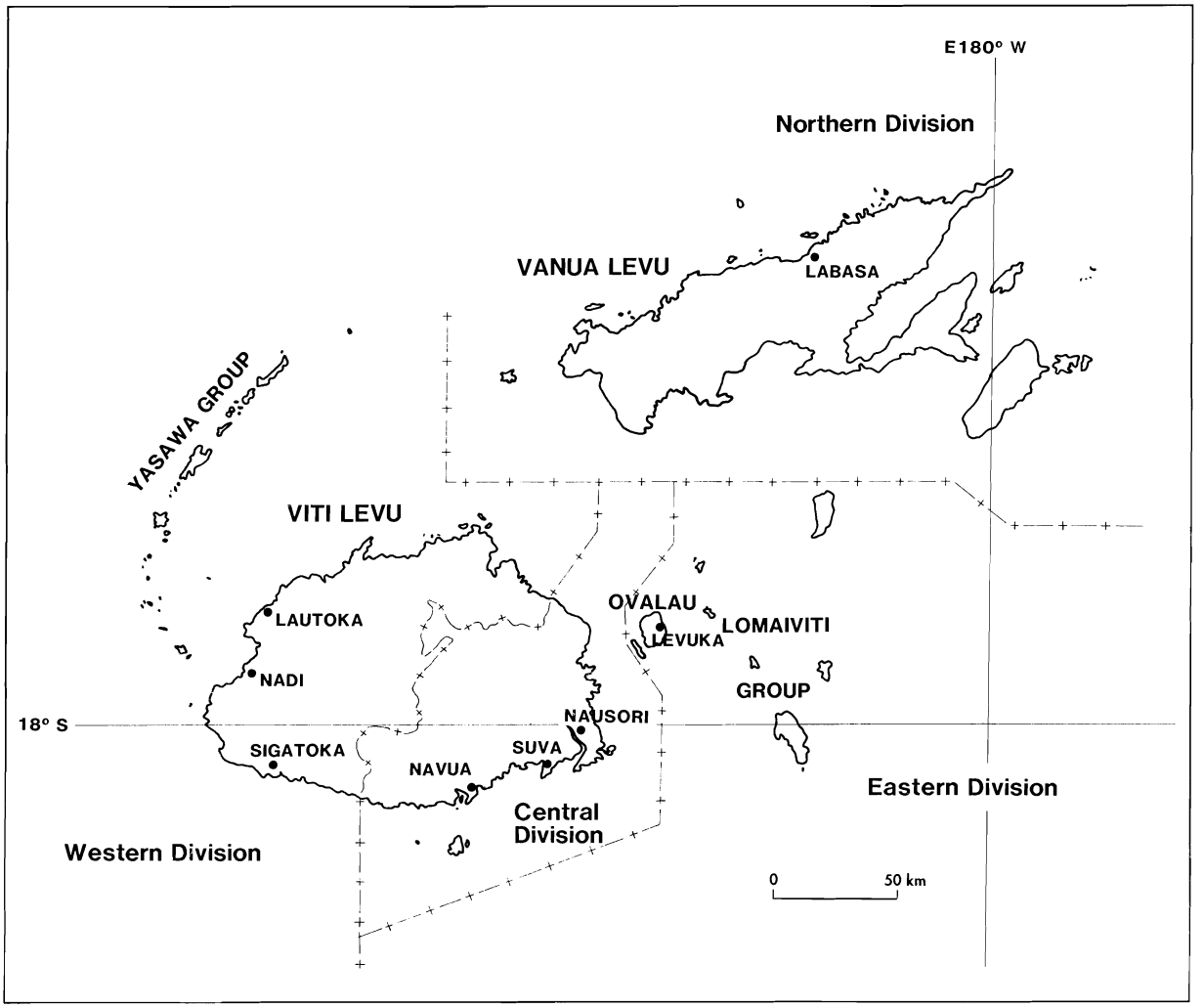
A Survey of the Subsistence and Artisanal Fisheries in Rural Areas of Viti Levu, Fiji



Map of Fiji showing central, western, northern, and eastern divisions

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N.J.F. Rawlinson, D.A. Milton,
S.J.M. Blaber, A. Sesewa, and S.P. Sharma

Fisheries Division, Ministry of Agriculture, Forestry and Fisheries, Suva, Fiji
Division of Fisheries, CSIRO, Cleveland, Australia

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Authors

N.J.F. Rawlinson

CSIRO Division of Fisheries, Marine Laboratories, P.O. Box 120, Cleveland, Queensland 4163, Australia.

D.A. Milton

CSIRO Division of Fisheries, Marine Laboratories, P.O. Box 120, Cleveland, Queensland 4163, Australia.

S.J.M. Blaber

CSIRO Division of Fisheries, Marine Laboratories, P.O. Box 120, Cleveland, Queensland 4163, Australia.

A. Sesewa

Fisheries Division, Ministry of Agriculture, Fisheries and Forestry, P.O. Box 358, Lami, Fiji.

S.P. Sharma

Fisheries Division, Ministry of Agriculture, Fisheries and Forestry, P.O. Box 358, Lami, Fiji.

Summary

The catch from the subsistence fishery makes a significant contribution to the Fijian economy. In 1992, the estimated catch from the subsistence fishery was 16,400 t (Anon. 1992). This estimate was calculated using a figure of 14,000 t based on a survey undertaken in 1978 with the addition of 200 t/year to cover population growth. There was some concern that this figure may not accurately reflect the current catch from the subsistence fishery in Fiji; consequently a detailed survey of the rural population of Viti Levu was undertaken between June and October 1993. The survey was undertaken collaboratively by staff from the Fisheries Division of Fiji and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) of Australia and funded by ACIAR.

The main aims of the survey were to:

(a) study the subsistence fishery in Viti Levu by expanding on the scope of related work undertaken during the Baitfish Research Project;

(b) make a quantitative estimate of catches taken in the subsistence fishery (including consumption levels); and

(c) refine and develop a technique for documenting and estimating the catches from the subsistence fishery that could be used by the Fisheries Division of Fiji on a regular basis after appropriate training of Fisheries Division staff.

The fishing activities of the rural population of Viti Levu were assessed using a combination of questionnaire, creel and fish consumption surveys.

The selection of sites to carry out the questionnaire survey was achieved by using data compiled from the 1986 Population Census of Fiji (Anon. 1989). The enumeration boundaries were used to assign each village and settlement to one of four strata based on their distance from the coast. One hundred and fifty villages/settlements were randomly selected, taking into consideration the population distribution across Viti Levu and the number of sites in each strata.

The majority (45%) of rural households are situated more than 5 km from the coast. Most *coastal* rural communities were Fijian. Indian communities tended to be situated further inland.

By the end of the survey 123 villages/settlements were visited and 2,252 households had been interviewed representing 13,220 people with an average of 5.87 people/house. 64.6% of the households were Indian, 34.6% Fijian and 0.8% were other races. The overall coverage of both the rural population of Viti Levu and households was about 4.4%. The coverage of coastal locations was more complete than for inland areas.

The following were the major findings from the questionnaire survey.

- 16% of households sold marine products for income with 8.8% of household reporting this activity as their major source of income and 4.4% as their only source of income. The proportion of Fijian households (36.7%) selling marine products was higher than Indian households (5.2%). Households in coastal locations were more actively involved in selling marine products than those inland.

- 70.7% of households selling marine products carried out this activity on a regular basis (more than once per week).

- Fresh fish was the main product sold, followed by shellfish and shells.

- 50.4% of all households interviewed reported having at least one member who went fishing. 86.8% of Fijian and 30.9% of Indian households reported having members who went fishing.

- Of the households reported fishing, 68.2% were classified as subsistence, 31.4% artisanal and 0.4% were commercial. Fijian households were 57.6% subsistence and 41.8% artisanal and Indian households were 84.4% subsistence and 15.8% artisanal.

- Artisanal fishing activities are more important for households situated in coastal locations whereas subsistence fishing activities are more important inland.
- 15.0% of the population sampled undertook some fishing activity. As a proportion of their total numbers, Fijian adult females (45.3%) were the most active fishing group whereas Indian adult females (1.9%) undertook the least fishing. Fijian (38.1%) and Indian (23.6%) males were the next most active groups. Children under 16 years of age generally undertook little fishing activity.
- Households most commonly reported undertaking 1 to 2 fishing trips per week.
- Handline fishing was the predominant method used and was more than twice as important as any of the other methods. Other methods commonly used were the use of push nets, spear fishing and collection.
- The most important habitat areas for fishing were estuaries and rivers, followed by lagoonal and mangrove areas.
- Handlines were the most commonly owned fishing gear with 31.4% of households owning an average of 4 handlines each. Push nets were owned by 9.5% of households. Fijian households owned more spear fishing equipment than Indian households. Indian households owned significantly more gill nets than Fijians.
- 99.3% of households consumed marine products at least once per week. Fijian households generally consumed marine products more regularly than Indian. Coastal communities consumed marine products more regularly than those inland.
- For Fijian households their own catch was the major source of the marine products consumed. For Indian households the purchase of marine products was their most important source.

A creel survey was made at four of the villages visited during the course of the questionnaire survey. The catch and effort of fishing activities at the villages of Votua, Namuaimada, Ucunivanua and Namatakula were monitored over a one-week period.

A total of 123 fishing trips was recorded representing an effort of 1,522.25 fisher hours. The catch was recorded for 118 of these trips and consisted of 7,177 organisms weighing 1,683 kg from 191 taxa.

The major findings from the creel survey were as follows:

- *Coastal* Fijian communities concentrate their fishing effort in areas adjacent to their villages. 60% of the observed fishing effort recorded during the creel survey took place in 'lagoonal' habitats. Fishing from along the shoreline was a common practice. The relative importance of mangroves areas, rivers and estuaries reported in the questionnaires was not reflected in the creel surveys due to the coastal location of the sites selected.
- From observations, invertebrates were more important than fish in artisanal catches (accounting for 72% by weight). They also contribute almost half of the subsistence catch.
- The sizes of the individual catch items taken for sale are generally larger than those taken for consumption. Some of the catch items taken in the subsistence fishery are extremely small and well under recommended size limits.
- During the creel survey the catch rate from all areas using all methods was 1.13 kg/person/hour. This varied from a low of 0.41 kg/person/hour from mangrove areas to a high of 1.52 kg/person/hour from lagoonal areas. The methods of collection and gillnetting produced the highest catch rates.
- Women expended more than half the fishing effort observed during the creel survey. Their efforts were concentrated in rivers and lagoonal areas. Most of the fishing effort (69%) carried out by males was targeted towards catching fish and invertebrates for sale.
- The main activity of artisanal fishers is to catch/collect aquatic products for sale, but anything taken that is not suitable for the market will be consumed at home.

At the villages used for the creel surveys, fish consumption surveys were also carried out. A form to record the amount of marine products and tinned fish consumed at each meal was distributed to as many households as possible. The surveys were most successful at Namuaimada and Namatakula and information was collected from 50 households representing a total of 310 household days and 943 different meals.

Marine products and tinned fish were consumed at 65% of the meals, primarily at midday and in the

evening. The consumption rate of fish products was 187 g/person/day (or 68.2 kg/person/year). There was close agreement in the species and size composition of the samples in the creel and fish consumption surveys.

Consumption rates calculated from the creel survey data varied from a minimum of 89 g/person/day (or 32.5 kg/person/year) to a maximum of 113 g/person/day (or 41.2 kg/person/year) from the four villages sampled.

The validity of using a questionnaire survey to sample the subsistence fishery was tested by comparing the results obtained using this technique with the information collected while monitoring the catch and effort of fishing activities from the four villages used for the creel surveys.

The following major points emerged from these comparisons.

- Observed effort from the creel surveys was lower than the effort reported from the questionnaires. This was due to the inability to monitor all the fishing activities that took place. The questionnaire data produced an accurate estimate of the observed fishing effort after the under-reporting had been taken into consideration.
- The mean observed length of fishing trips was different at each village and this was reflected in the questionnaire results.
- For the most important fishing habitat areas used at each village the reported ranking from the questionnaire followed closely those observed during the creel survey.
- Results from the questionnaire survey generally gave a good indication of the methods that were actually observed.
- At all sites there was significant correlation between the observed and reported target species in the catch.

Comparison of the results of this survey with a similar one in the outer islands of Fiji shows that the level of fishing activity in the outer islands is higher than in coastal communities on Viti Levu.

The results of the creel and questionnaire surveys can be combined to provide estimates of the importance of subsistence and artisanal fisheries to the economy of Fiji.

- The estimated total annual subsistence catch by *coastal* Fijians on Viti Levu was 470 t.
- The estimated annual artisanal catch by *coastal* Fijians on Viti Levu was 2,767 t which is worth FJD7.2 million[1] (@ FJD2.60/kg). This corresponds to an average weekly income of FJD34.15/household.

Applying the catch rates recorded from the coastal villages, the total catch made by subsistence fishers from rural Viti Levu would be 3,515 t and the artisanal catch would be 6,206 t. The estimated artisanal catches from this survey are higher than those currently evaluated by Fisheries Division. Although the artisanal fishery produces a larger catch than the subsistence fishery, the number of people involved in subsistence activities is higher.

[1] 1 FJD = Fiji dollar. As at January 1995, ca FJD1.33 = US$1

1. Introduction

Subsistence fishing is an important aspect of the socioeconomics of many village communities in the Pacific, but has received relatively little attention as it does not contribute directly to the economy in terms of measurable cash flow (Anon. 1979).

The Fisheries Division of Fiji conducted a Subsistence Fishery Survey in 1978. Before the survey, very little was known of the scope and magnitude of subsistence level fishing activities within the country.

The main aims of the 1978 survey were:

a) to improve the accuracy of previous estimates of Fiji's national annual fish catch;

b) to obtain an indication of recent trends in subsistence catch and effort; and

c) to obtain some idea of the relative importance of scale fish, crustaceans, molluscs, and other edible marine organisms to the subsistence fishery.

The results from this survey indicated that the annual estimated landings from the subsistence fishery in Fiji were about 14,000 t. Since then, Fiji Fisheries Division has increased this figure by an annual increment of 200 t to allow for population growth. The estimated catch from the subsistence fishery in Fiji in 1992 was 16,400 t (Anon. 1992).

Although the 1978 survey provided much improved data on the subsistence catch of finfish, it was limited in scope and suffered from some consequent problems (Anon. 1986). Principal among these was that only one respondent in each village was interviewed and the survey was thus based on one person's ability to recall or estimate landings over the preceding 12 months. Villages were not stratified by size, and extrapolation was made on a per village basis and not per capita. A breakdown of the catch by species was not reported.

The survey took place during two different periods and extrapolation from each subsample resulted in two widely different estimates of total production (Anon. 1986).

A) Involvement of CSIRO/ACIAR

In 1991, a collaborative research project was initiated between the Fisheries Division of Fiji and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) of Australia, and funded by ACIAR. One objective of this project was to assess the impact of commercial baitfishing by pole-and-line fishing vessels on the subsistence and artisanal fisheries in Fiji (Blaber et al. 1994). In order to achieve this it was necessary to collect information on the coastal fisheries where baitfishing was carried out. A questionnaire survey was designed and implemented at a number of these locations (Rawlinson and Sesewa 1994).

The results of this questionnaire survey produced baseline information at certain locations on the subsistence and artisanal fisheries. These fisheries are of particular interest to Fisheries Division as many people are involved in, and rely upon them. Although Fisheries Division regularly collects data on the amount of marine products passing through different market outlets, giving an assessment of the catches from the artisanal fishery, there had been few data collected since 1978 on the subsistence fishery.

In order to address this situation and to capitalise on the questionnaire survey technique developed during the course of the Baitfish Research Project, Fisheries Division approached ACIAR and CSIRO to assist them to collect data to assess the subsistence fishery in Fiji. As the acquisition of accurate data on this fishery was given a high priority, the Division was willing to commit personnel and resources to the project. A separate project was initiated in July 1994 for a period of six months, continuing the collaboration between Fisheries Division, ACIAR, and CSIRO, to assess the subsistence fishery within Fiji.

B) Definitions

The definitions used within this report are as follows:

a) Subsistence fishers — People who reported predominantly consuming all of their catch or giving it away, but not selling the catch.

b) Artisanal fishers — People who reported predominantly selling part of their catch but also retaining part of it for their own consumption. This was not necessarily the case for every trip but included the selling of their catch from a subset of the total fishing trips that are undertaken e.g. seasonally targeting for commercially important taxa.

c) Commercial fishers — People who reported predominantly selling all of their catch from all of the trips undertaken.

C) Objectives

The project had the following objectives:

a) To expand on the scope of the survey undertaken during the Baitfish Research Project in order to optimise the collection of information about the subsistence fishery in Fiji.

b) To collect data on the catches made in the subsistence fishery (including consumption levels) in order to make a quantitative estimate of the catches from the subsistence fishery.

c) To refine and develop a technique for documenting and estimating catches from the subsistence fishery that could be used by the Division on a regular basis, with appropriate training of Fisheries Division staff.

As only six months were available to carry out the work and due to logistical problems for travelling around the islands of Fiji, the survey was limited to the main island of Viti Levu. Three methods were used to collect data about the subsistence fishery:

1. Questionnaire Survey — Interviews of a subsample of the rural population concerning their fishing activities.

2. Creel Survey — Observation of fishing activities and monitoring the catches of fishers.

3. Fish Consumption Survey — Recording the daily consumption of marine products from selected households.

The objectives were achieved by collecting data on:

a) The importance of the sale of marine products as a source of income.

b) The frequency of fishing activities and the average length of the fishing trips.

c) The main fishing techniques being used and the people who are using them.

d) The main habitat areas for fishing.

e) The potential fishing power of families based on establishing their fishing assets.

f) A list of marine products that are being utilised including the main fish groups.

g) The frequency of fish consumption by household groups.

2. Methods

A) Questionnaire Survey

i) Design of questionnaire form

Munro and Fakahau (1993) stated that a well-executed sample survey carried out over a full year should:

(a) give an inventory of the fishing grounds based on their natural ecological characteristics, not on arbitrary boundaries;

(b) produce an estimate of the total tonnage of fish caught, broken down by principal species, fishing gears and areas;

(c) provide an inventory of all fishing boats and fishing gears;

(d) give estimates of the numbers of:

(i) full-time or part-time artisanal (= commercial) fishermen, and

(ii) subsistence fishermen (who are always part-time even though they might be specialists within their village);

(e) show the basic seasonal trends in the fishery.

A questionnaire form was designed to extract the above information from the respondents to the interview. It was considered that asking people to estimate their total catch of fish would have many inherent inaccuracies and so were estimated separately.

The final form used for the questionnaire survey followed very closely that used in Solomon Islands by Leqata et al. (1990) and during the Baitfish Research Project in Fiji by Rawlinson and Sesewa (1994). The actual questionnaire form used during the survey of Viti Levu is Appendix 2 of the Field Manual for the subsistence fisheries questionnaire survey of Viti Levu (Attachment A).

ii) Selection of sites

The number of households interviewed was dependent on the time available and the cost. Taking time and cost into consideration, the target sample size was set at 3,000 households in order to achieve interviews of approximately 2,500 households. Previous questionnaire surveys have shown that final returns are usually about 80% of the target sample size (S. Kincaid, pers comm.).

A list of Fijian villages and Indian settlements was compiled from the 1986 Population Census of Fiji (Anon. 1989). Only those villages and areas of Viti Levu that were defined as rural by the Bureau of Statistics were included in the list. The list included the number of households and population by ethnic groups (Fijian, Indian and Others) for each village and settlement. The villages and settlements were grouped by the various provinces and 'tikinas' (districts) of the island of Viti Levu. Urban areas were excluded as a different approach and more time would be required to properly sample the fishing activities of people living in these areas. Subsistence fishing activities are more important for people in the rural areas than those in the towns. However, people living in urban areas also go fishing (Beeching 1993); this should be taken into consideration when estimating total catches made in the subsistence fishery. It was not possible to provide estimates of this sector in this study.

Each village and settlement was allocated a stratum number determined by its distance away from the coast. Four strata were identified:

Stratum 10 — 0 to 0.5 km from the coast.

Stratum 20 — 0.5 to 1 km from the coast.

Stratum 30 — 1 to 5 km from the coast.

Stratum 40 — Greater than 5 km from the coast.

Maps at the Bureau of Statistics which define the enumeration boundaries for each village and settlement during the 1986 census were used to designate a stratum number to most of the villages and settlements. Some of the households in the census were not part of a village or settlement and were categorised as 'In Other Localities'. This refers to individual homesteads, which could not be individually located on the maps and could not be placed in a stratum. These were categorised as 'Others'.

After extracting all the relevant data from the 1986 population census, the following summaries were generated:

Total population for Viti Levu	533,811
Total number of houses for Viti Levu	93,402
Total number of villages/settlements for Viti Levu	1,103
Rural population for Viti Levu	279,449
Number of rural houses for Viti Levu	48,099
Number of rural villages/settlements for Viti Levu	926

The numbers of villages, houses and people in each stratum are shown in Table 1.

Table 1. The number of villages, houses and people living in each stratum on Viti Levu (HH = Households).

Stratum	10	20	30	40	Other
Villages	168	88	158	458	54
Houses	6,165	6,063	9,566	21,526	4,779
People	34,751	33,801	54,821	127,033	29,043
HH/Stratum (%)	12.8	12.6	19.9	44.8	9.9

iii) Household sampling strategy

In order to minimise the variance of the estimate of the overall number of households involved in fishing, n_S samples were assigned to stratum s. If N is the total number of samples collected ($\Sigma n_S = N$), n_S will be proportional to $N_S \sqrt{\{P_S(1-P_S)\}}$ (see Cochran 1977) where N_S is the number of houses in stratum s and P_S is the corresponding proportion in that stratum.

To apply this approach it was necessary to estimate the probability that people in each stratum were fishing. In another questionnaire survey based on Fijian coastal villages, Rawlinson and Sesewa (1994) showed that 97% of the households were involved in some form of fishing.

On Viti Levu it was estimated that 90% of Fijian households and 50% of Indian households (K. Swamy, pers comm.) would be involved in fishing. Therefore, for each stratum the number of Fijian and Indian households was multiplied by the corresponding probability of being involved in fishing; these figures were summed and divided by the total population in the stratum to estimate the overall probability of households in each stratum being involved in fishing (p).

Using a sample size of 3,000 households and the above information the number of houses to be interviewed by stratum (n_S) was calculated (see Table 2).

iv) Selection of villages and settlements

There are 34 tikinas listed in the 1986 population census within the seven provinces of Viti Levu (Anon. 1989). It was important to base the selection of the villages/settlements to be sampled on the relative population density across the island of Viti Levu. The number of households to be surveyed in each stratum area within each 'tikina' was calculated according to the number of households within each of these areas as a proportion of the total number of houses per stratum. This factor was used to assign the total number of interviews calculated per stratum (Table 2) among the tikinas in each stratum.

Table 2. Number of houses to be interviewed by stratum calculated using the formulae of Cochran (1977).

Stratum (s)	10	20	30	40
Houses	6,615	6,063	9,566	21,536
Probability (p)	0.8	0.6	0.4	0.5
Proportion (P_S)	2,466	2,971	4,687	10,768
Interviews (n_S)	355	425	675	1,545

In order to determine how many villages/settlements were to be visited the number of interviews per tikina by stratum was divided by the number of households to be visited in each village/settlement (20).

In many cases this division was not a whole number. Figures with a remainder less than one half were rounded down and those greater than one half were rounded up. This meant that overall there were more than the 150 villages/settlements on the final list of sites to be sampled.

Village/settlements were randomly selected from a list of all the different sites in each stratum in each tikina. A list of all the villages/settlements that were selected is given in Attachment B.

Example

Ba Province is comprised of seven tikinas, one of which is also named Ba. The boundaries of Ba tikina stretch across four strata. The number of households within each stratum of Ba tikina is as follows:

Stratum 10:	610
Stratum 20:	752
Stratum 30:	811
Stratum 40:	3,216

If these numbers are divided by the total number of households within each stratum across Viti Levu as detailed in Table 1 and then multiplied by the number of households to be interviewed within each stratum as detailed in Table 2, it was possible to calculate the number of households to be interviewed within each stratum in Ba tikina as follows:

Stratum 10:	(610/6,165) × 355 = 35 households
Stratum 20:	(752/6,063) × 425 = 53 households
Stratum 30:	(811/9,566) × 675 = 57 households
Stratum 40:	(3,216/21,536) × 1,545 = 231 households

To determine the number of villages/settlements to be visited the number of households to be interviewed was divided by 20, and the numbers rounded up or down to the nearest whole number:

Stratum 10:	35/20 = 1.75, rounded up to 2 sites.
Stratum 20:	53/20 = 2.65, rounded up to 3 sites.
Stratum 30:	57/20 = 2.85, rounded up to 3 sites.
Stratum 40:	231/20 = 11.53, rounded up to 12 sites.

The actual sites to be interviewed were selected from the alphabetically ordered lists of villages/ settlements. The villages in each list were allocated a number according to the order that they appeared in the list e.g. 1 for the village at the top of the list, 2 for the second etc. Random numbers were generated and the villages with the corresponding numbers were selected as sites to be interviewed. The sites from the different strata of Ba tikina are listed in Attachment B.

v) Interviews

Before enumerators visited any villages, they attended a training course to make them aware of the reasons for the survey and its importance. They were familiarised with the questionnaire format and how to interpret and ask the questions, and given advice on the techniques to be used for undertaking the house-to-house interviews. The training consisted of a series of lectures and exercises as well as actual fieldwork sessions. A general outline of the course content is given in the Field Manual which was produced as a guide for enumerators to take with them in the field during the course of the survey (Attachment A).

As there are several ethnic groups living on Viti Levu, it was agreed that the enumeration teams visiting different sites would be made up of people of the same race as the community being visited. This was to overcome any language difficulties that might arise.

Each enumeration team had a leader who was responsible for the logistical arrangements of the survey. This included ensuring that advance warning was given to all villages and settlements about when the enumeration team was due to carry out interviews. This was done by sending out messages over national radio and, in some cases, through personal visits. Other duties included ensuring that transport was available for the team, accommodation was arranged where necessary and the team had all the appropriate equipment to carry out the survey e.g. clipboards, pencils, forms etc.

When the enumeration team visited a Fijian village, the appropriate customary protocol was followed by presenting a traditional 'Sevusevu' to the chief or village representative, the 'Turaga-ni-koro', to gain permission to undertake the survey. During this meeting the opportunity was taken to make the chief and his representatives aware of the purpose and importance of the survey.

Indian settlements were visited by Indian members of the research team. There was a different community structure and distribution of houses in the settlements compared to Fijian villages. Houses were generally spread over a wider area and no formal consent was required from an individual to carry out the interviews.

The team leader was provided with a 'Site Information Form' which gave details of the location to be visited and available information (from the 1986 population census) about the composition of the village/settlement. This form (copy in Appendix 1 of Attachment A) was also used by the team leader to record the details of each survey trip and any observations made pertaining to fishing activities in the village/ settlement.

Whether at a Fijian village or Indian settlement the target number of houses to be interviewed was 20. Each enumeration team, comprised of 2–5 people (but optimally 4, with at least one female), would be directed by the team leader to the houses to be interviewed. The general rule was to divide the number of houses in the village or settlement by 20 to give the number of houses to be passed between interviews. A starting point was selected by the leader. If there was nobody in the household selected then the enumerator would move to the next house.

Respondents, who could be any member of the household, were asked the questions from the standard questionnaire (see Appendix 2 of Attachment A) and their replies were recorded on the form by the enumerator. The length of time one interview would last was very much dependent on the amount of fishing activity that was reported. In most cases, it took between 20 and 30 minutes to interview a respondent from a household that was actively involved in fishing. Interviews of households who reported no fishing effort would generally take between 5 and 10 minutes.

When all interviews at a site were completed, the team leader was responsible for collecting all the forms and checking them with the appropriate enumerator. In this way, any dubious responses could be checked while the details were still fresh in the minds of the enumerators. The final forms were returned to Fisheries Division headquarters in Lami.

Due to the absence of respondents and lack of time, it was not always possible for the enumeration team to complete interviews of 20 households at any one site. In other instances, when the team leader was not aware of his team's progress, more than 20 households were interviewed.

vi) Data processing

The data from the questionnaire forms were entered onto a computerised database using FoxPro software on a Hewlett Packard Vectra microcomputer. A program was written to allow data entry in the order that information appeared on the questionnaire form. Routines were incorporated into the program to error check entries being made onto the database.

The analysis of the data was carried out using Microsoft Access software. The original FoxPro databases were imported into an Access database before examination of the data .

B) Creel Survey

i) Sampling methods

Four of the villages that were used as sites for the questionnaire survey were also selected as locations to observe and monitor the catches made by fishers. The sites selected were all Fijian coastal villages and were located in areas of different surrounding habitat and proximity to market outlets. The four villages surveyed were Votua in Ba Province, Namuaimada in Ra Province, Ucunivanua in Tailevu Province and Namatakula in Nadroga/Navosa Province. These sites are all marked on Figure 1.

After prior consent had been given by the chiefs of the villages selected, two or three officers observed daily fishing activities and intercepted as many fishers as possible in order to identify the species taken and the size of the catch.

At three of the locations the officers resided in the village for the duration of the survey, approximately one week. The fourth site was only an hour from Suva by car so the team visited the site daily.

At each site, the first task was to describe to the village headmen the purpose of the survey and the activities that were to be carried out. This was a *vital* step for the success of the survey. Wherever possible the research team tried to encourage the village organiser, the 'Turaga-ni-koro', to assist in passing the message of the importance of the work to the villagers. In order to facilitate the measurement of catches, villagers were also requested to look for a member of the research team if their catch had not already been recorded. It was also extremely important to alleviate any fears that villagers had about the reasons for the survey and to stress the need for people not to make changes to their normal routine because of the presence of the research team.

A set of slides on 'Fisheries in the South Pacific' (King 1992) prepared as part of the Fisheries Awareness Project by the Forum Fisheries Agency was shown at each village in order to try and focus on issues involved and how the survey was trying to gather information to assist with the future management of fishery resources.

As far as possible during the course of a day in a village, the research team tried to locate themselves in a central position in order to observe movements of fishers. Two of the sites did not have a central observation point, so at least one member of the research team would make regular 'rounds' of the village. The team also tried to develop a network of village residents who could keep them informed of movements of fishers.

As people started their activities, the time was noted and a description of the individual/group recorded, including the fishing gear being carried. In this way, the lengths of fishing trips could be calculated and an overall daily estimate could be made of the fishing effort by the villager.

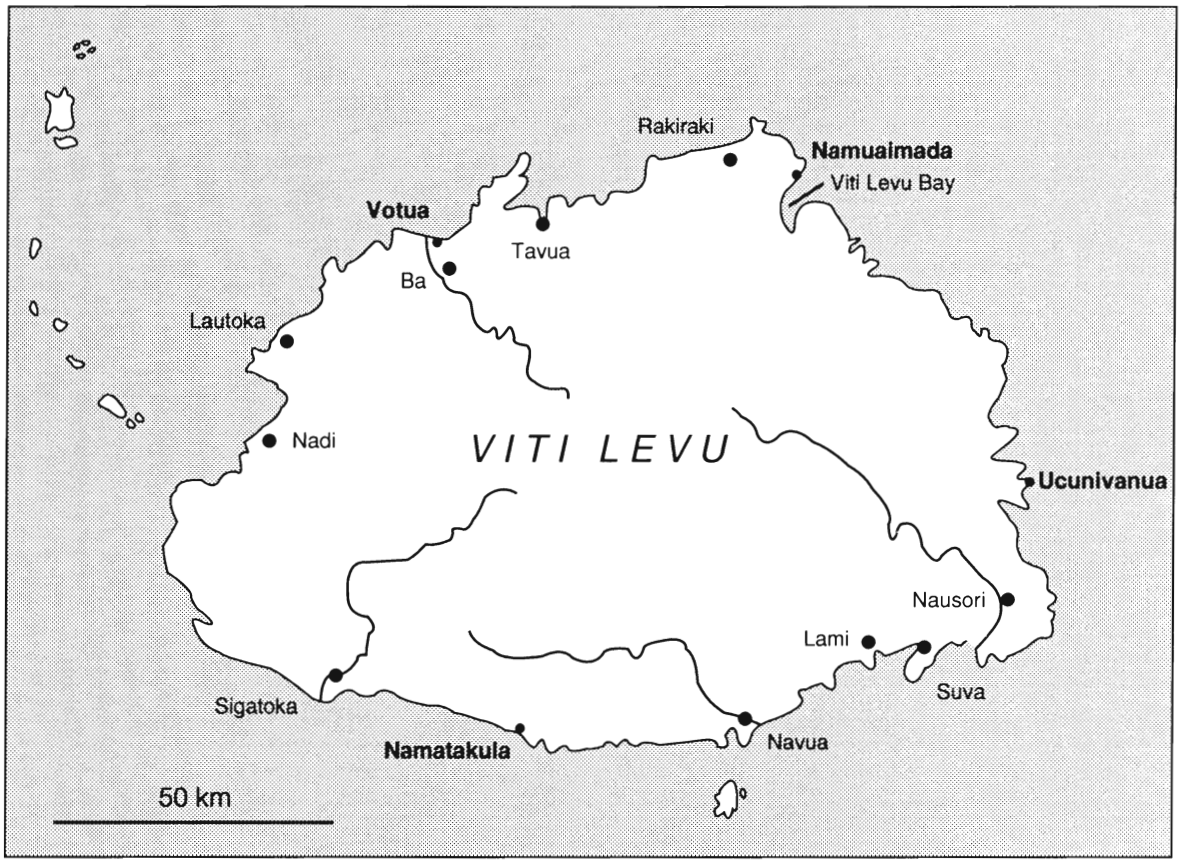

Figure 1. Sites of villages surveyed, Fiji.

As fishers returned to the village they would be intercepted by the research team and invited to present their catch for inspection. In nearly all cases, the fishers were happy to cooperate. The catch was sorted and the numbers of individuals of each taxa and their total weight were recorded. The lengths (mm) of the largest and smallest individuals in each taxa were also measured. Other information that was noted was the age (generally an estimate based on appearance) and sex of the fisher; the fishing method they had been using; the date and time of the return to the village and the general habitat area they had been fishing. The fisher was also asked what the fate of the catch would be. This was to find out whether the catch was to be used for home consumption or sold. A copy of the record sheet that was used for the collection of these data is given in Attachment C.

In certain circumstances when fishers wished to return quickly to their homes, e.g. after returning from a spear fishing trip and wishing to get out of wet clothes, the number of fishers was noted and the research team visited the homes of as many fishers as possible before they started to process their catch. This system worked well as long as the fishers were made aware that their catch was to be examined.

ii) General description of creel survey sites

1) Votua Village is located on the banks of the Ba River in northwestern Viti Levu about one km from the mouth of the estuary. The estuary opens out into an extensive area of mangroves and channels. Outside the mangrove area is a broad shallow reef that is covered by fine silt and debris such as tree trunks and branches, that have been deposited by the river. Offshore from this reef is deeper water with an extensive set of patch reefs.

The village is in a sugarcane growing area and is situated close to Ba town. In the 1986 census the village comprised of 73 houses and 544 people. As some of the boundaries are not clear it was difficult to assess the present figure, but it was reported by the chief that there were now 186 houses. The survey team remained in Votua village from 5 to 12 September 1993.

2) Namuaimada Village is on the northeastern side of Viti Levu, on the northern tip of Viti Levu Bay (Fig. 1). The shoreline comprises areas of sand and rock, and in some areas is fringed by mangroves. An intertidal reef stretches 200–300 m from the shore. The edge of this reef extends out into the lagoon and has had large mounds of dead coral deposited on it during storms.

The village is situated 20 km from Rakiraki, the nearest urban centre, and 100 km from Suva. The roads between both towns are poor for long stretches. Namuaimada is also situated in a sugar cane growing belt.

The census of 1986 recorded 33 households and 218 people. Data collected during the survey suggested that the number of households had now increased to 41 and the population to 250. Monitoring of the catches by villagers took place between 12 and 19 September 1993.

3) Ucunivanua Village is on the eastern side of Viti Levu. It is situated on an elevated promontory with steep cliffs down to the shoreline, (pathways have been built to allow easy access to the beach). An extensive intertidal reef flat stretches from the shoreline and is covered by sand and in some places thick mud. Further from the shoreline are extensive patch reefs, many of which are exposed at low tide. Mangroves fringe part of the surrounding coastline. The shoreline was covered by many piles of clam shells that had been discarded. (The low lying parts of the village were built on shells.)

The area around Ucunivanua village is primarily agricultural and used by dairy farmers for grazing cattle. The village is about 35 km from Suva and connected by good roads.

The census in 1986 revealed that the village had 49 households and 237 people. This is now reported to have risen to 70 households and 369 people. The creel surveys were undertaken between 27 September and 2 October 1993.

4) Namatakula Village is on the southern coast of Viti Levu which is a favoured tourist location known as the 'Coral Coast'. The village is bordered by an intertidal fringing reef which is about 500 m wide. A small river flows into the sea at the eastern side of the village. Over the years this has carved a deep passage in the reef through to the ocean. Large amounts of silt have been deposited over the reef close to the shoreline.

The village is approximately 30 km from the urban centre of Sigatoka and 80 km from Suva and is served by good roads in both directions.

The number of households and the population recorded at the village during the 1986 census were 27 and 200, respectively. The survey team carried out work in Namatakula Village between 6 and 9 October 1993.

C) Fish Consumption Survey

The consumption of marine products by households was assessed at the same locations as the creel surveys.

As many households as possible were issued with a form to record their daily consumption of fish and marine products. The form, Attachment D, was written in the Fijian language and invited households to record details of the date of the meal; the number of people at the meal; whether fish was consumed at the meal; the species of fish eaten; the number and their average length; whether tinned fish was consumed and the number of tins. For each day of the week there was space on the form to record details for three meals per day.

Due to the problems of issuing every household with a set of scales to weigh the fish they were going to consume, an attempt was made to get estimates of the size of fish by requesting respondents to record the average length of the fish to be eaten. In order to assist the respondents estimates, a graduated 0–15 centimetre scale was drawn as a guide along the side of the form, (Attachment D).

Lengths were converted in order to assess the weight of fish being consumed. Length–weight relationships were calculated for the major species consumed, using data collected during baitfish predator sampling (Blaber et al. 1994). A summary of the length–weight relationships that were used for the conversions of the consumption data for the different species is given in Table 3.

Completed data forms were collected at the end of each week's sampling, except from one site where they were returned to Fisheries Division by post after the survey team had departed.

Data was entered on an ORACLE database and analysed using SQLPLUS software.

Table 3. Length–weight relationships for the fish species important in the subsistence and artisanal fisheries during the survey ($W = aL^b$) (W = weight (g); L = length (mm); s.e. = standard error; r^2 = correlation coefficient; n = sample size).

Name	a ± s.e.	b ± s.e.	r^2	n
Acanthurus triostegus	$4.24\times10^{-5} \pm 2.43\times10^{-6}$	3.056 ± 0.120	0.937	46
Carangoides caeruleopinnatus	$2.84\times10^{-5} \pm 9.1\times10^{-7}$	3.020 ± 0.061	0.980	52
Caranx papuensis	$4.38\times10^{-5} \pm 1.17\times10^{-6}$	2.892 ± 0.045	0.991	39
Chaetodon unimaculatus	$6.17\times10^{-6} \pm 4.4\times10^{-7}$	3.468 ± 0.179	0.984	8
Cheilinus trilobatus	$2.26\times10^{-6} \pm 2.19\times10^{-8}$	3.597 ± 0.027	0.999	4
Chirocentrus dorab	$1.3\times10^{-6} \pm 1.79\times1^{-8}$	3.236 ± 0.030	0.985	180
Ctenochaetus striatus	$2.17\times10^{-5} \pm 8\times10^{-7}$	3.192 ± 0.094	0.998	4
Epinephelus merra	$2.75\times10^{-3} \pm 6.34\times10^{-4}$	2.054 ± 0.279	0.761	19
Epinephelus ongus	$4.14\times10^{-5} \pm 3\times10^{-6}$	2.942 ± 0.137	0.991	6
Epinephelus polyphekadia	$3.91\times10^{-5} \pm 1.5\times10^{-6}$	2.956 ± 0.069	0.989	22
Gerres oyena	$1.11\times10^{-4} \pm 2.2\times10^{-6}$	2.739 ± 0.039	0.924	401
Halichoeres trimaculatus	$2.87\times10^{-2} \pm 5.39\times10^{-2}$	1.543 ± 1.383	0.384	4
Hemiramphus far	$1.31\times10^{-5} \pm 8\times10^{-7}$	2.861 ± 0.119	0.784	161
Hyporhamphus dussumieri	$1.09\times10^{-3} \pm 4.14\times10^{-4}$	2.019 ± 0.459	0.547	18
Leiognathus equulus	$6.24\times10^{-4} \pm 1.01\times10^{-4}$	2.416 ± 0.239	0.953	7
Lethrinus harak	$6.35\times10^{-5} \pm 1.8\times10^{-6}$	2.860 ± 0.054	0.982	51
Lethrinus mahsena	$4.7\times10^{-5} \pm 5.3\times1^{-6}$	2.935 ± 0.211	0.927	17
Lethrinus xanthochilus	$1.24\times10^{-5} \pm 1.3\times10^{-6}$	3.131 ± 0.213	0.935	17
Liza subviridis	$4.50\times10^{-5} \pm 1.3\times10^{-6}$	2.884 ± 0.058	0.992	22
Liza vaigiensis	$2.09\times10^{-5} \pm 5\times10^{-7}$	3.049 ± 0.051	0.979	78
Lutjanus argentimaculatus	$5.3\times10^{-5} \pm 1.5\times10^{-6}$	2.900 ± 0.051	0.993	23
Lutjanus fulviflamma	$2.86\times10^{-5} \pm 5\times10^{-7}$	3.018 ± 0.042	0.988	68
Mugil cephalus	$2.45\times10^{-5} \pm 5\times10^{-7}$	2.984 ± 0.484	0.991	37
Mulloides flavolineatus	$6.2\times10^{-5} \pm 1.7\times10^{-6}$	2.785 ± 0.054	0.912	254
Myripristis violacea	$1.00\times10^{-3} \pm 1.24\times10^{-4}$	2.342 ± 0.182	0.797	44
Naso unicornis	$2.47\times10^{-5} \pm 1.2\times10^{-6}$	3.055 ± 0.092	0.998	4
Paraupeneus barberinus	$5.3\times10^{-5} \pm 9\times10^{-7}$	2.863 ± 0.032	0.991	73
Paraupeneus indicus	$1.8\times10^{-5} \pm 6\times10^{-7}$	3.084 ± 0.075	0.986	26
Plotosus lineatus	$9.07\times10^{-8} \pm 1.14\times10^{-9}$	3.836 ± 0.039	0.999	3
Pseudobalistes flavimarginatus	$3.72\times10^{-3} \pm 1.09\times10^{-3}$	2.273 ± 0.283	0.985	3
Rastrelliger kanagurta	$2.3\times10^{-6} \pm 3.78\times10^{-8}$	3.396 ± 0.037	0.977	199
Scarus frenatus	$9.3\times10^{-6} \pm 2\times10^{-7}$	3.258 ± 0.045	0.985	79
Scarus sordidus	$8.53\times10^{-5} \pm 3.4\times10^{-6}$	2.859 ± 0.071	0.960	70
Scolopsis bilineatus	$2.14\times10^{-5} \pm 2\times10^{-6}$	3.095 ± 0.216	0.880	30

Table 3. (contd) Length–weight relationships for the fish species important in the subsistence and artisanal fisheries during the survey ($W = aL^b$) (W = weight (g); L = length (mm); s.e. = standard error; r^2 = correlation coefficient; n = sample size).

Scolopsis trilineatus	$6.42\times10^{-4} \pm 7.56\times10^{-5}$	2.397 ± 0.178	0.830	39
Scomberoides tol	$2.42\times10^{-5} \pm 5.0\times10^{-7}$	2.837 ± 0.044	0.992	36
Selar crumenopthalmus	$5.6\times10^{-6} \pm 1\times10^{-7}$	3.268 ± 0.076	0.984	32
Siganus doliatus	$1.7\times10^{-6} \pm 2\times10^{-7}$	3.589 ± 0.430	0.886	11
Siganus punctatus	$2.24\times10^{-5} \pm 2\times10^{-6}$	3.101 ± 0.181	0.961	14
Siganus spinus	$7.13\times10^{-4} \pm 1.19\times10^{-4}$	2.337 ± 0.258	0.932	8
Sphyraena forsteri	$5.4\times10^{-6} \pm 1.0\times10^{-7}$	3.066 ± 0.054	0.946	188
Sphyraena putnamiae	$4\times10^{-6} \pm 9.69\times10^{-8}$	3.123 ± 0.049	0.967	134
Terapon jarbua	$4.24\times10^{-5} \pm 1.8\times10^{-6}$	2.929 ± 0.089	0.979	25
Upeneus vittatus	$7.4\times10^{-6} \pm 1\times10^{-7}$	3.245 ± 0.061	0.953	143
Valamugil seheli	$2.97\times10^{-5} \pm 1\times10^{-6}$	2.960 ± 0.064	0.988	27

3. Survey results

A) Questionnaire Survey

i) General

a) Survey coverage

One hundred and twenty three villages/ settlements were visited, and 2,252 households interviewed during the survey of Viti Levu. The households interviewed represented 13,220 people. This was 75.1% of the calculated target of 3,000 households and 90.1% of the planned target of 2,500 households. Table 4 gives the percentage of completed interviews by stratum as a proportion of the target number of houses.

Table 4. Target and actual number of houses interviewed.

Stratum	10	20	30	40
Target no. of interviews	355	425	675	1,545
Actual no. of interviews	341	381	487	1,043
Percentage completed	98.1	89.6	72.1	67.5

A combination of lack of transport and manpower were the main reasons that the target number of interviews was not achieved. Coastal locations were generally easier to get to, so the villages and settlements in Stratum 10 were covered more thoroughly in respect to the original targets than the less accessible inland locations.

A breakdown of the number of houses surveyed by stratum, including the number of people reported to be resident in these houses, is given in Table 5. There was an average of 5.87 people/ house during the survey compared with the 1986 census of 5.81 people/house for Viti Levu. Overall 64.6% of the households interviewed were Indian families, 34.6% were Fijian and 0.8% were from other races, as detailed in Table 6. This compares with a planned survey structure of 27.1% Fijian houses and 71.6% Indian houses. This disproportionate spread of effort was caused by the sampling structure which distributed sampling effort away from the coastal areas where the probability of fishing was high, to the inland areas (Strata 30 and 40) which are primarily inhabited by Indian people. The relative ease of sampling the coastal sites meant that more effort was concentrated on the Fijian villages than was originally planned.

Details of the estimated coverage of the sample area in terms of households and the population interviewed are given in Table 7. Estimates for the number of households and population in the sample area were made using the figures from the 1986 population census multiplied by a factor of 1.07. [This factor was calculated by dividing the estimated population at the end of 1993 for the whole of Fiji, 765,000, and the population at the 1986 census, 714,000]. This factor may well be too high for some of the areas of Viti Levu covered in the survey where the change in the number of persons per household from the survey and from the census was only 1.01. However, because there was no up-to-date information on the number of houses on Viti Levu it had to be assumed that the number of houses had increased by the same factor as the population, 1.07.

The factor representing the change in the number of persons per household from the survey results and the census suggests a greater increase in locations closest to the coast. This is likely to be a function of the higher annual population growth rate of Fijians (2.4%) over the Indians (1.8%) (Anon. 1993).

The overall coverage by the interview team of 4.42% of the estimated population of Viti Levu and 4.37% of the houses was achieved. Coverage of the coastal areas (Strata 10 and 20) was slightly better than for the more inland areas (Strata 30 and 40).

The number of interviews carried out at each selected site is given in Attachment B.

b) Household composition

Table 8 summarises the composition of Fijian and Indian households by stratum. Overall, the average number of people living in the houses interviewed was slightly higher for Fijian households (5.98 people/house) than Indian (5.82). The difference

Table 5. The number of houses and population sizes surveyed by stratum in Viti Levu and their composition.

Stratum	Houses	People	Adult male	Adult female	Child male	Child female	People/house
10	341	2,065	627	616	436	386	6.06
20	381	2,246	753	710	404	379	5.90
30	487	2,861	917	881	565	498	5.87
40	1,043	6,048	1,922	1,834	1,236	1,056	5.79
Total	2,252	13,220	4,219	4,041	2,641	2,319	5.87

Table 6. The number of houses and population sizes surveyed by stratum and race in Viti Levu.

Race	Stratum	House	People	Minimum people	Maximum people	Mean people
Banaban	10	1	14	14	14	14.00
Banaban	Total	1	14	14	14	14.00
Fijian	10	300	1,826	1	15	6.09
	20	79	497	1	13	6.29
	30	106	652	1	13	6.15
	40	295	1,690	1	14	5.73
Fijian	Total	780	4,665	1	15	5.98
Indian	10	39	221	2	15	5.67
	20	296	1,726	2	20	5.83
	30	373	2,163	1	21	5.80
	40	746	4,349	1	18	5.83
Indian	Total	1,454	8,459	1	21	5.82
Other	10	1	4	4	4	4.00
	20	6	23	2	5	3.83
	30	8	46	2	11	5.75
	40	2	9	4	5	4.50
Other	Total	17	82	2	11	4.82
Overall	Total	2,252	13,220	1	21	5.87

Table 7. The estimated household and population coverage of the survey area broken down by stratum.

Stratum	Estimated population	Surveyed population	Percentage coverage	Estimated households	Surveyed households	Percentage coverage
10	37,184	2,065	5.55	6,597	341	5.17
20	36,167	2,246	6.21	6,487	381	5.87
30	58,659	2,861	4.88	10,236	487	4.76
40	135,925	6,048	4.45	23,044	1,043	4.53
Others	31,076	0	0.00	5,114	0	0.00
Total	299,011	13,220	4.42	51,478	2,252	4.37

Note: Values come from 1986 population census (Anon. 1989) multiplied by a factor of 1.07 to account for growth over this period.

Table 8. The mean number of people per household and the family composition of interviewed households of each ethnic group in each stratum.

Stratum	Race	Houses	Numbers per household				
			People	Adult male	Adult female	Child male	Child female
			Mean ± s.e	Mean ± s.e	Mean ± se	Mean ± se	Mean ± se
10	Fijian	300	6.09 ± 0.14	1.83 ± 0.06	1.80 ± 0.06	1.30 ± 0.08	1.17 ± 0.07
	Indian	39	5.67 ± 0.48	1.85 ± 0.18	1.85 ± 0.18	1.10 ± 0.17	0.87 ± 0.16
20	Fijian	79	6.29 ± 0.30	1.96 ± 0.13	1.91 ± 0.13	1.35 ± 0.14	1.06 ± 0.12
	Indian	296	5.83 ± 0.13	1.99 ± 0.07	1.86 ± 0.05	0.99 ± 0.05	0.99 ± 0.06
30	Fijian	106	6.15 ± 0.22	1.92 ± 0.12	1.66 ± 0.09	1.18 ± 0.11	1.40 ± 0.11
	Indian	373	5.80 ± 0.14	1.87 ± 0.06	1.85 ± 0.05	1.17 ± 0.06	0.91 ± 0.05
40	Fijian	295	5.73 ± 0.14	1.71 ± 0.06	1.60 ± 0.05	1.24 ± 0.07	1.18 ± 0.07
	Indian	746	5.83 ± 0.10	1.90 ± 0.04	1.82 ± 0.04	1.16 ± 0.04	0.95 ± 0.04
Overall	Fijian	780	5.98 ± 0.09	1.81 ± 0.04	1.72 ± 0.03	1.27 ± 0.04	1.19 ± 0.04
	Indian	1454	5.82 ± 0.07	1.91 ± 0.03	1.84 ± 0.03	1.13 ± 0.03	0.94 ± 0.03

in the average size of Fijian households against Indian households was larger when the data were divided by strata (6.09 against 5.67 in stratum 10, 6.29 against 5.83 in stratum 20 and 6.15 against 5.80 in stratum 30). This difference is reversed in stratum 40 where the average size of Indian households (5.83) was greater than Fijian (5.73).

The average number of adult males and females was higher in Indian households than in Fijian households. The opposite situation was apparent for both male and female children, which accounts for the larger number of persons overall in Fijian households.

Across all strata of both races the average number of adult males per household was greater than (or equal to) the average number of adult females. There were more adults per household than children. There was an average of 3.53 and 3.75 adults per Fijian and Indian household, respectively as opposed to 2.46 and 2.07 children.

ii) Results

a) The importance of the sale of marine products as a source of income

1) Households involved in selling marine products

Sixteen percent of the households reported that they sold marine products to provide income (Table 9) and 8.8% of the households reported the sale of marine products to be their most important source of income. Half of these households (4.4%) relied on this activity as their sole method of earning money.

The number of Fijian households actively involved in selling marine products (36.7%) was much higher than Indian households (5.2%).

There was a great deal of variation in the number of households involved in selling marine products with respect to their distance from the coast. 54.0% of the households interviewed in stratum 10 reported selling marine products, 18.6% in stratum 20, 12.9% in stratum 30 and 4.5% in stratum 40.

These results imply that Fijian people living in coastal locations are the most dependent on the harvest of marine products for their monetary income.

Generally over the survey area the predominant income-producing activities of households are farming and paid wage employment (Table 9).

2) Frequency of sale and types of products sold

Of those households that reported selling marine products the majority (70.7%) claimed to carry out this activity frequently (more than once per week), 24.7% occasionally (more than once per month) and 4.6% only infrequently (less than once per month). Table 10 details the frequency that households within each strata sell marine products, expressed as a percentage of the number of houses reported to be involved in this activity.

Across all strata more than 50% of households sell marine products on a frequent basis. Households further away from the coast sell marine products less regularly.

The main product reported as sold by 67.4% of the households was fish, followed by shellfish

Table 9. Household activities reported by respondents to provide a source of income (values are percentages).

	Sale of marine products	Sale of copra	Income from farming	Wage employment	Own business	Other
Households involved	16.1	1.8	58.2	34.3	10.9	8.5
Households not involved	83.9	98.2	41.8	65.7	89.1	91.5
H'holds involved only in activity	4.4	<0.1	37.2	21.1	5.7	4.0
H'holds involved in activity+others	11.7	1.7	21.0	13.2	5.2	4.5
Most important source of income	8.8	0.6	47.3	29.2	7.7	5.2
Fijian h'holds involved	36.7	4.9	61.4	30.1	6.4	13.6
Indian h'holds involved	5.2	0.1	56.9	36.5	13.3	5.6

Table 10. The reported frequency (%) that households sell marine products as a percentage of the households involved (Frequently = > once per week; Occasionally = > once per month; Infrequently = < once per month).

Stratum	Frequently	Occasionally	Infrequently
10	72.3	20.1	7.6
20	71.8	15.5	12.7
30	52.4	33.3	14.3
40	55.3	21.3	23.4
Overall	70.7	24.7	4.6

(41.6%) and shells (11.8%) as summarised in Table 11. Many of the households reported selling more than one of the marine product groups e.g. only 34.2% of the 67.4% households selling fish reported this as the only commodity they sold.

Fish and shellfish were reported as the most important products sold across all strata but the percentage number of households involved declined further from the coast (from stratum 10 to 40). The 'Other' category, which included products such as seaweed, was reported to be the third most important grouping sold from stratum 10 (Table 12).

Overall, 22.2% of Fijian households were involved in selling fish, in contrast to 4.7% of Indian households (Table 13). All other product categories for non-Fijian households were less than 1% of reported sales.

Tables 14 and 15 show the percentages of Fijian and Indian households, respectively, by stratum that are involved in selling different marine products. For Fijian households (Table 14) fish is the most important product sold in all strata except 40. However, the importance of fish over other

Table 11. The percentage of households reporting to sell particular marine products.

	Fish	Shellfish	Bêche-de-mer	Sharkfin	Shells	Other
H'holds involved	67.4	41.6	2.7	0.3	11.8	23.4
Only product	34.2	17.6	0.0	0.0	3.0	11.3
Product + other	33.2	24.0	2.7	0.3	8.8	12.1

Table 12. The percentage of households in each stratum reporting to sell various marine products.

Stratum	Fish	Shellfish	Bêche-de-mer	Sharkfin	Shells	Other
10	39.3	29.6	2.3	0.3	6.2	10.9
20	15.5	6.6	0.0	0.0	0.8	2.9
30	7.2	3.5	0.0	0.0	1.6	4.3
40	1.6	0.8	0.0	0.0	1.1	1.7

Table 13. The percentage of households of the main ethnic groups that reported selling particular marine products.

Race	Fish	Shellfish	Bêche-de-mer	Sharkfin	Shells	Other
Fijian	22.2	18.2	1.3	0.1	5.3	10.3
Indian	4.7	0.6	0.0	0.0	0.1	0.5
Banaban	100.0	0.0	0.0	0.0	0.0	0.0
Other	11.8	0.0	0.0	0.0	0.0	0.0

Table 14. The percentage of Fijian households in each stratum that reported selling particular marine products.

Stratum	Fish	Shellfish	Bêche-de-mer	Sharkfin	Shells	Other
10	44.0	33.7	3.3	0.3	7.0	12.3
20	22.8	20.2	0.0	0.0	2.5	11.4
30	18.9	16.0	0.0	0.0	7.5	17.0
40	1.0	2.7	0.0	0.0	3.4	5.4

Table 15. The percentage of Indian households in each stratum that reported selling particular marine products.

Stratum	Fish	Shellfish	Bêche-de-mer	Sharkfin	Shells	Other
10	–	–	–	–	–	–
20	13.5	3.0	0.0	0.0	0.3	0.7
30	4.2	0.0	0.0	0.0	0.0	0.8
40	1.9	0.0	0.0	0.0	0.1	0.1

products is less pronounced further from the coast, where shellfish and other products make up a more important contribution to sales. Only 1% of Fijian households in stratum 40 sell fish, with other products being the most important group marketed (5.4%).

Fish is the most important group sold by Indian households (Table 15) across all strata, with households closer to the coast being more involved in this activity. Few households were involved in the sale of other products.

b) The frequency of fishing activities and the average length of the fishing trips

1) Households involved in fishing

Respondents were asked which members of their family went fishing and how frequently they undertake any fishing activities, and whether the catch was for commercial gain or subsistence use.

Overall, 1,134 (50.4%) of all households interviewed reported having at least one member who went fishing, if only very occasionally. However, there was a large difference between the number of Fijian (86.8%) and Indian (30.9%) households who reported having members who went fishing.

Table 16 summarises the households that reported having at least one member who went fishing, classified by their reported use of the catch.

Overall, of the houses that reported fishing, 68.2% were subsistence, 31.4% were artisanal and 0.4% were commercial (Table 16). Fijian houses reported undertaking more artisanal activities than Indian households. 57.6% of the Fijian fishing households were subsistence, 41.8% were artisanal and 0.7% were commercial. Indian fishing households were classified as 84.4% subsistence and 15.8% artisanal with no fully commercial activity.

These activities also varied with stratum. Table 17 separates the classification of the Fijian households by stratum. The percentage of artisanal fishing households declines from coastal areas (63.7% in stratum 10) to inland areas (14.1% in stratum 40). The proportion of artisanal fishing households in stratum 20 and 30 are similar at 49.3% and 46.6%, respectively. Subsistence fishing households follow a reversed pattern with a higher proportion (85.9% in stratum 40) in inland areas declining down through strata 30, 20 and 10 to proportions of 53.4%, 50.7% and 34.4%, respectively.

Table 16. Number of fishing households classified by their activities as subsistence, artisanal or commercial fishing units. Figures in brackets represent percentage of fishing households within each classification.

Class	Subsistence		Artisanal	Commercial	Total
Consumption of catch	All	Some/None sold	Some/Some sold	None/All sold	
Banaban	0 (0)	0 (0)	1 (100)	0 (0)	1 (100)
Fijian	248 (36.7)	141 (20.9)	283 (41.8)	5 (0.7)	677 (86.8)
Indian	324 (72.0)	55 (12.2)	71 (15.8)	0 (0.0)	450 (30.9)
Other	5 (71.4)	0 (0.0)	2 (28.6)	0 (0.0)	7 (41.2)
Total	577 (50.9)	196 (17.3)	356 (31.4)	5 (0.4)	1,134 (50.4)

Table 17. Number of Fijian fishing households classified by their activities as subsistence, artisanal or commercial fishing units. Figures in brackets represent percentage of fishing households within each classification.

Class	Subsistence		Artisanal	Commercial	Total
Consumption of fish	All	Some/None Sold	Some/Some Sold	None/All Sold	
10	63 (23.1)	31 (11.4)	173 (63.7)	5 (1.8)	273 (91.0)
20	21 (31.3)	13 (19.4)	33 (49.3)	0 (0)	67 (84.5)
30	27 (30.7)	20 (22.7)	41 (46.6)	0 (0)	88 (83.0)
40	137 (55.0)	77 (30.9)	35 (14.1)	0 (0)	249 (84.4)
Total	248 (36.7)	141 (20.98)	283 (41.8)	5 (0.7)	677

Excluding stratum 10 where sample sizes were small and no artisanal households were recorded, Indian households show a similar pattern (Table 18) with a higher proportion of subsistence fishing activity in the inland areas than the more coastal areas (92.4%, 85.1%, and 74.1% for strata 40, 30 and 20, respectively).

2) People involved in fishing

Fifteen percent of the total population represented by the households surveyed reported undertaking some fishing activity. The proportion of people who went fishing varied with respect to their sex and age. The percentage for each group who reported fishing were adult males 28.5%, adult females 16.3%, child males 2.9% and child females 2.1% (Table 19).

Table 18. Number of Indian fishing households classified by their activities as subsistence, artisanal or commercial fishing units. Figures in brackets represent percentage of fishing households within each classification.

Class	Subsistence		Artisanal	Commercial	Total
Consumption of fish	All	Some/None sold	Some/Some sold	None/All sold	
10	3 (100)	0 (0)	0 (0)	0 (0)	3 (7.7)
20	94 (62.2)	18 (11.9)	39 (25.8)	0 (0.0)	151 (51.0)
30	97 (77.0)	10 (8.1)	19 (15.1)	0 (0.0)	126 (33.8)
40	130 (76.5)	27 (15.9)	13 (7.6)	0 (0.0)	170 (22.8)
Total	324 (72.0)	55 (12.2)	71 (15.8)	0 (0.0)	450

Table 19. The reported age and sex of fishers and their frequency of fishing. Figures in brackets are percentages of the total number of houses and people reported in survey.

Overall	Minimum number of people	Maximum number of people	Number of h'holds	3–7 times per week	1–2 times per week	> 1 time per month	< 1 time per month	Total no. of people
Adult male	0	6	871 (38.7)	222 (5.3)	454 (10.8)	284 (6.7)	242 (5.7)	1,202 (28.5)
Adult female	0	6	517 (23.0)	191 (4.8)	347 (8.6)	76 (1.9)	45 (1.1)	659 (16.3)
Child male	0	3	61 (2.7)	9 (0.3)	35 (1.3)	23 (0.9)	9 (0.3)	76 (2.9)
Child female	0	3	35 (1.6)	5 (0.2)	32 (1.4)	6 (0.3)	5 (0.2)	48 (2.1)

This varied according to the race of the respondents. For the same sex and age groupings the reported percentage of involvement for Fijians was 38.1%, 45.3%, 4.1% and 4.5% (Table 20) as opposed to Indians for which it was 23.6%, 1.9%, 2.1% and 0.4% (Table 21). Across all sex and age groupings Fijians were more involved in fishing activities than their Indian counterparts. The most significant difference in activity occurred between Fijian adult females, who had the highest proportion (45.3%) of their numbers involved in fishing over all other groups, and Indian adult females, whose involvement was less than 2% of the total number.

Table 22 details the mean number of people per household (and the standard error) by sex and age grouping who reported going fishing. The highest overall value was 1.66 people per Fijian household in stratum 10 (ignoring Banaban and other households, whose sample sizes were small) out of a mean household size of 6.09 (Table 8). Means for Fijian houses in strata 20, 30 and 40 are slightly lower (1.51, 1.50 and 1.54, respectively). For the Fijian households the mean number of adult females going fishing is higher in all strata except 20, where a mean of 0.9 males go fishing as opposed to 0.57 females.

Table 20. The age and sex of Fijians reporting to undertake fishing activities. Figures in brackets are percentages of total number of houses and people reported in survey.

Fijian	Minimum number of people	Maximum number of people	Number of h'holds	3–7 times per week	1–2 times per week	> 1 time per month	< 1 time per month	Total no. of people
Adult male	0	6	419 (55.6%)	150 (10.6%)	277 (19.6%)	70 (5.0%)	40 (2.8%)	537 (38.1%)
Adult female	0	6	476 (62.2%)	188 (14.0%)	330 (24.6%)	61 (4.6%)	27 (2.0%)	606 (45.3%)
Child male	0	3	34 (6.4%)	7 (0.9%)	23 (2.3%)	7 (0.9%)	4 (0.4%)	41 (4.1%)
Child female	0	3	32 (6.3%)	4 (0.4%)	30 (3.2%)	4 (0.4%)	4 (0.4%)	42 (4.5%)

Table 21. The age and sex of Indians reporting to undertake fishing activities. Figures in brackets are percentages of the total number of houses and people reported in survey.

Indian	Minimum number of people	Maximum number of people	Number of h'holds	3–7 times per week	1–2 times per week	> 1 time per month	< 1 time per month	Total no. of people
Adult male	0	4	444 (30.9%)	71 (2.6%)	173 (6.2%)	211 (7.6%)	200 (7.2%)	655 (23.6%)
Adult female	0	3	41 (2.8%)	3 (0.1%)	17 (0.6%)	14 (0.5%)	18 (0.7%)	52 (1.9%)
Child male	0	3	27 (2.8%)	2 (0.1%)	12 (1.7%)	16 (0.1%)	5 (0.3%)	35 (2.1%)
Child female	0	3	3 (0.4%)	1 (<0.1%)	2 (0.1%)	2 (0.1%)	1 (<0.1%)	6 (0.4%)

Table 22. The mean number of people per household (± standard error) of each ethnic group in each stratum who were reported as actively fishing.

			People fishing by stratum and race				
Stratum	Race	Household	People	Adult male	Adult female	Male child	Female child
10	Banaban	1	2.00 ± –	2.00 ± –	0.00 ± –	0.00 ± –	0.00 ± –
10	Fijian	300	1.66 ± 0.06	0.72 ± 0.05	0.86 ± 0.05	0.03 ± 0.01	0.05 ± 0.02
10	Indian	39	0.10 ± 0.05	0.10 ± 0.05	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
10	Other	1	3.00 ± –	2.00 ± –	1.00 –	0.00 ± –	0.00 ± –
20	Fijian	79	1.51 ± 0.14	0.90 ± 0.10	0.57 ± 0.08	0.03 ± 0.02	0.01 ± 0.01
20	Indian	296	0.85 ± 0.07	0.75 ± 0.05	0.05 ± 0.01	0.04 ± 0.01	0.01 ± 0.01
20	Other	6	0.67 ± 0.21	0.67 ± 0.21	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
30	Fijian	106	1.50 ± 0.11	0.51 ± 0.06	0.88 ± 0.07	0.02 ± 0.01	0.09 ± 0.04
30	Indian	373	0.54 ± 0.05	0.48 ± 0.04	0.05 ± 0.01	0.01 ± 0.01	0.00 ± 0.00
30	Other	8	0.25 ± 0.16	0.25 ± 0.16	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
40	Fijian	295	1.54 ± 0.08	0.67 ± 0.05	0.72 ± 0.05	0.10 ± 0.02	0.05 ± 0.01
40	Indian	746	0.39 ± 0.03	0.34 ± 0.03	0.03 ± 0.01	0.02 ± 0.01	0.004 ± 0.003
40	Other	2	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00

The mean number of people fishing from Indian households is less than Fijians from the same stratum. The mean values are greater towards the coast (excluding stratum 10 where the sample size is small).

3) Frequency of fishing effort

Households most commonly reported that 1 to 2 fishing trips per week were undertaken by at least one member of the household. However, this varied between races as summarised in Table 23.

The mean numbers of adult males, adult females, child males and child females by stratum from both Fijian and Indian households classified as undertaking subsistence or artisanal fishing activities and their frequency of fishing effort are given in Tables 24, 25, 26 and 27, respectively.

Table 23. The reported frequency of fishing trips by active fishers of each ethnic group (fishing) and the overall number of houses that reported fishing (overall).

Race	Houses	3–7/week(%)	1–2/week(%)	> 1/month(%)	< 1/month(%)
Fijian	Fishing	33.5	57.3	15.1	7.4
	Overall	29.1	49.0	13.0	6.4
Indian	Fishing	11.8	31.1	37.3	37.3
	Overall	3.6	9.6	11.6	11.6
All	Fishing	24.7	46.3	23.9	19.4
	Overall	12.5	23.2	12.0	9.8

Table 24. The mean (± s.e.) number of adult males per household of each ethnic group in each stratum who reported making subsistence and artisanal fishing trips.

				Number of adult males fishing from subsistence/commercial households							
Stratum	Houses	Race	Type	3–7 per week		1–2 per week		> 1 per month		< 1 per month	
				Mean	± s.e.	Mean	± s.e.	Mean	± s.e.	Mean	± s.e.
10	121	Fijian	Subsistence	0.14	± 0.04	0.33	± 0.07	0.08	± 0.03	0.03	± 0.02
10	179	Fijian	Artisanal	0.38	± 0.04	0.30	± 0.05	0.07	± 0.02	0.06	± 0.03
20	46	Fijian	Subsistence	0.04	± 0.04	0.41	± 0.11	0.20	± 0.06	0.07	± 0.04
20	33	Fijian	Artisanal	0.28	± 0.10	0.79	± 0.19	0.09	± 0.05	0.00	± 0.00
30	65	Fijian	Subsistence	0.05	± 0.03	0.29	± 0.07	0.05	± 0.03	0.02	± 0.01
30	41	Fijian	Artisanal	0.25	± 0.08	0.45	± 0.09	0.00	± 0.00	0.00	± 0.00
40	260	Fijian	Subsistence	0.12	± 0.03	0.38	± 0.04	0.11	± 0.02	0.06	± 0.02
40	35	Fijian	Artisanal	0.26	± 0.09	0.09	± 0.05	0.11	± 0.05	0.17	± 0.10
10	39	Indian	Subsistence	0.00	± 0.00	0.00	± 0.00	0.10	± 0.06	0.00	± 0.00
20	257	Indian	Subsistence	0.04	± 0.01	0.20	± 0.03	0.21	± 0.03	0.20	± 0.03
20	39	Indian	Artisanal	0.80	± 0.15	0.51	± 0.10	0.15	± 0.06	0.08	± 0.04
30	354	Indian	Subsistence	0.01	± 0.01	0.10	± 0.02	0.18	± 0.03	0.14	± 0.02
30	19	Indian	Artisanal	0.47	± 0.15	0.53	± 0.16	0.32	± 0.15	0.00	± 0.00
40	733	Indian	Subsistence	0.01	± 0.01	0.07	± 0.01	0.10	± 0.02	0.13	± 0.02
40	13	Indian	Artisanal	0.85	± 0.27	0.62	± 0.27	0.08	± 0.08	0.15	± 0.15

Table 25. The mean (± s.e.) number of adult females per household of each ethnic group in each stratum who reported making subsistence and artisanal fishing trips.

				Number of adult females fishing from subsistence/commercial households							
Stratum	Houses	Race	Type	3–7 per week		1–2 per week		> 1 per month		< 1 per month	
				Mean	± s.e.	Mean	± s.e.	Mean	± s.e.	Mean	± s.e.
10	121	Fijian	Subsistence	0.25	± 0.05	0.41	± 0.07	0.09	± 0.03	0.02	± 0.01
10	179	Fijian	Artisanal	0.52	± 0.05	0.34	± 0.04	0.04	± 0.02	0.02	± 0.01
20	46	Fijian	Subsistence	0.11	± 0.06	0.28	± 0.09	0.04	± 0.03	0.07	± 0.05
20	33	Fijian	Artisanal	0.06	± 0.04	0.49	± 0.12	0.09	± 0.05	0.03	± 0.03
30	65	Fijian	Subsistence	0.26	± 0.07	0.52	± 0.11	0.05	± 0.03	0.02	± 0.02
30	41	Fijian	Artisanal	0.28	± 0.08	0.65	± 0.10	0.02	± 0.004	0.00	± 0.00
40	260	Fijian	Subsistence	0.08	± 0.02	0.43	± 0.05	0.11	± 0.02	0.05	± 0.02
40	35	Fijian	Artisanal	0.29	± 0.09	0.54	± 0.13	0.11	± 0.09	0.11	± 0.05
10	39	Indian	Subsistence	0.00	± 0.00	0.00	± 0.00	0.0	± 0.00	0.00	± 0.00
20	257	Indian	Subsistence	0.01	± 0.01	0.02	± 0.01	0.02	± 0.01	0.004	± 0.004
20	39	Indian	Artisanal	0.00	± 0.00	0.03	± 0.03	0.00	± 0.00	0.03	± 0.002
30	354	Indian	Subsistence	0.00	± 0.00	0.01	± 0.005	0.02	± 0.01	0.008	± 0.006
30	19	Indian	Artisanal	0.00	± 0.00	0.11	± 0.07	0.16	± 0.12	0.00	± 0.00
40	733	Indian	Subsistence	0.001	± 0.001	0.01	± 0.003	0.00	± 0.00	0.02	± 0.006
40	13	Indian	Artisanal	0.00	± 0.00	0.15	± 0.15	0.00	± 0.00	0.00	± 0.00

Table 26. The mean (± s.e.) number of male children per household of each ethnic group in each stratum who reported making subsistence and artisanal fishing trips.

				Number of male children fishing from subsistence/commercial households							
Stratum	Houses	Race	Type	3–7 per week		1–2 per week		> 1 per month		< 1 per month	
				Mean	± s.e.	Mean	± s.e.	Mean	± s.e.	Mean	± s.e.
10	121	Fijian	Subsistence	0.01	± 0.01	0.03	± 0.03	0.00	± 0.00	0.00	± 0.00
10	179	Fijian	Artisanal	0.01	± 0.01	0.01	± 0.01	0.00	± 0.00	0.00	± 0.00
20	46	Fijian	Subsistence	0.00	± 0.00	0.02	± 0.02	0.00	± 0.00	0.02	± 0.02
20	33	Fijian	Artisanal	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00
30	65	Fijian	Subsistence	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00
30	41	Fijian	Artisanal	0.00	± 0.00	0.05	± 0.04	0.00	± 0.00	0.00	± 0.00
40	260	Fijian	Subsistence	0.02	± 0.01	0.05	± 0.02	0.02	± 0.01	0.01	± 0.01
40	35	Fijian	Artisanal	0.00	± 0.00	0.03	± 0.03	0.03	± 0.03	0.00	± 0.00
10	39	Indian	Subsistence	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00
20	257	Indian	Subsistence	0.00	± 0.00	0.03	± 0.01	0.02	± 0.01	0.00	± 0.00
20	39	Indian	Artisanal	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00
30	354	Indian	Subsistence	0.00	± 0.00	0.01	± 0.01	0.003	± 0.003	0.003	± 0.003
30	19	Indian	Artisanal	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00
40	733	Indian	Subsistence	0.003	± 0.003	0.001	± 0.001	0.01	± 0.006	0.006	± 0.003
40	13	Indian	Artisanal	0.00	± 0.00	0.00	± 0.00	0.15	± 0.15	0.00	± 0.00

Table 27. The mean (± s.e.) number of female children per household of each ethnic group in each stratum who reported making subsistence and artisanal fishing trips.

				Number of female children fishing from subsistence/commercial households							
Stratum	Houses	Race	Type	3-7 per week		1-2 per week		> 1 per month		< 1 per month	
				Mean	± s.e.	Mean	± s.e.	Mean	± s.e.	Mean	± s.e.
10	121	Fijian	Subsistence	0.00	± 0.00	0.04	± 0.02	0.00	± 0.00	0.02	± 0.02
10	179	Fijian	Artisanal	0.01	± 0.01	0.03	± 0.01	0.00	± 0.00	0.01	± 0.006
20	46	Fijian	Subsistence	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00
20	33	Fijian	Artisanal	0.00	± 0.00	0.03	± 0.03	0.00	± 0.00	0.00	± 0.00
30	65	Fijian	Subsistence	0.03	± 0.03	0.06	± 0.04	0.00	± 0.00	0.00	± 0.00
30	41	Fijian	Artisanal	0.00	± 0.00	0.08	± 0.05	0.00	± 0.00	0.00	± 0.00
40	260	Fijian	Subsistence	0.00	± 0.00	0.04	± 0.01	0.02	± 0.01	0.00	± 0.00
40	35	Fijian	Artisanal	0.00	± 0.00	0.03	± 0.03	0.00	± 0.00	0.00	± 0.00
10	39	Indian	Subsistence	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00
20	257	Indian	Subsistence	0.004	± 0.004	0.004	± 0.004	0.004	± 0.004	0.00	± 0.00
20	39	Indian	Artisanal	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00
30	354	Indian	Subsistence	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00
30	19	Indian	Artisanal	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00
40	733	Indian	Subsistence	0.00	± 0.00	0.001	± 0.001	0.001	± 0.001	0.001	± 0.001
40	13	Indian	Artisanal	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00

c) The main fishing techniques being used and the people who are using them

Respondents were asked to identify in rank order the most important fishing methods, in terms of time, used by members of their household.

There were 14 different fishing methods recorded:

a) Handline — the use of a hook and line without any sinker (a small one might be pinched to the line in order to assist the propulsion of the bait away from the fisher) e.g. a line being thrown from the shore, usually used in shallow water.

b) Dropline — the use of a hook and line with the addition of a sinker. Usually used in deeper water than hand lines.

c) Towline (trolling) — the use of a line to drag a lure or bait behind a boat which is moving forward.

d) Gill net (Set) — the use of a gill net by anchoring it in one position for at least a few hours. No people chasing fish into the net.

e) Gill net (Drive) — the use of a gill net which is set in a position and then fish are chased towards it by fishers.

f) Spear — the use of a sharp pointed stick/ metal pole to stab fish.

g) Collection — the use of hands to pick up and collect marine/freshwater products e.g. shells, seaweeds etc.

h) Duva — the use of poison to kill fish.

i) Yavirau — a traditional fish drive using vines.

j) Fishing poles — the use of a hook and line which is attached to the end of a pole to act like a fishing rod.

k) Cast net — the use of a net which surrounds a fish/school of fish when it is thrown (cast) at them by the fisher.

l) Push net — the use of a short piece of net which is tied at its ends to pieces of stick which can then be pushed along by one person.

m) Crab trap — the use of a baited net trap to catch crabs.

n) Other — any other fishing technique not listed above.

The rankings were assigned a 'score' depending on the importance of the method to the household (14 for the most important method reducing by one for each decrease in ranking). A weighted index of relative importance for each fishing method was then calculated by summing the score for each method across all households, and then dividing

the score by the number of households reporting to use at least one fishing technique.

A plot of the different fishing methods against their corresponding weighted index is given in Figure 2. The indices were calculated for the overall responses as well as separately for Fijian and Indian households.

Handline fishing was the predominant method identified across all groups and was more than twice as important than any other method. Overall, the next most important methods were the use of push nets, spear fishing, collection and 'other' methods.

Some of the 'other' techniques included the following:

i) Bubura/Bura — the use of a long steel rod to capture eels both in fresh and sea water.

ii) Naimuso — the use of a stick (a mangrove root) to pin down crabs.

iii) Cina — the use of a source of light to attract fish. Typical sources of light include kerosene lamps, torches, burning coconut fronds and more recently portable generators.

iv) Bottles — a mixture of flour and water is used to bait bottles which are set in rivers to catch small mullet.

There were some significant differences in the use of fishing methods between the two races. Fijians are much more involved in the activities of spear fishing and collection than Indians.

The use of fishing methods varied between the different sexes for Fijians and Indians. The proportion of males and females of the total reported number of people carrying out a particular method is shown in Figures 3 and 4 for Fijians and Indians, respectively. For Fijians, this clearly shows that some methods such as spear fishing, gill netting and droplining are predominantly used by males. Push nets, fishing poles and collecting of items are activities undertaken primarily by females. The situation for Indian people is different with males being the predominant users of all techniques. The method most favoured by female Indians was the push net (Fig. 4).

d) The main habitat areas for fishing

Respondents were asked to identify in rank order the most important fishing (habitat) areas, in terms of time, used by members of their household.

There were fourteen different areas identified on the questionnaire form as follows:

a) Distant area — fishing in an area distant from the village/settlement where the household is located e.g. in the open ocean, on another island etc.

b) Around a fish aggregating device — fishing around an anchored raft which has been deployed to attract fish.

c) Outside edge of outer reef — fishing on the ocean side of the drop-off of the outer (barrier) reef.

d) On the outer reef — fishing actually on the outer (barrier) reef.

e) Inside lagoon (deep water) — fishing in the area between the outer reef and the shore in depths of greater than 10 m.

f) Inside lagoon (shallow water) — fishing in the area between the outer reef and the shore in depths of less than 10 m. This usually means fishing around shallow patch reefs.

g) Along shoreline — fishing from the shoreline or standing in shallow water adjacent to the shoreline. This area can be reached by foot and a boat is not required. This also includes intertidal areas.

h) Along the edge of mangroves — fishing in the shallow area adjacent to patches of mangroves. This also includes intertidal areas.

i) Amongst mangroves — fishing in an area (or channel) that is surrounded by mangroves.

j) Estuary or River — fishing anywhere along the stretch of a river.

k) Fish pond — fishing in artificial ponds holding cultured fish.

l) Lake — fishing in an open expanse of inland water.

j) Wharf — fishing from the edge of a jetty.

k) Other — fishing in an area not covered by the above list.

Rankings were again assigned a score and a weighted index of relative importance was produced for each habitat area.

Figure 5 is a plot of the weighted index of relative importance for each habitat area by stratum. The location of households had a large influence on the fishing areas used. Coastal households (stratum

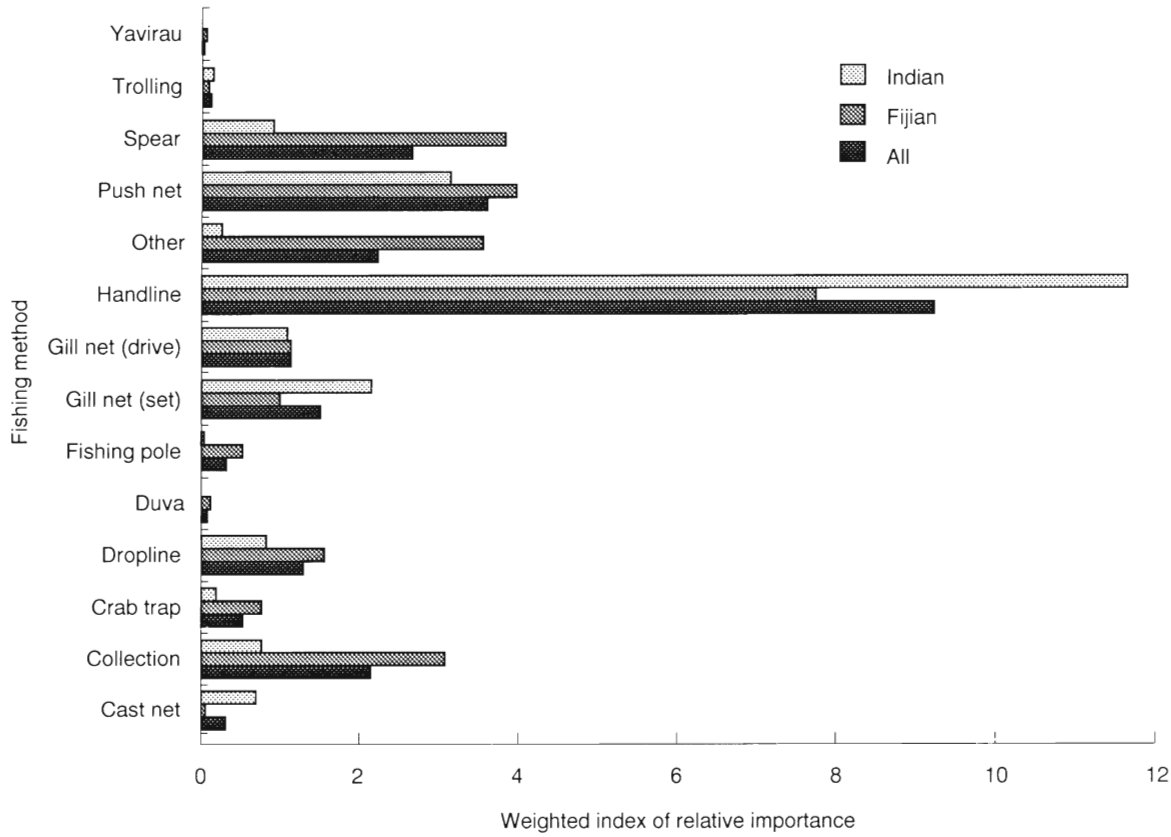

Figure 2. Relative importance of fishing methods reported from a questionnaire survey.

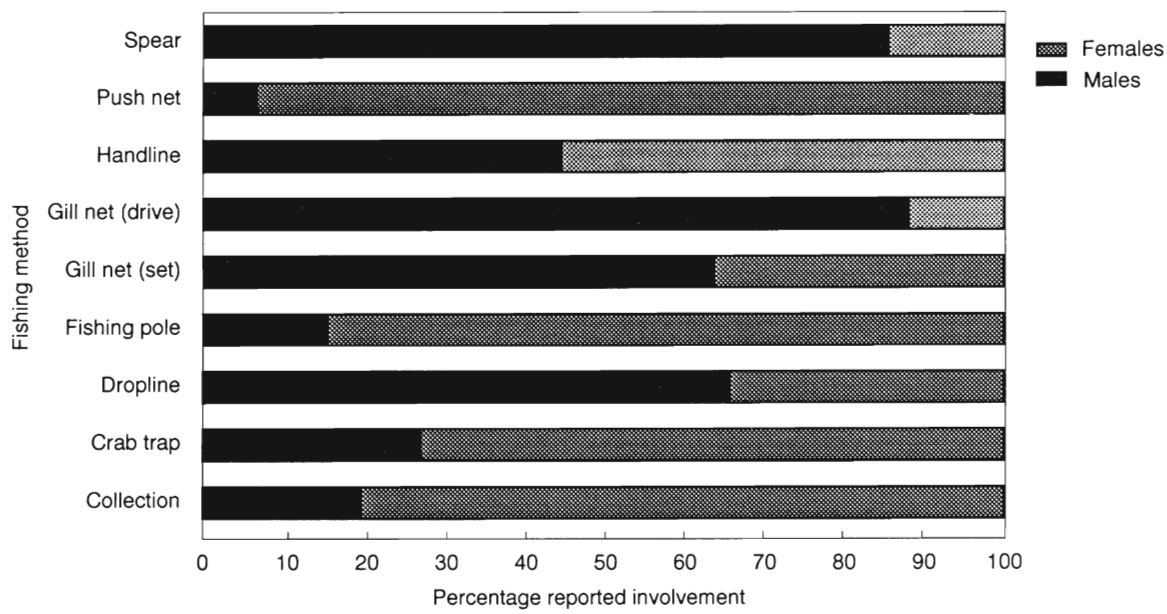

Figure 3. Comparison of fishing methods used by Fijian males and females.

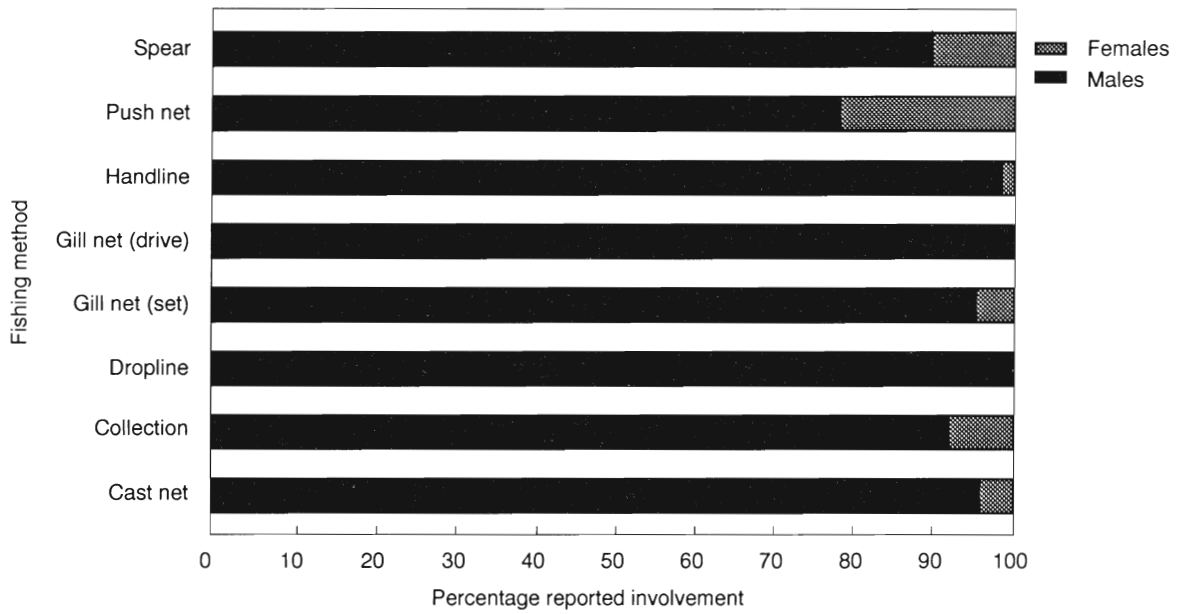

Figure 4. Comparison of fishing methods used by Indian males and females.

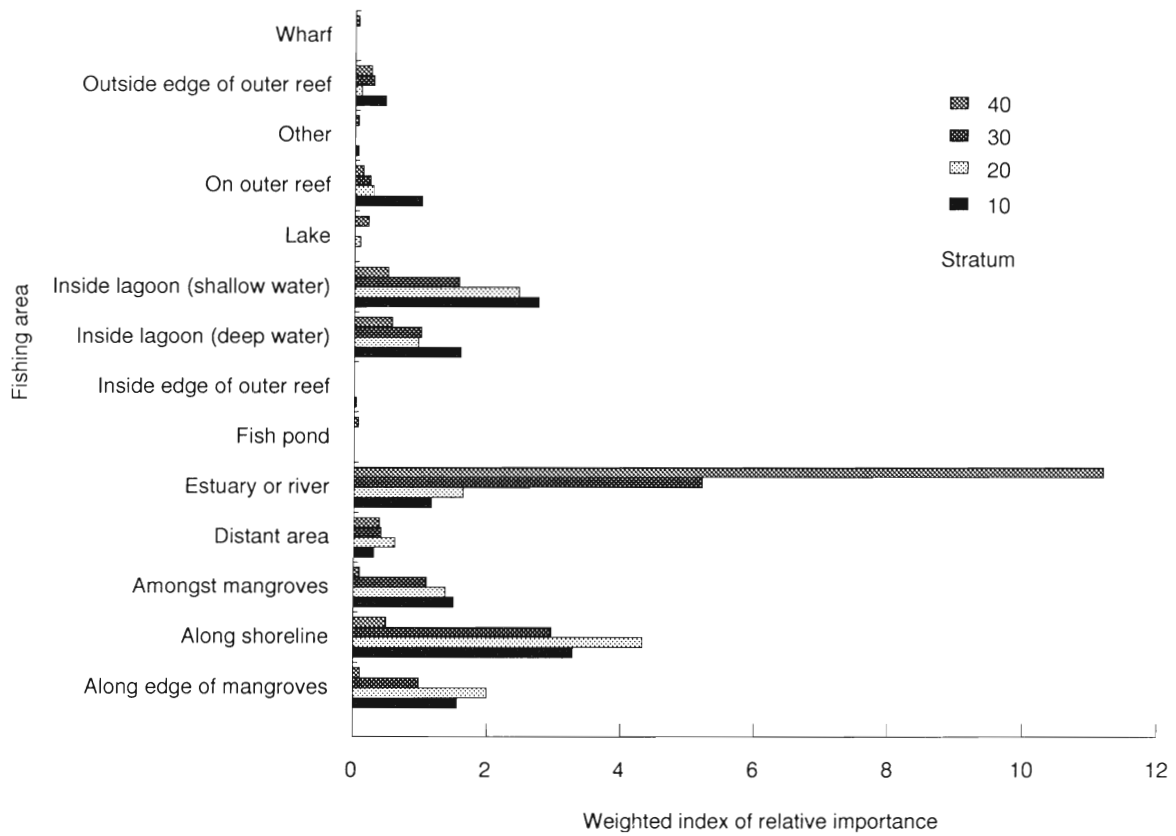

Figure 5. Relative importance of fishing areas used by stratum.

10) concentrate their effort in the lagoon areas [e.g. along the shoreline, inside lagoon (both deep and shallow)] close to their village. Fishing in and around mangrove areas was reported to be the next most important fishing area. Households living inland (stratum 40) undertake fishing activities primarily in the rivers although they also report making occasional trips to the sea.

Estuaries and rivers are the most important fishing areas to the people of Viti Levu. Most of the catch coming from this habitat is used for subsistence purposes (Fig. 6). Lagoonal and mangrove areas are used predominantly for the capture of commercial species. Fishing from along the shoreline was reported to be more important for the harvesting of products for consumption at home, but selling the catch from this area was considered to be nearly as important.

e) The potential fishing power of families based on establishing their fishing assets

During the questionnaire, respondents were asked about their ownership of fishing gear and the numbers of each type they possessed.

Table 28 details the different fishing gears and the numbers of each type reported as owned by each race.

Handlines were the most numerous fishing gear owned. Seven hundred and eight households (31.4%) were reported owning an average of 4 handlines each. The next most abundant item were push nets owned by 214 (9.5%) households. Few households owned a spear gun or towlines although those that owned these items usually had more than one (Table 28).

There were some significant differences between Fijians and Indians in the number and proportion of households owning particular items. More Fijian households owned spear-fishing equipment (goggles, spears) than Indians but the numbers owned by each household were similar. Indian households had significantly more gill nets than Fijians (t-test; $P < 0.05$) but the numbers of households were similar. Many more Fijians owned push nets, but those Indian households that possessed them had a significantly larger number (t-test; $P < 0.001$).

Few of the households reported owning boats (11%) (Table 29). Fijians owned more boats than Indians but the types owned by each group were similar. Indians owned more powered canoes, but wooden punts were the most common type recorded (Table 29). Not surprisingly coastal villagers owned more boats than those living

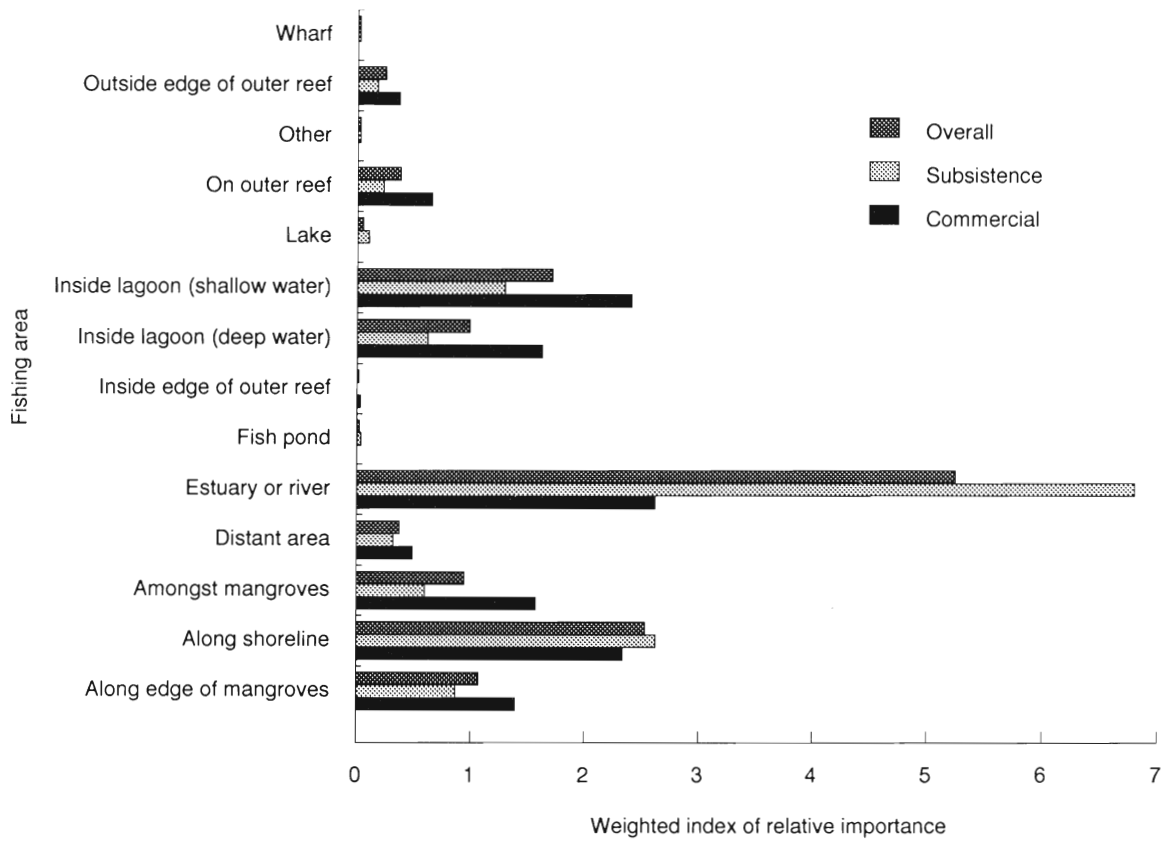

Figure 6. Relative importance of fishing areas used by fate of catch.

Table 28. The total number of households reporting owning at least one item of fishing gear (households), the total number of each type owned (Sum) and the mean number ± standard error owned for households reporting to possess at least one type (Mean).

Gear	Race	Households	Sum	Mean ± s.e.
Handline	Fijian	372	1381	3.71±0.15
	Indian	335	1507	4.49±0.24
	All	708	2891	4.08±0.14
Dropline	Fijian	52	186	3.57±0.54
	Indian	23	87	3.78±0.90
	All	78	286	3.67±0.45
Towline	Fijian	4	10	2.50±0.65
	Indian	5	15	3.00±0.84
	All	9	25	2.78±0.52
Spear (gun)	Fijian	72	133	1.85±0.14
	Indian	3	6	2.00±0.08
	All	75	139	1.85±0.10
Spear (hand)	Fijian	148	265	1.79±0.12
	Indian	23	31	1.35±0.15
	All	171	296	1.73±0.10
Goggles	Fijian	153	219	1.43±0.06
	Indian	2	2	1.00±0.00
	All	155	221	1.43±0.06
Gill net	Fijian	58	131	2.25±0.35
	Indian	69	378	5.48±0.99
	All	132	522	3.95±0.55
Push net	Fijian	158	209	1.32±0.06
	Indian	56	226	4.04±0.28
	All	214	435	1.72±0.14
Other gear	Fijian	111	267	2.41±0.27
	Indian	19	68	3.58±1.30
	All	132	337	2.55±0.29

Table 29. The total number of households (HH), maximum number of boats per household (Max) and the total number of boats of that type (Sum) reported by all (Total), Fijian and Indian households surveyed.

	Total			Fijian			Indian		
Type of boat	HH	Max	Sum	HH	Max	Sum	HH	Max	Sum
Paddle canoe	15	2	16	5	1	5	10	2	11
Powered canoe	56	2	57	17	1	17	37	2	38
Fibreglass boat	3	1	3	3	1	3	0	0	0
Wooden punt	96	2	101	69	2	70	26	2	30
FAO design	2	2	3	0	0	0	2	2	2
Other boat	19	1	19	10	1	10	7	1	7
Total			199			105			88

Table 30. The number of households (HH), maximum number of boats per household (Max) and the total number of boats in a stratum (Sum) reported during the questionnaire survey.

Type of boat	Stratum											
	10			20			30			40		
	HH	Max	Sum	HH	Max	Sum	HH	Max	Sum	HH	Max	Sum
Paddle canoe	3	1	3	8	2	9	3	1	3	1	1	1
Powered canoe	12	1	12	24	1	24	11	1	11	9	2	10
Fibreglass boat	3	1	3	0	0	0	0	0	0	0	0	0
Wooden punt	52	1	52	24	2	26	11	1	11	9	2	12
FAO design	0	0	0	0	0	0	0	0	0	3	2	3
Other boat	3	1	3	3	1	3	1	1	1	12	1	12
Total			73			62			26			38

further inland (Table 30). No household reported owning more than two boats of any particular type and most owned only one. Powered boats were more prevalent among people living in stratum 20. This is probably because more Indians live in this stratum than in stratum 10.

f) A list of marine products that are being utilised including the main fish groups

Respondents to the questionnaire were asked to identify the main target species from the fishing grounds that they utilised (section 5 of questionnaire form). Taxa were given in local Fijian names which were translated into their scientific equivalent. Attachment E lists the different Fijian names and the scientific equivalents that were used during the analysis of the survey results.

The numbers of times a species was reported were summed for each of the different habitat areas. The reported target lists are given in Tables 31 – 38.

Generally the lists for each habitat area were extensive but many of the species were only identified by one respondent on one occasion. The details of the main species identified are discussed more fully in Section 5.

g) Marine product consumption

1) The frequency of marine product consumption by households

In section 7 of the questionnaire form respondents were asked how often their household consumed fish/aquatic products, including tinned fish.

The majority of households reported consuming these products at least once per week. However, there were families that were vegetarian and never consumed any fish products.

Overall 99.3% of the houses consumed marine products at least once per week (Fig. 7). The greatest percentage (42.0%) of households consumed marine products once per week with a similar proportion (41.1%) eating them more

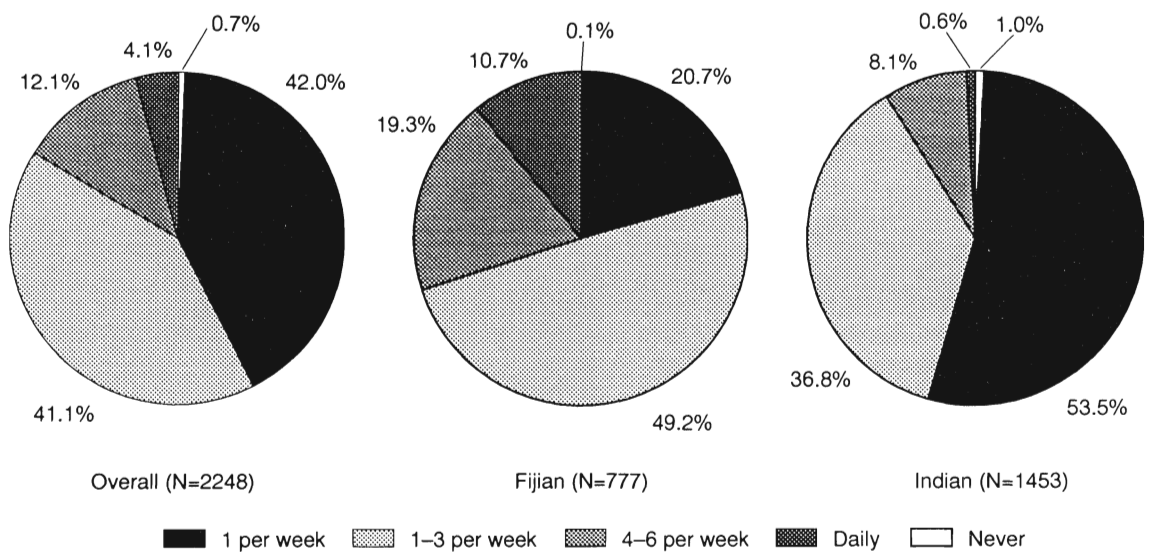

Figure 7. Frequency of consumption of marine products.

Table 31. The frequency of reported target species in estuaries and rivers.

Species	Frequency
Oreochromis mossambicus	384
Anguilla spp.	257
Kuhlia rupestris	173
Prawns	173
Lutjanus argentimaculatus	125
Eleotris melanosoma	136
Carangids	58
Batissa violacea	45
Leiognathus equulus	37
Palaemon concinnus	34
Mugil spp.	30
Shrimps	27
Crabs	26
Kuhlia marginata	25
Ctenopharyngodon idella	37
Mesopristes kneri	15
Terapon jarbua	13
Ophiocara porocephala	11
Ctenochaetus spp.	10
Upeneus vittatus	8
Lutjanus spp.	8
Anguilla marmorata	8
Lethrinus harak	6
Siganus spp.	5
Gerres spp.	4
Herklotsichthys quadrimaculatus	4
Ophioeleotris aporos	4
Acanthurus spp.	3
Sardinella fijiensis	3
Scatophagus argus	3
Megalops cyprinoides	3
Myripristis violaceus	2
Rastrelliger kanagurta	2
Scorpaena spp.	2
Kuhlia spp.	2
Aphareus rutilans	2
Anadara cornea	2
Acanthurus spp.	1
Lutjanus gibbus	1
Trochus niloticus	1
Sphyraena spp.	1
Scorpaena spp.	1
Puntius gonionatus	1
Plotosus lineatus	1
Plectorhynchus spp.	1
Lethrinus nebulosus	1
Epinephelus spp.	1
Other species	37

Table 32. The frequency of reported target species along the shoreline, based on the results of the questionnaire survey.

Species	Frequency
Lethrinus harak	164
Carangids	113
Lutjanus spp.	77
Mugil spp.	69
Lutjanus argentimaculatus	62
Anadara cornea	57
Leiognathus equulus	54
Upeneus vittatus	52
Terapon jarbua	43
Epinephelus spp.	48
Lethrinus mahsena	38
Gerres spp.	26
Siganus spp.	20
Rastrelliger kanagurta	17
Lethrinus nebulosus	15
Sphyraena spp.	12
Crabs	12
Trochus niloticus	10
Hemirhamphus far	10
Plectropomus spp.	7
Herklotsichthys quadrimaculatus	6
Mugil cephalus	5
Pseudobalistes flavimarginatus	5
Caulerpa racemosa	5
Metriatyla scabra	4
Mullids	4
Tylosurus crocodilus	4
Scarids	4
Octopus	4
Strombus gibberulus	4
Lutjanus rivulatus	3
Thryssa baelama	3
Eleotris melanosoma	3
Polydactylus plebeius	3
Epinephelus merra	3
Prawns	3
Acanthurus spp.	3
Cheilinus spp.	3
Dasyatids	3
Caranx spp.	2
Sphyraena forsteri	2
Ctenochaetus spp.	2
Chanos chanos	2
Mussels	2
Lethrinus xanthochilus	2
Shells	2
Sea cucumbers	2
Cephalopholis argus	1
Cardisoma carnifex	1
Arothron immaculatus	1
Aprion virescens	1
Naso unicornis	1
Selar crumenopthalmus	1
Scatophagus argus	1
Scarus spp.	1
Sardinella fijiensis	1
Plotosus lineatus	1
Plectorhynchus spp.	1
Kuhlia rupestris	1
Palaemon concinnus	1
Myripristis violaceus	1
Trichiurus lepturus	1
Megalops cyprinoides	1
Tridacna spp.	1
Lutjanus gibbus	1
Engraulids	1
Oreochromis mossambicus	1
Lambis lambis	1
Plectorhynchus chaetodontoides	1
Other species	16

Table 33. The frequency of reported target species from inside the lagoon (shallow water <10 m.) based on the results of the questionnaire survey.

Species	Frequency
Lethrinus harak	98
Carangids	69
Lethrinus mahsena	68
Epinephelus spp.	67
Mugil spp.	45
Lutjanus spp.	42
Lethrinus nebulosus	33
Lutjanus argentimaculatus	27
Sphyraena spp.	24
Leiognathus equulus	21
Lethrinus xanthochilus	21
Siganids	20
Upeneus vittatus	19
Rastrelliger kanagurta	18
Octopus	17
Gerres spp.	11
Lethrinus olivaceus	9
Plectropomus spp.	9
Terapon jarbua	9
Acanthurus spp.	9
Trochus niloticus	9
Pseudobalistes flavimarginatus	8
Naso unicornis	8
Scarids	7
Ctenochaetus spp.	6
Leiognathus equulus	5
Scarus spp.	4
Lutjanus gibbus	3
Mullids	3
Epinephelus merra	3
Sphyraena forsteri	3
Crabs	3
Tylosurus crocodilus	3
Scomberomorus commerson	3
Trichiurus lepturus	3
Parupeneus indicus	3
Scatophagus argus	3
Hemirhamphus far	2
Lethrinus xanthochilus	2
Polydactylus plebeius	2
Plectorhynchus spp.	2
Valamugil seheli	2
Cheilinus spp.	2
Chaetodon spp.	2
Atherinids	2
Dasyatids	1
Sea cucumbers	1
Cheilinus trilobatus	1
Arothron immaculatus	1
Conger cinereus	1
Chirocentrus dorab	1
Carcharhinus spp.	1
Caranx lugubris	1
Bothus spp.	1
Kuhlia marginata	1
Microthele nobillis	1
Plectorhynchus spp.	1
Mulloides vanicolensis	1
Diodon hystrix	1
Mesopristes kneri	1
Sphyraena flavicauda	1
Liza vaigiensis	1
Tridacna spp.	1
Kyphosus spp.	1
Kuhlia rupestris	1
Hyporhamphus dussumieri	1
Gymnothorax fimbriatus	1
Gymnocranius sp.	1
Turtles	1
Mulloides flavolineatus	1
Other species	1

Table 34. The frequency of reported target species from inside the lagoon (deep water > 10 m.) based on the results of the questionnaire survey.

Species	Frequency
Carangids	69
Lethrinus mahsena	54
Epinephelus spp.	48
Lethrinus harak	35
Sphyraena spp.	31
Lethrinus nebulosus	29
Scomberomorus commerson	26
Sphyraena forsteri	19
Lutjanus argentimaculatus	18
Lutjanus spp.	18
Plectropomus spp.	11
Terapon jarbua	10
Rastrelliger kanagurta	9
Mugil spp.	9
Leiognathus equulus	9
Ctenochaetus spp.	8
Upeneus vittatus	7
Naso unicornis	6
Lethrinus olivaceus	3
Valamugil seheli	3
Lethrinus xanthochilus	3
Scarids	3
Acanthurus spp.	3
Diodon hystrix	2
Siganids	2
Gerres spp.	2
Lutjanus bohar	2
Lutjanus gibbus	2
Pseudobalistes flavimarginatus	2
Carcharhinus spp.	1
Dasyatids	1
Cheilinus spp.	1
Acanthocybium solandri	1
Aprion virescens	1
Mulloides vanicolensis	1
Mesopristes kneri	1
Platax orbicularis	1
Lutjanus rivulatus	1
Sardinella fijiensis	1
Pristipomoides spp.	1
Epinephelus lanceolatus	1
Herklotsichthys quadrimaculatus	1
Hemirhamphus far	1
Myripristis violaceus	1
Trachinotus baillonii	1
Epinephelus merra	1
Plectorhynchus spp.	1
Other species	6

Table 35. The frequency of reported target species from mangrove areas, based on the results of questionnaire survey.

Species	Frequency
Scylla serrata	133
Mugil spp.	35
Lutjanus spp.	33
Lutjanus argentimaculatus	33
Carangids	27
Leiognathus equulus	24
Lethrinus harak	24
Terapon jarbua	17
Gerres spp.	16
Prawns	15
Siganids	13
Anadara cornea	13
Epinephelus spp.	13
Oreochromis mossambicus	10
Rastrelliger kanagurta	9
Palaemon concinnus	9
Hemirhamphus far	7
Upeneus vittatus	7
Herklotsichthys quadrimaculatus	7
Cardisoma carnifex	6
Sphyraena spp.	5
Acanthurus spp.	4
Lethrinus nebulosus	4
Lethrinus mahsena	3
Dasyatids	3
Trochus niloticus	3
Chanos chanos	3
Eleotris melanosoma	2
Parupeneus indicus	2
Tylosurus crocodilus	1
Sea cucumbers	1
Thryssa baelama	1
Sicyopterus spp.	1
Shark	1
Selar crumenopthalmus	1
Shells	1
Scomberoides spp.	1
Pseudobalistes flavimarginatus	1
Plotosus lineatus	1
Plectorhynchus spp.	1
Muraenesox cinereus	1
Metriatyla scabra	1
Mesopristes kneri	1
Megalops cyprinoides	1
Tridacna spp.	1
Liza vaigiensis	1
Scarids	1

Table 36. The frequency of reported target species from fringing reefs.

Species	Frequency
Trochus niloticus	16
Lethrinus mahsena	18
Carangids	11
Lethrinus harak	12
Epinephelus spp.	13
Tridacna spp.	8
Octopus spp.	8
Sphyraena spp.	7
Lethrinus nebulosus	7
Plectropomus spp.	5
Lambis lambis	5
Scomberomorus commerson	4
Siganids	4
Mugil spp.	3
Sphyraena forsteri	3
Naso unicornis	3
Metriatyla scabra	2
Sea cucumbers	2
Panilurus spp.	2
Lutjanus spp.	2
Plectorhynchus spp.	2
Turtle	2
Scarids	2
Gerres spp.	1
Tridacna maxima	1
Anadara cornea	1
Ctenochaetus spp.	1
Epinephelus merra	1
Lutjanus argentimaculatus	1
Rastrelliger kanagurta	1
Hypnea spp.	1
Prawns	1
Plectorhynchus chaetodontoides	1
Myripristis violaceus	1
Other species	7

Table 37. List of the reported target species from outside the edge of the outer reef.

Species	Frequency
Sphyraena spp.	13
Epinephelus spp.	14
Carangids	11
Lethrinus mahsena	7
Scomberomorus commerson	7
Lethrinus nebulosus	6
Lutjanus argentimaculatus	6
Lethrinus harak	6
Naso unicornis	4
Pseudobalistes flavimarginatus	4
Pristipomoides spp.	4
Plectropomus spp.	3
Mugil spp.	3
Lutjanus spp.	2
Rastrelliger kanagurta	2
Chaetodon spp.	2
Lethrinus xanthochilus	2
Lambis lambis	1
Carangoides spp.	1
Gymnosarda unicolor	1
Bolbometapon muricatus	1
Lutjanus gibbus	1
Paracaesio kusakari	1
Mesopristes kneri	1
Mullids	1
Carcharhinus spp.	1
Terapon jarbua	1
Plectorhynchus spp.	1
Tridacna niloticus	1
Diodon hystrix	1
Scarids	1
Tridacna maxima	1

Table 38. The frequency of reported target species from distant areas (based on the results of the questionnaire survey).

Species	Frequency
Carangids	21
Scomberomorus commerson	16
Sphyraena forsteri	13
Mugil spp.	12
Lethrinus nebulosus	10
Lethrinus mahsena	10
Leiognathus equulus	7
Sphyraena spp.	7
Lutjanus argentimaculatus	6
Lethrinus harak	5
Upeneus vittatus	3
Epinephelus spp.	3
Thunnus spp.	2
Lutjanus spp.	2
Rastrelliger kanagurta	2
Siganids	2
Lethrinus olivaceus	1
Acanthurus spp.	1
Caranx lugubris	1
Epinephelus lanceolatus	1
Gerres spp.	1
Gymnocranius robinsoni	1
Lutjanus bohar	1
Lethrinus xanthochilus	1
Lutjanus gibbus	1
Plectropomus leopardus	1
Other species	7

frequently than this (2 to 3 times/week). A further 16.2% consumed marine products more regularly than this with 4.1% of households reporting daily consumption. Only 0.7% of households never ate these products.

Fijian households generally consumed marine products more regularly than Indian households. About 79% of Fijian households consumed these items more than once per week with the majority of the remainder (20.7%) reporting consumption at least once per week. Just over half of the Indian households (53.5%) reported consumption once per week. The remainder consumed marine products more regularly than this. The major proportion consumed these items two or three times per week. One percent of Indian households never ate marine products (Fig. 7).

The pattern of household consumption of marine products varied across the strata (Fig. 8). Generally, households in stratum 10 consumed marine products more regularly than households further inland. The frequency of consumption across strata 20, 30 and 40 are similar, with most households (approximately 45.0%) reporting eating once per week. The proportion of households in stratum 20 eating marine products 4 to 6 times/week was twice that of households in strata 30 and 40.

2) Source of marine products consumed

In Section 7 of the questionnaire, respondents were asked to rank the major source of their marine products in order of their importance under the following categories:

a) Own caught — consumption of marine products that have been caught by a member of the household.

b) Bought fish — consumption of marine products that have been purchased.

c) Free fish — consumption of marine products that have been given to the household.

d) Tinned fish — consumption of tinned fish.

e) Other — consumption of marine products which have come from an alternative source to those listed above e.g. fish harvested from aquaculture ponds.

The rankings were assigned a 'score' depending on the importance of the source of marine products to the household (the most important method scored 5). A weighted index of relative importance for each source was then calculated by summing the score for each source across all households, and dividing this score by the number of households receiving marine products from that source.

The weighted index of relative importance for each source for Fijian, Indian and all households is given in Figure 9. For Fijian families the major source of marine products is their own catch and for Indian households the purchase of marine products is most important. The consumption of

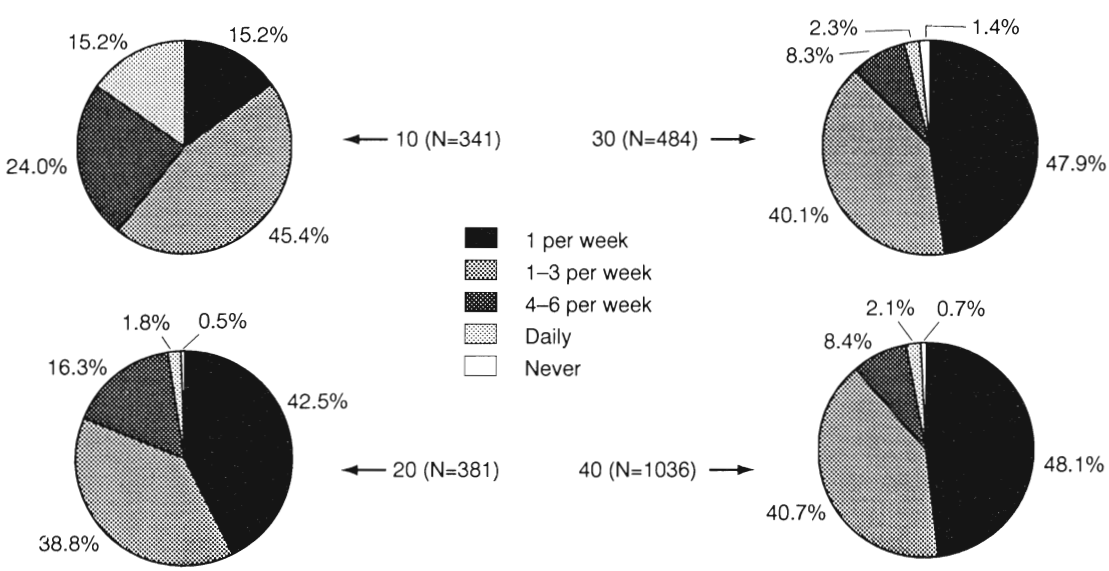

Figure 8. Frequency of consumption of marine products by stratum.

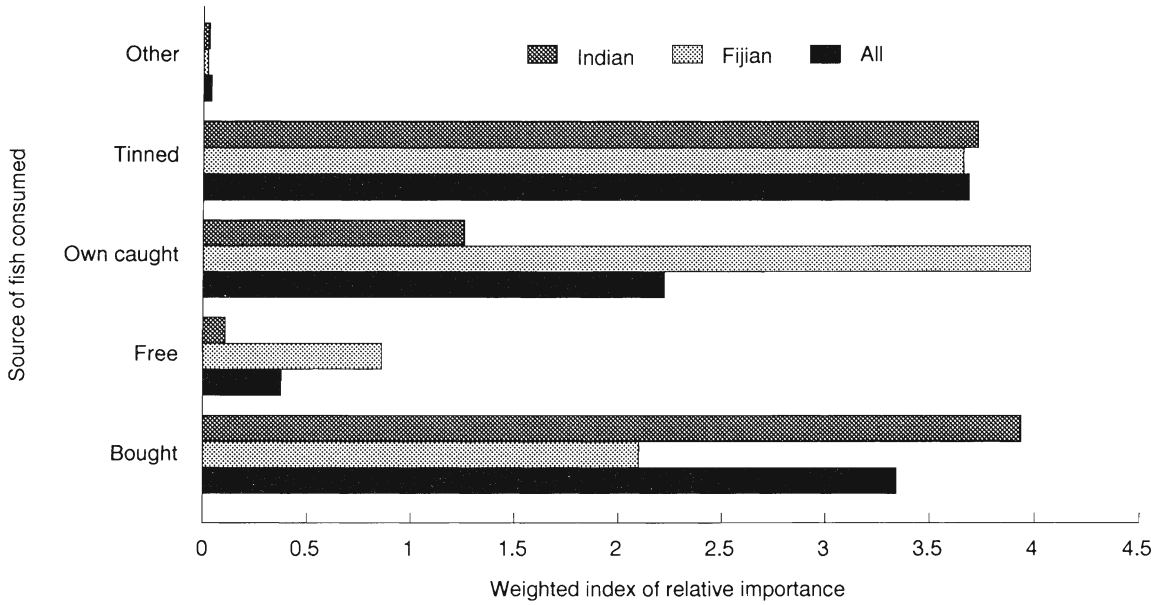

Figure 9. Relative importance of source of marine products consumed.

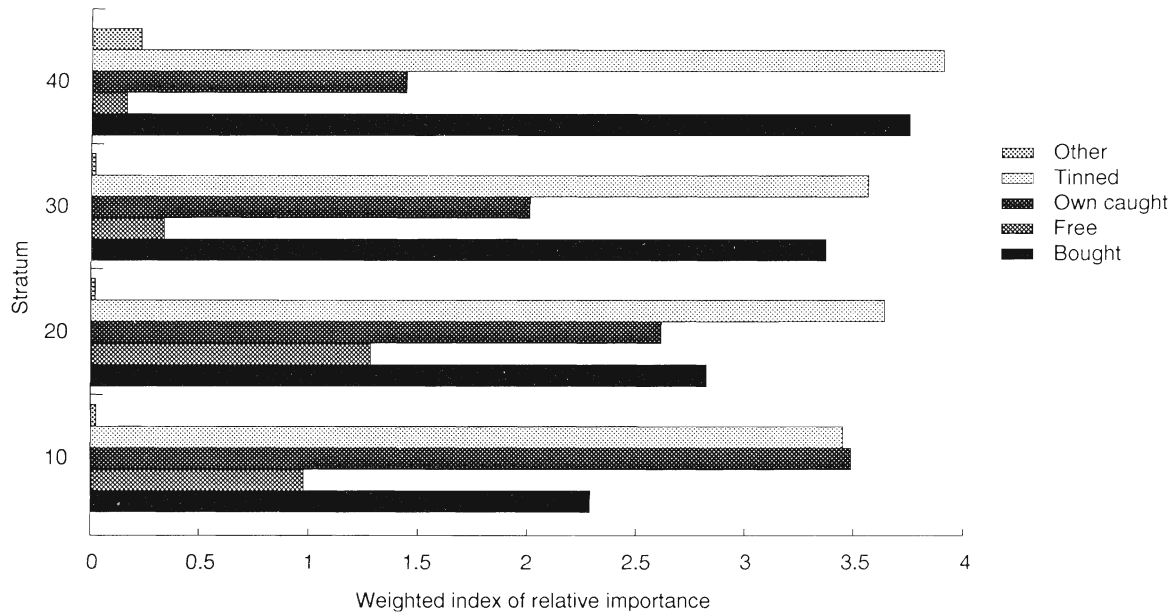

Figure 10. Relative importance of source of marine products consumed by stratum.

tinned fish was equally important to both Fijian and Indian households. Free fish is the least important source of marine products for both Fijian and Indian households though this practice is more common amongst Fijian families.

The relative importance of different sources of marine products consumed across each strata is given in Figure 10. The use of tinned fish is the most important for households across all strata except stratum 10 where own caught products is slightly more important. The purchase of fishery products and tinned fish increases in importance further inland. The reverse pattern is evident for own caught marine products. Free fish is more important in households in strata 10 and 20 than strata 30 and 40 due to the predominance of Fijian households in these areas and the higher levels of fishing effort resulting in more available product.

B) Creel Survey

A total of 123 fishing trips made by individuals or fishing groups was recorded during the creel survey. Effort was recorded for all of these trips

Table 39 . Number of trips, mean number of people (± s.e), total number of people for fishing trips with males only (Males), females only (Females), trips with combinations of males and females (Groups), all trips (All), and the trip length (hrs) and number of fisher hours for each village surveyed.

Village	Trips	Males	Females	Groups	All	Trip length (hrs)	Fisher hours
Namatakula	Trips	8	7	0	15	15	15
	Mean	3.13 ± 0.79	1.29 ± 0.18	-	2.27 ± 0.48	3.32 ± 0.65	6.12 ± 1.06
	Total	25	9	0	34	49.75	91.75
Namuaimada	Trips	11	26	1	38	38	38
	Mean	1.45 ± 0.16	1.65 ± 0.49	2.00	1.63 ± 0.20	5.09 ± 0.50	8.48 ± 1.04
	Total	16	43	2	61	193.35	322.50
Ucunivanua	Trips	16	15	9	40	40	40
	Mean	2.56 ± 0.67	1.67 ± 0.53	3.22 ± 0.60	2.38 ± 0.36	4.21 ± 0.38	10.37 ± 0.32
	Total	41	25	29	95	168.40	414.90
Votua	Trips	11	11	8	30	30	30
	Mean	4.00 ± 0.43	4.00 ± 1.09	3.75 ± 1.15	3.93 ± 0.51	5.33 ± 0.55	23.10 ± 4.76
	Total	44	44	30	118	159.80	692.9
Total	Trips	46	59	18	123	123	123
	Mean	2.74 ± 0.15	2.05 ± 0.20	3.38 ± 0.58	2.51 ± 0.20	4.64 ± 0.25	12.38 ± 1.49
	Total	126	121	61	308	571.30	1,522.15

which represented 1,522.15 fisher hours. The numbers of trips recorded from each village are summarised in Table 39.

Catch was recorded for 118 of these trips. A total of 7,177 individual organisms weighing 1,683 kg from 191 taxa was taken.

C) Fish Consumption Survey

There were returns from only three of the four villages surveyed. The combined information included details from 50 households for a total of 250 household days and 943 different meals.

The surveys at Namatakula and Namuaimada were the most successful. In Votua, the first village surveyed, forms were distributed but were not completed or returned. This was probably due to inadequate effort being given to emphasise the exercise. Similarly, the survey of Ucunivanua village also provided poor coverage due to insufficient effort being made to collect the forms. The research team was informed that the majority of the forms would be collected after their departure, but this was not followed up rigorously enough and the information was never forthcoming. Valuable lessons were learned from both occasions. Liaison efforts must be continually made with the people supplying the data. Completed forms should be collected at the end of the survey period rather than relying on a representative of the village.

4. Verification of Questionnaire Survey Data

In order to verify the questionnaire data, fishing activities were monitored at four villages and the results compared with those from the questionnaires at the same villages. Areas where comparisons could be made are: fishing effort in terms of the number of people fishing; the main habitats where fishing activities took place; the main fishing methods used; and species targeted.

A) Fishing Effort

i) Numbers of people fishing

Table 40 details the estimated number of people who undertake fishing activities at the four villages involved in the creel surveys: Namatakula, Namuaimada, Ucunivanua and Votua. Listed in the table are the number of people covered in the responses to the questionnaire interviews. The proportions of adult males and females and male and female children in each village from the interviews have been used to estimate the number of each grouping overall based on the total population reported in the 1986 population census. These figures have then been adjusted by the number of people reported to be fishing in each village. The proportion of the people covered in the interviews was used to estimate the total number of people to be fishing in each village.

The frequency of fishing effort by each of the age and sex groupings for the four villages was extracted from the questionnaire data. These figures were then adjusted by extrapolating by the total number of people estimated to be fishing in each village, as calculated in Table 40. This gave an estimate of the overall frequency of fishing effort within each village. Tables 41–44 detail the reported and estimated numbers of people within each age and sex grouping and the frequency of

Table 40. Numbers of households (HH), people, adult males, adult females, child males and child females who were represented during the course of the questionnaire survey [(Interviewed (Rep)], reported in the 1986 census [Census (est)] including the estimated division by age and sex groupings based on the results from the questionnaire, reported fishing in the questionnaire survey [Fishing (Rep)], and estimated to be fishing [Fishing (Est)] for the four villages visited during the creel surveys. Bold figures are estimates.

Village	Source	HH	People	Adult male	Adult female	Male child	Female child
Namatakula	Interviewed (Rep)	20	138	38	43	37	20
	Census (Est)	27	200	**55**	**62**	**54**	**29**
	Fishing (Rep)	19	43	19	21	0	3
	Fishing (Est)	**26**	**62**	**28**	**30**	**0**	**4**
Namuaimada	Interviewed (Rep)	20	121	25	36	28	32
	Census (Est)	33	219	**45**	**65**	**51**	**58**
	Fishing (Rep)	17	22	9	13	0	0
	Fishing (Est)	**28**	**39**	**16**	**23**	**0**	**0**
Ucunivanua	Interviewed (Rep)	15	99	32	28	19	20
	Census (Est)	49	238	**77**	**67**	**46**	**48**
	Fishing (Rep)	14	27	15	12	0	0
	Fishing (Est)	**46**	**63**	**34**	**29**	**0**	**0**
Votua	Interviewed (Rep)	20	152	49	37	31	35
	Census (Est)	74	545	**176**	**133**	**111**	**125**
	Fishing (Rep)	20	36	20	13	1	2
	Fishing (Est)	**74**	**129**	**72**	**47**	**4**	**7**

Table 41. Reported and estimated frequency of fishing effort by age and sex groupings for Namatakula with estimated number of people fishing on a weekly basis (weekly).

Group	Source	Total	3-7 times per week	1-2 times per week	> 1 per month	< 1 per month
Adult male	Reported	19	8	5	1	5
	Estimated	28	12	7	1	7
Adult female	Reported	21	11	8	2	0
	Estimated	30	16	11	3	0
Child male	Reported	0	0	0	0	0
	Estimated	0	0	0	0	0
Child female	Reported	3	0	3	0	0
	Estimated	4	0	4	0	0
Total	Reported	43	19	16	3	5
	Estimated	62	28	22	4	7
Weekly	Estimated	107.5	84	22	1	0.5

Table 42. Reported and estimated frequency of fishing effort by age and sex groupings for Namuaimada with estimated number of people fishing on a weekly basis (weekly).

Group	Source	Total	3-7 times per week	1-2 times per week	> 1 per month	< 1 per month
Adult male	Reported	9	5	2	2	0
	Estimated	16	9	3.5	3.5	0
Adult female	Reported	13	8	3	2	0
	Estimated	23	14	5	4	0
Child male	Reported	0	0	0	0	0
	Estimated	0	0	0	0	0
Child female	Reported	0	0	0	0	0
	Estimated	0	0	0	0	0
Total	Reported	22	13	5	4	0
	Estimated	39	23	8.5	7.5	0
Weekly	Estimated	79.5	69	8.5	2	0

Table 43. Reported and estimated frequency of fishing effort by age and sex groupings for Ucunivanua with estimated number of people fishing on a weekly basis (weekly).

Group	Source	Total	3-7 times per week	1-2 times per week	> 1 per month	< 1 per month
Adult male	Reported	15	6	9	0	0
	Estimated	34	14	20	0	0
Adult female	Reported	12	6	6	0	0
	Estimated	29	14.5	14.5	0	0
Child male	Reported	0	0	0	0	0
	Estimated	0	0	0	0	0
Child female	Reported	0	0	0	0	0
	Estimated	0	0	0	0	0
Total	Reported	27	12	15	0	0
	Estimated	63	28.5	34.5	0	0
Weekly	Estimated	120.5	86	34.5	0	0

Table 44. Reported and estimated frequency of fishing effort by age and sex groupings for Votua with estimated number of people fishing on a weekly basis (weekly).

Group	Source	Total	3-7 times per week	1-2 times per week	> 1 per month	< 1 per month
Adult male	Reported	20	11	9	0	0
	Estimated	72	40	32	0	0
Adult female	Reported	13	8	5	0	0
	Estimated	47	29	18	0	0
Child male	Reported	1	1	0	0	0
	Estimated	4	4	0	0	0
Child female	Reported	2	0	1	0	1
	Estimated	7	0	3.5	0	3.5
Total	Reported	36	20	15	0	1
	Estimated	130	73	43.5	0	3.5
Weekly	Overall	263	219	43.5	0	0.5

their activities at the villages of Namatakula, Namuaimada, Ucunivanua and Votua. Estimates of the total number of people involved in fishing activities on a weekly basis at each village were calculated by multiplying the numbers of people reporting to go fishing by a factor dependent on their frequency of fishing activity. Factors of 3, 1, 0.5 and 0.25 were used for the frequency groupings 3–7 times/week, 1–2 times/week, more than once per month and less than once per month, respectively.

The fishing effort observed during the creel surveys is summarised in Table 39. At the three sites of Namuaimada, Ucunivanua and Votua the numbers of people fishing were monitored for a week whereas at Namatakula this information was only recorded for three days. No fishing was carried out from any of the villages on a Sunday as it was a day of worship and rest.

Table 45 summarises the number of people estimated to be fishing on a weekly basis from the questionnaire data and the observed number of people from the creel surveys. The observed effort for Namatakula has been multiplied by a factor of two to account for only 3 days of data. The percentage of the estimated fishing effort (in terms of numbers of people) against the observed is also detailed in Table 45. It should be noted that estimates of overall fishing effort are based on an extrapolation from the 1986 census results and a growth factor of 1.07 has been applied.

In all cases the effort observed was lower than that reported. Namuaimada and Ucunivanua had similar percentage (approximately 70%) estimates of the reported effort against the observed. Estimates for Namatakula (59%) and Votua (42%) were less than this.

The lower figures for observed effort against reported effort can be explained by the inability to intercept and record every fishing activity that takes place within a village during the course of a creel survey. Harris et al. (1993) reported recording effectiveness by fisheries observers of 80% during creel survey activities in the Torres Straits.

This is a similar pattern to that recorded from Namuaimada and Ucunivanua. The discrepancy from Votua is much larger. This would be due to the difficulties in observing the activities of many of the people who would have reported fishing. Many of the males who are resident in Votua work as crew on small commercial vessels based in Ba town that go dropline fishing at night and are sometimes away for 2 to 3 days. Many women in

Table 45. Comparison of estimated weekly effort in terms of number of people reporting to go fishing from questionnaire data and the observed number of people fishing during the creel survey.

Village	Estimated weekly effort (people)	Observed weekly effort (people)	Percentage of estimated effort(%)
Namatakula	116	68	58.6
Namuaimada	86	61	70.9
Ucunivanua	130	95	73.0
Votua	281	118	42.0

Votua are involved in the 'kai' fishery, the collection of freshwater clams, *Batissa violacea*, from the Ba river. Both groups leave the village by road to undertake these activities and often return empty-handed as their catch had already been sold or stored elsewhere. It was difficult to intercept all these fishers which would account for the lower level of observed effort. The figure (59%) for Namatakula can be attributed to an important rugby match that took place at the weekend of the creel survey. This led to a high proportion of the residents attending the match and being absent from the village on the Friday and Saturday, usually two of the days when most fishing takes place.

From these data it would seem that the estimated number of people involved in fishing would be fairly accurate for a 'normal' week. However these figures are likely to vary to some degree from week to week depending on outside influences on the normal village routine e.g. festivities and commitments associated with weddings, births, deaths, church activities, sporting events etc., as well as prevailing weather conditions.

ii) Length of fishing trips

In Section 6 of the questionnaire, respondents were asked how long a normal fishing trip lasted. Table 46 lists the numbers of times respondents selected the different categories of average trip length from each of the four villages. In three cases, the mode was trip lengths of between 4–12 hours. For Namatakula the mode was 0–4 hours/trip. Votua also had one respondent reporting a trip length of 1–2 days which would suggest the activities of a crew member of a commercial boat.

The mean length of fishing trips was calculated for the activities during the creel surveys (Table 39). Average trip lengths of 3.32, 5.09, 4.21, 5.33 hours were recorded for Namatakula, Namuaimada, Ucunivanua and Votua, which fits well with the reported average length of fishing trips from the questionnaire survey.

B) Habitats

A weighted index of relative importance for each of the fishing habitats reported as used by respondents to the questionnaire survey was

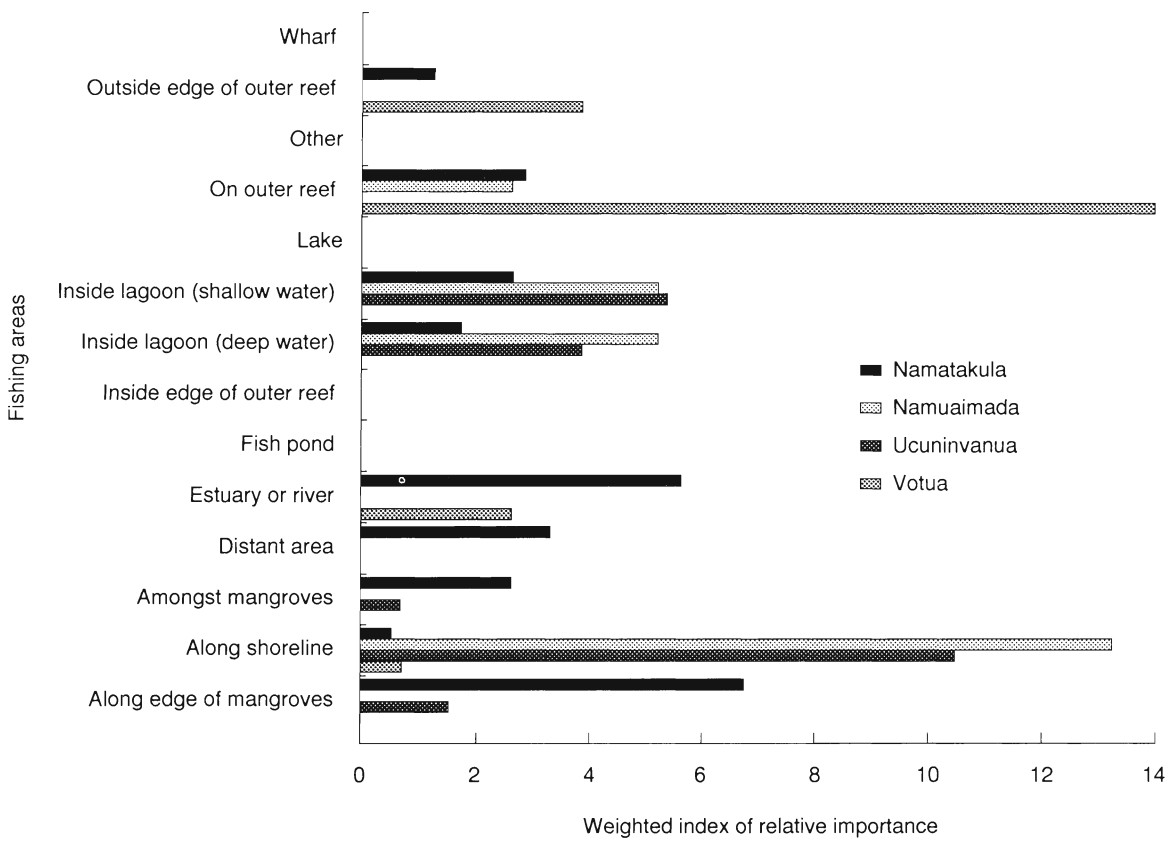

Figure 11. Relative importance of fishing areas by selected coastal Fijian village.

calculated for each of the villages involved in the creel survey (Fig. 11). The figure clearly shows the importance of fishing along the shoreline at Namuaimada and Ucunivanua. The reef at Namatakula and the mangroves in the estuarine system at Votua are the most important.

It should be noted that during interviews the responses suggested that lagoonal areas were most important to the people of Namatakula. This was corrected, as the village is situated next to a reef flat which drops off to the ocean, not a lagoonal area. Interviewers misunderstood the terms being used for each of these fishing areas, something that needs correcting for future surveys.

Table 47 summarises the rankings of reported and observed use of fishing areas. The reported rankings closely follow the observed ones indicating the responses to the questionnaire were accurate.

The discrepancies in rankings between reported and observed (time) at Namuaimada occur because fishing trips along the shoreline are generally short compared with trips made into the lagoon itself. So although more trips were reported and observed from along the shoreline the actual effort observed from the lagoon was greater.

C) Fishing Methods

A weighted index of relative importance for each fishing method was calculated for each village (Fig. 12). Spear fishing, handlining, collection and gillnetting were identified as the most commonly used methods at Namatakula, Namuaimada, Ucunivanua and Votua, respectively. This is expected, as different habitats surround each village. The type of fishing habitat influences the fishing methods that would be effective.

Table 48 summarises the rankings of reported and observed use of fishing methods. There was a close match between the two in most cases e.g. collection and gillnetting were the most important observed and reported methods at Ucunivanua and

Table 46. Number of respondents in the four villages surveyed who reported the length of an average fishing trip.

Length of trip	0–4 hours	4–12 hours	12–24 hours	1–2 days
Namatakula	15	4	–	–
Namuaimada	4	13	–	–
Ucunivanua	2	9	2	–
Votua	1	14	2	1

Table 47. The rank in order of importance of fishing areas reported to be used (Reported), the rank order of the number of trips observed in the village [Observed (Occ)] and the rank order of the number of man hours of operation [Observed (Time)] during the creel surveys.

Village	Method	River	Estuary	Mangroves	Shoreline	Lagoon (S)	Lagoon (D)	On reef	Reef edge
Namatakula	Reported	3	3	-	4	-	-	1	2
	Observed (Occ)	3	-	-	3	-	-	1	2
	Observed (Time)	3	-	-	3	-	-	1	2
Namuaimada	Reported	-	-	4	1	2	3	-	-
	Observed (Occ)	-	-	5	1	3	4	2	-
	Observed (Time)	-	-	5	3	1	4	2	-
Ucunivanua	Reported	-	-	-	1	2	2	4	-
	Observed (Occ)	-	-	-	2	1	-	3	-
	Observed (Time)	-	-	-	2	1	-	3	-
Votua	Reported	2	2	1	8	5	6	3	6
	Observed (Occ)	1	2	3	-	-	5	4	-
	Observed (Time)	1	2	3	-	-	5	4	-

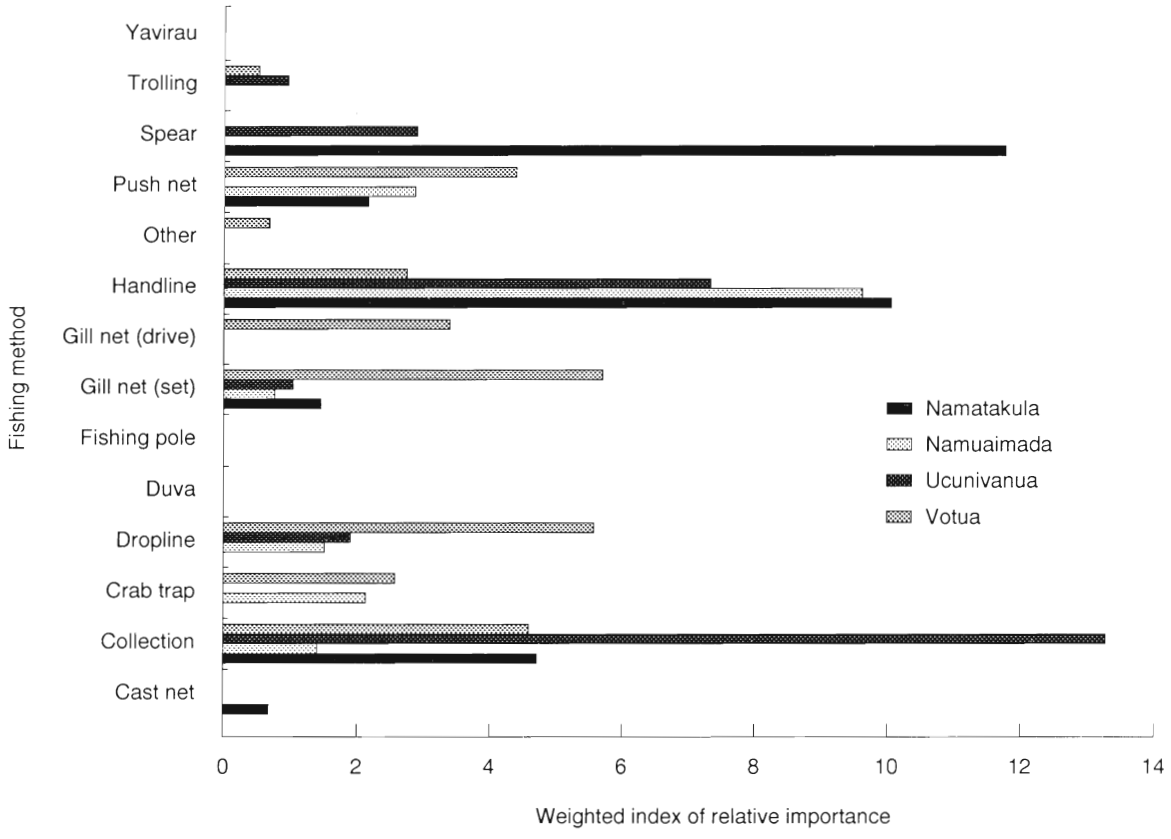

Figure 12. Relative importance of fishing methods by selected coastal Fijian village.

Table 48. The rank in order of importance of fishing methods reported to be used during the questionnaire survey (Reported), the rank order of the number of trips observed in the village [Observed (Occ)] and the rank order of the number of man hours of operation [Observed (Time)] during the creel surveys.

Village	Method	Handline	Dropline	Collection	Spear	Gill net	Push net	Duva	Other
Namatakula	Reported	2	-	-	1	5	-	-	-
	Observed (Occ)	2	4	-	3	1	-	-	-
	Observed (Time)	3	4	-	2	1	-	-	-
Namuaimada	Reported	1	4	5	-	-	2	-	-
	Observed (Occ)	4	3	1	6	-	2	5	7
	Observed (Time)	4	1	3	6	-	2	5	7
Ucunivanua	Reported	2	-	1	3	5	-	-	-
	Observed (Occ)	4	-	1	2	3	-	-	5
	Observed (Time)	4	-	1	2	3	-	-	5
Votua	Reported	4	2	3	-	1	4	-	-
	Observed (Occ)	-	-	3	4	1	2	-	5
	Observed (Time)	-	-	1	4	2	3	-	5

Votua, respectively; the push net was the second-most important observed and reported method at Namuaimada. Generally the most important methods that were reported in the questionnaire were observed during the course of the creel surveys.

Exceptions were the reported use of droplining from Votua village; but no observed trips. This was caused by the difficulties in monitoring dropline fishermen as they were crew members of commercial vessels which would land at the market rather than in the village. The use of poison (duva) was a method that was not reported, but was observed in Namuaimada. This method is generally forbidden and it is not surprising that respondents were not willing to admit to using this technique when questioned.

More thorough sampling over a longer period is likely to produce a closer match between the reported and observed fishing techniques. However, results from the questionnaire generally gave a good indication of the methods that were actually used.

D) Target Species

Respondents to the questionnaire identified the species that they targeted while fishing. The number of observations for each taxa was summed and they are ranked in descending order in Tables 49–52 for Namatakula, Namuaimada, Ucunivanua and Votua, respectively. Included in each of these tables is the number of trips that each of listed taxa were observed.

Table 49. The frequency of species reported to be targeted for in catches from Namatakula and their frequency of occurrence in creel survey catches.

Taxa	Reported	Observed
Lethrinus mahsena	14	0
Octopus spp.	13	3
Lethrinus harak	12	0
Epinephelus spp.	11	2
Trochus niloticus	8	1
Siganids	4	0
Carangids	4	0
Prawns	4	1
Lethrinus xanthochilus	4	0
Terapon jarbua	3	0
Chaetodon spp.	2	5
Lutjanus spp.	2	4
Pseudobalistes flavimarginatus	1	0
Carcharhinus spp.	1	0
Sphyraena spp.	1	0
Cheilinus trilobatus	1	0
Ctenochaetus spp.	1	5
Mesopristes kneri	1	0
Scarids	1	7
Upeneus vittatus	1	0
Kyphosus spp.	1	0
Naso unicornis	1	4
Mulloides flavolineatus	1	0
Lethrinus nebulosus	1	0
Mullids	1	1
Mugil spp.	1	0
Microthele nobillis	1	0
Diodon hystrix	1	0

Table 50. Species reported and observed to be targeted for in catches from Namuaimada.

Taxa	Reported	Observed
Lethrinus mahsena	14	5
Lethrinus harak	13	13
Carangids	11	7
Plectropomus spp.	9	0
Sphyraena spp.	6	9
Scomberomorus commerson	6	3
Gerres spp.	5	14
Mugil spp.	5	4
Siganids	5	12
Lutjanus spp.	4	14
Hemirhamphus far	4	5
Ctenochaetus spp.	3	0
Terapon jarbua	2	10
Crabs	2	6
Rastrelliger kanagurta	2	3
Sphyraena forsteri	2	1
Tylosurus crocodilus	2	1
Epinephelus spp.	1	3
Sea cucumbers	1	1
Cheilinus spp.	1	5
Cephalopholis argus	1	0
Caranx spp.	1	2
Scarus spp.	1	8
Dasyatis spp.	1	0

Table 51. The frequency of species reported to be targeted for in catches from Ucunivanua and their frequency in creel survey catches.

Taxa	Reported	Observed
Anadara cornea	14	9
Lethrinus harak	12	2
Lethrinus mahsena	7	2
Epinephelus spp.	6	1
Caulerpa spp.	5	8
Lethrinus nebulosus	5	4
Carangids	3	0
Lutjanus spp.	3	5
Plectropomus spp.	3	0
Plectorhynchus spp.	2	0
Naso unicornis	2	2
Pseudobalistes flavimarginatus	2	0
Cheilinus spp.	1	0
Scomberomorus commerson	1	1
Sphyraena spp.	1	2
Myripristis violaceus	1	0
Octopus spp.	1	10
Juvenile mullets	1	3

Table 52. The frequency of species reported to be targeted for in catches from Votua and their frequency in creel survey catches

Taxa	Reported	Observed
Mugil spp.	12	11
Scomberomorus commerson	9	1
Rastrelliger kanagurta	8	1
Batissa violacea	6	3
Prawns	6	9
Crabs	6	11
Carangids	5	3
Lethrinus nebulosus	3	1
Sphyraena forsteri	3	1
Lutjanus argentimaculatus	2	0
Epinephelus spp.	2	2
Terapon jarbua	2	0
Anadara cornea	2	1
Eleotris melanosoma	1	0
Epinephelus lanceolatus	1	0
Leiognathus spp.	1	1
Upeneus vittatus	1	4
Lethrinus harak	1	0
Lethrinus xanthochilus	1	0
Lutjanus spp.	1	0
Siganids	1	3
Sphyraena spp.	1	1
Thryssa baelama	1	0
Turtles	1	2
Gerres spp.	1	1

The degree of association between the reported and observed catches was tested using Spearman Rank Correlation. In all cases there was significant correlation between the observed and reported catches:

Namatakula ($r^2 = 0.37$, $p < 0.05$, $n = 28$), Namuaimada ($r^2 = 0.41$, $p < 0.05$, $n = 24$), Ucunivanua [$r^2 = 0.58$, $p < 0.01$, $n = 17$ (Octopus excluded)], and Votua ($r^2 = 0.68$, $p < 0.001$, $n = 26$). Octopus was excluded from the Ucunivanua data set as its high abundance during the creel survey was a seasonal phenomenon.

The reported target species would therefore be a good indication of the main taxa taken by fisher persons in the respective villages. There would be some seasonal differences in the species composition as certain taxa become temporarily available to fishers.

E) Conclusion

Overall the information received during the questionnaire survey seems to be reflected in observations made at the four creel survey sites. This indicates that the questionnaire data can be considered reliable. We can therefore have a good deal of confidence that the overall results coming from the questionnaire survey give an accurate reflection of actual fishing patterns.

5. Fishing Activities in the Different Habitats

The general results from the questionnaire survey suggest that the location of population centres with respect to the coast and to different habitat areas has a major bearing on fishing activities. To assess this, results from the questionnaire and creel surveys were compared under four major habitat groupings.

A) Rivers and Estuaries

i) Questionnaire survey

Rivers and estuaries were identified by respondents as the most important fishing areas (Figs 5 and 6). Both the Fijians and Indians interviewed identified these areas as the most important for their fishing activities (Section 3). The most frequently reported methods used were handlining, push netting and spearing (Table 53). The proportion of households fishing in estuaries and rivers increases dramatically away from the coast (Fig. 13). Over 85% of all fishing activity by households in stratum 40 was undertaken in rivers. This declined to only 9% of households from coastal villages (stratum 10) fishing in local rivers and estuaries.

The most frequently reported species caught in rivers and estuaries were the introduced tilapia (*Oreochromis mossambicus*), eels (probably *Anguilla obscura*), jungle perch (*Kuhlia marginata* and *K. rupestris*) and prawns (Table 31). All these species can be regarded as freshwater species. The most frequently reported estuarine species was *Lutjanus argentimaculatus* which was the fifth most important. In all, 40 different fish and invertebrate species or groups were identified and of these, only 6 were invertebrates. The most commonly reported invertebrate group targeted was prawns (Table 31).

All the most frequently reported target species were fished with the three major fishing methods (Table 54). Handlining was the most important method for all species except the jungle perch whose fishers preferred to use spears, and prawns and shrimps (mainly *Palaemon concinnus* and *Macrobrachium* spp.) for which push nets were used.

Table 53. The number and percentage contribution (in brackets) of each method reported as used in each fishing area (Total = total number of households who identified each area as major fishing ground).

Fishing method	Rivers/estuaries	Lagoons	Mangroves	Fringing reef
Cast net	6 (0.8)	6 (0.8)	5 (1.7)	- (0)
Collection	51 (6.8)	63 (8.5)	79 (27.3)	23 (24.5)
Crab trap	5 (0.7)	2 (0.3)	48 (16.6)	- (0)
Dropline	6 (0.8)	77 (10.4)	- (0)	17 (18.1)
Duva	4 (0.5)	- (0)	- (0)	- (0)
Fishing pole	17 (2.3)	- (0)	- (0)	- (0)
Gill net (set)	13 (1.7)	81 (10.8)	32 (11.1)	4 (4.3)
Gill net (drive)	15 (2.0)	40 (5.4)	8 (2.8)	5 (5.3)
Handline	291 (38.6)	382 (51.5)	71 (24.6)	20 (21.3)
Push net	207 (27.4)	28 (3.8)	28 (9.7)	1 (1.0)
Spear	132 (17.5)	51 (6.9)	15 (5.2)	23 (24.5)
Trolling	- (0)	2 (0.3)	- (0)	1 (1.0)
Other	7 (0.9)	10 (1.3)	3 (1.0)	- (0)
Total	754	742	289	94

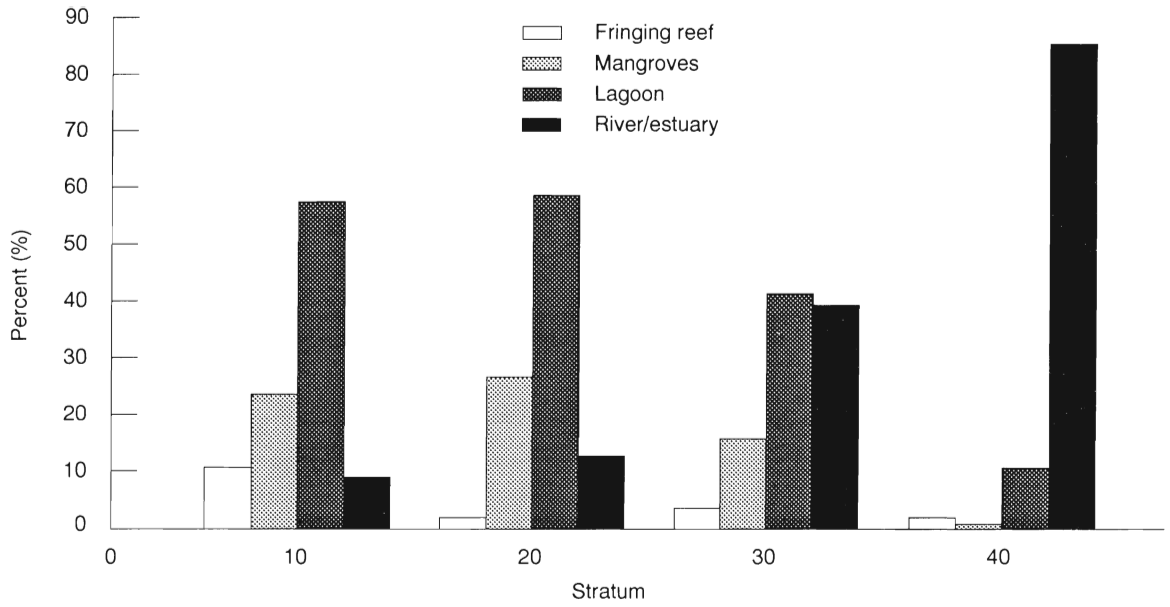

Figure 13. The proportion of households undertaking fishing activities in different habitats.

Table 54. The number of times that each fish and invertebrate taxa were reported as target species of the three major fishing methods used in rivers and estuaries in Viti Levu. Species were included if they were reported to be targeted by a method more than five times and are ranked according to their frequency of occurrence in handlining catches. Numbers in brackets are the percentage of all reports of that species.

Species	Handline	Spear	Push net	Total
Oreochromis mossambicus	187 (51)	92 (25)	55 (15)	369
Anguilla obscura	106 (41)	83 (32)	38 (15)	257
Lutjanus argentimaculatus	102 (82)	6 (5)	8 (6)	125
Kuhlia rupestris	73 (43)	49 (29)	25 (15)	171
Carangids	54 (93)	1 (2)	- (0)	58
Eleotris melanosoma	43 (34)	37 (30)	40 (32)	125
Leiognathus equulus	21 (57)	- (0)	13 (35)	37
Mesopristes kneri	12 (80)	- (0)	1 (7)	15
Terapon jarbua	11 (85)	- (0)	2 (15)	13
Prawns	11 (7)	52 (31)	90 (53)	169
Mugil spp.	10 (34)	1 (3)	5 (17)	29
Kuhlia marginata	7 (25)	13 (46)	3 (11)	28
Lutjanus spp.	7 (78)	- (0)	1 (11)	9
Ophiocara porocephala	6 (55)	1 (9)	- (0)	11
Upeneus vittatus	6 (75)	1 (13)	- (0)	8
Palaemon concinnus	- (0)	- (0)	61 (100)	61
All other species	52 (3)	30 (2)	21 (1)	1,682

ii) Creel survey

A total of 433 kg of fish and invertebrates was recorded from 38 fishing trips to rivers and estuaries. Of this, 172.4 kg (39.8 %) was fish (average 5.3 kg/trip) and 260.6 kg (average 11.3 kg/trip) were invertebrates. Most of the catch (overall: 77%) was sold, especially fish of the mullet family (96%). For invertebrates, approximately 70% was sold.

Much of the creel survey data of fishing in rivers came from Votua village. At the time of the visit, gill nets and push nets were the methods most frequently used in the rivers and estuaries (Table 55). No handlining was observed, although this was the most frequently reported activity in these fishing areas. Gill nets, droplines and push nets were the most important fishing methods reported by respondents from Votua (Fig. 12). The greater use of gill nets and collection to catch aquatic organisms is reflected in the species composition observed from river and estuarine fishing activity (Tables 56 and 57). An example of the effect of gill netting is the absence of eels (*Anguilla* spp.) from the survey catches despite their second placing as a targeted species (Table 31). Most fishing activities observed were targeting commercially-desirable crustaceans such as mud crabs (*Scylla serrata*) and river prawns (*Palaemon* spp.) or fish [e.g. mullet (Mugilidae) and tilapia]. The crustaceans were caught by hand or push nets and the fish in gill nets. The introduced tilapia species, *O. mossambicus*, was the fish most frequently taken home for consumption (Table 56). These were invariably juveniles (average weight 9 g) caught while push netting for prawns and so were unlikely to attract a high price at the market.

The bulk of the subsistence catch monitored coming into Votua village comprised freshwater mussels, *Batissa violacea*, that were collected in large quantities by women. From the results of the questionnaire surveys the mussel was the fourth most important recorded species (Table 31). This is probably due to the fact that most of our creel sampling of river and estuarine fishing was made at Votua. This village is in the lower reaches of the Ba river and near large beds of mussels. Women from the village collect mussels daily (except Sunday). Most were stored in bags in the river until sold at weekend markets. Part of the daily catch of mussels was usually taken home to eat.

As Votua village is situated in the lower reaches of the river, many of the reported target species from rivers and estuaries do not occur there. Catches from Votua village are therefore not totally representative of the overall situation for these habitats. There is a difference in the species composition of catches from the lower and upper reaches of the river.

Within the fish component of the catch, 372 (26%) were kept for home consumption at an average weight of 51 g, whereas the fish caught for sale (1,045) averaged 125 g. Also, the species kept for eating were not usually just smaller individuals of those sold but presumably less commercially-desirable species (Tables 56 and 57).

Only the larger crabs were sold at the market but juvenile crabs were also observed being taken for home consumption. This has important management implications with regard to legislation on the minimum legal size of capture and sale. It will be necessary to ensure that these size restrictions are being observed at all levels of fishing activities if such a measure is to have any effect.

B) Lagoon

i) Questionnaire survey

Lagoon areas were reported, by respondents to the questionnaires, to be the most commonly used by coastal communities (Fig. 13). This category included all shore-based fishing activity and fishing trips carried out in 'shallow' (depth < 10 m) and 'deep' lagoon areas (depth > 10 m deep). Intertidal and sub-tidal gleaning (collection) and handlining were included in the lagoon fisheries as these habitats are usually part of a coastal lagoon rather than a fringing reef. Of these habitats, more fishing activities were reported from along the shoreline than from either of the 'lagoon' habitats (Fig. 6). While both ethnic groups used the shallow and deep areas of the lagoons in a similar way, the questionnaire data showed that fishing along the shoreline was more important to Indians than Fijians. Within these fishing areas, most respondents used handlines (52%) followed by gill nets and droplines (Table 53). However, the emphasis on handlining is much greater for the lagoon fisheries than in rivers and estuaries.

The species targeted in the three lagoon fishing areas (shallow, deep, along shoreline) were similar (Tables 32, 33 and 34). The most frequently reported target species was *Lethrinus harak* for those fishing in the shallow lagoon and along the shoreline. In the deep lagoon, trevallies

Table 55. The number of fishing trips observed where fishers used selected fishing methods in different habitat areas.

	Collection	Dropline	Duva	Gill net	Handline	Knife	Spear	Turtle trap	Wading net	Total
River	3			6			1		5	15
Estuary	5			5			2		4	17
Mangroves	3			1					2	6
Mud flat				6						6
Shoreline	12			1	10		1		2	25
Lagoon (S)	14			5	4		11		3	37
Lagoon (D)		9								9
Reef flat	7		4	4	2	1	3	1	9	31
Reef passage		1			1		3			5
Total	44	10	4	27	17	1	21	1	25	151

Table 56. List of Species taken from river and estuaries for subsistence use during the creel survey of Viti Levu (No.= number, Wt.= weight, Max L = maximum length, Min L = minimum length and Samples = number of separate occurrences in catches).

Fish	No.	Wt. (kg)	Max L (mm)	Min L (mm)	Samples
Apogon semilineatus	4	0.007	70	65	2
Caranx sexfasciatus	1	0.030	100	-	1
Chirocentrus dorab	2	0.380	335	290	1
Epinephelus suillus	6	2.350	350	90	2
Gazza minuta	8	0.200	90	70	1
Gerres spp.	3	0.050	93	93	1
Leiognathus equulus	16	0.797	195	63	4
Leiognathus smithursti	12	0.250	95	63	1
Mugil cephalus	3	0.300	190	145	1
Mulloides vanicolensis	4	0.145	148	123	2
Plectorhynchus gibbosus	2	0.825	250	155	1
Sardinella fijiensis	1	0.030	150	–	1
Scatophagus argus	2	1.250	230	225	1
Scomberoides lysan	1	0.050	145	–	1
Oreochromis mossambicus	240	2.225	110	38	2
Trichiurus lepturus	7	1.500	765	545	1
Upeneus spp.	–	3.800	–	–	1
Upeneus vittatus	2	0.125	150	145	1
Valamugil seheli	58	5.047	145	125	5
Total	372	19.000			
Non-fish					
Batissa violaceum	–	78.100	–	–	2
Palaemon concinnus	8	0.105	145	103	2
Scylla serrata	6	1.100	110	100	2
Total	–	79.305			

Table 57. List of species taken from river and estuaries for commercial use during the creel survey of Viti Levu. (No.= number, Wt.= weight, Max L = maximum length, Min L = minimum length and Samples = number of separate occurrences in catches).

Species	No.	Wt. (kg)	Max L (mm)	Min L (mm)	Samples
Caranx papuensis	4	0.700	203	198	1
Epinephelus suillus	1	1.650	398	–	1
Leiognathus equulus	6	0.575	195	100	1
Mugil cephalus	203	16.950	190	145	2
Mulloides vanicolensis	3	0.120	130	–	1
Polydactylus plebius	1	0.110	265	–	1
Scatophagus argus	4	2.400	268	158	1
Siganus vermiculatus	4	1.050	235	145	2
Upeneus vittatus	6	0.325	170	145	2
Valamugil seheli	917	129.200	350	123	5
Total	1149	152.2			
Non-fish					
Alphaeids	7	0.050	–	–	1
Anadara cornea	–	69.720	145	–	1
Batissa violaceum	–	12.000	–	–	1
Gafrarium tumidum	–	17.430	145	–	1
Macrobrachium equidens	11	0.020	74	46	3
Macrobrachium rosenbergi	110	2.400	127	80	1
Mixed Penaeids	–	0.300	–	–	2
Palaemon concinnus	847	8.425	100	76	9
Penaeus canaliculatus	44	0.192	–	–	2
Penaeus monodon	19	0.375	90	52	8
Scylla serrata	195	70.400	190	104	11
Total	–	181.312			

(Carangidae) were the most often targeted species, although *L. harak* was still highly desired (Table 34).

Few invertebrates or plants were recorded among the targeted species in any of the fishing areas. The ark shell, *Anadara cornea*, was the most frequently targeted invertebrate for those fishing along the shoreline (Table 32) and four other invertebrate groups were also targeted. However, in the other fishing areas only *Trochus niloticus* was targeted in the shallow lagoon by a small number of households. Only fish were targeted by households fishing in the deep lagoon.

The three major fishing methods reported as used in lagoon areas (handlines, gill nets and dropline) were used to catch only fish (Table 58). Handlining was the preferred method for catching most of the commonly-reported species. The exceptions to this trend were the mullets (Family: Mugilidae) and the chub mackerel, *Rastrelliger kanagurta*, for which gill nets were the preferred method. Droplining and handlining methods were used to target similar species, with droplining used less frequently because it requires a boat. Species found in deeper-water, such as Spanish mackerel, *Scomberomorus commerson*, were targeted more frequently by droplining than handlining which suggests that the data are an accurate reflection of actual fishing patterns.

ii) Creel survey

One hundred and three species of fish and invertebrates weighing 906.6 kg were recorded from 98 fishing trips to lagoon areas (Tables 59 and 60). Of these, 277.6 kg (31% by weight) were fish, with the remainder comprising mainly gastropods. Catches averaged 9.7 kg/trip for fish and 4.6 kg/trip for invertebrates. Octopus were the single largest biomass (Table 59) followed by the ark shell. For the fish component of the catch, 61% (169.5 kg) was kept for home consumption, whereas for the other groups, 91% (570 kg) was

Table 58. The frequency of reporting of fish species targeted when fishing with the three major methods in lagoons. Species that were reported by at least five households are included and ranked according to their relative frequency in the handline catches. Numbers in brackets are the percentage of all reports of that species.

Species	Handline	Gillnet	Dropline	Total
Lethrinus harak	227 (76)	20 (7)	19 (6)	298
Carangids	154 (67)	24 (10)	39 (17)	230
Epinephelus spp.	127 (76)	–	22 (13)	168
Lethrinus mahsena	109 (68)	8 (5)	33 (21)	160
Lutjanus spp.	109 (73)	10 (7)	14 (9)	149
Lutjanus argentimaculatus	76 (71)	3 (3)	10 (9)	107
Upeneus vittatus	58 (74)	10 (13)	1 (1)	78
Leiognathus equulus	51 (60)	23 (27)	–	85
Terapon jarbua	48 (77)	7 (11)	2 (3)	62
Lethrinus nebulosus	45 (58)	7 (9)	22 (29)	77
Sphyraena spp.	41 (61)	2 (3)	20 (30)	67
Gerres spp.	24 (59)	11 (27)	–	41
Lethrinus xanthochilus	19 (76)	3 (12)	3 (12)	25
Plectropomus spp.	16 (59)	–	6 (22)	27
Pseudobalistes flavimarginatus	12 (86)	–	2 (14)	14
Scomberomorus commerson	11 (38)	–	16 (62)	29
Lethrinus olivaceus	8 (67)	1 (8)	3 (25)	12
Mugil spp.	8 (7)	54 (45)	3 (3)	119
Epinephelus merra	7 (100)	–	–	7
Sphyraena forsteri	7 (30)	–	16 (70)	23
Acanthurus spp.	6 (86)	–	1 (14)	7
Rastrelliger kanagurta	6 (14)	18 (41)	8 (18)	44
Hemirhamphus far	5 (38)	4 (31)	1 (8)	13
Cheilinus spp.	5 (100)	–	–	5
Siganus spp.	4 (10)	17 (40)	1 (2)	42
Ctenochaetus spp.	3 (30)	–	7 (70)	10
All other species	58 (3)	30 (1)	8 (<1)	96

Table 59. List of the species taken from lagoons during the creel survey for subsistence use. (No.= number, Wt.= weight, Max L = maximum length, Min L = minimum length and Samples = number of separate occurrences in catches)

Species	No.	Wt. (kg)	Max L (mm)	Min L (mm)	Samples
Abalistes stellaris	1	1.650	380	–	1
Ablennes hians	1	0.675	735	–	1
Acanthurus xanthopterus	3	0.125	92	83	2
Apogon angustatus	3	0.045	75	65	2
Apogon bandanensis	2	0.040	54	–	2
Bothus pantherinus	2	0.300	190	170	1
Carangoides plagiotaenia	1	0.100	162	–	1
Cheilinus chlorurus	2	0.270	170	–	2
Cheilodipterus macrodon	1	0.020	68	–	1
Chirocentrus dorab	5	4.050	845	495	4
Conger cinereus	1	0.075	–	–	1
Dasyatis kuhlii	8	9.950	370	254	4
Diplogrammus goramensis	2	0.140	92	–	2
Echeneis naucrates	2	2.300	–	–	1
Epinephelus ongus	1	0.500	230	–	1
Gazza minuta	3	0.200	180	170	1
Gerres oyena	50	2.105	150	76	9
Halichoeres trimaculatus	3	0.135	110	–	3
Hemigymnus melanopterus	1	0.475	230	–	1
Hemiramphus far	105	9.200	355	175	8
Hyporhamphus dussumieri	16	0.750	254	203	4
Leiognathus fasciatus	35	0.433	154	–	5
Leiognathus smithursti	2	0.050	–	–	1
Lethrinus harak	36	4.620	250	80	8
Lethrinus juv.	1	0.100	100	–	1
Lethrinus mahsena	15	2.125	215	104	5
Lethrinus nebulosus	7	1.550	227	115	4
Lethrinus obsoletus	3	0.400	163	150	1
Lethrinus variegatus	3	0.095	120	100	2
Liza vaigiensis	2	0.213	160	–	2
Lutjanus fulviflamma	29	3.058	215	78	10
Lutjanus fulvus	7	0.813	185	145	2
Lutjanus gibbus	2	0.100	110	–	2
Lutjanus quinquelineatus	1	0.050	96	–	1
Lutjanus semicinctus	1	0.070	130	–	1
Megalaspis cordyla	6	1.450	285	220	1
Mugil cephalus	3	0.150	96	90	1

Table 59. (contd) List of the species taken from lagoons during the creel survey for subsistence use. (No.= number, Wt.= weight, Max L = maximum length, Min L = minimum length and Samples = number of separate occurrences in catches)

Species	No.	Wt. (kg)	Max L (mm)	Min L (mm)	Samples
Muraenesox bagio	2	2.525	–	–	1
Naso unicornis	4	8.650	410	375	3
Paraupeneus barberinus	4	0.45	165	82	3
Paraupeneus indicus	17	1.555	240	105	6
Pastinachus sephen	1	50.00	1430	–	1
Plotosus lineatus	276	3.515	178	128	4
Pomacentrus spp.	2	0.050	67	–	2
Rastrelliger brachysoma	1	0.150	215	–	1
Rastrelliger kanagurta	5	1.600	270	255	1
Salinarius sinuosus	2	0.055	96	–	2
Sardinella fijiensis	108	6.650	160	146	2
Sargocentron spiniferum	3	1.500	240	–	3
Saurida gracilis	1	0.075	175	–	1
Scarus ghobban	3	0.500	189	125	1
Scarus globiceps	11	1.930	200	150	4
Scarus sordidus	2	0.275	180	110	1
Scolopsis trilineatus	2	0.065	110	–	2
Scomberoides tol	4	0.700	270	225	2
Scorpaenopsis venosa	1	0.080	100	–	1
Selar crumenopthalmus	1	0.250	230	–	1
Sideria picta	2	1.500	–	–	1
Siganus doliatus	46	5.225	173	115	7
Siganus spinus	12	0.375	112	66	5
Sphyraena barracuda	1	0.175	–	–	1
Sphyraena flavicauda	2	0.550	320	300	1
Sphyraena forsteri	2	2.25	–	–	1
Sphyraena putnamiae	32	13.468	460	335	7
Sphyrna lewini	2	5.100	460	–	2
Stegastes albofasciatus	1	0.030	75	–	1
Terapon jarbua	22	2.925	210	145	7
Trichiurus lepturus	21	7.800	903	604	5
Tylosurus crocodilus	1	0.325	750	–	1
Upeneus vittatus	7	0.382	165	112	2
Valamugil seheli	2	0.438	244	–	2
Total	723	169.500			

Table 59. (contd) List of the species taken from lagoons during the creel survey for subsistence use. (No.= number, Wt.= weight, Max L = maximum length, Min L = minimum length and Samples = number of separate occurrences in catches)

Species	No.	Wt. (kg)	Max L (mm)	Min L (mm)	Samples
Non-fish					
Anadara cornea	181	11.060	–	–	4
Caulerpa spp.	–	11.850	–	–	2
Chama spp.	1	0.010	–	–	1
Cone shell/cowrie	1	0.020	50	–	1
Crabs	3	0.015	49	28	1
Gafrarium tumidum	297	6.900	45	26	2
Hypnea nidifica	–	9.550	–	–	8
Lambis lambis	7	0.565	130	–	4
Octopus	13	15.975	–	–	8
Pinctada margaritifera	9	1.250	125	74	6
Polinices flemingiana	1	0.010	–	–	1
Scylla serrata	11	0.560	45	37	4
Squid	1	0.250	155	–	1
Thalamita crenata	1	0.010	50	–	1
Tridacna spp.	1	0.100	–	–	1
Tridacna squamosa	3	0.130	215	165	1
Trochus niloticus	–	0.600	–	–	1
Trochus pyramis	1	0.030	33	–	1
Turbo chyrsostomus	6	0.060	–	–	1
Total	–	58.945			

sold. The species of fish taken for sale were all species taken for eating with the exception of Spanish mackerel, all of which was sold. The mean weight of fish sold was much higher (395 g) than those kept for eating (175 g).

Lagoon areas were visited mainly by fishers from Ucunivanua and Namuaimada. Of these trips, most were for collecting (37%) or spearing (27%) (Table 53). Handlining was much less important (13%) than reported in the questionnaires (52%). The distribution of effort among the methods was biased by the high level of effort of fishers spearing for *Octopus* spp. These animals are available only at certain times of the year and are highly valued.

Table 60. List of species taken from lagoons for commercial use during the creel survey. (No.= number, Wt.= weight, Max L = maximum length, Min L = minimum length and Samples = number of separate occurrences in catches).

Fish	No.	Wt. (kg)	Max L (mm)	Min L (mm)	Samples
Carangoides hedlandensis	1	0.600	273	–	1
Caranx sexfasciatus	3	2.175	305	295	1
Caranx tille	4	3.100	300	295	1
Cheilinus trilobatus	1	0.225	180	–	1
Echeneis naucrates	1	0.575	570	–	1
Epinephalus timorensis	2	0.375	220	198	1
Epinephelus ongus	1	0.100	178	–	1
Gazza minuta	2	0.350	170	–	2
Hemiramphus far	12	2.650	390	380	1
Lethrinus harak	33	7.450	250	147	1
Lutjanus fulvus	5	0.925	190	160	1
Megalaspis cordyla	11	3.430	400	150	3
Rastrelliger brachysoma	8	3.550	280	255	3
Rastrelliger kanagurta	1	0.300	235	–	1
Scomberomorus commerson	8	12.650	785	390	3
Selar crumenopthalmus	12	3.500	250	195	4
Sphyraena forsteri	1	0.440	330	–	1
Sphyraena putnamiae	147	59.527	460	345	5
Terapon jarbua	5	0.600	175	150	1
Trichiurus lepturus	15	5.325	850	620	2
Upeneus vittatus	1	0.300	230	–	1
Total	274	108.147			
Non-fish					
Anadara cornea	931	85.900	–	–	8
Bohadschia marmorata	4	1.200	–	–	1
Caulerpa spp.	–	96.100	–	–	11
Hypnea nidifica	–	70.350	–	–	14
Lambis lambis	2	0.060	–	–	1
Metriatyla scabra	24	10.450	–	–	3
Octopus spp.	126	273.700	–	–	15
Periglyptera puerpera	57	10.300	–	–	3
Pinctada margaritifera	7	0.750	–	–	1
Scylla serrata	9	8.100	205	130	5
Stichopus chloronotus	35	7.000	–	–	1
Stichopus variegatus	28	5.220	–	–	2
Turbo chrysostomus	8	0.845	–	–	2
Total	–	562.975			

C) Mangroves

i) Questionnaire survey

The level of fishing activity reported from mangrove areas was less than that from the previous two habitats (Table 53). Fijians used mangroves areas more than Indians (Fig. 6) and about 20% of coastal households used these areas to obtain fish and invertebrates (Fig. 13). The methods used in mangroves also differed in their relative importance from the open habitats (Table 53) with collection and crab-trapping being the most frequently reported activities. Handlining was still an important method but its frequency of use was lower than in rivers and estuaries or lagoon areas.

The targeted species composition from the two mangrove-related habitats (among mangroves and along edge of mangroves) was very similar and we felt that there may be some inconsistency in reporting between the two areas, so the data from each were combined. The results clearly show that people most frequently went to mangrove areas to obtain crabs (Tables 35 and 61). The most sought after fish were mangrove Jack (*Lutjanus argentimaculatus*) and mullet (*Mugil* spp.). Many of the species targeted in mangroves were similar to those reported from adjacent habitats such as estuaries and rivers (Table 31). This is not surprising as many of the target species occur in both areas and there would be some overlap between areas classified as estuaries and mangroves.

When the reported species composition is broken down by method, it is evident that in the mangrove areas there are distinct species targeted by each method (Table 61). Mud crabs (*Scylla serrata*) are caught by hand and in crab traps. Predatory fish such as *Lutjanus argentimaculatus* are targeted with handlines. Mullets and chub mackerel (*Rastrelliger kanagurta*) were targeted with gill nets, as they were in lagoon habitats.

Table 61. The frequency of reporting of fish species targeted when fishing with the four major methods used in mangrove areas. Species that were reported by at least five households are included and ranked according to their relative frequency in the collection catches. Numbers in brackets are the percentage of all reports of that species.

Species	Collection	Handline	Crab trap	Gill net	Total
Scylla serrata	68 (51)	4 (3)	42 (32)	2 (2)	133
Anadara cornea	13 (100)	– (0)	– (0)	– (0)	13
Oreochromis mossambicus	5 (50)	1 (10)	– (0)	– (0)	10
Lutjanus spp.	– (0)	23 (70)	– (0)	7 (30)	33
Lutjanus argentimaculatus	– (0)	22 (67)	– (0)	6 (18)	33
Carangids	– (0)	19 (70)	1 (4)	4 (15)	27
Lethrinus harak	– (0)	18 (75)	– (0)	5 (21)	24
Terapon jarbua	– (0)	14 (82)	– (0)	2 (12)	17
Leiognathus equulus	– (0)	10 (42)	– (0)	10 (42)	24
Epinephelus spp.	– (0)	9 (69)	1 (8)	– (0)	13
Gerres spp.	– (0)	6 (38)	– (0)	6 (38)	16
Mugil spp.	– (0)	1 (3)	– (0)	15 (43)	35
Rastrelliger kanagurta	– (0)	– (0)	– (0)	6 (67)	9
Hemirhamphus far	– (0)	– (0)	– (0)	5 (71)	7
All other species	12 (2)	25 (5)	2 (<1)	17 (3)	518

ii) Creel survey

A total of 423 fish and invertebrates weighing 17.835 kg were taken from mangrove areas during 13 fishing trips (Tables 62 and 63). Of this, 10.07 kg (56%) was fish (mean of 0.84 kg/trip). Catch rates for invertebrates averaged 2 kg/trip. The small number of trips reflects the choice of villages at which the creel surveys were conducted. Mangroves were visited only by people from Namuaimada and Votua. Gill nets were the most commonly used method during the survey followed by collection (Table 53; mud flats were included in the mangrove habitat). Little handlining was observed but this probably reflected the type of mangrove habitat present around these villages. Around Namuaimada, the mangroves were not very extensive and there was little deep water for fishers to effectively use handlines. Most fishing trips to mangrove areas were to collect fish and invertebrates for household consumption (Table 62). None of the fish caught in mangrove areas during the survey was sold (Tables 62 and 63). This may also reflect our choice of survey villages or that mangrove areas are nursery grounds for many fish species and the fish in these areas are often smaller than can be sold. Average-sized fish weighed 34 g. The most common species taken were the silver biddy (*Gerres oyena*) and mullet (*Mugil cephalus*) (Table 62). For the invertebrates, all the catch consisted of prawns and mud crabs (*Scylla serrata*). Catch rates were higher than for fish, averaging almost 2 kg/trip at an average weight of 46 g.

D) Fringing Reef

i) Questionnaire survey

Of the four major fishing areas identified from the questionnaire results, fringing reefs were the least visited with only 5% of fishers using this habitat (Table 53). Collection and spearing were the most frequently reported activities, followed by handlining and droplining. The two line-fishing methods were used to fish from the shallows of the fringing reef into deeper water inside and outside the lagoons. This is reflected in the distribution of reported effort on the outer reef compared with that reported for the outside edge of the outer reef (Fig. 6). Fijians reported a higher incidence of activity on the outer reef than Indians, but both reported using the outside edge in similar frequencies. This is consistent with the composition of the reported target species (Table 37). There was a much higher incidence of reporting of sessile invertebrates from this area compared with that reported from the other three habitat types. The most frequently targeted species was trochus shell, *Trochus niloticus*, and clams, *Tridacna* spp., were the sixth-most frequently reported species.

When the reported species composition is broken down by method, one can see a similar pattern to that for the other fishing areas (Table 64). Emperors, (*Lethrinus* spp.), trevallies (Carangidae), and barracuda (*Sphyraena* spp.), were targeted by line-fishing. All invertebrates were collected and coral trout, *Plectropomus* spp., were most often targeted by spear fishing (Table 64). Many of the most commonly targeted species from fringing reefs were similar to those targeted in the 'deep' lagoon which shows that these fishing areas are not discrete.

ii) Creel survey

A total 327.3 kg of fish and invertebrates was recorded from 35 fishing trips to fringing reefs during the survey (Tables 65 and 66). Of this, 166.3 kg (51 %) was fish with a catch rate of 4.2 kg/trip. This was lower than the invertebrate catch rate of 7.7 kg/trip. The most commonly used method was the use of push nets (25%) followed by collection and spearing. These patterns were similar to the results of the questionnaires except for the much higher incidence of the use of the push net. Push nets were a favoured method at Namuaimada and so biased the distribution of effort towards this method.

The species composition of the fish catches from the fringing reef was the most diverse of the four fishing areas sampled. One hundred and eleven species of fish were identified during the survey (Tables 65 and 66). The most common species was the rabbitfish, *Siganus spinus*. Overall, 981 fish and 70 invertebrates were measured from fishing trips to fringing reef areas. Of these, only 8% of the fish (by numbers), but 45% by weight, were sold. Almost all invertebrates collected were kept to eat, except for a large green turtle *Chelonia mydas*, which was taken to the market for sale (Table 66). The average weights of fish and invertebrates from fringing reefs that were kept for eating were similar when the 50 kg green turtle was discounted (fish 110 g vs 158 g for invertebrates). These were much less than the average weight of the fish sold (1060 g). This pattern was similar to that for the other fishing areas. However, unlike the catches from the lagoons, there was little overlap in the

Table 62. List of species taken from mangroves for subsistence use during the creel survey. (No.= number, Wt.= weight, Max L = maximum length, Min L = minimum length and Samples = number of separate occurrences in catches).

Fish	No.	Wt. (kg)	Max L (mm)	Min L (mm)	Samples
Apogon semilineatus	7	0.010	75	75	2
Gazza minuta	4	0.100	97	75	1
Gerres oyena	121	4.010	155	77	9
Lethrinus harak	42	1.850	135	97	5
Lutjanus fulviflamma	25	0.750	125	85	7
Mugil cephalus	51	1.150	175	100	6
Ophiocara porocephala	1	0.050	135	–	1
Terapon jarbua	36	1.950	170	95	7
Upeneus vittatus	1	0.100	175	–	1
Valamugil seheli	2	0.100	80	75	1
Total	290	10.0700			
Non-fish					
Pinctada margaritifera	1	0.010	50	–	1
Scylla serrata	5	1.800	140	54	2
Total	6	1.810			

Table 63. List of species taken from mangroves for commercial use during the creel survey. (No.= number, Wt.= weight, Max L = maximum length, Min L = minimum length and Samples = number of separate occurrences in catches).

Non-fish	No.	Wt. (kg)	Max L (mm)	Min L (mm)	Samples
Macrobrachium equidens	3	0.045	65	45	1
Palaemon concinnus	74	0.500	130	76	2
Penaeus canaliculatus	12	0.250	100	60	2
Penaeus monodon	9	0.210	155	75	2
Scylla serrata	29	4.950	170	88	3
Total	127	5.955			

Table 64. The frequency of reporting of fish species targeted when fishing with the four major methods used around fringing reefs. Species that were reported by at least five households are included and ranked according to their relative frequency in the spear catches. Numbers in brackets are the percentage of all reports of that species.

Species	Spear	Collection	Handline	Dropline	Total
Epinephelus spp.	8 (33)	– (0)	9 (38)	5 (21)	24
Lethrinus mahsena	6 (32)	– (0)	8 (42)	4 (21)	19
Lethrinus harak	6 (38)	– (0)	6 (38)	– (0)	16
Plectropomus spp.	5 (62)	– (0)	– (0)	3 (38)	8
Trochus niloticus	– (0)	17 (100)	– (0)	– (0)	17
Tridacna spp.	– (0)	7 (78)	– (0)	– (0)	9
Lambis lambis	– (0)	6 (100)	– (0)	– (0)	6
Lethrinus nebulosus	1 (8)	– (0)	8 (62)	4 (31)	13
Carangids	3 (14)	– (0)	7 (32)	10 (45)	22
Sphyraena spp.	2 (10)	– (0)	8 (40)	10 (50)	20
Scomberomorus commerson	1 (9)	– (0)	2 (18)	7 (64)	11
All other species	27 (11)	11 (4)	8 (3)	15 (6)	255

Table 65. List of species taken from fringing reefs for subsistence use during creel surveys. (No.= number, Wt.= weight, Max L = maximum length, Min L = minimum length and Samples = number of separate occurrences in catches).

Fish	No.	Wt. (kg)	Max L (mm)	Min L (mm)	Samples
Abudefduf sexfasciatus	22	0.400	75	60	1
Acanthurus lineatus	3	0.750	195	146	2
Acanthurus nigricauda	4	0.375	177	72	2
Acanthurus xanthopterus	1	0.950	220	–	1
Aetobatus narinari	1	4.300	–	–	1
Amblygobius phalaena	2	0.110	104	–	2
Apogon bandanensis	7	0.065	59	42	3
Apogon novemfasciatus	4	0.040	75	41	2
Apogon taeniophorus	6	0.075	68	49	1
Arothron hispidus	1	0.375	205	–	1
Calotomus carolinus	5	1.175	194	170	2
Chaetodon auriga	1	0.050	81	1	1
Chaetodon lineolatus	2	0.300	145	132	1
Chaetodon melannotus	1	0.075	83	–	1
Chaetodon plebius	1	0.050	79	–	1
Chaetodon trifasciatus	1	0.100	100	–	1
Chaetodon vagabundus	1	0.100	110	–	1
Cheilinus chlorurus	21	2.090	175	120	8
Cheilinus diagramma	1	0.150	165	–	1
Cheilinus trilobatus	2	0.150	131	122	1
Cheilodipterus macrodon	4	0.075	65	60	3
Conger cinereus	12	2.375	730	340	3
Coris gaimardi	1	0.325	240	–	1
Ctenochaetus striatus	43	6.550	170	113	5
Epibulus insidiator	2	0.475	200	–	2
Epinephelus merra	2	0.170	145	–	2
Epinephelus ongus	5	0.650	210	119	3
Gazza minuta	1	0.130	–	155	1
Gerres oyena	39	1.505	126	60	10
Gnathanodon speciosus	1	0.250	–	–	1
Halichoeres hortulanus	2	0.350	163	158	1
Halichoeres trimaculatus	12	0.830	145	108	9
Hemigymnus fasciatus	1	0.200	123	–	1
Hemigymnus melapterus	2	1.000	285	–	2
Kyphosus vaigiensis	1	2.500	395	–	1
Lactoria cornuta	1	0.825	249	–	1
Leiognathus bindus	6	0.110	92	75	1
Leiognathus equulus	10	0.900	–	–	1
Leiognathus fasciatus	4	0.520	–	–	1
Leptoscarus vaigiensis	13	2.075	186	137	2
Lethrinus harak	17	1.720	238	93	9
Lethrinus mahsena	43	2.150	132	80	5
Lethrinus obsoletus	2	0.450	215	–	2
Lethrinus variegatus	4	0.375	155	143	3

Table 65. (contd) List of species taken from fringing reefs for subsistence use during creel surveys. (No.= number, Wt.= weight, Max L = maximum length, Min L = minimum length and Samples = number of separate occurrences in catches).

Fish	No.	Wt. (kg)	Max L (mm)	Min L (mm)	Samples
Liza vaigiensis	1	0.010	43	–	1
Lutjanus fulviflamma	12	0.830	150	91	8
Lutjanus fulvus	2	0.100	110	82	1
Lutjanus gibbus	2	0.525	246	–	2
Lutjanus semicinctus	2	0.225	155	–	2
Macropharyngodon meleagris	1	0.020	66	–	1
Mugil cephalus	2	0.130	132	–	2
Mulloides flavolineatus	1	0.020	135	–	1
Mulloides vanicolensis	14	2.100	170	161	1
Myripristis violaceum	2	0.250	127	127	1
Naso annulatus	6	0.800	165	139	4
Naso unicornis	3	6.300	465	150	2
Ostracion cubicus	1	0.100	–	–	1
Parapercis cylindrica	1	0.020	92	–	1
Parapercis hexophtalma	2	0.275	185	–	2
Parupeneus barberinus	10	0.705	160	85	6
Parupeneus cyclostomus	3	0.600	235	155	2
Parupeneus indicus	18	1.800	260	100	6
Parupeneus multifasciatus	3	0.300	150	–	3
Plectorhynchus diagramma	1	0.075	119	–	1
Plotosus lineatus	23	0.540	172	103	2
Pomacentrus pavo	1	0.025	62	–	1
Pomacentrus sp.	1	0.020	58	–	1
Salinarius sinuosus	11	0.435	111	80	5
Sargocentron violaceum	1	0.200	147	–	1
Scarus altipinnis	1	1.100	325	–	1
Scarus chameleon	2	0.950	239	205	1
Scarus frontalis	2	0.350	186	–	2
Scarus ghobban	1	0.900	302	–	1
Scarus globiceps	18	2.225	190	80	7
Scarus microrhinus	1	0.950	310	–	1
Scarus psittacus	36	2.825	183	95	4
Scarus rivulatus	2	1.000	238	–	2
Scarus rubroviolaceus	1	0.025	104	–	1
Scarus schlegeli	1	0.200	184	–	1
Scarus sordidus	30	6.225	230	135	11
Scolopsis bilineatus	14	0.845	132	90	6
Scolopsis trilineatus	16	0.775	153	86	6
Scomberoides tol	4	0.800	–	–	1
Scomberomorus commerson	2	1.500	–	–	1
Scorpaenopsis venosa	3	0.175	105	99	1
Sideria picta	1	0.200	520	–	1
Siganus doliatus	47	4.905	159	99	9

Table 65. (contd) List of species taken from fringing reefs for subsistence use during creel surveys. (No.= number, Wt.= weight, Max L = maximum length, Min L = minimum length and Samples = number of separate occurrences in catches).

Fish	No.	Wt. (kg)	Max L (mm)	Min L (mm)	Samples
Siganus punctatus	8	1.200	176	153	4
Siganus spinus	154	4.980	150	70	14
Sphyraena putnamiae	1	0.130	–	–	1
Stegastes albofasciatus	9	0.285	90	70	3
Stegastes nigricans	8	0.270	90	86	4
Stethojulis trilineata	4	0.150	111	105	2
Strongylura incisa	2	0.050	234	232	1
Terapon jarbua	7	0.375	141	56	2
Trachinotus blochii	1	0.020	60	–	1
Upeneus sulphureus	1	0.050	–	–	1
Upeneus vittatus	2	0.280	–	–	2
Valamugil seheli	11	1.400	–	–	1
Total	829	91.085			
Non-fish					
Anadara cornea	1	0.020	77	–	1
Chelonia mydas	1	50.000	700	–	1
Cone shell/cowrie	1	0.010	–	–	1
Crabs	3	0.015	35	33	1
Other	14	0.200	–	–	2
Hypnea nidifica	20	0.830	–	–	4
Lambis lambis	2	0.050	165	–	2
Octopus spp.	9	8.400	–	–	6
Periglypta puerpera	1	0.030	75	–	1
Pinctada margaritifera	6	0.120	138	125	5
Scylla serrata	1	0.950	150	–	1
Spondylus ducalis	1	0.010	60	–	1
Stichopus variegatus	3	0.040	–	–	1
Tridacna maxima	2	0.100	–	–	1
Tridacna squamosa	1	0.020	120	–	1
Trochus niloticus	3	0.110	100	50	2
Total	69	60.915			

Table 66. List of species taken from fringing reefs for commercial use during the creel surveys. (No.= number, Wt.= weight, Max L = maximum length, Min L = minimum length and Samples = number of separate occurrences in catches).

Fish	No.	Wt. (kg)	Max L (mm)	Min L (mm)	Samples
Acanthurus gahhm	2	0.960	–	–	1
Acanthurus xanthopterus	1	1.600	355	–	1
Balistoides viridescens	1	6.000	480	–	1
Caranx papuensis	5	20.150	–	–	1
Caranx sexfasciatus	3	0.420	–	–	1
Gazza minuta	9	1.266	–	–	1
Hemiramphus far	6	1.500	–	–	1
Leiognathus equulus	4	0.560	–	–	1
Lethrinus nebulosus	2	3.320	–	–	1
Lutjanus argentimaculatus	3	3.650	455	312	2
Lutjanus gibbus	1	1.300	305	–	1
Naso unicornis	11	13.600	445	237	2
Parupeneus cyclostomus	1	0.650	290	–	1
Plectorhynchus chaetodontoides	1	3.200	435	–	1
Plectropomus leopardus	1	4.800	600	–	1
Rastrelliger brachysoma	13	6.760	–	–	1
Scarus microrhinus	1	1.400	350	–	1
Scarus sordidus	2	0.600	215	205	1
Scomberomorus commerson	1	2.080	–	–	1
Siganus vermiculatus	3	1.440	–	–	1
Total	71	75.256			
Non-fish					
Chelonia mydas	1	100.000	999	–	1
Total	1	100.000			

species kept for eating and sale. For example, among the snappers (Lutjanidae), smaller species were kept to eat and the larger-growing species were all sold. All trevallies (Carangidae) were sold, as were chub mackerel (*Rastrelliger brachysoma*). If one excludes collecting trips from the analysis, the catch rate of fish-per-trip averaged 6.0 kg. This was slightly higher than found for more inshore fishing areas. There are at least two possible explanations, firstly, that either fishers go to fringing reef areas with a hope of catching larger, deeper-water species, or secondly, that as these areas are visited less due to their relatively more difficult access, the fishing pressure is lower, and larger individuals are more abundant. Both hypotheses are probably at least partly true.

E) Distant Areas

i) Questionnaire survey

One of the fishing areas distinguished on the questionnaire was termed 'distant areas' (Section 3). Although there were no creel survey data of fishing activities from these areas, the species targeted differed from the other major fishing grounds (Table 38). Most trips to distant areas were for droplining and almost all the target species are large predators. Most fishers reported going to known fishing grounds during particular seasons. At these times they target aggregations of particular species, such as Spanish mackerel (*Scomberomorus commerson*).

Discussion

There was general agreement between the species composition observed during the creel survey and that reported in the questionnaires. There was less agreement between the two surveys in the relative importance of particular fishing methods. This was probably due to the short time-span of the creel surveys at each village and because only four villages were surveyed. For example, during the creel survey in Ucunivanua a major part of the fishing effort was directed towards catching seasonally available commercial species (e.g.

octopus). Due to the limited time available for the creel surveys, only coastal villages were surveyed but the choice of habitats preferred by these fishers (strata 10 and 20; Fig. 13) agree with the relative distribution of fishing effort observed (Table 53). At least 60% of the fishing activity observed was in areas we have termed 'lagoon' habitats (along the shoreline, shallow and deep lagoon). This is similar to the proportion of fishers in the much larger sample from the questionnaire survey who reported fishing in these areas.

The relative importance of mangroves, rivers and estuaries reported in the questionnaires was not reflected in the fishing activity observed in the creel surveys. This was partly due to the small number of villages sampled and their position relative to these more restricted habitats, and partly because non-coastal villages could not be sampled with the time available. An important activity of future creel surveys would be to sample several inland villages and confirm the patterns that have emerged from the results of the questionnaire survey.

i) Comparisons of fishing activity in major habitats

Although rivers and estuaries were the most frequently reported fishing area, more fishers from coastal villages visited lagoon habitats during the creel surveys. Few, if any, of the species targeted in rivers and streams were caught during the creel surveys. These inconsistencies probably occurred because many target species live only in freshwater (e.g. *Kuhlia* and *Anguilla* spp.) or target species were caught only rarely (e.g. *Lutjanus argentimaculatus*).

During the creel surveys the largest catches of invertebrates and the highest catch rates were obtained from the rivers and estuaries. These high catches mainly comprised the freshwater clam, *Batissa violacea*. Previous studies of commercial catches at the Nadi market in 1980 found this species was the single largest item sold (Kunatuba 1981). This pattern continues today with *Batissa violacea* representing almost two-thirds of the total seafood passed through the municipal markets of Viti Levu (Anon. 1992). Large volumes of *Batissa violacea* are widely sold making this species an important staple food item for sale throughout Viti Levu. Little has been published on the biology of this species and so the effects of habitat degradation or pollution are unknown. It is a highly abundant filter-feeder which suggests that it may be a good indicator of water quality and any decline in catches should be investigated.

Among coastal villages, the creel survey results suggest that lagoon habitats close to villages are the most important fishing area. This pattern is not surprising as few fishers have powered boats and so are unable to fish more distant areas. Fish caught in the lagoons were larger than could be caught in the other easily accessible fishing areas. Beeching (1993) examined the fishing activity patterns of urban Fijians around Suva and found over 90% of all activity was shore-based and of this, the activity was divided evenly among fishers handlining from the shore and gleaning shallow reef areas in the lagoon. A similar pattern also occurs on the outer islands where there were many more shore-based fishing trips than using boats (Jennings and Polunin 1994). However, they found that the catch was dominated by serranids and lethrinids which were caught by line-fishing (handline and dropline) and spearing. These methods were not the most important ones used in the four villages during the survey and the catches from the lagoon and fringing reef habitats reflected these differences (Tables 59, 60 and 65–66). The target species reported during the questionnaire survey were very similar (Tables 32–34 and 36), which shows that they are the ones highly-desired by coastal Fijians.

Another difference between the results of the survey by Jennings and Polunin (1994) and our study lies in their focus on fish catches. Anon. (1992) showed that sales of 'non-fish' species accounted for almost 80% of seafood sold at municipal markets in Fiji. Our results also show that invertebrates account for almost half the total subsistence catches of coastal villages (41%) and 72% of the commercial catch. The level of fishing activity and fisheries yields will be drastically underestimated by concentrating on only one group.

Although most fishing effort was concentrated in the lagoon during the creel surveys, the largest fish were caught from the fringing reef. The greatest diversity of fish species was also taken from this area. The species composition of the commercial catch also differed from that taken in the lagoon. Barracuda, *Sphyraena* spp., were the most frequently taken fish in commercial catches from the lagoon (Table 60). Subsistence fish catches also varied between these areas with the most abundant fish family taken in the fringing reef catches (Siganidae) only poorly represented in lagoon catches. The lagoon fish catches were

dominated by smaller pelagic fish species such as garfish, *Hemirhamphus far*, and sardines, *Sardinella fijiensis*.

The catches from mangroves during the creel survey appear to under-represent the importance of this fishing area. Twice as many households report visiting mangrove areas to fish as fringing reefs (Tables 61 and 64). However, during the creel survey only half as many trips were made to mangrove areas as fringing reefs. This may have been due to several factors, including the choice of village and the time of year. Most households that were interviewed visited mangrove areas to catch mud crabs, *Scylla serrata* (Table 35). The valuable adults of this species may not have been present in the areas sampled, as the crabs caught were quite small (Tables 62 and 63).

ii) Catch rates

The overall catch rates in each fishing area (all methods combined) varied between 0.41 kg/person/hour in mangroves to 1.52 kg/person/hour in the lagoon. Catch rates from fringing reefs of 1.22 kg/person/hour were higher than from rivers and estuaries (0.80 kg/person/hour). When the data from all areas are combined the catch rate was 1.13 kg/person/hour during the creel survey. These catch rates appear to be lower than those estimated by Jennings and Polunin (1994) for six outer island communities.

Collection and gill netting were the two fishing methods that had the highest catch rates in all fishing areas (Table 67). Catch rates of all methods were higher in each fishing area when fishers targeted commercial species. Some methods had consistently lower catch rates than others. Handlining was only undertaken to catch fish for home consumption and had a lower catch rate than droplining in the same fishing area. Subsistence collection in rivers and estuaries had the highest effort, yet catch rates were less than a quarter that of the same method when fishers targeted commercial species (Table 67). These patterns suggest that effort is not always expended to maximise catch, or monetary return. Collection appears to be a popular method of harvesting seafood.

iii) Role of women in fisheries

Women were involved in a wide range of the fishing activities observed during the creel survey (Table 68). Our results support the conclusions of earlier studies that showed that women undertake a significant part of the fishing activity in each village (Lal and Slatter 1982). Females expended more than half the effort observed during the creel survey (817.9 of 1522.15 hours). They undertook almost all collecting activity for both sale and subsistence and were the major users of push nets. In the villages visited, men did all the droplining and almost all the spear-fishing (Table 68). Women appear to concentrate their activities in fishing areas close to the villages. The habitats where we recorded most of their fishing effort were in the rivers and the lagoon. On the fringing reefs, women tended to collect invertebrates by hand, or fish with a push net and handlines.

This distribution of different types of fishing activity between the sexes has important implications for the impact of humans on invertebrate and algal populations. Women (and children) are the major harvesters of these groups and most of their fishing activity is directed towards obtaining food for the household (456.83 hours; 56%). As the number of households and family size increases, invertebrates will be impacted more than fish populations. Also, invertebrates are most at risk from pollution. Their importance to the diets of coastal villagers means that any reduction in invertebrate densities will affect the cost and composition of the diet. Many of the invertebrates taken are filter-feeding gastropods and so changes to the bacterial load as a result of increasing untreated sewage inputs could have important health consequences.

By comparison, most of the fishing effort of males (69%) was directed towards catching fish and invertebrates for sale. Some of the catch from droplining or gill netting was used by the household (Table 68). Men were involved in most of the trips when part of the catch was sold.

The creel survey showed that fishers often sell and eat portions of the same catch. Portions of the catch from 29 fishing trips (24% of all trips intercepted) were both sold and taken home for consumption. Of these trips, the majority of the catch was sold from 22 trips (> 75%). This suggests that the main purpose of these trips was to catch seafood for sale but some of the less-saleable catch were eaten.

Table 67. Mean catch rates (kg/hour) and total effort (fisher hours) for catch from each fishing area that was sold or taken home during the creel survey.

Fishing area	Method	Fate of catch	Catch rate (kg/hour)	Effort (hours)
River	Collection	Subsistence	0.36	217.50 (14.2)
River	Collection	Sale	1.69	88.05 (5.8)
River	Gill net	Subsistence	0.82	81.85 (5.4)
River	Gill net	Sale	1.32	147.86 (9.7)
River	Spear	Subsistence	0.46	2.00 (0.1)
River	Spear	Sale	1.22	15.50 (1.0)
River	Push net	Subsistence	0.90	11.26 (0.7)
River	Push net	Sale	0.29	104.84 (6.9)
Lagoon	Collection	Subsistence	1.79	19.08 (1.2)
Lagoon	Collecton	Sale	2.31	188.18 (12.3)
Lagoon	Dropline	Subsistence	0.51	71.85 (4.7)
Lagoon	Dropline	Sale	1.42	68.15 (4.5)
Lagoon	Gill net	Subsistence	2.52	28.18 (1.8)
Lagoon	Gill net	Sale	0.53	22.27 (1.5)
Lagoon	Handline	Subsistence	0.33	20.65 (1.4)
Lagoon	Spear	Subsistence	4.05	7.41 (0.5)
Lagoon	Spear	Sale	1.73	160.02 (10.5)
Mangrove	Collection	Subsistence	0.45	7.50 (0.5)
Mangrove	Collection	Sale	0.29	27.50 (1.8)
Mangrove	Push net	Subsistence	1.11	0.13 (0.01)
Mangrove	Push net	Sale	1.09	3.87 (0.3)
Fringing reef	Collection	Subsistence	0.50	38.91 (2.5)
Fringing reef	Collection	Sale	3.80	6.84 (0.4)
Fringing reef	Duva	Subsistence	0.26	15.00 (1.0)
Fringing reef	Gill net	Subsistence	1.01	29.18 (1.9)
Fringing reef	Gill net	Sale	5.65	3.32 (0.2)
Fringing reef	Handline	Subsistence	0.47	31.75 (2.1)
Fringing reef	Push net	Subsistence	1.26	89.78 (5.9)
Fringing reef	Push net	Sale	4.66	1.60 (0.1)
Fringing reef	Spear	Subsistence	1.72	14.11 (0.9)
Fringing reef	Spear	Sale	3.61	5.00 (0.3)

Table 68. Total fishing effort (hours) and mean catch rates (kg/hour) made by male and female fishers in each habitat using different methods. Data are presented in order of decreasing female effort. Catches of both fish and invertebrates are combined. Only methods that were used for at least 10 hours have been included.

Fishing Area	Method	Fate	Female effort	Male effort	Number of trips
River	Collection	Subsistence	114.0 (13.9)	– (0)	2
River	Collection	Both	103.5 (12.7)	– (0)	1
Lagoon	Collection	Sale	101.0 (12.3)	22.0 (3.1)	8
River	Push net	Sale	89.5 (10.9)	10.0 (1.4)	5
Reef	Push net	Subsistence	83.5 (10.2)	0.1 (0)	12
River	Collection	Sale	78.05 (9.5)	10.0 (1.4)	4
Reef	Collection	Subsistence	35.75 (4.4)	2.0 (0.3)	15
Reef	Handline	Subsistence	28.75 (3.5)	3.0 (0.4)	9
Mangrove	Collection	Both	27.5 (3.4)	5.5 (0.8)	1
Lagoon	Handline	Subsistence	18.5 (2.3)	3.5 (0.5)	6
Lagoon	Collection	Both	17.5 (2.1)	8.0 (1.1)	6
Lagoon	Gill net	Subsistence	15.0 (1.8)	12.0 (1.7)	5
Reef	Duva	Subsistence	15.0 (1.8)	– (0)	4
River	Spear	Sale	14.0 (1.7)	– (0)	1
River	Push net	Both	13.1 (1.6)	3.5 (0.5)	4
Reef	Gill net	Subsistence	12.0 (1.5)	17.0 (2.4)	3
Lagoon	Collection	Subsistence	6.5 (0.8)	4.0 (0.6)	3
Reef	Spear	Subsistence	5.25 (0.6)	8.0 (1.1)	4
Lagoon	Gill net	Sale	5.0 (0.6)	11.5 (1.6)	3
River	Gill net	Sale	4.5 (0.6)	79.0 (11.2)	3
Lagoon	Spearing	Both	– (0)	110.0 (15.6)	3
River	Gill net	Both	2.0 (0.2)	87.0 (12.4)	4
Lagoon	Dropline	Both	– (0)	70.5 (10.0)	3
River	Gill net	Subsistence	– (0)	57.25 (8.1)	4
Lagoon	Dropline	Subsistence	– (0)	50.5 (7.2)	3
Lagoon	Spearing	Sale	– (0)	48.5 (6.9)	4
Lagoon	Dropline	Sale	– (0)	19.0 (2.7)	2

6. Fish Consumption Survey

Fish and marine products make up an important component of the diet of Fijians. The frequency of consumption recorded during the questionnaire survey from the four villages monitored during the creel surveys is shown in Figure 14. All households surveyed reported eating fish on at least one occasion per week, many reporting daily consumption (over 50% of the households from Namatakula village claimed to eat fish on a daily basis).

An assessment of the actual quantities of marine products consumed could be used to estimate (or verify) total fish catches that are made. A survey form (Attachment D) was therefore devised as described previously (Section 2c) in order to try and quantify the rate of consumption by households. The results from the survey are discussed in this section.

A) Importance of Fish Consumption

Records of 943 meals from 50 households representing 310 household days were recorded from Namatakula, Namuaimada and Ucunivanua villages (Table 69).

During these meals fresh fish (58.2% of the meals), tinned fish (6.4%) and a mixture of both (0.4%) were consumed (Table 70). No fish (or marine products) were consumed at approximately one third (35%) of these meals (Table 70).

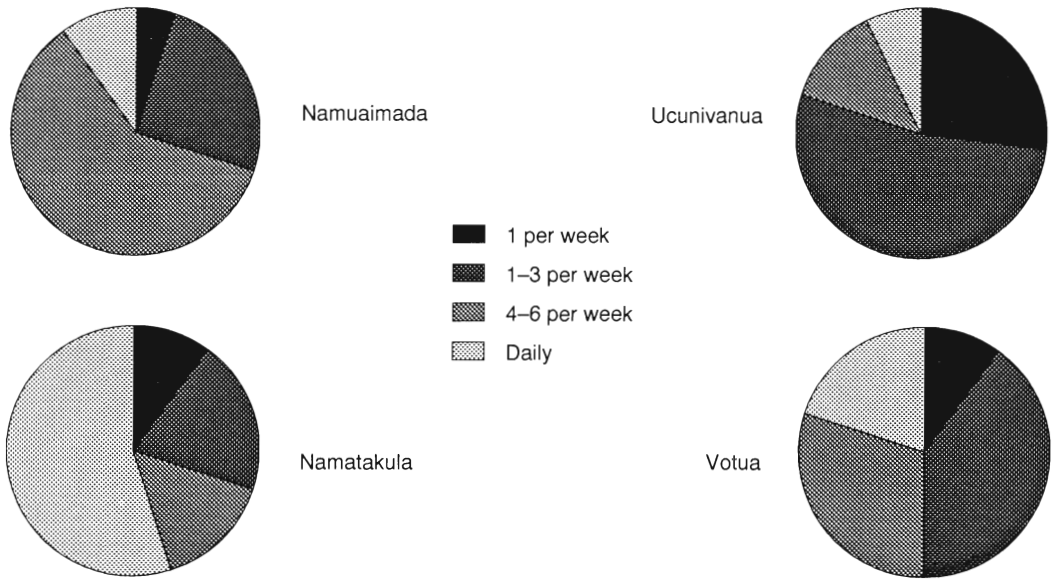

Figure 14. Frequency of consumption of fish by selected coastal Fijian village.

Table 69. Details of the dates the survey forms were started and finished, the number of households who completed forms, the total number of days information was recorded (household days) and the number of meals.

Village	Start date	Finish date	Households	Household days	Meals
Namatakula	06/10/93	12/10/93	33	221	667
Namuaimada	13/09/93	19/09/93	13	73	228
Ucunivanua	28/09/93	01/10/93	4	16	48
Total	–	–	50	310	943

Table 70. Number of meals that fresh fish, tinned fish or no fish were eaten during the fish consumption survey.

Consumed at meals	Number of meals	Percentage of total meals
No fish	330	35.0
Fresh fish	549	58.2
Tinned fish	60	6.4
Fresh and tinned fish	4	0.4
Total meals	943	100.0

Table 71. Number of people at the different meals during the day and the average amount of fish consumed at each meal during the fish consumption survey.

Meal	Meals recorded	People at meal	Fish meals	Fish consumed	Fish/person
Breakfast	39	5.35 ± 0.61	26	1199.4 ± 325.9	410.1 ± 113.1
Lunch	295	3.82 ± 0.19	221	2599.0 ± 258.2	1452.6± 1 52.1
Dinner	279	3.20 ± 0.17	215	2189.1 ± 287.6	1194.9 ± 164.5
All meals	613	3.62 ± 0.13	462	2326.9 ± 185.4	1272.4 ± 106.3

For the 613 meals during which fish was consumed, breakfast (the morning meal) made up 6.3%, lunch (the midday meal) 48.1% and dinner (the evening meal) a further 45.5% (Table 71). Fish is therefore not a regular component of the morning meal in rural Fijian households. As few households possess any form of refrigeration, fish needs to be eaten the same day it is caught. Most people carry out fishing during the day so any fish caught would need to be consumed during the remainder of the day and not left until the following morning. Fish is consumed, when available, both at lunch and dinner.

The average number of people reported at breakfast was greater than for the other two meals (Table 71). This would suggest that the majority of the household attend the morning meal but some members of the household eat elsewhere during the rest of the day. The average sizes of households from the questionnaire survey in Namatakula, Namuaimada and Ucunivanua were 6.9 ± 0.61, 6.05 ± 0.59 and 6.6 ± 0.55, respectively.

The mean number of people attending meals where fish was served was 2.81 ± 0.16, 5.78 ± 0.26 and 5.67 ± 0.51 for Namatakula, Namuaimada and Ucunivanua, respectively. For Namatakula this is a major discrepancy from the mean household size. For the other two villages the figures are closer. The reason for this discrepancy is not clear.

B) Fish Consumption

The recorded lengths of fish were converted to weights using the relationships in Table 3. For some of the taxa identified there was no factor available to make the conversions. The meals in which these taxa were consumed have been excluded from the analysis.

From the overall total of 613 meals in which fish were consumed, it was estimated that the total weight of fish eaten was 1065 kg during 462 of the meals. Extrapolating this figure for the 613 meals would give a total estimated weight of fish consumed of 1413 kg. This gives a mean consumption rate over all meals of approximately 1.5 kg/meal or 2.25 kg/day based on one and a half meals per day. These figures are based on whole fish weights so if a factor of 50% (from Harris 1977) is applied for the return of fish flesh the rates would be 0.75 kg/meal and 1.125 kg/day. Given an average household size of 6 people this would give a figure of 187 g of fish/person/day (or 68.2 kg/person/year).

However, during meals where fish is consumed (462) the mean weights were higher (Table 71). At breakfast, the amount of fish consumed per household was 1199.4 g as opposed to lunch and dinner where approximately 2599 g and 2189 g, respectively, of fish was eaten. Overall the mean weight of fish consumed each meal per household was 2326 g and per person was 1272.4 g during the 462 meals that data were available.

The average amount of fish consumed per meal and per person for Namatakula and Namuaimada villages is given in Figure 15. The reported amount of fish consumed at Namatakula village was much greater than at Namuaimada. The most noticeable pattern from both graphs is the higher rates of consumption on a Sunday. This is a trend that was

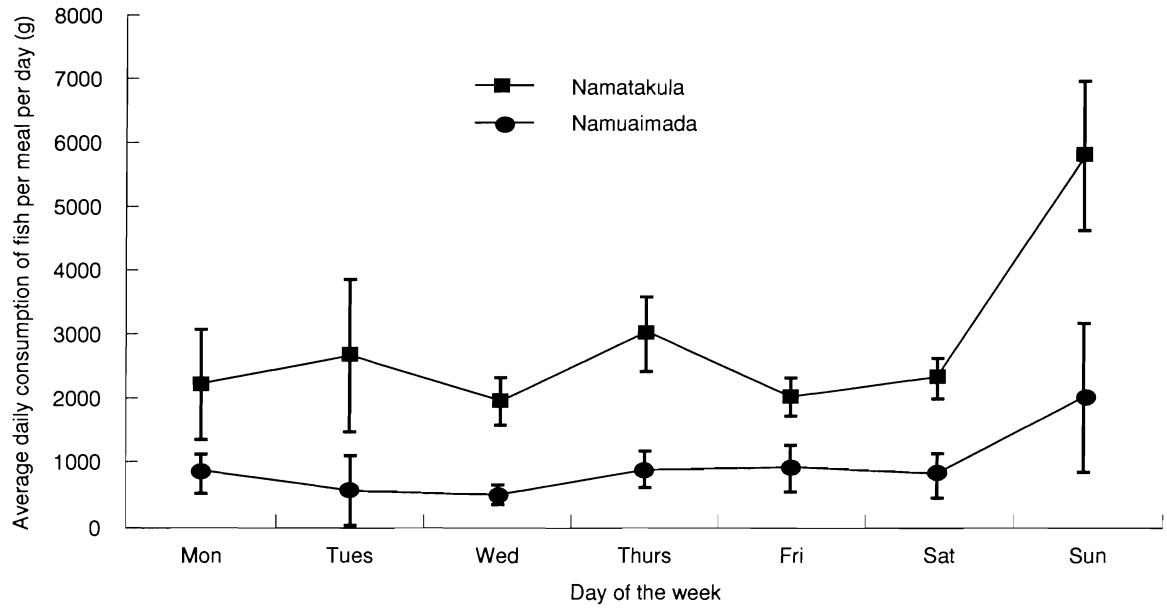

Figure 15a. Average daily consumption of fish per meal per day.

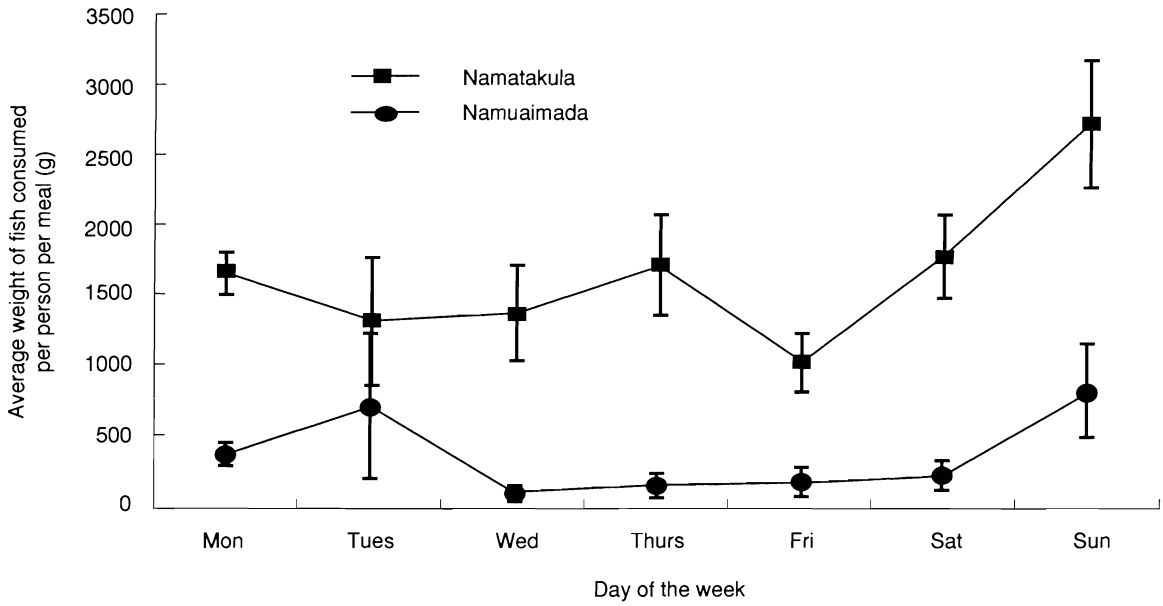

Figure 15b. Average weight of fish consumed per person per meal

highlighted by respondents during the course of the questionnaire survey. People frequently reported actively fishing on Friday and Saturday to ensure there are sufficient quantities of fish available for meals on a Sunday. This is an important day for Fijians both in terms of religious worship and family gatherings. Preparation of family meals, preferably with a sizeable component of fish, is an important part of these proceedings which would explain the increased consumption rates recorded on Sundays.

Another major feature of the results is the high rates of fish consumption recorded especially from Namatakula. Rates of approximately 2 kg/meal/day were recorded with a high on the Sunday of 5.8 kg/meal/day. These are extremely high rates of consumption which have a strong influence on the high overall rates that were recorded.

C) Major Species

The major species recorded from each village on the fish consumption form are listed in Table 72. Fijian names were recorded by the participants of this survey and these have been translated to at least family level. The lengths have been converted into weights. Total numbers and weights for each taxa were then compiled. Invertebrates do not appear in these lists as no estimated weights were available for this group. However, it should be noted that seaweeds, prawns and shells were consumed during some of the meals.

In order to check the validity of the species recorded during the survey, a check needs to be made against the reported catch coming into the village at the same time. Creel and fish consumption survey data were collected concurrently at Namuaimada village and can be used to check the consistency of the results from the different methods.

Table 73 details the major species recorded in both the consumption and the creel surveys from Namuaimada village. Generally the species occurred in both surveys and their average weights are similar.

The two surveys were carried out one week apart at Namatakula village. However, some of the major species occurring in the lists were recorded by both methods and their average sizes are similar (Table 74). This would indicate the consumption survey method does work sufficiently well to assess the major species being eaten and their average size.

Some of the reported numbers of fish being consumed are much greater than the observed catch even taking into consideration the catches that were missed as fishers returned to their homes. There may have been an alternative source of fish for meals (e.g. purchased), that would not have been apparent during the creel surveys, but has been recorded during the consumption survey. Figure 16 shows the relative index of importance of the source of fish in each village from the questionnaire survey. In all cases the most important source of fish was own caught. Next was tinned fish followed by free or bought fish. In most cases free fish would mean part of the catch by a

Table 72. List of the most important species eaten in each village during the fish consumption study. Species are ranked according to the number of meals at Namatakula (Tot = total number eaten; Wt = total weight in kg; N = number of meals).

Species	Namatakula			Namuaimada			Ucunivanua		
	Tot	Wt	N	Tot	Wt	N	Tot	Wt	N
Lethrinus harak	435	113.8	47	208	29.4	16	13	1.3	3
Mullidae	384	83.2	43	37	2.3	1	–	–	–
Epinephelus sp.	360	47.1	30	29	2.5	4	–	–	–
Ctenochaetus sp.	257	39.5	29	–	–	–	1	0.01	1
Octopus sp.	200	107.8	28	5	9.8	1	–	–	–
Mugil sp.	200	14.1	20	30	1.8	4	–	–	–
Lethrinus mahsena	115	93.8	21	24	0.7	1	–	–	–
Acanthurus sp.	63	30.1	10	–	–	–	–	–	–
Sphyraena sp.	62	21.0	11	60	9.1	14	7	0.04	1
Naso unicornis	59	141.6	15	–	–	–	1	0.8	1
Gerres sp.	–	–	–	282	21.0	26	9	1.3	2
Siganidae	–	–	–	43	0.8	3	–	–	–
Hemirhamphus far	24	10.1	2	142	7.0	10	10	00.2	3
Rastrelliger sp.	40	0.2	2	22	1.0	9	–	–	–
Lutjanus sp.	59	12.2	9	113	6.9	7	3	0.09	1
Plotosus lineatus	45	1.0	2	83	0.1	4	–	–	–
Sardinella fijiensis	–	–	–	–	–	–	6	0.4	1
Others	355	240.5	55	59	13.1	12	–	–	–
Total	2658	956.0	334	1137	105.0	117	50	4.2	12

Table 73. List of species recorded from Namuaimada village during the consumption and creel surveys. (Tot = total number eaten; Wt = total weight in kg; Av Wt = average weight in kg; Max L and Min L, the maximum and minimum length in mm).

Species	Consumption					Creel				
	Tot	Wt	Av Wt	Max L	Min L	Tot	Wt	Av Wt	Max L	Min L
Lethrinus harak	208	29.4	0.141	230	30	125	14.6	0.117	250	80
Mullidae	37	2.3	0.062	100	80	50	4.3	0.086	260	82
Epinephelus sp.	29	2.5	0.086	160	100	8	1.1	0.141	220	119
Ctenochaetus sp.	–	–	–	–	–	–	–	–	–	–
Octopus sp.	5	9.8	1.960	–	–	11	13.7	1.247	–	–
Mugil sp.	30	1.8	0.060	200	100	56	1.4	0.025	175	90
Lethrinus mahsena	24	0.7	0.029	90	90	44	2.6	0.060	215	80
Acanthurus sp.	–	–	–	–	–	6	0.2	0.033	92	72
Sphyraena sp.	60	9.1	0.151	350	150	179	73.0	0.408	460	335
Naso unicornis	–	–	–	–	–	–	–	–	–	–
Gerres sp.	282	21.0	0.075	180	60	194	6.5	0.033	155	60
Siganidae	43	0.8	0.018	150	40	259	15.5	0.060	173	66
Hemirhamphus far	142	7.0	0.049	250	150	94	7.0	0.074	300	175
Rastrelliger sp.	22	1.0	0.045	300	7	15	5.6	0.373	280	255
Lutjanus sp.	113	6.9	0.061	200	100	61	4.1	0.067	215	78
Plotosus lineatus	83	0.1	0.001	120	50	299	4.1	0.013	178	103
Sardinella fijiensis	–	–	–	–	–	–	–	-	–	–
Others	59	13.1	12	–	–	–	–	–	–	–
Total	1137	105.0	117	–	–	–	–	–	–	–

Table 74. List of species recorded from Namatakula village during the consumption and creel surveys. (Tot = total number eaten; Wt = total weight in kg; Av Wt = average weight in kg; Max L and Min L, the maximum and minimum length in mm).

Species	Consumption					Creel				
	Tot	Wt	Av Wt	Max L	Min L	Tot	Wt	Av Wt	Max L	Min L
Lethrinus harak	435	113.8	0.261	300	40	–	–	–	–	–
Mullidae	384	83.2	0.217	420	60	14	2.1	0.150	170	161
Epinephelus sp.	360	47.1	0.131	750	60	2	0.2	0.100	145	145
Ctenochaetus sp.	257	39.5	0.154	300	50	43	6.6	0.152	170	113
Octopus sp.	200	107.8	0.539	750	40	5	2.8	0.550	–	–
Mugil sp.	200	14.1	0.070	520	50	–	–	–	–	–
Lethrinus mahsena	115	93.8	0.815	390	80	–	–	–	–	–
Acanthurus sp.	63	30.1	0.478	250	60	6	3.6	0.600	355	146
Sphyraena sp.	62	21.0	0.339	950	140	–	–	–	–	–
Naso unicornis	59	141.6	2.400	450	60	14	19.9	1.421	465	150
Gerres sp.	–	–	–	–	–	–	–	–	–	–
Sphyraena forsteri	–	–	–	–	–	–	–	–	–	–
Siganidae	–	–	–	–	–	–	–	–	–	–
Hemirhamphus far	24	10.1	0.421	190	190	–	–	–	–	–
Rastrelliger sp.	40	0.2	0.005	100	100	–	–	–	–	–
Lutjanus sp.	59	12.2	0.207	300	50	–	–	–	–	–
Plotosus lineatus	45	1.0	0.022	150	100	–	–	–	–	–
Sardinella fijiensis	–	–	–	–	–	–	–	–	–	–
Others	322	194.4	0.604	–	–	–	–	–	–	–
Total	2658	956.0	0.360	–	–	–	–	–	–	–

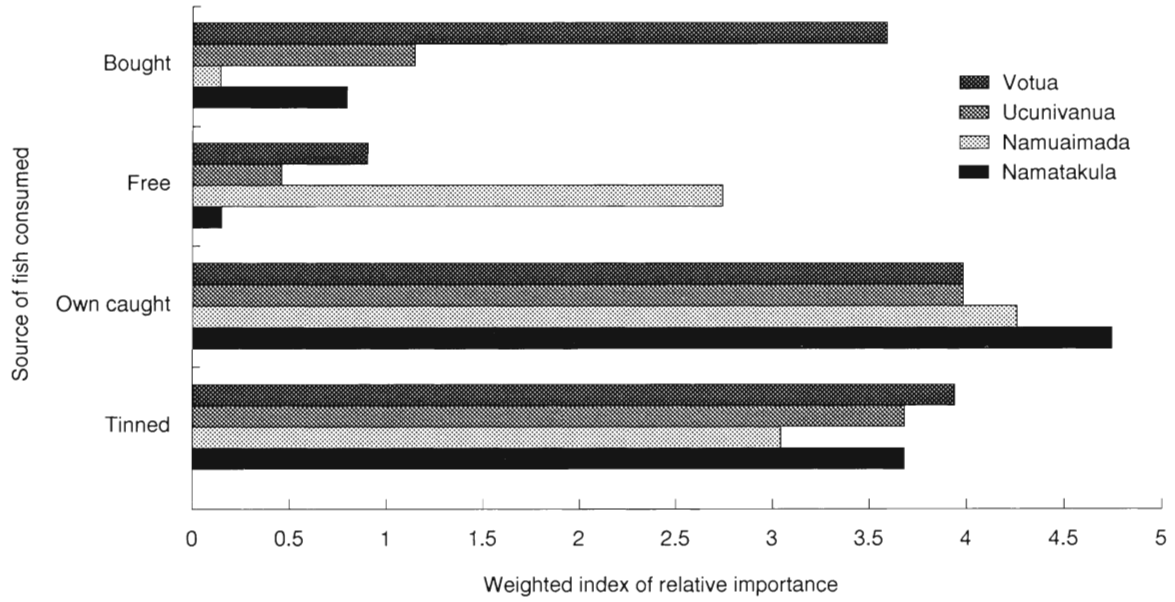

Figure 16. Relative importance of source of fish consumed from selected coastal Fijian village.

friend or relative in the same village. These catches should therefore have been intercepted during the creel surveys. Purchased fish seems to be an important part of fish consumed only at Votua village. From these data, it would seem that bought fish would only make up a small component of the fish consumed at the three villages. This would imply that the catches made by the villagers would supply the major component of the fish consumed. An improvement to the fish consumption form would be to include a column to identify the source of fish for each meal.

It is interesting to note from Figure 16 the lack of importance of receiving free fish. At Namuaimada, free fish is still an important source of fish to households. Namuaimada is more orientated towards a 'subsistence' lifestyle than the other three villages, where the sale of marine products is an important source of income. Although the sharing of the catch between families has not completely ceased, these results imply that the increased importance of generating cash from selling fish is leaving less fish available for consumption in the village and dividing with others.

The overall fish consumption rates estimated from the survey are much higher than previously reported (Vuki 1991: Zann, unpublished data) and need examination.

Looking at the subsistence catch recorded during the creel surveys at each village and dividing this by the total population of the village would give an indication of the consumption rates during the period of the survey. Table 75 details the subsistence catch monitored and the estimated fraction of the fishing effort that was observed. This was used to adjust the monitored catch to give an estimated final subsistence catch for the period of the survey.

After this factor was applied to the Namatakula data, the figure was multiplied by two to account for the fact that only three days (or half a weeks) monitoring was undertaken. Dividing this figure by the total population in each village gives the amount of fish available for consumption per person.

The amount of fish caught per person was similar in each village. For Namatakula, Namuaimada, Ucunivanua and Votua the amounts were 0.62, 0.79, 0.74 and 0.67 kg/person, respectively. This equates to a minimum of 89 g/person/day (or 32.5 kg/person/annum) to a maximum of 113 g/person/day (or 41.2 kg/person/annum). These figures closely follow estimates of average annual fish consumption of around 40 kg per capita by Zann (unpublished data).

These figures differ greatly from those of the fish consumption survey. There must be some doubt, therefore, on the accuracy of the data reported during the consumption survey. The data on the main species and their size agreed with field observations of catches. The numbers of fish eaten and the number of people eating them seem to be

Table 75. The amount of fish caught per person per week in each village from the adjusted subsistence catch recorded during the creel surveys.

Village	Subsistence catch (kg)	Estimated coverage (%)	Adjusted subsistence catch (kg)	Village population[a] (N)	Subsistence catch per person (kg)	Catch/person /day (g)
Namuaimada	150.4	71	211.8	268	0.79	113
Namatakula	39.1	59[b]	132.5	214	0.62	89
Ucunivanua	136.8	73	187.4	254	0.74	106
Votua	163.2	42	388.6	582	0.67	96

[a]Village populations were estimated by multiplying 1986 census figures by 1.07.
[b]A factor of 2 was applied to the adjusted figure to account for only 3 days monitoring of catches at Namatakula

inconsistent. The only explanation for this could be that fish additional to those caught by the villagers themselves are being eaten. Buying of fish or utilising fish caught previously but held in a deep freeze may be two such sources. The evidence from the questionnaire suggests that these were not as important as own caught fish for consumption.

A major ceremony in a village could also be the cause of an increased consumption of fish during any one week. Marriages, deaths, births, fund-raising and important religious days are all occasions associated with preparation of feasts. The capture of fish is one way of supplying the food for such festivities. A series of such events would have a major impact on the consumption levels of fish in a village.

Variation in the amount of available fish would have a direct effect on consumption rates. Therefore, traditional events, bad weather and seasonal abundances of different species would all influence the amount of fish available. In order to take these situations into account this type of survey would need to be carried out over a longer period than just one week and would preferably monitor activities over a whole calendar year. It would also be important to regularly check a subsample of houses to ensure that data were being recorded correctly.

7. Comparisons with Outer Islands Study

A similar questionnaire survey was undertaken in coastal Fijian village communities in islands outside of Viti Levu by Rawlinson and Sesewa (1994). All the sites were primarily locations remote from the main urban centres of the country, and will be referred to as outer island locations. All sites were next to the shoreline and would have been classified in stratum 10 of the present study.

To compare the two surveys, data taken from the those locations in stratum 10 of the present study have to matched with results coming from the 1994 study.

A) Household Size

Households in stratum 10 from Viti Levu had a higher mean number of members (6.06) than those in the outer island locations (5.73). The number of adults per household was higher on Viti Levu (1.84 males and 1.81 females) than the outer islands (1.54 males and 1.55 females). The situation was reversed for children: on Viti Levu (1.27 males and 1.13 females) and in the outer islands (1.43 males and 1.20 females).

B) Source of Income

The number of households involved in selling marine products were similar for outer islands (62.5%) and Viti Levu (60.6%). The sale of copra was undertaken by only 9.0% of households in Viti Levu whereas 58.2% of households in the outer islands still undertook this occupation. Sale of copra was recognised as the most important income source in the outer islands. The sale of marine products was the most important on Viti Levu.

The sale of farm/garden produce was more important in the outer islands (39.8% of households) than on Viti Levu (33.7%). Wage income and an income from other means were more important on Viti Levu. The percentage of households making income from a wage earning occupation was 38.7% and from other means 16.7%. The figures for the outer islands were 23.1% and 5.7%, respectively. The number of households running a business to make income was similar in both areas (6%).

Opportunities for wage employment would be far greater on Viti Levu than in the outer islands, as indicated by the figures. Few rural Fijian households actively run family businesses, except for the sale of local produce.

C) Numbers of Households Involved in Fishing

In the outer islands 96.7% of households went fishing whereas 91.0% of Fijian households in stratum 10 of Viti Levu carried out this activity. The number of households fishing for subsistence purposes were 39.6% in the outer islands and 34.5% on Viti Levu. Artisanal activities were carried out by 57.1% and 63.7% of outer island and Viti Levu households, respectively.

D) Number of People Involved in Fishing

From the total population, 31.8% from the outer islands and 26.7% on Viti Levu go fishing. The proportions for each of the following groups of the population were: adult males, 56.8% (outer islands) and 37.0% (Viti Levu), adult females, 55.5% and 47.7%, male children 4.7% and 2.1%, and female children, 2.8% and 4.6%.

The mean number of people who go fishing from each household was 1.82 in the outer islands and 1.66 from Viti Levu. The mean number of males was 0.88 and 0.72, females was 0.86 and 0.85, male children 0.07 and 0.03 and female children 0.03 and 0.05 for outer islands and Viti Levu, respectively within each group.

Overall it would appear that slightly less fishing activity takes place on Viti Levu as a proportion of the people involved. The primary difference being the activities of adult males. As more jobs are available on Viti Levu, it appears that some adult males work instead of going fishing.

E) Frequency of Fishing Effort

In the outer islands, 51.2 % of the adult population undertake fishing activities at least once a week and only a small proportion (3.8%) of children do any fishing at all. In Viti Levu the percentages of adults fishing once per week is 36.4% and children fishing is 3.2%.

Of the adult males who go fishing, 90.8% and 81.9% from the outer islands and Viti Levu undertake at least one fishing trip per week. For adult females the equivalent figures are 92.9% and 90.2%, respectively. Forty seven percent and 54.9% of males and females from outer islands who go fishing reported undertaking trips more frequently than this (> 2/week). On Viti Levu, 39.3% and 47.5% of males and females were fishing at the same frequency.

These figures would reinforce the observation of slightly less fishing activity taking place on Viti Levu by the adult population. Children in both situations appear to participate in fishing to a very limited degree.

F) Fishing Methods

A comparison of the percentage of households who utilised different fishing methods is summarised in Table 76.

Handlines, droplines and spear fishing are utilised by a greater proportion of households in outer islands. Collection and the use of wading nets are more important on Viti Levu. The use of gill nets was similar in both locations.

G) Fishing Assets

The numbers of different fishing gears, boats and ice boxes for the outer islands and Viti Levu are detailed in Table 77.

Table 76. Percentage of households reporting to use different fishing methods during the course of the questionnaire surveys of the outer islands and Viti Levu

Fishing method	Outer islands (%)	Viti Levu (%)
Handline	86.0	51.3
Spear	36.1	16.3
Dropline	28.4	15.3
Collection	25.1	34.0
Gill nets	13.7	14.3
Wade nets	1.0	16.0

More households in the outer islands own fishing gear than on Viti Levu. Except for push nets, they also possess more pieces of gear. The same was true for boats and ice boxes.

This would generally suggest there are fewer fishing assets on Viti Levu and there is a greater reliance on fishing in the outer islands.

H) Habitat Areas

The major habitat areas used by households both in the outer islands and on Viti Levu are listed in Table 78.

Fishing in the lagoonal areas [along the shoreline, lagoon (shallow) and lagoon (deep)] are the most important fishing habitats for both areas although more households from the outer islands reported fishing there. Activities within estuaries and rivers and around mangrove systems were more important to households on Viti Levu. Fishing around the outer (barrier) reefs and in distant areas away from the villages were more important to households in the outer islands.

Viti Levu is a much larger island than any of the outer islands and possesses considerable areas of freshwater and mangrove habitats, which people use for fishing. Consequently, the use of push nets are a favoured technique in these areas.

I) Target Species

Species from the family Lethrinidae (especially *L. harak*) were the most frequently targeted in the outer islands with serranids, hemiramphids, gerreids and scombrids also being prominent. A similar situation was noted in Viti Levu except that there was an increased importance of carangids. Invertebrates, especially mud crabs, *Scylla serrata*, were also identified as being more important on Viti Levu. This is a direct outcome of the increased use of mangrove areas.

Table 77. The percentage of households (% house) owning at least one of the fishing assets, the overall total of different assets owned (Number) and the number of each asset per household (No./house) for the outer islands and Viti Levu.

	Outer islands			Viti Levu		
	% house	Number	No./house	% house	Number	No./house
Fishing gear						
Handline	87.3	856	2.86	52.7	643	2.14
Dropline	25.1	213	0.71	12.0	153	0.51
Towline	11.0	47	0.16	1.0	6	0.02
Spear (gun)	24.1	97	0.32	5.0	29	0.10
Spear (hand)	23.4	102	0.34	17.0	82	0.28
Dive goggles	39.5	179	0.60	12.3	49	0.16
Gill net	18.7	108	0.36	10.7	93	0.31
UW torch	21.7	72	0.24	4.3	14	0.05
Wading net	1.0	3	0.01	15.3	53	0.18
Other gear	20.7	83	0.28	9.6	82	0.27
Boats						
Paddle canoe	6.0	20	0.07	1.0	3	0.01
Marine ply	0.3	1	–	1.0	10	0.03
Fibreglass	1.7	5	0.02	1.0	3	0.01
Wooden punt	23.7	71	0.24	17.0	51	0.17
FAO design	3.3	10	0.03	0.0	0	0
Other	0	0	0	0.7	2	0.007
Total boats	32.4	107	0.36	23.0	69	0.23
Ice boxes						
Homemade	4.7	17	0.05	5.6	18	0.06
Eskie	1.3	4	0.01	0.7	2	0.006
Total	6.0	21	0.07	6.3	20	0.07

Table 78. Main habitat areas where household fishing activities are undertaken. The number of houses (Houses) using these areas and the percentage of the total sample of houses (% houses) are given for outer islands and Viti Levu.

Habitat area	Outer islands		Viti Levu	
	Houses	% houses	Houses	%houses
Distant area	49	16.4	11	3.7
Outside edge of outer reef	82	27.4	18	6.0
On outer reef	84	28.1	40	13.3
Inside lagoon (deep)	153	51.2	63	21.0
Inside lagoon (shallow)	132	44.1	110	36.7
Along shoreline	190	63.5	130	43.3
Along edge of mangroves	15	5.0	64	21.3
Amongst mangroves	13	4.3	61	20.3
Estuary/rivers	9	2.7	47	15.7

8. Total Estimates of Fishing Effort and Catch

A) Estimation of Effort

From the questionnaire survey, estimates of the mean numbers of people per household who go fishing were made (Tables 24–27). By extrapolating these results by the total number of households involved in fishing for the different strata it is possible to estimate the overall number of people who go fishing within the sample area.

Table 79 details the total number of Fijian and Indian households and people by stratum within the sample area as compiled from the data from the population census figures in 1986 (Anon. 1989).

In order to estimate the actual number of Fijian and Indian households within each stratum who carry out subsistence and artisanal fishing activities, the total number of households had to be adjusted by a group of different factors:

Factor 1: A growth factor to account for an increase in population since 1986. This was set at 1.07.

Factor 2: The proportion of households within each stratum that undertake fishing as recorded from the questionnaire survey. This factor was taken for each strata, from the 'Fishing Total' columns in Tables 17 and 18 for Fijian and Indian houses, respectively.

Table 79. Total population and numbers of houses on Viti Levu broken down by stratum and race.

Race	Stratum	Population	Households
Fijian	10	23,660	4,165
Fijian	20	7,993	1,407
Fijian	30	15,014	2,537
Fijian	40	60,489	10,036
Indian	10	10,715	1,915
Indian	20	25,303	4,520
Indian	30	39,262	6,920
Indian	40	65,555	11,289

Factor 3: The proportion of households that carried out either subsistence or artisanal activities. These factors were taken from Tables 17 and 18 for Fijian and Indian households, respectively.

Factor 4: The mean number of people calculated to be fishing within each stratum, by race, by type of fishing activity and by age as detailed in Tables 24–27.

Using these figures the total number of people fishing and their frequency of fishing effort has been calculated and detailed in Tables 80–83 for adult males, adult females, and male and female children.

Example of application of adjustment factors

For the number of Fijian adult males fishing 3–7 times/week who reside in stratum 10 and undertake subsistence activities:

i) Total number of Fijian households in stratum 10 from 1986 census (from Table 79) : 4165 households

ii) Total number of Fijian households in stratum 10 adjusted to account for population growth since 1986: 4165×1.07

iii) Total number of Fijian households that reported fishing from stratum 10 (factor taken from Table 17): $4165 \times 1.07 \times 91.0\%$

iv) Total number of Fijian households that reported subsistence fishing activities in stratum 10 (factor taken from Table 17): $4165 \times 1.07 \times 91.0\% \times 34.5\%$

v) Total number of Fijian adult males that reported subsistence fishing activities in stratum 10 at the frequency of 3–7 trips/week (factor taken from Table 24): $4165 \times 1.07 \times 91.0\% \times 34.5\% \times 0.14 = 195.9$ adult males.

This procedure was followed for the four different age and sex groupings in order to compile Tables 80–83.

Table 80. The total number of adult males (± s.e.) of each ethnic group in each stratum who reported subsistence and artisanal fishing trips.

Stratum	Race	Type	Number of adult males fishing from subsistence/commercial households							
			3–7 per week		1–2 per week		> 1 per month		< 1 per month	
			Total	± s.e.	Total	± s.e.	Total	± s.e.	Total	± s.e.
10	Fijian	Subsistence	195.9	± 56.0	461.7	± 97.9	111.9	± 42.0	42.0	± 28.0
10	Fijian	Artisanal	981.8	±103.4	775.0	± 129.2	180.8	± 51.7	155.0	± 77.5
20	Fijian	Subsistence	25.8	± 25.8	264.3	± 70.9	128.9	± 38.7	45.1	± 25.8
20	Fijian	Artisanal	175.6	± 62.7	495.3	± 119.1	60.8	± 31.3	0.0	± 0.0
30	Fijian	Subsistence	60.2	± 36.1	348.9	± 84.2	60.2	± 36.1	24.1	± 12.0
30	Fijian	Artisanal	262.5	± 84.0	472.5	± 94.5	0.0	± 0.0	0.0	± 0.0
40	Fijian	Subsistence	934.3	± 233.6	2958.6	± 311.4	856.4	± 155.7	467.1	± 155.7
40	Fijian	Artisanal	332.3	± 115.0	115.0	± 63.9	140.6	± 63.9	217.3	± 127.8
10	Indian	Subsistence	–		–		15.8	± 9.5	–	
20	Indian	Subsistence	73.1	± 18.3	365.5	± 54.8	383.8	± 54.8	365.5	± 54.8
20	Indian	Artisanal	509.1	± 95.4	324.5	± 63.6	95.4	± 38.2	50.9	± 25.5
30	Indian	Subsistence	21.3	± 21.3	213.0	± 42.6	383.8	± 63.9	298.2	± 42.6
30	Indian	Artisanal	187.0	± 59.7	210.9	± 63.7	127.3	± 59.7	0.0	± 0.0
40	Indian	Subsistence	25.5	± 25.5	178.1	± 25.5	254.5	± 50.9	330.8	± 50.9
40	Indian	Artisanal	177.9	± 56.5	129.8	± 56.5	16.7	± 16.7	31.4	± 31.4
All	All	Subsistence	1336.1	± 416.6	4790.1	± 687.3	2195.3	± 451.6	1572.8	± 369.8
All	All	Artisanal	2626.2	± 576.7	2523.0	± 590.5	621.6	± 261.5	454.6	± 262.2
All	All	Total	3962.3	± 993.3	7313.1	± 1277.8	2816.9	± 713.1	2027.4	± 632.0

Table 81. The estimated total number of adult females of each ethnic group in each stratum who reported subsistence and artisanal fishing trips

Stratum	Race	Type	Number of adult females fishing from subsistence/commercial households							
			3–7 per week		1–2 per week		> 1 per month		< 1 per month	
			Total	± s.e.	Total	± s.e.	Total	± s.e.	Total	± s.e.
10	Fijian	Subsistence	349.8	± 70.0	573.7	± 97.9	125.9	± 42.0	28.0	± 14.0
10	Fijian	Artisanal	1343.5	± 129.2	878.4	± 103.3	103.3	± 51.7	51.7	± 25.8
20	Fijian	Subsistence	70.9	± 38.7	180.5	± 58.0	25.8	± 19.3	45.1	± 32.2
20	Fijian	Artisanal	37.6	± 25.1	307.2	± 75.2	56.4	± 31.3	18.8	± 18.8
30	Fijian	Subsistence	312.9	± 84.2	625.7	± 132.4	60.2	± 36.1	24.1	± 24.1
30	Fijian	Artisanal	294.0	± 84.0	682.6	± 105.0	21.0	± 4.2	0.0	± 0.0
40	Fijian	Subsistence	622.8	± 155.7	3347.9	± 389.3	856.4	± 155.7	389.3	± 155.7
40	Fijian	Artisanal	370.6	± 115.0	690.1	± 166.1	140.6	± 115.0	140.6	± 63.9
10	Indian	Subsistence	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
20	Indian	Subsistence	18.3	± 18.3	36.6	± 18.3	36.6	± 18.3	7.3	± 7.3
20	Indian	Artisanal	0.0	± 0.0	5.9	± 5.9	0.0	± 0.0	5.9	± 0.4
30	Indian	Subsistence	0.0	± 0.0	21.3	± 10.6	42.6	± 21.3	17.0	± 12.8
30	Indian	Artisanal	0.0	± 0.0	41.6	± 26.5	60.5	± 45.3	0.0	± 0.0
40	Indian	Subsistence	2.5	± 2.5	25.4	± 7.6	0.0	± 0.0	50.9	± 15.3
40	Indian	Artisanal	0.0	± 0.0	31.4	± 31.4	0.0	± 0.0	0.0	± 0.0
All	All	Subsistence	1377.2	± 369.4	4811.1	± 714.1	1147.5	± 292.7	561.7	± 261.4
All	All	Artisanal	2045.7	± 353.3	2637.2	± 513.4	381.8	± 247.5	217.0	± 108.9
All	All	Total	3422.9	± 722.7	7448.3	± 1227.5	1529.3	± 540.2	778.7	± 370.3

Table 82. The estimated total number of male children of each ethnic group in each stratum who reported subsistence and artisanal fishing trips

Stratum	Race	Type	Number of male children fishing from subsistence/commercial households							
			3–7 per week		1–2 per week		> 1 per month		< 1 per month	
			Total	± s.e.	Total	± s.e.	Total	± s.e.	Total	± s.e.
10	Fijian	Subsistence	14.0	± 14.0	42.0	± 42.0	0.0	± 0.0	0.0	± 0.0
10	Fijian	Artisanal	25.8	± 25.8	25.8	± 25.8	0.0	± 0.0	0.0	± 0.0
20	Fijian	Subsistence	0.0	± 0.0	12.9	± 12.9	0.0	± 0.0	12.9	± 12.9
20	Fijian	Artisanal	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
30	Fijian	Subsistence	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
30	Fijian	Artisanal	0.0	± 0.0	52.5	± 42.0	0.0	± 0.0	0.0	± 0.0
40	Fijian	Subsistence	155.7	± 77.9	389.3	± 155.7	155.7	± 77.9	77.9	± 77.9
40	Fijian	Artisanal	0.0	± 0.0	38.3	± 38.3	38.3	± 38.3	0.0	± 0.0
10	Indian	Subsistence	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
20	Indian	Subsistence	0.0	± 0.0	54.8	± 18.3	36.6	± 18.3	0.0	± 0.0
20	Indian	Artisanal	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
30	Indian	Subsistence	0.0	± 0.0	21.3	± 21.3	6.4	± 6.4	6.4	± 6.4
30	Indian	Artisanal	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
40	Indian	Subsistence	7.6	± 7.6	2.5	± 2.5	25.4	± 15.3	15.3	± 7.6
40	Indian	Artisanal	0.0	± 0.0	0.0	± 0.0	31.4	± 31.4	0.0	± 0.0
All	All	Subsistence	177.3	± 99.5	522.8	± 252.7	224.1	± 117.9	112.5	± 104.8
All	All	Artisanal	25.8	± 25.8	116.6	± 106.1	69.7	± 69.7	0.0	± 0.0
All	All	Total	203.1	± 125.3	639.4	± 358.8	293.8	± 187.6	112.5	± 104.8

Table 83. The estimated total number of female children of each ethnic group in each stratum who reported subsistence and artisanal fishing trips

Stratum	Race	Type	Number of female children fishing from subsistence/commercial households							
			3–7 per week		1–2 per week		> 1 per month		< 1 per month	
			Total	± s.e.	Total	± s.e.	Total	± s.e.	Total	± s.e.
10	Fijian	Subsistence	0.0	± 0.0	56.0	± 28.0	0.0	± 0.0	28.0	± 28.0
10	Fijian	Artisanal	25.8	± 25.8	77.5	± 25.8	0.0	± 0.0	25.8	± 15.5
20	Fijian	Subsistence	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
20	Fijian	Artisanal	0.0	± 0.0	18.8	± 18.8	0.0	± 0.0	0.0	± 0.0
30	Fijian	Subsistence	36.1	± 36.1	72.2	± 48.1	0.0	± 0.0	0.0	± 0.0
30	Fijian	Artisanal	0.0	± 0.0	84.0	± 60.2	0.0	± 0.0	0.0	± 0.0
40	Fijian	Subsistence	0.0	± 0.0	311.4	± 77.8	155.7	± 77.8	0.0	± 0.0
40	Fijian	Artisanal	0.0	± 0.0	38.3	± 38.3	0.0	± 0.0	0.0	± 0.0
10	Indian	Subsistence	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
20	Indian	Subsistence	8.3	± 8.3	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
20	Indian	Artisanal	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
30	Indian	Subsistence	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
30	Indian	Artisanal	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
40	Indian	Subsistence	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
40	Indian	Artisanal	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0	0.0	± 0.0
All	All	Subsistence	44.4	± 44.4	439.6	± 153.9	155.7	± 77.8	28.0	± 28.0
All	All	Artisanal	25.8	± 25.8	218.6	± 143.1	0.0	± 0.0	25.8	± 15.5
All	All	Total	70.2	± 70.2	658.2	± 297.0	155.7	± 77.8	53.8	± 43.5

B) Estimation of Catch

In order to assess the amounts of fish that would be caught by the level of fishing effort estimated, the data from Fijian households in stratum 10 has been used.

Tables 84 and 85 summarise the numbers of Fijian adult males, females and children who reside in stratum 10 and undertake subsistence and artisanal fishing activities, respectively.

In order to estimate how this relates to the numbers of fishing trips per week, each frequency of effort category has been assigned a factor which has been used to convert numbers of people to numbers of trips. Factors of 3, 1, 0.5 and 0.25 were used to adjust the 3–7 trips/week, 1–2 trips/week, greater than once per month and less than once per month categories, respectively.

The numbers of trips per week were converted to numbers of hours per week by applying an average trip length. The trip length was taken from data collected during the creel survey. The average length of subsistence trips was 3.23 hours ($\pm$ 0.31, n = 80) and artisanal trips were 4.88 hours ($\pm$ 0.38, n = 60), which were used for these conversions.

The number of hours per year was calculated by multiplying the weekly total by 52. The total fisher hours undertaken by Fijians living in stratum 10 for subsistence activities was 495,295 and for artisanal activities 2,306,044, as summarised in Tables 84 and 85, respectively.

Using catch rates calculated from the creel surveys, this amount of effort can be converted into a predicted annual catch. During the creel survey, the weight of fish caught was 492.5 kg and 1,170.2 kg and the time spent fishing was 517.0 fisher hours and 977.2 fisher hours for subsistence and artisanal activities, respectively. This is equivalent to catch rates of 0.95 and 1.20 kg/fisher hour for subsistence and artisanal activities.

The annual subsistence catch by Fijians in stratum 10 would therefore be 470 t (495,295 fisher hours $\times$ 0.95 kg/fisher hour) and the annual artisanal catch would be 2,767 t (2,306,044 fisher hours $\times$ 1.20 kg/fisher hour).

The factors used for adjusting the frequency of effort have a strong influence on the estimated effort and in turn the catch. The factors used in our calculations are at the lowest level for the ranges available. This would imply that overall estimates of total catch and effort given are *minimum* values.

Table 84. Estimated subsistence fishing effort by Fijians living in stratum 10.

	3–7 trips per week	1–2 trips per week	> 1 trip per month	< 1 trip per month	Total
Males	195.9	461.7	111.9	42.0	1007.4
Females	349.8	573.7	125.9	28.0	1077.4
Children	14.0	98.0	0.0	0.0	112.0
Total fishers per day	559.7	1,133.4	237.8	70.0	2,000.9
Total fishers per week	1,679.1	1,133.4	118.9	17.5	2,948.9
Total fisher hours per week	5,423.5	3,660.9	384.0	56.5	9,524.9
Total fisher hours per year	282,022.0	190,366.8	19,968.0	2,938.0	495,294.8

Table 85. Estimated artisanal fishing effort by Fijians living in stratum 10.

	3–7 trips per week	1–2 trips per week	> 1 trip per month	< 1 trip per month	Total
Males	981.8	775.0	180.8	155.0	2,072.6
Females	1,343.5	878.4	103.3	51.7	2,376.9
Children	51.6	103.3	0.0	25.8	180.7
Total fishers per day	2,376.9	1,756.7	284.1	232.5	4,630.2
Total fishers per week	7,130.7	1,756.7	142.0	58.1	9,087.5
Total fisher hours per week	34,797.8	8,572.7	693.0	283.5	44,347.0
Total fisher hours per year	1,809,485.6	455,780.4	36,036.0	14,742.0	2,306,044.0

The total number of Fijian people living in stratum 10 is 23,660 (Table 79). If the subsistence catch (470 t) is divided amongst the population this would equate to the consumption of 19.9 kg of marine products (unprocessed) per person per year.

Fisheries Division survey data of the markets in the Central and Western Division estimated a throughput of marine products of 5,257.44 t coming from all sources (Anon. 1992). If the estimates of artisanal catches by coastal Fijians in Viti Levu from this survey are accurate, their activities would account for 53% of this total catch, which is a large segment when considering the proportion of the population that caught it.

However, the survey has highlighted that there are other outlets for the sale of marine products other than the main markets targeted by Fisheries Division. Their figures may not be an accurate estimation of the actual situation.

An artisanal catch of 2,767 t using an average price of FJD2.60/kg from 1992 figures (Anon. 1992) would be worth FJD7.2 million to the coastal Fijian villagers. This figure divided by the estimated number of households that go fishing, 4,055, and the number of weeks in a year, would mean that each household earns FJD34.15/week from the sale of marine products.

Estimates of total cash expenditure by households for the Division's within Viti Levu are available from 1989–90 (Anon. 1991). For villages in the Central Division the estimated weekly expenditure was FJD26.81 and for the Western Division was FJD27.94. Even taking into consideration the cost of inflation since the time the survey was made, an estimated income of FJD34/week from the sale of marine products for coastal Fijian households would cover the estimated expenditure. As this figure covered just about every aspect of living including food, rent, household equipment, transport, recreation and education, this would imply that coastal Fijian villagers who are actively involved in selling marine produce could be considered to be financially 'better off' than other village households within these two Divisions.

The value of the subsistence catch, 470 t at FJD2.60/kg, would be worth a further FJD1.8 million. Dividing this amount by the number of households that go fishing, 4,055, and the number of weeks in a year would mean a further FJD5.80 that did not need to be spent on food. Estimated weekly expenditure for food was FJD13.05 and FJD15.09 for the Central and Western Divisions, respectively. Using these figures, the input from the subsistence catch would cover over one third of this expenditure.

C) Estimation of Total Effort for Rural Viti Levu

If the same calculations are made across all strata and all age, sex and race groupings it is possible to estimate the total number of fishers who go fishing. By summing, from Tables 80–83, the numbers of people in each frequency of effort category, the total number of people who undertake subsistence and artisanal activities can be approximated. These figures can be converted to number of fisher trips by applying the factors used above for each of the frequency of effort categories.

Overall, the number of fishers undertaking subsistence fishing activities during the course of one week was 19,496 which converts to 22,027 fisher trips/week or 1,145,404 fisher trips/year. The number of fishers undertaking artisanal activities per week was 11,989 which converts to 20,379 fisher trips/week or 1,059,708 fisher trips/year. This equates to a total of 2,205,112 fisher trips/year for rural Viti Levu.

Although these levels of effort sound extremely large, if we consider the total population in the sample area (250,406 $\times$1.07 = 267,934 people) and the total number of days in a year (365 days), there are 97,796,063 people days available in a year to undertake activities of any description. A total of 2,205,112 fisher trips takes up only 2.3% of the available people days, which puts these levels of effort in a better perspective. The estimate of people days includes all the days of the week (but Sunday, a day of worship, should be excluded for Fijians as this is not a day available for fishing) and the total population (but Indian adult females and children in general undertake limited fishing). If the figures were adjusted accordingly then days spent fishing would take up a greater proportion of the time. However the 2.3% level does give an indication of the proportion of the overall time given to fishing.

Using these levels of effort and the estimated catch rates and trip lengths for subsistence and artisanal activities calculated for Fijian households in stratum 10, the subsistence catch would be 3,515 t and the artisanal catch would be 6,206 t/year. Although the catch rates from stratum 10 may well

not be the appropriate to apply and separate catch rates should be identified for each stratum by undertaking creel surveys, these figures do give an idea of the total catches from these levels of effort.

Using the data from Table 16 and the known number of Fijian and Indian houses (Table 79), the total number of households within rural Viti Levu that go fishing can be estimated. Overall 25,000 households go fishing of which 16,665 can be classified as subsistence and a further 8,335 can be classified as artisanal.

The subsistence catch per household would be (3,515 t/16,665 households) 211 kg/year or 4.1 kg/week valued at FJD10.66/week (at FJD2.60/kg). The artisanal catch per household would be (6,206 t/8,335 households) 745 kg/year or 14.3 kg/week valued at FJD37.18/week (at FJD2.60/kg). Overall the catch per household that go fishing would be (9,721 t/25,000 households) 389 kg/year or 7.5 kg/week valued at FJD19.50/week.

If the total catch of 9,721 t is divided by the total number of Fijian and Indian households (42,789) the catch per household would be 227/year or 4.4 kg/week.

All these extrapolations are based on the catch rates and trip lengths from stratum 10 being applied across the whole sample area.

The figures presented would suggest that artisanal catches are more important than those for subsistence use. The artisanal catches are also higher than those estimated by Fisheries Division (Anon. 1992) which would suggest that some areas of this fishery are not being adequately monitored.

Recommendations

The results of this survey have highlighted several issues with regard to fishing activity in rural areas of Fiji. The survey was designed to subsample the entire rural population and questionnaires were administered throughout the island. However, there was no creel survey of inland fisheries even though the majority of the population lives in these areas, and the questionnaire results suggest that there is significant fishing activity in the rivers and streams of Viti Levu. Further, the fish consumption survey was conducted effectively at only two villages and both of these were coastal Fijian communities. Difficulties encountered during both surveys (creel and fish consumption) could be addressed in future studies. This study also shows that the level of fishing activity is higher than previously reported and it indicates that similar surveys should be conducted on all major islands in Fiji. The most accurate results have come from a composite approach, combining a suite of survey methods (questionnaire, creel and consumption).

Major recommendations are as follows:

1. A fisheries survey should be conducted on selected outer islands to complement the current survey on Viti Levu.

2. Future surveys must employ the composite approach using questionnaire, creel and fish consumption surveys simultaneously in order to get an accurate assessment of the fisheries.

3. At least two strategic creel and fish consumption surveys should be conducted among inland rural communities on Viti Levu and emphasising Indian villages. These data were lacking in this study and will ensure that all fisheries on Viti Levu are taken into account when assessing the relative importance of particular habitats and fisheries.

4. Future creel surveys should be undertaken at different times in the year to take into consideration any seasonal effects on catches.

5. Future fish consumption surveys should attempt to verify that families are filling in the data sheets accurately and include a question about the source of any fish eaten.

6. The importance of subsistence fisheries in Fiji should be recognised and monitoring of the fishery should be carried out to ensure the long-term sustainable use of resources including protecting habitats.

7. This survey has identified coastal coral reef lagoons and rivers and estuaries as the most important habitats used by subsistence fishers. The distribution of these habitats within Fiji should be mapped in relation to the distribution of rural coastal communities and their relative areas calculated, including the length of the coastline.

8. All future coastal development should take into consideration the possible impacts on artisanal and subsistence fisheries into account as they are a vital source of income and food for rural communities, especially Fijian.

9. Populations of the important invertebrates should be closely monitored.

10. Careful selection of interviewers to carry out the questionnaire survey should be made and it is imperative that all interviewers understand all the terms within the form. Training is essential.

11. Stratification of villages and settlements should include proximity to different habitat types as well as distance from the coast. This would enable a more accurate estimate of the most important taxa overall to be made.

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Attachment A. Field Manual

FISHERIES DIVISION
MINISTRY OF PRIMARY INDUSTRIES AND CO-OPERATIVES

SUBSISTENCE FISHERIES QUESTIONNAIRE SURVEY OF VITI LEVU

FIELD MANUAL

Prepared by
N.J.F. Rawlinson
C.S.I.R.O. Division of Fisheries, Australia

SUVA, FIJI
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Introduction

The subsistence fisheries of Fiji were estimated to account for approximately 80% of total annual domestic landings and just under 50% of total landings (from all sources) in 1992. (Source Fiji Fisheries Division Annual Report 1992).

At present Fiji Fisheries Division has monitoring systems in place to gather information on the catches being made in the commercial and artisanal fisheries sectors within the country but no method to monitor the subsistence fishery.

The Australian Centre for International Agricultural Research (ACIAR) agreed to fund a six month collaborative research project between the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Fiji Fisheries Division in order to investigate the levels of fishing activity within the subsistence fisheries sector in Fiji. The project was initiated to capitalise on similar work that was started during the ACIAR funded Baitfish Research Project.

The six month subsistence survey has two main components:-

a) A household questionnaire interview survey;
b) Collection of catch data from subsistence fishermen as well as data on the household consumption of fish.

The survey will be based on the island of Viti Levu. Further work is planned fort a similar survey of the whole of Fiji after appropriate methodologies have been developed during the course of the Viti Levu survey.

This manual has been produced to give some information on the questionnaire interview survey and to give enumerators using the technique some guidelines on how to complete the questionnaire forms. The manual aims to act as a field guide and as a backup to formal training classes for enumerators using the questionnaire survey.

Definition of Subsistence Fishery

For the purpose of this survey the subsistence fishery will be defined as follows:-

THE COMPONENT OF THE FISHING ACTIVITIES IN FIJI IN WHICH THE CATCH IS NOT SOLD BUT IS GENERALLY CONSUMED BY THE FISHERPERSON AND HIS (OR HER) FAMILY/FRIENDS.

Fisheries Division presently undertakes sampling of the main fish markets, road-side markets, shops etc. However those fish which are not sold are not being monitored.

Importance of the Subsistence Fishery to Fiji

Fresh fish remains an essential part of the diet in many areas of Fiji and consumption estimates are amongst the highest recorded in the world. Estimates of average annual fish

consumption (including imports) are around 40 kg per capita. Annual consumption of local fish range from about 15 kg per capita in urban areas (Zann 1984), to 50 kg per capita in agricultural areas on the fertile main islands (Anon. 1990; Vuki, 1991; and Zann, 1984), to 100 kg per capita in the less fertile islands of Lau.

Fisheries Division estimates the average annual consumption figure as 22 kg per capita for fish which is consumed which is not purchased ie fish caught by the subsistence fishery. If this figure is applied to the total population of Fiji then an approximation of the total fish consumed can be made:-

730,000 people × 22 kg per person = 16,060 tonnes per year consumed which is caught by consumers.

This figure gives an indication of the size of the fishery and although it is of great importance to the rural Fijian population, there are presently no reliable estimates of the subsistence catch.

Previous Work

A Fisheries Division survey in 1978-1980 indicated that the annual landings were about 14,000 tonnes per year. The estimate has been increased by an increment of 200 tonnes per year to allow for population growth - 1991 estimate now stands at 16,400.
The above estimate was based on a questionnaire of 9% of coastal villages in which village leaders were asked to "estimate" landings in their village.

Several other localised studies have been done but no further assessment of the total subsistence fishery catch for Fiji has been made since 1978-80.

Pressure on the Fishery

As the population of Fiji continues to rise further pressure will be applied to the stocks of fish which are targeted by the subsistence fisherpersons. This coupled with the introduction/increased use of more efficient fishing gear eg nets will combine to produce greater fishing effort on many stocks of fish.

Expected Outcomes from the Survey

1. The expected information to be collected during the Subsistence Fisheries Questionnaire Survey for Viti Levu is as follows:-

a. The main habitat areas where subsistence fishing activities are being carried out;

b. The main fishing techniques being used and the people who are using them;

c. The frequency of fishing activities and the average length of fishing trips;

d. The potential fishing power of families based on establishing their fishing assets;

e. A list of the marine products that are being utilized, including the main fish groups;

f. The frequency of fish consumption by household groups;

g. The importance of the sale of marine products as a source of income;

h. Other general information that the interviewees wish to volunteer including fishing seasons, problems experienced and traditional fisheries knowledge.

The questionnaire is not being used to ask people to make estimates of the actual quantity of fish being caught due to the inaccuracies in such an approach.

After the questionnaire survey has been completed it will be possible to assess where effort for the catch sampling should be undertaken. The expected outcomes in terms of data from this work will be:-

i. A realistic estimate of the importance of the subsistence fishery to the people of Fiji;

ii. The provision of framework for research methods for use in the future;

iii. Relative fishing effort between different regions of Fiji and the relative importance of subsistence versus artisanal fisheries;

iv. Accurate identification to species level of fish taken by different fishing techniques;

v. Estimate of the quantity of fish and other marine products that are taken in the subsistence fishery;

vi. Identification of the most commonly used fishing techniques in Fiji;

vii. The role of women in fisheries in Fiji.

The expected users of this data will be:-

a) Fisheries Division

i. To assist to identify priority areas for future research;

ii. To advise customary fishing right owners on the management of their resources;

iii. To identify the development requirements of local communities in terms of fishing assets;

iv. As a basis for fisheries infrastructure planning;

v. As a baseline to assess the impacts of future proposed developments.

b) National Government

i. There is a need to put a dollar value on the subsistence fishery in order to be able to make an assessment for compensation payments that are required due to future developments;

ii. For National Policy Planning;

iii. There is a requirement for accurate information on the current use of natural resources to certain Government Departments eg National Environmental Plan.

Questionnaire Survey Method

The questionnaire survey will be based on a team of officers (enumeration team) interviewing a member of different households within a number of selected villages.

A. Team Job Description

Each enumeration team will include a team leader or supervisor, three or four enumerators and a driver. Specific duties of each member of the team are as follows:-

a. Supervisor

He is responsible for:

i) The adequate availability of survey materials such as questionnaires forms, clip boards, pencils, rubbers, fish identification albums and any other items to successfully undertake the survey.

ii) The administrative procedures of the whole team. This means ensuring that there is sufficient fuel for the vehicle, accommodation arrangements have been organized, meals have been arranged, and payment of allowances for enumerators has been organized.

iii) Introduction and presentation of 'sevusevu', where necessary, of the survey team to the village chief. It is essential that people living in the area where the survey is being carried out are aware of what is happening and the proper protocol has been undertaken.

iv) To make sure radio messages, informing people of the survey teams schedule, have been transmitted.

v) The technical aspects of the enumeration. He must check each questionnaire before the team leaves the field, and afterwards, before the questionnaires are sent to Fisheries Headquarters in Lami.

vi) Complete the Site Information Form for each village/settlement that is visited by the survey team.

vii) To participate in conducting some of the interviews.

b. Enumerator

The enumerator is responsible:-

i) For conducting the interviews and completing the questionnaire forms.

Even though it is the supervisors overall responsibly to ensure that the enumerator has all the required items to undertake the planned schedule of interviews for the day, the enumerator can assist by preparing all his own requirements before departing for the days events.

c. Driver

i) He is responsible for checking and keeping the vehicle in good working condition. Preparation of the vehicle before each days work eg refuelling, checking tyre pressures etc, should be done early in the morning so that no time is lost for undertaking the survey work.

ii) He must at all times follow the instructions of the supervisor and must work according to his directions.

Completion of Questionnaire Survey Forms

General

Accuracy of Data:-

1. It is absolutely essential that data recorded on the questionnaire forms is done NEATLY so anyone can understand what has been written.

2. It is equally essential that accurate answers are obtained from the respondent and this information is recorded on the questionnaire forms. Mis-information could effect the results badly which in turn would influence any decisions made which use the data collected.

3. It is essential that ALL questions on the form our answered. Even if some sections of the questionnaire are not applicable to the household member being interviewed, make sure that this made clear on the form. Either mark the boxes with a cross or put a line through the whole section. This will make it clear to the person entering your data into the computer that the question was asked but the question was not relevant to

that particular household. If nothing is written on the form, confusion could be caused as a blank could mean none of the questions were actually asked to the respondent.

4. ALWAYS remember that the form you have completed is going to be read by some body else who will be responsible for entering the data into the computer. Keep it in mind that even though the personalised notes or marks might mean something to you, to another person they may not make any sense at all. While filling in the form ensure that anything you write can easily be read and interpreted by another person.

a) The Site Information Form

This form must be completed by the supervisor for every village or settlement which is visited by a survey team for undertaking household interviews. A copy of the form can be found as Appendix 1 in this manual.

The boxes that are shaded will be completed before the team goes out into the field and will give details already known about the site. The province, tikina, name and stratum code of the village or settlement to be visited will be recorded in these shaded boxes. It is essential that the supervisor makes sure that all members of his team are aware of these details so they can record them on their questionnaire forms.

Details of the composition of the particular village or settlement will also be marked in the shaded boxes provided. The number of Fijian, Indian, Other and Total people and houses will be specified in the space provided using the information from the 1986 Population Census.

The number of houses to be interviewed will be recorded in the next shaded box as well as the number of the house to start the interviews from.. In each village or settlement, the supervisor will have to identify a starting point to begin the interviews. Once this has been identified, he should then start the interview at the first, second, third etc house depending on the number recorded in the "Starting with House Number" box. This approach is used is used in order to keep the selection of houses as a random process.

This will be the only information recorded on the forms before the supervisor leaves to undertake the interviews. The other sections of the form should be completed by the supervisor on his arrival at the site.

The form allows space for the supervisor to record his or her name along with the names of the enumerators who are in the team to carry out the interviews in this particular village/settlement.

The next section allows the supervisor to record the number of houses and people in the village/settlement who are presently living there. This may not be achievable in all situations but in some cases it may. In villages, it should be possible to

actually count the number of houses in the village though it will be difficult to count the actual number of people. On the other hand the 'Turag-ni-koro' may well have the latest details on the number of houses and people in his village which would be important information to record. Depending on whether the numbers have actually been counted by the supervisor or he has been informed of these details then either the COUNTED or INFORMED box should be ticked. Wherever possible the supervisor should try to attain this information.

If a more accurate number of houses in the village/settlement from the 1986 census can be obtained then this figure should be used to calculate how many houses should be disregarded between houses to be interviewed (N). This can be calculated by dividing the number of houses in the village by the number of houses to be interviewed. The value of N should be recorded in the box provided and every Nth house should be interviewed. Where possible this approach should be used in all cases. However on the day of the interviews it might be that there is nobody in the house to be interviewed. In this case go to the next house where there are people in.

The next part of the Site Information Form requires the entry of the date the village/settlement was visited, the time of arrival at the village, the time of the first interview was undertaken and the time of departure from the village. This is important information for planning of interview surveys in the future.

The next section requires the supervisor to record any observations that were made pertaining to fishing activities within the village that were seen on the day of the visit. Such observations can give an overall idea of any fishing activities that might be taking place in that area. The form requires the supervisor to note numbers of people fishing, boats , fishing gears, processing activities and fish ponds that were seen. If any of the above were seen then space is provided to write more details about the observations made eg. what type of fishing were people seen doing, the type of fishing gear seen, the actual products being processed etc.

There is a space provided underneath this section to record the actual number of interviews (questionnaire forms) that were completed at the village/settlement. In most cases this should equal the number of houses to be interviewed in the shaded box detailed.

At the bottom of the form is a space provided for the supervisor to record Any Other Information. This should include a brief description about the village/settlement, any interesting information that came to light at the village/settlement which would not have been recorded elsewhere and some general comments on how the visit went. The supervisor must use his common sense when completing this section but must bear in mind that if he ignores to record any useful information that was noted at the site visited, the information could well be lost.

b) Fishing Interview Survey Questionnaire

The Fishing Interview Survey Questionnaire has been designed to gather information on household activities which relate to fishing. A copy of the form can be found as Appendix 2 in this manual.

The Questionnaire is divided into nine sections - eight of the sections require answers to certain questions and the last one (Miscellaneous) allows space for any comments or points of view that might come to light during the course of the interview, which should be noted for future reference.

The following notes define what the questions refer to in each section and are to be used as a guideline for the enumerators.

Definitions

There are a few terms which appear in various sections of the questionnaire but there meaning is the same throughout. These are detailed here:-

Rank - for certain questions a list of possible answers has been provided. The actual answer could be a combination of more than one of these possibilities and so it is necessary to rank them in their order of importance to the answer of the question. For the most applicable answer an entry of 1 should be entered into the rank box, for the second answer 2 should be entered, for the third it should be three and so on. It is important that this procedure is carried out for those questions where the rank is requested. Even if there is only one possible answer identified out of the group, enter a 1 in the rank box.

Section 1: Respondents Identification

Aim of Section: To record relevant information on where and when the interview took place and who the interviewer and respondent were. It is vital that this is completed neatly at the time of the interview as this data will be vital to the analysis of the questionnaire forms.

Details required for each question:-

1. Interviewer - the name of the person asking the questions (your own name).

2. Code Number - DO NOT ENTER ANYTHING IN THIS BOX - a number will be given to each completed questionnaire in the office prior to data being entered in the computer database.

3. Date - the data the interview takes place.

4. Time - the time the interview takes place.

5. Village - the name of the village or settlement.

6. Tikina - the name of the tikina in which the village/settlement is situated.

7. Area Code - an area code will be given to each village - your supervisor will have this code and should give it to you before you commence your interviews - ask if the code has not been given to you. (The area code is the same as the stratum code).

8. Respondent - the name of the person to whom you are asking the questions.

9. Household Status - the position of the respondent in the households family eg father, mother, brother, aunt etc.

10. Race - the ethnic race of the respondent eg Fijian, Indian, Rotuman etc.

Section 2: Personal and Socioeconomic

Aim of Section: To assess the number of people who are living in the household, the main source(s) of income to the household, the importance of fishing as a source of income, whether fishing activities are mainly for subsistence or commercial use, and the level of fishing effort by members of the family.

1. Number Permanently Living in Household? - the figure entered in the box provided should be the number of people who usually live in the household. Please make sure that the number does not include members of the family who are no longer living in the household eg sons and daughters who have moved away from home.

2. Composition of the Household? - this question requires the breakdown of the number of people permanently living in the household by sex and age. Children should be considered as persons who are under 16 years of age. The actual age of the household residents should also be recorded in the box provided. NB. MAKE SURE THE TOTAL NUMBER OF ADULTS AND CHILDREN EQUALS THE NUMBER PERMANENTLY LIVING IN HOUSEHOLD FROM QUESTION 1.

This information is very important as the age and sex of people influences the types of fishing activities they are likely to undertake.

3. Households Main Sources of Income? - the main source of income to the household should be ranked in order of importance to the household. There could well be more than one source of income coming into the household so it is important to determine which activity provides the most income to the family by ranking accordingly.

The options for the answer to this question are:-

a) Sale of Marine/Freshwater Products - this is the sale of any fish, shells, shellfish etc which were removed from either the sea or from freshwater bodies eg lakes or rivers.

b) Sale of Copra
c) Farming - income from the sale of products produced by farming eg sugar, vegetables from the garden etc.
d) Wage Employment - income received from a job paying a salary eg government officer, farm worker, hotel staff etc.
e) Own Business - income received from the household running its own business eg store, sale of mats etc.
f) Other - income received from another source not detailed above eg. pension. Please enter name of this source next to the word Other.

If any of the activities identified only provide income for a part of the year then enter this in the Season box. Enter the months involved eg Jun-Aug, or Jan-May. If the activities provide income all year around the enter All Year.

4. If Marine Products are Sold then How Often? - if in question 3 the respondent identified the SALE OF MARINE/FRESHWATER PRODUCTS as a source of income then complete this question. If not then ignore question 4 and go straight on to question 5.

Question 4 requires the respondent to estimate how often his household sells marine/freshwater products. The answer can either be FREQUENTLY (once a week or more), OCCASIONALLY (once a month or more, but not greater that once a week) or INFREQUENTLY (less than once a month). The box with the most appropriate answer should be ticked.

The second part of the Question requires the respondent to identify what types of marine/freshwater products are sold. The products should be ranked in order of their importance. The options for the type of product are:-

a) Fish
b) Shellfish - this means crabs, lobsters, prawns etc.
c) Bêche-de-mer - sea cucumbers.
d) Shark Fin
e) Shells - this means bivalves, gastropods etc.
f) Other - this will include such products as sea urchins, worms, turtles etc. Write down the name of the product mentioned by the respondent.

For whatever product is sold details of the market it is sold at or to, at what price (please ensure the price given is for a defined amount of the product eg $2 per kg, $15 per bundle, $5 for one etc) and estimate of how much, in terms of weight or money, and how often the product is sold, are required.

5. Members of the Family Who Go Fishing and How Often Do They Carry Out Fishing Activities? - this question is to identify the members of the household who undertake fishing activities and how often.

The number of adult males and females, and child male and females of the household who undertake <u>any fishing activities at all</u> should be entered into the Column marked Number. If no one

in any of the categories goes fishing then enter a 0 in the number box.

The frequency of these peoples activities should then be entered in the appropriate box. This selection can be either 3 to 7 times per week (3-7 week), 1 to 2 times per week (1-2 week), more than once a month but more than once a week (> 1 Month) and less than once per month (< 1 Month). If there is more than one in the number category it maybe that the individuals referred to do not undertake fishing activities at the same frequency. If this is so, place the number of people undertaking fishing activities in different but the appropriate boxes.

6. Amount of Fish Caught by Household which is Consumed by the Household? - if no fishing is carried by any members of the family then this question should be ignored and the interview should then continue from SECTION 4: FISHING ASSETS.

If at least one person from the household goes fishing then the interviewer must establish how much of the fish caught is consumed by the family. The options are ALL, SOME or NONE. The box next to the appropriate answer should be ticked. If ALL is the answer given then go directly to SECTION 3: FISHING METHODS.

If only SOME or NONE of the fish caught by the household is consumed by the household then the second part of the question should be asked. This part tries to establish what happens to the fish which is not consumed by the family. Is it either SOLD, GIVEN TO FAMILY, GIVEN TO FRIENDS, GIVEN TO ANIMALS (eg pigs for food) or does it go to some OTHER use? The most appropriate answers should be ranked by their importance.

Question 6 is vital for establishing whether a household is undertaking fishing activities for subsistence or commercial purposes.

Section 3: Fishing Methods

Aim of Section: To assess what are the most important fishing methods used by members of a household and if season or moon phase has any influence on the timing of the methods used. The section also aims to assess the main hook baits used and also the use of lights during fishing activities.

1. What are the Main Fishing Methods used by the Members of the Household? - there are 14 fishing methods which have been identified as likely alternatives to those being used by household members and these should be ranked in order of importance to the household. If a fishing method is identified by a household which is not in the list then record this next to the OTHER box and make a note of the method being referred to in SECTION 9: MISCELLANEOUS. The alternative fishing methods listed are:-

a) Hand line - the use of a hook and line without using any sinker (a small one might be pinched to the line in order to

assist the propulsion of the bait away from the fisherman) eg a line being thrown from the shore, usually used in shallow water.
b) Drop line - the use of a hook and line with the addition of a sinker. Usually used in deeper water than a hand line.
c) Tow line - the use of a line to drag a lure or bait behind a boat which is moving forward.
d) Gill net (Set) - the use of a gill net by anchoring it in one position for at least a few hours at a time. No people chasing fish into the net.
e) Gill net (Drive) - the use of a gill net which is set in a position and then fish are chased towards it by fishermen in their boats.
f) Spear - the use of a sharp pointed stick/metal pole to stab fish with.
g) Collection - the use of hands to pick up and collect marine/freshwater products eg shells, seaweeds etc.
h) Duva - the use of poison to kill fish.
i) Yavirau - the traditional fish drive using vines to capture the fish.
j) Qoli samu - a fish drive, usually in shallow water, with fish either being caught in nets after being herded towards it by people splashing/making a noise in the water.
k) Fishing poles - the use of a hook and line which is attached to the end of a pole to act like a fishing rod.
l) Cast net - the use of a net which surrounds a fish/school of fish when it is thrown (cast) at them by the fisherman.
m) Push net - the use of a short piece of net which is tied at its ends to pieces of stick which can then be pushed along by one person.
n) Crab trap - the use of a baited net trap to catch crabs.
o) Other - any other fishing technique which is not listed above.

After a method has been identified as being used by a household it is important to establish who uses each method. This should be entered in the BY WHO column. The time of use eg day or night should be entered in the USUAL TIME column and the preferred moon phase for undertaking the fishing method should be entered in the MOON PHASE column. Finally the best months for using the fishing method should be identified by placing an asterisks under the appropriate month(s) identified by the respondent.

2. What is the Main Hook Bait Used? - the most common baits used for fishing used by a household should be ranked in order of their importance. The options for the types of bait are:-

a) Crab
b) Squid/Octopus
c) Small fish - the of small (generally whole) fish eg daniva and sardines (walu bait).
d) Larger fish - the use of sections of flesh cut off a fish too large to be put on a hook.
e) Other - any other type of bait identified. Write down the name of the bait referred to.

3. Does Anyone in the Household Use Lights During Any of Their Fishing Operations? - this question refers to the use of kerosene lamps or torches at night during fishing operations.

Tick either the box for Yes or No depending on the answer. If the answer is Yes ask for details of what type of light is used and why it is used? Record this information in the box provided.

Section 4: Fishing Assets

Aim of Section: To assess the gear and equipment owned in order to estimate the potential fishing power of a household. Fishing gear owned also gives further evidence of the main fishing methods likely to be undertaken.

1. Number Possessed by Household? - the number of items of each different type of fishing gear should be recorded under number. It is imperative that only those items actually owned by the household are recorded and not those that they might borrow.

If the household possesses an item of fishing gear listed then include the size of gear where applicable eg mesh sizes for gill nets, breaking strain (test) of line etc.

2. Number Possessed by Household? - the number of boats alongside the descriptions listed should be recorded in the Number column. The different types of boats are as follows -

a) Paddle Canoe - a small, usually one-man vessel, that is propelled by the operator using some form of paddle eg dugout canoe, canoe made out of roofing iron etc.
b) Marine Ply-wood Boat
c) Aluminium Boat
d) Fibreglass Boat
e) Local Wooden Punt
f) FAO Design Boat
g) Other - any other design not covered by the above list.

The size of the boats that are owned should be recorded in the column Boat Size and the size of the engine, in terms of horsepower, used to propel the boat should be detailed in the column Engine HP.

3. Number of Ice Boxes Owned by Household? - the number of either homemade iceboxes eg old refrigerators, or plastic eskies owned should be included in the Number column.

4. Does your Household use Ice? - tick either the Yes or No box depending on whether ice is used during the course of fishing activities.

If the answer to question 4 is Yes then enter in the space provided where the household gets its ice from.

Section 5: Fishing Grounds

Aim of Section: To establish in broad terms where most of the households fishing activities take place, the type of fishing methods they would use in those areas and the type of marine/freshwater products they are trying to capture/collect. Information on the ownership of fishing rights and access to

fishing grounds, in order to assess range of operation of fishermen should also be recorded in this section.

1. Does Anyone in your Household go Fishing in the Following Areas? - the areas used by members of the household for fishing should be ranked in order of importance and the value entered in the Rank column. The alternative fishing grounds listed are as follows:-

a) Distant Area - fishing in an area distant from the village/settlement were the household is located eg in the open ocean, on another island etc.
b) Around a Fish Aggregating Device - fishing around an anchored raft which has been deployed to attract fish.
c) Outside Edge of Outer Reef - fishing on the ocean side of the drop off of the outer (barrier) reef.
d) On the Outer Reef - fishing actually on the outer (barrier) reef.
e) Inside Lagoon (Deep water) - fishing in the area between the outer reef and the shore in depths of water greater than 10 meters.
f) Inside Lagoon (Shallow water) - fishing in the area between the outer reef and the shore in depths of water less than 10 meters. This is usually means fishing around shallow patch reefs.
g) Along Shoreline - fishing from the shoreline or standing in the shallow water adjacent to the shoreline. This area can be reached by foot and a boat is not required. This could well be an inter-tidal area.
h) Along Edge of Mangroves - fishing in the shallow area adjacent to patches of mangroves. This could well be an inter-tidal area.
i) Amongst mangroves - fishing in an area (or channel) that is surrounded by mangroves.
j) Estuary or River - fishing anywhere along the stretch of a river.
k) Other - fishing in an area not covered by the above list.

If one of the fishing areas is reported to be used then it is important to find out which members of the family operate in that area. This should be recorded in the BY WHO column.

If there are any particular months which are considered better for fishing in the area identified then mark this neatly with an asterisk under the appropriate letter referring to the month.

The main fishing method used in the fishing referred to should be detailed in the column FISHING METHOD.

The marine/freshwater products which the household member is intending to catch or collect from the fishing area should be detailed under the TARGET SPECIES column. Local or English names can be used. A list of the Fijian names of the most common fish and non-fish species are detailed in this manual. If a name given by the respondent does not appear in either of the lists then ensure that you know what is being referred to and make a note of it in Section 9: Miscellaneous. Photograph albums of the most common species caught will also be provided.

2. Are there any Areas where your Household has Ownership/Fishing Rights? - tick the appropriate Yes or No box for the answer to this question.

If the answer is Yes, ask the name of the fishing right area and write this down in the space provided.

3. Does your Household Allow Other People to Fish in these Areas? - tick the appropriate Yes or No box.

4. Are there Areas where your Household is not Allowed to Fish? - tick the appropriate Yes or No box.

Section 6: Fishing Effort

Aim of Section: To assess the usual length of a fishing trip by different members of the household and to identify days when fishing can not be carried out.

1. What is the Average Length of a Fishing Trip? - the usual time spent fishing on anyone occasion by members of the household should be ranked according to length of a fishing trip. The rank number should be recorded in the RANK column against the most appropriate time period.

The persons who undertake the length of fishing trips selected should be recorded in the BY WHO column.

2. Are there Any Days not Available for Fishing? - if there are any days which can not be utilized for fishing by members of the household due to religious beliefs, tradition or social commitments then the Yes box should be ticked. If not, the No box should be ticked.

If the answer is Yes, then write in the day (or days) which are not available for fishing in the space provided.

Section 7: Fish Consumption

Aim of Section: To establish how often a household consumes marine/freshwater products, what the main source of the fish consumed is and the actual supplier or fishing ground from where these products come from.

1. How often does your Household Consume Fish? - five alternatives are given for the average rate at which the members of a household consume marine/freshwater products including tinned fish. The appropriate answer given by the respondent should be recorded with a tick. The alternatives are as follows:-

a) Every day - this means that at least one member of the household would consume marine/freshwater products on at least one occasion everyday.
b) 4-6 Times per Week - this means that marine/freshwater products are consumed by a household for at least one meal per day for 4 to 6 days of the week.

c) 1-3 Times per Week - this means that marine/freshwater products are consumed by a household for at least one meal per day for 1 to 3 days of the week.
d) 1 Time per Week - this means that marine/freshwater products are consumed by a household for at least one meal per day for 1 day each week.
e) Never - this means that marine/freshwater products are never consumed by any member of the household.

2. What is the Source of this Fish? - the main source of the marine/freshwater products, in general terms, consumed by the household is required. If there is more than one source identified, the different answers should be ranked by order of their importance. The alternative answers to this questions are:-

a) Own Caught - this is the consumption of marine/freshwater products that have been caught by a member of the household.
b) Bought Fish - this is the consumption of marine/freshwater products that have been purchased.
c) Free Fish - this is the consumption of marine/freshwater products that have been given to the household.
d) Tinned Fish -this is the consumption of tinned fish eg tinned tuna or mackerel.
e) Other - this is the consumption of fish which has come from an alternative source to those listed above. Details of the source should be detailed next to the word Other.

3. Where does the Fish come from? eg. Name of Fishing Area or Supplier - if a source of fish has been identified in question 2 then actual details of this source should be provided in the space available for question 3. For instance if Own Caught has been identified in question 2 then the name of the fishing area should be recorded for the answer to question 3; or if Bought Fish has been recorded in question 2 then the name of the market or store it has been purchased from should be recorded for question 3.

Section 8: Fishing Licence

Aim of Section - to establish whether the household possesses a fishing licence and if so what type.

1. Does your Household Possess a Fishing Licence? - depending on whether the household owns a fishing licence the appropriate Yes or No box should be ticked. If the answer is Yes then the type of licence (either IDA or ODA) should be recorded in the box provided.

Section 9: Miscellaneous

Aim of Section - to record information that has been supplied by the respondent which is of relevance to the interview but has not been detailed in another part of the form.

INTERVIEWING TECHNIQUES

The way in which you approach respondents determines the success or failure of the interview. Proper interviewing techniques are reviewed below.

1. Introduction

You must properly introduce yourself to the respondent and explain the purpose of the visit. Immediate identification helps avoid being mistaken for being at the village and/or household for another purpose. An identification card will assist you to make yourself known to the respondent.

Explain the subject and purpose of the Subsistence Fisheries Questionnaire Survey. It may be necessary to convince the respondent of the usefulness of the Survey. It will be much easier if the respondent is convinced of the importance of the survey and believes that their cooperation is needed. Here is where self-confidence on your part is essential.

EXPLAIN THAT CONFIDENTIALITY OF DATA IS ABSOLUTE.

2. Voluntary Cooperation

Explain that cooperation with the Survey is voluntary. Information given by respondents in a friendly atmosphere is the best.

3. Appearance

As a representative of the Government you should be clean and neat.

4. Place for the Interview

Sometimes this can not be controlled, but, if possible, select a place out of the weather with no distractions, noise, etc.

5. Call Backs

Do everything possible to obtain all the information in the first visit. Since some villages and/or houses are in hard to reach areas, returns for successive interviews will be limited.

6. Attendance during Interviews

Do not conduct interviews in the presence of other people unless the respondent gives his/her permission. Sometimes the answers given by the respondent are influenced by the person who is listening.

7. Probing

Never suggest an answer. If the respondent persists with "I don't know" ask him for his best estimate.

If some replies seem out of the ordinary, probe and write notes on the questionnaire for the answers that seem unusual. A good probe to use is "What do you mean by that answer?".

8. Refusals

A few respondents may be hostile or unfriendly. Do not argue with them, do not agree with them. Many will cooperate after "letting off steam". Sometimes it's helpful to talk for a while about other things before beginning the interview. Be sincere when giving praise about his/her activities.

Desirable Attributes for the Enumerator

A successful enumerator must possess certain essential qualifications and characteristics and undergo training. It is conceded that ability to interview rests not on any single trait, but on a vast complex of them. Habits, skills, techniques and attitudes all are involved. Competence in interviewing is acquired only after careful and diligent study, training and prolonged practice and a good bit of trial and error and plain common sense.

There is always a place for individual initiative, for imaginative innovations, and for combinations of old approaches. The skilful enumerator cannot be bound by a set of rules. Likewise, there is no set of rules which can guarantee to the enumerator that his interviewing will be successful. There are however, some accepted, general guidelines which may help the beginner to avoid mistakes, learn how to conserve his efforts, and establish effective working relationships with the respondents, to accomplish, in a short time, what he sets out to do.

1. Preparation for the interview.

a) The enumerator should plan his daily routine for interviewing. It is important that the enumerator knows clearly what he wishes and feels able to accomplish. It may be desirable, especially for beginners, to write down these objectives, spell out possible problems and possible modification. In other words, he should plan and decide what is to be accomplished.

b) It is desirable to have advance information about the area of interview and the people to be interviewed. If possible, as it usually is, the enumerator should learn as much as possible about the place the interview will be conducted and persons to be interviewed. What needs to be known will vary with the situation, but the general principle of knowing the respondents holds in all cases. This advantage is available to the local enumerator.

If the area involved is one of a cultural group, it is often wise to interview the leaders first to enlist their cooperation and if they see justification for the interview, to have them recommend the enumerator to others in the group.

The principle of interviewing the leaders first does not only apply to cultural groups. It is also applicable where there exists an organization or an institution. The persons in charge should be approached and their cooperation secured before interviewing others in the organization or institution.

c) If possible, appointments should be made in advance. Such appointments can be made through publications, announcements, etc. and should detail the date the census will begin. In some countries, every household is requested to have somebody present in the house during the time the enumerator is expected to be in that vicinity. The enumerator can also make his own appointment. This means that he should have the knowledge of the daily routine of the respondent if a proper time and place are to be chosen.

Some experiences in surveys show that when interviewing the householder it is advantageous to have the wife present. She usually remembers a lot of details involved in the fishing operations, especially those pertaining to financial matters.

d) The enumerator should practice taking the respondents point of view. The objective in this practice is to be able to see the problems as another sees them and to feel towards them as he does (this is known as empathy). A substantial amount of emphatic ability is essential for successful interviewing.

e) The enumerator should know himself. Few people realize the extent to which everyone is committed in advance to certain opinions, convictions, attitudes and preconceptions. Everyone has some prejudices whether he realizes this or not; everyone carries with him certain stereotypes, preconceived notions about individuals or groups. There is probably no such thing as a truly open mind, one totally unencumbered by preconceptions, and totally perceptive to new ideas. This does not mean, however, that such preconceptions cannot be reduced in number and effect or that they should not be faced and either eliminated or discounted.

2. Some tips on interviewing

The adequacy of a technique for collecting data is ordinarily judged in terms of criteria of 'reliability' and 'validity'. Reliability requires that repeated measurements yield results which are identical or fall within narrow and predictable limits of variability. The criterion of validity demands that the measurement be meaningfully related to the objectives.

Both these criteria apply not only to the data collection instrument but also to the technique and procedure specified for using the instrument. The reliability and validity of census data depend not only on the design of the questionnaire but also on instrument to the technique and procedure specified for using the instrument, which in this case is the technique of interviewing. The following are some tips on conducting interviews to aid the information-getter in achieving the two-

fold goal of reliability and validity in his/her data collection.

The enumerator should establish a relationship of confidence. The first step is often the most difficult for the enumerator because at the initial contact the respondent needs to be motivated to permit the interview. The ideal atmosphere for such motivation is one of mutual confidence. The confidence must not just be one-sided. It must also rest on genuine and deeply felt respect on the part of each for the other person. It is the enumerator's responsibility to take the lead in establishing the relationship of mutual confidence.

Ordinarily the enumerator may follow a sequence of procedure as follows:

(a) identify himself/herself by showing an authorization card
(b) explain the purpose and objectives of the census
(c) explain that this household was selected by sampling or by chance
(d) state the anonymous or confidential nature of the interview as provided by the Statistics Act.

In many cases this is enough to secure cooperation and confidence. Most people are only too ready to talk about themselves and air their views. Common politeness, mixed with curiosity, does the rest.

The enumerator should help the respondent feel at ease and make him ready to talk (motivated). To achieve this end, the interviewer should also be at ease. Show this to the respondent by using an informal and natural (conversation) manner of talking. Begin by a conversation on something of mutual interest or easy to talk about, topics such as ball games or the weather. Carry on such a conversation to allow the respondent a little time to get accustomed to the situation. However, this warm-up conversation should not be too prolonged for it may suggest to the respondent that the enumerator is reluctant to deal with the real purpose of the interview.

Good interviewing means attaining uniformity in the asking of questions and in recording of answers. The enumerators are expected to ask all the applicable questions; to ask them in the order given with no more elucidation and probing than is explicitly allowed and to make no unauthorized variations in the wording. The manner of asking the question will differ and affect the way it is answered. The enumerator should be warned about this and instructed to adhere to the prescribed wording and not to give any lead by explanations.

It is essential that the respondent feels free to talk unhampered by unnecessary interruptions. Once the interview is proceeding, the respondent should be allowed to talk freely with little prodding from the interviewer. The enumerator should not dominate nor make any prejudicing remarks. The interview must be in a warm and cordial atmosphere.

One of the most important qualities which the enumerator should develop is to listen. Listening is a skill which must be learned and practiced. Only through proper listening, the enumerator can discriminate between what should and should not be recorded.

Enough time should be allocated for the interview. The time to be allocated for the interview should be sufficient for the respondent to ponder on the answers. The respondent should not feel that he is being pressed to complete the interview in as short as time as possible. The enumerator should not cut the interview short because he is under pressure to complete the census of an area in a definite period. Otherwise the interview will be a hasty one and the respondent may be forced to withhold information.

The enumerator should keep the interview under control. Quite often respondents will avoid certain questions by trying to wander to other topics in the course of the interview. The enumerator should learn the technique of rationing and putting up timely questions.

Some questions are necessary and often unavoidable in some items in the census questionnaire. The respondent may run dry of answers and need restimulation. On other occasions he may be engaging in irrelevant accounts of how he happened to use a particular spark plug for his outboard engine. Raising a well-timed question will put the interview back on its proper course.

Responses should be recorded during the interview. Experience has shown that the only accurate way to reproduce the responses is to record them during the time of the interview. A good deal of relevant information is almost certain to be lost if the recording is left until the interview has been completed.

Completion of the interview does not mean the interview is closed. Even after the usual exchanges of departing remarks, the interview is not yet closed. There are still post-census activities to be done and therefore the respondent should already be warned about these at the completion of the interview.

3. Some suggestions on resolving common problems in interviewing.

Available literature does not provide the enumerator with adequate methods for dealing with all the variables at work during the interview. Much of the available literature consists of rules of thumb presented as lists of "do's and don/t's" for the enumerator. These do's or don't's are compiled and based on interviewing experience derived from a variety of situations over a considerable period of time. They represent practices which have achieved a degree of success in a variety of situations. As yet, there is no integrated theory on which to base a complete understanding of the communication process and the interaction between interviewer and respondent. A lot must depend on experience and theory in communication.

The way the question is asked will have a great effect on the answer that is likely to be given. Some of the ways of wording questions that should be avoided are listed below:-

* CATCH all QUESTIONS - this is trying to cover several different questions (or topics) within one question. This is an attempt to save time - NOT GOOD!

For example: "Can you tell me the time, gear used and target species when you go fishing?"

* DOUBLE BARRELED - this is asking the question in such a way that there is a single response to two different questions.

For example: "What species do you catch using gill nets and handlines?"

* LONG QUESTIONS - using long questions, one part will get lost and responses tend to relate only to the beginning or end.

For example: "Do you think there are enough crabs left for a commercial fishermen like yourself to make a living in this district or do you think there is a better possibility elsewhere for a person like you?"

* LEADING / LOADING QUESTIONS - a question asked in such a way that it is easier, or more desirable, for the respondent to choose a particular alternative over others. This can be caused by:-

- emotionally charged wording
- appeal to stereotypes
- reference to the status quo
- partial mention of alternatives/a better way
- items which touch matters of prestige or pride;and
- personalization of questions.

For example: "How do you generally catch walu - trolling, or what?"

* NEGATIVES - try not to use negatives in your question.

For example: If I disagree with this statement "Should fishermen who use poison, not be punished?', what am I disagreeing with?

Find positive ways of expressing a negative. eg. "Should fishermen who use poison be let off with a caution?"

* HYPOTHETICAL QUESTIONS - in attitudinal research hypothetical questions cannot always be avoided but they give rise to unreliable results because people answer them from different assumptions. They answer either from:

:the ideal
:what they might achieve
:levels of expectations

In this case try to avoid asking people questions beginning with 'What if?'.

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Appendix 1

SUBSISTENCE FISHERIES QUESTIONNAIRE SURVEY

SITE INFORMATION FORM — Confidential

This form must be completed by the supervisor for every village /settlement which is visited by the survey team for the purpose of undertaking household interviews.

PROVINCE	TIKINA	VILLAGE/SETTLEMENT	STRATUM

FROM 1986 CENSUS	NUMBER OF HOUSES	POPULATION
FIJIAN		
INDIAN		
OTHER		
TOTAL		

NUMBER OF HOUSEHOLDS TO BE INTERVIEWED	
STARTING WITH HOUSE NUMBER	
NUMBER OF HOUSES BETWEEN INTERVIEWS (N)	

NAME OF SUPERVISOR		
NAMES OF ENUMERATORS	1.	
	2.	
	3.	
	4.	
	5.	

NUMBER OF HOUSES IN VILLAGE/SETTLEMENT			Houses	
SOURCE:	COUNTED		INFORMED	
Use number of houses in village to calculate N (N=Number of Houses/House to be Interviewed).				
POPULATION IN VILLAGE/SETTLEMENT			People	
SOURCE:	COUNTED		INFORMED	

DATE		TIME OF ARRIVAL	
TIME OF FIRST INTERVIEW		TIME OF DEPARTURE	

RECORD OF OBSERVATIONS MADE:		
	NUMBER	DETAILS
PEOPLE FISHING		
BOATS		
FISHING GEAR		
PROCESSING		
FISH PONDS		

NUMBER OF INTERVIEWS UNDERTAKEN:	

ANY OTHER INFORMATION:-

Appendix 2

FISHING INTERVIEW SURVEY QUESTIONNAIRE

Confidential

SECTION 1: RESPONDENTS IDENTIFICATION

1. INTERVIEWER		2. CODE NUMBER	
3. DATE		4. TIME	
5. VILLAGE		6. TIKINA	
7. AREA CODE		8. RESPONDENT	
9. HOUSEHOLD STATUS		10. RACE	

SECTION 2: PERSONAL AND SOCIOECONOMIC

1. NUMBER PERMANENTLY LIVING IN HOUSEHOLD

2. COMPOSITION OF HOUSEHOLD:-

	NUMBER	AGES
ADULT MALE		
ADULT FEMALE		
CHILD MALE		
CHILD FEMALE		

3. HOUSEHOLDS MAIN SOURCES OF INCOME:

	RANK	SEASON
SALE OF MARINE/FRESHWATER PRODUCTS		
SALE OF COPRA		
FARMING		
WAGE EMPLOYMENT		
OWN BUSINESS		
OTHER		

4. IF MARINE/FRESHWATER PRODUCTS ARE SOLD, THEN HOW OFTEN?

HOW OFTEN? FREQUENTLY (> 1/WEEK)

OCCASIONALLY (> 1/ MONTH)

INFREQUENTLY (< 1/ MONTH)

5. WHAT TYPES OF MARINE/FRESHWATER PRODUCTS ARE SOLD?

	RANK	TO WHAT MARKET?	AT WHAT PRICE? DOLLARS/AMOUNT	HOW MUCH/HOW OFTEN AMOUNT/TIME PERIOD
FISH			/	/
SHELLFISH			/	/
BECHE-DE-MER			/	/
SHARK FIN			/	/
SHELLS			/	/
OTHER			/	/

6. MEMBERS OF THE FAMILY WHO GO FISHING AND HOW OFTEN DO THEY MAKE FISHING TRIPS?

	NUMBER	3-7 WEEK	1-2 WEEK	> 1 MONTH	<1 MONTH
ADULT MALE					
ADULT FEMALE					
CHILD MALE					
CHILD FEMALE					

7. AMOUNT OF FISH CAUGHT BY HOUSEHOLD WHICH IS CONSUMED BY THE HOUSEHOLD?

ALL

SOME

NONE

8. IF NOT ALL WHAT ABOUT REST — RANK

SOLD

GIVEN TO FAMILY

GIVEN TO FRIENDS

GIVEN TO ANIMALS

OTHERS

SECTION 3: FISHING METHODS

1. WHAT ARE THE MAIN FISHING METHODS USED BY THE MEMBERS OF THE HOUSEHOLD?

	RANK	BY WHO	USUAL TIME	MOON PHASE	JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
HAND LINE					
DROP LINE					
TOW LINE					
GILL NET (SET)					
GILL NET (DRIVE)					
SPEAR					
COLLECTION					
DUVA					
YAVIRAU					
QOLI SAMU					
FISHING POLE					
CAST NET					
PUSH NET					
CRAB TRAP					
OTHER					

2. WHAT IS THE MAIN HOOK BAIT USED?

	RANK
CRAB	
SQUID/OCTOPUS	
SMALL FISH	
LARGER FISH	
OTHER	

3. DOES ANYONE IN YOUR HOUSEHOLD USE LIGHTS DURING ANY OF THEIR FISHING OPERATIONS? YES or NO [ ]

IF YES, GIVE DETAILS?

SECTION 4: FISHING ASSETS

1. NUMBER POSSESSED BY HOUSEHOLD?

	NUMBER	SIZE
HAND LINE		
DROP LINE		
TOW LINE		
SPEAR (GUN)		
SPEAR (HAND)		
DIVING GOGGLES		
GILL NET		
PUSH NET		
FISHING POLE		
U/W TORCH		
SCUBA GEAR		
OTHER		

2. NUMBER POSSESSED BY HOUSEHOLD?

	NUMBER	BOAT SIZE			ENGINE HP
PADDLE CANOE					
MARINE PLYWOOD BOAT					
FIBREGLASS BOAT					
LOCAL WOODEN PUNT					
FAO DESIGN					
OTHER					

3. NUMBER OF ICE BOXES OWNED BY HOUSEHOLD?

	NUMBER
HOMEMADE ICEBOX	
PLASTIC ESKIES	

4. DOES YOUR HOUSEHOLD USE ICE? YES [ ] NO [ ]

5. IF YES, FROM WHERE?

SECTION 5: FISHING GROUNDS

1. DOES ANYONE IN YOUR HOUSEHOLD GO FISHING IN THE FOLLOWING AREAS?

	RANK	BY WHO	J F M A M J J A S O N D	FISHING METHOD	TARGET SPECIES
DISTANT AREA					
FISH AGGREGATING DEVICE (FAD)					
OUTSIDE EDGE OF OUTER REEF					
ON OUTER REEF					
INSIDE LAGOON (DEEP WATER)					
INSIDE LAGOON (SHALLOW WATER)					
ALONG SHORELINE					
ALONG EDGE OF MANGROVES					
AMONGST MANGROVES					
ESTUARY or RIVER					
OTHER					

2. ARE THERE ANY AREAS WHERE YOUR HOUSEHOLD HAS OWNERSHIP/FISHING RIGHTS?	YES or NO	
IF YES, WHERE?		
3. DOES YOUR HOUSEHOLD ALLOW OTHER PEOPLE TO FISH IN THESE AREAS?	YES or NO	
4. ARE THERE AREAS WHERE YOUR HOUSEHOLD IS NOT ALLOWED TO FISH?	YES or NO	

SECTION 6: FISHING EFFORT

1. WHAT IS THE AVERAGE LENGTH OF A FISHING TRIP?		RANK	BY WHO
	0 - 4 HOURS		
	4 - 12 HOURS		
	12 - 24 HOURS		
	1 - 2 DAYS		
	3 - 7 DAYS		
	> THAN 1 WEEK		

2. ARE THERE DAYS NOT AVAILABLE FOR FISHING?	YES or NO		IF ANY WHICH?	

SECTION 7: FISH CONSUMPTION

1. HOW OFTEN DOES YOUR HOUSEHOLD CONSUME FISH?	TICK	2. WHAT IS THE SOURCE OF THIS FISH?	RANK	3. WHERE DOES THE FISH COME FORM? EG. NAME OF FISHING AREA OR SUPPLIER
EVERY DAY		OWN CAUGHT FISH		
4 - 6 TIMES PER WEEK		BOUGHT FISH		
1 - 3 TIMES PER WEEK		FREE FISH		
1 TIME PER WEEK		TINNED FISH		
NEVER		OTHER		

SECTION 8: FISHING LICENCE

1. DOES YOUR HOUSEHOLD POSSESS A FISHING LICENCE?	YES		NO		IDA or ODA	

SECTION 9: MISCELLANEOUS

Appendix 3

Fijian Fish Names

FIJIAN NAME	GROUP	ENGLISH NAME	SCIENTIFIC NAME
B			
Bati	Coral reefs, cakau	Red bass	*Lutjanus bohar*
Bedford	Deep bottom	Kusakars snapper	*Paracaesio kusakarii*
Bo	Coral reefs, cakau	Paddletail snapper	*Lutjanus gibbus*
Busa	Estuaries, lagoons	Barred garfish	*Hemirhamphus far*
Buse	Estuaries, lagoons	Garfish	*Hyporhamphus dussumieri*
C			
Canati	Deep bottom	Blue-lined flower snapper	*Pristipomoides amoenus*
Ceva	Coral reefs, cakau	Purple rockcod	*Epinephelus cyanopodus*
Cevaninubu	Deep bottom	Wirenetting cod	*Epinephelus chlorostigma*
Corocoro	Coral reefs, cakau	Soidier fish	*Myripristis violaceus*
Cumudamu	Coral reefs, cakau	Green trigger fish	*Pseudobalistes flavimarginatus*
Cumulacai	Coral reefs, cakau	Orange-lined trigger fish	*Balistapus undulatus*
D			
Dabea	Coral reefs, cakau	Moray eel	*Gymnothorax fimbriatus*
Damu	Rivers	Mangrove jack	*Lutjanus argentimaculatus*
Daniva	Estuaries, lagoons	Goldspot herring	*Herklotisichthys quadrimacutalus*
Davilai	Estuaries, lagoons	Leopard flounder	*Bothus pantherinus*
Dokonivudi	Coral reefs, cakau	Long-nose emperor	*Lethrinus elongatus*
Donu	Coral reefs, cakau	Big spot coral trout	*Plectropomus sp.*
Donu	Coral reefs, cakau	Coral trout	*Plectropomus leopardus*
Drekeni	Estuaries, lagoons	Brown sweetlip	*Plectorhinchus nigra*
Duna	Rivers	Freshwater eel	*Anguilla marmorata*
I			
Ikadroka	Rivers	Flagtail	*Kuhlia rupestris*
Ikasa	Estuaries, lagoons	Pike eel	*Muraenesox cinereus*
Ikavuka	Pelagic	Flying fish	*Cypselyrus spp.*
Ikibuli	Coral reefs, cakau	Black spotted swallowtail	*Trachinotus bailloni*
Isulutavoi	Coral reefs, cakau	Lunar-tailed bullseye	*Priacanthus sp.*
K			
Kabatia	Estuaries, lagoons	Thumbprint emperor	*Lethrinus harak*
Kabatia ni cakau	Coral reefs, cakau	Variegated emperor	*Lethrinus variegathus*
Kaboa	Estuaries, lagoons	Eeltail catfish	*Plotosus lineatus*
Kacika	Coral reefs, cakau	Slender emperor	*Lethrinus xanthochilus*
Kaikai	Estuaries, lagoons	Pony fish	*Leiognathus equulus*
Kake	Coral reefs, cakau	Blackspot sea perch	*Lutjanus fulviflamma*
Kake	Coral reefs, cakau	Blue-lined snapper	*Lutjanus quinquelineatus*
Kalia	Coral reefs, cakau	Double headed parrot fish	*Bolbometopon muricatus*
Kanace	Estuaries, lagoons	Bluetail mullet	*Valamugil seheli*
Kanailagi	Pelagic	Rainbow runner	*Elagatis bipinnulata*
Kasalaninubu	Deep bottom	Spotted fin cod	*Epinephelus fuscus*
Kasaledamu	Coral reefs, cakau	Marbled cod	*Cephalopholis miniatus*
Kava	Estuaries, lagoons	Diamond scale mullet	*Liza vaigiensis*
Kawago	Coral reefs, cakau	Spangled emperor	*Lethrinus nebulosus*

FIJIAN NAME	GROUP	ENGLISH NAME	SCIENTIFIC NAME
Kawakawabatilotu	Coral reefs, cakau	White-lined rockcod	*Anyperodon leucogrammicus*
Kawakawaloa	Coral reefs, cakau	Peacock rockcod	*Cephalopholis argus*
Kela	Estuaries, lagoons	Milk trevally	*Lactarius lactarius*
Ki	Estuaries, lagoons	Yellow striped goatfish	*Upeneus vittatus*
Koto	Estuaries, lagoons	Sea mullet	*Mugil cephalus*
M			
Maimai	Pelagic	Dolpin fish	*Coryphaena hippurus*
Malaka	Deep bottom	Snake mackerel	*Prometichthys prometheus*
Maleya	Rivers	Tilapia	*Tilapia mossambica*
Mama	Coral reefs, cakau	Blue lined large-eye bream	*Gymnocranius robinsoni*
Mama	Coral reefs, cakau	Large eyed bream	*Monotaxis grandoculis*
Mamaninubu	Deep bottom	Roundtail seabream	*Gymnocranius lethrinoides*
Marshi	Deep bottom	Red snapper	*Etelis carbunculus*
Mataba	Rivers	Flagtail	*Kuhlia bilunulata*
Matu	Estuaries, lagoons	Silver body	*Gerres sp.*
Motomoto	Estuaries, lagoons	Sea pike	*Sphyraena flavicanda*
N			
Nuqa	Coral reefs, cakau	Rabbit fish	*Siganus spinus*
Nuqa	Coral reefs, cakau	Spine foot	*Siganus vermiculatus*
O			
Ogo	Pelagic	Dark finned barracuda	*Sphyraena qenie*
Ogo	Pelagic	Great barracuda	*Sphyraena barracuda*
Onaga	Deep bottom	Longtail snapper	*Etelis coruscans*
Ose	Estuaries, lagoons	Goatfish	*Mulloidichthys vanicolensis*
P			
Pakapakabuidromo	Deep bottom	Yellow finned pakapaka	*Pristipomoides flavipinnis*
Pakapakaqia	Deep bottom	Purple cheek pakapaka	*Pristipomoides multidens*
Q			
Qawaqawa	Coral reefs, cakau	Snubnosed dart	*Trachinotus blochi*
Qitawa	Estuaries, lagoons	Cresent perch	*Therapon jarbua*
R			
Reve	Rivers	Orange-spotted Therapon Perch	*Mesopristes kneri*
Rosinibogi	Deep bottom	Scarlet seaperch	*Lutjanus timorensis*
S			
Sabutu	Coral reefs, cakau	Yellow-tailed emperor	*Lethrinus mahsena*
Sabutu damu	Coral reefs, cakau	Yellow-spotted emperor	*Lethrinus kallopterus*
Sabutu kula	Deep bottom	Large eye bream	*Gnathodentex mossambicus*
Sakelo	Rivers	Flagtail	*Kuhlia marainata*
Saku	Estuaries, lagoons	Long tom	*Tylosurus crocodilus*
Salala	Estuaries, lagoons	Chub mackerel	*Rastrelliger brachysoma*
Salala ni cakau	Estuaries, lagoons	Chub mackerel	*Rastrelliger kanagurta*
Salalanitoga	Coral reefs, cakau	Finny scad	*Megalaspis cordyla*
Salalanitoga	Pelagic	Scad	*Grammatorcynus bicarinatus*
Saqadrau	Coral reefs, cakau	Fringe fin trevally	*Carangoides hedlandensis*
Saqaleka	Coral reefs, cakau	Great trevally	*Caranx ignobilis*
Saqaloa	Deep bottom	Black trevally	*Caranx lugubris*

FIJIAN NAME	GROUP	ENGLISH NAME	SCIENTIFIC NAME
Saqanivatu	Coral reefs, cakau	Bluefin trevally	*Caranx melampygus*
Saqavatoga	Deep botom	Amber jack	*Seriola rivoliana*
Senikawakawa	Coral reefs, cakau	Honey comb rockcod	*Epinephelus merra*
Sevaseva	Coral reefs, cakau	Harlequin sweetlip	*Plectorhynchus chaetodonoides*
Sewidri	Deep bottom	Red jobfish	*Aphareus rutilans*
Silasila	Coral reefs, cakau	Fosters seapike	*Sphyraena forsteri*
Sirisiriwai	Coral reefs, cakau	Topsail drummer	*Kyphosus cinerescens*
Soisoi	Estuaries, lagoons	Orange spotted cod	*Epinephelus malabaricus*
Sokisoki	Coral reefs, cakau	Porcupine fish	*Diodon hystrix*
T			
Ta	Coral reefs, cakau	Yellowfin surgeon fish	*Naso unicornis*
Tabacenitoga	Coral reefs, cakau	Surf surgeon fish	*Acanthurus guttatus*
Tanabe	Coral reefs, cakau	Red tail snapper	*Lutjanus fulvus*
Tovisi	Estuaries, lagoons	Hair tail	*Trichiurus haumela*
Tunatuna	Estuaries, lagoons	Conger eel	*Conger cinereus*
U			
Uculuka	Estuaries, lagoons	Threadfin	*Polydactylus plebeius*
Ulavi	Coral reefs, cakau	Bicolor parrotfish	*Cetoscarus bicolor*
Ulavi	Coral reefs, cakau	Five-banded parrotfish	*Scarus ghobban*
Uluqa	Deep bottom	Kusakars snapper	*Paracaesio kusakarii*
Utouto	Coral reefs, cakau	Green jobfish	*Aprion virescens*
V			
Vaidina	Estuaries, lagoons	Bluspotted ray	*Amphotistius kuhlii*
Varavaranitoga	Coral reefs, cakau	Lunar-tailed cod	*Variola albomarginata*
Varivoce	Coral reefs, cakau	Hump-headed maoriwrasse	*Cheilinus undulatus*
Vatunitoga	Pelagic	Dogtooth tuna	*Gymnosarda unicolor*
Vetakau	Estuaries, lagoons	Spotted scat	*Scatophagus argus*
Vilu	Coral reefs, cakau	Golden trevally	*Gnathanodon speciosus*
Voivoi	Estuaries, lagoons	Wolf herring	*Chirocentrus dorab*
Vosevose	Estuaries, lagoons	Fiji sardine	*Sardinella fijiense*
Votonimoli	Coral reefs, cakau	Queen fish leatherskin	*Scomberoides lysan*
Votoqaninubu	Deep bottom	Snakeskin cod	*Epinephelus morrhua*
Vunavuna	Estuaries, lagoons	Batfish	*Platax orbicularius*
W			
Walu	Pelagic	Spanish mackerel	*Scomberomorus commerson*
Wau	Pelagic	Wahoo	*Acanthocybium solandri*
Y			
Yalayala	Deep bottom	Flower snapper	*Pristipomoides zonatus*
Yatu	Pelagic	Mackerel tuna	*Euthynnus affinis*
Yatu	Pelagic	Skipjack	*Katsuwonus pelamis*
Yatulele	Coral reefs, cakau	Bigeye scad	*Selar crumenophthalmus*
Yatunitoga	Pelagic	Yellowfin tuna	*Thunnus albacares*
Yavula	Rivers	Oxeye herring	*Megalops cyprinoides*
Yawa	Estuaries, lagoons	Milkfish	*Chanos chanos*
Yawakio	Estuaries, lagoons	Bone fish	*Albula neoguinaica*

Fijian Names of Non-Fish Groups

FIJIAN NAME	GROUP	ENGLISH NAME	SCIENTIFIC NAME
?			
?	Prawns	Giant Malaysian freshwater prawn	*Macrobrachium rosenbergii*
B			
Bakera	Crabs	Green mangrove crab	*Scylla paramamosain*
Boro	Bivalves	Mangrove mussel	*Modiolus agripetus*
Bu	Bivalves	Jewelbox shell	*Chama sp.*
C			
Cawaki	Echinoderms	Sea urchin	*Tripneustes gratilla*
Cega	Bivalves	Fluted giant clam	*Tridacna squamosa*
Civa	Bivalves	Blacklip pearlshell	*Pinctada magaritifera*
Civaciva	Bivalves	Pigmy pearlshell	*Pinctada martensi*
Civare	Bivalves	Pigmy pearlshell	*Pinctada martensi*
D			
Dairo	Echinoderms	Sandfish	*Metriatyla scabra*
Dioniveitiri	Bivalves	Mangrove oyster	*Crassostrea mordax*
Dova	Miscellaneous	Lamp shell	*Lingula unguis*
Drevula	Gastropods	Moon sail	*Polinices flemingiana*
Drose	Miscellaneous	Upsidedown jelly	*Cassiopea sp*
Durulevu	Gastropods	Horn shell	*Cerithium nodulosum*
E			
Ega	Gastropods	Spider shell	*Lambis lambis*
G			
Gera	Gastropods	Stromb	*Strombus gibberulus*
Golea	Gastropods	Stromb	*Strombus gibberulus*
Gwaca	Echinoderms	Sea urchin	*Tripneustes gratilla*
Gwerativi	Gastropods	Red-lipped stromb	*Strombus luhuanus*
I			
Ikadina	Turtles	Green turtle	*Chelonia mydas*
Ivinibila	Lobsters	Slipper lobster	*Parribacus caledonicus*
Ivoce	Miscellaneous	Lamp shell	*Lingula unguis*
K			
Kadikadi	Prawns	River prawn	*Macrobrachium equidens*
Kai	Bivalves	Freshwater clam	*Batissa violacea*
Kaibakoko	Bivalves	Hardshell clam	*Periglypta puerpera*
Kaidawa	Bivalves	Hardshell clam	*Periglypta puerpera*
Kaikoso	Bivalves	Ark shell	*Anadara cornea*
Kaininiu	Bivalves	Coconutscraper cockle	*Vasticardium sp.*
Kaitakadiri	Bivalves	Venus shell	*Gafrarium tumidum*
Kaivadra	Bivalves	Littleneck clam	*Tapes literata*
Katavatu	Bivalves	Rugose giant clam	*Tridacna maxima*
Kativatu	Bivalves	Rugose giant clam	*Tridacna maxima*
Kavika	Crabs	Three-spot reef crab	*Carpilius maculatus*
Kolakola	Bivalves	Thorny oyster	*Spondylus ducalis*
Kotia	Miscellaneous	Green seahare	*Dolabella auricularia*

FIJIAN NAME	GROUP	ENGLISH NAME	SCIENTIFIC NAME
Kotiaika	Miscellaneuos	Black seahare	*Dolabella sp.*
Kuita	Miscellaneous	Octopus	*Octopus sp*
Kuitanu	Miscellaneous	Big reef squid	*Sepioteuthis lessoniana*
Kukadamu	Crabs	Red-clawed crab	*Sesarma erythrodactyla*
Kukadra	Crabs	Red-clawed crab	*Sesarma erythrodactyla*
Kukaloa	Crabs	Black mangrove crab	*Metopograpsus messor*
Kukavulu	Crabs	Black mangrove crab	*Metopograpsus messor*
Kuku	Bivalves	Mangrove mussel	*Modiolus agripetus*
L			
Lairo	Crabs	Land crab	*Cardisoma carnifex*
Leru	Gastropods	Trochus shell	*Trochus niloticus*
Loaloa	Echinoderms	Black teatfish	*Microthele nobillis*
Lolo	Echinoderms	Black teatfish	*Microthele nobillis*
Lumicevata	Seaweeds	Maiden hair	*Hypnea nidifica*
Lumitamana	Seaweeds	Goldenweed	*Solieria sp.*
Lumiwawa	Seaweeds	Glassweed	*Gracilaria verrucosa*
Lumiyabia	Seaweeds	Maiden hair	*Hypnea nidifica*
Lumiyara	Seaweeds	Glassweed	*Gracilaria verrucosa*
M			
Madrali	Gastropods	Polished nerite	*Nerita polita*
Mana	Lobsters	Mud lobster	*Thalassina anomala*
Matau	Bivalves	Smooth giant clam	*Tridacna derasa*
Midro	Echinoderms	Sea cucumber	*Stichopus sp.*
Moci	Prawns	Mangrove prawn	*Palaemon concinnus*
Motoqi	Crabs	Redeye crab	*Eriphia sebana*
Mudra	Echinoderms	Sea cucumber	*Stichopus sp.*
N			
Na	Seaweeds	Sea grapes	*Caulerpa racemosa*
Nama	Seaweeds	Sea grapes	*Caulerpa racemosa*
Namadrauniivi	Seaweeds	Sea grapes	*Caulerpa sp.*
Namakeibelo	Seaweeds	Sea grapes	*Caulerpa sp.*
Q			
Qaqa	Bivalves	Venus shell	*Gafrarium tumidum*
Qari	Crabs	Green mangrove crab	*Scylla paramamosain*
Qarivatu	Crabs	Swimmer crab	*Thalamita crenata*
Qeqe	Bivalves	Ark shell	*Anadara cornea*
S			
Sagati	Seaweeds	Codium	*Codium geppii*
Sasakadi	Prawns	River prawn	*Macrobrachium equidens*
Saulaki	Bivalves	Thorny oyster	*Spondylus ducalis*
Sici	Gastropods	Trochus shell	*Trochus niloticus*
Siciyarayara	Gastropods	Horn shell	*Cerithium nodulosum*
Sigawale	Bivalves	Surf clam	*Atactodea striata*
Silawale	Bivalves	Surf clam	*Atactodea striata*
Sobu	Bivalves	Jewelbox shell	*Chama sp.*

FIJIAN NAME	GROUP	ENGLISH NAME	SCIENTIFIC NAME
Su	Bivalves	Jewelbox shell	*Chama sp.*
Sucuwalu	Echinoderms	White teatfish	*Microthele fuscogilva*
Sulua	Miscellaneous	Octopus	*Octopus sp*
Suluanu	Miscellaneous	Big reef squid	*Sepioteuthis lessoniana*
T			
Tadruku	Miscellaneous	Chiton	*Acanthozostera gemmata*
Taku	Turtles	Hawksbill turtle	*Eretmochelys imbricata*
Taqalito	Crabs	Redeye crab	*Eriphia sebana*
Tarase	Echinoderms	Surf redfish	*Actinopyga mauritiania*
Tave	Bivalves	Freshwater clam	*Batissa violacea*
Tavutolu	Crabs	Three-spot reef crab	*Carpilius maculatus*
Tero	Echinoderms	Sandfish	*Metriatyla scabra*
Tivikea	Gastropods	Red-lipped stromb	*Strombus luhuanus*
Tola	Lobsters	Mud lobster	*Thalassina anomala*
Totoyava	Seaweeds	Codium	*Codium geppii*
Tovu	Gastropods	Top shell	*Trochus pyramis*
Tuba	Crabs	Land crab	*Cardisoma carnifex*
U			
Ugavule	Crabs	Coconut crab	*Birgus latro*
Uradina	Prawns	Freshwater prawn	*Macrobrachium lar*
Urakeirasaqa	Prawns	Giant tiger prawn	*Penaeus monodon*
Uranicakau	Prawns	Witch prawn	*Penaeus canaliculatus*
Urata	Lobsters	Banded prawn killer	*Lysiosquilla maculata*
Uraubola	Lobsters	Ornate rock lobster	*Panulirus ornatus*
Uraudina	Lobsters	Painted rock lobster	*Panulirus versicolor*
Uraukula	Lobsters	Golden rock lobster	*Panulirus penicillatus*
Uraura	Prawns	Mangrove prawn	*Palaemon concinnus*
Urautamata	Lobsters	Ornate rock lobster	*Panulirus ornatus*
Urauvatuvatu	Lobsters	Golden rock lobster	*Panulirus penicillatus*
V			
Vale	Prawns	Giant tiger prawn	*Penaeus monodon*
Vasuadina	Bivalves	Smooth giant clam	*Tridacna derasa*
Vavaba	Lobsters	Slipper lobster	*Parribacus caledonicus*
Veata	Miscellaneous	Green seahare	*Dolabella auricularia*
Veataika	Miscellaneous	Black seahare	*Dolabella*
Vetuna	Miscellaneous	Peanut worm	*Spinculus sp*
Voce	Miscellaneous	Lamp shell	*Lingula unguis*
Vonudina	Turtles	Green turtle	*Chelonia mydas*
Vula	Echinoderms	Brown sandfish	*Bohadschia marmorata*
Y			
Yaga	Gastropods	Spider shell	*Lambis lambis*
Yalove	Miscellaneous	Upsidedown jelly	*Cassiopea sp*

Attachment B

List of villages and settlements randomly selected to be interviewed, giving details of political location, stratum (STR), the population (POP) and number of households (HH) recorded in the 1986 census and the number of interviews actually carried out at each site (N).

PROVINCE	TIKINA	STR	VILLAGE	POP	HH	N
BA	BA	10	SASA VILLAGE	238	43	20
BA	BA	10	VOTUA VILLAGE	544	73	20
BA	BA	20	LAVUCI	430	79	20
BA	BA	20	VAROKO	643	108	20
BA	BA	20	WAILAILAI	929	177	21
BA	BA	30	NAVATU	656	112	21
BA	BA	30	VATIYAKA	905	150	20
BA	BA	30	VUTUNI CREEK	547	94	19
BA	BA	40	CHINAKOTI	403	73	15
BA	BA	40	KUBUKUBU	305	49	20
BA	BA	40	MAURURU	168	28	20
BA	BA	40	NACICI	397	66	21
BA	BA	40	NAKAVIKA	121	27	20
BA	BA	40	NAMADA	775	125	20
BA	BA	40	NUKULOA	824	132	20
BA	BA	40	QARA	183	29	16
BA	BA	40	RARAWAI RURAL	1282	218	19
BA	BA	40	TAUVEGAVEGA	618	117	20
BA	BA	40	VARADULI	292	50	21
BA	BA	40	VATUSOI	571	93	20
BA	MAGODRO	40	NUKULOA	384	64	19
BA	MAGODRO	40	TABATABA	617	110	20
BA	MAGODRO	40	TABUQUTO VILLAGE	66	8	12
BA	NADI	10	NASOSO	881	183	20
BA	NADI	20	KOROVUTO VILLAGE	164	30	19
BA	NADI	20	NABUTE	138	23	0
BA	NADI	30	AROLEVU	202	33	0
BA	NADI	30	DRATABU	447	82	0
BA	NADI	30	LAVUSA	301	48	21
BA	NADI	30	MAQANIA	1009	174	19
BA	NADI	30	QELELOA	577	113	19
BA	NADI	30	VUNAYASI	1459	248	15
BA	NADI	40	NACOVI	651	114	20
BA	NADI	40	SOLOVI	482	84	20
BA	NADI	40	TOGO	439	79	21
BA	NADI	40	VOTUALEVU	3640	641	20
BA	NAWAKA	40	NAWAKA	1004	194	20
BA	NAWAKA	40	NAMULOMULO VILLAGE	62	13	9
BA	NAWAKA	40	TOGO	141	29	0
BA	NAWAKA	40	TUBENASOLO VILLAGE	14	2	0
BA	TAVUA	10	VATUTAVUI VILLAGE	157	26	16
BA	TAVUA	20	ASIASI	994	160	20
BA	TAVUA	40	BALATA	478	81	21
BA	TAVUA	40	LAUSA	543	90	20
BA	TAVUA	30	LUBULUBU	415	73	20
BA	TAVUA	30	MALELE	1108	193	18
BA	TAVUA	40	DRAMASI	478	76	20
BA	TAVUA	40	KORO VILLAGE	98	13	11
BA	TAVUA	40	MATANAGATA	462	76	20
BA	TAVUA	40	NAGATAGATA VILLAGE	56	12	11
BA	VUDA	10	LAUWAKI VILLAGE	316	50	22
BA	VUDA	10	NAVIYAGO VILLAGE	323	50	14
BA	VUDA	10	LOMOLOMO VILLAGE	188	31	21
BA	VUDA	10	TEIDAMU	413	75	20
BA	VUDA	20	DRASA VILA	389	69	0
BA	VUDA	20	LOVU	1759	308	13

PROVINCE	TIKINA	STR	VILLAGE	POP.	HH	N
BA	VUDA	20	RAVIRAVI	1878	346	20
BA	VUDA	20	DREKETI	700	135	20
BA	VUDA	30	KOROYACA VILLAGE	116	15	0
BA	VUDA	30	LOMOLOMO	1481	259	19
BA	VUDA	30	NAIKABULA	384	69	17
BA	VUDA	30	SAWENI	1642	321	19
BA	VUDA	30	VUDA BACKROAD	467	85	20
BA	VUDA	40	BOUTINI	543	110	20
BA	VUDA	40	BUABUA	728	133	19
BA	VUDA	40	KOROBEBE VILLAGE	203	29	20
BA	VUDA	40	SABETO	2674	452	19
BA	VUDA	40	SARU	820	140	20
BA	VUDA	40	VAKABULI	458	78	21
BA	VUDA	40	VAKABULI VILLAGE	365	62	19
NADROGA	BARAVI	10	NAMATAKULA VILLAGE	200	27	20
NADROGA	BARAVI	20	SOVI BAY	154	24	16
NADROGA	BARAVI	30	BIAUSEVU VILLAGE	141	21	0
NADROGA	BARAVI	40	KAVANAGASAU	373	61	20
NADROGA	BARAVI	40	NAWAMAGI VILLAGE	178	30	0
NADROGA	BARAVI	40	YALAVA	575	105	21
NADROGA	CUVU	10	CUVU VILLAGE	236	31	21
NADROGA	CUVU	20	NEWTOWN	465	95	20
NADROGA	CUVU	30	NAVOVO	259	43	22
NADROGA	CUVU	40	NADROUMAI VILLAGE	204	33	9
NADROGA	MALOMALO	10	LOMAWAI VILLAGE	230	38	20
NADROGA	MALOMALO	10	NABILA VILLAGE	208	38	0
NADROGA	MALOMALO	20	NAMATA	739	129	21
NADROGA	MALOMALO	20	TIVIRIKI	113	22	19
NADROGA	MALOMALO	20	YAKO VILLAGE	176	29	11
NADROGA	MALOMALO	30	MOMI	188	26	21
NADROGA	MALOMALO	30	NABILA	389	68	19
NADROGA	MALOMALO	30	TOGABULA VILLAGE	108	20	19
NADROGA	MALOMALO	40	KABISI VILLAGE	47	7	6
NADROGA	MALOMALO	40	NAWAICOBA	1513	247	19
NADROGA	SIGATOKA	20	KULUKULU	1094	200	20
NADROGA	SIGATOKA	20	OLASARA	911	167	23
NADROGA	SIGATOKA	30	OLOOLO	488	91	21
NADROGA	SIGATOKA	40	NAKALAVO VILLAGE	120	20	12
NADROGA	SIGATOKA	40	TILIVALEVU VILLAGE	49	11	8
NADROGA	NAVOSA	40	DRAIBA VILLAGE	138	19	15
NADROGA	NAVOSA	40	NAMOLI VILLAGE	200	35	8
NADROGA	NAVOSA	40	SAWENE	156	27	0
NADROGA	RUWAILEVU	40	NAWAIRABE VILLAGE	127	21	8
NADROGA	RUWAILEVU	40	TUVU VILLAGE	90	17	10
NADROGA	RUWAILEVU	40	VOLINAGERUA VILLAGE	23	4	0
NAITASIRI	LOMAIVUNA	40	DELAIWAIMALE VILLAGE	42	5	0
NAITASIRI	LOMAIVUNA	40	IN OTHER LOCALITIES	1176	200	0
NAITASIRI	LOMAIVUNA	40	NATAVEA VILLAGE	100	17	0
NAITASIRI	MATAILOBA	40	VUISIGA VILLAGE	201	34	0
NAITASIRI	MATAILOBA	40	VUNIDAWA	184	29	0
NAITASIRI	NAITASIRI	40	DELADAMANU VILLAGE	131	26	0
NAITASIRI	NAITASIRI	40	IN OTHER LOCALITIES	1411	255	0
NAITASIRI	NAITASIRI	40	NAKINI VILLAGE	130	22	0
NAITASIRI	NAITASIRI	40	NAVUSO	232	38	0
NAITASIRI	NAITASIRI	40	NAVUSO VILLAGE	202	31	0
NAITASIRI	NAITASIRI	40	SAWANI	1267	206	0
NAITASIRI	NAITASIRI	40	ULUIBEKA	135	23	0
NAITASIRI	WAIMARO	40	NASEUVOU VILLAGE	159	23	0
NAITASIRI	WAIMARO	40	NAVUREVURE VILLAGE	221	39	0
NAITASIRI	WAINIMALA	40	KOROVOU VILLAGE	160	26	0
NAITASIRI	WAINIMALA	40	ROMA VILLAGE	38	7	0
NAMOSI	NAMOSI	40	VUNINIUSAWA VILLAGE	16	2	0
NAMOSI	VEIVATULOA	10	NAQARIBUTA VILLAGE	16	3	0
NAMOSI	VEIVATULO	20	NAMELIMELI VILLAGE	58	10	0
NAMOSI	VEIVATULO	30	LOBAU VILLAGE	152	29	0
NAMOSI	VEIVATULO	40	NAKAVU VILLAGE	271	48	0
NAMOSI	WAINIKORO	40	WAINIMAKUTU VILLAGE	196	34	0

PROVINCE	TIKINA	STR	VILLAGE	POP.	HH	N
RA	NAKOROTUBU	10	NACOBAU VILLAGE	78	18	14
RA	NAKOROTUBU	30	NAKOROVOU VILLAGE	142	22	15
RA	NAKOROTUBU	40	TOBU VILLAGE	118	19	20
RA	NALAWA	30	MATAWAILEVU VILLAGE	108	21	19
RA	NALAWA	40	NAMARA VILLAGE	172	32	0
RA	NALAWA	40	ROKOVUAKA VILLAGE	235	43	20
RA	RAKIRAKI	10	NAMUAIMADA VILLAGE	219	33	20
RA	RAKIRAKI	20	BALATA	325	62	19
RA	RAKIRAKI	20	KAVULI	449	78	22
RA	RAKIRAKI	20	RABULU VILLAGE	115	20	0
RA	RAKIRAKI	30	GALLAU	652	114	18
RA	RAKIRAKI	30	MULLAU	470	72	18
RA	RAKIRAKI	40	WAIMARI	455	64	14
RA	SAIVOU	10	NANUKULOA VILLAGE	203	43	15
RA	SAIVOU	20	MADHIVANI	239	36	20
RA	SAIVOU	30	BAROTU VILLAGE	123	16	16
RA	SAIVOU	40	ROKOROKO VILLAGE	87	13	5
REWA	NOCO	10	NAROCAKE VILLAGE	99	130	
REWA	NOCO	20	NALASE VILLAGE	42	6	0
REWA	NOCO	30	NABULI VILLAGE	33	3	0
REWA	NOCO	40	BUREBASAGA VILLAGE	162	22	0
REWA	REWA	10	MUANAIRA VILLAGE	168	32	0
REWA	REWA	20	WAISALULU VILLAGE	44	7	0
REWA	REWA	30	NASILAI VILLAGE	83	15	0
REWA	REWA	40	NAKAIKOGO	813	153	24
REWA	SUVA	10	MUAIVUSO VILLAGE	127	23	0
REWA	SUVA	20	TOGALEVU VILLAGE	79	11	0
REWA	SUVA	30	NABORO	274	42	0
SERUA	NUKU	10	WAINIYABIA VILLAGE	135	22	0
SERUA	NUKU	20	NAKOROVOU VILLAGE	135	26	0
SERUA	NUKU	40	MASI VILLAGE	80	13	0
SERUA	SERUA	10	NABOTINI VILLAGE	276	38	7
SERUA	SERUA	10	VUNIBAU	266	54	23
SERUA	SERUA	20	KOROVISILOU VILLAGE	352	62	9
SERUA	SERUA	20	NAITATA	–	–	20
SERUA	SERUA	30	SAUNIVEIUTO VILLAGE	119	23	0
SERUA	SERUA	30	WAIDRADRA	444	75	23
SERUA	SERUA	40	SABATA VILLAGE	41	5	0
TAILEVU	BAU	10	VIWA VILLAGE	105	18	12
TAILEVU	BAU	10	WAICOKA VILLAGE	111	15	16
TAILEVU	BAU	30	BAU TIKINA ROAD	186	32	0
TAILEVU	BAU	30	NAMATA VILLAG	171	34	0
TAILEVU	BAU	40	NAILA VILLAGE	157	24	0
TAILEVU	BAU	40	RARALEVU	1174	185	25
TAILEVU	BAU	40	VERATA	377	88	21
TAILEVU	NAKELO	10	VADRAI VILLAGE	26	6	0
TAILEVU	NAKELO	30	NAIMALAVAU VILLAGE	210	36	0
TAILEVU	NAKELO	30	NAKAILE VILLAGE	180	31	0
TAILEVU	NAKELO	40	NATOGAUDRAVU	426	74	19
TAILEVU	NAKELO	40	TUMAVIA	287	52	19
TAILEVU	NAKELO	40	VISAMA	588	104	22
TAILEVU	SAWAKASA	10	SAWAKASA VILLAGE	215	38	14
TAILEVU	SAWAKASA	20	DELEIKUKU VILLAGE	63	11	5
TAILEVU	SAWAKASA	30	DELAKADO VILLAGE	201	35	18
TAILEVU	VERATA	10	UCUNIVANUA VILLAGE	238	49	15
TAILEVU	VERATA	20	VEINUQA VILLAGE	168	33	17
TAILEVU	VERATA	30	NATOBUNIQIO VILLAGE	103	18	8
TAILEVU	VERATA	30	WAIDALICE	402	59	18
TAILEVU	VERATA	40	SOTE VILLAGE	256	47	20
TAILEVU	WAINIBUKA	40	NAQIA VILLAGE	183	43	10
TAILEVU	WAINIBUKA	40	NAYAVU	111	21	16

Attachment C

CREEL SURVEY FORM

VILLAGE		FISHING AREA			
DATE		TIME			
METHOD		FISHING HOURS			
NUMBER OF FISHERMEN		MALES		FEMALES	
ESTIMATED AGES					

ID: NO	SPECIES	NUMBER	WEIGHT	MAXIMUM LENGTH	MINIMUM LENGTH

Attachment D

FISH CONSUMPTION FORM

				KORO:			
SIGA 1	LEWE VICA E VAKAITAVI?	IKA BULABULA E LAUKANA?	MATAQALI IKA CAVA?	KENA I WILIWILI?	KENA BALAVU?	TINI IKA E LAUKANA?	KENA I WILIWILI?
TIKI NI SIGA?							
		10 SE SIGA			CM.	10 SE SIGA	
KATALAU							
VAKASIGALEVU							
VAKAYAKAVI							

SIGA 2	LEWE VICA E VAKAITAVI?	IKA BULABULA E LAUKANA?	MATAQALI IKA CAVA?	KENA I WILIWILI?	KENA BALAVU?	TINI IKA E LAUKANA?	KENA I WILIWILI?
TIKI NI SIGA?							
		10 SE SIGA			CM.	10 SE SIGA	
KATALAU							
VAKASIGALEVU							
VAKAYAKAVI							

SIGA 3	LEWE VICA E VAKAITAVI?	IKA BULABULA E LAUKANA?	MATAQALI IKA CAVA?	KENA I WILIWILI?	KENA BALAVU?	TINI IKA E LAUKANA?	KENA I WILIWILI?
TIKI NI SIGA?							
		10 SE SIGA			CM.	10 SE SIGA	
KATALAU							
VAKASIGALEVU							
VAKAYAKAVI							

SIGA 4	LEWE VICA E VAKAITAVI?	IKA BULABULA E LAUKANA?	MATAQALI IKA CAVA?	KENA I WILIWILI?	KENA BALAVU?	TINI IKA E LAUKANA?	KENA I WILIWILI?
TIKI NI SIGA?							
		10 SE SIGA			CM.	10 SE SIGA	
KATALAU							
VAKASIGALEVU							
VAKAYAKAVI							

SIGA 5	LEWE VICA E VAKAITAVI?	IKA BULABULA E LAUKANA?	MATAQALI IKA CAVA?	KENA I WILIWILI?	KENA BALAVU?	TINI IKA E LAUKANA?	KENA I WILIWILI?
TIKI NI SIGA?							
		10 SE SIGA			CM.	10 SE SIGA	
KATALAU							
VAKASIGALEVU							
VAKAYAKAVI							

SIGA 6	LEWE VICA E VAKAITAVI?	IKA BULABULA E LAUKANA?	MATAQALI IKA CAVA?	KENA I WILIWILI?	KENA BALAVU?	TINI IKA E LAUKANA?	KENA I WILIWILI?
TIKI NI SIGA?							
		10 SE SIGA			CM.	10 SE SIGA	
KATALAU							
VAKASIGALEVU							
VAKAYAKAVI							

SIGA 7	LEWE VICA E VAKAITAVI?	IKA BULABULA E LAUKANA?	MATAQALI IKA CAVA?	KENA I WILIWILI?	KENA BALAVU?	TINI IKA E LAUKANA?	KENA I WILIWILI?
TIKI NI SIGA?							
		10 SE SIGA			CM.	10 SE SIGA	
KATALAU							
VAKASIGALEVU							
VAKAYAKAVI							

15 cm
10 cm
5 cm
0 cm

Attachment E

LIST OF SPECIES REPORTED IN CATCHES WITH FIJIAN NAMES

Scientific name	Fijian/local name	Family/group
Acanthocybium solandri	WAHOO	Scombridae
Acanthurus sp.	BALAGI	Acanthuridae
Acanthurus sp.	IKALOLO	Acanthuridae
Acanthurus sp.	KALO	Acanthuridae
Acanthurus sp.	KALOA	Acanthuridae
Acanthurus sp.	NAIKALOA	Acanthuridae
Anadara cornea	KAIKOSO	Shells
Anadara cornea	QEQE	Shells
Anguilla marmorata	DUNA	Anguillidae
Aphareus rutilans	SILVER FISH	Lutjanidae
Aprion virescens	UTO	Lutjanidae
Aprion virescens	UTOUTO	Lutjanidae
Arothron immaculatus	SUMUSUMU	Tetraodontidae
Arothron immaculatus	HEKEHEKE	Tetraodontidae
Atherinids	SARA	Atherinidae
Batissa violacea	KAI	Shells
Batissa violacea	TAVE	Shells
Bolbometapon muricatus	KALIA	Scaridae
Bothus sp.	DAVILAI	Bothidae
Carangids	SAQA	Carangidae
Carangids	VILU	Carangidae
Carangids	KODRO	Carangidae
Carangids	KODROKODRO	Carangidae
Carangoides sp.	DOLE	Carangidae
Caranx lugubris	SAQALOA	Carangidae
Carcharhinus sp.	QIO	Carcharinidae
Cardisoma carnifex	LAIRO	Sea Cucumber
Caulerpa racemosa	NAMA	Sea weed
Cephalopholis argus	TEKILO	Serranidae
Chaetodon sp.	TIVITIVI	Chaetodontidae
Chanos chanos	YAWA	Chandidae
Cheilinus sp.	DRADRAVI	Labridae
Cheilinus sp.	DRANIKURA	Labridae
Cheilinus sp.	KURAKURA	Labdridae
Cheilinus trilobatus	DRAUNIKURA	Labridae
Chirocentrus dorab	VOIVOI	Chirocentridae
Conger cinereus	BAKU	Congridae
Crab	KUKA	Crab
Ctenochaetus striatus	GURU	Acanthuridae
Ctenochaetus sp.	DRIDRI	Acanthuridae
Ctenochaetus sp.	IKALOA	Acanthuridae
Ctenochaetus sp.	METO	Acanthuridae
Ctenopharyngodon idella	IKASUSU	Cyprinidae
Ctenopharyngodon idella	PARALUMI	Cyprinidae
Dasyatis sp.	VAI	Dasyatidae
Diodon hystrix	SOKISOKI	Diodontidae
Eleotris melanosoma	KULUKOTO	Eleotridae
Eleotris melanosoma	KURUKOTO	Eleotridae
Eleotris melanosoma	KURUKOTO(VO)	Eleotridae
Eleotris melanosoma	VO	Eleotridae
Epinephelus lanceolatus	KAVU	Serranidae
Epinephelus merra	SENIKAWAKAWA	Serranidae
Epinephelus sp.	KASALA	Serranidae
Epinephelus sp.	KAWAKAWA	Serranidae
Epinephelus sp.	SONI	Serranidae
Epinephelus sp.	SONISONI	Serranidae
Gerres sp.	MATU	Gerreidae

Gerres sp.	MATUMATU	Gerreidae
Gerres sp.	MOTUMOTU	Gerreidae
Gymnocranius lethrinoides	MAMANINUBU	Lethrinidae
Gymnocranius robinsoni	MAMA	Lethrinidae
Gymnothorax fimbriatus	DABEA	Muraenidae
Hemirhamphus far	BUSA	Hemirhamphidae
Herklotsichthys quadrimaculatus	DANIVA	Clupeidae
Herklotsichthys quadrimaculatus	TANIVE	Clupeidae
Hypnea nidifica	LUMI	Sea weed
Hyporhamphus dussumieri	BUSE	Hemiramphidae
Juvenile eleotrids	CIGANA	Eleotridae
Juvenile eleotrids	CIQANA	Eleotridae
Juvenile eleotrids	DIQANA	Eleotridae
Juvenile mullets	MALISA	Mugiladae
Juvenile mullets	MOLISA	Mugilidae
Katsuwonus pelamis	YATU	Scombridae
Kuhlia marginata	SAKELO	Kuhliadae
Kuhlia marginata	DRAVA	Kuhlidae
Kuhlia rupestris	IKADROKA	Kuhlidae
Kyphosus sp.	SIRISIRI	Kyphosidae
Lambis lambis	EGA	Shells
Lambis lambis	YAGA	Shells
Leiognathus equulus	CEBE	Leiognathidae
Leiognathus equulus	KAIKAI	Leiognathidae
Lethrinus harak	KABATIA	Lethrinidae
Lethrinus mahsena	SABUTU	Lethrinidae
Lethrinus nebulosus	KAWAGO	Lethrinidae
Lethrinus olivaceus	DOKONIVUDI	Lethrinidae
Lethrinus xanthochilus	GUSULA	Lethrinidae
Lethrinus xanthochilus	KACIKA	Lethrinidae
Liza vaigiensis	KAVA	Mugilidae
Lutjanus argentimaculatus	DAMU	Lutjanidae
Lutjanus bohar	BATI	Lutjanidae
Lutjanus gibbus	BO	Lutjanidae
Lutjanus gibbus	YABO	Lutjanidae
Lutjanus rivulatus	REGUA	Lutjanidae
Lutjanus rivulatus	RENUA	Lutjanidae
Lutjanus sp.	KAKE	Lutjanidae
Megalops cyprinoides	VUVULA	Megalopidae
Megalops cyprinoides	YAVULA	Megalopidae
Mesopristes kneri	REVE	Terapontidae
Mesopristes kneri	URUURU	Terapontidae
Metriatyla scabra	DAIRO	Sea cucumber
Microthele nobillis	LOALOA	Sea cucumber
Molly fish	TIATIA	Cyprinidae
Mugil cephalus	KOTO	Mugilidae
Mugil sp.	KANACE	Mugilidae
Mullid	OSE	Mullidae
Mulloides flavolineatus	VULA	Mullidae
Mulloides vanicolensis	OSEKULA	Mullidae
Muraenesox cinereus	IKASA	Muraenidae
Myripristis violaceus	COROCORO	Holocentridae
Naso unicornis	TA	Acanthuridae
Octopus sp.	KUITA	Cephalapod
Ophiocara porocephala	BAU	Eleotridae
Ophioeleotris aporos	IKABAU	Eleotridae
Palaemon concinnus	MOCI	Prawn
Paracaesio kusakari	BEDFORD	Lutjanidae
Paracanthurus hepatus	JILA	Acanthuridae
Parupeneus indicus	MATAROKO	Mullidae
Parupeneus indicus	MATOROKO	Mullidae
Parupeneus indicus	MATROKO	Mullidae
Penaeus monodon	VALE	Prawns
Platax orbicularius	VUNAVUNA	Ephippidae
Plectorhynchus chaetodontoides	KOLEKOLE	Haemulidae

Plectorhynchus chaetodontoides	KOLELE	Haemulidae
Plectorhynchus sp.	DREKENI	Haemulidae
Plectorhynchus sp.	SEVA	Haemulidae
Plectorhynchus sp.	SEVASEVA	Haemulidae
Plectropomus leopardus	SALMON COD	Serranidae
Plectropomus sp.	DONU	Serranidae
Plotosus lineatus	KABO	Plotosidae
Plotosus lineatus	KABOA	Plotosidae
Polydactylus plebeius	UCULUKA	Polynemidae
Prawn	URA	Prawn
Pristipomoides sp.	PAKAPAKA	Lutjanidae
Pseudobalistes flavimarginatus	CUMU	Balistidae
Pseudobalistes flavimarginatus	CUMUDAMU	Balistidae
Puntius gonionatus	PUNTIUS	Unknown
Rastrelliger kanagurta	SALALA	Scombridae
Sardinella fijiensis	NIVA	Clupeidae
Scaridae Unid sp.	KARAKARAWA	Scaridae
Scaridae Unid sp.	ULAVI	Scaridae
Scarus sp.	RARA	Scaridae
Scarus sp.	RAWARAWA	Scaridae
Scatophagus argus	BABA	Scatophagidae
Scatophagus argus	VETAKAU	Scatophagidae
Scomberoides sp.	MOLI	Carangidae
Scomberomorus commerson	WALU	Scombridae
Scorpaena sp.	IKAVATU	Scorpaenidae
Scylla paranamosain	HEKA	Scyllidae
Scylla serrata	QARI	Scyllidae
Selar crumenopthalmus	VATULE	Carangidae
Selar crumenopthalmus	YATULE	Carangidae
Shark	BULUBULU	Carcharinidae
Sicyopterus sp.	BELETI	Sicydiaphiidae
Siganidae Unid sp.	NUQA	Siganidae
Sphyraena flavicauda	SASA	Sphyraenidae
Sphyraena forsteri	DULUTOGA	Sphyraenidae
Sphyraena forsteri	SILASILA	Sphyraenidae
Sphyraena sp.	OGO	Sphyraenidae
Strombus gibberulus	GERA	Shells
Strombus gibberulus	GOLEA	Shells
Terapon jarbua	QITAWA	Terapontidae
Thryssa baelama	VACA	Engraulidae
Tilapia mossambica	MALEYA	Cichlidae
Trachinotus baillonii	LALI	Carangidae
Trichiurus haumela	TOVISI	Trichiuridae
Tridacna maxima	KATAVATU	Tridacnidae
Tridacna sp.	VASUA	Tridacnidae
Trochus niloticus	SICI	Shells
Tylosurus crocodilus	SAKU	Belonidae
Upeneus vittatus	KI	Mullidae
Valamugil seheli	SEVOU	Mugilidae
Variola albimarginata	NITOGA	Serranidae