SOUTH PACIFIC COMMISSION

UNPUBLISHED REPORT No. 31

ON REPORT OF SECOND VISIT TO

TRUK STATE,

FEDERATED STATES OF MICRONISIA

24 May to 21 October 1988

by

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South Pacific Commission
Noumea, New Caledonia
1999

This unpublished report forms part of a series compiled by the Capture Section of the South Pacific Commission's Coastal Fisheries Programme.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

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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ACKNOWLEDGEMENTS

The South Pacific Commission gratefully acknowledges the considerable support and assistance received from the individuals and Government Departments involved in various aspects of the project's visit. These include the Marine Resources Division, the Truk Maritime Authority, the Department of Resources and Development, the Small Industries and the Param Fishing Group. Deserving of special mention are: Mr Marion Henry, Deputy Director, Dept. of Resources and Development; Mr Kenneth Filak, Chief of Marine Resources; Mr Eliot Cholymay, Assistant Chief of Marine Resources; and Mr Mark Mailo, Manager, Truk Maritime Authority, for their administrative support. In addition, Mr Manny Sonis, Accountant, Resources and Development, for keeping all financial records; and Mr Angken Kupura, licensee of the project vessel; Mr Sos Awota, Skipper; Mr Adam Kupura, Engineer; and Mr Bekit Paul and Mr Sinfer Sato, the crew who worked tirelessly throughout the project visit.

SUMMARY

The South Pacific Commission's Deep Sea Fisheries Development Project operated in Truk State, Federated States of Micronesia over a five month period from 24 May to 21 October 1988, under the supervision of Masterfisherman Lindsay Chapman. The project visit was conducted primarily to survey the deep-water snapper resource around Truk lagoon using bottom handreels, and to assess the economics of developing this resource. Training of Government staff and interested local fishermen in these techniques, was also a major objective. If time permitted, one trip to an outer island location was to be undertaken so that the catch rate from that area could be compared to that of the Truk lagoon area.

Most fishing was conducted using handreels in depths from 100 m (55 fathom) to 200 m (110 fathom), with the principal target species being deep-water snappers of the family Lutjanidae, and associated species. Substantial time was also spent in trolling activities, both along the outer reef edge and across the lagoon, though this activity was conducted on a rather more opportunistic basis. A single hook shark line was also used on two occasions when sharks interfered with other fishing activities.

A total of 2,191 saleable fish, with a round weight of 3,923.3 kg (8,647 lb) were landed. A further 163 unsaleable fish weighing 1,233.4 kg (2,718 lb) were also taken. Handreel catch rates for saleable species were 3.8 kg/reel-hour (8.5 lb/reel-hour) around Truk Lagoon and 5.2 kg/reel-hour (11.5 lb/reel-hour) at Ruo Island, with the overall catch rate being 4.0 kg/reel-hour (8.8 lb/reel-hour). Trolling catch rates for saleable species in both areas were very low with an overall rate of 0.3 kg/reel-hour being recorded. No saleable species were caught at all on the single hook shark line. The catch rates for bottom fishing were slightly below those achieved by the Project in other Pacific countries. An analysis of fishing economics based on the catches achieved during this project visit would suggest that one or two fishing vessels could fish around Truk Lagoon and make a reasonable living by using handreels as the major fishing technique.

The results obtained by deep-water fishing during this project visit suggest that the deep-water snapper resource in the areas fished is small and possibly fragile, although the lesser-valued species that live in slightly shallower depths are in larger numbers. This may be due in part to the deep-water species being caught in much shallower water than the Projects experience in other Pacific countries. This would cut down the natural habitat that these fish have to live in. Recommendations have been made to suggest further fishing trials both in the same areas and the offshore banks to the west and northwest of the state to truly assess this fishery state-wide.

RÉSUMÉ

Certaines activités du projet Développement de la pêche au demi-large de la CPS ont été mises en œuvre dans l'État de Truk, aux États fédérés de Micronésie, pendant cinq mois, du 24 mai au 21 octobre 1988, sous la responsabilité du maître de pêche, Lindsay Chapman, avec pour objectif principal l'inventaire de la ressource en vivaneaux du lagon de Truk au moyen de moulinets à main de pêche au fond et une estimation de son potentiel économique, ainsi que la formation d'agents du service des pêches et de pêcheurs locaux. Si le temps imparti le permettait, un déplacement sur une des îles éloignées avait été prévu afin de comparer les taux de prise de cette zone et ceux du lagon de Truk.

Le plus souvent, ce sont des moulinets à main qui ont été utilisés, à des profondeurs variant de 100 m à 200 m, visant essentiellement les vivaneaux (Lutjanidés) et les espèces qui leurs sont associées. Beaucoup de temps a été consacré en outre à la pêche à la traîne, tant sur le tombant externe du récif qu'à l'intérieur du lagon, lorsque l'occasion s'est présentée. Une ligne à requin à hameçon unique a également été utilisée par deux fois, lorsque les squales gênaient le travail des pêcheurs.

En tout, ce sont 2 191 poissons commercialisables qui ont été débarqués, représentant 3 923, 3 kg, auxquels il convient d'ajouter 163 poissons non susceptibles d'être vendus pesant 1 233,4 kg. Les taux de capture au moulinet à main d'espèces commercialisables ont atteint 3,8 kg par moulinet/heure dans le lagon de Truk, et 5,2 kg par moulinet/heure autour de l'île de Ruo, le taux de capture global étant de 4 kg par moulinet/heure. S'agissant de la pêche à la traîne dans les deux zones, les taux de prise enregistrés pour les espèces commercialisables sont restés faibles, avec un taux global de 0,3 kg par moulinet/heure. Aucune espèce commercialisable n'a été capturée grâce à la ligne à requin à hameçon unique. Les taux de capture concernant la pêche au fond ont été légèrement inférieurs à ceux obtenus lors d'activités conduites dans d'autres pays océaniens dans le cadre du même projet. L'analyse du potentiel économique des prises effectuées donne à penser qu'un ou deux bateaux de pêche pourraient exploiter les eaux du lagon de Truk et y trouver une certaine rentabilité en employant comme technique de base la pêche au moulinet à main.

Les résultats de la pêche au fond entreprise lors de ce déplacement semblent indiquer que la ressource en vivaneaux des zones étudiées reste modeste et sans doute fragile, mais que les poissons de plus faible valeur qui vivent dans des zones moins profondes y sont présents en plus grand nombre. Ceci s'explique peut-être en partie du fait que les espèces profondes, quant à elles, ont été capturées ici à des profondeurs bien moindre qu'elles ne l'ont été dans le cas d'autres activités conduites ailleurs dans le Pacifique par les agents du projet, et que leur habitat naturel était donc plus restreint. Les recommandations formulées au terme de cette évaluation préconisent que soient menés d'autres essais, tant dans la même zone qu'autour des bancs situés au large à l'ouest et au nord-ouest de l'État de Truk afin d'obtenir une véritable évaluation de ses ressources halieutiques.

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1. INTRODUCTION

The South Pacific Commission's Deep Sea Fisheries Development 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, and in particular the deep-bottom resources of the outer reef slope;

– To develop and evaluate new and simple technology, fishing gear and techniques suitable for use by village fishermen, which will enable fishermen to increase catches substantially 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 current project visit was based at Moen Island, the administrative centre for the State of Truk, under the supervision of SPC Masterfisherman Lindsay Chapman, and had the following specific objectives:

– To conduct survey fishing using handreels for deep-water snappers around the outer reef slopes of the Truk lagoon, so as to establish the incidence of various species as well as providing catch per unit of effort data;

– To train both government fisheries employees and interested local fishermen in all aspects of handreel fishing techniques, as well as correct on board handling and preservation of the catch to maximise the quality to meet export market standards;

– To assess the feasibility of developing a commercial fishery for deep-water snappers based on the catch and economics of the Project's activities; and

– To conduct, if time permitted, some comparative fishing at an outer island location so that the catch rates from the two areas could be compared.

The visit commenced on 24 May 1988 and concluded on 21 October 1988 with the Masterfisherman taking two weeks in August to attend the Regional Technical Meeting on Fisheries in Noumea and an additional one week in early October as leave; making this a four month visit. Fishing trips were conducted in as many different areas around the outer reef slopes of Truk Lagoon as the weather would allow. These trips were all overnight trips so as to maximise fishing effort. One trip of six days duration was undertaken to Ruo Island, in the Hall Island group, to conduct comparative fishing trials.

2. BACKGROUND

2.1 General

Truk State is one of the four states that make up the Federated States of Micronesia (FSM), the other three being Pohnpei (where the capital is located), Kosrae and Yap. These states were formerly part of the Trust Territory of the Pacific Islands, which was administered by the United States of America from the end of World War II until a vote on a common constitution was taken in 1978. This vote split the then Trust Territory of the Pacific Islands into what is now 'The Federated States of Micronesia', 'The Republic of Palau', and 'The Republic of the Marshall Islands'. A Compact of Free Association between the US and FSM was signed in 1982 and implemented in 1986.

This Compact gives FSM a 15 year treaty, which nets them US $60 million annually for the first 5 years, US $51 million annually the second 5 years and US $40 million annually the third 5 years, all

adjusted 7 per cent for inflation. In exchange the US has the option to establish and use military areas and facilities, receive exemption for their installations from local taxes, and access free entry into the FSM for their personnel. As well as this, the FSM has to renounce any claim to 'a regime of archipelagic waters', something the US considers important for the free passage of its nuclear submarines and tuna fishing fleet.

Truk State (Figure 1) includes 192 outer islands in addition to the 15 islands and more than 80 islets that make up the Truk Lagoon. About 40 of Truk's islands are inhabited. The Truk Lagoon is large, and is enclosed by a barrier reef some 225 km (140 mile) long. At its widest point, the 2,104 km² (840 sq mile) lagoon is almost 64 km (40 mile) from one side to the other. There are 5 main passages through the reef, as well as numerous small craft passages.

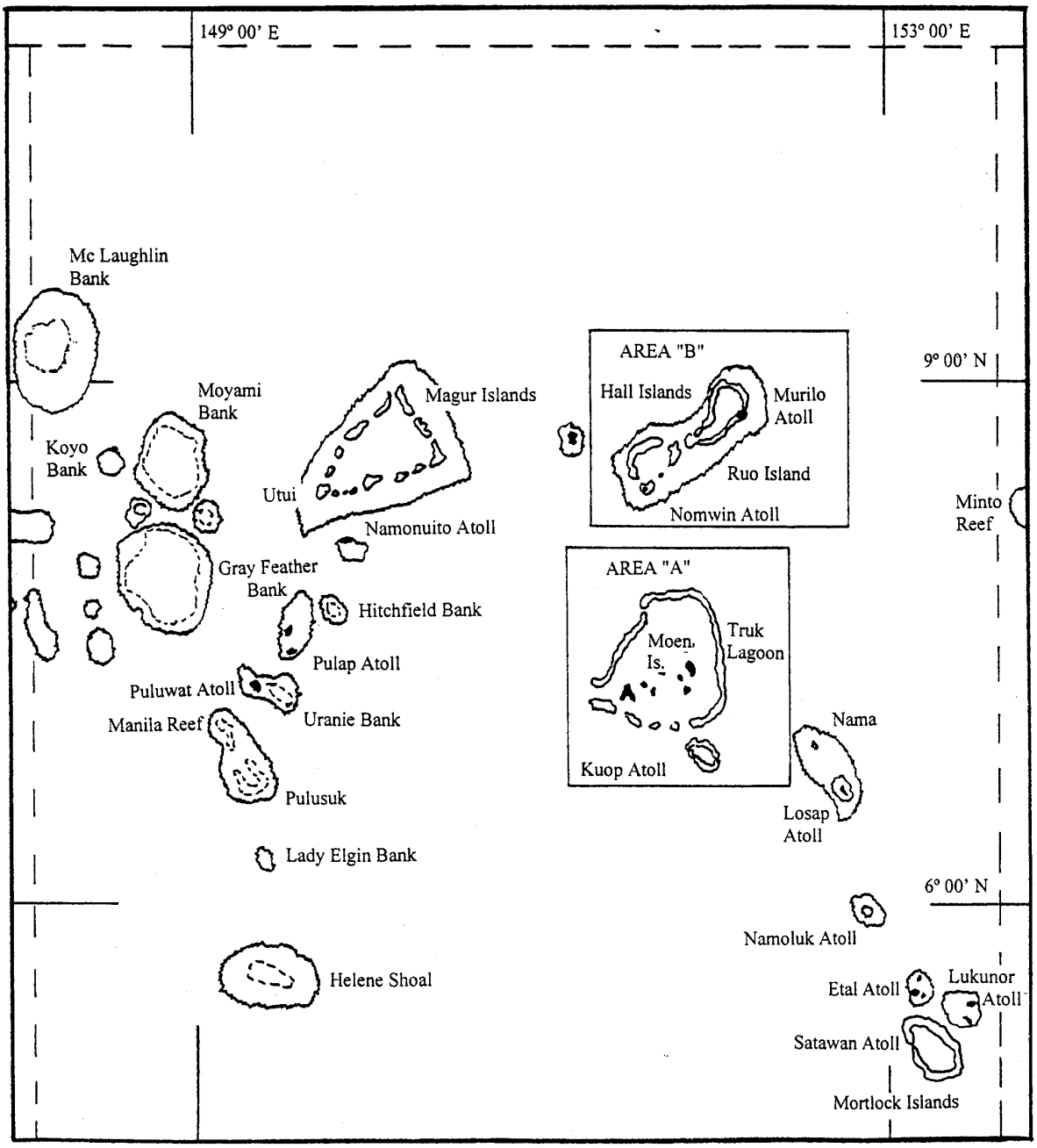

Figure 1: Truk State showing approximate boundaries and the two Project locations

The major islands in the lagoon are Moen (the administrative centre for the state), Dublon, Fefan, Uman, Eten, Param, Udot, Pata, Polle and Tol. All of these islands are mountainous and wooded. The islands in Truk lagoon total about 118 km² (47 sq mile) of land.

The population of Truk State, as calculated in a 1980 census, totalled 37,488. The 1987 population, as projected by the Office of Statistics, is estimated at 49,365. Of this total, 76 per cent of the people are located within the Truk lagoon, 14 per cent in the Upper and Lower Mortlocks, and the remaining 10 per cent divided between the Western Islands, the Hall Islands and the Nomwinwitto Islands.

2.2 Fisheries

In 1978, the Micronesian Maritime Authority (MMA) was established as a national authority to regulate foreign fishing activities within the FSM's 320 km (200 mile) extended fishing zone. It administers a licensing system for as many as 800 foreign fishing vessels each year and obtains catch data from these vessels. Fees collected through the MMA permit system amount to several million dollars per year, and are deposited in the General Fund of the FSM Congress. Fees for 1981, for example, came to a total of approximately US $2,900,000. The MMA has also developed a surveillance system using chartered planes and ships and a team of Micronesian observers to monitor licensed foreign tuna fishing boats.

Historically, Truk has lead the four states of FSM in fisheries development. In the early 1980s there were 3 government and 3 private owned small pole-and-line vessels fishing tuna, as well as 3 government and several private boats used for fish transportation from the outer islands to Moen for marketing. In addition, several foreign tuna and bottom fishing vessels were chartered, and hundreds of small boats with outboard engines fished to supply the local and export markets.

At the time of this visit, there was one full-time and one part-time commercial pole-and-line boats still working tuna, while the fish transportation vessels carried more cargo and passengers than fish between the outer islands and Moen. The chartered fishing vessels are all gone although there has been an increase in the number of small outboard-powered vessels.

The main fishing techniques employed by the smaller fishing vessels are, spear fishing (both day and night), trolling for tuna outside the reef, handlining within the lagoon, gillnetting on the reef flats, and dynamiting. The latter method is illegal, although widely used as the sunken wrecks from World War II that scatter the lagoon floor are laden with easily accessible explosives that can be modified and used.

Both cold storage and ice facilities are located on the wharf at Moen. The two ice machines are rated at a total of 6 t/day (6.5 short ton/day). This capacity is rarely reached due to frequent power outages, water shortages, and the age of the machinery which is causing frequent breakdowns. The cold storage rooms serve as storage for several of the local supermarkets, where they store their frozen imported products. Some local fish is stored in these freezers, although only a small amount when compared to the imported products.

A new cold storage and ice facility was completed on the island of Dublon in 1986. This complex is some 10 km (6 mile) by boat from the Moen plant and the main harbour. This plant to date is only being used to produce block ice at between 20 and 40 per cent of it's rated production capacity. Some ice is stored in the holding freezers, although the demand for ice in general exceeds the present production level. It is hoped that in the near future the ice production will increase as well as the utilisation of the cold storage for freezing locally caught fish, for both the local and export markets.

There are several organisations at present exporting locally caught fish to markets in Guam, Saipan and Hawaii. The Truk Maritime Authority (TMA) is one such organisation which is exporting fish, as well as collecting as much data as possible on fish exports. This data collection was started in 1986, with records showing that TMA in the last 9 mouths of that year exported some 3,735 kg (8,232 lb) of fish with a FOB Truk value of US $7,777.87. In 1987 TMA's exports amounted to 11,057 kg (24,370 lb), valued at US $24,575.58, and for the first 7 months of 1988 exports were 4,992 kg (11,000 lb)

valued at US $12,086.35. These exports are mainly of reef or bottom fish at present, although it is hoped that in the near future a larger percentage of pelagic species will be exported.

The other main marine export is Trochus shell (*Trochus niloticus*). This is a seasonal fishery that is only opened for brief periods when stocks are deemed plentiful. In 1978 and 1979 the yields of shell were 24.1 t and 35.8 t (26.5 and 39.4 short ton), with an export value of US $15,889 and US $32,629 respectively. The next fishing season was 1986 when a record 112.1 t (123.3 short ton) of shell was collected, having an export value of US $121,290. There has not been another season since, and a recent survey conducted by the Marine Resource Division and Truk Maritime Authority, revealed that the present stocks of Trochus seem depleted and will need an estimated 2–3 years to recover to harvestable levels.

The Deep Sea Fisheries Development Project has operated in the state of Truk on one previous occasion. This visit was from 1 February to 31 March 1980, and had as its main objectives to demonstrate deep-bottom fishing techniques, to train local personnel, and to investigate the commercial viability of deep-bottom fishing under local conditions. This project was based in Moen and conducted by SPC Masterfisherman, Pale Taumaia.

3. PROJECT OPERATIONS

3.1 General

The Project was based on Moen Island, the administrative centre for the state. Fishing activities were conducted in as many different locations around the outer reef slopes of Truk lagoon as possible. As well, one 6 day trip to the Hall Group was conducted where the Project was based on Ruo Island. Figure 1 shows the two Project locations. All fishing trips around Truk lagoon were overnight so as to maximise fishing effort; cut down on running costs; take advantage of the cooler temperatures of the night, and to get an overall species composition including day and night feeding fish.

Weather conditions were variable with persistent light breezes from the east which only allowed the east face to be fished occasionally. These light breezes, as well as passing rain squalls from every point of the compass, made staying in one depth or position for longer that 2 hours very difficult. Changing moderate to strong currents also added to the difficulties of staying in one position or depth on a mostly sheer drop-off. No fishing trips were cancelled due to the weather or current although many fishing hours were lost on various trips.

The project was originally scheduled to last 3 months. During this time it became apparent that additional time would be required to meet the objectives that were set. The project was therefore extended by an additional 2 months; one month to complete the project, two weeks to allow the Masterfisherman to attend the annual SPC Regional Technical Meeting on Fisheries held in Noumea, one week of annual leave for the Masterfisherman, and two weeks for report writing.

The project vessel belonged to the Marine Resources Division and was leased out to a fishing group from Param Island. The Masterfisherman therefore worked with this fishing group for the full duration of the Project. Four people from the group were assigned full-time to the vessel, these being, Sos Awota—Captain, Adam Kupura—Engineer, and Sinfer Sato and Bekit Paul—Crew. Additional trainees and observers, both from the government and the private sector, were taken on many fishing trips.

3.2 Boats and equipment

An 11 m (36 ft) fibreglass mono hull, Japanese design vessel, belonging to the Marine Resources Department and leased out to the Param fishing cooperative, was used for the full duration of the Project visit. The *Esinou*, (Figure 2) was powered by a 60 hp, 6 cylinder diesel inboard engine, with a conventional shaft and propeller drive. This vessel had below-deck ice-holds, which were very poorly

insulated, as well as below-deck storage for all equipment carried. A single burner kerosene stove was also carried as part of the standard equipment.

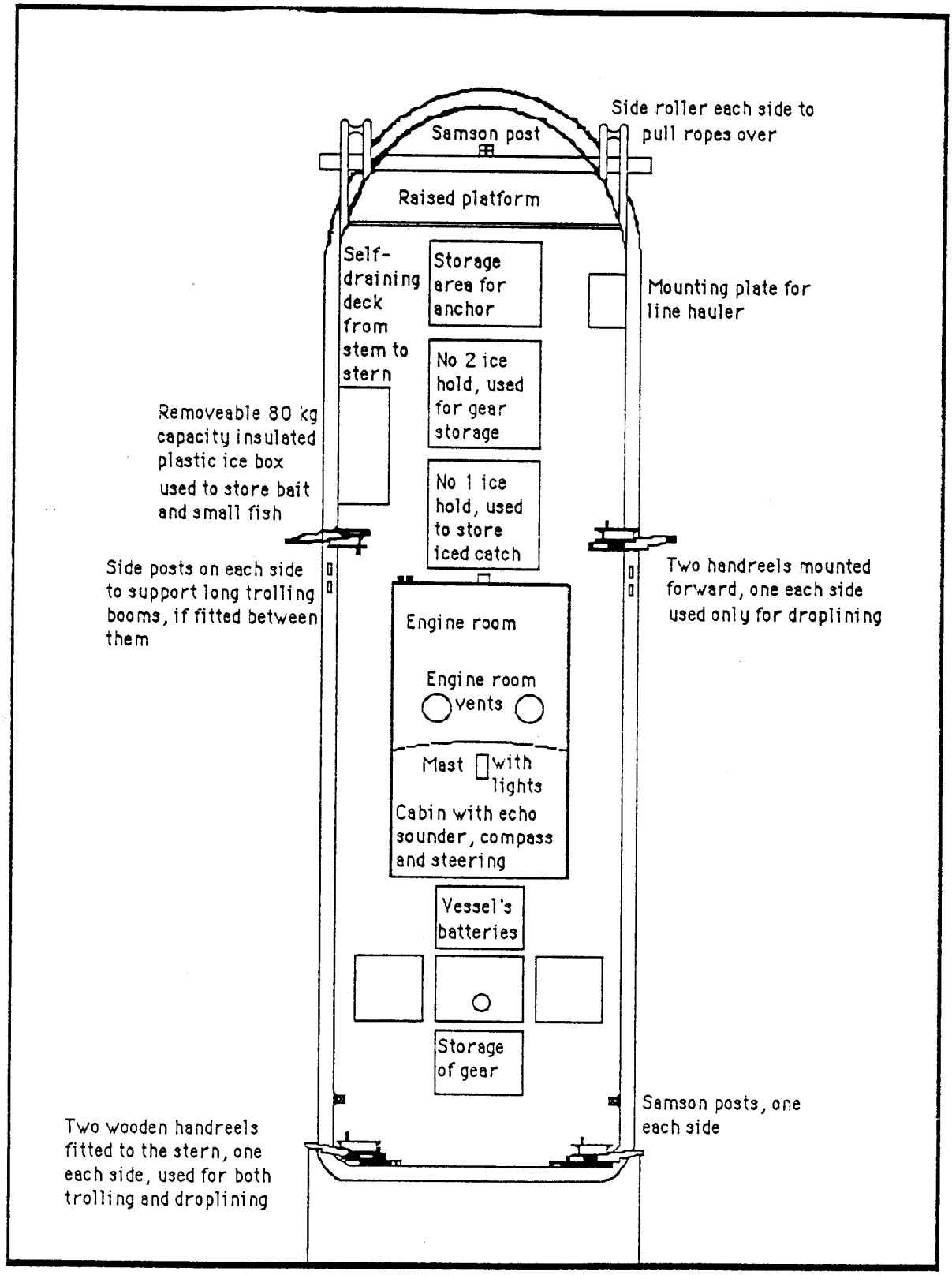

Figure 2: Fishing layout of the Project vessel *Esinou*

Western Samoan type wooden handreels (Figure 3), were used for all fishing methods. Four handreels were fitted to the vessel, two at the stern which were used for both trolling and deep-bottom fishing, and two just forward of amidships which were only used for bottom fishing. The vessel also came equipped with a Furuno deep-water graph echo-sounder with a maximum depth range of 825 m (450 fathom).

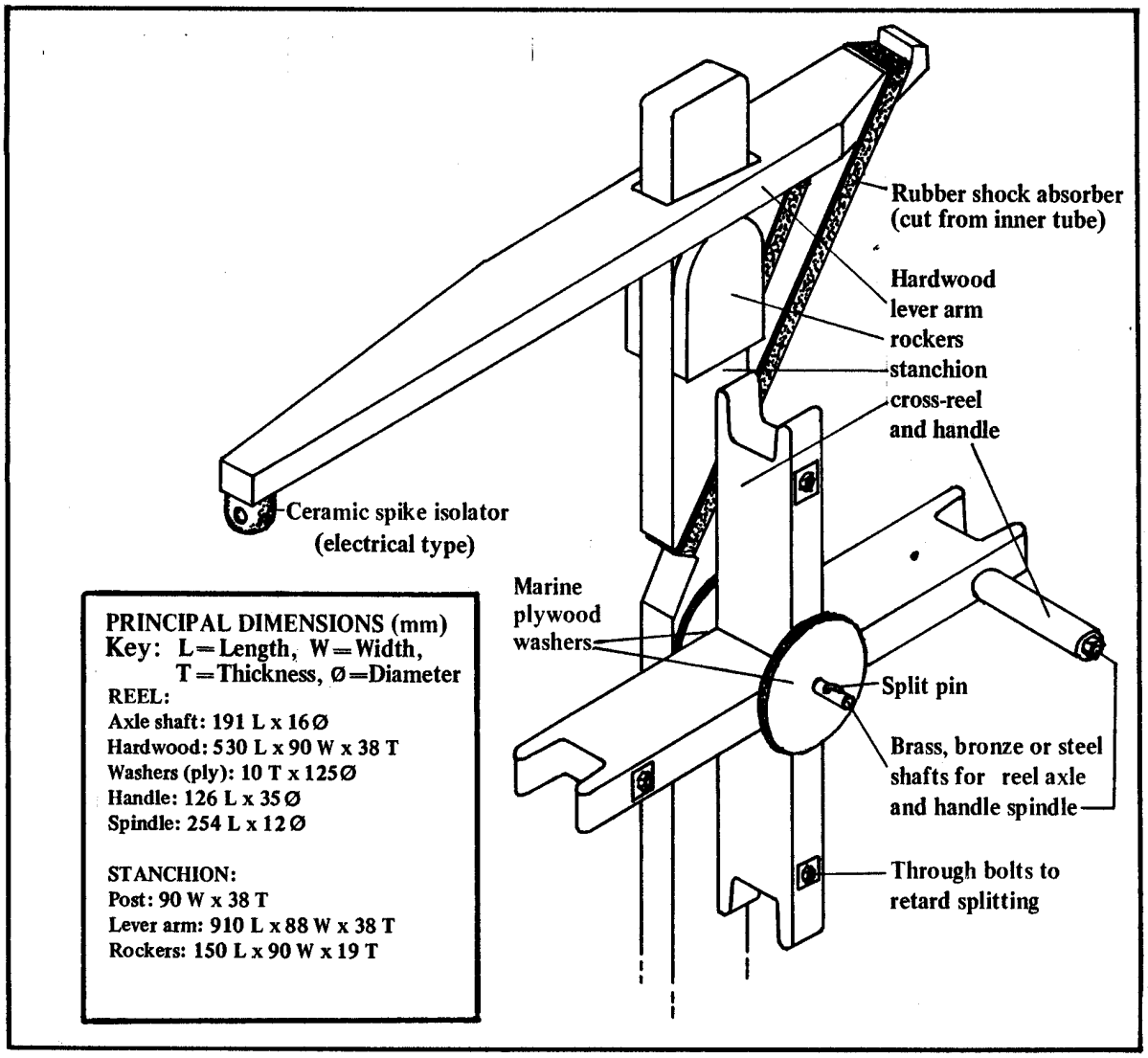

Figure 3: The Samoan type wooden handreel used by the Project

Anchoring gear for the fishing vessel consisted of a simple grapnel anchor, made out of 13 mm (1/2 in) steel reinforcing rod and 37 mm (1 1/2 in) steel pipe, 400 m (220 fathom) of 15 mm (5/8 in) polypropylene anchor line, and a polyethylene balloon buoy (Figure 4).

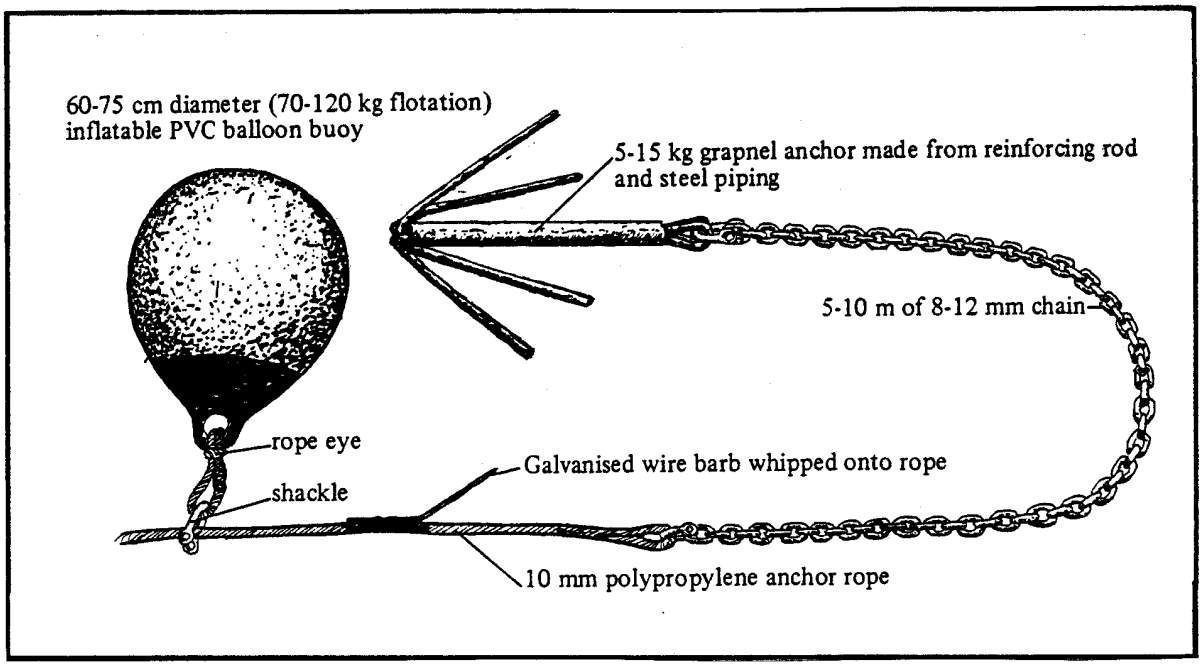

Figure 4: 'Self-hauling' anchor gear used by the project

3.3 Data collection

SPC Masterfishermen use a standard logsheet (Appendix 1) to record catch, effort, and other data, and make detailed notes of their daily activities and of supplementary information required. During this Project visit, data for each trip comprised of: time spent steaming, anchoring and fishing by method; fishing area; weather and current conditions; fishing depth or depth range each hour; number of crew, trainees and observers; quantity and type of gear, fuel and bait used; the specific identity of each fish caught by fishing method, where this could be determined; and the total number and weight of each species taken by fishing method.

Half way through the Project, the Masterfisherman was asked by the National Division of Marine Resources to collect more detailed data on these virgin stocks as a baseline for future comparison, if stocks start to decline. This more detailed data consisted of: the specific identity of each fish caught; the length and weight of each fish caught on a one hour basis; the depth range noted each time it changed; and changes in weather and current conditions occurring during fishing.

3.4 Training

Training was to be an important part of this visit. Marine Resources staff were responsible for the selection of trainees, and it was decided that each trainee and the four crew of the vessel would receive a US $10.00/day allowance. A selected person would have to do two consecutive trips to qualify as a trainee and receive the allowance. Other interested people and government employees were taken out as observers and received no allowance. All food was provided free and every person on board for a fishing trip received part of the catch to take home.

Over the 29 fishing trips conducted, 6 trainees were assigned to the project. A further 13 observers came out on at least one trip, including; 1 staff from the Marine Resources Division, 5 staff of the Truk Maritime Authority, 5 other fishermen from Param Island, and 2 fishermen from Ruo Island. Including the vessel crew a total of 23 people were introduced to the techniques used in deep-bottom fishing. The level of exposure varied according to the number of trips a person undertook, and usually included: basic seamanship; the use of the vessel's compass and echo-sounder; preparation of terminal rigs for deep-bottom fishing; the use of a buoy to pull the anchor; and the use of the Samoan handreel. All of the training was conducted at sea under actual fishing conditions.

3.5 Disposal of the catch

Disposal of the catch was the responsibility of the Masterfisherman as there were no government employees on the vessel full-time to take care of this. Arrangements were made with the Truk Maritime Authority (TMA) to purchase the catch at between US $1.65/kg ($0.75/lb) and US $1.76/kg ($0.80/lb) for export to further develop their overseas markets. The export markets were very selective regarding species, which meant that TMA would only accept those species that they could export. Because the TMA was a semi-government body they were only allowed to export fish and not allowed to sell fish on the local market. This then created a problem as TMA selected the prime species for export, leaving the remainder of less desirable species to be sold elsewhere. This latter proportion grew towards the end of the Project as the export markets became even more selective.

The fish that TMA did not purchase was either shared amongst the crew, sold to other wholesale and retail buyers at TMA prices, or sold to the Marine Resource and TMA staff at US $1.65/kg ($0.75/lb). One large grouper, that was too large to sell, was donated to the local hospital. All money from fish sales was turned over to the accountant at Resources and Development (R &D) who was responsible for handling the financial side of the Project. This fish-sale money was enough to cover all running costs for the Project vessel and pay allowances for both the crew and trainees.

In the early stages of the Project, some sharks were bought in dressed (headed, gutted, and all fins removed) to try and promote the use of shark. Some of these were given away with the general reluctance dictating that it was a waste of time and energy to pursue this any further. TMA however, showed interest at trying to open a market for shark fins so the fins were kept and dried until the end of the Project, when they were given to TMA to send off as a trial shipment.

4. FISHING ACTIVITIES AND RESULTS

4.1 General

Twenty five fishing trips were completed around Truk lagoon, with a further four trips being carried out from Ruo Island in the Hall Island Group. A total of 656.5 hours were spent at sea, making the average trip 22.5 hours in duration. The Param fishing cooperative's vessel *Esinou* was used throughout the Project's stay.

Deep-bottom handreeling was by far the most important fishing method used. Trolling was mainly conducted on an opportunistic basis while ever to vessel was underway. The only other fishing method used by the Project was a single hook shark line, set on two trips.

The effort devoted to each of these fishing techniques varied between fishing locations and individual trips, depending on the local marine environment and its resources, the weather, current and sea conditions, and the enthusiasm and willingness of the crew and trainees. Appendix 2 provides a summary of all fishing activities by trip.

4.2 Catch and effort by fishing method

4.2.1 Deep-water handreeling

Bottom fishing using handreels was carried out at anchor and the techniques used were standard for the Project. Suitable fishing areas were located using the echo-sounder, target depths being from 100–200 m (55–110 fathom). Where possible, the anchor was dropped in water shallower than those of the selected fishing spot, in a position selected so that the prevailing wind and current would carry the boat back over the deeper area as the anchor rope was paid out. At many of the locations fished, however, the current and shifting winds would hold the vessel parallel to the reef, which meant that the vessel had to be anchored in approximately the same depth as fishing was to take place in.

Once the boat was resting at anchor, bottom fishing was conducted using the handreels fitted with 500 m (275 fathom) of 130 kg (300 lb) test nylon monofilament line, a wire terminal arrangement bearing three tuna circle hooks, and a 1 kg (2 lb) to 3.5 kg (8 lb) sinker (Figure 5). The sinker was lowered to the bottom, and enough tension kept on the line by hand so that when the boat was on the top of a wave the line was tight, and as the boat reached the bottom of a wave the line was just slack.

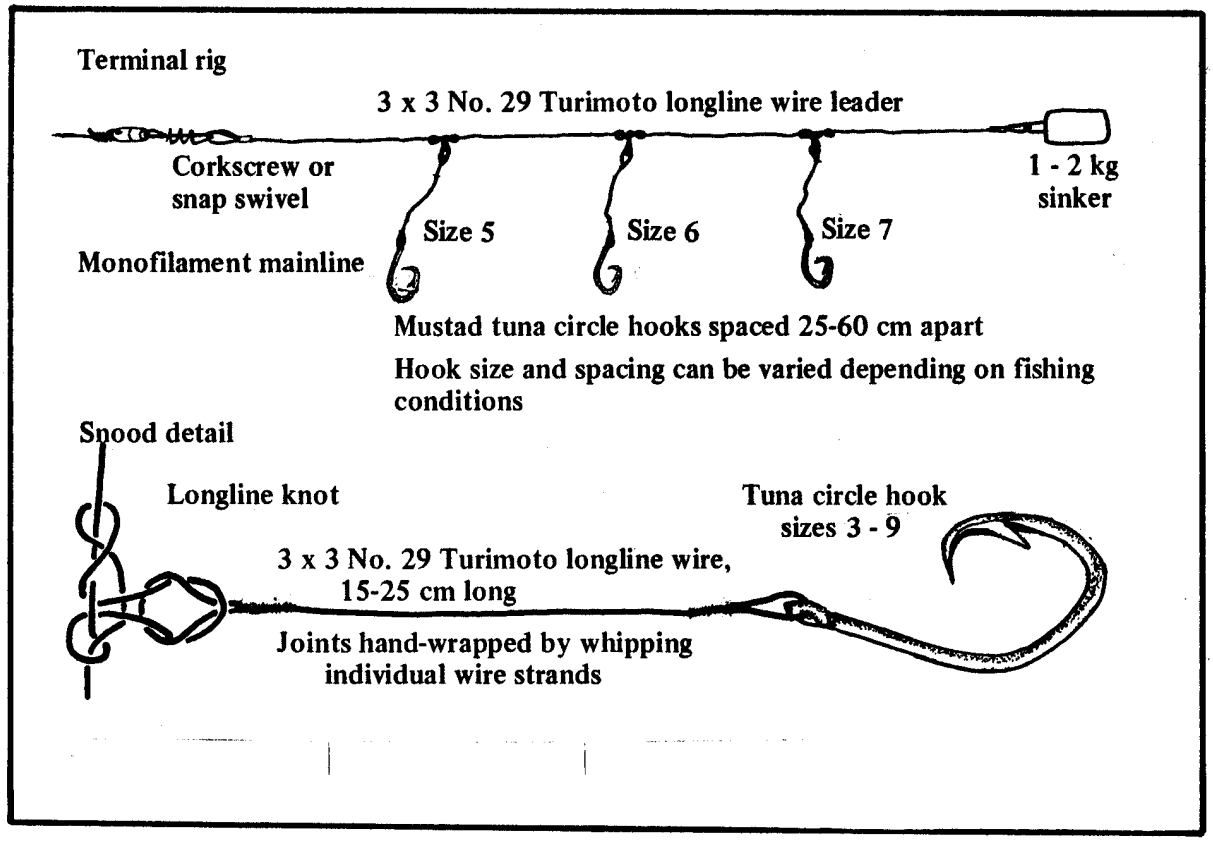

Figure 5: Typical terminal rig used for deep-bottom fishing

This allows the fisherman to feel the bites and respond by quickly taking 4 to 5 turns on the reel to hook and lift the fish off the bottom, so as to avoid tangles with other lines or hooking the bottom. Because of the length and elastic properties of the line, which makes rapid striking difficult, much reliance is placed on the effectiveness of the self-hooking tuna circle hooks used. Although hook sizes 3–9 were carried by the Masterfisherman, sizes 5, 6 and 7 were used for both day and night fishing. The larger sizes, 3 and 4 were not used at all during this project visit while the smaller sizes 8 and 9 were only used on several occasions.

The preferred bait for deep-bottom fishing is skipjack (*Katsuwonus pelamis*), and this was purchased from local fishermen and used on every trip. The quality of the bait purchased varied considerably, fresh skipjack, when available, being in excellent condition while the more readily available frozen skipjack was bordering on being rotten and usually dehydrated. Trolling activities were conducted to and from fishing grounds following the reef, in the hope that suitable fresh bait would be caught to supplement that purchased. No skipjack were caught trolling, so on several occasions when the purchased bait ran out, freshly caught barracuda and wahoo were used.

A simple technique was used to retrieve the anchor after fishing which greatly reduced the effort involved in hauling by hand (Figure 6). The boat was motored forward slowly, while slack rope was pulled in until the rope was almost vertical over the anchor, then the rope was tied off. The boat was then motored forward rapidly, breaking out the anchor and towing it behind the boat. While the vessel was still underway a free-running buoy clipped onto the rope and released, would be forced back along the rope until, close to the anchor, it was trapped by a ‘no-return’ wire barb whipped onto the

line (see Figure 4). The boat could then be run back along the anchor line at slow speed, with one crew member feeding the rope on board until reaching the anchor, which, suspended by the buoy at the sea surface, could then be easily recovered.

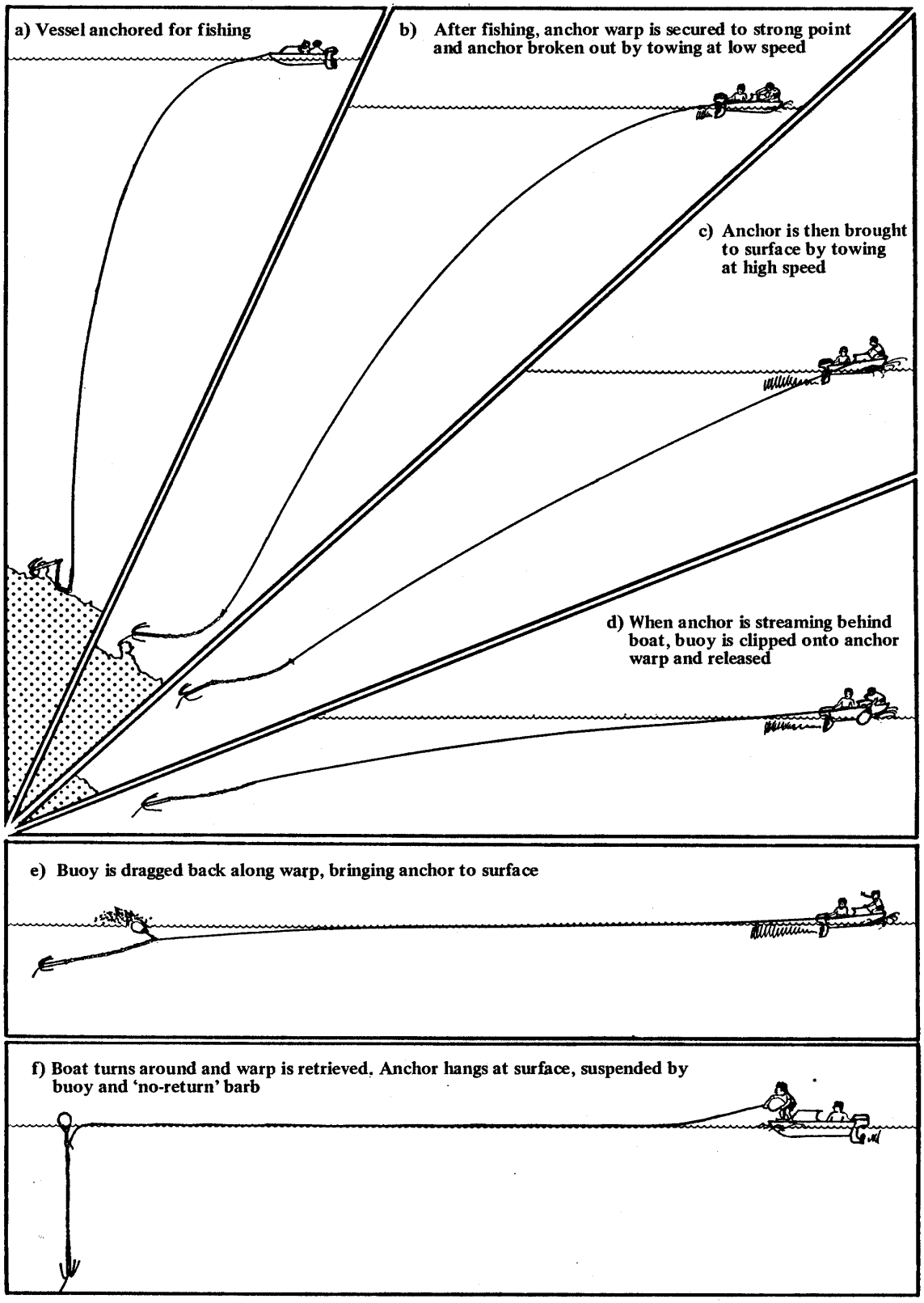

Figure 6: Simple anchor recovery method

Primary target species for this type of fishing are deep-water snappers (*Etelis* spp.), jobfish (*Aphareus*, *Pristipomoides* spp.) and sea breams (*Gnathodentex*, *Gymnocranius* spp.), but a wide variety of other species are also taken, including a proportion of less desirable types such as sharks and eels. Usually species characteristic of shallower waters (e.g. *Lethrinus* spp. and shallow water *Lutjanids*) appear in the catch, due to the fact that bottom irregularities and vessel swing while at anchor usually result in a considerable range of depths being fished. The deeper-living oilfish and snake mackerels (family *Gempylidae*) also occur, being caught at night when they appear to ascend to depths typically fished by the project.

Deep-water handreeling produced the majority of the catch, as might be expected since it occupied by far the greatest amount of fishing time (68.4%). The overall catch rate for saleable species was 3.96 kg/reel-hour (8.7 lb/reel-hour) and if unsaleable species are included then the catch rate would increase to 5.15 kg/reel-hour (11.3 lb/reel-hour—Table 1). This saleable catch rate is a little below average when compared to the catch rates achieved in other countries by the Project, as can be seen in Table 2.

Table 1. Summary of the catch and effort by deep-bottom handreeling for both areas

Location	No. of trips	Fishing hours	Effort (line hours)	Saleable catch No.	Saleable catch Weight (kg)	Unsaleable catch No.	Unsaleable catch Weight (kg)	Total catch (kg)	CPUE (kg) Note
Truk lagoon area	25	235.0	890.6	1,958	3,418.3	138	1,016.4	4,434.7	5.0
Ruo island area	4	21.5	86.0	220	448.7	17	149.0	597.7	7.0
Total	29*	256.5	976.6	2,178	3,867.0	155	1,165.4	5,032.4	5.2

Note: Truk lagoon: If sharks are excluded from the catch, CPUE = 3.9
If sharks and other locally unsaleable species are excluded, CPUE = 3.8

Ruo island: If sharks are excluded from the catch, CPUE = 5.2
If sharks and other locally unsaleable species are excluded, CPUE = 5.2

All areas If sharks are excluded from the catch, CPUE = 4.0
If sharks and other locally unsaleable species are excluded, CPUE = 4.0

* All trips combined more than one fishing method

Table 2: Comparative deep-bottom catch rates recorded by the Deep Sea Fisheries Development Project in selected Pacific countries or territories

Country	Dates of visit	Catch rates excluding sharks (kg/reel-hour)
Truk	May 88 – October 88 (this visit)	4.0
Truk	February 80 – March 80	4.1
Palau	October 87 – May 88	2.3
Palau	May 83 – November 83	4.5
Palau	November 79 – January 80	3.1
Vanuatu (Central)	August 80 – May 81	6.5
Vanuatu (Efate)	September 78 – March 79	5.3
Papua New Guinea	September 79 – December 79	4.9
Fiji	November 79 – September 80	9.3
New Caledonia	April 79 – September 79	7.2

Catches varied between the two areas, from 3,418.3 kg (7,534 lb) at Truk lagoon to 448.7 kg (989 lb) at Ruo Island. This to a great extent reflects the different fishing time spent in each area as the catch rates of 3.96 kg/reel-hour (8.7 lb/reel-hour) and 5.22 kg/reel-hour (11.5 lb /reel-hour) respectively, are not greatly different. A total of 25 fishing trips were conducted around Truk lagoon as compared to only 4 around Ruo Island.

About 77 per cent of the total bottom fish catch weight was saleable with only 12 per cent comprising of deep-water snappers. Emperors and shallow-water snappers were more prevalent and made up 24 per cent. All of the unsaleable catch except 8 sharks were taken by the handreels. This figure of 1,165.4 kg represents 23 per cent of the total fish caught by handreeling, and of this, 99 per cent was dressed shark.

The species composition of the catch is depicted graphically in Figure 7. The groupings used are loosely based on a combination of the component species' taxonomy, habitat, and recognisable concurrence in the catch. Appendix 3A gives a more detailed breakdown of the deep-bottom species composition.

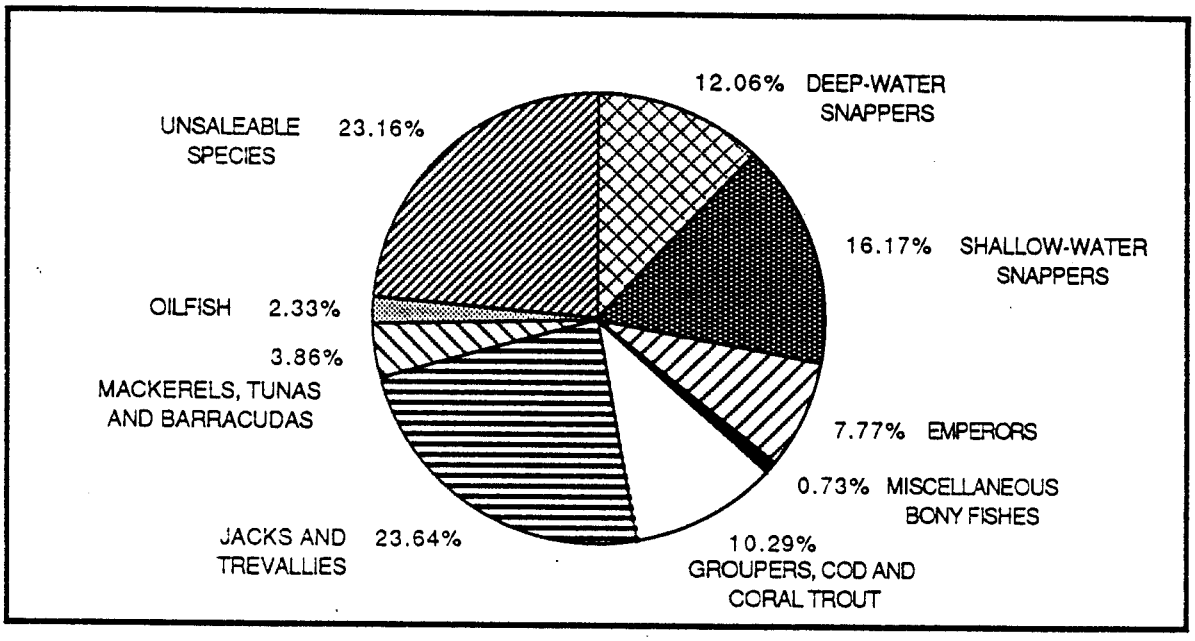

Figure 7: Species composition of the deep-bottom handreel catch

The *Esinou* was equipped with four handreels, and on most occasions all of the reels were used. However on some occasions only three reels were used due to the number of crew, the prevailing weather conditions and the enthusiasm of the crew. This resulted in an effort of about 3.8 reel-hours, and a saleable catch of 15.05 kg (33.2 lb) per boat fishing hour. Some 364.1 kg (802 lb) of bait (see Appendix 2) was used yielding a saleable catch of about 10.6 kg (23.4 lb) of fish per kilo of bait. This usage of bait was quite high and can be attributed to the amount of gear (terminal rigs with baited hooks) lost to sharks, the number of fish that were mauled and lost to sharks, and the generally small size of many of the fish caught.

Fishing activities during this Project visit were directed at a previously unexploited resource. The catch rates achieved would indicate that the resource is not large and could be quite fragile. Sustained increases in fishing pressure accompanying development of the fishery may well result in a decline in average catch rates, and associated changes in the species composition of the catch.

4.2.2 Trolling

Trolling was conducted whilst ever the vessel was travelling to and from fishing grounds, as well as between fishing grounds. Two lines were trolled directly from the stern-mounted handreels on all

occasions. Trolling lures were made up from commercially manufactured plastic heads, onto which vinyl octopus skirts were tied. These lures were then placed on a 2–3 m (7–10 ft) length of 80 kg (175 lb) or 130 kg (300 lb) test stainless steel 49-strand trace wire, which had a 5/0–11/0 double trolling hook crimped in place at one end. The other end of the trace ended in a Flemish knot (Figure 8).

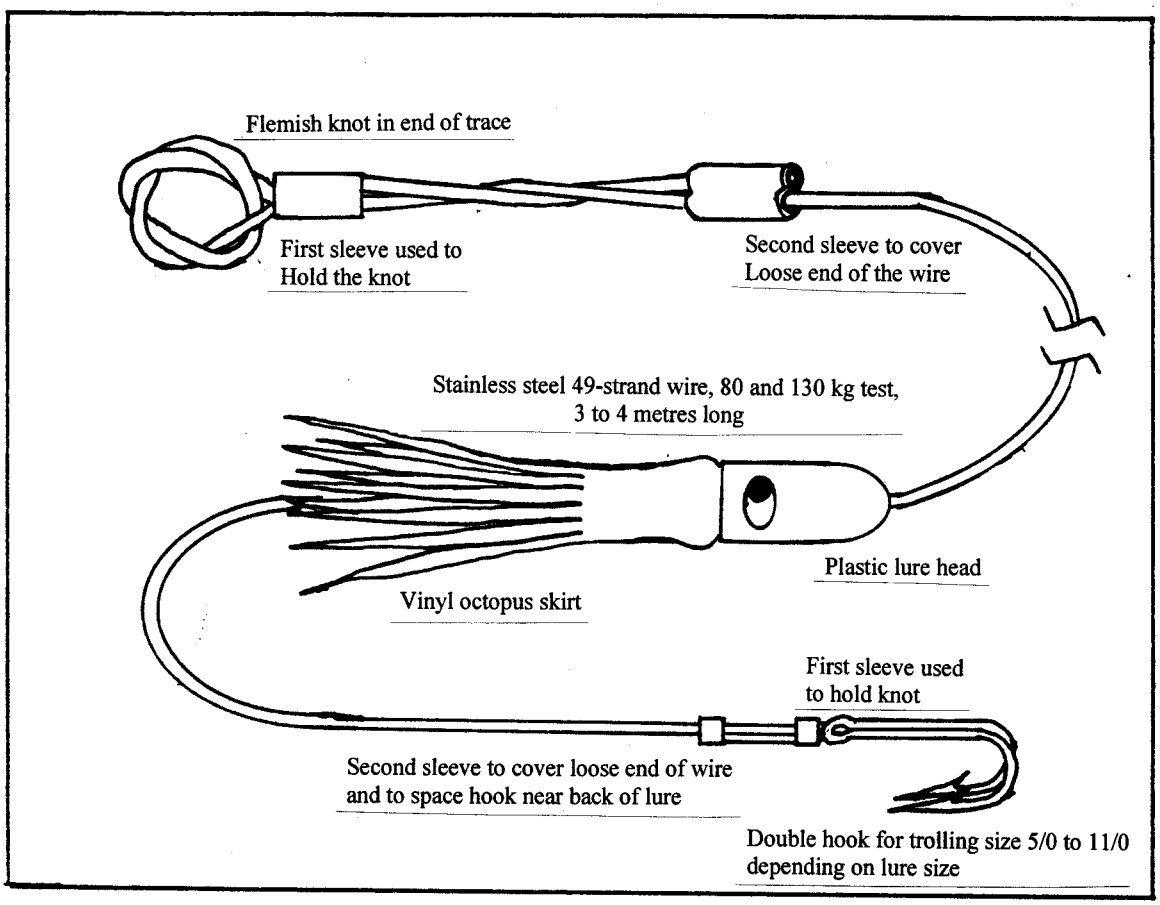

Figure 8: Typical trace, with lure and double hook used for trolling

Trolling catch rates were extremely low, in consideration of the effort devoted to this method. Table 3 summarises these figures. Trolling was carried out mainly on an opportunistic basis, meaning that many hours were spent in areas where there was little or no chance of catching fish, hence increasing the hours of effort. However, improved catch rates could probably have been achieved in all areas of trolling, had it been practised as the primary activity.

Table 3. Summary of the catch and effort by trolling

Location	No. of trips	Fishing hours	Effort (line hours)	Saleable catch No.	Saleable catch Weight (kg)	Unsaleable catch No.	Unsaleable catch Weight (kg)	Total catch (kg)	CPUE (kg)
Truk lagoon area	25	96.0	192.0	6	29.6	0	0.0	29.6	0.2
Ruo island area	4	13.5	27.0	7	26.7	0	0.0	26.7	1.0
Total	29*	109.5	219.0	13	56.3	0	0.0	56.3	0.3

* All trips combined more than one fishing method

A total of only 56.3 kg (124 lb) of fish was taken by this method, with an overall catch rate of 0.26 kg/reel-hour (0.57 lb/reel-hour). No unsaleable species were taken by this fishing method. The major species taken were seasonal pelagics. Appendix 3B gives a complete breakdown of these species.

4.2.3 Single hook shark line

The single hook shark line was only used on two occasions when sharks seriously hindered bottom fishing operations. The line consisted of 40 m (22 fathom) of 6 mm (1/4 in) rope with a large swivel spliced onto one end and the other end terminating in an eye splice. A 4 m (13 ft) trace made from 9 strand turimoto wire was hand whipped onto the swivel and had a large shark hook attached to the other end. Eight sharks were caught by this method for a dressed weight of 68 kg (150 lb). Only 5.5 kg (12 lb) of waste skipjack heads and backbones were used as bait. This method is specifically designed for catching sharks and is very effective. Appendix 3C summarise the species composition.

4.3 Fishing Areas

4.3.1 Truk lagoon (area 'A')

Figure 9 shows the Project base on Moen Island and the locations of each area fished by fishing trip number. The weather conditions experienced were not always favourable for bottom fishing, with light variable winds, rain squalls and strong currents. The main wind direction was east to north-east, and although these winds were generally light, it prevented many fishing trips from being carried out on the eastern reef face, and made fishing difficult on the north and south faces.

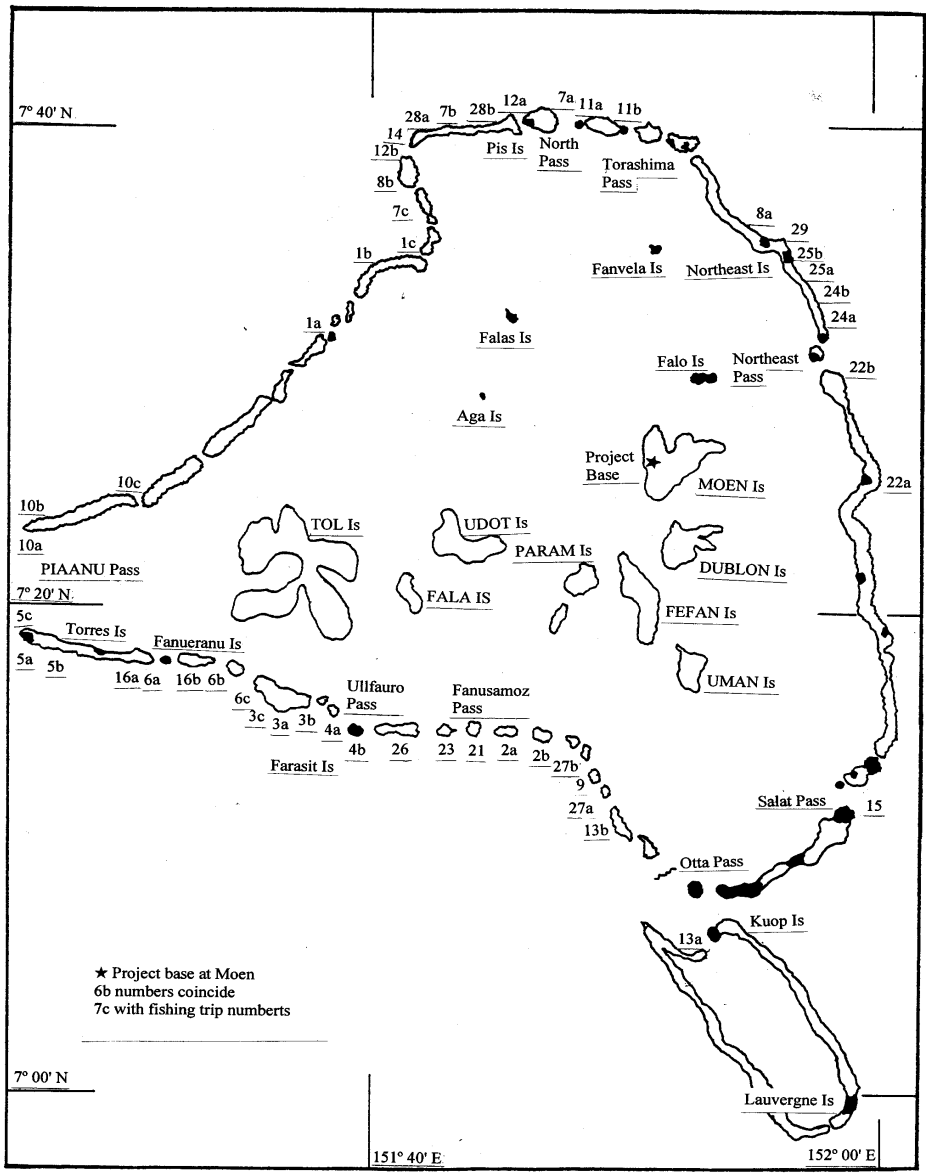

Figure 9: Truk lagoon (area 'A')

Table 4 summarises the Project's catch around Truk lagoon (area 'A'). Detailed trip records can be found in Appendix 2A.

Table 4: Summary of the catch and effort by fishing method around Truk lagoon (area 'A')

Fishing method	No. of trips	Fishing hours	Effort (line hours)	Saleable catch No.	Saleable catch Weight (kg)	Unsaleable catch No.	Unsaleable catch Weight (kg)	Total catch (kg)	CPUE (kg)
Handreeling	25	235.0	890.6	1,958	3,418.3	138	1,016.4	4,434.7	5.0
Trolling	25	96.0	192.0	6	29.6	0	0.0	29.6	0.2
Shark line	2	9.0	9.0	0	0.0	8	68.0	68.0	7.6
Total	25*	340.0		1,964	3,447.9	146	1084.4	4,532.3	

* All trips combined more than one fishing method

Bottom fishing grounds varied considerably around Truk Lagoon, and for that reason it is best to break these areas up for description:

- Western face: there was no shelf outside the reef flat, which resulted in a sheer to vertical drop-off starting at the edge of the outer reef flat. Fishing was very difficult due to the constant depth changes which resulted from the slightest change in weather or current conditions. The catch was also noticed to be less than in most other areas except for around the mouth of the west passage;

- North-west point and off the north-east island: both of these locations had a shoal of reef running out to sea that had good fishing depths at a distance of 100–200 m (110–220 yds) from the main reef. Fishing on these spots was difficult mainly due to the stronger currents experienced over the shoal areas. The catch was higher than many other areas but sharks were numerous especially on the north-east island shoal;

- Eastern face: there was a noticeable shelf outside the reef flat that sloped gently until it reached around 100 m (55 fathom) in depth, where the drop-off then became sheer once again. Weather conditions in general were not favourable for fishing the eastern face and trying to stay on the edge of the drop-off was difficult. The catch was consistently better on this coast and the best catch in deep-waters achieved;

- Northern face: the drop-off outside the reef was not as sheer as the western face although it was still very steep. Weather conditions were not very favourable, although when the wind was blowing off the reef it was easier to stay in one position. The catch was consistent along this face with no big catches; and

- Southern face: this face varied as to the sheerness of the drop-off, and it was noted that the areas that had the more gentle slope had the most fish. Weather conditions were more favourable for this area as the wind usually had some north in its direction. Catches varied considerably along this face, with a marked drop in landings in areas that were fished more than once.

The trolling in general was extremely poor which is reflected in the very low catches. When trolling across the lagoon, very little fish or bird activity was noticed. Outside the reef schools of tuna were observed off the reef, however, no time was spent chasing them. Trolling activities were conducted opportunistically while travelling to and from fishing grounds after the first few trips produced no fish. The single hook shark line, although only used on two occasions was most successful in capturing sharks that were attacking hooked bottom fish as they were hauled to the surface.

4.3.2 Ruo Island—Hall Group (area 'B')

Figure 10 shows the Project base at Ruo Island and the actual location of each of the four trips conducted. The weather was generally favourable for fishing waters on the west and south-west faces. Light east to north-east breezes did not allow any fishing on the north and east faces. The current was generally slight, which allowed the vessel to be anchored according to the wind.

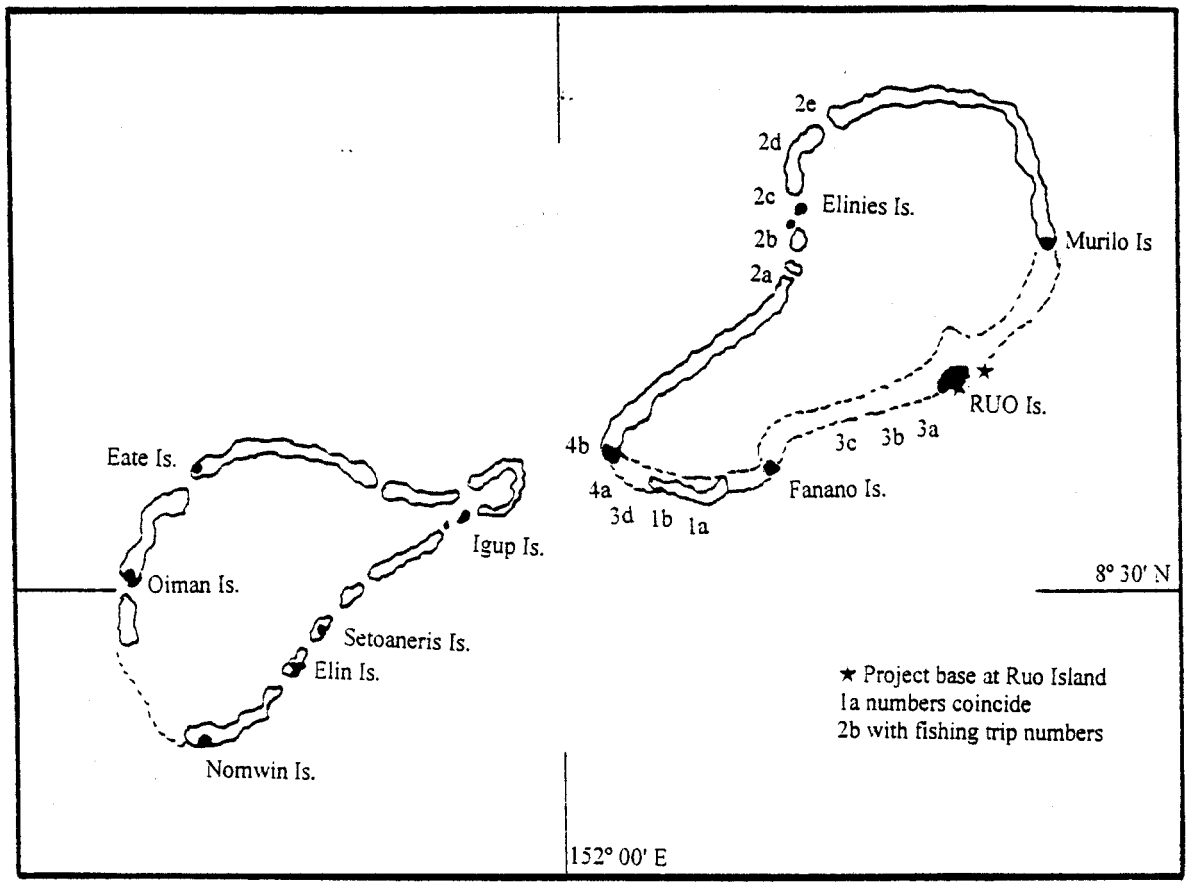

Figure 10: Ruo Island—Hall Group (area 'B')

Table 5 summarises the project's catch in the Ruo Island area. Detailed trip records can be found in Appendix 2B.

Table 5. Summary of the catch and effort by fishing method around Ruo Island (area 'B')

Fishing method	No. of trips	Fishing hours	Effort (line hours)	Saleable catch No.	Saleable catch Weight (kg)	Unsaleable catch No.	Unsaleable catch Weight (kg)	Total catch (kg)	CPUE (kg)
Handreeling	4	21.5	86.0	220	448.7	17	149.0	597.7	7.0
Trolling	4	13.5	27.0	7	26.7	0	0.0	26.7	1.0
Total	4*	35.0		227	475.4	17	149.0	624.4	

* All trips combined more than one fishing method

Bottom fishing catch rates were higher in this area, which could be attributed in part to only 4 fishing trips being conducted on a virgin stock of fish. The south-west face produced the best catches, and this was due to the fact that the drop-off was not as steep as that of the western face. The south-east face

was found to be unproductive, mainly because the weather conditions were not favourable for staying in one position or depth.

Trolling was found to be a little more productive in this area although still disappointing. The single hook shark line was not used at all in this area as sharks were not as prevalent.

5. ECONOMICS OF FISHING ACTIVITIES

Table 6 has been drawn up from the results obtained during the Project visit to show the economics of the fishing activities carried out, based on prices in Truk at the time (in US dollars). It should be noted that Table 6 is a projection based on the sale of all saleable fish.

Table 6. Summary of vessel income and expenses

(a)	Income	US Dollars
	Fish sales - 3923.3kg @ $1.65/kg average	$6,473.45
	Total income	**$6,473.45**
(b)	Expenses	
	Diesel fuel – 3,465 litres @ $0.20/l (govt. rate)	$693.00
	Ice – 29 trips – 12 blocks per trip @ $1.50/block	$522.00
	Bait – 369.6 kg @ $1.10/kg	$406.56
	Training and crew allowance – 29 trips x 5 persons @ $10.00 each	$1,450.00
	Fish eaten by crew – 392 kg (10% of catch Est,) @ $1.65/kg	$646.80
	Replacement fishing gear – estimate	$350.00
	Food – Est. 5 people – $5.00/trip/crew – 29 trips	$725.00
	Maintenance – marine paint – spare parts – oil – estimate	$250.00
	Total expenses	**$5,043.36**
	Surplus from 4 month Project visit	**$1,430.09**

Many factors still have to be taken into account when considering Table 6. The factors that would increase income are:

- In a commercial enterprise, the limitations on maximising catches imposed by the running of a training programme would be absent, thus increasing effort;
- Higher prices could have been received if alternative markets had been sought, especially if the deep-water snappers were sold to hotels or exported to Hawaii;
- Seasonal trends may occur for this style of fishing, meaning that the summer months not fished by the Project could be more productive;
- Concentration on creating markets for both shark fins and shark meat. The meat could be smoked to make it more acceptable to the consumers;
- Varying the fishing methods used so as to take advantage of any seasonal runs of fish. This would come from local knowledge;
- Longer trips, meaning more time spent at sea each trip to increase catches and cut down running costs in and out of port; and

– Building of an awning or cover on the vessel to give the crew some protection from weather conditions, and a dry place to sleep. A well rested crew is a happy crew and will work harder.

Factors that may hinder fishing activities or increase expenses are:

– Fishing permission is necessary if a person from Truk lagoon wants to fish at another island outside the lagoon. This could be a problem in the future if fish become scarce around Truk;

– Rental on the project vessel from the Marine Resource Division is normally US $150.00/month. This fee was waived for the months of the project, however under normal conditions this fee would be paid, which would add another US $600.00 to the expenses and the surplus would then be US $830.09;

– No provision has been made for payment of wages to the skipper or the crew of the vessel, although the $10.00/day allowance has been included in Table 6. Wages based on a percentage of the catch may well exceed the allowances paid;

– No provision has been made for any medical coverage for the skipper or crew;

– No provision has been made for vessel insurance;

– No provision has been made for the initial purchase of anchor rope (US $530.00), the construction of fishing reels, or fishing gear to make the vessel operational. This gear should last for several years and would depreciate over that time; and

– Lost time due to either prolonged bad weather or vessel breakdowns and subsequent waiting for spare parts to arrive from overseas.

After all these factors have been taken into consideration, the feasibility for one or two vessels to operate profitably around Truk Lagoon using the fishing methods used by the project seems encouraging.

6. CONCLUSIONS

6.1 The Resource

The results of the deep-bottom fishing activities carried out in the two areas of Truk State would indicate the presence of a small, possibly fragile resource of high price deep-water snappers. The reef flats and lagoons of the two area fished are known to be rich in marine life. The outer reef slopes appear to hold reasonable stocks of fish in general with the deep-water species being more scarce.

Fishing activities during this Project visit, were directed at a previously unexploited fish stock. The only recorded fishing pressure on the deep-water stocks has been three previous surveys, including one conducted eight years earlier by this Project. Factors observed by the Masterfisherman, which could have contributed to the average, to slightly below average, country catch rate include:

a) The outer reef slope from the reef edge to the 100 m (55 fathom) isobar is slight to moderate. Past 100 m (55 fathom) the slope becomes almost vertical. This sheer drop-off does not allow the deep-water species to have much area or habitat to live in as the distance on the surface from fishing in 100 m (55 fathom) to 200 m (110 fathom) depth is around 20–40 m (22–44 yds);

b) The deep-water species in Truk were all being caught in much shallower depths than the Masterfisherman's experience in other Pacific Island countries. This could possibly be due to water temperature, food or some other phenomena. This restriction on depth appears to have

the deep-water species living in a much narrower depth band (down to 200 m (110 fathom))around the reef, which would thus limit their habitat. With a smaller habitat, this would naturally mean that the physical numbers of fish that could be supported would be reduced;

c) The average size of the deep-water snappers, (Appendix 3A gives a breakdown of the species caught) genus *Etelis* and *Pristipomoides* was quite large which would indicate that there had been very little or no fishing pressure on the stocks;

d) No more than 5 individuals of the *Etelis* or *Pristipomoides* family were caught in one fishing spot in one fishing session. This would indicate a lack of numbers, which could come back to the relatively small habitat by depth band that appears to exist; and

e) Although the deep-water species exist in the Project areas fished, it is felt that the stocks are likely to be fragile to increased or sustained fishing pressure.

The catch rates achieved during this project visit were slightly below those obtained in many Project visits elsewhere. High value species were present in the catch, although they only made up a small percentage (12.06%) of the total saleable catch. The unsaleable portion of the catch was significant (23.16%), however, with product development and consumer education, this portion may be reduced. Very little is currently known of the ability of deep-water bottom resources to withstand exploitation or the long-term effects on them of fishing activities and a change in the species composition may occur with fishing pressure.

6.2 Development Potential

Despite the apparent existence of a small deep-bottom resource capable of supporting limited commercial exploitation, and economic circumstances which would appear to provide a reasonable financial return on commercial fishing activities, there are a number of constraints which may hinder development of the fishery. Some of these relate to the marketing of fish, as well as the catching.

There are many different types and styles of fishing craft in Truk, ranging from small outboard-powered skiffs, to the 11 m (36 ft) vessel used by the Project, to 17 m (56 ft) pole-and-line tuna boats. The larger fibreglass vessels are preferred for working outside the reef because of their size and seaworthiness, however, these vessels do have some drawbacks. The below-deck ice-holds are very poorly insulated and require an excess of ice for long trips or the duration of trips must be limited. The availability of spare parts for the engines of these vessels is also a problem.

At present there is little to no fishing pressure on the deep-water stocks and there is no locally recorded scientific data at all on these species. Once a good set of data is on hand then catches could be monitored and management plans drawn up if they are needed.

On many occasions the supply of ice was sporadic in both the Dublon and Moen plants. This in part was due to the inconsistent power supply and a shortage of water at Moen and it was not clear what the problems were at Dublon.

The availability of appropriate fishing gear will influence fishing effectiveness, as well as the price that is paid for the gear. At present only a few shops carry a limited selection of fishing gear for handlining in the lagoon and trolling for tuna outside the reef. The prices paid for this gear varies between the shops, but was generally quite expensive.

The Truk Maritime Authority is presently purchasing fish for export. The prices paid to fishermen is in two categories, with US $0.11/kg difference between them. This pricing will not encourage fishermen to put out the initial outlay to equip their vessels for deep-water handreeling, or change from the methods they already know and use. The way in which TMA purchases the fish for export is also a hindrance for fishermen. At present TMA only purchases those fish that they know they have export markets for as they are not allowed by law to sell fish on the local market. This selective buying is

necessary at present to enable TMA to operate. However, this would stop a lot of fishermen from supplying TMA with fish since after the more desirable species have been selected from the catch the fisherman then needs to find another buyer who is willing to take the remaining, usually less desirable species at a cheaper price.

7. RECOMMENDATIONS

Both the National Government of FSM and the State Government of Truk have as part of their development polices, the development of their fishery resources. The results of this Project visit indicate that a small, possibly fragile deep-bottom resource does exist around the areas fished and could be exploited by one or two small-scale commercial fishing vessels. The following recommendations suggest possible moves to overcome some restraints which may hinder the development of the fishing industry. These are:

- To conduct further fishing trials for deep-water snappers in the two locations fished by the Project and collect as much data as possible on these almost virgin stocks. This data would then become the basis for comparison in the future once the fishery is developed. Once enough data is collected and analysed, management plans can be drawn up if necessary to control and protect this fishery from over exploitation;

- To conduct similar fishing trials for deep-water snappers in other areas of the state especially the off-shore banks found in the west and north-west of the state. If this can be done then accurate and detailed data should be collected right from the first trip to form the basis for future development and management as discussed in the previous recommendation;

- To increase the overall ice production at the two facilities. Some suggestions for each location are:

  a) Moen

  - To construct larger water storage tanks than those in use at present and to use the rainwater-catching capabilities of roofs on existing buildings and pipe this into the storage tanks;

  - To consider installing a back-up generator to overcome the frequent power stoppages that occur;

  - To purchase and hold an adequate supply of spare parts on hand to avoid lengthy breakdowns on this ageing machinery;

  b) Dublon

  - To investigate why this facility is running at less than 50 per cent of capacity for ice production, when this is the only function performed at the plant;

  - To look into why the island water supply has been turned off to the facility, causing a water shortage when it has not rained for several days;

- To ensure that the Marine Resources Division carries a comprehensive selection of necessary spare parts for the larger diesel-powered vessels at all times by making sure that new orders for replacement spares are placed regularly. This would keep good stocks on hand, as these vessels are ageing and will need increasing repairs in future years;

- To establish a Government fishing gear store to supply cheaper equipment to bona fide fishermen. This would come under the control of either the Marine Resources Division or Truk Maritime Authority. This would have a two-tier pricing system with amateur or non-

commercial fishermen paying a higher price for goods than recognised commercial fishermen. This should be a non-profit store, and possibly be run on a revolving fund basis, with either the Government or an Aid Organisation funding the initial purchase of fishing equipment;

- To change the fish purchasing arrangements presently used by the Truk Maritime Authority, with regards the following areas:

  - To establish a pricing structure for export sales which offers premium prices for the more valued species, especially deep-water snappers. Once this is established then fisherman can be encouraged to develop this fishery, with the incentive of higher prices;

  - To allow TMA to purchase the entire catch off fishermen so as to get away from the selective buying. This could be done by having a lesser price paid for those fish that are not for export, giving the fisherman the option on whether or not he would sell those fish to TMA or find another market. TMA should then have made arrangements with a local wholesaler to take the non export fish at TMA's purchase price plus a nominal handling fee. This would allow TMA to function more realistically without directly selling fish or competing on the local retail market; and

  - To investigate the possibility of doing post-harvest processing onshore of shark meat and all the non-export species. This could take the form of salting and drying, smoking or just filleting, and could be sold locally or exported.

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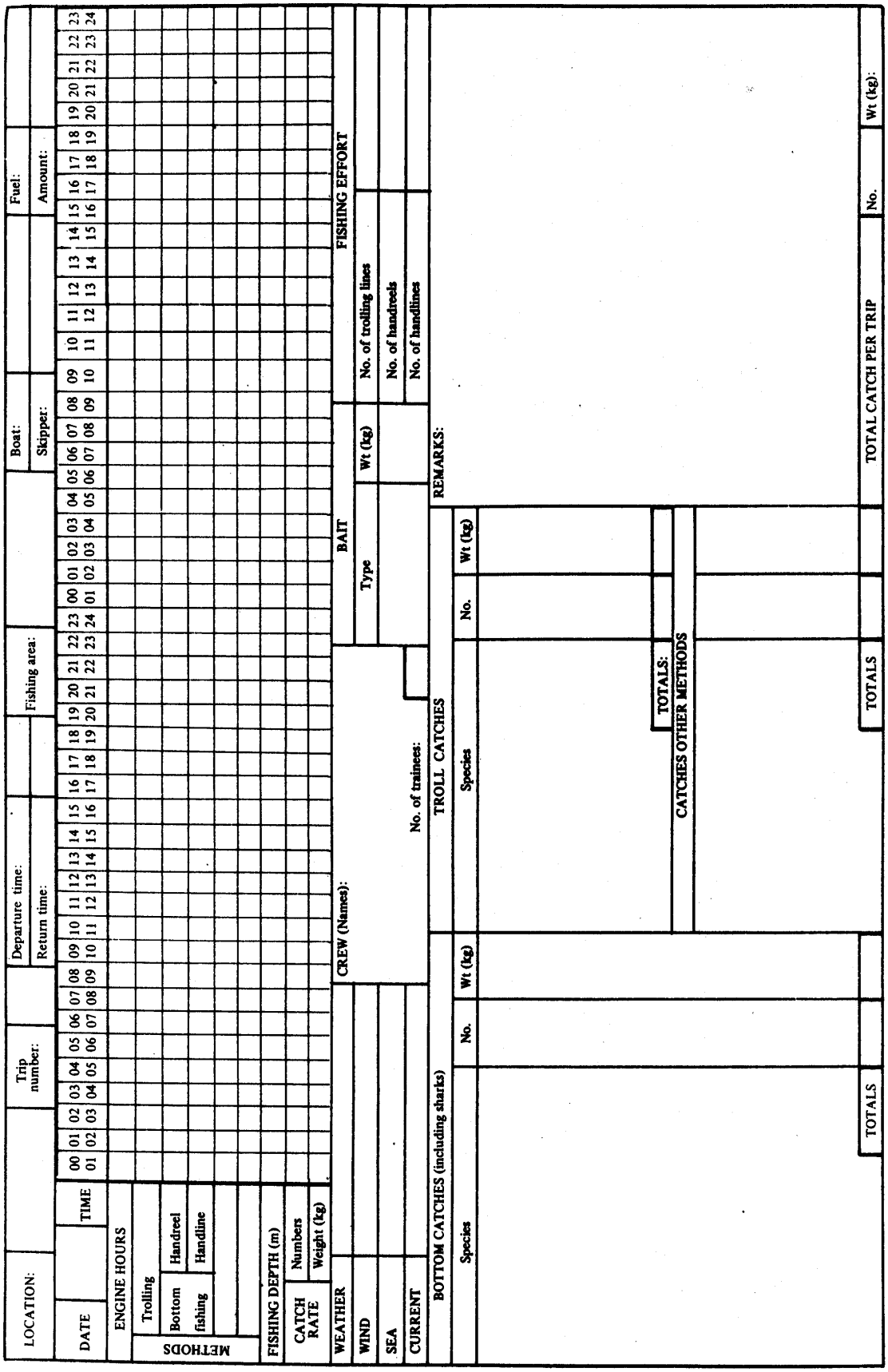
APPENDIX 1

STANDARD SPC DATA FORM USED DURING THE PROJECT



APPENDIX 2

SUMMARY OF FISHING TRIP RECORDS:

A. TRUK LAGOON

Trip No.	Fishing Method	Duration Hours	Engine Hours	Fishing Hours	Units of Effort	Saleable Catch No.	Saleable Catch Weight	Unsaleable Catch No.	Unsaleable Catch Weight	Bait Kg	Fuel (l)
1	Handreeling			10.0	40.0	47	106.2	2	16.0	7.0	
	Trolling			3.5	7.0						
	Total	21.5	7.0	13.5		47	106.2	2	16.0	7.0	100
2	Handreeling			11.0	40.0	75	161.9	9	64.0	8.5	
	Trolling			4.5	9.0						
	S.H.S.Line			6.0	6.0			4	30.0	3.0	
	Total	23.0	7.5	21.5		75	161.9	13	94.0	11.5	100
3	Handreeling			9.0	36.0	113	184.2	3	8.4	9.0	
	Trolling			5.0	10.0						
	Total	22.5	9.0	14.0		113	184.2	3	8.4	9.0	120
4	Handreeling			7.5	30.0	56	74.4	4	20.0	9.0	
	Trolling			2.5	5.0						
	Total	21.5	7.5	10.0		56	74.4	4	20.0	9.0	100
5	Handreeling			9.0	31.5	80	160.1	1	35.0	12.0	
	Trolling			6.0	12.0						
	Total	24.5	9.5	15.0		80	160.1	1	35.0	12.0	140
6	Handreeling			9.0	31.5	68	129.0	5	26.0	8.0	
	Trolling			4.0	8.0						
	Total	24.0	8.0	13.0		68	129.0	5	26.0	8.0	120
7	Handreeling			8.5	34.0	97	217.3			17.0	
	Trolling			5.5	11.0	2	26.0				
	Total	24.0	8.5	14.0		99	243.3	0	0.0	17.0	120
8	Handreeling			11.0	44.0	136	223.8	12	90.0	20.0	
	Trolling			3.5	7.0						
	Total	23.0	8.0	14.5		136	223.8	12	90.0	20.0	130
9	Handreeling			12.0	48.0	94	265.2	5	20.0	15.0	
	Trolling			3.0	6.0						
	Total	23.0	5.0	15.0		94	265.2	5	20.0	15.0	80
10	Handreeling			10.0	40.0	90	127.6	7	70.0	12.0	
	Trolling			5.5	11.0	1	1.0				
	Total	24.5	9.5	15.5		91	128.6	7	70.0	12.0	140
11	Handreeling			8.5	34.0	47	92.6	4	9.0	12.0	
	Trolling			4.0	8.0						
	Total	22.5	7.5	12.5		47	92.6	4	9.0	12.0	100
12	Handreeling			8.0	32.0	49	123.7			13.0	
	Trolling			5.5	11.0						
	Total	23.0	8.5	13.5		49	123.7	0	0.0	13.0	125
13	Handreeling			7.0	24.5	57	71.0	4	38.0	12.0	
	Trolling			3.5	7.0						
	Total	24.0	8.5	10.5		57	71.0	4	38.0	12.0	140

Trip No.	Fishing Method	Duration Hours	Engine Hours	Fishing Hours	Units of Effort	Saleable Catch No.	Saleable Catch Weight	Unsaleable Catch No.	Unsaleable Catch Weight	Bait Kg	Fuel (l)
14	Handreeling			10.5	33.6	94	122.4			17.0	
	Trolling			3.5	7.0						
	Total	23.0	7.0	14.0		94	122.4	0	0.0	17.0	120
15	Handreeling			11.5	46.0	94	190.6	8	62.0	15.0	
	Trolling			3.0	6.0						
	Total	24.0	6.5	14.5		94	190.6	8	62.0	15.0	120
16	Handreeling			8.5	34.0	39	91.2	8	29.0	10.0	
	Trolling			3.0	6.0	1	1.0				
	Total	23.5	8.5	11.5		40	92.2	8	29.0	10.0	140
21	Handreeling			10.0	40.0	83	126.2	14	84.0	12.0	
	Trolling			3.5	7.0						
	Total	23.0	6.5	13.5		83	126.2	14	84.0	12.0	100
22	Handreeling			10.5	42.0	81	206.5	6	54.5	11.6	
	Trolling			4.0	8.0	1	0.6				
	Total	23.5	7.0	14.5		82	207.1	6	54.5	11.6	120
23	Handreeling			9.5	38.0	96	130.4	6	20.0	15.0	
	Trolling			3.0	6.0						
	Total	23.5	7.5	12.5		96	130.4	6	20.0	15.0	120
24	Handreeling			10.0	30.0	94	156.4	5	42.0	14.0	
	Trolling			2.5	5.0						
	Total	23.5	7.0	12.5		94	156.4	5	42.0	14.0	120
25	Handreeling			10.0	40.0	93	117.6	7	67.0	14.0	
	Trolling			3.0	6.0						
	Total	23.5	6.5	13.0		93	117.6	7	67.0	14.0	100
26	Handreeling			8.5	29.8	82	84.6	3	18.0	13.0	
	Trolling			4.0	8.0						
	Total	23.5	7.0	12.5		82	84.6	3	18.0	13.0	110
27	Handreeling			8.5	29.8	47	55.6	2	22.0	10.0	
	Trolling			3.5	7.0						
	Total	23.0	8.0	12.0		47	55.6	2	22.0	10.0	120
28	Handreeling			5.0	20.0	55	63.7	3	32.0	10.0	
	Trolling			4.0	8.0	1	1.0				
	Total	23.5	6.5	9.0		56	64.7	3	32.0	10.0	100
29	Handreeling			12.0	42.0	91	136.1	20	189.5	15.0	
	Trolling			3.0	6.0						
	S.H.S.Line			3.0	3.0			4	38.0	2.5	
	Total	23.5	4.5	18.0		91	136.1	24	227.5	17.5	70
	SUMMARY										
25	Handreeling			235.0	890.6	1,958	3,418.3	138	1,016.4	311.1	
25	Trolling			96.0	192.0	6	29.6	0	0.0	0.0	
2	S.H.S.Line			9.0	9.0	0	0.0	8	68.0	5.5	
25	**TOTAL**	**582.0**	**186.5**	**340.0**		**1964**	**3447.9**	**146**	**1084.4**	**316.6**	**2855**

B. RUO ISLAND—HALL GROUP

Trip No.	Fishing Method	Duration Hours	Engine Hours	Fishing Hours	Units of Effort	Saleable Catch No.	Saleable Catch Weight	Unsaleable Catch No.	Unsaleable Catch Weight	Bait Kg	Fuel (l)
17	Handreeling			6.0	24.0	49	155.1	3	25.0	13.0	
	Trolling			3.5	7.0	1	1.6				
	Total	22.0	10.5	9.5		50	156.7	3	25.0	13.0	170
18	Handreeling			8.0	32.0	68	108.6	7	59.0	13.0	
	Trolling			3.5	7.0	2	10.5				
	Total	17.0	8.0	11.5		70	119.1	7	59.0	13.0	130
19	Handreeling			5.5	22.0	62	104.7	4	40.0	14.0	
	Trolling			2.5	5.0						
	Total	11.5	6.0	8.0		62	104.7	4	40.0	14.0	90
20	Handreeling			2.0	8.0	41	80.3	3	25.0	13.0	
	Trolling			4.0	8.0	4	14.6				
	Total	24.0	14.0	6.0		45	94.9	3	25.0	13.0	220
	SUMMARY										
4	Handreeling			21.5	86.0	220	448.7	17	149.0	53.0	
4	Trolling			13.5	27.0	7	26.7	0	0.0	0.0	
4	**TOTAL**	**74.5**	**38.5**	**35.0**		**227**	**475.4**	**17**	**149.0**	**53.0**	**610**

APPENDIX 3

SPECIES COMPOSITION OF THE CATCHES

A. DEEP-BOTTOM HANDREELING

GROUP / FAMILY / Species / English name	Truk lagoon area No.	Truk lagoon area Weight (kg)	Ruo island area No.	Ruo island area Weight (kg)	Total No.	Total Weight (kg)
DEEP-WATER SNAPPERS						
LUTJANIDAE (sub-families ETELINAE, APSILINAE)						
Aphareus furcatus Blue small-toothed jobfish	5	2.4	1	0.3	6	2.7
Aphareus rutilans Small-tooth jobfish/silvermouth	71	134.5	3	7.3	74	141.8
Aprion virescens Green jobfish	21	59.7	2	5.0	23	64.7
Etelis carbunculus Short-tailed red snapper	6	22.8	1	1.4	7	24.2
Etelis coruscans Longtail snapper	6	30.2			6	30.2
Paracaesio sordidus Fusilier	3	1.4			3	1.4
Paracaesio xanthurus Southern fusilier	1	0.6			1	0.6
Pristipomoides auricilla Gold-tailed jobfish	106	86.9	7	3.4	113	90.3
Pristipomoides filamentosus Rosy jobfish	26	87.3			26	87.3
Pristipomoides zonatus Banded flower snapper	123	148.6	15	15.2	138	163.8
Sub-total	**368**	**574.4**	**29**	**32.6**	**397**	**607.0**
SHALLOW-WATER SNAPPERS						
LUTJANIDAE (sub-family LUTJANINAE)						
Lutjanus argentimaculatus Mangrove jack	128	359.2	1	7.0	129	366.2
Lutjanus bohar Red bass	77	262.7	33	105.3	110	368.0
Lutjanus gibbus Paddletail	107	74.0	4	1.3	111	75.3
Lutjanus kasmira Blue-lined snapper	5	0.9			5	0.9
Lutjanus monostigma Onespot snapper	2	1.2			2	1.2
Lutjanus semicinctus Snapper	2	0.8			2	0.8
Macolor niger Black snapper	1	1.1			1	1.1
Sub-total	**322**	**699.9**	**38**	**113.6**	**360**	**813.5**

GROUP / FAMILY / Species / English name	Truk lagoon area No.	Truk lagoon area Weight (kg)	Ruo island area No.	Ruo island area Weight (kg)	Total No.	Total Weight (kg)
EMPERORS						
LETHRINIDAE						
Gnathodentex mossambicus Large-eye sea bream	11	16.4			11	16.4
Gymnocranius greseus Sea bream	6	5.6	2	1.6	8	7.2
Lethrinus kalopterus Orange spotted emperor	28	39.5	6	8.6	34	48.1
Lethrinus miniatus Long-nose emperor	39	62.0	5	13.0	44	75.0
Lethrinus ribrioperculatus Emperor	46	18.2	2	1.1	48	19.3
Lethrinus xanthochilus Emperor	187	191.8	30	33.1	217	224.9
Sub-total	**317**	**333.5**	**45**	**57.4**	**362**	**390.9**
GROUPERS, CODS AND CORAL TROUTS						
SERRANIDAE						
Cephalopholis igarasiensis Yellow-banded grouper	1	1.0			1	1.0
Cephalopholis sexmaculatus Rock cod	4	2.8			4	2.8
Cephalopholis sonnerati Tomato rock cod	15	8.2			15	8.2
Epinephelus hoedti Blue grouper	23	47.5	1	2.5	24	50.0
Epinephelus maculatus Spotted grouper	186	139.6	7	6.4	193	146.0
Epinephelus microdon Marbled cod	28	30.0	3	4.0	31	34.0
Epinephelus miliaris Grouper	80	78.7			80	78.7
Epinephelus morrhua Curve-banded grouper	6	14.9	2	2.4	8	17.3
Epinephelus retouti Red-spined grouper	3	3.3	2	1.3	5	4.6
Epinephelus septemfasciatus Seven-banded grouper	1	81.0			1	81.0
Gracila albomarginata Grouper	1	0.4			1	0.4
Plectropoma laevis Footballer trout	1	2.7			1	2.7
Plectropoma oligacanthus Island trout	7	9.0			7	9.0
Saloptia powelli Deep-water yellow rock cod	2	2.1	1	1.2	3	3.3
Variola albimarginatus Coronation trout	59	25.3			59	25.3
Variola louti Luna-tail trout	36	33.5	23	20.2	59	53.7
Sub-total	**453**	**480.0**	**39**	**38.0**	**492**	**518.0**

GROUP FAMILY Species English name	Truk lagoon area No.	 Weight (kg)	Ruo island area No.	 Weight (kg)	Total No.	 Weight (kg)
JACKS AND TREVALLIES						
CARANGIDAE						
Carangoides emburyi Trevally	1	2.9			1	2.9
Carangoides orthogrammus Yellow spotted trevally	4	8.6			4	8.6
Caranx lugubris Black trevally	360	912.5	59	122.0	419	1,034.5
Caranx melampygus Blue trevally	1	1.5			1	1.5
Caranx sexfasciatus Big-eye trevally	5	8.6	2	2.2	7	10.8
Elegatis bipinnulatus Rainbow runner	2	2.6			2	2.6
Seriola rivoliana Deep-water amberjack	60	122.5	5	5.5	65	128.0
Uraspis helvoli Trevally	1	0.6			1	0.6
Sub-total	**434**	**1059.8**	**66**	**129.7**	**500**	**1189.5**
MACKERELS AND TUNAS						
SCOMBRIDAE						
Gymnosarda unicolor Dogtooth tuna	3	47.5	2	63.4	5	110.9
Thunnus albacares Yellowfin tuna	3	39.0	1	14.0	4	53.0
Sub-total	**6**	**86.5**	**3**	**77.4**	**9**	**163.9**
OILFISH AND SNAKE MACKERELS						
GEMPYLIDAE						
Promethicthys prometheus * Snake mackerel	1	0.4			1	0.4
Ruvettus pretiosus Oilfish	8	117.5			8	117.5
Sub-total	**9**	**117.9**	**0**	**0.0**	**9**	**117.9**
SOLDIERFISH, SQUIRRELFISH AND GLASSEYES						
HOLOCENTRIDAE						
Myripristis berndti Squirrelfish	1	0.2			1	0.2
Sargocentron spiniferum Squirrelfish	9	6.1			9	6.1
Sub-total	**10**	**6.3**	**0**	**0.0**	**10**	**6.3**

GROUP FAMILY Species English name	Truk lagoon area No.	 Weight (kg)	Ruo island area No.	 Weight (kg)	Total No.	 Weight (kg)
BARRACUDAS AND SEAPIKES						
SPHYRAENIDAE						
Sphyraena barracuda Great barracuda	2	17.4			2	17.4
Sphyraena forsteri Forster's seapike	15	12.8			15	12.8
Sub-total	**17**	**30.2**	**0**	**0.0**	**17**	**30.2**
MISCELLANEOUS BONY FISHES						
ANOMALOPIDAE						
Anomalops spp.	2	0.8			2	0.8
CONGRIDAE						
Conger cinereus * Conger eels	2	3.0			2	3.0
ECHENEIDAE						
Echeneis naucrates * Remora	3	4.0	1	1.0	4	5.0
GRAMMISTIDAE						
Pogonoperca punctata	1	0.3			1	0.3
LABRIDAE						
Cheilinus undulatus Maori wrasse	1	14.5			1	14.5
MUGILOIDIDAE						
Parapercis roseoviridis	2	0.2			2	0.2
MULLIDAE						
Parupeneus chrysopleuron Goatfish	7	5.6			7	5.6
Parupeneus cyclostomus Goatfish	1	0.7			1	0.7
MURAENESOCIDAE						
Muraenesox cinereus * Eel	2	3.5			2	3.5
SCORPAENIDAE						
Pontinus macrocepholis Deep-water red rock cod	6	6.8			6	6.8
Sebasticus spp. Rock cod	3	1.3			3	1.3
Sub-total	**30**	**40.7**	**1**	**1.0**	**31**	**41.7**

GROUP FAMILY Species English name	Truk lagoon area No.	 Weight (kg)	Ruo island area No.	 Weight (kg)	Total No.	 Weight (kg)
SHARKS						
CARCHARHINIDAE						
Carcharhinus albimarginatus * Silver-tip reef shark	39	186.5	1	12.0	40	198.5
*Carcharhinus amblyrhynchus** Black-tip reef shark	90	815.0	15	136.0	105	951.0
SQUALIDAE						
Squalus spp. * Unidentified spiny dog shark	1	4.0			1	4.0
Sub-total	**130**	**1005.5**	**16**	**148.0**	**146**	**1153.5**
TOTAL	**2096**	**4434.7**	**237**	**597.7**	**2333**	**5032.4**

* Indicates locally unsaleable species

B. TROLLING

GROUP / FAMILY / Species / English name	Truk lagoon area No.	Truk lagoon area Weight (kg)	Ruo island area No.	Ruo island area Weight (kg)	Total No.	Total Weight (kg)
LUTJANIDAE						
Aprion virescens Green jobfish			2	6.3	2	6.3
CARINGIDAE						
Elegatis bipinnulatus Rainbow runner	3	2.6			3	2.6
SCOMBRIDAE						
Acanthocybium solandri Wahoo	2	26.0	1	6.2	3	32.2
Euthynnus affinis Mackerel tuna	1	1.0			1	1.0
Gymnosarda unicolor Dogtooth tuna			1	3.8	1	3.8
SPHYRAENIDAE						
Sphyraena barracuda Great barracuda			3	10.4	3	10.4
TOTAL	**6**	**29.6**	**7**	**26.7**	**13**	**56.3**

C. SINGLE HOOK SHARK LINE

GROUP / FAMILY / Species / English name	Truk lagoon area No.	Truk lagoon area Weight (kg)	Ruo island area No.	Ruo island area Weight (kg)	Total No.	Total Weight (kg)
CARCHARHINIDAE						
Carcharhinus albimarginatus * Silver-tip reef shark	1	4.0			1	4.0
*Carcharhinus amblyrhynchus** Black-tip reef shark	7	64.0			7	64.0
TOTAL	**8**	**68.0**	**0**	**0.0**	**8**	**68.0**

* Indicates locally unsaleable species