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REPORT ON FOURTH VISIT TO PAPUA NEW GUINEA

31 March – 23 September 1988

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This unpublished report forms part of a series compiled by the Capture Section of the South Pacific Commission's Coastal Fisheries Programme.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.

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SUMMARY

The South Pacific Commission's Deep Sea Fisheries Development Project (DSFDP) visited Papua New Guinea for the fourth time between March and September 1988, under the supervision of SPC Masterfisherman Paxton Wellington.

The visit was conducted to promote the development of small-scale artisanal deep-bottom fisheries in the Oro Bay area in Northern Province and around Rabaul in East New Britain Province, and to conduct training in deep-bottom gear rigging and fishing technique for students of the National Fisheries College at Kavieng in New Ireland Province. Fifty fishing trips were completed during the visit, during which counterpart officers, provincial fisheries extension staff, Fisheries College students and village fishermen were trained in aspects of deep-bottom droplining and trolling. While working with village fishing groups, particular emphasis was given to the identification of suitable deep-bottom fishing grounds by sounding and reference to landmarks and bearings, rather than the use of an echo-sounder.

During 478.5 hour spent at sea a total of 1,376 fish was taken, with a combined weight of 2,816.9 kg, of which 83.3 per cent by weight was of locally saleable species. The saleable catch included 1,515.3 kg of deep-water snappers of the genus Lutjanidae, the primary species targeted by deep-bottom droplining.

Deep-bottom catch rates were low in comparison to results previously recorded in Papua New Guinea by the DSFD Project; the average catch rate from the three fishing areas being 3.2 kg/reel hour. Despite this low productivity it is considered that the areas fished hold significant stocks of deep-bottom fish which are amenable to exploitation by small-scale artisanal operators, at least in localised sites. This evaluation is based in part on the presence of extensive grounds likely to harbour deep-bottom stocks, as indicated by available charts, and the fact that fishing productivity during this visit was hampered by the requirements of the survey and training programme and by significant operational difficulties. The operational difficulties encountered included restricted access to fishing grounds subject to traditional fishing rights, difficulties in securing adequate bait supplies, and the poor condition of some fishing or support vessels and gear.

Although local fishermen generally demonstrated enthusiasm and aptitude for deep-bottom fishing a number of restraints likely to impede the development of this fishery at a commercial level were evident. The more important of these related to the difficulties in providing the necessary technical and material support to promote a wider awareness of the fishery's potential, and to providing fishermen with the means to participate in it, particularly in the more remote areas. As well as the considerable difficulties in landing catches in good condition at centres where they could be marketed. The restrictions imposed by the concept of traditional fishing rights extending beyond the outer reef edge was also noted as likely to restrain development in some areas.

This report includes a number of recommendations which, if adopted, may help to alleviate the constraints noted. The most important of these suggests the utilisation of existing general-purpose village craft for deep-bottom fishing, with basic fishing equipment such as handreels, reel mounts and grapnel anchors, constructed at provincial workshops, and the wider availability of appropriate fishing gear such as line and hooks.

It is apparent that the successful exploitation of deep-bottom stocks in the areas visited will require extensive support at the village level as well as the gradual improvement of catch handling, transport and marketing infrastructures at provincial level.

RÉSUMÉ

Sous la direction du maître de pêche Paxton Wellington, les agents de la Commission du Pacifique Sud ont séjourné, pour la quatrième fois, entre mars et septembre 1988, en Papouasie-Nouvelle-Guinée, dans le cadre du projet de développement de la pêche au demi-large.

Cette mission avait pour objet de promouvoir le développement des petites exploitations de pêche artisanale au grand fond, dans la province du nord et au large de Rabaul, dans la province de la Nouvelle-Bretagne orientale, ainsi que de dispenser une formation aux techniques de montage des engins et de pêche au grand fond aux étudiants du Collège national des pêches à Kavieng, dans la province de la Nouvelle-Irlande. Cinquante sorties ont été effectuées dans le cadre de cette mission, pendant lesquelles des homologues du maître de pêche, des agents chargés du développement des pêches de la province, des étudiants du Collège des pêches et des pêcheurs locaux ont été rompus à certaines méthodes de pêche profonde à la ligne à main et à la traîne. Le travail s'est fait en collaboration avec les groupes de pêcheurs locaux, mais il s'agissait surtout de rechercher de nouveaux lieux de pêche profonde par sondage et en procédant à des relèvements par rapport à des amers, plutôt qu'à l'aide d'un échosondeur.

Au cours des 478,5 heures passées en mer, 1 376 poissons en tout ont été capturés pour un poids total de 2 816,9 kg, dont 83,3 pour cent étaient composés d'espèces commercialisables sur le marché local. Parmi ces dernières, on peut citer les lutjanidés d'eau profonde, espèce principalement visée par la pêche profonde à la ligne à main.

Les taux de prises en eaux profondes étaient faibles par rapport aux résultats enregistrés précédement en Papouasie-Nouvelle-Guinée dans le cadre du projet. Le taux moyen de prises pour les trois zones de pêche a été de 3,2 kg/heure/moulinet. En dépit de ce faible rendement, on estime que les zones de pêche prospectées recèlent des stocks importants de poissons profonds que pourraient exploiter de petits opérateurs de pêche artisanale, du moins sur certains sites précis. Cette évaluation se fonde notamment sur l'existence de vastes sites susceptibles de contenir des stocks de poissons profonds, ainsi que l'indiquent les données disponibles, et sur le fait que la productivité de la pêche pendant la mission a été entravée par les impératifs liés au programme d'évaluation et de formation et par d'importantes difficultés techniques. Au nombre de ces problèmes, on citera l'accès restreint aux sites de pêche soumis à des droits de pêche traditionnels, les difficultés d'approvisionnement en appâts et le mauvais état de certains équipements et navires de pêche ou accessoires.

Bien que les pêcheurs locaux se soient, d'une manière générale, montrés enthousiastes et capables de pêcher en eaux profondes, il est apparu qu'un certain nombre de facteurs peuvent faire obstacle à la viabilité de cette pêcherie à des fins commerciales. Il a surtout été difficile d'apporter le soutien technique et matériel nécessaire pour mieux faire connaître les possibilités qu'offre le secteur des pêches et pour donner aux pêcheurs les moyens d'exploiter ces ressources, notamment dans les régions les plus reculées. D'une part, il était extrêmement difficile de débarquer les prises dans de bonnes conditions aux centres où elles pouvaient être commercialisées; enfin, les restrictions imposées par le système des droits de pêche traditionnelle, qui s'appliquent au-delà de la barrière récifale externe, risquaient également de freiner le développement de certaines régions.

Ce rapport contient plusieurs recommandations dont la mise en œuvre pourrait précisément atténuer toutes ces difficultés, principalement l'utilisation pour la pêche profonde d'une embarcation polyvalente du village, qui serait équipée du matériel de base (moulinets, supports de moulinets, ancres à grappin, etc.) fabriqué dans les ateliers de la province, mais aussi la mise à disposition de matériel de pêche approprié tel que des lignes et des hameçons.

Il semble que l'exploitation réussie des stocks profonds dans les zones visitées exigera un très large soutien des villageois ainsi que l'amélioration progressive de la manipulation, du transport et de la commercialisation des prises au niveau de la province.

ACKNOWLEDGEMENTS

The South Pacific Commission acknowledges with gratitude the friendly support and co-operation afforded the Deep Sea Fisheries Development Project while in Papua New Guinea.

Particular thanks are due to Mr David Cooke, Chief Fisheries Extension Officer; Mr Kema Mailu, Manager of Oro Fisheries Authority; and Mr Soria Mah, Principal Fisheries Officer Rabaul.

Deserving of special mention is Mr Melchior Ware for the enthusiastic support of the Project at Kavieng.

CONTENTS

1. INTRODUCTION

The South Pacific Commission's Deep Sea Fisheries Development Project (DSFDP) 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, 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 Papua New Guinea on three previous occasions. A 1979 visit was based at Kimbe, West New Britain (Fusimalohi & Crossland, 1980) and a second visit, during 1982, operated at Port Moresby, and at Samarai and Manus Islands (Chapman & Fusimalohi, 1998). A third visit, during 1984, visited West New Britain, Manus, and East Sepik Provinces (Chapman, 1998).

The first two of these visits involved the survey and assessment of deep-bottom fish resources along the outer reef-slopes, and the demonstration of appropriate gear and fishing techniques to promote the artisanal exploitation of this resource. The third visit continued this work but also involved limited surveys of coastal pelagic fish stocks and participation in a fish aggregation device (FAD) deployment and trial fishing programme.

The fourth visit, described in this report, was conducted following a request to SPC by the Government of Papua New Guinea for assistance in further promoting the development of local deep-bottom fisheries in three areas not previously visited by the DSFD Project. The visit extended over six months, operating at Oro Bay in Northern Province, Rabaul in East New Britain, and Kavieng in New Ireland, under the supervision of SPC Masterfisherman, Paxton Wellington.

The specific objectives of the work to be undertaken at each area varied according to local need, as follows:

Oro Bay
- to conduct a preliminary survey of deep-bottom fishing grounds,
- to demonstrate deep-bottom fishing gear and techniques to local fishermen,
- to train a counterpart fisheries officer in appropriate fishing techniques and extension methods in order that this officer could continue a local deep-bottom fishing training programme;

Rabaul
- to conduct practical deep-bottom fishing training with the operators of new fishing craft,
- to demonstrate techniques for identifying deep-bottom fishing gounds without the use of an echo-sounder,
- to provide additional training for Fisheries Division extension staff; and

Kavieng
- to conduct a practical introduction to deep-bottom fishing gear and techniques for students and staff of the National Fisheries College.

2. BACKGROUND

2.1 General

Papua New Guinea (PNG) (Figure 1) has a land area of some 476,500 sq km comprising the eastern half of the New Guinea mainland, the Bismarck Archipelago (Manus, New Ireland and New Britain), Bougainville and Buka. Hundreds of smaller islands lie within PNG's borders, scattered across the Bismarck, Solomon and Coral Seas.

The central core of the mainland is a massive cordillera interspersed with wide valleys at altitudes up to 1,800 m. Alluvium derived from active mountain erosion is deposited extensively in the broad, swampy Sepik River Basin and the low, swampy plain of the Fly River and Gulf of Papua. New Britain, New Ireland and Bougainville are part of high-island arcs.

Tropical rainforest covers about three-quarters of the country. The remainder is covered in savannah, grassland and swamps. Some 97 per cent of all land is held under customary tenure and part of this is used for subsistence agriculture (much of it on a shifting or rotational basis). Cash crops include copra, coffee, rubber, palm oil and tea, grown on smallholdings and on plantations. There is some forestry.

Except in high altitudes the climate is tropical with uniformly high temperatures and regular heavy rainfall. PNG is one of the largest constantly wet areas in the world and rainfall in some areas ranges up to 5,000 mm annually. South-east trade winds predominate from May to October, and the north-east monsoons from December to March. During the transition, winds are variable with periods of hot, humid calm.

Population is estimated at nearly 3.5 million, 98 per cent of whom are indigenous Melanesians. The rugged topography has divided the country into numerous regional settlements and has contributed to a remarkable cultural diversity. There are more than 700 indigenous spoken languages, which fall into two main groups, Papuan and Melanesian. Pidgin was first used in trade and has become the common language, though English is taught in schools and is widely understood.

The majority of the work force is engaged in primary production, either at subsistence level or in cash-cropping. Mining is important and a number of small manufacturing industries produce for the local market. The main exports are copper, gold, coffee, cocoa, copra and coconut oil, and fish.

Politically independent since 1975, the country is divided into 19 administrative provinces, with the national capital at Port Moresby on the southern coast of the mainland. The national unit of currency is the PNG Kina (1 Kina = 100 Toea).

2.2 Existing fisheries

PNG's extensive coastline and offshore archipelagoes present a great diversity of coastal types and marine environments. The Gulf of Papua is characterised by large delta areas, mud flats and mangrove swamps. The North Coast and the high island coasts are typified by fringing coral reefs and narrow lagoons. Some of the smaller island clusters lie adjacent to extensive submerged reef systems or broad shallows.

Artisanal fisheries throughout the country reflect the diversity of coastal environments and, although an important element in subsistence food-gathering, are poorly developed by Pacific standards. This reflects to some extent the traditional preoccupation with agriculture common in Pacific states having large areas of arable land available.

Along the mainland and high-island coasts and in the smaller island communities, fishing activities include the harvesting of the reef flats, spearfishing, shallow-water handlining from dugout canoes, netting, and trapping in the fresh-water reaches of the larger rivers.

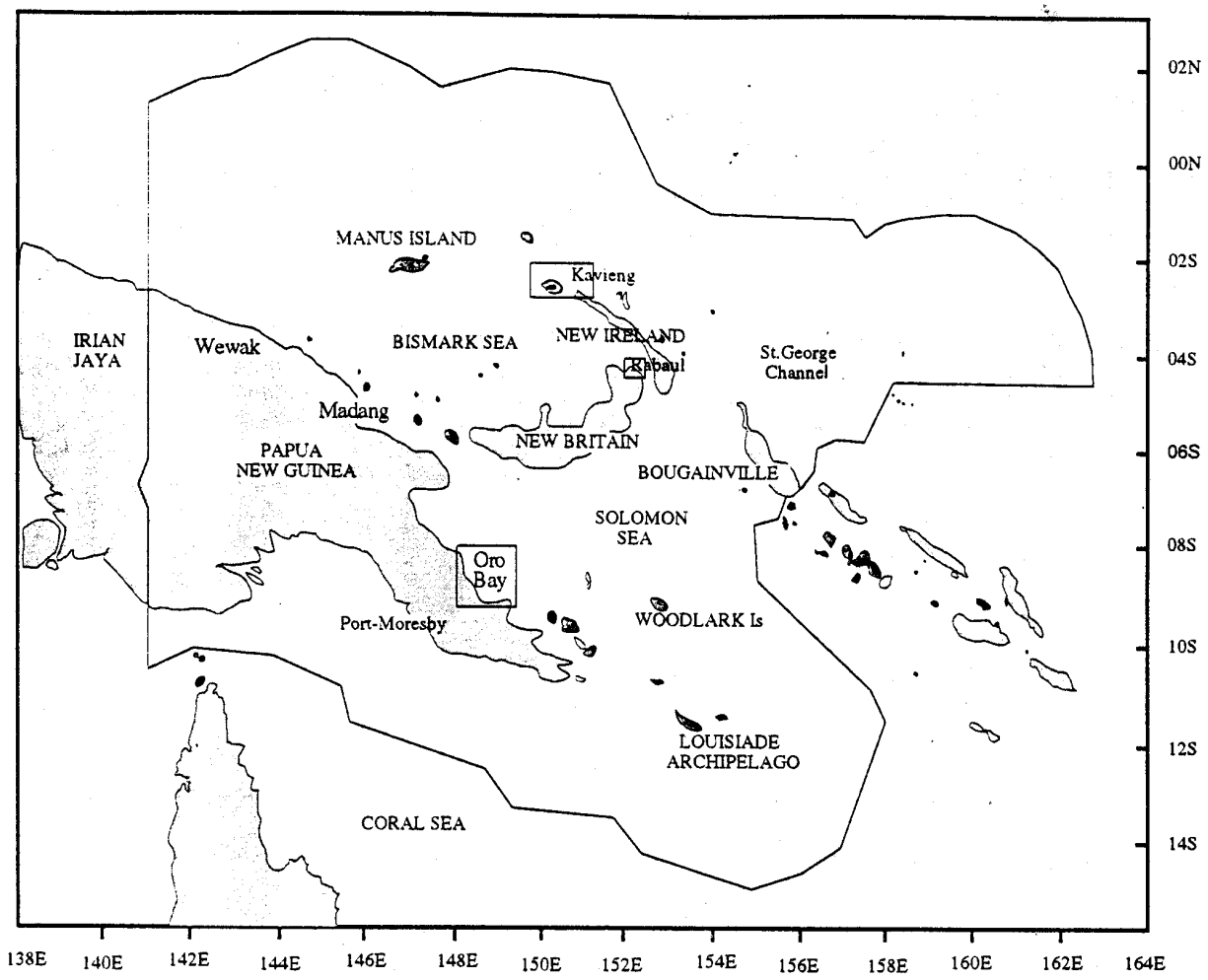

Figure 1. **Papua New Guinea, showing the three areas fished during this visit**

Commercial exploitation of local marine resources has long been dominated by the offshore tuna fishery, conducted by foreign-based vessels and foreign vessels based locally under joint venture arrangements. During the 1970s the locally based pole-and-line fishery was the most productive Pacific-based tuna fishery. Japanese vessels fishing under joint ventures averaged catches of nearly 30,000 t annually between 1971 and 1981 (Tuna Programme, 1983).

At the time of this visit the domestic fishery had been suspended following a downturn in the economics of the industry, but a major offshore fishery continued with foreign purse-seine, pole-and-line, and longline vessels fishing under licence in PNG's 200-mile Declared Fishing Zone. During 1982 the catch by Japanese purse-seiners and longliners alone was more than 67,000 t (PNG Department of Primary Industry, unpublished data). Joint venture prawn and lobster fisheries have also operated in the Gulf of Papua. Other commercial exploitation of local marine resources is limited but includes a number of coastal fisheries stations maintained by government, some of which were established by foreign aid organisations. Catches collected at these stations are generally air-freighted to coastal urban centres or to Highland settlements where a shortage of affordable protein foodstuffs is general. Some of the coastal fisheries stations have exported quantities of reef fish and barramundi fillets and at others the collection and sale of crabs and lobsters is important. Demand for fisheries products exceeds supply in most areas.

Oro Bay

Fisheries in this area are mostly at subsistence level, based on shallow-water handlining and hand-harvesting of the reef flats. Fishermen from several villages in the Tufi area engage in deep-bottom fishing and sell their catches at the Tufi Coastal Fisheries Station which is equipped with ice-making equipment, a blast freezer, and two walk-in storage freezers. Catches are generally later carried to Oro Bay by boat and landed at the Oro Bay Fisheries Authority in Popondetta for local sale.

Rabaul

Fisheries development in East New Britain Province is the responsibility of the Provincial Fisheries Department based in Rabaul. A boat building project begun in 1987 with the construction of five FAO 'Red Snapper'-design canoes has a projected output of around 40 fishing craft. The Fisheries Department also operates a small walk-in freezer and has some ice-making equipment. Rabaul also has a public fish market where ice is available to fishermen, and several retail outlets which buy fish from the Fisheries Department.

Kavieng

The National Fisheries College is located at Kavieng in New Ireland Province and has operated since 1975, conducting two-year courses covering boat handling, navigation, marine engineering, and fishing gear construction, as well as business studies, biology and English. The college caters to between 40 and 60 students at a time, most of whom are Papua New Guineans. Kavieng also serves as the base for a Provincial Fisheries Department, a Fisheries Research Station, and an Extension Station. Although freezer facilities are established, there are only limited marketing outlets for local catches.

3. PROJECT ACTIVITIES

3.1 General

During the six months of this visit the Project operated in the three areas shown in Figure 1 for varying periods and conducting different activities, as detailed in Table 1.

Table 1: Summary of activities

Dates (1988)	Activity
31 March – 15 April	Arrived in Oro Province, prepared fishing gear and boat.
16 April – 24 April	Fishing trips conducted in Awia and Ambasi areas.
25 April – 28 April	Returned to Oro Bay, prepared for travel to Tamari Bay.
29 April – 3 May	Fishing trips conducted in Tamari Bay area.
4 May – 7 May	Arrived in Tufi area, support vessel broke down.
8 May – 11 May	Returned to Oro Bay, prepared for travel to Port Moresby.
12 May – 16 May	Completed arrangements to travel to Rabaul.
17 May – 27 May	Arrived Rabaul, fishing trips conducted around Urara Island.
28 May – 5 June	Fishing trips conducted from base at Kurakabaul.
6 June – 10 June	Fishing trips conducted from base at Rabura
11 June – 22 June	Trip to Duke of York Islands, fishing trips conducted from base at Matupi.
23 June – 28 June	Prepared Fisheries Department boat for fishing, completed one trip with Department's staff.
29 June – 3 July	Prepared for travel to Kavieng.
4 July – 12 July	Arrived Kavieng, fishing reels constructed, boat prepared for fishing.
13 July – 15 July	Training discussions conducted about deep-bottom droplining
16 July – 27 July	Fishing trips conducted with 1st Year college students.
28 July – 6 August	Travelled to SPC headquarters in New Caledonia to attend Regional Technical Meeting on Fisheries.
7 August – 6 Sept.	Fishing trips conducted at Kavieng with 1st Year students.
7 Sept. – 12 Sept.	Fishing trips conducted with 2nd Year students.
13 Sept. – 17 Sept.	Deep-bottom droplining training workshop conducted for interested participants.
18 Sept. – 23 Sept.	Report prepared, de-briefing in Port Moresby with National Fisheries Division Staff. Departed Papua New Guinea.

3.2 Boats and equipment

A locally-constructed canoe design, the *Red Snapper* (Figure 2) was employed as the Project's fishing craft at both Oro Bay and at Rabaul. These 7.2 m plywood outrigger craft, which follow the FAO, KIR 4 design, proved to be well constructed and popular among local fishermen. The canoes are made available to fishermen complete with outboard motors and basic fishing gear for around 3,000 Kina. The design provides for both sail and outboard power. With a 15 hp outboard motor the canoes had an effective speed of between 9 and 14 knots, depending on load and the condition of the motor. Appendix 1 details this craft's design specifications.

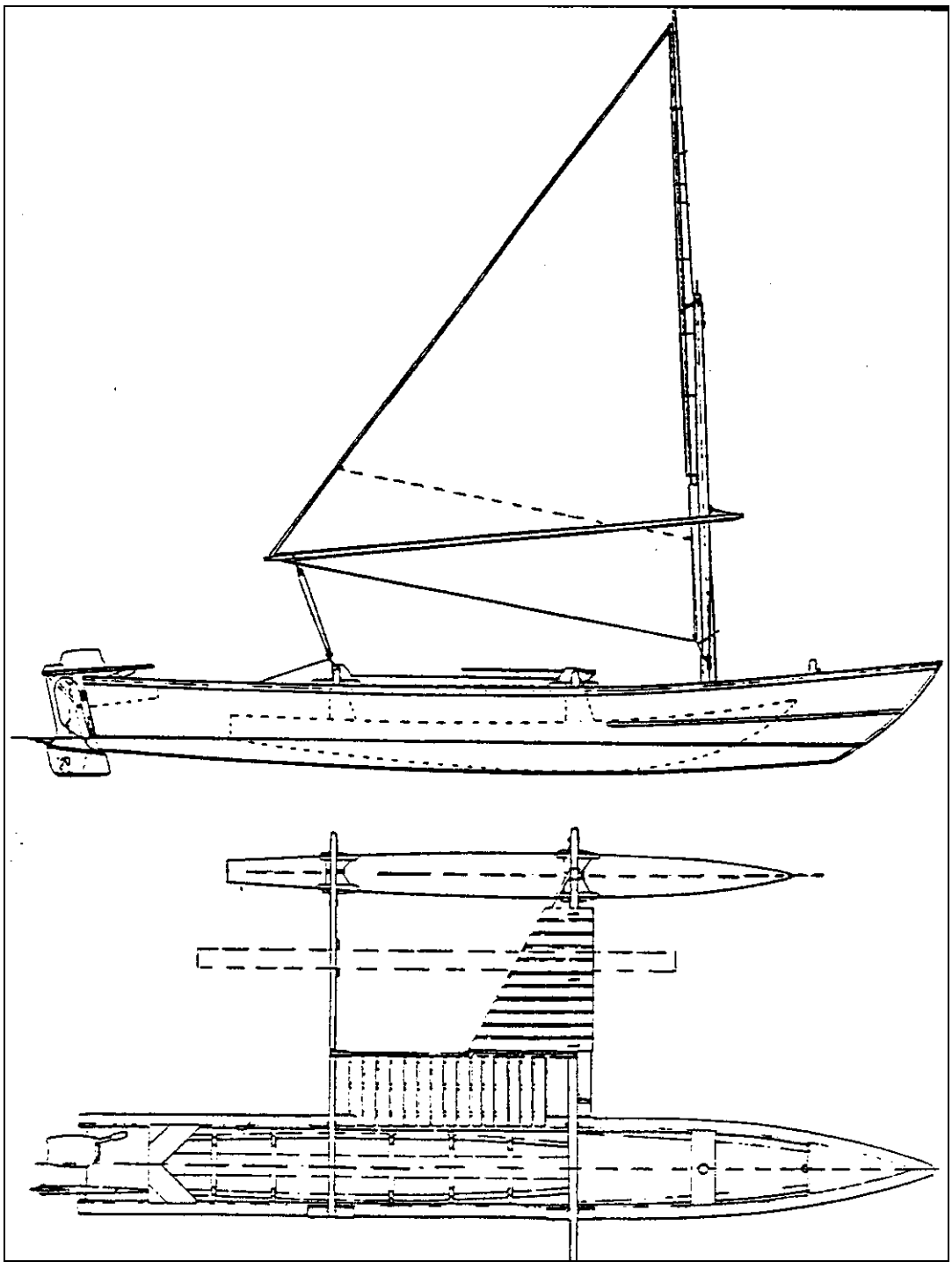

Figure 2. **The *Red Snapper* canoe**

Each canoe used was fitted with between two and four FAO, Western Samoan-design wooden handreels (Figure 3) mounted on FAO, KIR-design canoe reel mounts (Figure 4).

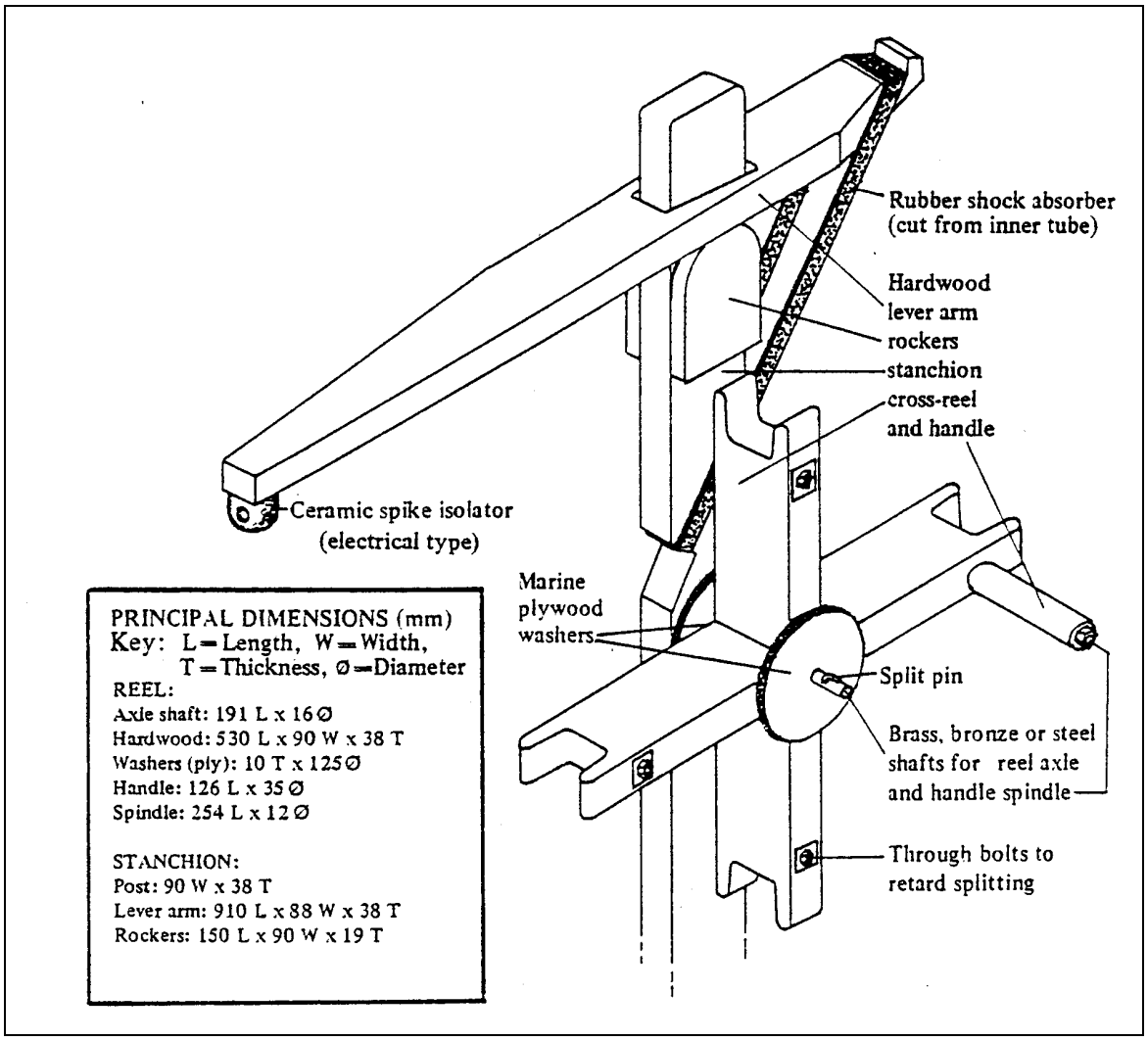

Figure 3. FAO, Western Samoa-design wooden handreel

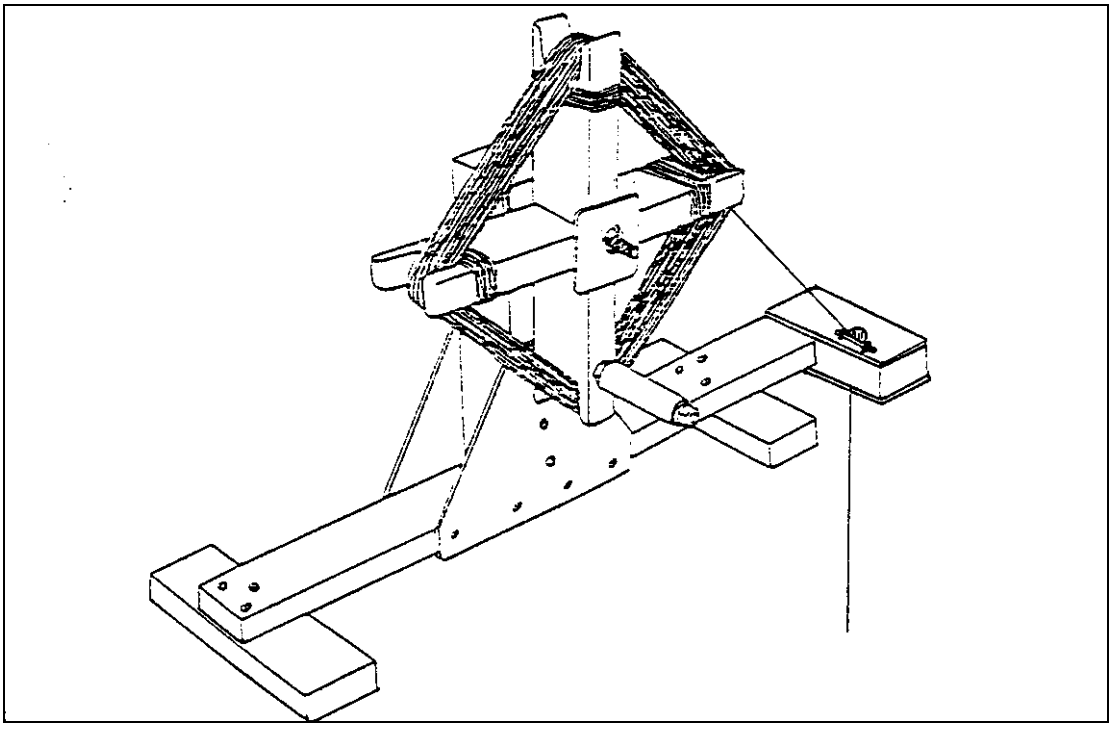

Figure 4: FAO, KIR-design canoe reel mount

Fishing trips at Kavieng were conducted on board the National Fisheries College training vessel, an 8 m planked dory powered by a 3 QM Yanmar diesel engine. Two FAO, Western Samoa-design wooden handreels were mounted at the stern for trolling. This vessel was also outfitted with a Koden Chromascope Model CVS 101 echo-sounder, with a depth range to 370 m.

Anchoring gear for all vessels comprised a simple grapnel anchor constructed from two 3 m lengths of 8 mm diameter reinforcing rod bent to the appropriate shape. These lengths were held together by welding, binding with wire, or by inserting them into a length of galvanised steel pipe before bending and securing them by driving a wooden spike into the pipe. A 5–6 m length of 8–10 mm diameter galvanised chain served as a connection between the anchor eye and the anchor rope. The anchor rope was a 400–500 m length of 8–10 mm diameter polypropylene line, actual length and diameter depending on boat size. A balloon buoy fitted with a snap-shackle was used when hauling the anchor, as described in Section 4.2. This anchoring gear is illustrated in Figure 5. A list of basic fishing gear is detailed in Appendix 2.

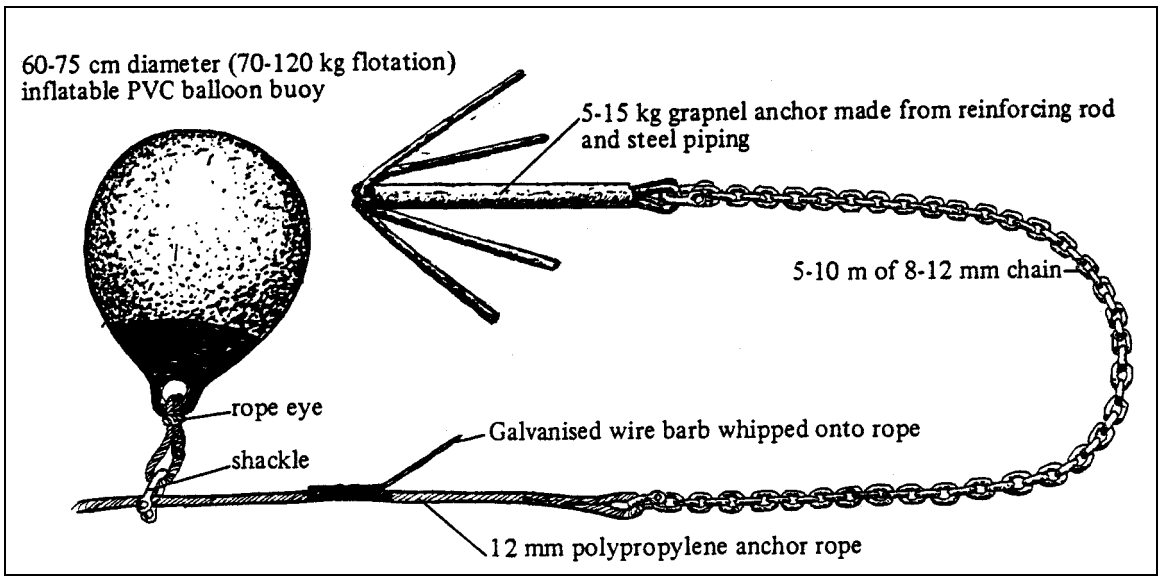

Figure 5: Self-hauling anchor gear

3.3 Fishing techniques employed

Most fishing effort was devoted to deep-bottom droplining along the outer-reef slope, with the fishing craft at anchor and employing the handreels to lower and haul the lines. The primary species targeted by this technique are deep-water snappers (*Etelis* spp.), jobfish (*Aphareus*, *Pristipomoides* spp.), sea breams (*Gnathodentex*, *Gymnocranius* spp.), and fusiliers (*Paracaesio* spp.), although a wide variety of other deep-dwelling species also occur in the catch, including less desirable Gempylids and sharks. Species characteristic of shallower waters, including emperors (*Lethrinus* spp.), trevallies (*Caranx* spp.) and shallow-water Lutjanids, also appear in the catch because bottom irregularities and the swing of the fishing craft at anchor usually results in a considerable depth range being fished.

Trolling was most often conducted opportunistically while in transit to and from, or between, bottom fishing grounds. Areas trolled included the edge of the outer reef drop-off, targeting such species as jacks and trevallies (*Caranx* spp.), Spanish mackerel (*Scomberomorus commerson*), barracudas (*Sphyraena* spp.) and dogtooth tuna (*Gymnosarda unicolor*). Some trolling was also conducted offshore, particularly in pursuit of school fish such as skipjack tuna (*Katsuwonus pelamis*) which were sought as bait for bottom fishing.

3.4 Training activities

Training was conducted as part of fishing activities in each area visited. At each site informal training workshops were held with prospective trip participants, demonstrating the rigging of fishing gear and discussing fishing technique, seamanship, and gear and boat maintenance. Practical training was conducted during fishing trips, with participants encouraged to take an active role in all activities under the Masterfisherman's supervision.

While at Oro Bay and at Rabaul special attention was given to demonstrating techniques to identify suitable deep-bottom fishing grounds without the use of an echo-sounder. Charts were used to identify likely areas and further investigated by taking soundings using weighted lines from the handreels. Once suitable grounds were located, trainees were shown how to locate such sites again by referring to landmarks and bearings.

A counterpart fisheries officer worked with the Masterfisherman during most trips and participated in all fishing activities and training. The topics covered in the training programme are detailed in Appendix 3.

3.5 Data collection

SPC Masterfishermen use a standard data form, shown at Appendix 4, 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

4.1 General

Fifty fishing trips were completed during the course of the survey and training programmes conducted in the three areas visited, with a total of 478.5 hours spent at sea. Eleven trips were made in the Oro Bay area, 18 around Rabaul, and 21 during training sessions conducted at Kavieng. Deep-bottom droplining and trolling were combined during most trips and although more hours were spent trolling this technique was largely employed opportunistically, lines being trailed routinely whenever the fishing boat was under way in order to maximise fishing effort, and in the hope of obtaining bait supplies. Most fishing effort was devoted to deep-bottom droplining, and the direction and duration of trips were determined by the Project's assigned goal of identifying suitable bottom fishing grounds and promoting their exploitation. Weather conditions were generally favourable, with mild south-east winds predominating during most of the visit. Some fishing time was lost in the latter stages of the visit during periods of strong winds and rough sea conditions. Detailed trip records for each fishing area are given in Appendices 5A, 5B and 5C.

4.2 Deep-bottom droplining

Deep-bottom droplining was conducted at anchor along the outer reef slopes, using the handreels to lower and haul the lines, during 48 fishing trips. The reels were wound with 300–500 m of 115 kg or 130 kg test nylon monofilament line, with a terminal rig, as illustrated in Figure 6, bearing three tuna circle hooks.

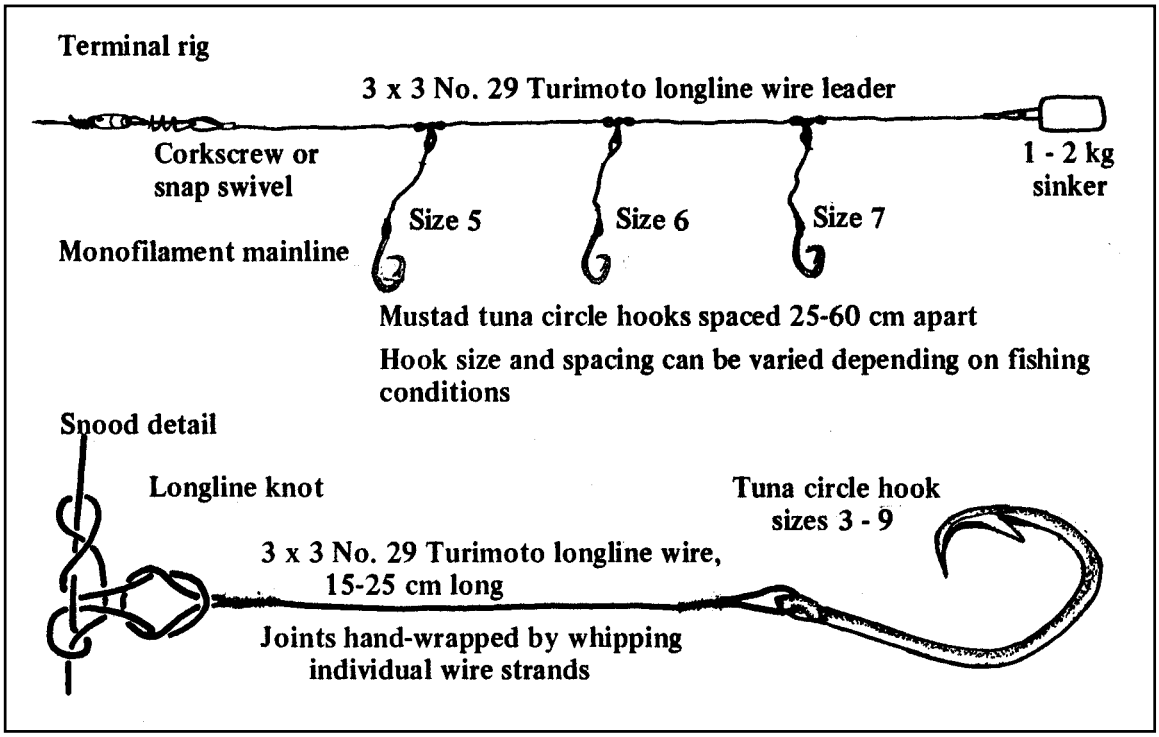

Figure 6. Typical terminal rig for deep-bottom fishing

While fishing from 'Red Snapper' canoes around Oro Bay and Rabaul, suitable sites were identified by sounding with the handreels. Landmarks and bearings were noted at productive grounds so that these sites might be more easily found again later. At Kavieng, sites were more often identified by echo-sounding. Once a site was selected the anchor was dropped in shallower water and in a position chosen so that prevailing wind or current would carry the boat back over the fishing site as the anchor warp was paid out. At many of the areas fished, however, the bottom gradient was very moderate and it was frequently necessary to anchor in water of the same depth as the fishing site, or even in deeper water.

Once the boat was resting at anchor, fishing was commenced by lowering the lines from the handreels, each line being fitted with a terminal rig as described, and a 1–2 kg sinker, depending on depth and current strength. The sinker was lowered to the bottom and thereafter the line was kept taut by hand to allow the fisherman to respond to bites by striking and to reduce the possibility of fouling other lines. Because of the elasticity of the long lines employed much reliance is placed on the 'self-hooking' qualities of the tuna circle hooks.

After fishing, or preparatory to shifting to another fishing site, a simple technique was employed to retrieve the anchor, which greatly reduced the effort required in hauling by hand. The anchor warp was made fast to the stern and the boat motored quickly ahead to break the anchor free of the bottom. Forward motion was continued as the anchor streamed behind the boat and the inflatable buoy clipped onto the warp and released. The resistance of the water forced the buoy back along the warp until it became trapped by the 'no-return' barb. The boat was then run back toward the anchor with the warp being handed inboard and the anchor and chain, suspended at the surface by the buoy, easily retrieved. This technique is illustrated in Figure 7.

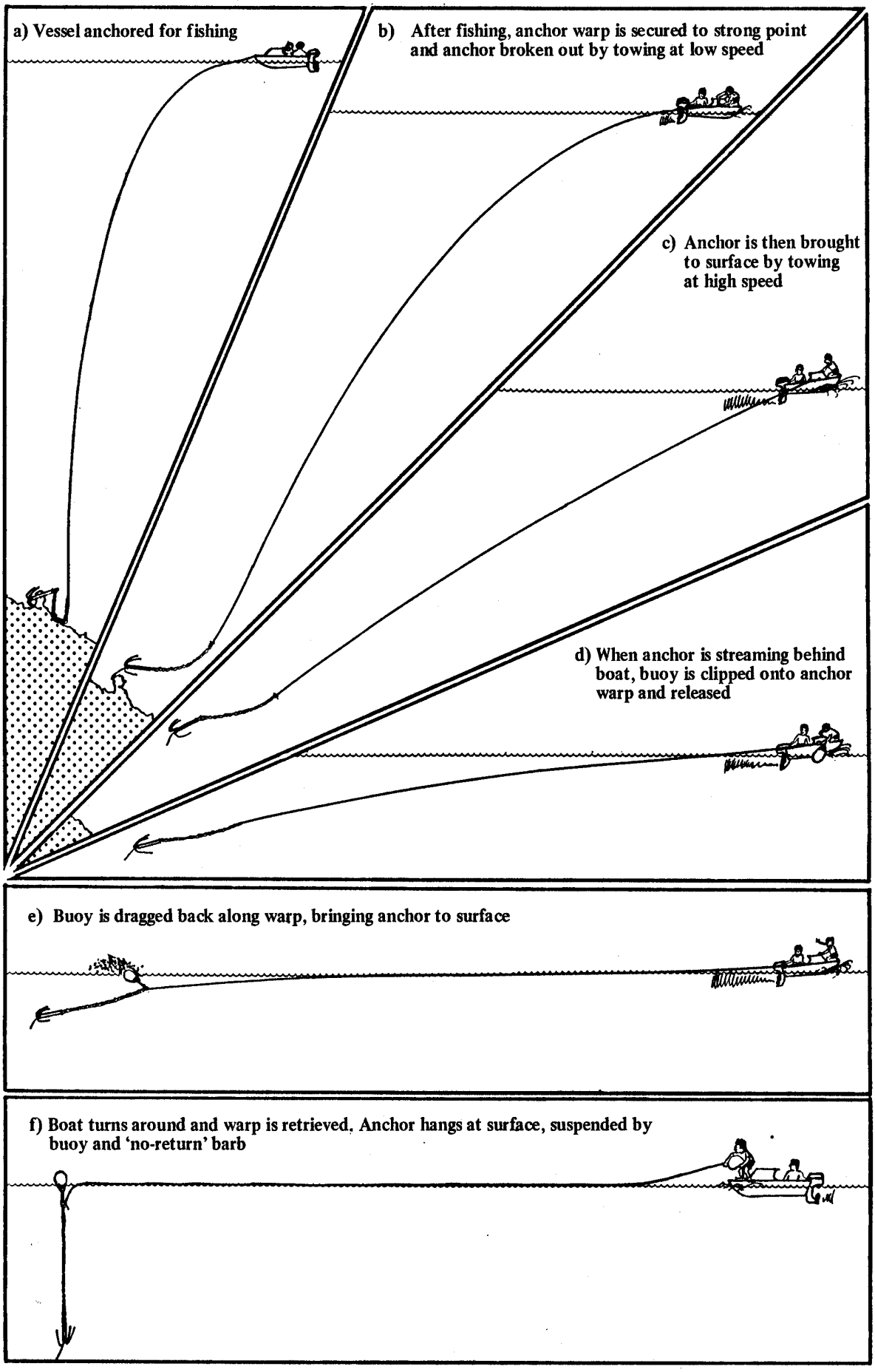

Figure 7: Anchor retrieval method

The best proven bait for this fishing method is fresh skipjack tuna (*Katsuwonus pelamis*) and this, or other tunas, was used whenever available.

Deep-bottom droplining occupied 281.5 fishing hours (70.6% of the total fishing time), with a total calculated fishing effort of 845 reel hours; reel hours being the standard unit of fishing effort used in determining the relative productivity of bottom droplining operations, and defined as the use of one handreel over one hour of fishing.

The catch comprised 1,322 fish with a total weight of 2,670.6 kg and a catch rate (catch per unit of effort, or CPUE) of 3.2 kg/reel hour was recorded over all areas combined. The catch included 25 fish, with a combined weight of 413.5 kg, which were unsaleable. The greater part of the unsaleable catch consisted of sharks of various species and the total unsaleable catch accounted for 15.5 per cent of the whole catch. No species taken were locally regarded as ciguatoxic.

The saleable catch was dominated by deep-water snappers (Lutjanidae) of the Etelinae and Apsilinae sub-families, which together comprised 895 fish with a combined weight of 1,515.3 kg, 56.7 per cent of the total catch by weight. The most significant species occurring in this group were the large-scaled jobfish (*Pristipomoides multidens*), with 350 fish having a combined weight of 582.1 kg, and the small-toothed jobfish (*Aphareus rutilans*), represented by 87 individuals with a combined weight of 269.8 kg. The next most important group of fishes taken was the shallow-water snappers (sub-family Lutjaninae). One hundred and forty-eight fish of various species from this group accounted for 270.1 kg (10% of the total catch by weight). The most commonly taken species in this group was the scarlet sea-perch (*Lutjanus malabaricus*). Other important components of the catch included 159.3 kg of emperors and sea breams of the Lethrinidae family, 155.2 kg of groupers, cods and coral trouts of the Serranidae family, and 122.1 kg of jacks and trevallies of the Carangidae family. The genus composition of the catch is represented graphically in Figure 8 while Appendix 6A details this information by individual species.

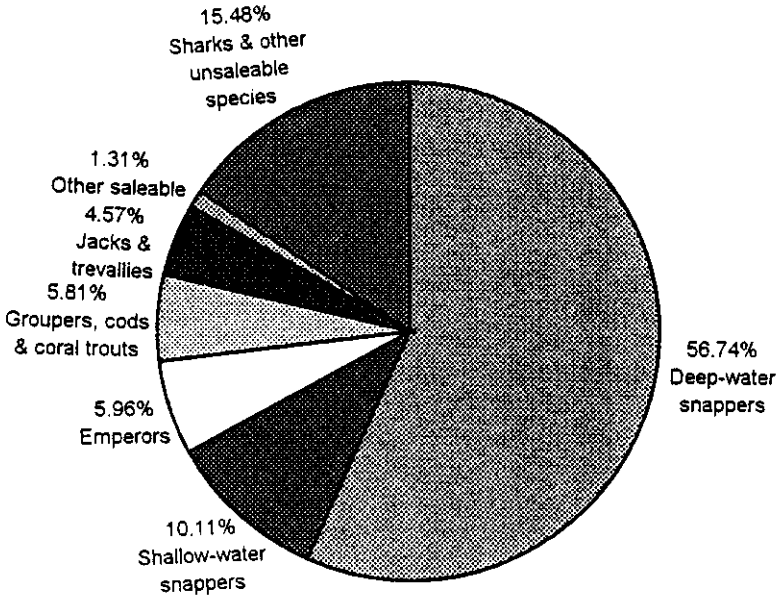

Figure 8: **Species composition of the deep-bottom catch by group**

The deep-bottom catch rate varied only slightly from one fishing area to another, the best catch rate being recorded at Kavieng (3.1 kg/reel hour). When unsaleable species are excluded from calculations catch rates from the three areas are even closer, a variation of only 1.2 kg/reel hour being recorded between the lowest and the highest rates. This information is summarised in Table 2.

Table 2: **Summary of catch and effort by deep-bottom droplining at each area**

Location	No. of trips	Fishing hours	Effort (line hours)	Saleable No.	Catch Weight (kg)	Unsaleable No.	Catch Weight (kg)	Total catch (kg)	CPUE (kg)
Oro Bay	10	45.5	177.0	184	344.1	9	55.7	399.8	2.3
Rabaul	18	122.5	337.5	535	801.4	7	208.0	1,009.4	3.0
Kavieng	20	113.5	330.5	578	1,111.6	9	149.8	1,261.4	3.8
Total	*48	281.5	845.0	1,297	2,257.1	25	413.5	2,670.6	3.2

*All trips combined more than one fishing method.

Note: Oro Bay — If sharks are excluded from the catch, CPUE = 2.0
If sharks and other locally unsaleable species are excluded, CPUE = 1.9
Rabaul — If sharks are excluded from the catch, CPUE = 2.4
If sharks and other locally unsaleable species are excluded, CPUE = 2.4
Kavieng — If sharks are excluded from the catch, CPUE = 3.1
If sharks and other locally unsaleable species are excluded, CPUE = 3.1
All areas — If sharks are excluded from the catch, CPUE = 2.7
If sharks and other locally unsaleable species are excluded, CPUE = 2.7

Catch rates recorded from all areas were low in comparison to rates recorded previously by the DSFD Project elsewhere in Papua New Guinea. This may be explained in part by the particular emphasis given during this visit to identifying new bottom fishing grounds, training, and foregoing the use of an echo-sounder to assist in quickly identifying likely fishing sites. Operational difficulties and the restriction imposed by traditional fishing rights in some areas may also have served to limit the productivity of some trips. Table 3 summarises deep-bottom fishing catch rates previously recorded by the DSFD Project in selected Pacific countries and territories.

Table 3: Deep-bottom fishing catch rates recorded by the DSFDP in selected Pacific countries and territories

Country/ Territory	Fishing area	Year of visit	Catch per unit of effort All species	Catch per unit of effort Excluding sharks
Papua New Guinea	N. Province (Oro Bay)	1988	2.3	2.0
"	E. New Britain (Rabaul)	"	3.0	2.4
"	New Ireland (Kavieng)	"	3.8	3.1
"	W. New Britain	1982	10.8	6.9
	(Manus)	"	6.4	6.1
"	East Sepik (Wewak)	"	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
"	Espiritu Santo	"	9.2	7.8
New Caledonia	Lifou	1979	7.5	7.2
"	Isle of Pines	"	7.8	7.1

4.3 Trolling

Although trolling lines were routinely trailed during transit to deep-bottom fishing sites, deviations from direct travel were made only occasionally, for example when schooling fish were observed. Lines were either trolled directly from the handreels or fixed length lines trailed from the stern of the boat. Varieties of lure sizes and types were rigged on wire traces and nylon monofilament leaders depending on the species targeted and their size.

Catches were generally poor and little success was had in fishing the schools of small tunas frequenting the Oro Bay area. Only 54 fish were taken from all areas, with a combined weight of 146.3 kg. The overall catch rate was quite low at 0.4 kg/line hour, reflecting the opportunistic nature of the fishing effort devoted to trolling. Table 4 summarises catch and effort by trolling at each fishing area and Appendix 6B details the species composition of the catch.

Table 4:. Summary of catch and effort by trolling

Location	No. of trips	Fishing hours	Effort (line hours)	Saleable catch		Unsaleable catch		Total catch (kg)	CPUE (kg)
				No.	Weight (kg)	No.	Weight (kg)		
Oro Bay	9	19.5	60.0	7	13.5	0	0.0	13.5	0.2
Rabaul	16	26.5	62.0	8	5.3	0	0.0	5.3	0.1
Kavieng	21	71.0	210.5	39	127.5	0	0.0	127.5	0.6
Total	**46**	**117.0**	**332.5**	**54**	**146.3**	**0**	**0.0**	**146.3**	**0.4**

5. FISHING AREAS

5.1 Oro Bay—Northern Province

The Project operated in Northern Province (Figure 9) ranging from Cape Ward Hunt to Tufi, between 31 March and 11 May, 1988. During the eleven fishing trips completed in this area the Masterfisherman was assisted by counterpart fisheries officer Mr Mahara Auki assigned from Port Moresby, and two extension officers on attachment from Oro Fishing Authority. Fishing was conducted aboard a ‘Red Snapper’ canoe and operations were supported by a 'mother' vessel. This 10 m support vessel was used for overnight accommodation in some areas, and to carry catches to Popondetta for sale.

Waters off Oro Bay are shallow and suitable deep-bottom grounds lie as much as 40 km offshore. The Project therefore concentrated on fishing areas to the north and south from Cape Ward Hunt to the Tufi area, where deep-bottom grounds were located on average 1.5 km outside the reef. Despite the regular presence of offshore schools of small tunas, few could be caught and some problems were experienced in maintaining adequate bait supplies. Some difficulties were experienced concerning fishing access to areas which by accepted custom are controlled by the traditional owners. Such rights are recognised as extending well beyond the reef flats to include the outer reef-slope and offshore waters. These problems and the breakdown of the support vessel caused a decision to be made, in consultation with the National Fisheries Department in Port Moresby, to shorten the visit to this area.

The deep-bottom catch rate recorded (2.3 kg/reel hour) was low and individual fish sizes rather small. Table 5 summarises the results of fishing activities in this area and Appendix 5A details the operational aspects of trips completed.

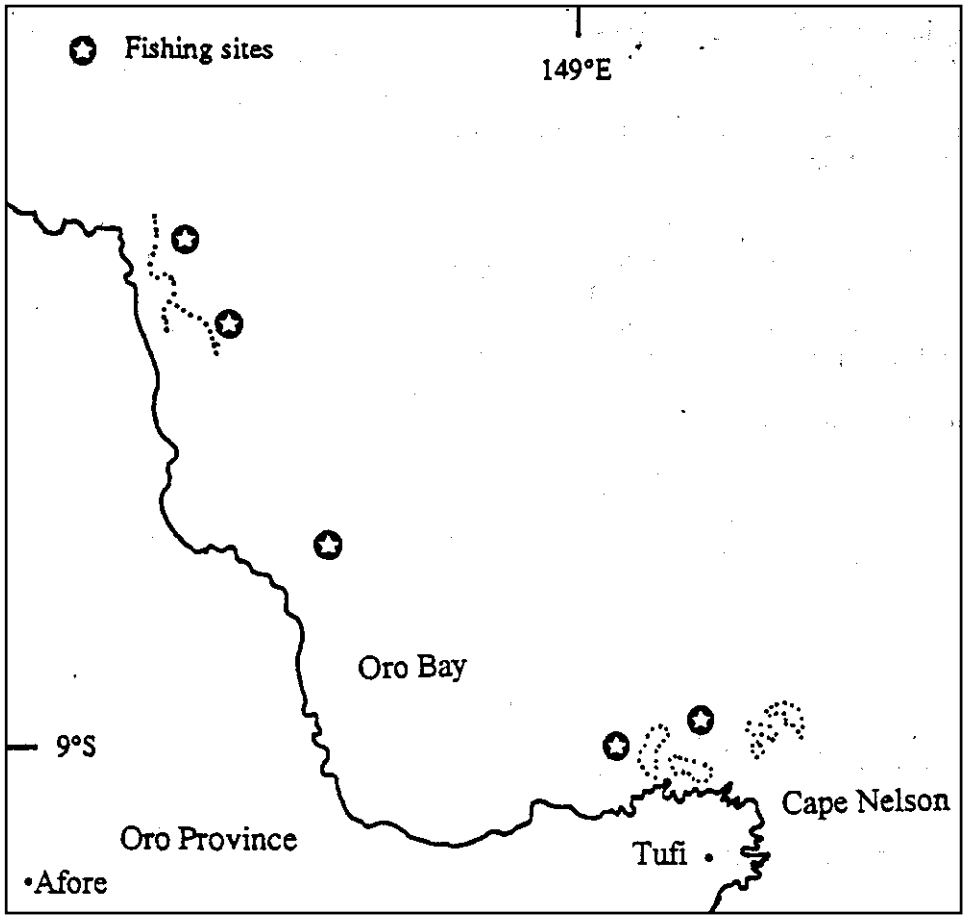

Figure 9. The Oro Bay area showing sites visited and fishing locations

Table 5:. Summary of catch and effort by each fishing method in Northern Province

Fishing method	No. of trips	Fishing hours	Effort (line hours)	Saleable catch		Unsaleable catch		Total catch (kg)	CPUE (kg)
				No.	Weight (kg)	No.	Weight (kg)		
Droplining	10	45.5	177.0	184	344.1	9	55.7	399.8	2.3
Trolling	11	19.5	60.0	7	13.5	0	0.0	13.5	0.2
Total	***11**	**65.0**		**191**	**357.6**	**9**	**55.7**	**413.3**	

* All trips combined more than one fishing method.

5.2 Rabaul—East New Britain Province

Figure 10 shows the area around Rabaul where the Project operated between 17 May and 3 July, 1988. During the 18 fishing trips completed the Project worked with four local fishing groups who operate 'Red Snapper' canoes. Fishing sites ranged from Urara Island and Reimer's Reef, Kurakabaul and Waton Island, Karavia Bay and Credner Island, to Maputi. A survey trip was also made to the Duke of York group but no fishing was conducted there.

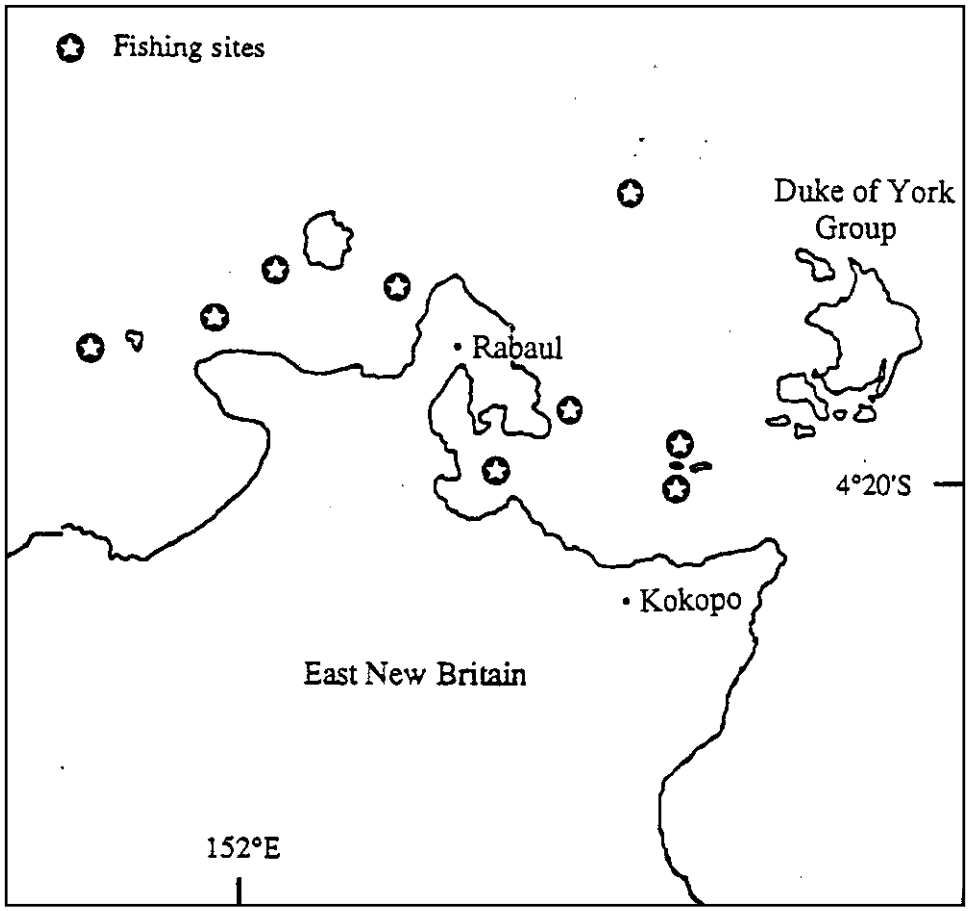

Figure 10. **The Rabaul area showing sites visited and fishing locations**

Tuna were scarce in the area at the time of the visit and bait was therefore obtained by netting sardines. Apart from the rigging and use of deep-bottom fishing gear, the Masterfisherman conducted informal training sessions in net-mending and business aspects of small-scale fishing operations.

The offshore areas fished, particularly the reef-slopes around the offshore islands, proved to be generally more productive than areas along the coast of the main island. Although the catch rate recorded by deep-bottom droplining was low at 3.0 kg/reel hour, there were indications that local fishing groups could, with improved techniques and gear, profitably exploit local deep-bottom resources. Table 6 summarises catch and effort by each fishing method in this area and Appendix 5B details the operational aspects of trips completed.

Table 6:.Summary of catch and effort by each fishing method in East New Britain Province

Fishing method	No. of trips	Fishing hours	Effort (line hours)	Saleable catch		Unsaleable catch		Total catch (kg)	Cpue (kg)
				No.	Weight (kg)	No.	Weight (kg)		
Droplining	18	122.5	337.5	535	801.4	7	208.0	1,009.4	3.0
Trolling	16	26.5	62.0	8	5.3	0	0.0	5.3	0.1
Total	***18**	**149.0**		**543**	**806.7**	**7**	**208.0**	**1,014.7**	

* All trips combined more than one fishing method.

5.3 Kavieng—New Ireland Province

The Project operated in the areas indicated in Figure 11 between 4 July and 18 September 1988, conducting training in deep-bottom gear rigging and fishing techniques for staff and students of the National Fisheries College. During the early part of the visit the Masterfisherman supervised the refurbishing of the College's training vessel and outfitted this craft for deep-bottom droplining and trolling. The training programme included shoreside lectures and discussion groups, but most training was conducted at sea during fishing trips. Table 7 summarises catch and effort by each fishing method in this area and Appendix 5C details the operational aspects of trips completed.

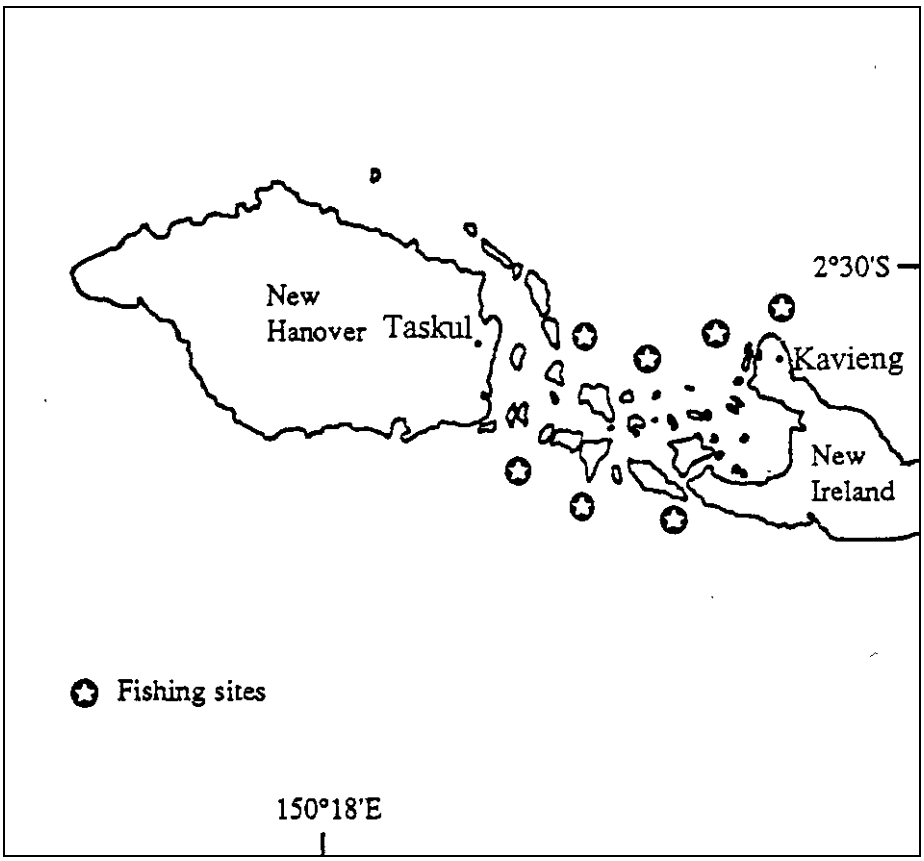

Figure 11. The Kavieng area showing fishing sites

Table 7:. Summary of catch and effort by each fishing method in New Ireland Province

Fishing method	No. of trips	Fishing hours	Effort (line hours)	Saleable catch		Unsaleable catch		Total catch (kg)	Cpue (kg)
				No.	Weight (kg)	No.	Weight (kg)		
Droplining	20	113.5	330.5	578	1,111.6	9	149.8	1,261.4	3.8
Trolling	21	71.0	210.5	39	127.5	0	0.0	127.5	0.6
Total	***21**	**184.5**		**617**	**1,239.1**	**9**	**149.8**	**1,388.9**	

* All trips combined more than one fishing method.

6. DISCUSSION

Prospects for the development of small-scale artisanal exploitation of deep-bottom fish resources in the areas surveyed during this visit appear to be good. Local fishermen were quick to learn the principles of identifying suitable fishing grounds and the use of the handreels and anchoring gear, and were generally enthusiastic about the value of catches and the opportunities that catches offered for generating cash income. In all areas visited, the local demand for fish exceeded supply, and prospects for marketing fish elsewhere, such as in the larger urban centres and the heavily populated Highlands, also appeared to be good.

At all sites visited it was evident that villagers own numerous dugout canoes and small dinghies which could, if properly outfitted, be employed for deep-bottom fishing without the relatively high capital outlay that would be required to construct and outfit craft specific to this fishery.

The major restraints likely to hinder the successful development of a deep-bottom fishery include a lack of awareness of the fishery's potential, a general unavailability of even basic deep-bottom fishing gear, poor fish handling practices by both fishermen and fish handling authorities (including a tendency to freeze all catches on landing rather than attempting to sell chilled fish), and a lack of effective marketing strategies. A further important restraint, and one noted during the previous DSFDP visit to PNG, is the recognition of traditional fishing rights well beyond inshore waters and reef flats. Fishermen are generally restricted by this exclusion to fishing only in the areas adjacent to their home territory. Commercial operations are likely to be severely hampered by this practice. Restraints particular to each area visited included:

Oro Bay

Fishermen likely to exploit deep-bottom resources live in small, dispersed communities. To develop the fishery commercially in such areas, regular and reliable sea transport will need to be available to supply ice, fuel and gear, and to carry catches to markets.

Rabaul

The greatest difficulty faced by the Project in this area was in obtaining adequate supplies of suitable bait. Local deep-bottom fishermen would require reliable bait supplies to support regular deep-bottom fishing.

Kavieng

Kavieng fishermen presently bottom-handline at depths around 60–80 m and an awareness of the potential of deep-bottom fishing is not general. The deep-bottom fishing surveys and training conducted by the National Fisheries College have not promoted the use of this technique among local village fishermen to any significant degree.

7. RECOMMENDATIONS

These recommendations arise from the Project's fishing and training activities during this visit and have been prepared in support of the National Fisheries Division's goal of developing artisanal deep-bottom fisheries throughout Papua New Guinea.

A programme which aims to equip present village fishing boats for deep-bottom fishing should be implemented. Such a programme would be most successful if regional workshops were established for the construction of the FAO Western Samoa-design wooden handreels, the FAO KIR-design handreel mountings for canoes, and simple grapnel anchors. This equipment should be made available to fishermen under either subsidised or instalment purchase schemes.

Basic deep-bottom fishing requisites, including nylon monofilament line, tuna circle hooks, swivels, and wire for rigging terminal gear, should be stocked at regional fisheries centres and made available at cost or near cost. Fisheries extension officers should have a thorough grounding in all aspects of small-boat handling, seamanship and safety at sea. As part of their extension work in promoting fisheries, they should give particular attention to the above.

Improved fish handling and storage practices should be encouraged at all levels in local fisheries pursuits. Encouraging the use of ice and ice-boxes, proper cleaning and filleting procedures by fishermen, and fresh-chilled fish sales rather than the freezing and storage of catches will be likely to produce a higher quality product with greater marketability.

The recognition of traditional fishing rights as holding sway over waters beyond the edge of the outer reef should be reviewed and attempts made to encourage negotiated access agreements between neighbouring areas. Some Pacific governments have legislated to give wider access to such waters while still recognising the basic rights of traditional owners to manage the exploitation of their marine resources.

The following recommendations are specific to the areas visited:

Oro Bay

Sea transport between village fishing sites (particularly Tufi) and Oro Bay should be regularised. A fixed and reliable schedule will play an important part in encouraging fishermen to land catches which they know they can have transported to market and ultimately sold. Regular transport will also increase the availability of ice, fuel and fishing gear.

Rabaul

The regional fishing authority should investigate the possibility of stockpiling tuna during the seasonal peak fishing period and making it available to fishermen for bait during periods of scarcity.

The boat-building programme should incorporate a more extensive inventory of fishing gear as basic equipment to be supplied with each craft sold, including anchor rope, monofilament nylon fishing line, tuna circle hook and anchor chain.

Kavieng

The National Fisheries College should attempt to extend its extensive expertise and experience of deep-bottom fishing to local village communities. This could be achieved through College- sponsored workshops and training seminars in which both staff and students could participate.

The College should undertake an extensive survey of deep-bottom grounds by echo-sounding. Simple charts could be prepared to assist village fishermen to identify suitable deep-bottom fishing grounds.

8. REFERENCES

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APPENDIX 1

DESIGN SPECIFICATIONS FOR 'RED SNAPPER' DESIGN 7.2 M CANOE

(Gulbrandsen and Savins, 1987)

Characteristics

Length overall	7.16 m (23.5 ft)
Beam overall	3.80 m
Beam, main hull	0.81 m
Depth, main hull	0.69 m
Cubic number, main hull	4.0 m^3
Draught, loaded	0.65 m
Weight empty with 9.9 hp outboard and sails	300 kg
Normal load: 3 men + gear	270 kg
Weight loaded	570 kg
Engine	9.9 hp outboard, 20 in shaft
Maximum speed with normal load	11.0 kts
Fuel consumption	6.3 l/h = 0.57 l/nm
Service speed	10 kts
Fuel consumption	5.8 l/h = 0.58 l/nm
Sail	9.0 m^2 emergency sail,or with jib and gunter rig: 15 m^2

Sailing performance with 9 m^2 sail in 8 kt wind	Tacking angle: 130° close hauled: 2.8 kts Broad reach: 3.5 kts, running: 3.0 kts
Fishing methods	Trolling for tuna 9–11 kts, handlining with 3 reels, gillnetting.
Construction	Marine plywood 9 mm sides, 12 mm bottom, alternatively double-planked bottom where grounding on reef might be a problem. Built upside down on a jig.
Construction time	Eight man weeks

Cost, 1986 (**$US**)		
	Hull/outrigger	1,000
	Sail rig – 9 m^2	260
	Engine	740
	Total	2,000

Comments:

This vessel was designed by FAO for use where trolling speeds of 9–11 kts are required for catching tuna. It can be fitted with a boom tent for protection against sun or rain. By the end of 1986, 18 vessels of this type had been built in Kiribati, all fitted with a 15.0m^2 sail rig, having the outrigger spaced at 3.0 m instead of 2.5 m from the centre line, to allow both better balance under sail and a wider working platform. They can be prepared in kit form for shipment and assembled by semi-skilled labour. In Papua New Guinea, they are known as 'Red Snapper' canoes.

APPENDIX 2

BASIC GEAR FOR DEEP-BOTTOM DROPLINING

1. Grapnel anchor with at least 3 m of 8–12 mm diameter chain and 400–500 m of 8–10mm anchor rope
2. Handreels wound with 115 kg or 130 kg test monofilament nylon line, 500 m per reel
3. Turimoto No. 29 longline wire (or equivalent) 3 x 3 braided, 120 kg test
4. Tuna circle hooks, sizes 10–15
5. Size 4/0 swivels with clip (either corkscrew or equivalent type)
6. 1 and 2 kg sinkers
7. Inflatable balloon buoy for anchor retrieval
8. Side-cutting pliers
9. Standard pliers
10. Bait knife

APPENDIX 3

TOPICS COVERED IN THE TRAINING PROGRAMME

1. Handling of a fishing boat

Safety at sea
Knots and splices
Constructing a grapnel anchor
Use of equipment checklist before departure
Anchoring in order to fish at the right depth
Use of a compass
Marking a fishing site by landmarks and compass bearings
A simple method of anchor retrieval
Boat care and maintenance

2. Handling of equipment and fishing gear

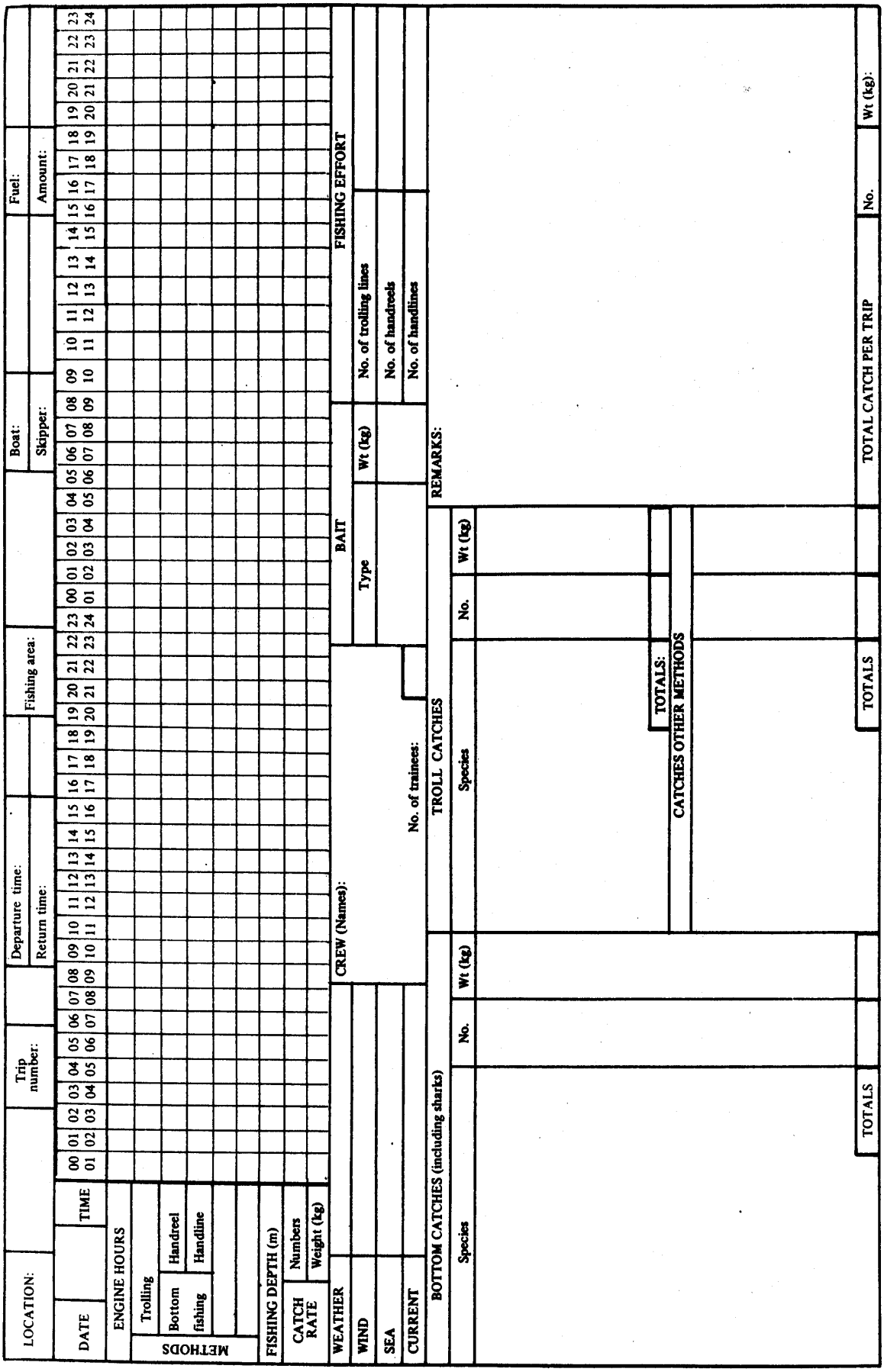
Personal safety during fishing operations
Use of wooden handreels
Knots and connection for monofilament nylon line, wire leaders and traces
Techniques for handling large fish
Care of gear and rust prevention
Rigging of gear in tackle-balance (appropriate matching of hook, line and swivel sizes and types)

3. Handling an outboard motor

Fuel mixing
Starting procedure
Emergency spares and tool kit
Care and maintenance procedures
Laying-up procedure
Treatment for engine accidentally submerged in sea-water

APPENDIX 4

STANDARD FORM FOR DATA COLLECTION USED BY SPC MASTERFISHERMEN



APPENDIX 5A

SUMMARY OF OPERATIONAL ASPECTS OF FISHING TRIPS AT ORO BAY

Trip No.	Fishing method	Duration hours	Engine hours	Fishing hours	Effort line hrs	Saleable catch		Unsaleable catch		Bait kg	Fuel litres
						No.	kg	No.	kg		
1	Droplining			5.0	15.0	3	2.0			0.5	
	Trolling			3.0	12.0						
	Total	**9.0**	**4.0**	**8.0**		**3**	**2.0**	**0**	**0.0**	**0.5**	**25**
2	Droplining			5.0	20.0	32	42.7			3.0	
	Trolling			2.0	6.0	1	1.6				
	Total	**7.5**	**3.0**	**7.0**		**33**	**44.3**	**0**	**0.0**	**3.0**	**15**
3	Droplining			4.0	16.0	23	50.2	3	15.0	3.0	
	Trolling			1.0	2.0	1	3.0				
	Total	**7.0**	**3.0**	**5.0**		**24**	**53.2**	**3**	**15.0**	**3.0**	**15**
4	Droplining			5.0	20.0	26	27.5			1.4	
	Trolling			1.0	2.0						
	Total	**6.5**	**2.0**	**6.0**		**26**	**27.5**	**0**	**0.0**	**1.4**	**17**
5	Trolling	6.0	6.0	6.0	24.0	3	4.5	0	0.0	0.0	25
6	Droplining			5.5	22.0	6	9.0			2.0	
	Trolling			1.0	2.0	1	3.0				
	Total	**10.0**	**5.0**	**6.5**		**7**	**12.0**	**0**	**0.0**	**2.0**	**18**
7	Droplining			5.5	22.0	28	45.1	3	26.0	2.5	
	Trolli ng			2.0	6.0	1	1.4				
	Total	**10.0**	**4.5**	**7.5**		**29**	**46.5**	**3**	**26.0**	**2.5**	**20**
8	Droplining			4.0	16.0	8	31.7			1.5	
	Trolling			1.0	1.0						
	Total	**7.0**	**3.0**	**5.0**		**8**	**31.7**	**0**	**0.0**	**1.5**	**20**
9	Droplining	6.0	3.0	3.5	14.0	3	1.8	0	0.0	0.5	15
10	Droplining			4.0	16.0	24	47.8	1	13.3	1.2	
	Trolling			2.5	5.0						
	Total	**8.0**	**4.0**	**6.5**		**24**	**47.8**	**1**	**13.3**	**1.2**	**25**
11	Droplining	7.0	2.5	4.0	16.0	31	86.3	2	1.4	3.0	24
	SUMMARY										
10	Droplining			45.5	177.0	184	344.1	9	55.7	18.6	
9	Trolling			19.5	60.0	7	13.5	0	0.0	0.0	
11	**TOTAL**	**84.0**	**40.0**	**65.0**		**191**	**357.6**	**9**	**55.7**	**18.6**	**219**

APPENDIX 5B

SUMMARY OF OPERATIONAL ASPECTS OF FISHING TRIPS AT RABAUL

Trip No.	Fishing method	Duration hours	Engine hours	Fishing hours	Effo rt	Saleable catch		Unsaleable catch		Bait kg	Fuel litres
					line hrs	No.	kg	No.	kg		
1	Droplining			6.0	21.0	5	6.3	1	18.0	0.8	
	Trolling			3.0	8.0						
	Total	**14.5**	**6.0**	**9.0**		**5**	**6.3**	**1**	**18.0**	**0.8**	**10**
2	Droplining			3.0	12.0	13	12.2			1.0	
	Trolling			1.0	2.0	1	0.6				
	Total	**4.0**	**1.0**	**4.0**		**14**	**12.8**	0	0.0	1.0	**3**
3	Droplining			4.0	16.0	12	10.0			1.0	
	Trolling			0.5	1.0						
	Total	**6.0**	**2.0**	**4.5**		**12**	**0.0**	**0**	**0.0**	**1.0**	**5**
4	Droplining			3.5	13.0	9	6.4			1.0	
	Trolling			1.0	2.0	1	0.5				
	Total	**5.0**	**1.5**	**4.5**		**10**	**6.9**	**0**	**0.0**	**1.0**	**5**
5	Droplining			6.0	14.0	35	28.5	1	0.6	3.0	
	Trolling			0.5	1.0						
	Total	**7.5**	**1.5**	**6.5**		**35**	**28.5**	**1**	**0.6**	**3.0**	**6**
6	Droplining			11.0	26.5	86	111.9	1	75.0	5.0	
	Trolling			1.5	3.0						
	Total	**17.5**	**3.0**	**12.5**		**86**	**111.9**	**1**	**75.0**	**5.0**	**7**
7	Droplining			6.0	12.0	40	32.2			2.5	
	Trolling			1.0	2.0	3	2.2				
	Total	**9.0**	**3.0**	**7.0**		**43**	**34.4**	**0**	**0.0**	**2.5**	**8**
8	Droplining			4.5	9.0	5	6.4			0.5	
	Trolling			1.0	2.0						
	Total	**7.5**	**4.0**	**5.5**		**5**	**6.4**	**0**	**0.0**	**0.5**	**7**
9	Droplining			7.5	15.0	13	16.1			0.7	
	Trolling			1.0	2.0						
	Total	**10.5**	**3.0**	**8.5**		**13**	**16.1**	**0**	**0.0**	**0.7**	**10**
10	Droplining			9.0	21.0	47	74.1	3	29.4	1.9	
	Trolling			2.0	4.0						
	Total	**12.5**	**2.5**	**11.0**		**47**	**74.1**	**3**	**29.4**	**1.9**	**9**
11	Droplining			6.5	13.0	35	70.6			1.3	
	Trolling			1.5	3.0						
	Total	**8.0**	**1.5**	**8.0**		**35**	**70.6**	**0**	**0.0**	**1.3**	**10**
12	Droplining			5.0	1 0.0	8	7.4			0.5	
	Trolling			1.0	2.0						
	Total	**7.0**	**2.0**	**6.0**		**8**	**7.4**	**0**	**0.0**	**0.5**	**15**

Trip No	Fishing method	Duration hours	Engine hours	Fishing hours	Effort line hrs	Saleable catch		Unsaleable catch		Bait kq	Fuel litres
						No.	kg	No.	kg		
13	**Droplining**	**17.0**	**4.5**	**10.0**	**25.0**	**8**	**22.2**	**0**	**0.0**	**1.0**	**12**
14	Droplining			7.5	15.5	3	22.4			2.0	
	Trolling			1.5	3.0						
	Total	**10.5**	**2.5**	**9.0**		**13**	**22.4**	**0**	**0.0**	**2.0**	**17**
15	Droplining			8.5	20.0	16	41.6			1.0	
	Trolling			2.0	4.0						
	Total	**10.5**	**4.0**	**10.5**		**16**	**41.6**	**0**	**0.0**	**1.0**	**15**
16	**Droplining**	**4.5**	**1.0**	**3.5**	**10.5**	**1**	**1.5**	**0**	**0.0**	**0.5**	**5**
17	Droplining			4.0	12.0	1	3.3			0.5	
	Trolling			1.0	2.0						
	Total	**5.0**	**1.0**	**5.0**		**1**	**3.3**	**0**	**0.0**	**0.5**	**6**
18	Droplining			17.0	72.0	188	328.3	1	85.0	17.5	
	Trolling			7.0	21.0	3	2.0				
	Total	**28.0**	**8.0**	**24.0**		**191**	**330.3**	**1**	**85.0**	**17.5**	**150**
	SUMMARY										
18	Droplining			122.5	337.5	535	801.4	7	208.0	41.7	
16	Trolling			26.5	62.0	8	5.3	0	0.0	0.0	
18	**TOTAL**	**184.5**	**52.0**	**149.0**		**543**	**806. 7**	**7**	**208.0**	**41.7**	**300**

APPENDIX 5C

SUMMARY OF OPERATIONAL ASPECTS OF FISHING TRIPS AT KAVIENG

Trip No	Fishing method	Duration hours	Engine hours	Fishing hours	Effort line hrs	Saleable catch		Unsaleable catch		Bait kg	Fuel litres
						No.	kg	No.	kg		
1	Droplining			6.0	18.0	47	124.0			4.0	
	Trolling			5.0	21.0						
	Total	**14.0**	**8.0**	**11.0**		**47**	**124.0**	**0**	**0.0**	**4.0**	**35**
2	Droplining			3.0	6.0	5	7.9			1.0	
	Trolling			2.0	5.0						
	Total	**5.0**	**2.0**	**5.0**		**5**	**7.9**	**0**	**0.0**	**1.0**	**10**
3	Droplining			7.5	22.5	47	78.2	2	31.6	4.0	
	Trolling			2.0	3.0						
	Total	**10.5**	**3.0**	**9.5**		**47**	**78.2**	**2**	**31.6**	**4.0**	**10**
4	Droplining			4.0	12.0	22	32.9			2.5	
	Trolling			3.5	13.0						
	Total	**8.5**	**4.5**	**7.5**		**22**	**32.9**	**0**	**0.0**	**2.5**	**12**
5	Droplining			3.5	1 0.5	14	22.8			1.2	
	Trolling			2.0	3.0						
	Total	**6.0**	**2.5**	**5.5**		**14**	**22.8**	**0**	**0.0**	**1.2**	**8**
6	**Trolling**	**3.0**	**3.0**	**3.0**	**6.0**	**25**	**74.1**	**0**	**0.0**	**0.0**	**25**
7	Droplining			6.0	18.0	48	108.7			3.0	
	Trolling			4.0	12.0	1	6.2				
	Total	**10.0**	**4.0**	**10.0**		**49**	**114.9**	**0**	**0.0**	**3.0**	**27**
8	Droplining			3.0	9.0	10	10.5			2.0	
	Trolling			1.0	3.0						**15**
	Total	**7.0**	**4.0**	**4.0**		**10**	**10.5**	**0**	**0.0**	**2.0**	
9	Droplining			6.0	18.0	35	82.2			3.0	
	Trolling			4.0	12.0	2	5.8				
	Total	**11.5**	**5.5**	**10.0**		**37**	**88.0**	**0**	**0.0**	**3.0**	**25**
10	Droplining			6.0	13.0	28	39.1			3.0	
	Trolling			6.0	18.0						
	Total	**12.0**	**6.0**	**12.0**		**28**	**39.1**	**0**	**0.0**	**3.0**	**30**
11	Droplining			6.5	20.5	40	37.0	1	26.0	3.0	
	Trolling			1.0	2.0						
	Total	**11.0**	**4.5**	**7.5**		**40**	**37.0**	**1**	**26.0**	**3.0**	**19**
12	Droplining			6.5	20.5	21	59.1			2.5	
	Trolling			4.0	12.0						
	Total	**12.0**	**5.5**	**10.5**		**21**	**59.1**	**0**	**0.0**	**2.5**	**25**
13	Droplining			7.0	21.0	28	47.1	1	18.5	2.0	
	Trolling			4.0	12.0						
	Total	**11.0**	**4.0**	**11.0**		**28**	**47.1**	**1**	**18.5**	**2.0**	**25**

Trip No.	Fishing method	Duration hours	Engine hours	Fishing hours	Effort line hrs	Saleable catch		Unsaleable catch		Bait kg	Fuel litres
						No.	kg	No.	kg		
14	Droplining			5.5	16.5	47	77.2	1	41.5	3.0	
	Trolling			5.0	15.0	4	16.6				
	Total	**12.0**	**6.0**	**10.5**		**51**	**93.8**	**1**	**41.5**	**3.0**	**30**
15	Droplining			6.0	18.0	36	55.9			3.0	
	Trolling			2.5	7.5	1	5.4				
	Total	**11.0**	**5.0**	**8.5**		**37**	**61.3**	**0**	**0.0**	**3.0**	**31**
16	Droplining			6.5	19.5	66	90.4			2.5	
	Trolling			1.0	3.0	**66**	**90.4**				
	Total	**9.0**	**3.0**	**7.5**				**0**	**0.0**	**2.5**	**24**
17	Droplining			4.0	12.0	13	90.0			1.5	
	Trolling			5.0	15.0	2	9.2				
	Total	**9.0**	**5.0**	**9.0**		**15**	**99.2**	**0**	**0.0**	**1.5**	**30**
18	Droplining			1.0	3.0	1	2.4			0.4	
	Trolling			2.0	6.0	**1**	**2.4**				
	Total	**3.0**	**2.0**	**3.0**				**0**	**0.0**	**0.4**	**10**
19	Droplining			5.0	15.0	13	15.4			1.5	
	Trolling			6.0	18.0	1	5.4				
	Total	**11.0**	**6.0**	**11 .0**		**14**	**20.8**	**0**	**0.0**	**1.5**	**35**
20	Droplining			5.0	15.0	23	48.7			3.0	
	Trolling			4.0	12.0	2	2.4				
	Total	**9.0**	**4.0**	**9.0**		**25**	**51.1**	**0**	**0.0**	**3.0**	**23**
21	Droplining			15.5	42.5	35	84.5	4	32.2	5.0	
	Trolling			4.0	12.0	**35**	**84.5**				
	Total	**24.5**	**6.0**	**19.5**				**4**	**32.2**	**5.0**	**30**
	SUMMARY										
20	Droplining			113.5	330.5	578	1111.6	9	149.8	51.1	
21	Trolling			71.0	210.5	39	127.5	0	0.0		
21	**TOTAL**	**210.0**	**93.5**	**184.5**		**617**	**1239.1**	**9**	**149.8**	**51.1**	**479**

APPENDIX 6A

SPECIES COMPOSITION OF THE DEEP-BOTTOM CATCH

GROUP FAMILY *Species* Engllish name	ORO BAY AREA No.	 Kg	RABAUL AREA No.	 Kg	KAVIENG AREA No.	 Kg	TOTAL No.	 Kg
DEEP-WATER SNAPPERS								
LUTJANIDAE (sub-families ETELINAE, APSILINAE)								
Aphareus rutilans								
Small-tooth jobfish/silvermouth	1	1.2	29	119.6	57	149.0	87	269.8
Aprion virescens								
Green jobfish					3	12.7	3	12.7
Etelis carbunculus								
Short-tailed red snapper	1	1.6	28	30.1	14	102.3	43	134.0
Etelis coruscans								
Longtail snapper			9	11.2	2	3.8	11	15.0
Etelis radiosus								
Silver-gilled red snapper	1	1.0	8	35.0	13	40.7	22	76.7
Lipocheilus carnolabrum								
Deep-wter bream			2	5.8	1	4.4	3	10.2
Paracaesio caeruleus								
Fusilier	2	2.9	14	17.1	5	6.1	21	26.1
Paracaesio kusakarii								
Kusakar's snapper			42	102.0	11	31.7	53	133.7
Paracaesio stonei								
Stone's snapper			3	3.5	13	17.0	16	20.5
Paracaesio sp.								
Fusilier			1	1.5			1	1.5
Pristipomoides amoenus								
Large-eye flower snapper			1	0.1	2	0.6	3	0.7
Pristipomoides auricilla								
Gold-tailed jobfish			2	0.7	2	0.6	4	1.3
Pristipomoides filamentosus								
Rosy jobfish	42	44.6	53	60.0	72	45.8	167	150.4
Pristipomoides flavipinnis								
Yellow jobfish	1	0.1	41	17.3	33	24.4	72	45.8
Pristipomoides multidens								
Large-scale jobfish	60	105.8	185	257.2	105	219.1	350	582.1
Pristipomoides typus								
Sharp-tooth snapper			9	23.8	1	0.4	10	24.2
Pristipomoides zonatus								
Banded flower snapper			1	0.6	25	14.0	26	14.6
Sub-total	**108**	**157.2**	**428**	**685.5**	**359**	**672.6**	**895**	**1,515.3**

SHALLOW-WATER SNAPPERS								
LUTJANIDAE (sub-family LUTJANINAE)								
Lutjanus argentimaculatus								
Mangrove jack	4	18.6			1	4.9	5	23.5
Lutjanus bohar								
Red bass	1	5.1			10	44.9	11	50.0
Lutjanus gibbus								
Paddletail			19	16.9			19	16.9
Lutjanus lemniscatus								
Red sea perch			1	0.6			1	0.6
Lutjanus malabaricus								
Scarlet sea perch	50	117.2	26	16.8	6	12.3	82	146.3
Lutjanus rivulatus					1	7.2	1	7.2
Lutjanus rufolineatus								
Rufou's snapper			1	0.1	1	0.3	2	0.4
Lutjanus sebae								
Red emperor					1	5.1	1	5.1
Lutjanus temorensus								
Blood snapper			20	13.8			20	13.8
Lutjanus sp.								
Unidentified snapper					4	5.8	4	5.8
Symphorus nematophorus								
Chinaman snapper					2	0.5	2	0.5
Sub-total	**55**	**140.9**	**67**	**48.2**	**26**	**81.0**	**148**	**270.1**
EMPERORS								
LETHRINIDAE								
Gnathodentex mossambicus								
Large-eye sea bream					43	63.7	43	63.7
Gymnocranius robinsoni								
Blue-lined large-eyed sea bream					2	5.3	2	5.3
Lethrinus chrysostomus								
Red throat sweet lip	4	5.3					4	5.3
Lethrinus mahsena								
Yellow-tailed emperor					1	0.4	1	0.4
Lethrinus microdon								
Emperor			1	0.2			1	0.2
Lethrinus miniatus								
Long-nose emperor	1	2.3	1	2.5	32	79.3	34	84.1
Lethrinus sp.								
Unidentified emperor			1	0.3			1	0.3
Sub-total	**5**	**7.6**	**3**	**3.0**	**78**	**148.7**	**86**	**159.3**

GROUPERS, CODS AND CORAL TROUTS								
SERRANIDAE								
Cephalopholis igarasiensis								
Yellow-banded grouper					1	0.2	1	0.2
Cephalopholis sexmaculatus								
Rock cod			1	0.2	6	3.9	7	4.1
Epinephelus amblycephalus								
Grouper			2	0.8			2	0.8
Epinephelus areolatus								
Yellow spotted grouper	5	9.1	2	0.7	8	2.6	15	12.4
Epinephellus chlorostigma								
Brown-spotted grouper	1	1.0			26	43.9	27	44.9
Epinephelus cometae								
Snake skin grouper			1	2.7			1	2.7
Epinephelus microdon								
Marbled cod			2	1.2	2	7.0	4	8.2
Epinephelus miliaris	1	4.0	2	10.5	1	1.4	4	15.9
Epinephelus morrhua								
Curve-banded grouper			12	11.5	40	49.3	52	60.8
Epinephelus retouti								
Red-spined grouper			1	0.6			1	0.6
Epinephelus sp.								
Unidentified grouper	1	0.1					1	0.1
Plectropoma leopardus								
Small-spot coral trout	2	1.5					2	1.5
Variola albimarginatus								
Coronation trout			2	1.1	4	1.9	6	3.0
Sub-total	**10**	**15.7**	**25**	**29.3**	**88**	**110.2**	**123**	**155.2**
JACKS AND TREVALLIES								
CARANGIDAE								
Caranx lugubris								
Black trevally	1	2.3	2	5.0	14	31.5	17	38.8
Caranx melampygus								
Blue trevally					3	4.6	3	4.6
Caranx sexfasciatus								
Big-eye trevally			5	9.3	1	3.5	6	12.8
Caranx tille								
Dusky trevally	3	9.6					3	9.6
Seriola rivoliana								
Deep-water amberjack	1	8.3	2	9.2	6	38.8	9	56.3
Sub-total	**5**	**20.2**	**9**	**23.5**	**24**	**78.4**	**38**	**122.1**

MACKERELS AND TUNAS								
SCOMBRIDAE								
Gymnosarda unicolor								
Dogtooth tuna			1	9.5	2	20.5	3	30.0
Sub-total	**0**	**0.0**	**1**	**9.5**	**2**	**20.5**	**3**	**30.0**
SOLDIERFISH, SQUIRRELFISH AND GLASSEYES								
HOLOCENTRIDAE								
Ostichthys japonicus								
Deep-water squirrelfish			1	1.6			1	1.6
Sub-total	**0**	**0.0**	**1**	**1.6**	**0**	**0.0**	**1**	**1.6**
BARRACUDAS AND SEAPIKES								
SPHYRAENIDAE								
Sphyraena barracuda								
Great barracuda	1	2.5					1	2.5
Sphyraena jello								
Yellow-tail seapike			1	0.8			1	0.8
Sub-total	**1**	**2.5**	**1**	**0.8**	**0**	**0.0**	**2**	**3.3**
MISCELLANEOUS BONY FISHES								
ECHENEIDAE								
*Echeneis naucrates**								
Remora or sucher shark	2	1.4					2	1.4
LABRIDAE								
Choerodon zamboangae								
Wrasse					1	0.2	1	0.2
TRIODONTIDAE								
*Triodon bursarius**					1	1.6	1	1.6
Sub-total	**2**	**1.4**	**0**	**0.0**	**2**	**1.8**	**4**	**3.2**
SHARKS								
CARCHARHINIDAE								
Carcharhinus sp.								
Shark	7	54.3	4	202.5	6	134.0	17	390.8
HEXANCHIDAE								
*Hexanchus griseus**								
Six-gill shark					2	14.2	2	14.2
SQUALIDAE								
Squalus sp.								
Unidentified spiny dog shark			3	5.5			3	5.5
Sub-total	**7**	**54.3**	**7**	**208.0**	**8**	**148.2**	**22**	**410.5**
TOTAL	**193**	**399.8**	**542**	**1,009.4**	**587**	**1,261.4**	**1,322**	**2,670.6**

* Indicates locally unsaleable species.

APPENDIX 6 B

SPECIES COMPOSITION OF THE TROLL CATCH

GROUP	ORO BAY AREA		RABAUL AREA		KAVIENG AREA		TOTAL	
FAMILY	**No.**	**Kg**	**No.**	**Kg**	**No.**	**Kg**	**No.**	**Kg**
Species								
Engllish name								
LUTJANIDAE (sub family ETELINAE)								
Aprion virescens								
Green jobfish					3	9.6	3	9.6
CARANGIDAE								
Caranx melampygus								
Blue trevally			1	0.6			1	0.6
Caranx sexfasciatus								
Big eye trevally					1	5.0	1	5.0
Elegatis bipinnulatus								
Rainbow runner	1	1.4	5	3.3			6	4.7
SCOMBRIDAE								
Grammatorcynus bicarinatus								
Double lined mackerel	2	1.3	1	0.7			3	2.0
Gymnosarda unicolor								
Dog tooth tuna			1	0.7			1	0.7
Katsuwonus pelamis								
Skipjack tuna					25	74.1	25	74.1
Scomberomorus commerson								
Spanish mackerel	2	6.2			3	12.6	5	18.8
SPHYRAENIDAE								
Sphyraena barracuda								
Great barracuda	1	3.0			5	23.8	6	26.8
Sphyraena jello								
Yellow tailed seapike					2	2.4	2	2.4
BELONIDAE								
Tylosurus crocodilus crocodilus								
Longtom	1	1.6					1	1.6
TOTAL	**7**	**13.5**	**8**	**5.3**	**39**	**127.5**	**54**	**146.3**