



**SOUTH PACIFIC COMMISSION**

**CAPTURE SECTION**

**UNPUBLISHED REPORT No.1  
OF  
THE DEEP SEA FISHERIES  
DEVELOPMENT PROJECT'S  
REPORT ON SECOND VISIT TO FIJI**

**1 September —9 October 1981**

**and**

**19 February —13 April 1982**

by

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Masterfisherman

**SOUTH PACIFIC COMMISSION  
NOUMEA, NEW CALEDONIA  
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## SUMMARY

The South Pacific Commission's Deep Sea Fisheries Development (DSFD) Project visited Fiji for the second time between 1 September 1981 and 13 April 1982.

Priority activities during the visit were to undertake a programme of deep-bottom fishing demonstration and training for village fishermen of the Lau island group and to assist the Fiji Fisheries Division in a resource survey of the same area.

Thirty-one fishing trips, mainly of short duration, were carried out, during which 60 local fishermen participated in the training programme. A total of 2,668.6 kg of fish was caught by a combination of deep-bottom fishing and trolling. Of the deep-bottom catch, 1,011.3 kg (whole weight) were technically un-saleable (sharks, and the red bass *Lutjanus bohar*), although all the sharks were actually consumed. Overall bottom fishing catch rates for the Lau group were 16.6 kg/line-hour, reducing to 8.2 kg/line-hour if only saleable fish are considered. Both rates were high compared to many other areas of the South Pacific region.

The deep-bottom resource of the Lau group is probably small in absolute terms because the area of suitable habitat for deep-bottom fish is limited. The resource nevertheless has potential for development on a small scale using vessels that are currently available in Fiji. Because of the nature of the resource and the population distribution in the area, the fishery would probably need to be decentralised. The main constraint to its development will be the lack of support and infrastructure services available to small fishing boats operating in remote areas. This report recommends some possible future directions to aid the development of a deep-bottom fishery in Lau.

## RÉSUMÉ

Dans le cadre de son projet de développement de la pêche au demi-large, la Commission du Pacifique Sud a, pour la deuxième fois, conduit une mission à Fidji. Cette mission s'est déroulée entre le 1er septembre 1981 et le 13 avril 1982.

Au nombre des objectifs prioritaires, figuraient l'organisation d'un programme de formation et de démonstration de pêche profonde à l'intention de pêcheurs des villages du groupe des îles de Lau et un soutien à la division des pêches de Fidji pour l'aider à mener à bien une étude des ressources halieutiques de cette même zone.

Trente-et-une sorties de pêche, de brève durée pour la plupart, ont été effectuées pendant le stage de formation auquel 60 pêcheurs locaux ont participé. Combinées, les techniques de pêche profonde et de pêche à la traîne ont permis de rapporter 2 668,6 kg de poissons au total. Une partie des prises de pêche profonde, soit 1 011,3 kg (poids des poissons entiers non éviscérés), était constituée de poissons qui n'étaient techniquement pas commercialisables (requins et *Lutjanus bohar*, l'anglais) quoique tous les requins aient été consommés. En général, les taux de prise de la pêche au fond se sont établis à 16,6 kg par heure de ligne mais n'ont plus représenté que 8,2 kg par heure de ligne en ne prenant en compte que les seuls poissons commercialisables. Ces deux taux sont élevés si on les compare à ceux obtenus dans de nombreuses autres zones du Pacifique Sud.

Ne comportant qu'un nombre limité d'habitats marins convenant aux espèces profondes, le groupe des îles de Lau n'est probablement pas très richement doté en termes absolus. Il devrait cependant être possible de mettre ces ressources en valeur, dans des proportions modestes, avec les bateaux de pêche actuellement disponibles à Fidji. Compte tenu de la nature de la ressource et de la répartition de la population dans la zone étudiée, les activités de pêche devraient sans doute être décentralisées. L'obstacle majeur sera l'insuffisance des services de soutien et d'infrastructure pour les petits bateaux pratiquant la pêche dans les zones éloignées. Plusieurs options permettant de favoriser des activités de pêche au grand fond sont suggérées dans ce rapport.

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## 1. INTRODUCTION

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

- To promote the development or expansion of artisanal fisheries throughout the region, based on fishery resources which are at present under-utilised, in particular the deep-bottom resources of the outer reef-slope;
- To develop and evaluate new simple technology, fishing gear and techniques suitable for use by village fishermen, which will enable fishermen to substantially increase catches while reducing dependence on costly imported fuels;
- To provide practical training in appropriate fishing techniques to local fishermen and government fisheries extension workers.

The Project has operated in 14 countries and territories of the SPC region since it commenced activities in 1978. This assignment was its twentieth country visit, and its second to Fiji.

The DSFD Project first visited Fiji between November 1979 and September 1980. The main aim of this earlier visit was 'to encourage bottom-fishing in the unexploited deep water along the outer reef-slopes by the use of gear and techniques used successfully in other Pacific Island countries'. The Project was based in Lautoka, in Fiji's Western District, and fishing operations were carried out in the Yasawa and Mamanuca Island groups. The catch rates obtained by the Project were high, and the report of the Project's visit gave encouraging projections of fishing economics for an enterprising fisherman (Mead, 1980).

The current Project visit followed a request from the Government of Fiji for assistance in certain areas within its programme of development for the local deep-bottom fishery. The visit was conducted mainly in the Lau island group of Fiji's Eastern Division. Its priority objectives were:

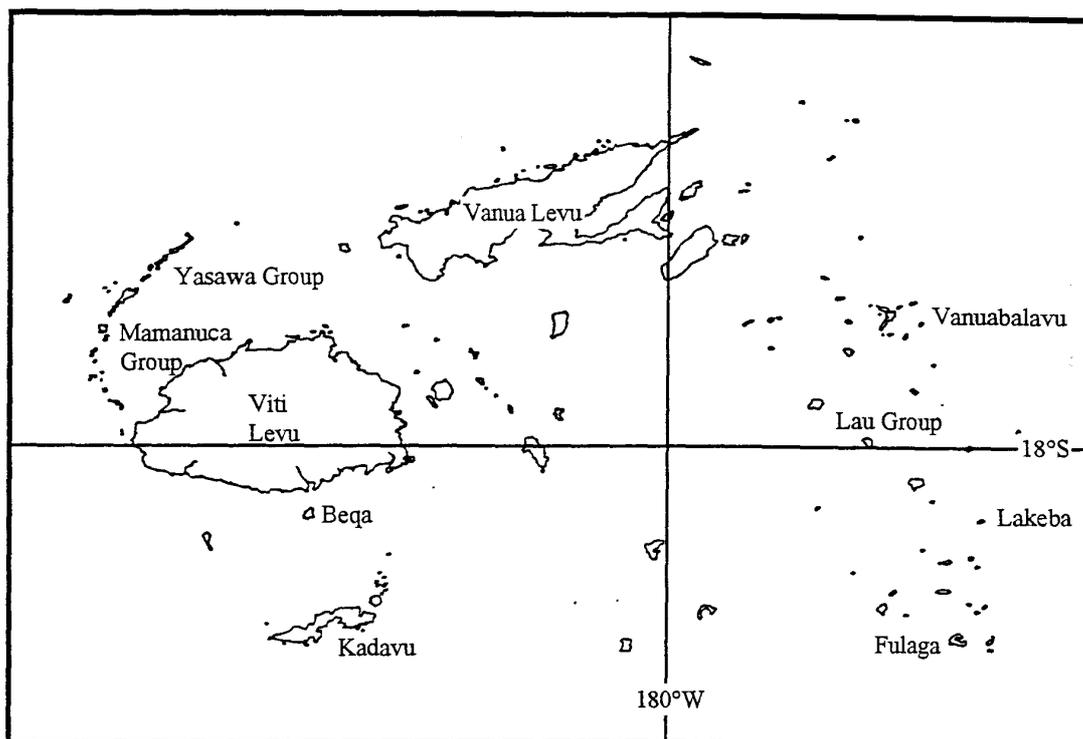
- To train selected village fishermen in deep-bottom fishing techniques;
- To conduct controlled deep-bottom fishing, for resource assessment purposes, in conjunction with the Fiji Fisheries Division.

In response to this request, one of the Project's three Masterfishermen, Paul Mead, was assigned to work in Fiji for approximately three months. The visit was broken into two parts by a period of recreation leave for the Masterfisherman. The first part of the visit ran from 1 September to 9 October 1981, and the second from 19 February to 13 April 1982.

## 2. BACKGROUND

### 2.1 General

Fiji comprises a group of over 300 islands (see Figure 1) with a total land area of some 18,376 sq km, located between 15° and 22° S latitude and 177° and 178° W longitude. Over 100 of the islands are permanently inhabited, with a population estimated by the most recent census (in 1976) to be 588,000 (Navunisaravi & Naroba, 1985). Slightly more than half the population are Indo-Fijian, descendants of the immigrant labour force indentured during British colonial rule, which ended with Fiji's independence in 1970 (Carter, 1981). About 370,000 people (63% of total population) were classed by the census as living in rural areas; of these about 14,450 were residents of the Lau group.



**Figure 1: The Fiji archipelago**

Fiji's main export product is sugar, which, together with other sugar products such as molasses, accounted for F\$ 141 million (73%) of the country's total domestic export earnings of F\$ 194 million in 1981 (Anon., 1982). Until 1975, fish was an insignificant export earner, but with the establishment of a tuna cannery and the development of a local tuna fishing fleet, production expanded rapidly and canned tuna, plus miscellaneous other fish products, now vie with gold and coconut products for the position of second-largest export earner. A total of 574, 123 cartons of canned fish valued at F\$ 11.31 million, plus 833 tonnes of frozen fish and other marine products worth F\$ 1.64 million, was exported in 1983, with a further 9,151 cartons sold locally for about F\$ 110,000. By comparison, fish imports in 1982 were valued at F\$ 8.41 million. Of this, F\$ 6.5 million worth was canned fish, mainly low value mackerel from Japan.

The Fiji group includes a wide range of island and reef types, from large, high volcanic islands to small sandy cays, and from nearshore fringing reefs to barrier reefs several miles offshore (Dahl, 1980). Fiji's 200 mile exclusive economic zone, declared in 1980, encloses an area of some 1.26 million sq km (SPC estimate).

The Lau group (Figure 2), where the major portion of the work of this Project visit was carried out, is a widely scattered group of islands and reefs lying in a generally north-south direction, in an area between 16° and 21° S latitude and 179° to 178° W longitude. The majority of the island-reef complexes of the group are made up of one or more raised limestone-type islands, usually associated with a lagoon. As many of the islands are of substantial height, it is possible, in clear weather, to navigate by line of sight through most of the group.

Within most of the lagoons of the Lau group are extensive areas of moderate depth (20–60 m). From most of the reefs and islands the outer reef-slope drops off steeply, with depths in excess of 400 m occurring within 100–200 m of the reef edge. Notable exceptions are a few areas around Vanuabalavu and Lakeba, where it is possible to fish the 200–300 m contour of the slope at distances of up to 400–600 m from the reef. Most of the slopes appear to be of rock/coral composition; typical of steeply shelving slopes associated with raised limestone islands, with limited or no mud/sand areas.

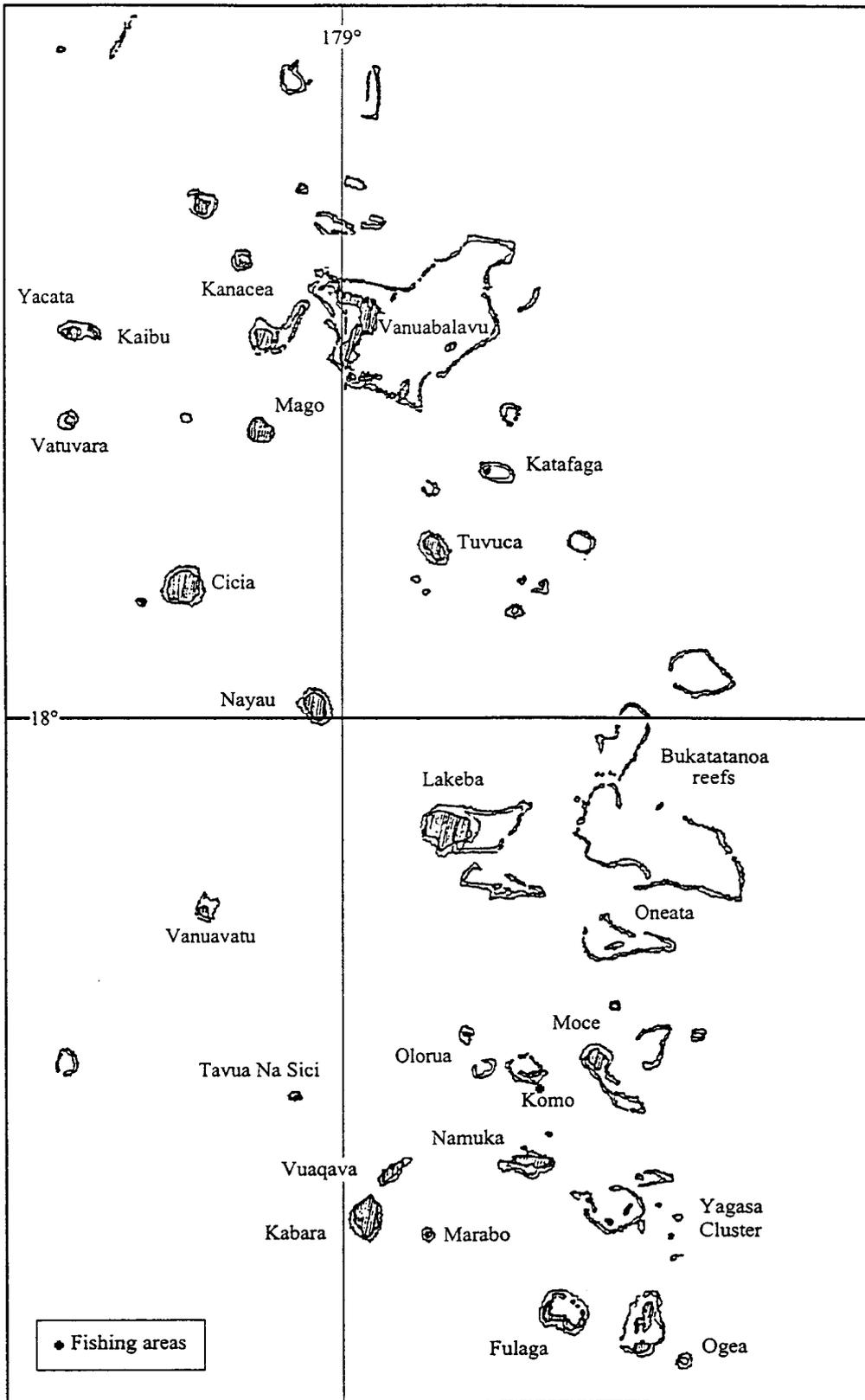


Figure 2: Islands and reefs in the Lau group

Easterly winds predominate throughout the year, with moderate SE winds and moderate to rough seas in the period June-August, and extended periods of light, variable winds during the cyclone season from November to March. Light to moderate easterly winds of 8–15 knots, with slight to moderate seas, prevailed throughout most of this Project visit. Only three fishing days were lost due to bad weather during this period. Because of the ready availability of a lee shore, small-boatfishing operations would be possible throughout the year, except for periods of extreme bad weather.

## 2.2 Fisheries

There are very few, if any, full-time fishermen in Lau. Most fishing is carried out on a part-time basis, usually inside the lagoons, and the resources of the outer reef-slopes of the group remain relatively untouched. What little fishing is practised by the Lau islanders outside the reef is limited to trolling for pelagic species such as skipjack (*Katsuwonus pelamis*) and yellowfin tuna (*Thunnus albacares*), or bottom handlining using light gear in depths which seldom exceed 60 m. Fishing activities are carried out from a variety of paddling canoes, sailing canoes, and small outboard-powered runabouts and punts 3.6–6.0 m (12–20 ft) in length.

While there is no existing deep-bottom fishery in the Lau group, the Fiji Fisheries Division has previously conducted some exploratory bottom-fishing on the outer reef-slopes. This survey was limited, both in time and in the area surveyed.

## 3. PROJECT OPERATIONS

### 3.1 General

The activities of the Project for the period 1 September 1981 to 13 April 1982 are summarised in Table 1. Throughout this period, the SPC Masterfisherman was assisted by counterpart officer Mr Semisi Naivalu (Senior Fisheries Assistant with the Fiji Fisheries Division), and operated from the 8.6 m Fisheries Division monohull, *Kacika*.

The *Kacika* was commissioned in Lautoka and motored to Vanuabalavu for the first operational phase of the project (18–30 September), during which priority was given to training activities. During the second phase (19 February–1 March 1982), which was implemented following the return of the Masterfisherman from recreation leave, the Project assisted with a comprehensive survey of the fishery resources of the Lau Islands, co-ordinated by the Fiji Fisheries Division. Throughout this period, the *Kacika* operated in conjunction with two other vessels: an 8.6 m Fisheries Division monohull, similar in construction to the *Kacika* but specially rigged for trolling, and the 20 m fisheries research vessel *Tui ni Wasabula*, which acted as mother-ship to the two monohulls. Operating with Fisheries Division personnel, limited bottomfishing was carried out around Moce, Olorua, Komo, Yaqasa and Namuka. With the return of the *Tui ni Wasabula* to Suva on 2 March, the trolling vessel continued survey activities around other islands of the Lau group, while the *Kacika* reverted to normal Project activities, with the emphasis on training local fishermen. During this latter period, the Project operated around Fulaga (2–6 March) and Lakeba (7–13 March).

In these areas, as with the earlier Project activities in Vanuabalavu, trips were usually limited to daylight hours, largely because of the lack of ice and the number of fishermen interested in receiving training in deep-bottom fishing techniques. In all these areas, the programme for a typical fishing day would be as follows:

0600–0630	Gear, boat and engine checked by SPC Masterfisherman and counterpart.
0630–1080	Pick up 3–6 trainees, from a number of different villages.
0800–1000	Steam to the fishing grounds, trolling for bait on the way.
1000–1400	Deep-bottom fishing, surveying of new areas.
1400–1800	Drop off trainees, clean up gear and boat

On March 15, the *Kacika* steamed from Lakeba to Suva. In the following two weeks, working out of Suva, six fishing trips were completed around the Suva, Beqa and Kadavu areas. The last of these, a three-day trip to northern Kadavu, using the 17.6 m fisheries extension vessel *Gonedau* as mother-ship, was particularly productive, both in terms of fish catch and in its value as a training exercise. Ten trainee fishermen (all future fishing-boat owners undertaking a six-month Fisheries Division training course), together with one of their instructors, accompanied the *Gonedau*, and all made at least one fishing trip with the SPC Masterfisherman.

**Table 1: Summary of activities**

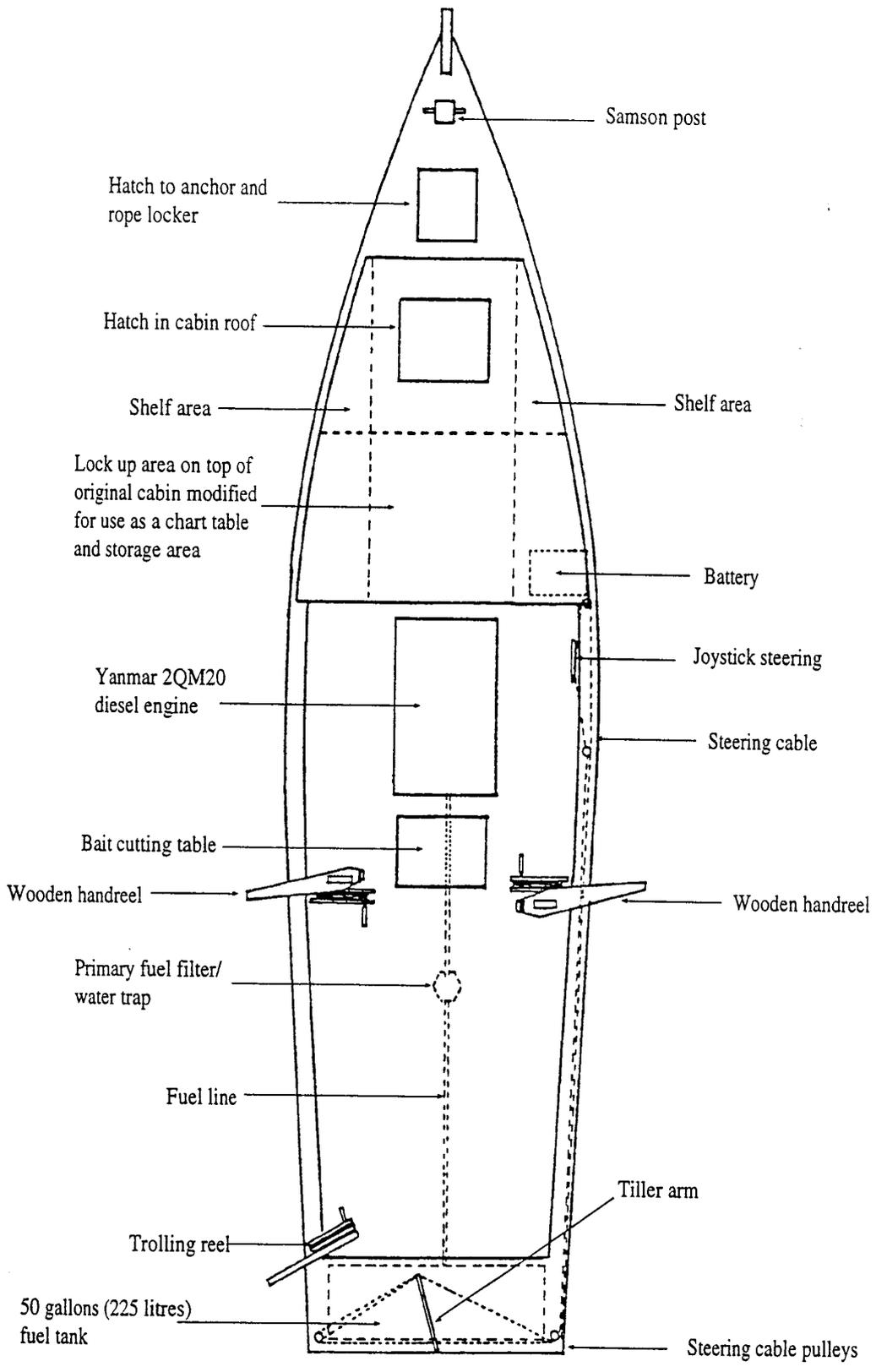
DATE	ACTIVITIES
1–17 September 1981	Modifications to project boat <i>Kacika</i> and preparation of fishing equipment
18–22 September 1981	Transit to Vanuabalavu
23–29 September 1981	Fishing and training operations in Vanuabalavu area. Trips 1–6.
29–30 September 1981	Return trip to Lautoka
1–4 October 1981	Vessel and gear maintenance
5–6 October 1981	Suva –debriefing and planning for second phase of survey
7–9 October 1981	Project administration
10 October 1981–18 February 1982	Recreation leave, SPC Masterfisherman
19 February –1 March 1982	Fishing operations in Moce, Komo, Yaqasa, Namuka, and Fulaga with other Fisheries Division vessels to assess fishery resources of Lau group. Trips 7–14.
2–6 March 1982	Fishing and training operations in Fulaga area. Trips 15–20.
7–13 March 1982	Fishing and training operations in Lakeba area. Trips 21–25.
13–14 March 1982	Return trip to Suva
15 March –5 April 1982	Based in Suva, fishing operations in Beqa, Kadavu, Suva Point. Trips 26–31.
6 April 1982	Transit to Lautoka
7–12 April 1982	Report preparation. Pack and ship equipment.
13 April 1982	Depart Fiji

### 3.2 Boat and equipment

The Fisheries Division-constructed 8.6 m (28 ft) monohull *Kacika*, a wide-beam version of the successful fishing dory designed by the Food and Agriculture Organization of the United Nations (FAO) for Western Samoa, and fitted with a 22 hp Yanmar 2QM diesel motor, was used throughout the survey. This same vessel had also been used during the 1980/81 DSFD Project visit to Fiji. During the present visit it again proved superior to the original design in a number of important respects. It was more seaworthy, had a greater carrying capacity, and was faster -though powered by the same engine.

A number of modifications, as illustrated in Figure 3, were made to the vessel to equip it for effective deepbottom fishing operations in a remote area such as the Lau group:

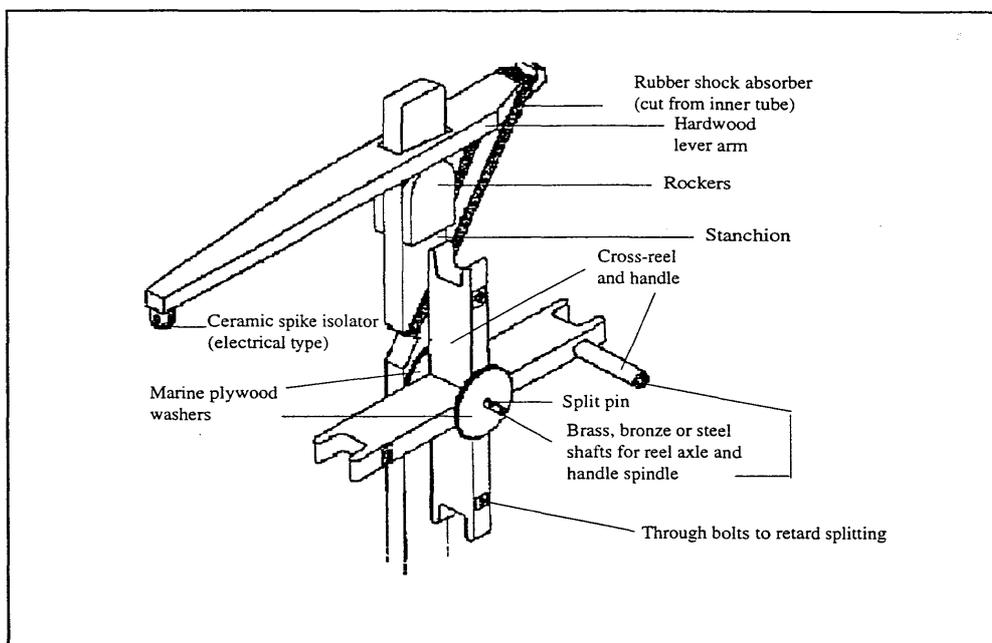
- The cabin was modified to facilitate the storage of fishing gear, provisions, etc., and an area over the original cabin was enclosed and weather-proofed for use as a work table where charts, echosounder and record books could be safely stowed.



**Figure 3: Kacika deck arrangement and modifications**

- A long-range fuel tank (225 litres [50 gallons]) was installed to replace the original tank (100 litres [20 gallons]), giving the boat a cruising range of 560 km (350 miles). This was considered essential given the large transit distances involved and the lack of refuelling facilities in many of the Lau islands.
- To minimise problems caused by dirty fuel, a primary fuel filter was installed between the tank and the engine.
- A simple 12-volt lighting system, using three 40-watt bulbs with separate switches, was wired into the engine's electrical system. The engine battery was able to power two such lights for a full night, and still start the engine the following morning. (The standard engine provided with the boat was equipped with a reliable, easy-to-use hand start system which could be used in the event of battery failure.)

Two wooden handreels (Figure 4) were installed midships on each side of the boat, and a commercially manufactured American trolling reel mounted on the stern.



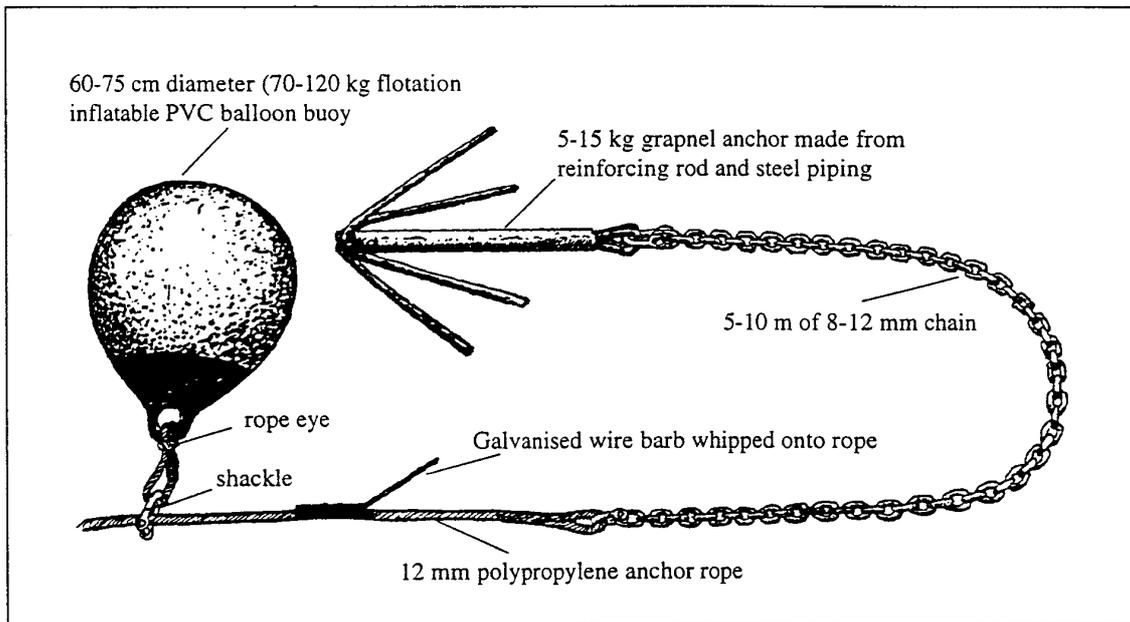
**Figure 4: The wooden handreel used by the Project**

Appropriate fishing gear for deep-bottom fishing and trolling was carried on all trips. The wooden handreels were used for bottom-fishing, after being fitted with a sinker and multiple-hook terminal rig carrying three tuna circle hooks (Figure 5). For trolling, both the wooden reels and the American reel were used, the latter fitted with 300 m of 125 kg (275 lb) test stainless steel cable. A variety of artificial lures were trolled; the most effective were found to be 8 mm or 13 mm pearl heads rigged with a small doublehook on a short trace of 20–30 kg test single-strand stainless steel wire.

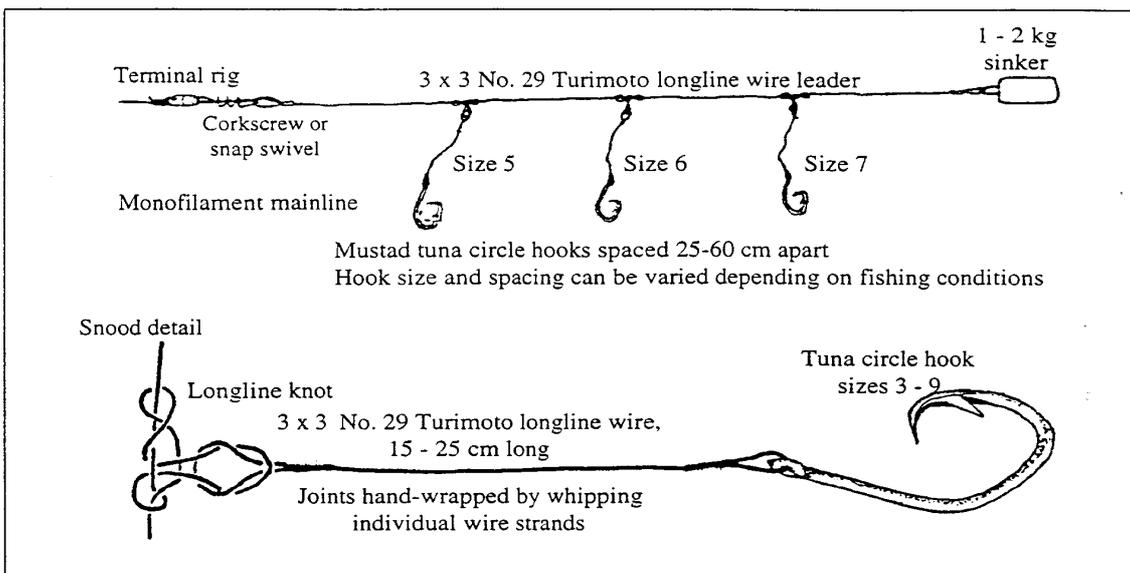
In addition, a JMC-707 portable battery-powered echo-sounder, with a range of up to 420m, was carried on all trips and was used to locate suitable depths for fishing on the outer reef-slope.

The *Kacika* was equipped with suitable anchoring gear for deep-bottom fishing as illustrated in Figure 6. This comprised: a simply constructed grapnel anchor made of four approximately 1.5 m lengths of 9 mm (3/8 in) steel bars, welded together and bent into a grapnel shape; a 5 m length of 12 mm (1/2 in) chain shackled to the anchor; approximately 440 m of polypropylene

anchor rope, of a diameter appropriate to the size of the vessel (generally 12 mm), to which a 'no-return' barb made of 4 mm diameter galvanised fence wire was whipped; and an inflatable buoy of 75 kg or greater flotation, fitted with a snap shackle or short rope eye.



**Figure 5: Typical terminal gear for bottom fishing**



**Figure 6: Anchor gear for bottom fishing**

### 3.3 Fishing techniques

Fishing methods were the same in most respects as those used successfully in other countries in which the Project has operated.

All deep-bottom fishing was carried out from an anchored position in depths from 60 to 400 m, depending on the locality, prevailing wind and sea conditions, with the main fishing effort being concentrated in the 120–240 m depth range. The boat in most instances was positioned by anchoring in relatively shallow water (20–60 m) on a bottom sloping up towards the prevailing wind. After the anchor was let go and set, anchor rope was slowly paid out until a suitable fishing depth was reached, with fishing usually starting when the boat was over the 80–100 m contour. If after 10–15 minutes no fish were landed, rope would again be paid out to increase the fishing depth by approximately 20–30 m. This process of slacking off the anchor rope

to position the boat over progressively deeper water and fishing for 10–15 minutes would continue until fish were being caught or the 350–400 m depth was reached. The most productive depth was usually the 170–200 m range. If the 350–400 m range was reached without landing fish, the anchor would be hauled, and the boat moved to a new location.

A simple method was used to retrieve the anchor after fishing (Figure 7), greatly reducing the effort involved in hauling. The anchor warp was transferred from the bow to the stem of the boat, and the boat motored slowly ahead to break out the anchor. The anchor was towed along until, aided by the buoyancy of the rope, it streamed behind the boat. Still under way, a free-running buoy was then shackled to the line. This would be forced back along the warp by the water resistance, to be trapped by the 'no-return' barb of galvanised wire whipped onto the line close to the anchor. The floating warp and the anchor, suspended by the buoy at the surface, could then be easily retrieved by hand.

Trolling was carried out on an opportunistic basis only, usually on the way to and from bottom-fishing areas. Nevertheless, it was an important part of the fishing activities, as trolled fish provided the fresh bait which is most effective for productive bottom-fishing. This was particularly the case in the Lau group, where no ice or freezer facilities were available for bait storage. On most fishing trips, sufficient bait was caught on the way to the fishing grounds for the day's bottom-fishing. Besides providing fresh bait, trolling contributed significantly to the total catch, a positive feature as most pelagic fish in the Lau area are highly regarded as food fish.

### 3.4 Training activities

Training local fishermen remained a priority task of the Project. Sixty interested fishermen, in four locations, experienced at least one fishing trip involving deep-bottom fishing techniques (Table 2). The more interested fishermen were given the opportunity of additional trips whenever possible.

**Table 2: Formal training activities**

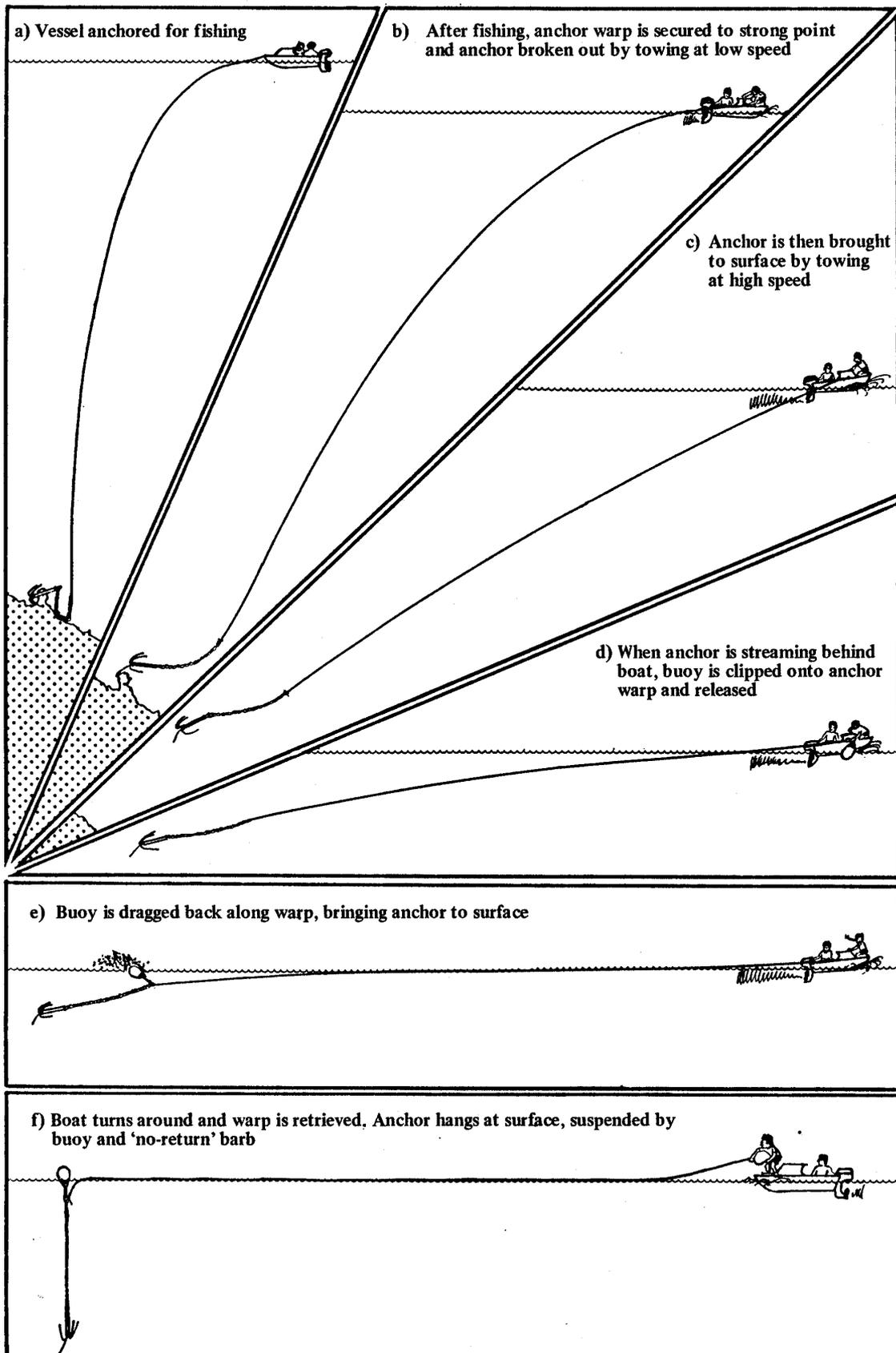
Dates	Project location	No. of trainees
18 Sept. 1981–29 Sept. 1981	Vanuabalavu	20
2 Mar. 1982 – 7 Mar. 1982	Fulaga	11
7 Mar. 1982 –13 Mar.1982	Lakeba	18
15 Mar. 1982–5 Apr. 1982	Suva, Beqa, Kadavu	11
TOTAL		60

The selection of trainees was undertaken by Fisheries Division personnel, in collaboration with local authorities and the Masterfisherman. Preference was given to people already involved in village-level fishing activities. In view of the high level of interest expressed in the training offered, it was decided to limit the intake from each village to one or two fishermen, and to cover as many villages as possible within the time available. The training programme, conducted informally under actual fishing conditions, covered general seamanship, the rigging and use of the Samoan handreel, deep-bottom fishing techniques and the safe handling of small boats at sea (see Appendix 1).

### 3.5 Handling of the catch

Ice was unavailable for most of the fishing trips carried out in the Lau group. The trips were therefore kept short to minimise deterioration of the catch. After landing, fish were kept in the shade and washed down with seawater from time to time. The fish were not gutted, but landed whole in the manner preferred by local people.

While fishing in the southern Lau group, the Masterfisherman participated in the Fiji Fisheries Division's two-week programme of exploratory fishing in the area. Normal practice was to return to the fisheries research vessel *Tui ni Wasabula*, which acted as mother-ship, at the end of each day's fishing. The catch was then gutted, gilled, and iced-down in the *Tui ni Wasabula*'s ice-holds, to be taken back to Suva at the end of the two-week period, and sold by the Fisheries Division to Fiji's National Marketing Authority (NMA).



*Figure 7: Anchor retrieval method*

For those fishing trips carried out in the Suva/Beqa/Kadavu area, ice was loaded in Suva prior to each trip, and carried in an on-board ice-box, The fish were packed whole in a slurry of ice and

seawater as soon as possible after landing, and held in this condition for the duration of the trip. Following the return to Suva, the fish were gutted and gilled prior to sale to the NMA.

Sharks were bled as soon as possible after landing to prevent urea taint to the flesh. Ideally, they were beheaded, belly-flaps and viscera removed, tails cut off, and the carcasses hung to drain for 15 to 30 minutes. Treated in this fashion (and then well iced if possible), shark flesh is a high-quality product which is readily eaten throughout the Lau group. However, since shark flesh is difficult to sell in Suva or other urban centres in Fiji, it has been classified as unmarketable in later sections of this report.

### 3.6 Data collection

SPC Masterfishermen use a standard logsheet (shown at Appendix 2) to record catch, effort and other fishing data, and make detailed notes of their daily activities and of any supplementary information required. During this Project visit, data were collected at the end of each trip and comprised: time spent travelling, anchoring and fishing; fishing area; fishing depth or depth range; number of crew; quantity and type of fishing gear, fuel and bait used; the specific identity of each fish caught, where this could be determined; and the total number and weight of each species taken by each fishing method.

Sharks were recorded by dressed weight, having been butchered immediately on capture. These figures were then converted to round (whole) weights by multiplying by a conversion factor of 2.5, which allowed for a recovery rate of about 40 per cent.

## 4. RESULTS

### 4.1 General

Thirty-one fishing trips were completed during a 13-week operational period in Fiji: 6 in the Vanuabalavu area (23–29 Sept. 1981), 19 in Central/Southern Lau (19 Feb.–13 Mar. 1982), and 6 in the Suva/Beqa/ Kadavu area (15 Mar.–5 Apr. 1982). A detailed breakdown of fishing activity by individual trip is given in Appendices 3a and 3b.

Throughout the Lau group, trips were generally of limited duration (12 hours) with fishing confined to daylight hours for operational reasons (see Section 3.1). When operating out of Suva, more extended trips were possible, and three overnight trips were made in the Suva/Beqa area.

### 4.2 Catches and catch rates

Catches and catch rates throughout the survey were very good in comparison to results obtained by the Project elsewhere in the Pacific (see Table 3). The total bottom-fishing catch was 2,258.6 kg (round weight), of which 1,011.3 kg were unsaleable. Trolling, conducted opportunistically while steaming to and from the fishing grounds, produced a further 410.1 kg. The total landed catch was therefore 2,688.7 kg, of which 1,657.4 kg were marketable, giving an average catch of 53.3 kg/trip of marketable fish.

The unmarketable catch (1,011.3 kg) consisted of the sharks (931.3 kg) and the red bass *Lutjanus bohar* (80 kg), all of which were caught bottom-fishing. Shark, properly handled (see Section 3.5), was readily eaten throughout Lau, and may eventually prove saleable, at least in this area. Red bass, also eaten and even sold in Lau, is regarded as ciguatoxic in other areas of Fiji, and is banned from sale in most municipal markets.

The overall bottom-fishing catch per unit of effort (CPUE) for the visit was 12.9 kg/reel-hour, or 7.1 kg/ reel-hour for marketable fish only. CPUE varied considerably between locations (see Section 4.3). The average catch rate in the Lau group was 8.2 kg/reel-hour, which approaches the rate of 9.3 kg/reel-hour recorded for the Western District by the 1980–81 Project visit to Fiji (Mead, 1980). The lower average catch per trip (51.5 kg/trip in Lau, as opposed to 123.5 kg/trip achieved during operations in the Western District) largely reflects the shorter duration of the fishing trips in Lau.

**Table 3: Bottom-fishing catch rates recorded by the Deep Sea Fisheries Development Project in selected Pacific Island locations**

Locality	Year	Deep bottom catch rate (kg/reel-hour)	
		Total catch	Excluding sharks
Fiji – Lau group	1981/82 (this visit)	16.6(a)	8.9
Fiji – Suva/Beqa/ Kadavu	1981/82 (this visit)	4.6(a)	4.6
Fiji – Western Division	1979/80	14.1(a)	9.3
New Caledonia (Lifou)	1979 (b)	7.5	7.2
Vanuatu	1974/75 (b)	–	3.5
Vanuatu	1978/79	2.7(c)	2.5(c)
Vanuatu	1980/81	8.2	6.5
Wallis Island	1980	9.3	8.7
Futuna Island	1980	5.6	5.2
Western Samoa	1975 (b)	–	4.1
American Samoa	1978 (b)	–	4.9
Tonga - Nuku'alofa	1978	–	3.6(d)
Tonga	1979	7.6	5.7
Tonga	1980/81	3.3(e)	3.0(e)

#### Notes

- (a) Sharks were originally recorded as dressed weights; these have been converted to whole weights by multiplying by 2.5, and the catch rates recalculated on this basis.
- (b) Crossland & Grandperrin. 1980.
- (c) Troll catches were included in the calculations presented in the published report of this visit. The values shown here have been recalculated from original catch data.
- (d) Catch rate is estimate only, and excludes *Lutjanus bohar*.
- (e) Handreel fishing only (excludes some deep-bottom fishing by handline carried out during this visit).

#### 4.3 Fishing areas

Figure 8 depicts the general areas surveyed in the Lau group, where most fishing was carried out. Appendix 3c gives catch and effort information for each locality visited and this is summarised in Table 4.

The area of Lau covered by the present survey may for convenience be divided into three island and reef groups, or complexes, with Vanuabalavu in the north, Fulaga in the south, and Lakeba centrally located. Each group comprises many separate reefs and islands, most of which feature steeply shelving outer reef slopes, extensive and largely underexploited lagoons, and numerous protected anchorages suitable for small fishing boats.

Outer reef-slopes fished in Lau were usually those sheltered from the prevailing easterly winds, which blew consistently throughout the time of the survey. Depths fished varied from 80 to 300 m, with the most productive depth in all areas being around 180 m. Around Vanuabalavu, the most productive areas for bottom-fishing were off the points of the reef along the north-western side of the island. The south-western slope of Lakeba produced the best catches from the central area, while around Fulaga, the most productive areas were the north-west point of Namuka, the southernmost tip of Yaqasa, and the western side of Ogea. The Fulaga group, as well as producing the highest catch rates in Lau, also produced some of the poorest, such as those from the western slope of Moce and the north-eastern slope of Fulaga.

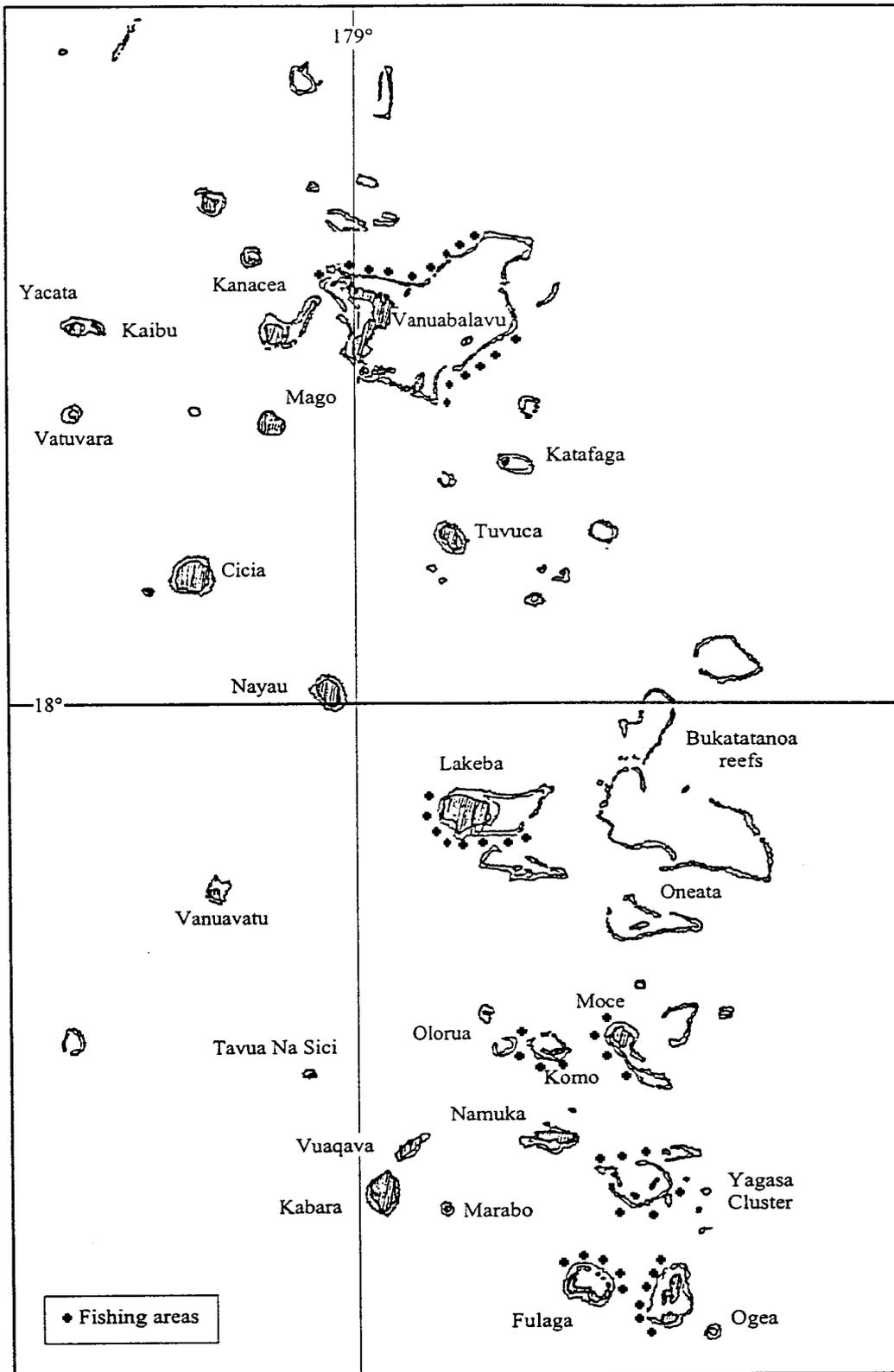


Figure 8: Fishing areas in the Lau group

**Table 4: Summary of catch and effort by area**

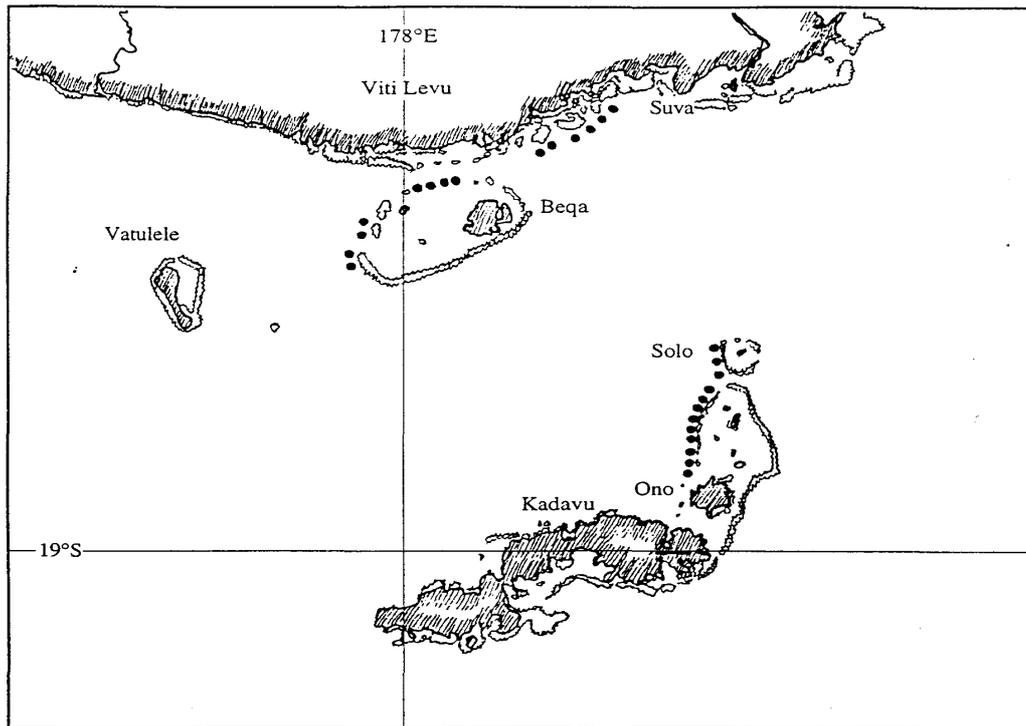
Area	Vanuabalavu	Lakeba	Southern Lau	Total Lau	Suva/Beqa/Kadavu	Total
No. of trips	6	6	13	25	6	31
<b>Deep-bottom fishing</b>						
Effort (reel-hours)	30	35	56	121	54	175
Overall catch (No.)	145	146	243	534	108	642
Overall catch (kg)	986.8	334.3	687.0	2008.1	250.5	2258.6
Overall catch rate (kg/reel-hour)	32.9	9.6	12.3	16.6	4.6	12.9
Saleable catch (No.)	124	141	232	497	108	605
Saleable catch (kg)	274.8	235.0	487.0	996.8	250.5	1247.3
Saleable catch rate (kg/reel-hour)	9.2	6.7	8.7	8.2	4.6	7.1
<b>Trolling</b>						
Effort (line-hours)	40	23	31	94	32	126
Catch (No.)	61	35	33	129	17	146
Catch (kg)	116.0	76.5	103.1	295.6	114.5	410.1
Catch rate (kg/line-hour)	2.9	3.3	3.3	3.1	3.6	3.3
<b>Total</b>						
Total catch (No.)	206	181	276	663	125	788
Total catch (kg)	1102.8	410.8	790.1	2303.7	365.0	2668.7
Total catch/trip (kg)	183.8	68.5	60.8	92.1	60.8	86.1
Saleable catch (kg)	390.8	311.5	590.1	1292.4	365.0	1657.4
Saleable catch/trip	65.1	51.9	45.4	51.7	60.8	53.5

Figure 9 shows the other areas, outside the Lau group, fished by the Project during the present survey. Of the areas fished, only Kadavu slopes produced satisfactorily productive catch rates. Fishing time was limited and it is possible that catches could improve with a working knowledge of the area. However, the lower catch rates may also be indicative of increasing fishing pressure in this area.

#### 4.4 Species composition of the catch

A total of 63 species from 10 families was recorded during the survey; of which 48 species (8 families) were caught bottom-fishing. The bottom catch composition is illustrated in Figure 10. Appendix 4 lists all species caught, with common English and Fijian names (where known), and gives details of catch (numbers and weight) by fishing method both for individual species and for families.

In terms of whole weight, sharks were the dominant group, making up 931.3 kg (estimated whole weight), or 41 per cent of the bottom catch of 2258.6 kg. Of this quantity, 675 kg, or 72 per cent of the total shark catch, was caught in the first 6 trips around Vanuabalavu, with 375 kg (40% of the shark catch) being taken on a single trip (trip number 3). It is not known whether such a high proportion of sharks could be expected in future fishing activities in the Vanuabalavu area. In the other areas fished during this Project visit, sharks made up about 20 per cent of the bottom catch. During the 1979/1980 Project visit to Fiji, the total bottom catch was 2,145 kg, of which 369 kg was dressed shark (Mead, 1980). Using a conversion factor of 2.5, the estimated whole weight of shark during that visit would have been 922.5 kg of a total of 2698.5 kg, or 34 per cent of the bottom catch.



**Figure 9: Fishing areas around Suva, Beqa and Kadavu**

Snappers (family Lutjanidae) were the second most important component of the catch, comprising 34.8 per cent of the bottom catch weight. The deep-water snappers (family Lutjanidae, sub-family Etelinae) are the main target species for deep-bottom fishing. Within this group, jobfish of the genus *Pristipomoides*, most commonly found in 'mid-range' depths of 120-220 m, dominated: the species *P. flavipinnis*, *P. multidens* and *P. filamentosus*, listed in order of importance, together made up 18.8 per cent of the bottom catch and small-toothed jobfish (*Aphareus rutilans*) 4.7 per cent. The deeper-occurring *Etelis* species, most common in depths greater than 220 m, contributed only 2.8 per cent of the catch weight, a fact largely attributable to the limited time spent fishing in these depths. *Etelis radiosus*, the most commonly taken species in Lau, has only recently been described (Anderson, 1981) and, while not recorded by the 1980-81 survey, has since been found in the Western District and appears to be widely distributed in the South Pacific.

Other fish groups or species of importance in the bottom catch were: groupers, family Serranidae (8.1%), of which the spotted-finned grouper (*Epinephelus miliaris*) comprised 2.9 per cent; emperors, family Lethrinidae (6.2%), of which the long-nosed emperor (*Lethrinus miniatus*) made up 2.2 per cent and the sweet lip emperor (*L. chrysostomus*) 1.8 per cent; dogtooth tuna (*Gymnosarda unicolor*) 4.3 per cent; red bass (*Lutjanus bohar*) 3.5 per cent, and deep-water amberjack (*Seriola rivoliana*) 2.2 per cent. Of the species caught by trolling, the double-lined mackerel (*Grammatocynus bicarinatus*) was the most important, and made up 23.6 per cent of the troll catch. Other important species were yellowfin tuna (*Thunnus albacares*) 19.9 per cent, wahoo (*Acanthocybium solandri*) 18.2 per cent, Spanish mackerel (*Scomberomorus commerson*) 8.2 per cent and skipjack (*Katsuwonus pelamis*) 7.2 per cent.

By family, the overall catch composition (including both bottom fishing and trolling) for the present survey is similar to that recorded for the Western District by the 1979-80 SPC Survey (Figure 10); the major differences are the increased importance of tuna and tuna-like species in the more oceanic Lau area and the greater contribution of trevally to catches in the Western District (a region with extensive areas of shallow reef waters). Dogtooth tuna, one of the more common species caught in Lau by both bottomfishing and trolling, was not recorded from the Western District by the earlier survey, while the great trevally (*Caranx ignobilis*), 11 per cent of the bottom catch in Western District, was uncommon in Lau (1.9%) during this visit. Also worthy of note is the restricted distribution of the sweetlip emperor (*Lethrinus chrysostomus*),

which occurred regularly in Lau, but was not taken in other areas of Fiji fished by the Project.

#### 4.5 Disposal of the catch

In Suva, and in Lau when operating with the *Tui ni Wasabula* as mother-ship, the catch was sold by the Fisheries Division to the National Marketing Authority, and thence to the public. In the Lau area, in an effort to stimulate further interest among village fishermen, most of the catch was distributed equally amongst the trainee fishermen. Small quantities were given away as *sevu sevu* or in traditional form of recognition of assistance to the Project. The return of the trainees after the day's fishing with good quantities of deep-bottom fish, many of which were previously unknown to the villagers, created considerable interest in this type of fishing.

In none of the areas of Lau fished by the Project was ciguatera fish-poisoning regarded as a problem by the villagers. Even batidamu (the red bass, *Lutjanus bohar*, a species regarded as ciguatoxic in the Western District and many other areas of Fiji, and classified as unsaleable in other sections of this report) was known and eaten regularly by the villagers. In contrast to many areas of Fiji, tuna, particularly large yellowfin, were prized eating fish.

### 5. DISCUSSION

#### 5.1 Observations

During this Project visit a number of observations were made regarding the development of local fishing activities, particularly in Lau.

Deep-bottom fishing produced very satisfactory catch rates of high-quality fish, which under certain circumstances would command high prices. Deep-bottom catches also included significant proportions of shark, which under normal circumstances would not be marketable, although considered acceptable when given away. Trolling as an incidental activity produced appreciable quantities of prime fish.

The areas fished consisted mainly of numerous small reefs and islets, which provided many safe small-boat anchorages, and sheltered areas in which fishing could be carried out in all but the worst weather. Between the islands are extensive areas of very deep water. Outer reef-slopes are often steep, and the grounds available for deep-bottom fishing are therefore probably quite limited.

The vessel used for fishing was a locally built 8.6 m (28 ft) FAO-design plywood monohull, with some modifications. The vessel proved to be a safe and reliable fishing platform, capable of fishing effectively in most of the weather conditions encountered, and able to make quite long passages within the Fiji group. The modified version would be a suitable deep-bottom fishing vessel for the Lau group.

Sixty local fishermen participated in the Project's demonstration and training programme. Most displayed interest in the deep-bottom fishing techniques, and, in the Masterfisherman's assessment, perhaps three quarters of them would have the potential to develop reasonable deep-bottom fishing skills, given the right encouragement, support, and the development of a fisheries infrastructure in the Lau area.

The lack of infrastructure is probably the most important constraint on small-scale fisheries development in the Lau group in the short term. The scattered nature of the island groups, small populations, and limited communications, all act to constrain post-harvest fisheries activities, particularly the distribution and sale of the catch. During this Project visit, the catch was given away (except when special circumstances allowed it to be transported for sale in Suva); however, if it had been necessary to sell the catch, this would have proved difficult or impossible in most of the islands visited, due to the small size of the local market—in terms of both the population and the cash resources available to local people. The two exceptions to this generalisation are Lakeba and Vanuabalavu, the Lau group's two administrative centres, where larger populations, with many individuals in employment, provide more substantial retail outlets for local fish produce. Nevertheless, only a small amount of production would be needed to satisfy local demand for fish in these centres.

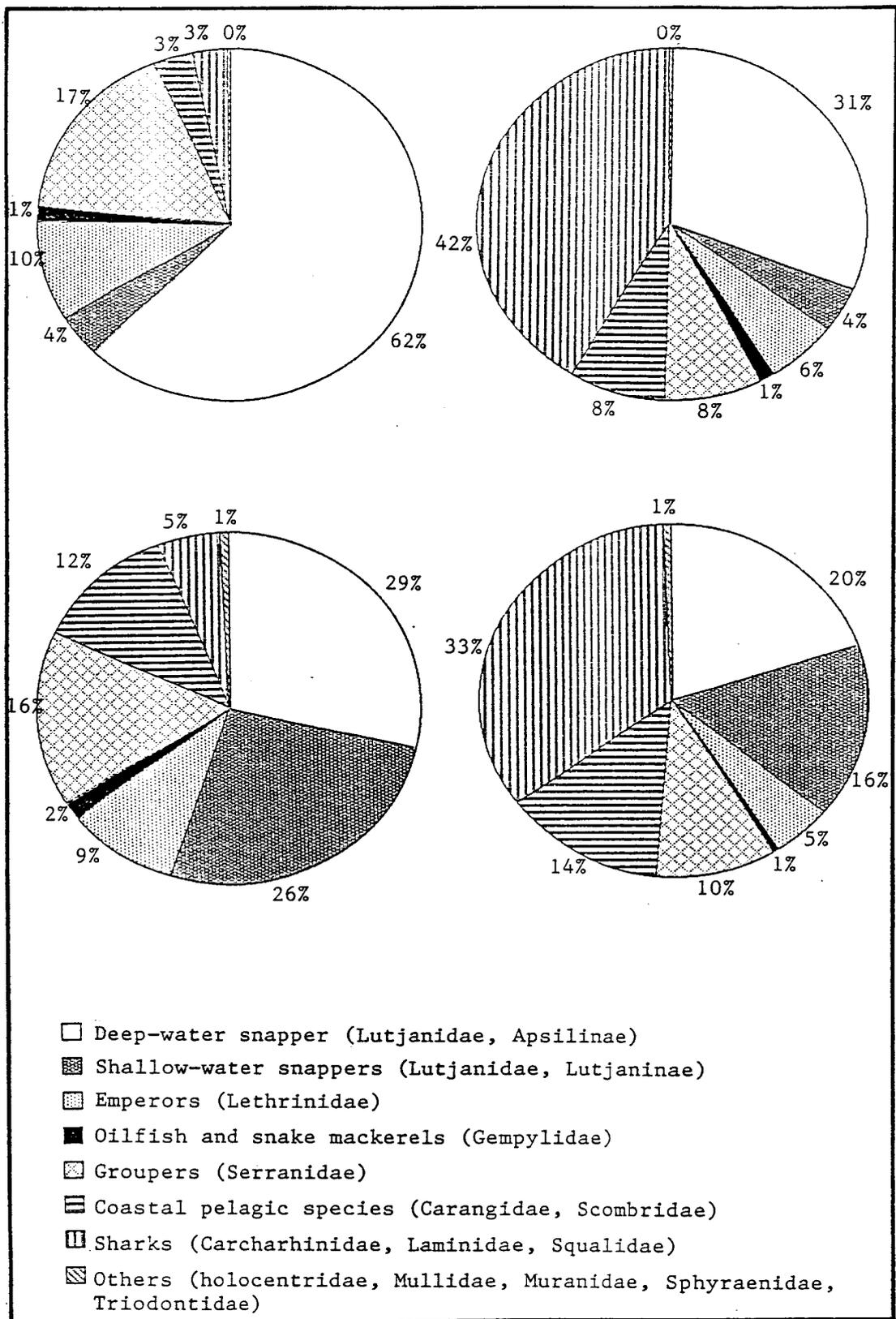


Figure 10: Species composition of the catch

## 5.2 Conclusions

It is possible to make a number of general conclusions regarding the future development of deep-bottom and other fishing activities in Lau.

- (1) The area provides a suitable environment for the development of a deep-bottom fishery, with good catch rates, grounds which are accessible in most weather conditions, and many sheltered anchorages providing safe cover.
- (2) Deep-bottom fishing grounds are scattered and limited in extent. A centralised deep-bottom fishery would therefore not be feasible. Rather, fishing effort needs to be spread, ideally by having small numbers of fishing vessels distributed throughout the group.
- (3) Local markets are limited, except perhaps at Lakeba and Vanuabalavu. The development of a decentralised fishery requires the parallel development of an infrastructure capable of reliably making available essential fishing supplies (fuel, ice, oil, engine spares, fishing tackle, etc.) and services (vessel and engine maintenance and repair), and improving fish marketing opportunities for Lau fishermen. This is likely to be the major constraint to local fisheries development.
- (4) In addition to the establishment of a fisheries support infrastructure, it will be necessary for the Fiji Government to actively foster the development of the deep-bottom fishery, presumably via the Fisheries Division. This would involve encouraging interested fishermen or fishing groups to enter the fishery. Such encouragement could include assisting in the provision of fishing vessels and equipment, organising demonstration and training programmes in all aspects of commercial fishing, vessel maintenance and business management, and providing extension, advisory and follow-up services to assist fishermen with the problems they may encounter in marketing, fish handling procedures, and carrier systems.
- (5) In the longer term, an expanding deep-bottom fishery will ultimately focus excessive fishing pressure on what can only be a limited resource. It will be necessary to prevent this by turning attention to other available resources. During this survey, trolling gave encouraging catches, which included both coastal pelagic and oceanic species, the latter being especially prized in Lau. The deployment of fish aggregation devices in areas accessible to local vessels would probably increase troll catches, increase the catch of oceanic species, provide increased fishing opportunities, and, ultimately, relieve fishing pressure on deep-bottom resources.

## 5.3 Recommendations

The following recommendations are formulated with the preceding points in mind.

- (1) The Fisheries Division, via its boatbuilding programme, should continue to make available suitable deep-bottom fishing vessels to fishermen and fishing groups in the Lau area. The 8.6 m FAO-design plywood monohull currently being produced by the Division is a suitable vessel and, in the opinion of the Masterfisherman, would be improved by these design modifications:
  - The cabin should be widened to within 75 mm (3 in) of the gunwale on either side of the boat.
  - A water trap should be installed between the fuel tank and the engine.
  - The fuel-carrying capacity should be increased to 225 litres (50 gallons) to give the vessel the range necessary to travel between the Lau group and Fiji's main islands.
  - All fuel tanks should be located in the stern of the vessel, to improve balance.
  - The vessel's working area should be increased towards the stem by reducing the width of the transom coaming, allowing easier landing of fish over the transom.
  - All steering-cable pulleys should be at least 75 mm (3 in) in diameter, particularly where the angle of the cable is smaller than 90 degrees, to prevent damage to the cable.

- The tiller arm should be detachable to prevent it interfering with fishing activities or crew movement in the working area.
  - The size of the ice-box should be increased to a capacity of 250 kg of fish and ice.
  - Greater care should be taken in the construction and mounting of the wooden handreels, particularly as regards alignment of the reel arm with the reel, the straight positioning of the reel shaft, and the use of timber of adequate strength.
- (2) The Fisheries Division should strengthen its advisory and extension programme so as to be able to carefully monitor the progress of its vessels, encourage and facilitate improved performance, and assist fishermen in identifying and overcoming problems.
  - (3) Fishing gear stores, retailing appropriate fishing and vessel supplies to local fishermen, should be established in Vanuabalavu and Lakeba. Careful consideration would need to be given to the question of whether this should be done by the Fisheries Division, the private sector, or some other arrangement.
  - (4) The Fisheries Division should investigate the feasibility of establishing a system of fish transportation from the Lau group to market centres on Fiji's main islands, particularly to Suva. This should include consideration of the various options available (institution of a dedicated collection system, use of existing sea and air transport, etc.), the requirement for onshore fish storage and processing facilities, and the institutional mechanisms for its operation. The Fisheries Division should then encourage the establishment of the system deemed to be most appropriate.
  - (5) One or more fish aggregation devices should be deployed in selected sites accessible to Lau fishermen. Initial deployments would probably be most appropriate in the vicinity of Vanuabalavu and Lakeba, with further deployments depending on the development of the local fishing fleet.

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**TOPICS COVERED IN THE PROJECT TRAINING PROGRAMME**

**1. Handling a fishing boat**

Safety at sea

Knots and splices for mooring and anchor lines Use of equipment checklist before departure Anchoring in order to fish at the right depth

Compass use

Marking of good fishing spots by landmarks or compass bearings

Simple method of anchor retrieval

Boat care and maintenance

**2. Handling equipment and fishing gear**

Personal safety during fishing operations

Use of the Western Samoan handreel

Knots and rigs for monofilament line, wire leaders and traces

Techniques for handling large fish

Operation of the echosounder

Care of gear and rust prevention

Rigging of gear in tackle-balance (appropriate matching of hooks, line and swivels)

STANDARD FORM USED FOR DATA COLLECTION

LOCATION:		Trip number:		Departure time:		Return time:		Fishing area:		Boat:		Fuel:														
										Skipper:		Amount:														
DATE	TIME	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
ENGINE HOURS																										
METHODS																										
Trolling																										
Bottom fishing																										
Handtreel																										
Handline																										
FISHING DEPTH (m)																										
CATCH RATE																										
Numbers																										
Weight (kg)																										
WEATHER																										
WIND																										
SEA																										
CURRENT																										
CREW (Names):																										
No. of trawlers:																										
BAIT																										
Type																										
Wt (kg)																										
No. of trolling lines																										
No. of handtreels																										
No. of handlines																										
FISHING EFFORT																										
REMARKS:																										
TROLL CATCHES																										
Species																										
No.																										
Wt (kg)																										
TOTALS:																										
CATCHES OTHER METHODS																										
TOTALS																										
TOTAL CATCH PER TRIP																										
No.																										
Wt (kg):																										

Appendix 3a

Trip Number	Date	Number of crew/trainees	Trip duration (hours)	Hours spent travel.	Fuel used (L.)	Hours spent fishing	Catch (No.)	Catch weight (kg)	Bait used (kg)	Locality
1	23-Sep-81	7	8	5	23	5	54	88.3	3.0	Vanuabalavu
2	24-Sep-81	5	10	7	23	4	28	240.5	4.5	Vanuabalavu
3	25-Sep-81	5	18	11	23	12	58	511.0	4.0	Vanuabalavu
4	27-Sep-81	3	6	4	14	11	19	114.0	3.0	Vanuabalavu
5	28-Sep-81	6	11	9	18	10	30	108.5	3.0	Vanuabalavu
6	29-Sep-81	5	35	34	9	2	17	40.5	3.0	Vanuabalavu
7	19-Feb-82	8	2	1	5	1	14	57.0	2.0	Lakeba
8	20-Feb-82	2	6	3	9	3	15	24.9	2.0	Moce
9	21-Feb-82	2	6	2	5	3	8	12.0	2.0	Moce
10	21-Feb-82	2	5	3	14	3	7	19.6	1.0	Olorua reef
11	22-Feb-82	2	5	4	9	2	17	43.0	2.0	Komo
12	23-Feb-82	2	4	2	14	2	21	47.0	3.0	Cakau Levu/Yaqasa
13	24-Feb-82	2	12	4	9	6	41	97.1	3.0	Yaqasa
14	28-Feb-82	1	5	1	5	4	26	50.5	3.0	Nomuka
15	1-Mar-82	2	7	7	5	2	8	26.0	0.0	Fulaga
16	2-Mar-82	5	7	4	14	3	20	93.5	3.0	Ogea
17	3-Mar-82	5	8	5	14	6	27	47.5	1.5	Ogea
18	4-Mar-82	6	10	6	14	6	18	37.5	2.5	Fulaga
19	5-Mar-82	5	12	8	14	7	43	172.5	6.0	Ogea
20	6-Mar-82	5	6	4	18	3	25	119.0	1.5	Yaqasa
21	9-Mar-82	2	9	4	14	5	41	60.0	3.0	Lakeba
22	10-Mar-82	4	11	9	36	10	45	125.5	3.0	Lakeba
23	11-Mar-82	3	3	0	1	3	30	64.0	5.0	Lakeba
24	12-Mar-82	5	8	2	9	6	31	61.5	4.0	Lakeba
25	13-Mar-82	7	8	3	9	5	20	42.8	2.0	Lakeba
26	23-Mar-82	3	16	3	14	5	18	41.0	5.0	Suva
27	24-Mar-82	3	46	17	64	18	37	69.5	6.0	Beqa
28	29-Mar-82	6	3	1	5	3	9	69.0	2.0	Kadavu
29	30-Mar-82	10	11	3	9	7	35	76.5	3.0	Kadavu
30	31-Mar-82	5	3	1	5	3	10	25.5	2.0	Kadavu
31	1-Apr-82	2	17	8	27	7	16	83.5	3.0	Suva
<b>Total</b>			<b>318</b>	<b>175</b>	<b>452</b>	<b>167</b>	<b>788</b>	<b>2668.7</b>	<b>91.0</b>	

## CATCH AND EFFORT BY TRIP

Trip No.	Location and date	Fishing method	Saleable/unsaleable	Fishing hours	Fishing effort (line-hours)	Catch No	Weight (kg)	Cpue (kg/line hour)
1	Vanuabalavu 23 Sep.81	Bottom fishing	saleable	1	2	40	65.3	32.7
		Trolling		4	8	14	23.0	2.9
		Total		5		54	88.3	
2	Vanuabalavu 24 Sep.81	Bottom fishing	saleable unsaleable total			21	44.0	11.0
					2	4	2	187.5
		Trolling		2	4	5	231.5	57.9
		Total		4		51	472.0	2.3
3	Vanuabalavu 25 Sep.81	Bottom fishing	saleable unsaleable total			22	61.5	4.4
					17	412.0	29.4	
				7	14	39	473.5	33.8
		Trolling		5	10	19	37.5	3.8
Total		12		97	984.5			
4	Vanuabalavu 27 Sep.81	Bottom fishing	saleable unsaleable total			13	33.0	8.3
					1	62.5	15.6	
				2	4	14	95.5	23.9
		Trolling		9	9	5	18.5	2.1
Total		11		33	209.5			
5	Vanuabalavu 28 Sep.81	Bottom fishing	saleable unsaleable total			15	35.0	8.8
					1	50.0	12.5	
				2	4	16	85.0	21.3
		Trolling		8	8	14	23.5	2.9
Total		10		46	193.5			
6	Vanuabalavu 29 Sep.81	Bottom fishing	saleable	1	2	13	36.0	18.0
		Trolling		1	1	4	4.5	4.5
		Total		2		17	40.5	
7	Lakeba 19 Feb. 82	Bottom fishing	saleable unsaleable total			13	17.0	17.0
					1	40.0	40.0	
				1	1	14	57.0	57.0
Total		0		14	57.0			
8	Moce 20 Feb.82	Bottom fishing	saleable	2	4	13	22.9	5.7
		Trolling		1	1	2	2.0	2.0
		Total		3		15	24.9	
9	Moce 21 Feb.82	Bottom fishing	saleable	2	4	6	9.5	2.4
		Trolling		1	1	2	2.5	2.5
		Total		3		8	12.0	
10	Olorua reef 21 Feb.82	Bottom fishing	saleable	2	4	5	14.0	3.5
		Trolling		1	2	2	5.6	2.8
		Total		3		7	19.6	

**Appendix 3b (Cont'd.)**

**CATCH AND EFFORT BY TRIP**

<b>Trip No.</b>	<b>Location and date</b>	<b>Fishing method</b>	<b>Saleable/unsaleable</b>	<b>Fishing hours</b>	<b>Fishing effort (line-hours)</b>	<b>Catch No</b>	<b>Weight (kg)</b>	<b>Cpue (kg/line hour)</b>
11	Komo 22 Feb.82	Bottom fishing	saleable	1	2	13	16.5	8.3
		Trolling		1	1	4	26.5	26.5
		Total		2		17	43.0	
12	Cakau Levu/ Yaqasa 23 Feb.82	Bottom fishing	saleable			17	26.0	6.5
			unsaleable			4	21.0	5.3
		Total	total	2	4	21	47.0	11.8
13	Yaqasa 24 Feb.82	Bottom fishing	saleable			36	80.1	16.0
			unsaleable			3	14.0	2.8
			total		5	5	39	94.1
		Trolling		1	1	2	3.0	3.0
		Total		6		80	191.2	
14	Nomuka 28 Feb.82	Bottom fishing	saleable	3	3	22	46.5	15.5
		Trolling		1	1	4	4.0	4.0
		Total		4		26	50.5	
15	Fulaga 1 Mar.82	Trolling		2	4	8	26.0	6.5
16	Ogea 2 Mar.82	Bottom fishing	saleable	2	4	17	89.5	22.4
		Trolling		1	2	3	4.0	2.0
		Total		3		20	93.5	
17	Ogea 3 Mar.82	Bottom fishing	saleable	3	6	25	35.5	5.9
		Trolling		3	6	2	12.0	2.0
		Total		6		27	47.5	
18	Fulaga 4 Mar.82	Bottom fishing	saleable	4	8	17	34.5	4.3
		Trolling		2	4	1	3.0	0.8
		Total		6		18	37.5	
19	Ogea 5 Mar.82	Bottom fishing	saleable			39	79.5	9.9
			unsaleable			2	80.0	10.0
			total		4	8	41	159.5
		Trolling		3	6	2	13.0	2.2
		Total		7		84	332.0	
20	Yaqasa 6 Mar.82	Bottom fishing	saleable			22	32.5	8.1
			unsaleable			2	85.0	21.3
			total		2	4	24	117.5
		Trolling		1	2	1	1.5	0.8
		Total		3		49	236.5	
21	Lakeba 9 Mar.82	Bottom fishing	saleable	3	6	35	51.5	8.6
		Trolling		2	3	6	8.5	2.8
		Total		5		41	60.0	

## CATCH AND EFFORT BY TRIP

Trip No.	Location and date	Fishing method	Saleable/unsaleable	Fishing hours	Fishing effort (line-hours)	Catch No	Weight (kg)	Cpue (kg/line hour)
22	Lakeba 10 Mar.82	Bottom fishing	saleable			16	22.5	5.6
			unsaleable			3	45.5	11.4
			total	2	4	19	68.0	17.0
		Trolling		8	16	26	57.5	3.6
		Total		10		64	193.5	
23	Lakeba 11 Mar.82	Bottom fishing	saleable	3	6	30	64.0	10.7
24	Lakeba 12 Mar.82	Bottom fishing	saleable	5	10	29	52.5	5.3
					1	2	2	9.0
		Total		6		31	61.5	
25	Lakeba 13 Mar.82	Bottom fishing	saleable			18	27.5	3.4
			unsaleable			1	13.8	1.7
			total	4	8	19	41.3	5.2
		Trolling		1	2	1	1.5	0.8
		Total		5		39	84.1	
26	Suva 23 Mar.82	Bottom fishing	saleable	4	8	14	24.5	3.1
					1	2	4	16.5
		Total		5		18	41.0	
27	Beqa 24 Mar.82	Bottom fishing	saleable	10	20	37	69.5	3.5
					8	16	0	0.0
		Total		18		37	69.5	
28	Kadavu 29 Mar.82	Bottom fishing	saleable	2	4	7	14.0	3.5
					1	2	2	55.0
		Total		3		9	69.0	
29	Kadavu 30 Mar.82	Bottom fishing	saleable	5	10	31	69.0	6.9
					2	4	4	7.5
		Total		7		35	76.5	
30	Kadavu 31 Mar.82	Bottom fishing	saleable	2	4	7	21.5	5.4
					1	2	3	4.0
		Total		3		10	25.5	
31	Suva 1 Apr.82	Bottom fishing	saleable	4	8	12	52.0	6.5
					3	6	4	31.5
		Total		7		16	83.5	
<b>TOTALS:</b>		<b>Bottom fishing:</b>	<b>saleable</b>			<b>605</b>	<b>1247.3</b>	<b>7.1</b>
			<b>: unsaleable</b>			<b>37</b>	<b>1011.3</b>	<b>5.8</b>
			<b>: Total</b>	<b>92</b>	<b>175</b>	<b>642</b>	<b>2258.6</b>	<b>12.9</b>
		<b>Trolling:</b>		<b>75</b>	<b>126</b>	<b>146</b>	<b>410.1</b>	<b>3.3</b>
		<b>Total</b>		<b>167</b>		<b>788</b>	<b>2668.7</b>	

Appendix 3c

CATCH AND EFFORT BY AREA

Trip number	Location	Fishing method	Saleable/ unsealable	Fishing hours	Fishing effort (line-hours)	Catch No.	weight kg	Cpue (kg/line-hour)
<b>Southern Lau</b>								
<i>YAGASA</i>								
12	Cakau Levu/ Yagasa	Bottom fishing:	saleable			17	26.0	6.5
			unsealable			4	21.0	5.3
			total	2	4	21	47.0	11.8
13	Yagasa	Bottom fishing:	saleable			36	80.1	16.0
			unsealable			3	14.0	2.8
			total	5	5	39	94.1	18.8
		Trolling:		1	1	2	3.0	3.0
		Total		6		41	97.1	
20	Yagasa	Bottom fishing:	saleable			22	32.5	8.1
			unsealable			2	85.0	21.3
			total	2	4	24	117.5	29.4
		Trolling:		1	2	1	1.5	0.8
		Total		3		25	119.0	
<i>Sub-total Yagasa</i>		Bottom fishing:	saleable			75	138.6	10.7
			unsealable			9	120.0	9.2
			total	9	13	84	258.6	19.9
		Trolling:		2	3	3	4.5	1.5
		Total		11		87	263.1	
<i>FULAGA</i>								
15	Fulaga	Trolling:		2	4	8	26.0	6.5
18	Fulaga	Bottom fishing:	saleable	4	8	17	34.5	4.3
		Trolling:		2	4	1	3.0	0.8
		Total		6		18	37.5	
<i>Sub-total Fulaga</i>		Bottom fishing:	saleable	4	8	17	34.5	4.3
		Trolling:		4	8	9	29.0	3.6
		Total		8		26	63.5	

Appendix 3c (Cont'd.)

CATCH AND EFFORT BY AREA

Trip number	Location	Fishing method	Saleable/unsealable	Fishing hours	Fishing effort (line-hours)	Catch No.	weight kg	Cpue (kg/line-hour)
<i>OLORUA / KOMO</i>								
10	Olorua reef	Bottom fishing:	saleable	2	4	5	14.0	3.5
		Trolling:		1	2	2	5.6	2.8
		Total		3		7	19.6	
11	Komo	Bottom fishing:	saleable	1	2	13	16.5	8.3
		Trolling:		1	1	4	26.5	26.5
		Total		2		17	43.0	
<i>Sub-total Olorua/Komo</i>		Bottom fishing:	saleable	3	6	18	30.5	5.1
		Trolling:		2	3	6	32.1	10.7
		Total		5		24	62.6	
<i>MOCE</i>								
8	Moce	Bottom fishing:	saleable	2	4	13	22.9	5.7
		Trolling:		1	1	2	2.0	2.0
		Total		3		15	24.9	
9	Moce	Bottom fishing:	saleable	2	4	6	9.5	2.4
		Trolling:		1	1	2	2.5	2.5
		Total		3		8	12.0	
<i>Sub-total Moce</i>		Bottom fishing:	saleable	4	8	19	32.4	4.1
		Trolling:		2	2	4	4.5	2.3
		Total		6		23	36.9	
<i>NOMUKA</i>								
14	Nomuka	Bottom fishing:	saleable	3	3	22	46.5	15.5
		Trolling:		1	1	4	4.0	4.0
<i>Sub-total Nomuka</i>		Total		4		26	50.5	
<i>OGEA</i>								
16	Ogea	Bottom fishing:	saleable	2	4	17	89.5	22.4
		Trolling:		1	2	3	4.0	2.0
		Total		3		20	93.5	

Appendix 3c (Cont'd.)

CATCH AND EFFORT BY AREA

Trip number	Location	Fishing method	Saleable/ unsealable	Fishing hours	Fishing effort (line-hours)	Catch No.	weight kg	Cpue (kg/line-hour)	
17	Ogea	Bottom fishing:	saleable	3	6	25	35.5	5.9	
		Trolling:		3	6	2	12.0	2.0	
		Total		6		27	47.5		
19	Ogea	Bottom fishing:	saleable			39	79.5	9.9	
			unsealable			2	80.0	10.0	
			total		4	8	41	159.5	19.9
		Trolling:		3	6	2	13.0	2.2	
		Total		7		43	172.5		
<i>Sub-total Ogea</i>		Bottom fishing:	saleable			81	204.5	11.4	
			unsealable			2	80.0	4.4	
			total		9	18	83	284.5	15.8
		Trolling:		7	14	7	29.0	2.1	
		Total		16		90	313.5		
<b>Sub-Total Southern Lau</b>		<b>Bottom fishing:</b>	<b>saleable</b>						
			<b>unsealable</b>						
			<b>total</b>		<b>61</b>	<b>109</b>	<b>464</b>	<b>1327.5</b>	
			<b>Trolling:</b>		<b>35</b>	<b>61</b>	<b>62</b>	<b>202.2</b>	
		<b>Total</b>		<b>96</b>	<b>170</b>	<b>526</b>	<b>1529.7</b>		
<b>Lakeba</b>									
<i>LAKEBA</i>									
7	Lakeba	Bottom fishing:	saleable			13	17.0	17.0	
			unsealable			1	40.0	40.0	
			total		1	1	14	57.0	57.0
21	Lakeba	Bottom fishing:	saleable	3	6	35	51.5	8.6	
		Trolling:		2	3	6	8.5	2.8	
		Total		5		41	60.0		

Appendix 3c (Cont'd.)

CATCH AND EFFORT BY AREA

Trip number	Location	Fishing method	Saleable/ unsealable	Fishing hours	Fishing effort (line-hours)	Catch No.	weight kg	Cpue (kg/line-hour)		
22	Lakeba	Bottom fishing:	saleable	2	4	16	22.5	5.6		
			unsealable			3	45.5	11.4		
			total			19	68.0	17.0		
		Trolling:	8	16	26	57.5	3.6			
		Total	10	45	125.5					
23	Lakeba	Bottom fishing:	saleable	3	6	30	64.0	10.7		
24	Lakeba	Bottom fishing:	saleable	5	10	29	52.5	5.3		
			Trolling:			1	2	2	9.0	4.5
			Total			6	31	61.5		
25	Lakeba	Bottom fishing:	saleable	4	8	18	27.5	3.4		
			unsealable			1	13.8	1.7		
			total			19	41.3	5.2		
		Trolling:	1	2	1	1.5	0.8			
		Total	5	20	42.8					
<b>Sub-total Lakeba</b>		<b>Bottom fishing:</b>	<b>saleable</b>	<b>28</b>	<b>35</b>	<b>141</b>	<b>235</b>			
			<b>unsealable</b>			<b>5</b>	<b>99.3</b>			
			<b>total</b>			<b>18</b>	<b>146</b>	<b>334.3</b>		
		<b>Trolling</b>	<b>12</b>	<b>23</b>	<b>35</b>	<b>76.5</b>				
		<b>Total</b>	<b>30</b>	<b>181</b>	<b>410.8</b>					
<b>Vanuabalavu</b>										
<i>VANUABALAVU</i>										
1	Vanuabalavu	Bottom fishing:	saleable	1	2	40	65.3	32.7		
			Trolling:			4	8	14	23.0	2.9
			Total			5	54	88.3		
2	Vanuabalavu	Bottom fishing:	saleable	2	4	21	44.0	11.0		
			unsealable			2	187.5	46.9		
			total			23	231.5	57.9		
		Trolling:	2	4	5	9.0	2.3			
		Total	4	28	240.5					
3	Vanuabalavu	Bottom fishing:	saleable	7	14	22	61.5	4.4		
			unsealable			17	412.0	29.4		
			total			39	473.5	33.8		
		Trolling:	5	10	19	37.5	3.8			
		Total	12	58	511					

Appendix 3c (Cont'd.)

CATCH AND EFFORT BY AREA

Trip number	Location	Fishing method	Saleable/ unsealable	Fishing hours	Fishing effort (line-hours)	Catch No.	weight kg	Cpue (kg/line-hour)
4	Vanuabalavu	Bottom fishing:	saleable			13	33.0	8.3
			unsealable			1	62.5	15.6
			total	2	4	14	95.5	23.9
		Trolling:		9	9	5	18.5	2.1
		Total		11		19	114	
5	Vanuabalavu	Bottom fishing:	saleable			15	35.0	8.8
			unsealable			1	50.0	12.5
			total	2	4	16	85.0	21.3
		Trolling:		8	8	14	23.5	2.9
		Total		10		30	108.5	
6	Vanuabalavu	Bottom fishing:	saleable	1	2	13	36.0	18.0
		Trolling:		1	1	4	4.5	4.5
		Total		2		17	40.5	
<b>Sub-total Vanuabalavu</b>		<b>Bottom fishing:</b>	<b>saleable</b>	<b>2</b>		<b>124</b>	<b>274.8</b>	
			<b>unsealable</b>			<b>21</b>	<b>712.0</b>	
			<b>total</b>	<b>15</b>	<b>30</b>	<b>145</b>	<b>986.8</b>	
		<b>Trolling</b>		<b>29</b>	<b>40</b>	<b>61</b>	<b>116</b>	
		<b>Total</b>		<b>44</b>		<b>206</b>	<b>1102.8</b>	
<b>Suva/Beqa/Kadavu</b>								
<i>SUVA</i>								
26	Suva	Bottom fishing:	saleable	4	8	14	24.5	3.1
		Trolling:		1	2	4	16.5	8.3
		Total		5		18	41.0	
31	Suva	Bottom fishing:	saleable	4	8	12	52.0	6.5
		Trolling:		3	6	4	31.5	5.3
		Total		7		16	83.5	
<i>Sub-total Suva</i>		Bottom fishing:	saleable	8	16	26	76.5	4.8
		Trolling:		4	8	8	48.0	6.0
		Total		12		34	124.5	

Appendix 3c (Cont'd.)

CATCH AND EFFORT BY AREA

Trip number	Location	Fishing method	Saleable/ unsealable	Fishing hours	Fishing effort (line-hours)	Catch No.	weight kg	Cpue (kg/line-hour)
<i>BEQA</i>								
27	Beqa	Bottom fishing:	saleable	10	20	37	69.5	3.5
		Trolling:		8	16	0	0.0	0.0
<i>Sub-total Beqa</i>		Total		18		37	69.5	
<i>KADAVU</i>								
28	Kadavu	Bottom fishing:	saleable	2	4	7	14.0	3.5
		Trolling:		1	2	2	55.0	27.5
		Total		3		9	69.0	
29	Kadavu	Bottom fishing:	saleable	5	10	31	69.0	6.9
		Trolling:		2	4	4	7.5	1.9
		Total		7		35	76.5	
30	Kadavu	Bottom fishing:	saleable	2	4	7	21.5	5.4
		Trolling:		1	2	3	4.0	2.0
		Total		3		10	25.5	
<i>Sub-total Kadavu</i>		Bottom fishing:	saleable	9	18	45	104.5	5.8
		Trolling:		4	8	9	66.5	8.3
		Total		13		54	171.0	
<b>Total Suva/Beqa/Kadavu</b>		<b>Bottom fishing:</b>	<b>saleable</b>	<b>44</b>	<b>54</b>	<b>108</b>	<b>250.5</b>	<b>4.6</b>
		<b>Trolling:</b>		<b>24</b>	<b>32</b>	<b>17</b>	<b>114.5</b>	<b>3.6</b>
		<b>Total</b>		<b>50</b>		<b>125</b>	<b>365.0</b>	
<b>GRAND TOTAL</b>		<b>Bottom fishing:</b>	<b>saleable</b>			<b>605</b>	<b>1247.3</b>	<b>7.1</b>
			<b>unsealable</b>			<b>37</b>	<b>1011.3</b>	<b>5.8</b>
			<b>total</b>	<b>92</b>	<b>175</b>	<b>642</b>	<b>2258.6</b>	<b>12.9</b>
		<b>Trolling:</b>		<b>75</b>	<b>126</b>	<b>146</b>	<b>410.1</b>	<b>3.3</b>
		<b>Total</b>		<b>167</b>		<b>788</b>	<b>2668.7</b>	

## SPECIES COMPOSITION OF THE CATCH

<b>FAMILY/Species</b>				
<b>English name Fijian name (where known)</b>	<b>Deep bottom Number</b>	<b>Fishing Weight (kg)</b>	<b>Number</b>	<b>Trolling Weight (kg)</b>
<b>BELONIDAE</b>				
Halfbeaks				
Strongylurus sp. Needlefish. Saku	-	-	1	4.0
Sub-total: BELONIDAE	-	-	1	4.0
<b>CARANGIDAE</b>				
Jacks. trevallies. runners				
Carangoides caerulopinnatus Trevally	-	-	2	3.0
Carangoides plagiotaenia Trevally Saqa drodrove	-	-	4	4.5
Caranx ignobilis Great trevally Saqa uluvatu	2	29.0	1	15.0
Caranx lugubris Black trevally	3	8.0	-	-
Caranx melampygus Bluefin trevally Saqa	-	-	11	29.8
Caranx papuensis Brassy trevally Saqa uluvatu	-	-	1	2.5
Caranx tille Horseyejack Saqa matawaiwai	1	1.5	-	-
Scomberoides lysan Queenfish	-	-	1	1.5
Seriola rivoliana Amberjack Saqa votoqa	8	50.5	-	-
Sub-total: CARANGIDAE	14	89.0	20	56.3

Appendix 4 (cont'd.)

SPECIES COMPOSITION OF THE CATCH

<b>FAMILY/Species</b>				
<b>English name Fijian name (where known)</b>	<b>Deep bottom Number</b>	<b>Fishing Weight (kg)</b>	<b>Number</b>	<b>Trolling Weight (kg)</b>
<b>CARCHARHINIDAE (Note 1)</b>				
Requiem (Whaler) sharks				
Carcharhinus albimarginatus* Silvertip reef shark	7	300.0	-	
Carcharhinus amblyrhynchos* Grey reef shark	3	122.5	-	
Carcharhinus falciformis* Silky shark	1	40.0	-	
Carcharhinus melanopterus* Blackfin reef shark	1	37.5	-	
Carcharhinus sp.* Shark	8	431.3	-	
<hr/>				
Sub-total: CARCHARHINIDAE	20	931.3	-	
<hr/>				
<b>GEMPYLIDAE</b>				
Oilfishes, snake mackerels				
Promethichthys prometheus Snake mackerel Malaka	7	13.0	-	
Ruvettus pretiosus	1	16.0	-	
Castor oil fish				
<hr/>				
Sub-total: GEMPYLIDAE	8	29.0	-	
<hr/>				

## SPECIES COMPOSITION OF THE CATCH

<b>FAMILY/Species</b>				
<b>English name Fijian name (where known)</b>	<b>Deep bottom Number</b>	<b>Fishing Weight (kg)</b>	<b>Number</b>	<b>Trolling Weight (kg)</b>
<b>LETHRINIDAE</b>				
Emperors, sea breams				
Gnathodentex mossambicus Large-eye sea bream Sabutu kula	19	31.5	-	
Gymnocranius griseus Sea bream Matuwaiwai	2	2.5	-	
Gymnocranius japonicus Pearl-eyed snapper Matuwaiwai	5	9.0	-	
Lethrinus chrysostomus Sweetlip emperor	15	41.0	-	
Lethrinus mahsena Yellow-tailed emperor Sabutu	2	1.4	-	
Lethrinus miniatus Long-nosed emperor Dokonivudi, gusula	13	50.5	-	
Lethrinus variegatus Variegated emperor Kacika badamu	3	3.5	-	
Lethrinus sp. Emperor	2	1.0	-	
Sub-total: LETHRINIDAE	61	140.4	-	-

**Appendix 4 (cont'd.)**

**SPECIES COMPOSITION OF THE CATCH**

<b>FAMILY/Species</b>				
<b>English name Fijian name (where known)</b>	<b>Deep bottom Number</b>	<b>Fishing Weight (kg)</b>	<b>Number</b>	<b>Trolling Weight (kg)</b>
<b>LUTJANIDAE (sub-family APSILINAE) (Note 2)</b>				
Paracaesio kusakarii Saddled fusilier	4	9.0	-	
Sub-total: LUTJANIDAE (APSILINAE)				
	4	9.0	-	
<b>LUTJANIDAE (Sub-family ETELINAE) (Note 2)</b>				
Deep-water snappers, jobfish				
Aphareus rutilans Small-tooth jobfish Se widri	31	106.0	-	
Aprion virescens Green jobfish Utouto	16	66.5	4	7.8
Etelis carbunculus Short-tailed red snapper Laulau sevusevu	4	13.3	-	
Etelis coruscans Ribbon-tailed red snapper Reveni	6	17.2	-	
Etelis radiosus	6	44.0	-	
Pristipomoides AMoenus Large-eye flower snapper	12	4.3	-	
Pristipomoides filAMentousus Rosy jobfish Loa bui Damu	61	81.0	-	
Pristipomoides flavipinnis Yellow jobfish Loa bui dromodromo	199	215.5	-	

## SPECIES COMPOSITION OF THE CATCH

<b>FAMILY/Species</b>				
<b>English name Fijian name (where known)</b>	<b>Deep bottom Number</b>	<b>Fishing Weight (kg)</b>	<b>Trolling Number</b>	<b>Trolling Weight (kg)</b>
Pristipomoides multidens Large-scale jobfish Loa bui vulavula	51	127.5	-	
Pristipomoides zonatus Banded flower snapper Yalayala	11	12.5	-	
Sub-total: LUTJANIDAE (ETELINAE)	397	687.8	4	7.8
<b>LUTJANIDAE (Sub-family LUTJANINAE) (Note 2)</b>				
Snappers, sea basses				
Lutjanus argentimaculatus Mangrove jack Damu	2	6.0	-	-
Lutjanus bohar* Red bass Bati damu	17	80.0	-	-
Lutjanus gibbus Paddletail Bo	2	1.5	-	
Lutjanus malabaricus Scarlet seaperch Damu rosi ni bogi	1	1.5	-	
Lutjanus russelli Moses seaperch Kake gumu	2	0.5	-	
Sub-total: LUTJANIDAE (LUTJANINAE)	24	89.5	-	

Appendix 4 (cont'd.)

SPECIES COMPOSITION OF THE CATCH

FAMILY/Species				
English name Fijian name (where known)	Deep bottom Number	Fishing Weight (kg)	Trolling Number	Trolling Weight (kg)
<b>SCOMBRIDAE</b>				
Tunas, mackerels, Spanish mackerels				
Acanthocybium solandri Wahoo	-	-	2	74.5
Euthynnus affinis Mackerel tuna	-	-	12	14.5
Grammatocynus bicarinatus Scad, double-lined Mackerel	-	-	75	97.0
Gymnosarda unicolor Dogtooth tuna	5	96.5	2	9.5
Katsuwonus pelamis Skipjack tuna Yatu	-	-	10	29.5
Scomberomorus COmmerson Spanish mackerel Walu	-	-	9	33.5
Thunnus albacares Yellowfin tuna Yatu	-	-	10	81.5
Sub-total: SCOMBRIDAE	5	96.5	120	340.5

## SPECIES COMPOSITION OF THE CATCH

FAMILY/Species				
English name Fijian name (where known)	Deep bottom Number	Fishing Weight (kg)	Trolling Number	Trolling Weight (kg)
<b>SERRANIDAE</b>				
Groupers, rock cods, coral trouts				
Cephalopholis argus Peacock rock cod	1	0.5	-	-
Cephalopholis miniatus Rock cod	3	1.0	-	-
Epinephelus areolatus Yellow-spotted grouper Kawakawa ulutomo	14	9.5	-	-
Epinephelus fuscoguttatus Flowery cod Kasala	1	1.0	-	-
Epinephelus hoedti Blue grouper Kavu	3	10.0	-	-
Epinephelus maculatus Rockcod Kawakawa ceva	5	8.0	-	-
Epinephelus magniscuttis Large-scaled grouper	2	6.5	-	-
Epinephelus microdon Marbled cod Kawakawa	3	2.0	-	-
Epinephelus miliaris Spotted-finned grouper Kawakawa	46	64.5	-	-
Epinephelus morrhua Curve-banded grouper Votoqa	15	37.0	-	-
Epinephelus sp. near tauvina Grouper	3	29.5	-	-
Plectropomus leopardus Blue-spot coral trout Donu	1	5.0	-	-

Appendix 4 (cont'd.)

SPECIES COMPOSITION OF THE CATCH

<b>FAMILY/Species</b>				
<b>English name Fijian name (where known)</b>	<b>Deep bottom Number</b>	<b>Fishing Weight (kg)</b>	<b>Trolling Number</b>	<b>Weight (kg)</b>
Variola louti Lunar-tail cod Donu	11	8.6	-	-
Sub-total: SERRANIDAE	108	183.1	-	-
<b>SPHYRAENIDAE</b>				
Barracudas, seapikes				
Sphyaena barracuda Great barracuda Ogo	-	-	1	2.0
Sub-total: SPHYRAENIDAE	-	-	1	2.0
<b>TRIODONTIDAE</b>				
Three-toothed puffer fishes				
Triodon bursarius	1	3.0	-	-
Sub-total: TRIODONTIDAE	1	3.0	-	-
TOTAL:	642	2258.6	146	410.1
*Unsaleable	37	1011.5	0	0.0

Notes: 1. Shark weights were recorded dressed. Whole weights were estimated by multiplying by 2.5.  
2. Classification of Lutjanidae follows Johnson, 1980.