equipment onto the vessel for the duration of the time in Lifou. An extra Samoan handreel (Figure 3) was mounted on the port side at the stern; the light monofilament on the two existing reels was replaced with heavier line suitable for deep-water fishing; and the anchor gear was replaced with 400 m of 12 mm polypropylene rope and a grapnel anchor as depicted in Figure 4. In addition, the project's echo-sounder was used for locating suitable fishing grounds with the transducer mounted securely to enable continuous recording of depth.

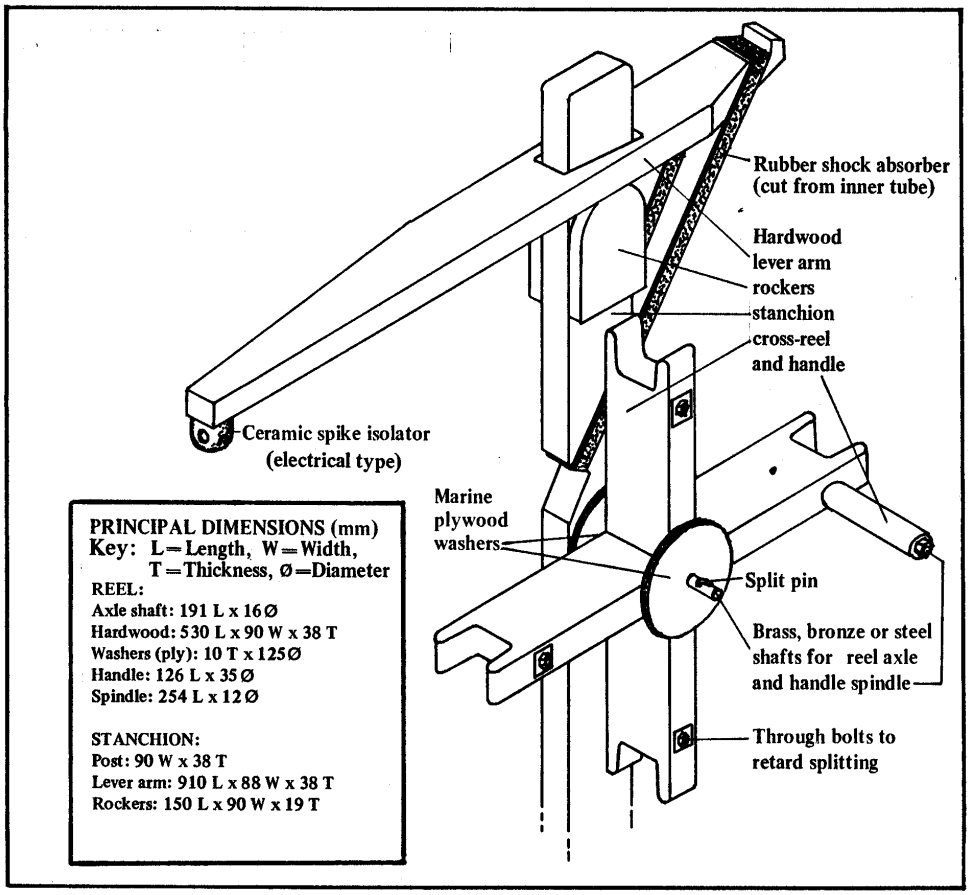

Figure 3: Samoan handreel used by the project

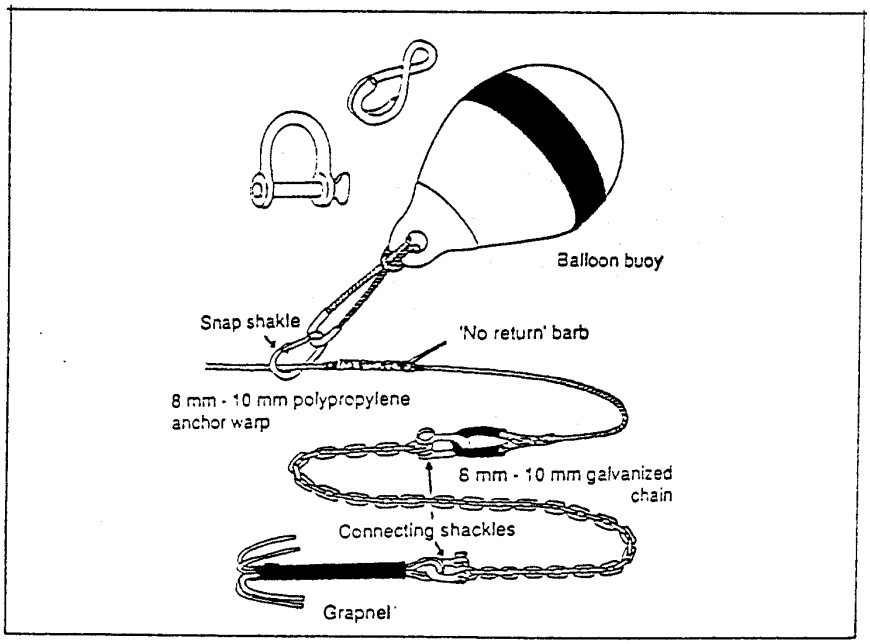

Figure 4: Anchor gear used by the project

Eni—Mare Island

A 'Samson Express' design vessel was also used by the project for fishing operations out of Eni, Mare Island. This vessel was powered by 2 x 40 HP Johnson outboards. The vessel was fitted with 2 Samoan handreels, an echo-sounder, and 400 m of polypropylene anchor rope and grapnel anchor. No project equipment was required to be mounted on this vessel for the fishing and training activities.

Noumea

The project used a local deep-bottom fisherman's vessel, F/V *L'alliance,* for the Noumea part of the project. The 9.8 m vessel was powered by 2 x 106 HP Volvo Penta Diesel inboard-outboards and had one small and two large ice boxes with a total carrying capacity of around 1,000 kg of iced fish. The vessel was also fitted with 2 'Velo' reels (Figure 5) which are locally constructed reels using an up-turned bicycle frame with rear wheel and pedal arrangement mounted on a piece of wood—the wheel replaced by a spool to store the line.

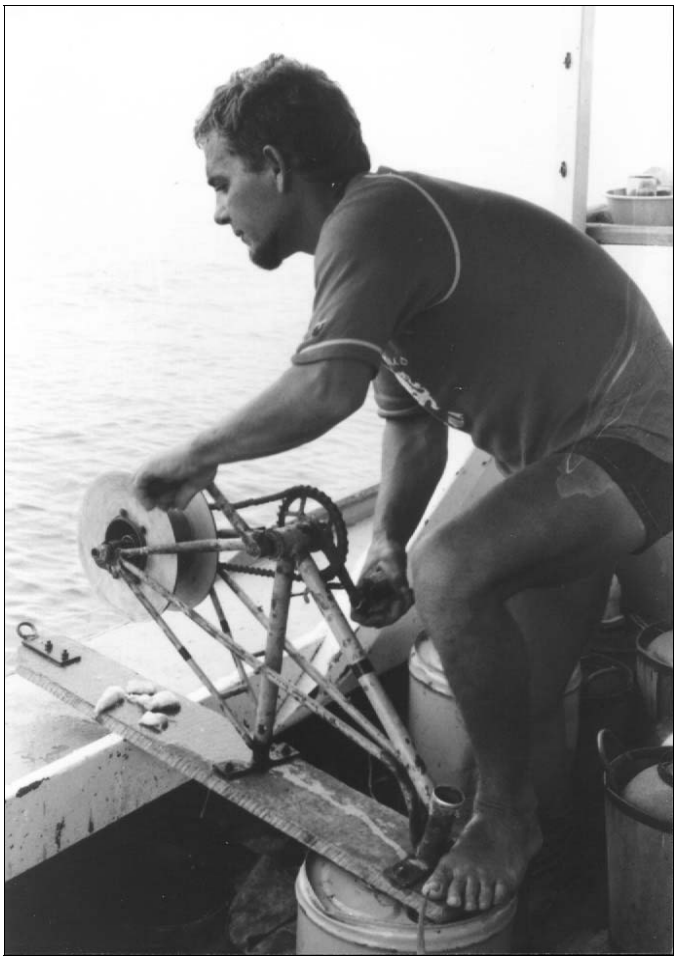

Figure 5: 'Velo' design reel used on commercial vessel fishing out of Noumea

In all locations, light handlines were used when the vessel swung into shallow water. Also, trolling was conducted at all locations as an opportunistic method employed when the vessels were moving between port and fishing ground, or between different fishing grounds.

It was originally hoped that some bottom longlining trials would be undertaken as part of the project to test its applicability to harvesting the deep-water snapper resources of New Caledonia. Unfortunately, there was no suitable line hauler available so this part of the project was not undertaken.

3.3 Training activities

The demonstration to village fishermen of deep-bottom fishing technique using the wooden handreels was an important aspect of the project's work programme. Fishing with the handreels along the outer reef slope was conducted with the aim of creating an awareness of the technique's potential for producing catches of valued species that had been previously little-exploited.

Table 2 summarises the numbers of local fishermen trained by location. In Doking on Lifou, training was restricted due to the distance between fishermen in the area and the number of vessels in the area suitable for this type of fishing. Limited time was the main factor for the small number of people trained in Noumea.

Table 2: Number of participants trained at the different locations

Project Base	Number of local fishermen
Doking—Lifou Island	3
Eni—Mare Island	20
Noumea	5
TOTAL	**28**

3.4 Disposal of the catch

The disposal of the catch varied by location as follows:

Doking—Lifou Island: The marketing of the catch had improved tremendously to that of the previous visit in 1979 (Fusimalohi & Grandperrin 1979). The cooperative's deep freezer situated in Cheperehe village can hold any excess catch. Practically all the catches were sold locally in Doking village at a price of 270 CFP/kg for deep-water snappers, and 220 CFP for the other species. Larger catches could he sold in the other villages including the 3 restaurants in the main centre of We'.

Eni—Mare Island: Most of the catch was sold immediately at the beach with any excess sold in the nearby village. Only once a part of the catch was taken to Tadine for sale.

Noumea: Deep-water snappers were sold at an ex-boat price of 400 CFP/kg, while other species and fillets were sold for 300–350 CFP/kg. It is therefore believed that there is a good demand for deep-bottom species in Noumea both by the locals and hotels.

3.5 Data collection

SPC Masterfishermen use a standard data form (Appendix 1) 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.

4. FISHING ACTIVITIES AND RESULTS BY FISHING AREAS

4.1 General

Fishing for deep-water snappers using the wooden handreels (see Figure 3) to lower and haul lines fitted with multiple-hook terminal rigs bearing three tuna circle hooks (Figure 6), was the most important fishing activity conducted during this project visit. This technique was employed at all three locations with nine trips undertaken from Lifou, eleven from Mare, and two from Noumea.

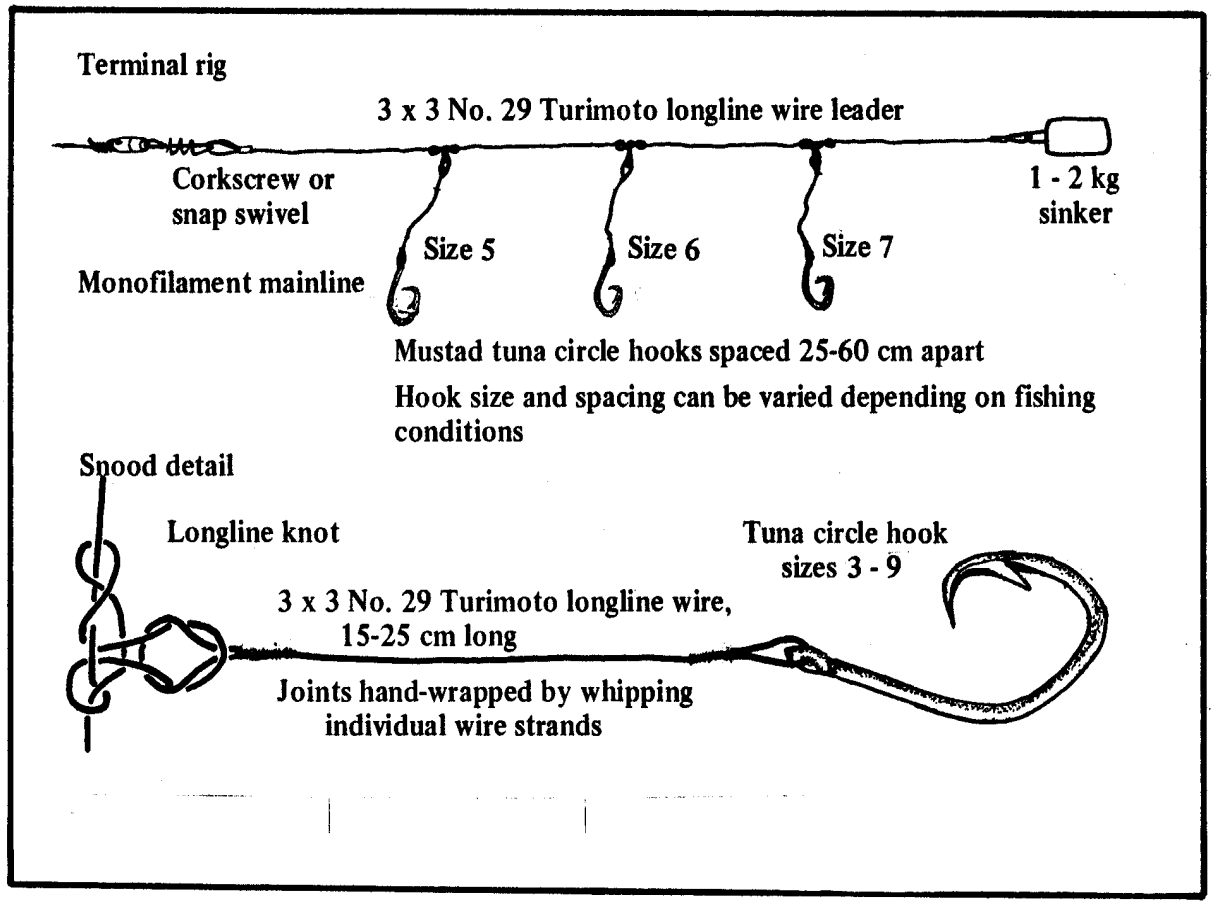

Figure 6: Typical terminal rig for deep-bottom fishing

The technique used was that standard for the Project and developed during ten previous visits to other Pacific countries or territories. Suitable fishing sites were located by echo-sounding and the anchor then dropped, when possible, in shallower water, in a position selected so that prevailing wind or current could carry the boat back over the deeper target area as the anchor warp was paid out. However, during this visit, frequent strong south-east winds blowing parallel to the reef required that the boat often be anchored in water of the same depth, or deeper, than that of the chosen fishing site.

Once the boat was resting at anchor the baited lines were lowered from the handreels until the sinkers touched bottom. Thereafter the lines were kept taut by hand to allow the fishermen to feel bites. Once bites were made four or five turns were quickly taken on the handreel in order to hook the fish and lift them clear of bottom snags as well as to avoid fouling other lines. Because of the elasticity of the long lengths of line in use, much reliance is placed on the 'self-hooking' qualities of the tuna circle hooks.

At the conclusion of fishing or preparatory to moving to another fishing site a simple technique was demonstrated to haul the anchor, which greatly reduced the effort that would be required in hauling by hand. By motoring rapidly forward the anchor was broken out and towed until it streamed behind the boat (Figure 7). While still under way the inflatable buoy (illustrated in Figure 4) was clipped by a snap-shackle over the anchor warp and released. Water resistance forced the buoy back along the warp

until it became trapped by the 'no-return' barb whipped in place. The boat was then motored slowly back along the floating warp, which was fed inboard by hand, and the anchor, suspended at the surface by the buoy, was easily recovered.

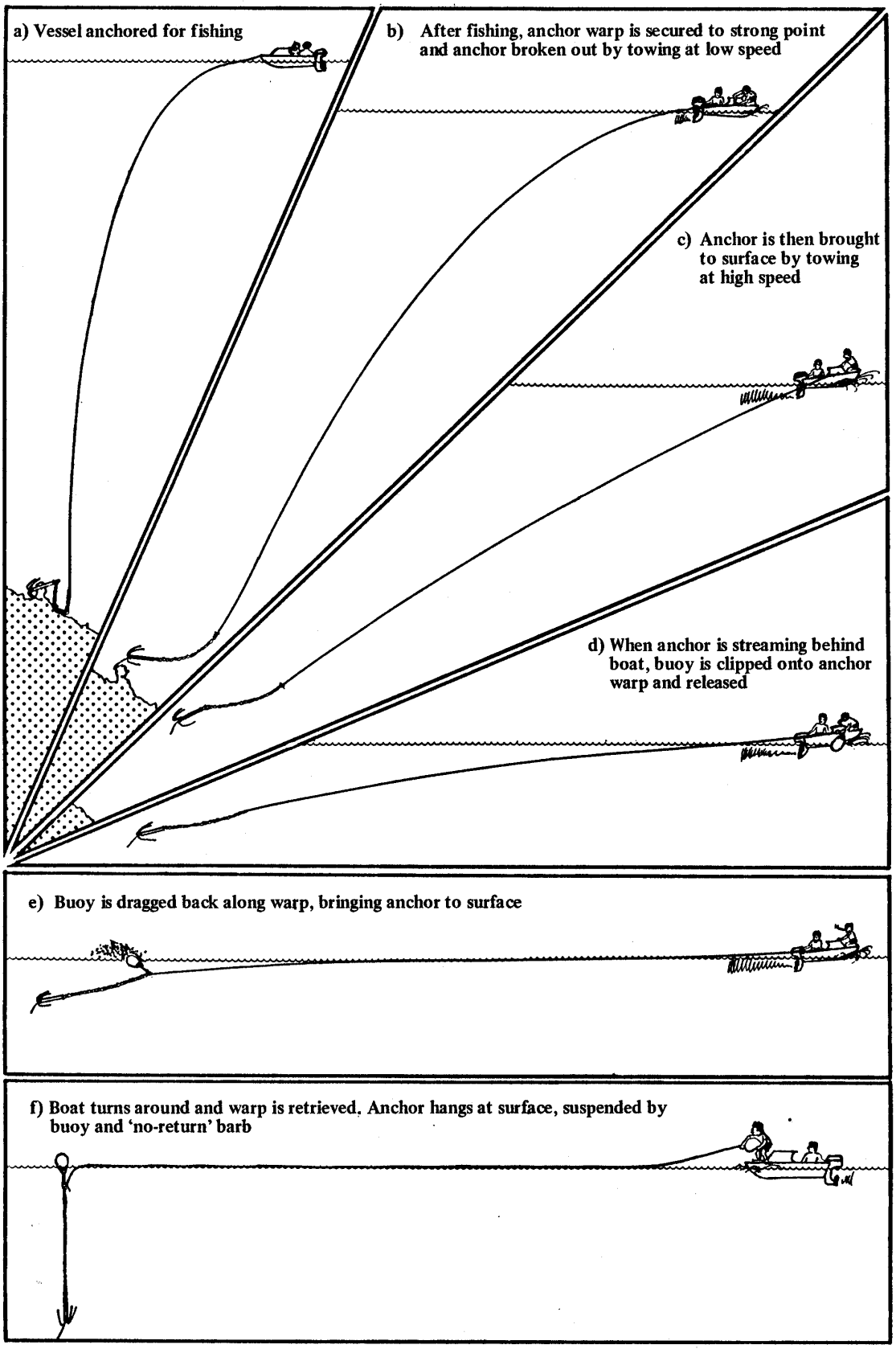

Figure 7: Anchor retrieval method

The only other method used by the project was trolling, and this was conducted on an opportunistic basis as a means of trying to catch bait for bottom fishing activities.

4.2 Doking—Lifou Island

A total of nine fishing trips were conducted in the area around Doking village, Lifou Island (Figure 8) during the two months the project was stationed there. The overall catch rate, or catch per unit of effort (CPUE) was 4.3 kg/line-hour excluding sharks from the catch. Catches varied between trips from 20.0–110.0 kg with an average catch per trip of 54.4 kg. Appendix 2A provides a summary of trip records for fishing activities at Lifou Island.

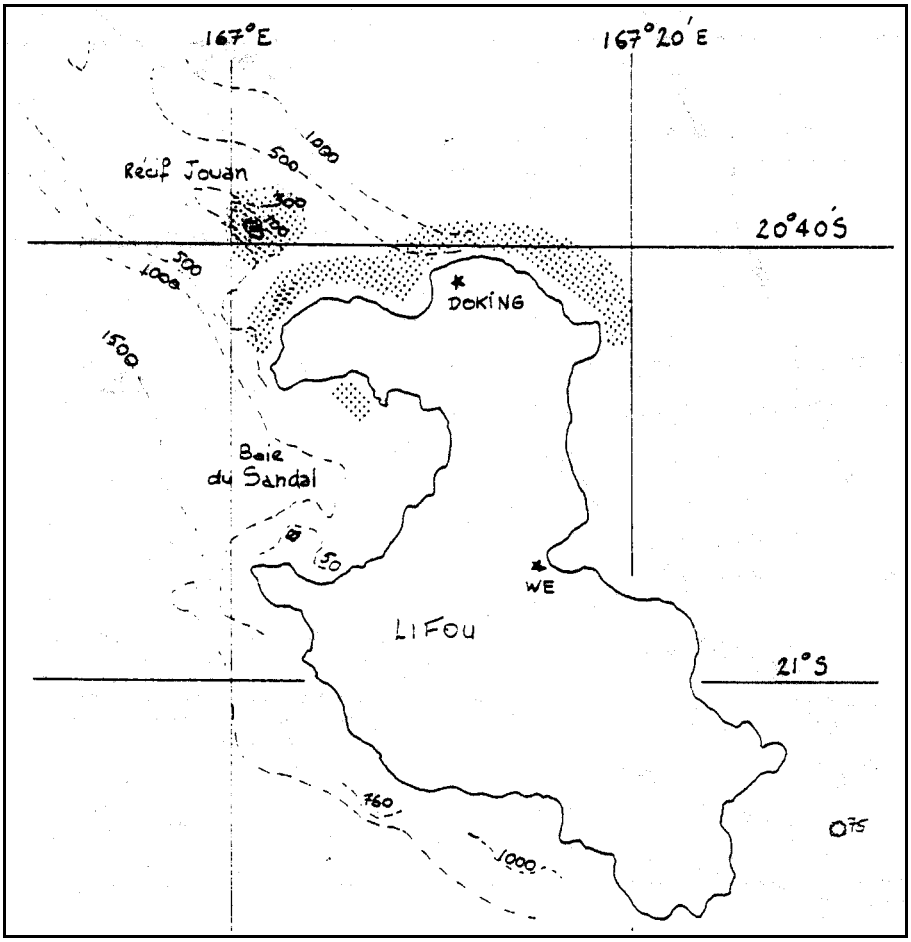

Figure 8: Areas fished around Doking—Lifou Island

One of the objectives for the project in the Doking area was to locate new and productive fishing grounds. This was difficult to achieve as the project vessel was too small with limited speed, carrying capacity, and shelter. Also, the owner of the vessel being used was more interested in catching fish than looking for new and possibly more productive fishing locations. Therefore most fishing was conducted in areas fished during the 1979 fishing trials.

Ice was available from the cooperative's freezer in blocks, for preservation of the catch at sea. However, ice was only used on the longer trips as getting the ice from the cooperative was a time consuming exercise and around one-third of the ice was lost due to melting during the transportation to the project vessel.

Bait was a major constraint to the bottom fishing activities of the Project at Lifou. Trolling was conducted as a means of catching fresh bait, however, only one small skipjack tuna and one small yellowfin tuna were caught during the two months. Therefore, other baits were used which included half-cooked octopus, fresh and frozen mackerels, salted squid, and other fish fillets. Sometimes the bait was soaked in tuna oil to try and increase its effectiveness.

4.3 Eni—Mare Island

The project operated in the waters around Eni village on Mare Island (Figure 9) for one month and completed 11 fishing trips. The overall CPUE for this area was 2.4 kg/line-hour when sharks are excluded from the catch. Catches varied between trips from 11.0–65.0 kg, with an average catch of 31.2 kg/trip. Appendix 2B provides a summary of trip records for fishing activities at Mare Island.

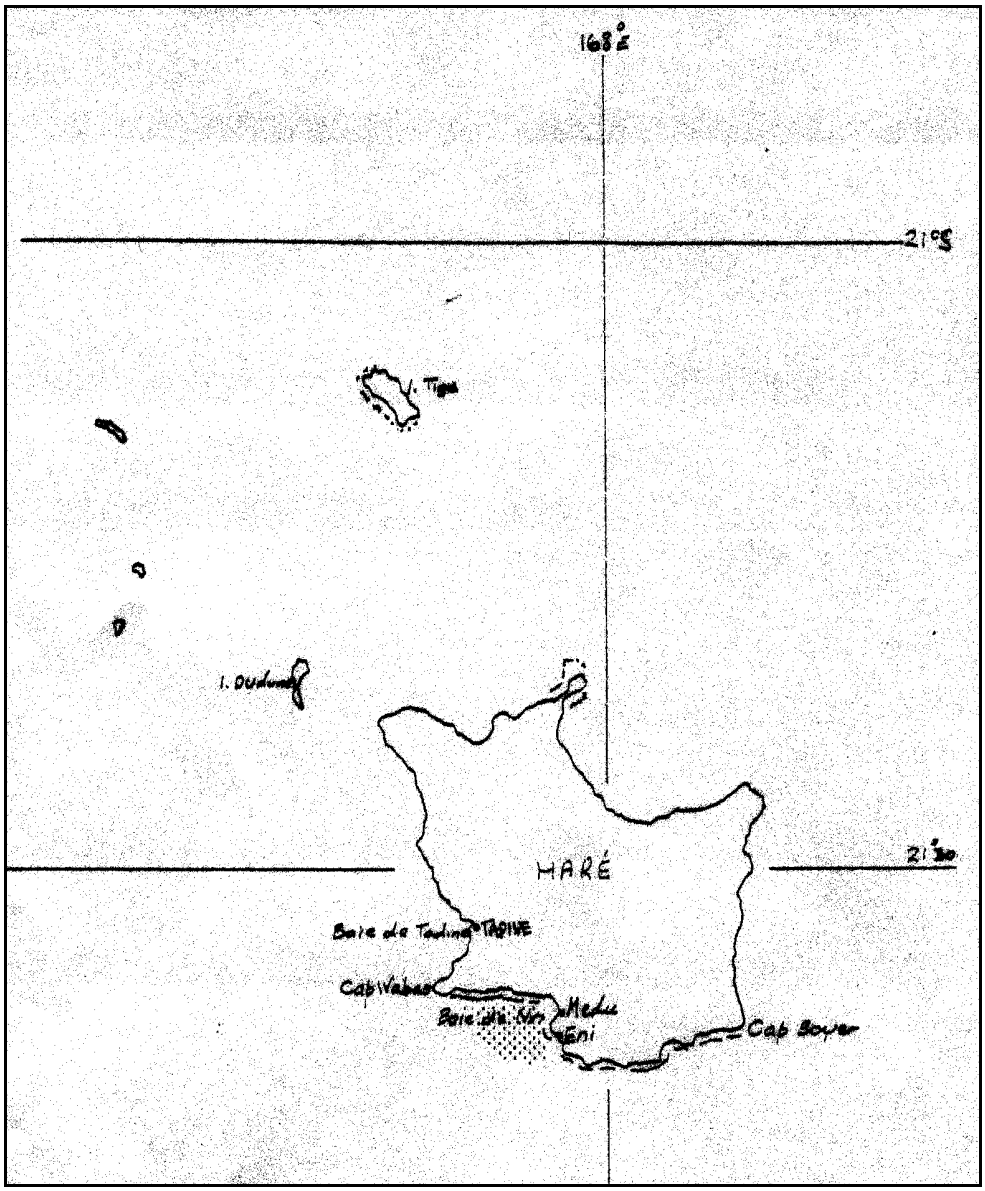

Figure 9: Areas fished around Eni—Mare Island

Weather conditions restricted fishing and survey activities to the Baie de Niri off Eni village. The area of traditional fishing access was larger than this, however, the area to the east around Cap Boyer that was reported to be a much better fishing ground, could not be fished with the persistent south-easterly winds.

Although the Island was said to have block ice available, little or no effort was made to find or make a suitably insulated on-board storage facility to ice the catch. This was regarded impossible taking into account there were only 4 weeks on the Island. The idea was stressed to the fishing group that when they had their own boat, it was essential to have ice in order to extend fishing time and quality of the catch. For this visit, night trips were longer as the fish remains cool till the morning, but shorter trips were undertaken during the day due to hot conditions

The project's catch result in Mare were gravely affected by the lack of good or suitable bait. Trolling produced a 'zero' result, thus contributing nothing to the bait situation. A few squid caught by jigging during the day and salted were regarded as the best bait to be used in Mare. Hardyheads caught with a cast net were supplemented for half cooked octopus and showed little effect. Frozen mackerel bought from a village store 25 km away at almost 400 CFP/kg was much better than the other bait used, but too expensive and once thawed fell apart if not salted. Fresh fish fillets soaked in tuna oil showed little improvement.

4.4 Noumea

Two fishing trips were conducted with a local fisherman in the area to the south of Noumea (Figure 10) during the two weeks the project was stationed there. The CPUE was 2.5 kg/line-hour excluding sharks from the catch. Catches varied between trips from 128.5–304.5 kg with an average catch per trip of 216.5 kg. Appendix 2C provides a summary of trip records for fishing activities south of Noumea.

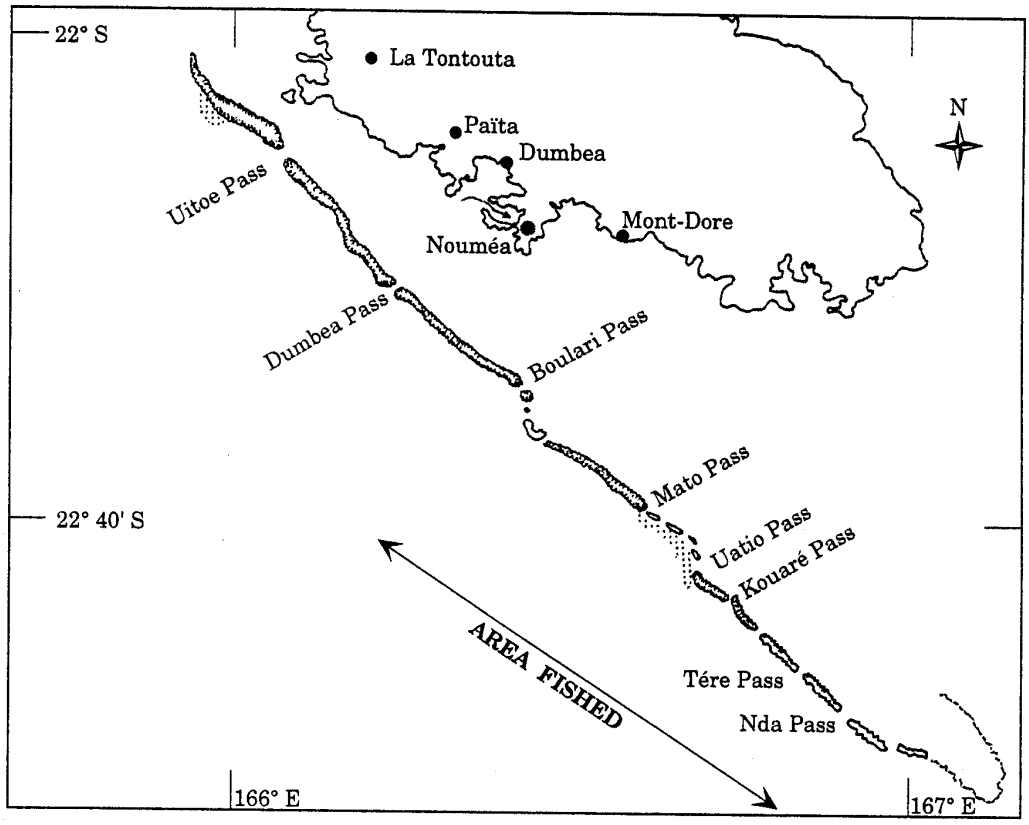

Figure 10: Area fished to the south of Noumea

The area covered during the 2 trips was from 'Passe de Bulari' to 'Recif Nogumatiugi', the farthest reef south west of Noumea (Figure 10). The area and spot to be fished was determine by the Masterfisherman after studying the chart to locate a gradual drop-off where it is believed to be a favourable spot for deep-water snappers. Also taken into account was the distance of the boat from the reef and channel or passages through the reef. It was very important to anchor the boat a reasonable distance from one or two channels so there was minimum effect of current as a result of the rise and fall of the tide. A distance of 2–5 kms was kept between fishing spots and very little difference was noticed as far as the catch composition and catch rates were concerned.

Ice was readily available for fishing operations. The limitation was that the vessel's ice boxes could only carry around 1,000 kg of ice and fish. Ice came in 25 kg blocks and these were kept in a separate ice chest to the fish. Icing of the catch occurred every 30–45 minutes to maintain fish quality.

Bait was not a problem in Noumea as there was a ready supply of frozen squid and fresh mackerel. Trolling activities were also conducted, which produced some mackerel tuna and barracuda which were good bait. Fresh squid and sardines were also caught using a cast net at one of the small islands in the lagoon.

The Masterfisherman observed some differences regarding the use of the local 'Velo' reel compared to the project's wooden handreel. These were:

Retrieving the line (with light weight) was much faster with the wooden handreel which lessened the chance of loosing fish to sharks;

When hauling heavier weight (3–4 fish at one time) less effort was needed when retrieving the line using the Velo, because of it mechanical arrangement;

The Velo is not fixed permanently to the boat so it can be operated anywhere around the boat when the current changes or lot of tangling occurs; and

With the wooden reels no mechanical maintenance is required—rinse only in fresh water.

4.5 Summary of deep-water snapper catches and comparison with other locations

Deep-water snapper fishing was the main activity undertaken during this project. Table 3 summarises the catch and effort for the three locations fished and shows an overall catch rate of 2.9 kg/line-hour being achieved.

Table 3: Catch rates recorded for the saleable deep-bottom fish catch at each area

Location	Effort (line hours)	Catch excluding sharks No.	Weight (kg)	CPUE (kg)
Doking—Lifou Island	112.5	232	478.5	4.3
Eni—Mare Island	141.0	175	342.7	2.4
Noumea	176.0	228	433.0	2.5
TOTAL	**429.5**	**635**	**1,254.2**	**2.9**

When comparing this to catch rates achieved in other locations (Table 4) the catch rate in each of the three locations is low. The lack of suitable bait could have been a contributing factor to the low catch rates achieved at Lifou when compared to the catch rates achieved in this location in 1979.

Table 4: Deep-bottom fishing catch rates recorded by the DSFDP at selected Pacific countries and territories

Country or territory	Fishing area	Year of visit	Catch per unit of effort All species	Excluding sharks
Papua New Guinea	West New Britain	1982 (this visit)	10.8	6.9
" "	Manus	" "	6.4	6.1
" "	East Sepik	" "	7.0	6.3

Vanuatu	Tanna	1979	2.7	2.5
"	Efate	1983	6.6	6.1
"	Malekula	"	2.0	2.0
"	Epi	"	3.6	3.3
"	Paama	"	6.7	6.5
"	Espirito Santo	"	9.2	7.8
Fiji	Vanua Balavu	1981/82	32.9	9.2
"	Lakemba	"	9.6	6.7
"	Southern Lau	"	12.3	9.4
"	Labasa	1984/85	10.8	6.3
New Caledonia	Lifou	1979	7.5	7.2
	Ille des Pines	"	7.8	7.1

5. SPECIES COMPOSITION OF THE CATCH

The primary target species for deep-water fishing at depths of 100–200 m are jobfishes (*Aphareus*, *Pristipomoides* spp.), sea breams (*Gnathodentex*, *Gymnocranius* spp.) and groupers and cods (*Cephalopholis*, *Epinephelus* spp.). A wide range of other species are also taken including the less desirable sharks and eels. Species characteristic of more shallow depths also commonly occur in the catch as the swing of the boat at anchor often results in a range of depths being fished. A significant component of the bottom fish catch during this project was the red-throat sweetlip (*Lethrinus chrysostomus*).

The main species group in the bottom catch was the deep-water snappers, making up 33.45 per cent of the total bottom fish catch by weight (Figure 11). The next most important group in the bottom catch was the shallow-water snappers and emperors (18.76%) and groupers and cods (14.82%). Although there were only 9 sharks caught in total they accounted for 20.83 per cent of the catch by weight. Appendix 3A lists the species composition of the bottom catch by location.

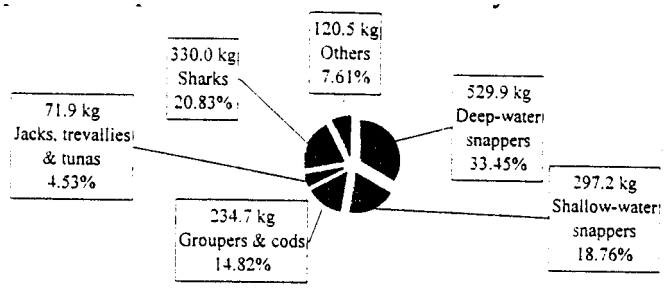

Figure 11: Species composition of the bottom fish catch

Trolling catches were low in all locations with only 7 fish taken for a total weight of 25.0 kg. The trolling catch included 5 different species from two families. Appendix 3B lists the species composition of the troll catch by location.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The catches recorded by the Project indicated the presence of a reasonable deep-bottom fish resources in all three areas visited. Catch rates were low when compared with results obtained elsewhere in the Pacific and high value species occurred in adequate proportion, with only a small unsaleable component. No ciguatoxicity was noted in species taken and there were indications that sharks, though

then unsaleable, could be sold if properly processed and marketed. Although troll catches were poor it appeared likely that this fishing activity could be seasonally productive.

Deep-bottom catches were taken from virtually an unexploited stocks and it is probable that catch rates would ultimately decline under increased fishing pressure. The relatively scattered populations likely to exploit these resources (outside Noumea) indicate that a number of small-scale operations could enter the fishery productively, most probably on a village co-operative basis. Whether or not such operations could become economically viable is less certain.

Training of local people in the fishing techniques used for deep-water snappers will be required in the future if this fishing method is to be more widely accepted. Coupled with the training will be the need for suitable boats and equipment to be available so that interested fishermen can enter the fishery.

A number of restraints were noted which have the potential to hinder the development of commercial deep-water fishing activities in New Caledonia. The main one is the availability of ice in different locations for the correct preservation of the catch whilst at sea and during transportation to market. Ice is essential for maintaining fish quality, especially if any of this product is to be exported in the future. Another restraint was the suitability of some of the vessels used during the present work. The 'Samson Express' design boats used in two of the locations were found to have poor stability, rolled considerably, had limited carrying capacity and no shade over the fishing area. The availability of suitable bait was also identified as a restraint to fishing activities and in the case of this project, probably attributed to the low catch rates achieved.

6.2 Recommendations

Based on the work undertaken during this project and the experience of the Masterfisherman, it is recommended that:

(a) The Service territorial de la marine machande et des pêches maritimes look at developing an ongoing training programme to introduce deep-bottom fishing techniques into other areas around New Caledonia;

(b) The Service territorial de la marine machande et des pêches maritimes look closely at the 'Samson Express' design boat being promoted at present in New Caledonia, and possibly suggest modifications to the design to the manufacturers so that it is a more appropriate boat for deep-water fishing activities; and

(c) The Service territorial de la marine machande et des pêches maritimes examine ways to increase the availability of ice in any location where deep-water snapper fishing is encouraged.

7. REFERENCES

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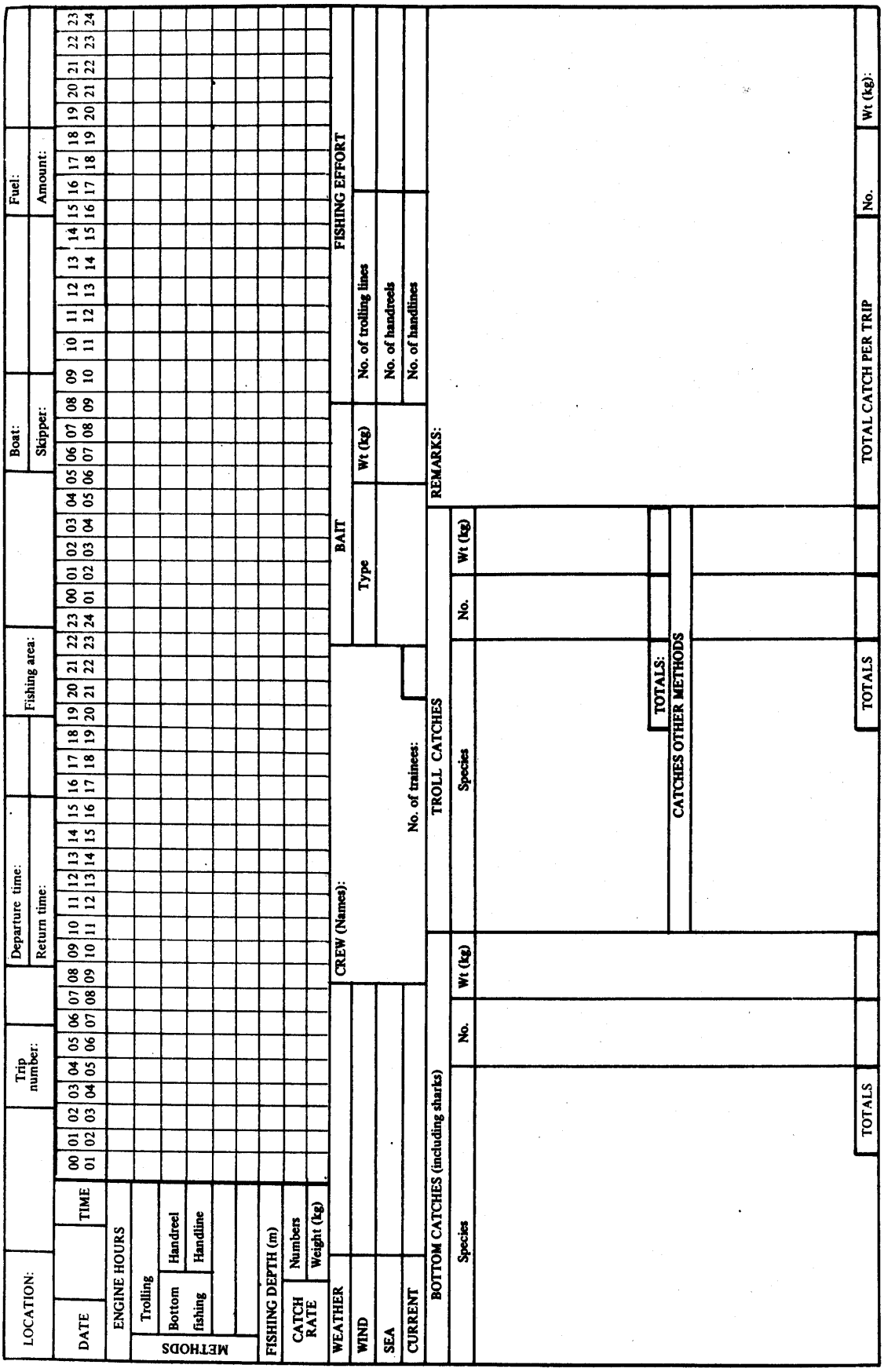
Appendix 1

STANDARD FORM USED FOR DATA COLLECTION



Appendix 2A

BOTTOM FISHING TRIP RECORDS FOR LIFOU

Trip No.	Total hours	Fishing hours	Units of Effort (reel-hours)	Catch * No.	Catch * Weight (kg)	Bait (kg)	Number of crew
1.	8.0	5.5	11.0	12	20.0	1.0	4
2.	6.5	4.0	8.0	17	41.0	2.0	1
3.	23.0	9.0	18.0	18	33.0	1.5	1
4.	9.0	3.5	7.0	25	49.5	3.0	1
5.	11.5	4.0	8.0	26	75.0	2.5	1
6.	23.0	5.5	11.0	35	69.0	2.0	1
7.	22.0	6.0	12.0	18	35.0	3.0	1
8.	19.0	7.5	22.5	48	110.0	5.0	3
9.	11.0	5.0	15.0	33	46.0	2.0	3
Total	**133.0**	**50**	**112.5**	**232**	**478.5**	**22.0**	**16**
Average per trip	**14.8**	**5.5**	**12.4**	**25.8**	**54.4**	**2.4**	

* Catch excludes sharks

Appendix 2B

BOTTOM FISHING TRIP RECORDS FOR MARÉ

Trip No.	Total hours	Fishing hours	Units of Effort (reel-hours)	Catch * No.	Catch * Weight (kg)	Bait (kg)	Number of crew
1.	10.0	8.0	16.0	15	22.0	3.0	5
2.	5.5	3.0	6.0	13	25.0	3.0	3
3.	8.0	4.0	8.0	7	11.0	1.0	3
4.	8.0	3.0	6.0	9	13.0	1.0	4
5.	12.0	8.0	16.0	27	65.0	3.0	2
6.	8.0	5.0	22.0	18	36.3	2.0	5
7.	7.0	3.0	15.0	16	26.5	2.0	4
8.	6.0	4.0	15.0	13	17.0	1.0	5
9.	12.0	6.0	12.0	19	36.9	2.0	2
10.	13.0	5.0	10.0	11	50.5	3.0	2
11.	8.0	5.0	15.0	27	39.5	2.0	2
Total	**97.5**	**54.0**	**141.0**	**175**	**342.7**	**23.0**	**37**
Average per trip	**8.9**	**4.9**	**12.8**	**15.9**	**31.2**	**2.1**	

* Catch excludes sharks

Appendix 2C

BOTTOM FISHING TRIP RECORDS FOR NOUMEA

Trip No.	Total hours	Fishing hours	Units of Effort (reel-hours)	Catch * No.	Catch * Weight (kg)	Bait (kg)	Number of crew
1	78.0	24.0	90.0	164	304.5	14.0	4
2	24.0	19.0	86.0	64	128.5	4.0	5
Total	**102.0**	**43.0**	**176.0**	**228**	**433.0**	**18.0**	**9**
Average per trip	**51.0**	**21.5**	**88.0**	**114**	**216.5**	**9.0**	

* Catch excludes sharks

Appendix 3A

SPECIES COMPOSITION OF THE DEEP-BOTTOM CATCH AT EACH LOCATION

FAMILY *Species* English name	NOUMEA No.	NOUMEA Weight (kg)	LIFOU No.	LIFOU Weight (kg)	MARE No.	MARE Weight (kg)	TOTAL No.	TOTAL Weight (kg)
DEEP-WATER SNAPPERS								
LUTJANIDAE (sub-families ETELINAE, APSILINAE)								
Aphareus rutilans Small-tooth jobfish/silvermouth	3	12.5	2	18.5			5	31.0
Aprion virescens Green jobfish	1	6.0	1	3.0			2	9.0
Etelis carbunculus Short-tailed red snapper	7	12.5	1	1.0	2	5.4	10	18.9
Etelis coruscans Longtail snapper					1	2.0	1	2.0
Pristipomoides amoenus Flower snapper	5	1.0					5	1.0
Pristipomoides filamentosus Rosy jobfish	46	117.0	13	21.0	56	109.0	115	247.0
Pristipomoides flavipinnis Yellow jobfish	2	2.0	64	74.5	46	58.5	112	135.0
Pristipomoides multidens Large-scale jobfish			43	86.0			43	86.0
Sub-total	**64**	**151.0**	**124**	**204.0**	**105**	**174.9**	**293**	**529.9**
SHALLOW-WATER SNAPPERS								
LUTJANIDAE (sub-family LUTJANINAE)								
Lutjanus bohar Red bass			5	16.0	2	9.0	7	25.0
Lutjanus kasmira Blue-lined snapper			3	1.0			4	1.0
Lutjanus rufolineatus Rufous sea perch			1	1.0	5	1.1	6	2.1
Sub-total			**9**	**18.0**	**7**	**10.1**	**16**	**28.1**

EMPERORS								
LETHRINIDAE								
Gnathodentex mossambicus Large-eye sea bream			2	1.0			2	1.0
Gymnocranius japonicus Sea bream	34	43.5	26	42.0	20	29.4	80	114.9
Gymnocranius spp. Striped-faced sea bream	1	3.0					1	3.0
Lethrinus chrysostomus Red-throat sweetlip	50	65.5	8	26.0	9	27.2	67	118.7
Lethrinus miniatus Long-nose emperor			2	8.0			2	8.0
Lethrinus variegatus Variegated emperor	25	21.5	2	2.0			27	23.5
Sub-total	**110**	**133.5**	**40**	**79.0**	**29**	**56.6**	**179**	**269.1**
GROUPERS, CODS AND CORAL TROUTS								
SERRANIDAE								
Cephalopholis aurantius Rock cod			5	5.0	1	0.5	6	5.5
Epinephelus chlorostigma Brown-spotted grouper			2	2.0	4	6.0	6	8.0
Epinephelus hoedti Blue grouper			2	13.0	2	11.0	4	24.0
Epinephelus magniscuttus Large-scaled grouper			2	6.0			2	6.0
Epinephelus malabaricus Flowery grouper			1	20.0			1	20.0
Epinephelus microdon Marbled cod			2	4.0			2	4.0
Epinephelus morrhua Curve-banded grouper			19	54.0	4	8.0	23	62.0
Epinephelus retouti Grouper			3	3.0	4	6.9	7	9.9
Epinephelus spp Unidentified grouper	22	51.5			1	1.6	23	53.1
Variola louti Luna-tail trout	21	24.0	8	13.0	3	5.2	32	42.2
Sub-total	**43**	**75.5**	**44**	**120.0**	**19**	**39.2**	**106**	**234.7**

JACKS AND TREVALLIES

CARANGIDAE

Caranx lugubris								
Black trevally			2	7.0			2	7.0
Caranx spp.								
Trevally					1	1.9	1	1.9
Seriola dumerili								
Deep-water amberjack	4	22.0	2	9.0			6	31.0
Seriola rivoliana								
Deep-water amberjack	1	15.0	1	7.0			2	22.0
Sub-total	**5**	**37.0**	**5**	**23.0**	**1**	**1.9**	**11**	**61.9**

MACKERELS AND TUNAS

SCOMBRIDAE

Gymnosarda unicolor								
Dogtooth tuna	1	10.0					1	10.0
Sub-total	**1**	**10.0**					**1**	**10.0**

OILFISH AND SNAKE MACKERELS

GEMPYLIDAE

Revettus pretiosus								
Oilfish	2	22.0			4	40.0	6	62.0
Sub-total	**2**	**22.0**			**4**	**40.0**	**6**	**62.0**

BARRACUDAS AND SPIKES

SPHYRAENIDAE

Sphyraena spp.								
Barracuda			6	27.0	10	20.0	16	47.0
Sub-total			**6**	**27.0**	**10**	**20.0**	**16**	**47.0**

MISCELLANEOUS BONY FISHES								
LABRIDAE								
Bodianus perdito Golden-spot pigfish	3	4.0	1	1.0			4	5.0
HOLOCENTRIDAE								
Myripristis spp. Squirrelfish			1	1.0			1	1.0
POMADASYIDAE								
Rubber-lip bream			1	3.0			1	3.0
TRIODONTIDAE								
Triadon macropterus Deep-water toadfish			1	2.5			1	2.5
Sub-total	**3**	**4.0**	**4**	**7.5**			**7**	**11.5**
TOTAL (excluding sharks)	**228**	**433.0**	**232**	**478.5**	**175**	**342.7**	**635**	**1,254.2**
SHARKS								
CARCHARHINIDAE								
Carcharhinus spp. Reef shark	1	30.0	1	80.0	6	170.0	8	280.0
Triaenodon obesus White-tip reef shark			1	50.0			1	50.0
Sub-total	**1**	**30.0**	**2**	**130.0**	**6**	**170.0**	**9**	**330.0**
TOTAL (all species)	**229**	**463.0**	**234**	**608.5**	**181**	**512.7**	**644**	**1,584.2**

Appendix 3B

SPECIES COMPOSITION OF THE TROLL CATCH AT EACH LOCATION

FAMILY *Species* English name	NOUMEA No.	 Weight (kg)	LIFOU No.	 Weight (kg)	MARE No.	 Weight (kg)	TOTAL No.	 Weight (kg)
SNAPPERS								
LUTJANIDAE								
Aprion virescens Green jobfish	1	2.0					1	2.0
Sub-total	**1**	**2.0**					**1**	**2.0**
MACKERELS AND TUNAS								
THUNNIDAE & SCOMBRIDAE								
Euthynnus affinis Mackerel tuna	1	3.0					1	3.0
Katsuwonus pelamis Skipjack tuna			1	2.0			1	2.0
Scomberomorus commerson Spanish mackerel	1	3.0					1	3.0
Thunnus albacares Yellowfin tuna	2	12.0	1	3.0			3	15.0
Sub-total	**4**	**18.0**	**2**	**5.0**			**6**	**23.0**
TOTAL	**5**	**20.0**	**2**	**5.0**			**7**	**25.0**