The Secretariat of the Pacific Community

Coastal Fisheries Programme

CAPTURE SECTION REPORT OF TECHNICAL ASSISTANCE TO THE RAROTANGAN-BASED TUNA LONGLINE FLEET, AND DEMONSTRATION OF MID-WATER FISHING TECHNIQUES TO ARTISANAL FISHERMEN IN RAROTONGA AND AITUTAKI, COOK ISLANDS

26 January – 3 May 1997

by

Steve Beverly
Masterfisherman

and

Lindsay Chapman
Fisheries Development Adviser

Original text: English

Secretariat of the Pacific Community cataloguing-in-publication data

Beverly, Steve and Chapman, Lindsay

Capture-Section Report of Technical Assistance to the
Rarotongan-Based Tuna Longline Fleet, and Demonstration
of Mid-Water Fishing Techniques to Artisanal Fishermen
in Rarotonga and Aitutaki, the Cook Islands / by
Steve Beverly and Lindsay Chapman

1. Tuna fishing—Cook Islands
2. Longlining (Fisheries)—Cook Islands
3. Tuna Fisheries
I. Title II. Secretariat of the Pacific Community

639.2'9623 AACR2

ISBN 982-203-594-2

'**Pacific Community**' is the new name of the South Pacific Commission (SPC).

The new name became official on 6 February 1998, in commemoration of the 50th anniversary of the 1947 Canberra Agreement which originally established the SPC.

The change of name does not alter all the established SPC acronyms, but their meanings are modified.

'**Pacific Community**' applies to the total organisation, i.e. the member governments, the Conference, the CRGA and the Secretariat.

'**Secretariat of the Pacific Community (SPC)**' refers to those who provide the service to members of the Community.

Secretariat of the Pacific Community
BP D5
98848 Noumea Cedex
New Caledonia

Tel: (687) 26 20 00
Fax: (687) 26 38 18
e-mail: capture@spc.org.nc
http:/www.spc.org.nc/

Prepared for publication and printed at
Secretariat of the Pacific Community headquarters
Noumea, New Caledonia, 1998

ACKNOWLEDGEMENTS

The Secretariat of the Pacific Community would like to acknowledge the Secretary of Marine Resources, Mr Raymond Newnham and Fisheries Consultant, Mr Colin Brown for initiating the Cook Islands' longline project and FAD fishing workshops. The SPC would like to acknowledge Mr Victor Uherbelau, Director, and Mr Tony Kingston, Manager, Economics and Marketing Division of Forum Fisheries Agency for assistance in funding; and the United Nations Development Programme for providing funding for the project under UNDP's Regional Fisheries Support and National Capacity Building Programme.

The SPC would like to acknowledge the support of Cook Islands' Ministry of Marine Resources staff, particularly Marine Surveillance Officer Mr Josh Mitchell, MMR Finance Officer Mr George Matutu, Fisheries Officer Mr Sonny Tatuava, Fisheries Officer Mr Vane Kaitara, Station Manager Mr John Ngu (Aitutaki), and Mr Jason Marurai Fisheries Officer (Aitutaki). The SPC would like to thank the entire Fisheries Development Unit staff for all of their hard work in preparing fishing gear and refurbishing the Yamaha 7 m skiff, and in helping with the two workshops.

In the private sector, the SPC would like to acknowledge Mr Lucky Matapuku and Ms Adrienne Matapuku, owners of Seaquest Ltd (F/V *Farquest*) and Mr Brent Fisher of Fisher's Fishing Tours (owner of F/V *Peka-Anne*) not only for the use of their vessels but for the considerable time each put into the project. The SPC would also like to thank the captains and crews of F/V *Farquest* and F/V *Peka-Anne* for their hard work and patience with the Masterfisherman during fishing trials.

Several small boats were volunteered by their owners for FAD fishing trials during the course of the two FAD fishing workshops (Rarotonga and Aitutaki). The SPC would like to thank the following small-boat owners for use of their vessels: Mr Tupe Short, Dr Roro Daniel, Mr William Vogel, and Mr Teariki Buckley on Rarotonga; and Mr Junior Maoate and the Baxter brothers (John, Clive, and Mark) on Aitutaki.

The SPC would like to thank all of the fishermen on Rarotonga and Aitutaki who participated in either longline fishing trials or one of the two FAD fishing workshops.

The authors are also grateful to all those involved in the production of this report, in particular, Ms Marie-Ange Roberts for the report format and layout, Ms Sarah Langi for the editing, Ms Patricia Martin for the design of the cover, and Mr Keith Bigelow for background information used from the Confidential Cook Islands' National Fisheries Assessment. The authors also thank the SPC's Printery staff for the printing of this report.

SUMMARY

Secretariat of the Pacific Community (SPC) Masterfisherman, Steve Beverly was in Rarotonga, Cook Islands from 26 January to 3 May 1997 to assist the fledgling tuna longline fleet and, along with SPC's Fisheries Development Adviser, Lindsay Chapman, conduct a FAD fishing workshop for artisanal fishermen on Rarotonga, 14–18 April 1997. The Masterfisherman also conducted a second FAD fishing workshop on Aitutaki, along with the Ministry of Marine Resources' Fisheries Development Unit from 21–24 April 1997.

This project was the result of an official request from the Government of the Cook Islands for assistance, which was instigated by the Ministry of Marine Resources' Secretary, Ray Newnham, and Fisheries Consultant, Colin Brown. In October 1996, Ray Newnham, Colin Brown and Steve Beverly submitted a proposal to the Forum Fisheries Agency (FFA) seeking funding of around US $40,000. The project was approved and funding was granted.

When the Masterfisherman arrived in Rarotonga in January 1997 to commence his work with the domestic longline fleet, only one vessel remained—F/V *Farquest*—owned and operated by Seaquest Ltd. A second vessel was also in operation, F/V *Peka-Anne*. However, this vessel was small by industry standards and could not have become a serious sashimi export vessel.

It soon became apparent, after an inspection by the Masterfisherman, why Seaquest Ltd was having troubles with F/V *Farquest*. The vessel was 27 years old with limited capabilities. The fish hold could only hold about 2 mt of iced fish and the fuel tanks held only enough fuel for about one week of continuous operation. However, the vessel did have a good monofilament longline system with 40 kilometres of line and 800 branchlines and all of the other gear to go with it (the line setter, however, was inoperable).

One month of fishing was undertaken on F/V *Farquest* by the Masterfisherman, with 8 sets made. Catch rates were fairly low at 37 kg/100 hooks for all saleable species. Maintenance problems and the lack of spare parts restricted the fishing operations during the Masterfisherman's time on board. All of the catch was sold locally, as Seaquest Ltd had not exported product since November 1996. Overall it was felt that F/V *Farquest* would not be a viable commercial longline vessel in the sashimi export trade because of its limited capabilities.

F/V *Peka-Anne* did have potential for supplying fish to the domestic markets in Rarotonga due to its low running costs, and could possibly have become part of an export operation if one were to start again. This vessel also had potential as a charter sport-fishing vessel—combining longlining, vertical longlining, palu-ahi fishing, and deep bottom fishing with Fisher's Fishing Tours, another business venture run by the owner. The Masterfisherman also conducted one month of fishing on this vessel with 8 sets made. The overall catch rate recorded was similar to that of F/V *Farquest*, at 39.4 kg/100 hooks. Longline trials concluded abruptly when the line guide on the mainline reel broke. The Masterfisherman then equipped the vessel with vertical longlines and palu-ahi lines for fishing around FADs. Initial catches were poor with these methods. This was attributed to the lack of fish around the FADs and the strong currents encountered at times. Fish caught by F/V *Peka-Anne* were sold either whole or processed into loins or chunks to local restaurants.

Cook Islands Seafoods Ltd (a joint venture between F/V *Farquest's* owners and a foreign company) was surviving by processing and marketing the catch of F/V *Farquest* locally. Not enough fish were being caught to justify exports. The physical plant at Cook Islands Seafoods Ltd at Avatiu was found to be sub-standard. If exports were to resume, particularly to USA markets, the plant would need substantial improvements and would need to produce a HACCP plan. It should be noted that Seaquest Ltd and Fisher's Fishing Tours were competing for the same small-niche market on Rarotonga to sell their respective catches.

At the time of the project, development of domestic tuna longlining operations had not worked. However, domestic longline fishing in the Cook Islands may have a chance for development if Government exercises some control on what type of vessels and how many vessels are allowed entry into the fishery. New entrants should be capable of being based in Rarotonga and fishing in the Northern Cook Islands, where catches are considerably higher according to the available data. Vessels should also be capable of adapting to the broadbill swordfish longline fishery and the southern albacore troll fishery.

Two successful workshops were held, one in Rarotonga and the other at Aitutaki, encouraging the use of mid-water fishing techniques by artisanal fishermen. The workshops were a mixture of theory and practice with two days fishing being conducted at each workshop using vertical longlines and palu-ahi lines, made by the participants. Although catch rates for these methods were low, enthusiasm was high and fishermen were keen to learn how to use the gear.

RÉSUMÉ

Le maître de pêche de la Communauté du Pacifique, Steve Beverly, a séjourné à Rarotonga (Îles Cook) du 26 janvier au 3 mai 1997 afin d'aider la flottille naissante de bateaux de pêche thonière à la palangre, et, avec le conseiller pour le développement de la pêche côtière, Lindsay Chapman, il a animé, à Rarotonga, du 14 au 18 avril 1997, un atelier de pêche autour des DCP, destiné à des petits pêcheurs. En collaboration avec la section Développement de la pêche côtière du ministère des Ressources marines (Ministry of Marine Resources Fisheries Development Unit), le maître de pêche a également dirigé un deuxième atelier consacré à la pêche autour des DCP à Aitutaki, du 21 au 24 avril 1997.

Ce projet a fait suite à une demande officielle d'aide adressée par le gouvernement des Îles Cook, à l'instigation de Ray Newnham, premier secrétaire (Secretary) au ministère des Ressources marines et de Colin Brown, expert-conseil en pêche. En octobre 1996, Ray Newnham, Colin Brown and Steve Beverly ont présenté à l'Agence des pêches du Forum un descriptif de projet assorti d'une demande de financement d'un montant approximatif de 40000 dollars É.-U. Le projet a été approuvé et le financement accordé.

Lorsque le maître de pêche est arrivé à Rarotonga, en janvier 1997, pour entamer sa mission auprès de la flottille locale de palangriers, il ne restait plus au port qu'un seul bateau, le Farquest, propriété de la société Seaquest Ltd. qui en assurait l'exploitation. Un second navire, le Peka-Anne était, quant à lui, en campagne. Cependant, ce dernier était de petite taille par rapport aux normes en vigueur dans cette branche d'activité et il n'aurait pu sérieusement contribuer aux exportations de thon sashimi.

Après l'inspection réalisée par le maître de pêche, les causes des difficultés éprouvées par la société Seaquest Ltd. avec le Farquest sont rapidement devenues évidentes. Fabriqué 27 ans auparavant, ce navire avait des capacités limitées. Dans la cale, seules deux tonnes de poisson sous glace pouvaient être stockées et les réservoirs de carburant ne pouvaient contenir de carburant que pour une campagne ininterrompue d'une semaine. Toutefois, le navire était équipé d'une bonne ligne-mère à monofilament de 40 km de longueur sur laquelle étaient montés 800 avançons et tout le matériel nécessaire (toutefois, l'éjecteur de ligne n'était pas opérationnel).

Sous la direction du maître de pêche, le Farquest est parti pour une marée d'un mois au cours de laquelle il a mouillé la palangre à huit reprises. Les taux de prises ont été assez faibles, 37 kg/100 hameçons d'espèces commercialisables ayant été capturés. Des problèmes d'entretien et le manque de pièces détachées ont entravé le bon déroulement des opérations de pêche pendant le séjour à bord du maître de pêche. Toutes les prises ont été vendues sur le marché local, puisque la société Seaquest Ltd. n'avait pas exporté de marchandises depuis novembre 1996. Dans l'ensemble il a été estimé que le Farquest, en raison de ses capacités limitées, ne pourrait être un bateau de pêche commerciale à la palangre viable pour le commerce d'exportation du sashimi.

En raison de ses faibles coûts d'exploitation, le Peka-Anne, avait, quant à lui, le potentiel nécessaire pour approvisionner les marchés de poissons de Rarotonga et, en cas de reprise des exportations, il pourrait apporter sa pierre à l'édifice. Ce bateau pouvait également être exploité comme un bateau de pêche sportive car il pouvait être utilisé pour la pêche à la palangre, la pêche à la palangre verticale, la pêche au palu-ahi et la pêche profonde par la Fisher's Fishing Tours, une autre entreprise commerciale dirigée par son propriétaire. Le maître de pêche a également entrepris une campagne d'un mois à bord de ce navire qui a mouillé la palangre à huit reprises. Le taux de prises global enregistré a été semblable à celui du Farquest avec 39,4 kg/100 hameçons. Les essais de pêche ont pris fin brutalement lorsque le guide-ligne fixé sur l'enrouleur de la ligne-mère s'est cassé. Le maître de pêche a alors

équipé le navire de palangres verticales et de lignes à palu-ahi pour pêcher autour des DCP. Les premiers résultats obtenus à l'aide de ces méthodes n'ont guère été satisfaisants; ils ont été attribués à un manque de poissons dans le voisinage immédiat des DCP et à la force des courants rencontrés, parfois. Le poisson capturé par le Peka-Anne a été vendu soit entier, soit débité en filets ou en darnes aux restaurants locaux.

La Cook Islands Seafoods Ltd. (société d'exploitation mixte regroupant les propriétaires du *Farquest* et une société étrangère) survivait en transformant et en commercialisant localement le produit de la pêche du *Farquest*. La quantité de poissons vendue était insuffisante pour justifier des exportations. Il a été constaté que les installations de la *Cook Islands Seafoods Ltd*., à Avatiu, ne répondaient pas aux normes. Dans l'hypothèse où les exportations devraient reprendre, notamment vers les marchés américains, il conviendrait de les améliorer substantiellement et de publier un plan d'analyse des risques et des points de contrôle critiques. Il faut faire remarquer que la Seaquest Ltd. et la *Fisher's Fishing Tours* étaient en concurrence pour la vente du produit de leurs pêches respectives sur le même petit créneau à Rarotonga.

Lors de la mise en œuvre du projet, les opérations de pêche thonière à la palangre menées par la flottille locale ne s'étaient pas développées. Cependant, la flottille locale de palangriers a des chances de se développer aux Îles Cook si les pouvoirs publics se donnent les moyens de contrôler le type et le nombre de navires autorisés à exploiter les ressources halieutiques du pays. Les nouveaux venus devraient être à même de relâcher à Rarotonga et de pêcher dans le nord des Îles Cook où les taux de prises sont sensiblement plus élevés, selon les données disponibles. Les bateaux devraient également pouvoir être adaptés à la pêche de l'espadon à la palangre et du germon du sud à la traîne.

Deux ateliers ont été organisés avec succès, l'un à Rarotonga et l'autre à Aitutaki; à l'issue des travaux, l'utilisation de techniques de pêche entre deux eaux par les petits pêcheurs a été encouragée. Lors de ces deux ateliers, théorie et pratique ont été combinées, puisque deux jours ont été consacrés, dans les deux cas, à la pêche à la palangre verticale et au palu-ahi, qui avaient été confectionnés par les participants. Bien que les taux de prises réalisés à l'aide de ces méthodes aient été faibles, les pêcheurs se sont montrés très enthousiastes et désireux d'apprendre à utiliser ces engins.

CONTENTS

1. Introduction and Background

1.1 General[1]

The 15 islands of the Cook Islands lie between 9º S and 22º S and 157º W and 166º W (Figure 1). They are divided into the Northern Group which is composed of six small islets and atolls (Penrhyn, Rakahanga, Manihiki, Pukapuka, Nassau, and Suwarrow) and the Southern Group which includes the high volcanic island of Rarotonga (65 km^2) and eight other islands with a range of relief patterns (Palmerston, Aitutaki, Manuae, Takutea, Mitiaro, Atiu, Mauke, and Mangaia). The total land area of the Cook Islands is 240 km^2 (Douglas & Douglas, 1989). By contrast the Cook Islands' exclusive economic zone (EEZ) encompasses an area of 1.8 million km^2 of ocean and is the eighth largest of the 30 fishing and economic zones in the Secretariat of the Pacific Community's statistical area. *The Territorial Sea and Exclusive Economic Zone Act of 1977* established a 12-mile territorial sea boundary around all the islands and a 200-mile EEZ. The Cook Islands' EEZ shares common boundaries with five other Pacific Island nations or territories (Kiribati, Niue, New Zealand with respect to Tokelau, USA with respect to American Samoa, and France with respect to French Polynesia). About 48 per cent of the Cook Islands' EEZ borders on international waters (high seas).

The Cook Islands lie on the Pacific Plate in two groups: the Northern Cook Islands and the Southern Cook Islands. The region is geologically inactive and there are few seamounts and guyots in comparison to other areas in Polynesia. Most of the islands rise from depths of about 4,000 m except for the islands in the Northern Group that lie on the Manihiki Plateau, which is about 2,000 m deep. The Southern Group is a continuation of the Austral Islands of French Polynesia, formed as volcanic material escaped from a southeast–northwest fracture in the earth's crust (Figure 2). Rarotonga is the only high volcanic island in the group. It is surrounded by a barrier reef with a narrow lagoon. Aitutaki is similar to Bora Bora in Tahiti in that it consists of a middle-aged volcanic island surrounded by an atoll-like barrier reef with many small islets, or motus, defining the lagoon boundaries. Atiu, Mangaia, Mauke, and Mitiaro are uplifted coral atolls. The islands in the Northern Group are typical atolls with motus, or sand cays without lagoons.

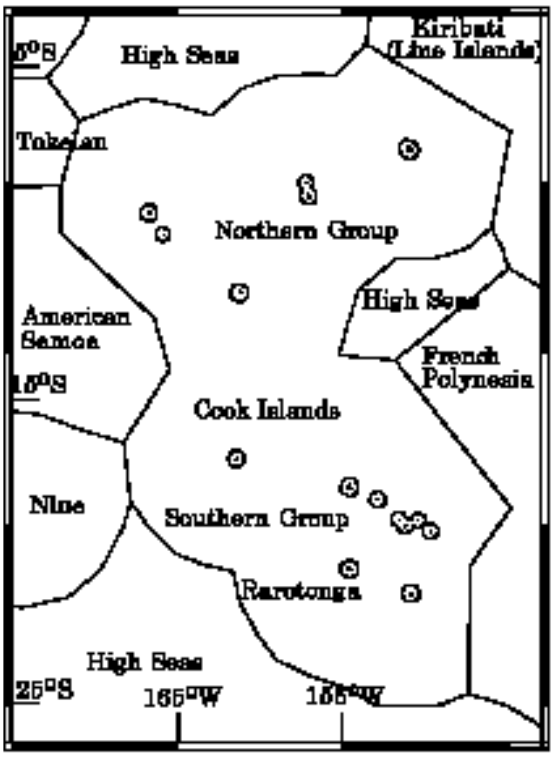


Figure 1: Cook Islands fishing zone and 12 nm territorial limit

Politically the Cook Islands are a self-governing state in free association with New Zealand. The country formally became a part of New Zealand on 11 June 1901 and gained self-government in 1965. Cook Islanders are free to travel to New Zealand and Australia. SPC's Population and Demography Section data show a 1996 population of 18,904, up just 287 people from the 1991 census. The population of Rarotonga was 11,100 in 1996, up 214 people from 1991 (personal communication from Andreas Demmke, SPC's Population and Demography Section). The main source of foreign exchange is tourism and offshore banking. The currency is the New Zealand dollar, with Cook Island coins and a three-dollar note.

[1] This section draws on work compiled by the Oceanic Fisheries Programme's Confidential Cook Islands National Fisheries Assessment.

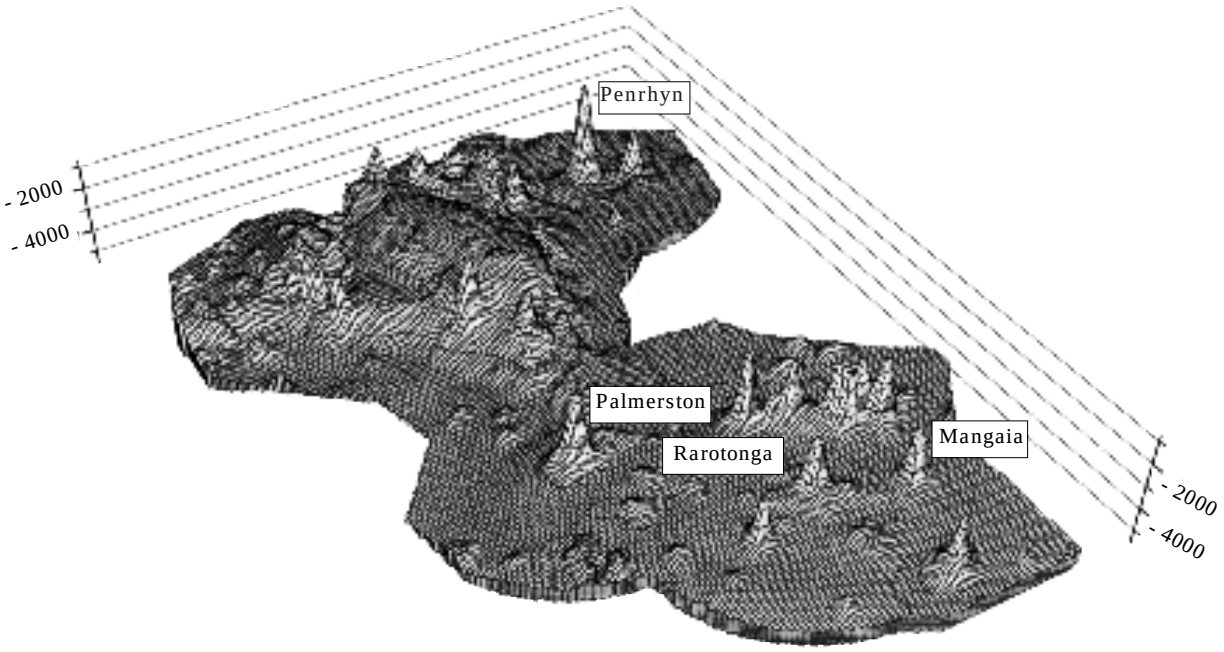


Figure 2: Three-dimensional representation of the bathymetry for waters surrounding the Cook Islands as viewed from the south. Data source:* Seafloor imaging *produced this map from data compiled by the National Geographical Data Center

1.1.1 Oceanography

Ocean circulation in the Cook Island waters is mainly driven by winds and changes in temperature and salinity which affect sea-water density. The Westwind Drift (40º S to 50º S) and the equatorial current system create an anti-clockwise current flow, or gyre, in the South Pacific. From the equator to 20º S, four main currents or counter-currents are recognised (Delcroix et al., 1992):

- The northern branch of the South Equatorial Current flows westward between 1º S and 7º S at a mean speed of 30 cm/sec and is 200 m thick;
- The southern branch of the South Equatorial Current flows westward between 11º S and 14º S at a mean speed of 5 cm/sec and is 200 m thick;
- Between these two westward-flowing currents is the eastward-flowing South Equatorial Counter-current at 7º S to 11º S with a mean speed of 20 cm/sec and 50–100 m thick; and
- South of 15º S the South Tropical Counter-current flows eastward.

In general, current velocities are weak for the Cook Islands' EEZ as the maximum velocity is about 25 cm/sec (52 cm/sec = 1 knot). Currents appear southwesterly in the north (5º S to 10º S), southerly between 10º S and 15º S, and southerly or southwesterly in the south (15º S to 25º S).

A 100 m deep pool of uniformly warm water (29º C) extends over the equatorial western Pacific within 10º N to 10º S (Delcroix et al., 1992). The majority of the Cook Islands' EEZ lies farther to the south than the western Pacific warm pool, in more saline and cooler waters of the subtropical Pacific.

In the Cook Islands, sea-surface temperature (SST) is warmest during January and February and coolest during July and August (Reynolds & Smith, 1994). A large portion of the northern Cook Islands' EEZ is isothermal (29º C) during January to June. SSTs show a north–south gradient, and seasonal variation increases with latitude. SSTs are 29º C in northern areas and 26º C in southern areas in summer. During winter SSTs are 1º C cooler in the north and 4º C cooler in the south.

Three major *El Niños* (1982–83, 1986–87, and 1991–95) resulted in 1º C cooler SSTs in the southern area than in normal years. One major *La Niña* (1988–89) resulted in cooler summer SSTs in the northern area but had little effect on the southern area.

The depth of the thermocline in the Cook Islands' EEZ generally increases with latitude. Based on historical data taken from passing ships (Levitus, 1982), at 5º S the thermocline (depth of the 15º C isotherm) extends from 120–220 m. At southern latitudes (15º S to 25º S) it extends from about 50–325 m. There is also a latitudinal gradient of dissolved oxygen with depth in the Cook Islands' EEZ. Northern latitudes have less oxygen at a given depth than southern latitudes. In waters south of 15º S, oxygen concentrations are generally high (>3.5 ml/l above 300 m depth). Between 5º S and 10 º S, oxygen concentrations are low (<3.0 ml/l below 250 m depth). Cook Island waters are relatively low in productivity compared to waters around the Society Islands in French Polynesia. Chlorophyll pigments in the Cook Island waters based on satellite imagery are only about 0.05 mg/m^3, whereas in French Polynesia the concentrations are greater than 0.1 mg/m^3. There is little interannual variation in productivity in the Cook Island fishing zone except northeast of 10º S during the months May to August.

1.1.2 Government policies affecting fisheries

Recent legislation in the Cook Islands will see the Turnover Tax (10% of all goods and services) replaced, probably in early 1998, by a value-added tax, or VAT. This will affect any person or business, including commercial fishing ventures, earning in excess of NZ $30,000, and will be 12.5 per cent of the price of all goods and services.

The Cook Islands are represented by three commercial banks: ANZ, Westpac, and Post Savings Bank—and have a development bank as well. Cook Islands Development Bank (CIDB) has facilities to lend up to NZ $100,000 to commercial fishing ventures. The terms are that the borrower must hold 30 per cent equity and the interest rates range from 14.5–17.5 per cent over 3–6 years. Some of the capital can be used for initial operating expenses and there can be a three-month grace period for start-up ventures.

The Ministry of Marine Resources (MMR) is responsible for fisheries management, surveillance, and development. The Ministry was created as a result of the *Ministry of Marine Resources Act of 1984*. It has a head office in Rarotonga and sub-offices in Aitutaki, Pukapuka, Penrhyn, Palmerston, Mitiaro, and Manihiki. MMR has four key sectors with their goals being:

- *Commercial Development Assistance*: Promote the development of commercially viable offshore and inshore marine resources;
- *Subsistence Fisheries Development*: Ensure the sustainability of subsistence fisheries;
- *Research*: Develop and implement research programmes that are focused on proper management of marine resources; and
- *Ministry Support Services*: Ensure that appropriate resources are available for the efficient and effective operation of the ministry.

Under the Ministry of Marine Resources' goals and objectives implemented in January 1997, the Ministry's mission statement is:

> 'to ensure the sustainable development of the living and non-living marine resources of the Cook Islands for the benefit of the people of the Cook Islands.'

In April 1997, the above policy was expanded to reflect and encourage the changes that were occurring in the fisheries sector. Whilst maintaining the status quo, MMR was looking to actively expand and enhance future productivity at all levels. A copy of the expanded policy statement is at Appendix A.

Four types of fishing vessels are recognised by MMR, three of which require a licence:

1. Local vessel under ten metres—no licence required, can fish anywhere in EEZ (for example, F/V *Peka-Anne*);

2. Local vessel over ten metres—annual licence required (fee NZ $2,500), can fish anywhere in EEZ including inside 12-mile limit but not inside six-mile limit (for example, F/V *Farquest*);

3. Locally based foreign vessel—annual licence required (fee NZ $5,000), can fish anywhere in EEZ outside 12-mile Territorial Waters; and

4. Foreign fishing vessel—fees vary, can fish in areas specified under an agreement (currently there are no vessels fishing under bilateral access agreements, however, there are foreign vessels fishing under the US Multi-Lateral Treaty Agreement).

1.1.3 Infrastructure

The main port facilities on Rarotonga are two small harbours, Avarua and Avatiu. Avarua is a shallow-draft harbour, suitable only for small artisanal fishing and pleasure boats. Avatiu Harbour is small in comparison to harbours in other countries but is the largest in the Cook Islands. Vessels of up to 75 m length and 4.5 m draft can berth in Avatiu Harbour. Several longline vessels (three to four) could use the harbour at any one time but would probably have to tie up abreast when cargo ships were in port as dock space is limited. There are lead lights leading into the harbour so it can be entered at night. There is a fresh-water supply at the harbour but no shore power or telephone connections for vessels. When weather is coming out of the north the harbour can get very rough, as there is no break-water at the entrance. During cyclones (cyclone season is from December to April with an average of one every other year—Stanley, 1986) the harbour is too rough and all vessels have to put to sea.

There are reliable ship-to-shore radio communications available in the Cook Islands via Cook Islands' Radio (ZKR) on both VHF (ch 16) and SSB frequencies (2182, 4125, and 6215 Mhz). All vessels are required to call in on a regular schedule while at sea, reporting time of departure, positions while steaming at 0830 and 2030 hours, and estimated time of arrival (ETA).

There are no commercial slipway facilities in the Cook Islands. Vessels have to travel to Suva, Fiji; Papeete, Tahiti; or New Zealand, for haulouts or major repairs. However, there is a small engineering firm that can handle minor above-water repairs, including minor steel fabrications and fitting and turning. There are two refrigeration engineers on Rarotonga and one electronics company, but no one well-versed in marine electronics. There are two retail hardware outlets that sell the usual variety of tools, nuts, bolts, and materials found in most population centres. However, parts and services specific to marine applications and fishing vessels are not available. There is no ship's chandlery on Rarotonga, but one of the hardware stores stocks appliances, including some safety gear (EPIRBS, flare kits, etc), for small vessels along with artisanal fishing gear—but all at inflated prices. The Harbourmaster sells some safety gear, including radar reflectors, life jackets, and flare kits—and charts of Cook Island waters—from his office at Avatiu Harbour.

There are two fuel depots in Rarotonga that provide fuel and bunkering for fishing vessels and ships: Mobil Ltd and Triad Ltd. The cost of fuel for fishing vessels was NZ $ 0.65/l (April 1997). Fuel is delivered dockside to vessels at Avatiu Harbour by tanker truck.

There were two flake-ice machines on Rarotonga: a 3 mt-per-day machine at Cook Islands Seafoods that supplied F/V *Farquest*, and a small machine operated Monday to Friday during office hours by MMR at Avatiu Harbour. The MMR machine can produce an estimated 500 kg daily, based on the demands of artisanal fisherman. F/V *Peka-Anne* used ice from MMR's machine. Neither machine operated at full capacity.

Rarotonga International Airport was capable of handling 747 aircraft (Air New Zealand was the only international carrier with landing rights at Rarotonga International). There were two flights weekly that ended up in Los Angeles: Monday—Rarotonga to Honolulu to Los Angeles; and Saturday—Rarotonga to Papeete to Los Angeles. Each of these flights could carry up to 3 mt of fresh chilled export fish (three LD3 containers). The freight rate to Honolulu was NZ $ 2.75/kg and NZ $2.85/kg to Los Angeles. There were four flights per week to Auckland, New Zealand—on Wednesdays, Thursdays, Fridays, and Saturdays. The only Rarotonga–Auckland flight that could take fresh chilled fish was the Saturday flight, and then it could only take up to 1.5 mt. The reason for the lack of space available for fish going to Auckland was that there was a fairly large trade in fresh fruit and vegetables being exported from Rarotonga to Auckland. This trade had been going on for several years and thus had priority over fish exports, which were a more recent export commodity. The freight rate from Rarotonga to Auckland was NZ $1.50 per kg, if the consignment was over 0.5 mt (the above freight rates were a personal communication from Adrienne Matapuku). The estimated freight rate to Japan from Rarotonga was in the order of NZ $5.00/kg. Any fish being freighted to Japan would have to go first to Honolulu or Auckland.

1.2 THE FISHERY

1.2.1 The domestic fleet (locally owned and locally based foreign vessels)

During the project the domestic longline fleet in the Cook Islands consisted of just one vessel, F/V *Farquest*, which was owned and operated by Seaquest Ltd. The 8.8 m FAO-designed Ton-7, F/V *Peka-Anne*, was also capable of fishing tuna longline gear, but only on a very small scale, so was not considered to be a commercial tuna longline vessel. During 1994–95 there were two locally based foreign longline vessels licensed to fish in the Cook Islands' EEZ, the 109 gross registered tonne (GRT) F/V *Southern Progress* and the 181 GRT F/V *Kona Wind* (Mitchell, 1996). These two vessels had since departed the Cook Islands. In 1995–96 one locally based foreign longline vessel fished in Cook Island waters, the 109 GRT F/V *Suzanne M* (now departed from the Cook Islands), plus the local vessel, F/V *Farquest*.

The Cook Islands' MMR presented annual catches to SPC's Oceanic Fisheries Programme (OFP) of 97 mt for all species caught during 1994 and 127 mt during 1995 (Lawson, 1996). Most of the effort for 1995 was centred on Rarotonga with just a little in the Northern Group and a little in international waters southwest of the Cook Islands' EEZ (Figure 3). During 1995 seventy-one trips were made and each trip averaged 5 days (to coincide with airline flight schedules). Approximately five sets were made per trip with an average effort of 1100 hooks per set (Mitchell, 1996). From 1995 unloading data, the catch by species included 29 mt (21%) of albacore tuna, 13 mt (10%) of bigeye tuna, 18 mt (14%) of yellowfin tuna, 29 mt (22%) of marlin, 27 mt (20%) of broadbill swordfish, 8 mt (6%) of mahi mahi, 3 mt (1%) of wahoo, and 3 mt (1%) of spearfish (Mitchell, 1996).

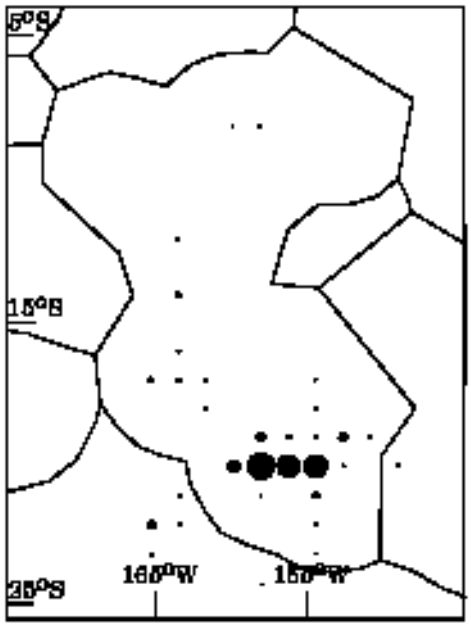


Figure 3: Longlining effort in Cook Island waters in 1995

1.2.2 The distant water fishing nation (DWFN) fleets

In the past, DWFN vessels from Japan (1962–95), Taiwan (1967–95), and Korea (1975–93) have fished in the vicinity of the Cook Islands' waters. Catch and effort data for these fleets is aggregated into 5º latitude by 5º longitude squares by year (Lawson & Lewis, 1996).

Both annual effort and catch by DWFNs have varied considerably over the years. Prior to 1975, effort in the area was about 2,000,000 hooks per year; thereafter effort has averaged about 6,000,000 hooks per year (Lawson & Lewis, 1996). The highest annual effort was almost 15,000,000 hooks in 1991. The Japanese fleet fished within the vicinity of the Cook Islands from 1962 to 1971, but recent effort in the area has been negligible. The Korean fleet dominated in the 1980s and the Taiwanese fleet in the 1990s. The highest annual catch rate in the vicinity of the Cook Islands was 6,400 mt in 1980. During the 1980s, the average annual catch of tuna was about 2,800 mt, composed of 1,200 mt (43%) of albacore tuna, 750 mt (27%) of yellowfin tuna, and 850 mt (30%) of bigeye tuna. The catch varied significantly by latitude: most of the tuna catch, apart from albacore, was in the latitudes between 5º S and 15º S in the vicinity of the Cook Islands (Lawson & Lewis, 1996).

1.3 COOK ISLANDS SEALORDS LTD, COOK ISLANDS SEAFOODS LTD, SEAQUEST LTD, AND F/V *FARQUEST*

In late 1993/early 1994, Cook Islands Sealords Ltd was established and entered into a joint venture with a company in New Zealand to bring in several vessels to longline in the EEZ of the Cook Islands. In order to process and export the catch from the joint-venture vessels, Cook Islands Seafoods Ltd was established and a pack-house set up. As part of this operation, domestic markets, wholesale and retail, were established to sell the non-export fish. Appendix B provides more detail on the establishment of these two companies and the activities up to the departure of all the locally based foreign vessels fishing under this joint venture in 1996.

In early 1996 Lucky Matapuku and his wife Adrienne Matapuku formed Seaquest Ltd. With financial assistance from the Cook Islands Development Bank, Seaquest Ltd purchased a second-hand longline vessel from New Zealand, F/V *Farquest*. The licence fee for F/V *Farquest* was NZ $2,500 annually, and F/V *Farquest* could fish inside the 12-mile limit, but not inside the six-mile limit. From November 1996 to the conclusion of this project, the only vessel fishing for Cook Islands Seafoods Ltd was F/V *Farquest*, and the only fish sales were domestic. As a consequence, Cook Islands Seafoods Ltd and Seaquest Ltd were both on the brink of financial collapse (personal communication from Adrienne Matapuku).

Figure 4: F/V* Farquest *tied up at the Avatiu wharf in Rarotonga in 1989

Early in the operations of the companies, it was recognised by the partners that to remain viable, at least three vessels would have to be fishing under the banner of the pack-house. Whether or not Sealords Ltd, Cook Islands Seafoods Ltd, and Seaquest Ltd survived beyond 1997 depended on whether or not the J/V could bring more longline vessels into the fishery and could begin exporting to foreign markets once again.

F/V *Farquest* (Figure 4) was built in Port Chalmers, New Zealand in 1970 for the crayfish fishery in Chatham Islands. In 1992 new owners converted it to surface longline fishing by the addition of a 40 km (3.0 mm monofilament) alloy longline reel and line-setter—both manufactured in New Zealand. At that time the fish hold was fitted with a hydraulically powered spray-brine system (RSW). The fish hold was listed as a 'seven tonne hold' in the survey reports. Whether this refers to 7 mt of spray-brined (or RSW) product, or the volume of the fish hold, ie., 7 m^3, is not known. The spray-brine system had since been removed (in mid-1996). Reportedly the vessel fished longline for blue fish (bluefin tuna) for a time in Australia. No general arrangement drawings of F/V *Farquest* were available—Appendix C outlines the main specifications for F/V *Farquest*.

1.4 FISHER'S FISHING TOURS AND F/V *PEKA-ANNE*

Brent Fisher was the owner/operator of Fisher's Fishing Tours (Rarotonga). His main activity was taking tourists on around-the-island day trips on a 28 foot (8.6 m) outrigger canoe, F/V *Corey-Anne*. Fisher built the F/V *Corey-Anne* during an MMR/FAO boat-building course held on Rarotonga in 1989. The design of F/V *Corey-Anne* was a modified version of the FAO trimaran called the PNG-10. The main modification was that it had been changed from a three-hull configuration to a two-hull configuration. F/V *Corey-Anne* held five passengers as well as the operator and was powered by a nine-horsepower four-cycle outboard. While circumnavigating Rarotonga, lures were trolled behind the vessel on several medium-sized game-fishing rods. The usual catch was mahi mahi, small yellowfin tuna, or wahoo. The F/V Corey-Anne was Fisher's Fishing Tours main source of revenue.

In mid-1996, Fisher wanted to expand his operation and get into commercial fishing. An opportunity came up when MMR put up for tender a second-hand vessel that had been under-utilised by the Fisheries Development Unit of MMR. In the late 1980s, MMR had the Fisheries boat yard in Tonga build an FAO-design Ton-7. The Ton-7 was an 8.8 m wooden snapper boat powered by a Yanmar diesel engine, and came equipped with a British-made mini-longline reel (Figure 5) and pot hauler, both hydraulically powered via a power-take-off from the engine. The machinery was made one-off by Spencer-Carter Marine and Hydraulic Equipment Company Ltd (UK). The vessel was used for survey work by MMR but only for a year or two and then it was put up on the hard where it started to deteriorate.

Figure 5: The FAO-design Ton-7 in Avatiu Harbour after a fishing trip in 1989

Fisher was awarded the winning tender and proceeded to re-build the Ton-7. Extensive work had to be done on the hull, deck, and wheelhouse but most of the machinery and electronics were in reasonable condition. By October 1996 the vessel was ready to go to sea again. Fisher's plan was to use the newly christened F/V *Peka-Anne* (Figure 6) for small-scale commercial fishing. As the F/V *Peka-Anne* was under 10 m in length, she was allowed to fish within the six-mile limit. Appendix D lists the main specifications for the F/V *Peka-Anne*.

Figure 6: The F/V* Peka-Anne *(old Ton-7) after an extensive refit in 1996

1.5 INITIATION OF THE PROJECT AND ITS OBJECTIVES

In October 1996, the Cook Islands' MMR approached the SPC's Capture Section, to seek assistance in assessing the tuna longlining operations in Rarotonga. In response to this approach, the SPC's Masterfisherman, Steve Beverly, went to the Cook Islands for one week to assess the fishing activity and offer advice as to where the Capture Section could assist.

After assessing the situation, the Masterfisherman with MMR's Secretary, Raymond Newnham, and Fisheries Consultant, Colin Brown, submitted a draft proposal to the Forum Fisheries Agency seeking funding for a project to assist the domestic longline fleet, and to assist artisanal fishermen working around fish aggregating devices (FADs), to target the larger, deeper-swimming tunas. Subsequently, funding was approved through UNDP's joint SPC/FFA Regional Fisheries Support and National Capacity Building Programme. The budget of nearly US $40,000 called for $10,000 to be spent on new fishing gear, $10,000 on sanma bait, and the balance on operating expenses.

In December 1996, the SPC received an official request for the technical assistance of a Masterfisherman to conduct a 3–4 month project in the Cook Islands. The specific objectives of the project were:

- To assist Seaquest Ltd in the operation of their vessel, F/V *Farquest*, and Fisher's Fishing Tours in the operation of their vessel, F/V *Peka-Anne*; and to assist these two operations with fishing-gear configuration, fishing strategies, fish-handling techniques, and marketing—in order in enhance production and product quality, and to train the captains and crew in all aspects of tuna longline fishing and sashimi-grade tuna handling; and

- To conduct two artisanal FAD fishing workshops along with MMR's Fisheries Development Unit (FDU)—one in Rarotonga and one in Aitutaki.

2. Observations Before Fishing

2.1 SEAQUEST LTD (F/V *FARQUEST*)

During the first two weeks of February, prior to going out on the first of six longline fishing trips (eight sets total) on F/V *Farquest*, the Masterfisherman had a chance to examine the vessel and all of the fishing equipment and gear.

Initial observations of the F/V *Farquest* indicated it to be a fairly well maintained and seaworthy vessel. There was a full complement of in-date safety gear on board.

F/V *Farquest* appeared to be narrow in the beam for its length and shallow in depth. Although the hull design was a chine hull, it was a multiple chine which gave the vessel a semi-rounded, or molded shape in cross-section. The vessel had outrigger booms for trolling that were equipped with 'flopper-stoppers' (vanes or stabilisers), to keep the vessel from rolling. The dimensions and shape of the hull, along with the presence of 'flopper-stoppers', led the Masterfisherman to believe that the vessel was not sea-kindly. This was found to be true on the first trip. The crew did not feel comfortable taking the vessel out in any seas that were moderate to rough—conditions that would not normally stop longline operations.

The fish hold appeared to be very small for the length of the boat (Figure 7). Below decks in the wheelhouse, it was observed that there was a large crew's quarters just forward of the fish hold below the main deck (four bunks and a large open space). Most of the space taken up by the crew's quarters on F/V *Farquest* would normally be fish hold on a longline vessel. Although the fish hold was listed as being seven-tonnes capacity in the survey reports, it appeared that it would only hold about 2 mt of iced fish.

***Figure 7: Small fish hold of F/V* Farquest**

The forward bulkhead of the fish hold had a mass of loose wires, piping, and hydraulic hoses and fittings hanging from it (Figure 8). Apparently all of this used to supply the RSW system (coils had been removed from hold). On deck just forward of the fish-hold hatch there were several blanked-off pipes and hydraulic hoses (Figure 9). These, too, were for the RSW system.

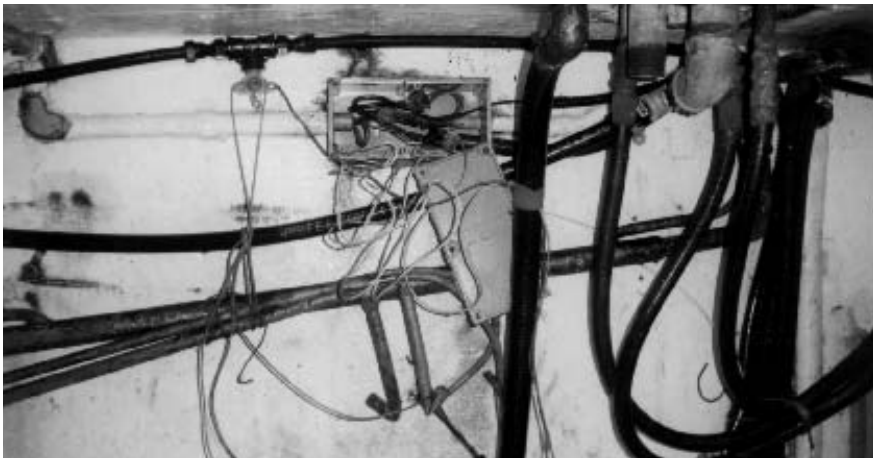


Figure 8: Loose wires, piping and fittings hanging from forward bulkhead of fish hold

Figure 9: Blanked-off pipes and hydraulic hoses forward of fish-hold hatch

The fish hold had three compartments: one on either side and a large space in the centre (slaughter bin). There were only two aluminium bin boards (pound boards) running fore-and-aft to separate the three compartments. Thus, each bin would only be about 50 cm deep when full and so could accommodate only one layer of large fish or two layers of medium or small fish (if both bin boards were used). There was also no pump to remove melt water from the fish hold. The sump in the fish hold had to be hand bailed with a bucket (this was observed on the first day the Masterfisherman looked at the boat—the crew were cleaning up after a fishing trip).

The original plug (insulated hatch cover that fits under the water-tight hatch) for the fish hold was apparently missing as a make-shift plug made from two pieces was in current use, namely: a scrap piece of styrofoam over a scrap piece of foam sandwich insulation, which was ill-fitting in the hatch (Figure 10).

Figure 10: Ill-fitting make-shift plug for fish hold

The aluminium (alloy) hydraulic reel appeared to be in good condition but it was not full with line. It appeared to be about 75 per cent full with 3.0 mm monofilament mainline (Figure 11). When all of the line was set, it was observed that the core of the reel was damaged and was starting to collapse (Figure 12).

Figure 11: Mainline reel about 75 per cent full of 3.0 mm monofilament

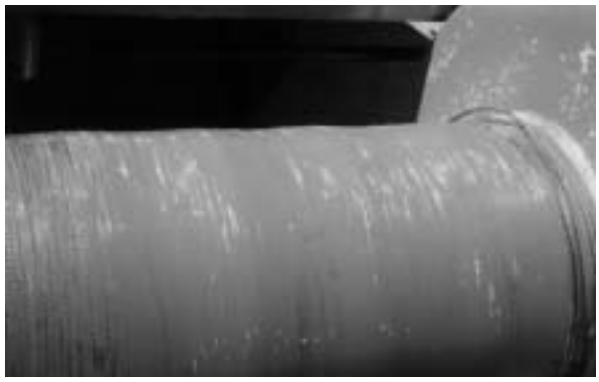


Figure 12: Damaged core of mainline reel

The reel was controlled from the starboard rail (outside steering station) with a 'Brand' hydraulic valve that was routed through an electric solenoid by-pass valve (Figure 13). Apparently the 'Brand' valve would be left on and the reel would be controlled by switching the solenoid valve off or on. There was also an engine control on a pedestal at the outside steering station with a bracket for a remote autopilot control (Figure 14).

Figure 13: 'Brand' hydraulic valve with electric solenoid by-pass valve

Figure 14: Engine control mounted on pedestal at outside steering station

The line-setter appeared to be out of service. The rubber parts on it were in poor condition (Figure 15) and there were no spares.

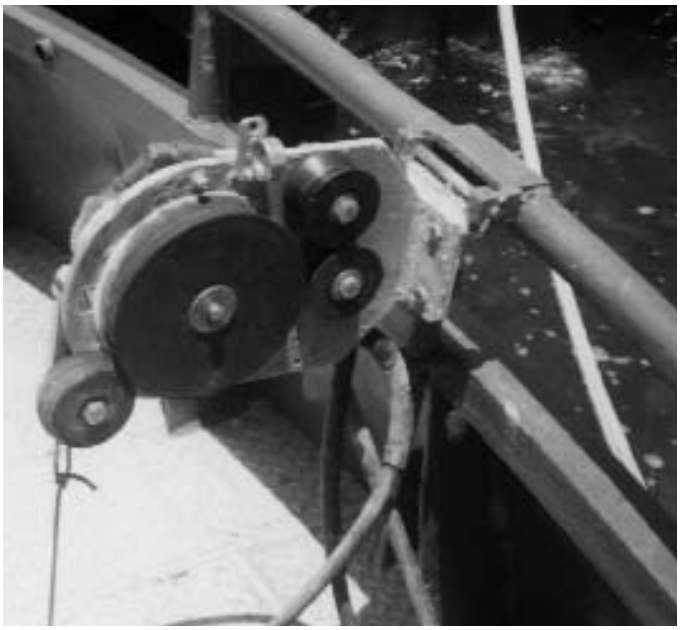


Figure 15: Line-setter with rubber parts in poor condition

There were two branchline bins (Figure 16), each with approximately 350 x 8–10 m branchlines made from 1.8 mm monofilament. They were of the simplest type with a snap at one end and a 16/0 circle hook at the other end with no leaded swivel or trace wire (Figure 17). Some of the snaps were New Zealand-made shark clips with 3.6 mm jaws (not suitable for use with 3.0 mm monofilament mainline), some were Canadian-made snaps, and some were Taiwanese-made snaps (both types suitable for 3.0 mm monofilament mainline). Some branchlines were in good condition and some were in poor condition (Figure 16).

Figure 16: Branchline bin with branchlines—some in poor condition

Figure 17: Simple branchline with snap and hook attached to monofilament

There were about 45–50 floats of various sizes and materials stored in a large plastic bin on deck (Figure 18). Some of the floats were white styrofoam and had soaked up water (Figure 19). All of the floats had attached floatlines made from polypropylene rope (floating rope) of various diameters. None of the floats had reflective tape. Most of the floatlines were 10–14 m long. There were two radio buoys in good condition but only one had a net around the float collar (Figure 18).

Figure 18: Floats of various sizes stored in plastic bin

Figure 19: Styrofoam float with polypropylene floatline attached

2.2 COOK ISLANDS SEAFOODS LTD

Cook Islands Seafoods Ltd's physical plant was situated across from Avatiu Harbour, and left a lot to be desired in terms of plant layout and design. The ice machine, for instance, was deep within the building, so delivering ice to a vessel was a very labour-intensive exercise. Furthermore, Seaquest Ltd, Cook Islands Sealords Ltd, and Cook Islands Seafoods Ltd were receiving little from the Cook Island Government in terms of concessions and incentives, despite being the only export-oriented commercial longline fishing operation in the country. With only one vessel supplying product, Lucky Matapuku, Adrienne Matapuku, and the staff at Cook Islands Seafoods were able to survive, through hard work and persistence, and even had plans for future growth and expansion.

Observations made of the Cook Islands Seafoods Ltd plant (Figure 20) suggested that the lay-out of the physical plant caused a 'bottleneck'—there was no back or side (service) entrance for deliveries of fish or supplies or for product going out. There were four entrances to the plant centred around a common porte cochère: an office door on the left; a trap door with plastic strip barrier for fish going in and out in the centre; a door to a storage area just to the right of the trap door—which led to another door (internal) to the processing room with freezer, chiller, and ice room; and two doors on the right going into the retail shop (one for staff, the other for customers). All of these doors were close to each other. Since deliveries of fish and removals of fish, bait, and ice were through the trap door in the centre of the *porte cochère*, service vehicles needed to park in this area. This effectively blocked all other doors except for the customer entrance to the retail shop. One serious problem with having only one entrance/exit for fish was the likelihood of cross-contamination[2]. Another problem created by having only one door for fish going and coming was that there was no proper product flow[2] in the plant.

Figure 20: Cook Islands Seafoods Ltd retail shop with processing plant behind and to the left

Wash-down water from the processing room ran into an open drain going through the *porte cochère* that emptied into a grating right in front of the entrance to the retail shop. During times of fish deliveries, or when fish were being processed, clouds of flies were attracted to the drain and to the trap door leading into the processing room. There was little being done, other than the use of a strip barrier, for exclusion of pests[2].

[2] Prevention of cross-contamination, proper product flow, exclusion of pests, and provision of hand-washing basins are all part of Good Manufacturing Processes (GMP).

No toilet or hand-washing basin[2] was observed. If the plant had a hand-washing basin, it was not readily apparent, nor was there a sign indicating its location.

The flat-bed truck used to deliver fish from the vessel to the plant was not covered, although a plastic tarp was laid down on the bed to protect fish, and no ice was used on the truck bed.

The ice machine was mounted above the chill room (Figure 21), inside the building. Since it was an air-cooled unit, it was not working at full capacity (3 t/day) as the condenser could not remove heat from the refrigerant under these circumstances. (A make-shift duct was fabricated so that outside ambient-temperature air could be circulated past the radiator. The ice machine worked better under these circumstances but still not at full capacity). Also, it was very inconvenient to load ice onto a vessel as ice had to be bagged deep within the plant and then carried out to a truck through a maze of doors, and then trucked to the wharf.

Figure 21: Ice machine mounted inside building over chill room

The freezer was never observed to be operating at full capacity (–20ºC). Temperatures ranged from 0º C to –15º C. The freezer contained old, partially decomposed squid and jack mackerel bait that had been thawed and re-frozen (Figure 22), and frozen gilled-and-gutted tunas and billfish, in the same room (the freezer reportedly had broken down for several days in 1996). Having rotten bait along with product in the same freezer was another possible source of cross-contamination[2].

Figure 22: Boxes of rotten bait stored in freezer

The processing room and equipment were generally clean and in good order but were far from being eligible to have a HACCP Plan (Hazard Analysis and Critical Control Point)[3]. There was no evidence that Good Manufacturing Processes (GMP) or Sanitation Standard Operating Procedures (SSOP) were in place[4]. (Cook Islands Seafoods Ltd had exported fish to USA markets in the past).

[3] Food processors exporting to USA will have to meet the new Mandatory HACCP Regulation coming into effect on 18 December 1997.
[4] GMP and SSOP are both pre-requisites for a HACCP plan.

Often fish loins or partially processed fish were left on the processing table uncovered and not iced while staff took coffee or smoke breaks (Figure 23).

The retail shop was well laid out and everything was generally clean and sanitary. However, fish chunks, fillets, and steaks were iced but were not bagged in plastic or wrapped in cello wrap (Figure 24).

Figure 23: Processed fish lying on table un-iced while staff have a break

As no fish were being exported, no observations were made concerning export processing and handling procedures.

Figure 24: Fish cuts presented in retail shop on ice, but not covered.

3. Fishing Operations and Observations

3.1 Gear made up for fishing operation

The Masterfisherman's schedule called for one month of fishing on F/V *Farquest* and one month of fishing on F/V *Peka-Anne*. Prior to the commencement of fishing, the Masterfisherman, along with the FDU, made up some new gear for both vessels (from 28 January to 7 February). The new gear included twenty-five 30 cm plastic floats with snaps and reflective tape; two 36 cm plastic floats with strobe lights; thirty 30 m Kuralon floatlines (sinking rope—Figure 25); two hundred 2.0 mm monofilament 12 m branchlines with 3.6 Japan tuna hooks with ring (Figure 26); and two hundred 3.0 mm tarred red polyester 10 m branchlines with 0.5 m of stainless steel trace wire, 60 gram leaded swivel, and 3.6 Japan tuna hook with ring (Figure 27).
Aside from the new fishing gear, the project brought into Rarotonga three tonnes of sanma bait

Figure 25: Making up floatlines for new floats

Figure 26: Making up new monofilament branchlines

Figure 27: Making up new branchlines from 3.0 mm tarred red polyester line, with leaded swivel and wire trace

(*Cololabis sairi*, or saury) that came from Japan via New Zealand in 10 kg boxes of 120 pieces per box. Appendix E lists all of the gear and bait ordered for the project.

3.2 FISHING ON BOARD F/V *FARQUEST* AND OBSERVATIONS MADE

From 11 February until 14 March the Masterfisherman accompanied the crew of F/V *Farquest* on six fishing 'trips', with eight sets made during this time. The crew of F/V *Farquest* were hard-working and conscientious. They often had to work against difficult odds for little reward, but did so in a fairly professional manner with few complaints.

Before the arrival of the Masterfisherman, the crew had been setting baskets of just 15 hooks each using the short floatlines made from floating rope. F/V *Farquest* had a line setter but it was not functioning and was in need of spare parts (none available on Rarotonga). The line was being 'towed' during setting with an interval of eight seconds between branchlines. Boat speed was varied, depending on who was in the wheelhouse. That, and the short floatlines made from floating rope, tended to keep the mainline and the baited branchlines near the surface and away from the targeted tuna species.

With the new gear and new bait, the fishing strategy was changed after the first trip so that each basket had 20 hooks (the line was still towed, however, as the line setter was not working). Half of each set used the old floatlines and half used the new, longer Kuralon floatlines.

On the first set on 11 February there were three crew on F/V *Farquest* (not including the Masterfisherman), but no one was identified as the captain of the vessel. One man was sort of in charge of the wheelhouse, including taking the vessel in and out of the harbour, navigation, radio schedules etc., and one man was sort of in charge of the deck and fishing operations. The third man was obviously the 'deckhand'. As a result of not having one person in charge, trip planning on 11 February was very poor. F/V *Farquest* had only enough ice for one set but bait for five sets, and the fresh-water tank was not topped off. As a consequence, only one set could be made before the vessel had to return to port, and water had to be strictly rationed while the vessel was at sea. As there was no captain, nobody was accountable.

Insufficient quantities of ice were taken on all trips. Usually about thirty to forty 50 kg bags were loaded (about 1.5–2 mt). This was only enough ice for about 750 kg of fish so F/V *Farquest* usually ran out of ice after one or two sets and had to return to port. Instructions were given to the crew by the Masterfisherman in proper on-board handling and icing of fish. However, the small amount of ice taken on each trip made it difficult even for a trained fisherman to ice the fish properly.

Ice melted very quickly in the fish hold. Insulation, including the make-shift plug, was not adequate. Melt-water from the ice in the fish hold had to be bailed by hand from the sump with a bucket. If this was not done regularly, the water left in the fish hold would slosh around and cause even more ice to melt. The sump was very small and filled quickly. (Reportedly, the 12 VDC pump that had been in place in the sump had burned out when it had been allowed to run dry.)

The bait that F/V *Farquest* had been using prior to the project was squid and jack mackerel. (Sometime in 1996 the freezer at Cook Islands Seafoods Ltd broke down and before it was repaired all of the bait supply thawed. It was subsequently re-frozen but had partially decomposed in the meantime.) Cook Islands Seafoods Ltd had several tonnes of this partially rotten bait on hand and was continuing to use it for longline fishing on F/V *Farquest*. Old squid bait was used on the set of 3 March. Only one fish (including discards) was caught on this set of 350 hooks.

The supply of bait for each trip that was stored in the fish hold was not covered with ice (sanma was used on all but one set during the project). The bait was stacked in the centre compartment (slaughter bin).

The crew had a variety of methods of handling fish—billfish were usually all headed and gutted but tunas were sometimes gilled and gutted, sometimes headed and gutted, sometimes finned, sometimes not finned; and often they were not spiked or bled properly (however, they were destined for local sales only).

The crew used poor techniques in icing fish—often fish were not completely covered with ice (sometimes there was not enough ice to adequately cover the fish). On the set of 6 March a 75 kg bigeye tuna was caught but it could not be iced properly as all of the ice had been used to cover previously caught fish. A large marlin was removed from the ice so that the bigeye could be buried but there was not adequate ice to completely cover it. By the time the vessel returned to port and off-loaded, the bigeye tuna was in poor condition.

After unloading the catch, the fish hold was only occasionally cleaned and sanitised. Often dirty ice (used ice contaminated with blood and fish slime) was left in the fish hold and re-used on the following trip after unloading. This was done partly for economy and partly because the ice machine at the pack-house was not producing enough ice.

The crew did not seem to have a clear fishing strategy—when and where exactly to set were mostly controlled by knowledge of past trips of F/V *Farquest* or other vessels. They also did not have a clear understanding of why it was advantageous to set with the wind so that hauling would be against the wind, or why it was better to set perpendicular to the current (the line would fish more area of ocean if it moved sideways). The set of 4 March, for instance, was done going up-wind and parallel to the current.

F/V *Farquest* did not range far from Rarotonga. All sets were done well within a 30 nm radius of Rarotonga. A fishing spot regularly targetted was the seamount that lies approximately 10 nm to the west of Rarotonga at 21° 10' S and 160° W.

Some of the crew were receptive to suggestions, particularly concerning fishing strategies, while others were not. Whether or not the Masterfisherman's recommendations were followed depended on who was in the wheelhouse at the time.

The use of the available vessel electronics was variable. The sea-surface temperature (SST) monitor was not turned on during steaming to and from fishing grounds. The single-side-band (SSB) radio was either not turned on or was not working while the vessel was underway. The colour echosounder was not turned on during steaming to and from fishing grounds. Also, the plotter function of the GPS plotter was not used during setting and hauling the line, or for general navigation.

The combination of longer floatlines, bigger baskets (20 hooks), and new sanma bait resulted in relatively good catches compared to the catches achieved before the Masterfisherman's participation.

Cleaning out the branchline bins was not normally done. They were found to be encrusted with dried blood and slime from bait. Typically on longline vessels, branchline bins are given a rinse after every set, when they are empty, and are scrubbed thoroughly at the end of each trip. F/V *Farquest's* crew reported that they had not cleaned the bins in three months. The Masterfisherman then scrubbed all dried bait and bait blood from both bins.

During the haul on the second set (19 February) the hydraulic system began leaking. The leak was found to be coming from one of the steel tubes that supplied the solenoid by-pass valve going to the 'Brand' valve for controlling the reel. There were no spares on board to repair the leak. There were no parts to make a 'make-shift' repair. F/V *Farquest* had to return to port, leaving about 75 per cent of the line and fishing gear in the water. In port, parts were borrowed from F/V *Peka-Anne* and the hydraulic system was fixed.

Actually, the solenoid by-pass valve was removed and the 'Brand' valve was shifted up to where the solenoid valve had been (Figure 28). The result was a much smoother and safer operation during hauling. None of the crew were familiar enough with hydraulics to do the necessary repairs, even though it was a relatively simple task. After repairs were completed the vessel returned to the line and hauling was resumed (20 February).

Figure 28: Modified mounting of hydraulic valve to operate mainline reel

The crewman who ran the reel (the hauler) generally kept his left hand on the mainline and used it for sliding snaps, while his right hand was used for operating the controls and for removing branchlines from the mainline (Figure 29). This created a dangerous situation when a knot or tangle came up. Also, the open block was turned so that the open side faced forward during hauling. This also created a dangerous situation as snaps could not pass through the block. After the solenoid by-pass valve was removed and the 'Brand' valve shifted higher on the rail, the hauler used his right hand for removing snaps and his left hand for controlling the reel (Figure 30). Hauling was much smoother and safer done in this way.

Figure 29: Incorrect method of removing snaps from the mainline during hauling

On the way in to fix the hydraulics (19 February) the generator died and could not be restarted. As a result, the batteries were not being charged, so the autopilot was not working. The 12 volt direct current (12 VDC) and 24 VDC systems were constantly breaking down, rendering most of the electronic appliances useless.

On the set of 22 February it was learned after returning to port that a local cargo/passenger vessel, M/V *Avatapu* (Cook Islands) was burning and that all hands and passengers (25 people) had abandoned ship and were drifting in liferafts about 200 nm north of the position of F/V *Farquest's* set. Since the SSB radio on F/V *Farquest* was not working, the distress call was not heard, even though F/V *Farquest* had been in range to offer assistance.

Figure 30: Correct method of removing snaps from mainline during hauling

The crew of F/V *Farquest*, even though requested otherwise by the Masterfisherman, discarded plastic into the sea. Cardboard bait cartons with plastic liners were thrown overboard during each set (Figure 31).

Figure 31: Bait boxes with plastic liners being discarded at sea

Tulagi Group Ltd had supplied Seaquest Ltd with a fairly comprehensive routine maintenance check list for F/V *Farquest*. The crew, however, failed to duly check most of the items on the list. For example, when the Masterfisherman inquired as to how often the shaft gland was checked, the reply was, 'Once a month'. On the list provided by Tulagi Group Ltd it was recommended that the shaft gland be checked every ten hours while the vessel was underway. The gland was checked by the Masterfisherman and found to be leaking. The bilge compartment under the shaft gland was flooded and needed to be pumped. It was also observed that the crewman assigned to look after the engine room had only a rudimentary understanding of marine diesel engines, pumps, hydraulics, and marine electrical systems.

After the Masterfisherman left F/V *Farquest* to work with F/V *Peka-Anne*, it was learned that company policy was changed so that there were two alternate captains and crews on F/V *Farquest* on a week-on, week-off basis.

Finally, because of the vessel's age and the scarcity of parts and services available on Rarotonga, F/V *Farquest* was plagued by maintenance problems.

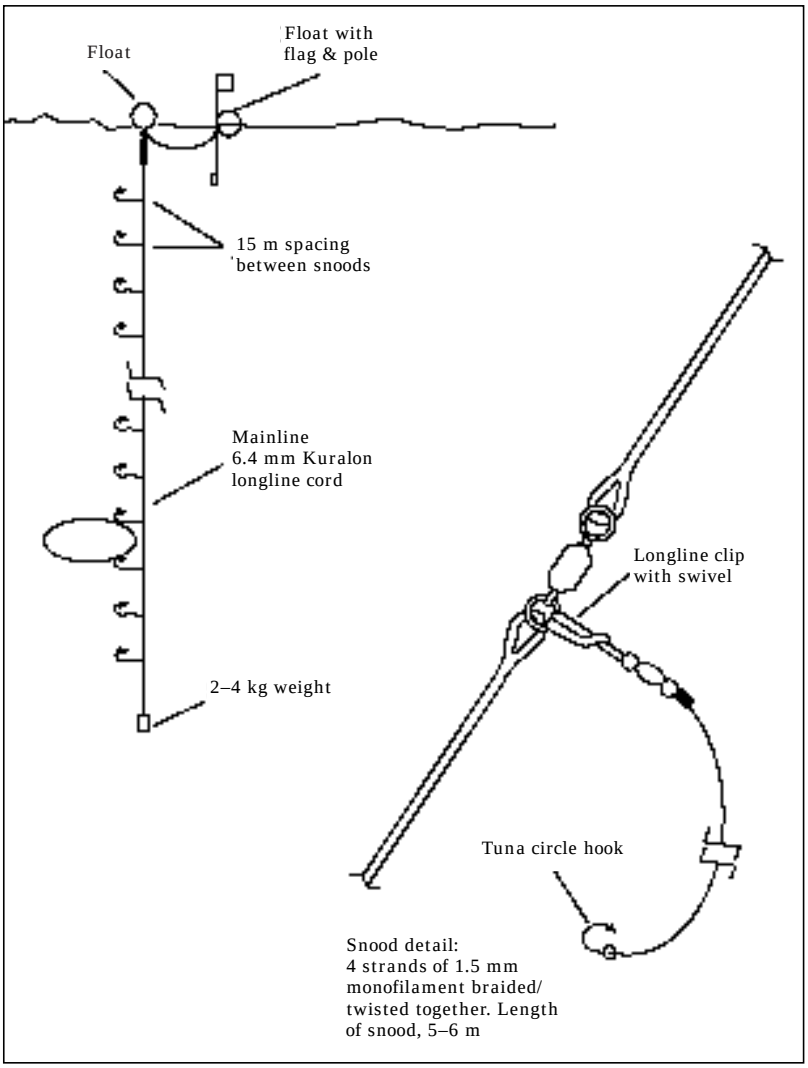
3.3 FISHING ON BOARD F/V *PEKA-ANNE* AND OBSERVATIONS MADE

From 17 March to 2 April the Masterfisherman accompanied the crew of F/V *Peka-Anne* on eight longline sets. On most of the sets there was a regular captain and one crew. However, the captain was relieved of duty on 1 April and B. Fisher appointed himself captain. Only one longline trip was made with B. Fisher as captain as the reel broke down on the set of 2 April and no more longline sets could be made.

In order to continue fishing for the balance of the Masterfisherman's time with F/V *Peka-Anne*, three vertical longlines were made up from tarred 6.4 mm Kuralon (Figure 32). Each vertical longline had 15 branchlines made from braided 1.5 mm monofilament. Two palu-ahi lines were also made up (Figure 33). Fishing continued, but closer to shore, around the FADs at Black Rock and Ngatangiia. Vertical-longline and palu-ahi fishing were not nearly as successful as horizontal-longline fishing on F/V *Peka-Anne*. Six fishing trips were made setting two or three vertical longlines each time. Palu-ahi fishing was done near the FADs while the vertical longlines soaked.

For a small vessel (8.8 m), F/V Peka-Anne was remarkably well equipped and seaworthy. The captain(s) and crew generally knew what they were doing and worked in a professional manner. Furthermore, they readily took to suggestions from the Masterfisherman and asked lots of questions about vessel operations, maintenance, fishing, and fish handling (particularly the owner, B. Fisher). F/V *Peka-Anne* had a full complement of in-date safety gear aboard.

Figure 32: Vertical longline made from tarred Kuralon



Although F/V *Peka-Anne* had extensive work done in 1996, some important periodic maintenance jobs had not been done, and some routine maintenance jobs were being neglected. The most important periodic maintenance job that was not attended to was re-packing the shaft gland. It was found to be leaking badly and there was no spare packing on board. It had not been repacked when the vessel was on the hard or later, after re-launching, probably because the owner was not experienced in the procedure and thought the boat had to be out of the water (the Masterfisherman re-packed the shaft gland and instructed the owner in how to do the job while the vessel was in the water).

Additionally, the marine gear had not been serviced, the engine and gear box had not been painted and were rusted, some hydraulic fittings were exposed (no paint, 'Denso Tape', or 'Soft Spray' for protection) and were badly rusted, and the rudder brackets holding the rudder to the hull were loose. Routine maintenance that was being neglected included: cleaning the outside of the engine and marine gear, checking water levels in batteries, and greasing all fittings—steering, longline reel, blocks, etc.

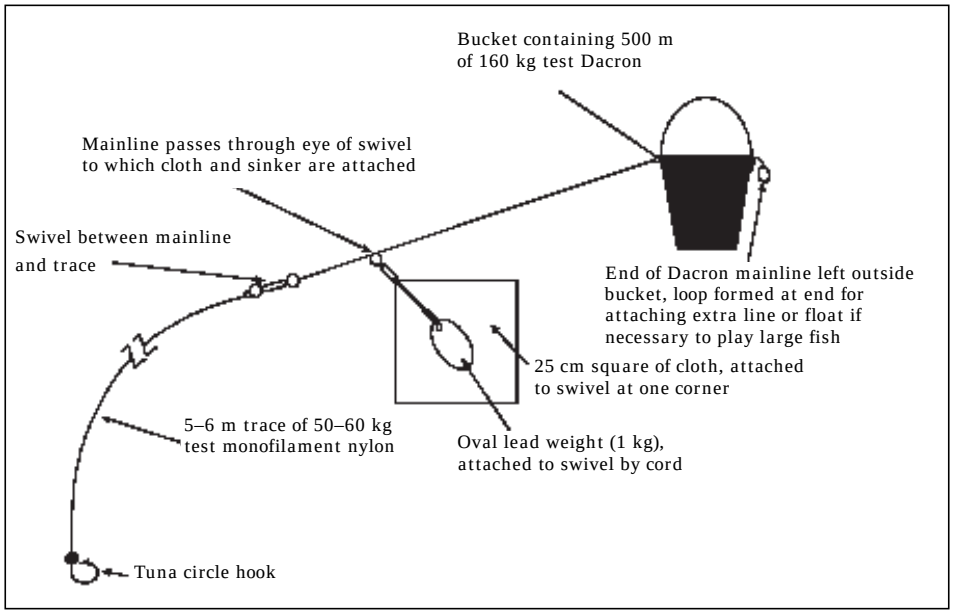


Figure 33: Palu-ahi line

The F/V *Peka-Anne* was very economical to run. Only one fuelling took place during the month that the Masterfisherman was on board (the fuel capacity was somewhere around 400 l). Regardless of this, F/V *Peka-Anne* was very limited in capabilities—both in range of operation and fishing effort. Even though F/V *Peka-Anne* was equipped with GPS, VHF radio, and all of the necessary safety appliances and devices (the SSB radio and the radar had been removed and put in storage), the crew did not venture out of sight of Rarotonga.

Prior to fishing trials with the Masterfisherman, F/V *Peka-Anne*'s crew was setting the longline in the evening and hauling in the morning. They were using project bait (sanma), new 30 m floatlines, and new tarred red 3.0 mm polyester branchlines, but were not doing well. After consulting with the Masterfisherman they switched to morning sets and evening hauls, and catch rates improved. Later, the crew cut all floatlines in half so they could be configured as 15 or 30 m floatlines by joining the cut sections.

The fish hold on F/V *Peka-Anne* was small (1.8 m3) and not very well insulated. Ice melted quickly and melt water had to be hand-bailed with a bucket. Only about 150 kg of ice was taken on each trip and the fish were all iced, not slurried.

The longline reel (winch, drum) was slow moving and under-powered. At the end of each haul, when the reel was nearly full with line, it bogged down and laboured to pull in the remainder of the line. B. Fisher had decided not to add more line (and branchlines) to F/V *Peka-Anne*, as the reel probably could not have handled the increased load (at a constant hauling speed, pulling force available decreases as a drum fills—Prado, 1990).

F/V *Peka-Anne* had no line-setter so the line was towed off the vessel during setting. Only 220 hooks were set on most sets. It was difficult, under these circumstances, to achieve a deep set.

The limited deck space on F/V *Peka-Anne* made it difficult to properly spike, bleed, and gill-and-gut or head-and-gut fish. The sea-water wash-down pump (used for cleaning fish) was not working. A bucket was used to clean and rinse all fish. (A new pump was ordered from Hawaii. It arrived and was installed by B. Fisher, but not in time for project fishing trials).

Generally, fish landed from F/V *Peka-Anne*, although saleable on the domestic market, did not meet export standards due to improper handling. It was the practice of the crew to spike and bleed, but not to gill and gut all tunas (this was to keep up the weight, and thus the price, of whole fish).

Fish that were not sold whole were filleted and cut into chunks at B. Fisher's home. This was done outdoors on a wooden picnic table under relatively unsanitary conditions. Fish chunks were stored in three chest freezers on a patio near where they were cut. Bait was also stored in these freezers. B. Fisher was in the process of constructing a small fish-processing facility in a new building on the same lot as his home—so conditions and product quality are likely to improve in the future.

4. SPC/MMR Fisheries Workshops

4.1 GENERAL

As part of the overall project in the Cook Islands, two workshops had been scheduled, one in Rarotonga and the other at Aitutaki. The aim was to promote mid-water fishing techniques to target the deeper-swimming, larger tunas associated with the fish aggregating devices (FADs) deployed at both islands.

The Fisheries Development Adviser (FDA), Lindsay Chapman, travelled to Rarotonga to assist the Masterfisherman and the FDU prepare for, and present, the first workshop. The following week, the Masterfisherman and two staff of MMR's FDU conducted the second workshop in Aitutaki.

During the week prior to the first workshop, it was identified that some gear would need to be ordered so that several types of vertical longlines and palu-ahi lines could be made. This gear was ordered from Ocean Producers International (OPI) in Hawaii, and is included in the list of gear purchased for the project (Appendix E). Also, the FDA undertook two fishing trips during this week on board MMR's outboard-powered Yamaha skiff. These trips allowed the MMR staff and FDA to arrange gear and test the FADs for the availability of fish.

A public meeting was held with local fishermen in Rarotonga the week before the workshop, to give them an outline of the workshop and to assess the numbers likely to attend. At the meeting it was stressed that attendees could select the sessions they wanted to attend. The meeting was very well attended and over 20 fishermen signed up for the workshop at that time.

4.2 RAROTONGA WORKSHOP

The Rarotonga workshop ran for five days from 14–18 April 1997. Over 30 participants attended at least one session, with around 24 participants attending the majority of sessions. A copy of the timetable for this workshop is at Appendix F.

The Secretary for MMR, Mr. Raymond Newnham, opened the workshop and welcomed the resource personnel and the participants. The first session focussed on FADs and fishing methods associated with FADs. As Cook Island fishermen are quite adept in trolling techniques, these were only mentioned. The main discussion was on the vertical-longlining and palu-ahi fishing methods, designed to target the larger tunas in the water column.

The second session was a hands-on practical session where several styles of vertical longlines, monofilament on a handreel and hand-hauled rope (Figure 34), palu-ahi lines (Figure 35), and different types of snoods, single strand monofilament and twisted or braided monofilament (using an electric drill to twist several strands of monofilament together—Figure 36) were made up. The participants were very keen to learn and participate in gear construction. The Masterfisherman, FDA and staff of the FDU assisted groups of fishermen in making different gear.

Figure 34: Workshop participants splicing 6.4 mm tarred Kuralon to make a vertical longline

Figure 35: Workshop participants making up palu-ahi lines

Figure 36: Making a twisted or braided snood using several strands of monofilament and an electric drill

After lunch, Keith Bigelow from the SPC's Oceanic Fisheries Programme gave a presentation on the resource in Cook Islands' waters, based on all available data. For the final session for the day, Josh Mitchell from MMR presented a discussion on MMR policy so that the participants could provide their ideas to MMR on policy direction. Before concluding for the day, a schedule was drawn up for fishing trials using the gear that was made. Following the conclusion of the day's activities, some fishermen stayed to ask questions and assist in the final preparation of gear needed for fishing trials.

Day two was a fishing day when three vessels (MMR's skiff, the Avatiu Fishing Club's skiff and one workshop participant's vessel) were used to take about half of the participants out to the two FADs to use the gear that had been made the previous day. Two vessels used monofilament vertical longlines mounted on handreels (Figure 37) whilst the third vessel used the hand-hauled rope style (see Figure 32). All vessels used palu-ahi lines as well (see Figure 33).

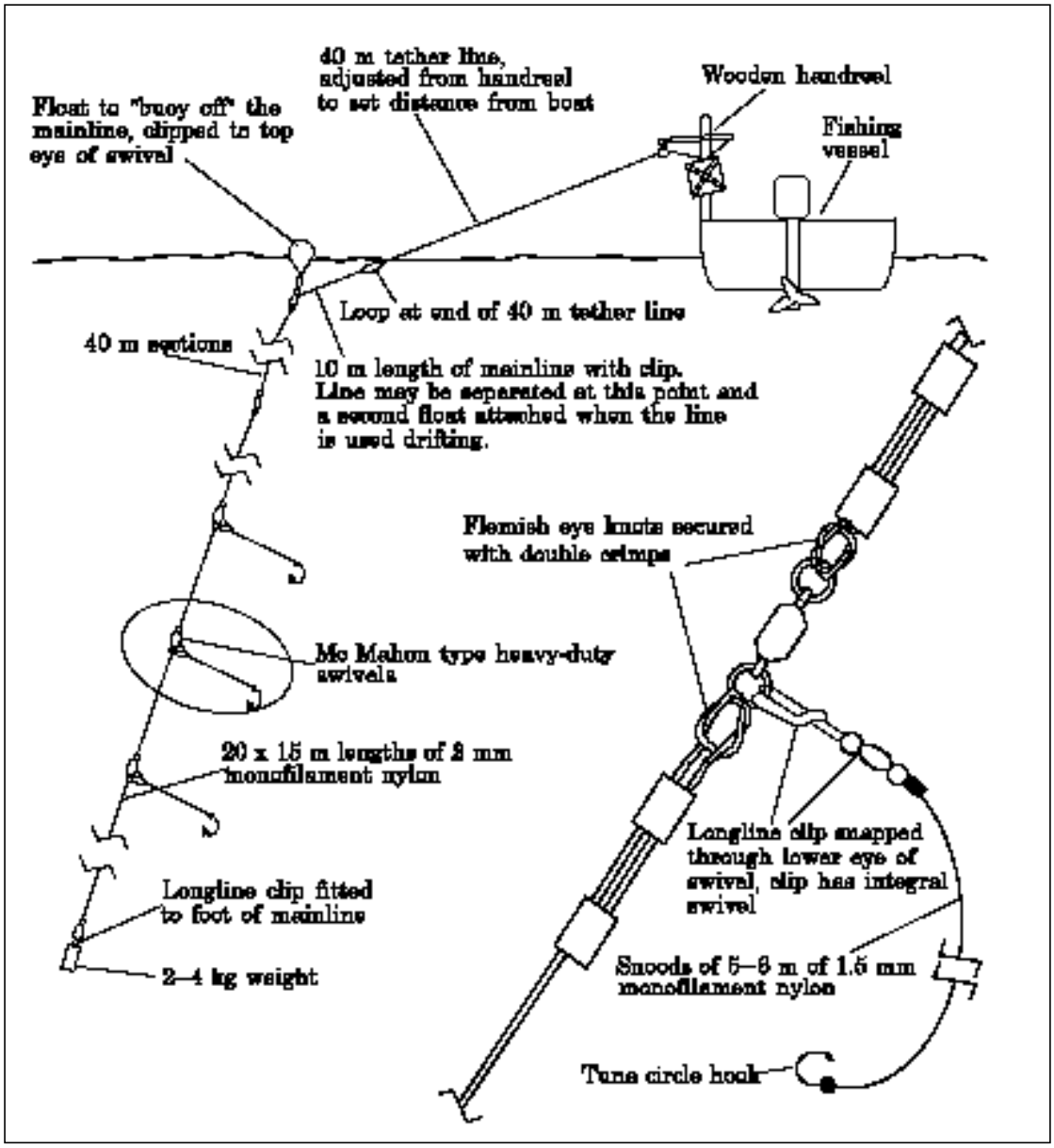


Figure 37: Construction of a monofilament vertical longline mounted on a handreel

During the fishing trials, all participants were given the opportunity to use the different gear. All fish caught were retained whole and placed on ice on board each vessel. When the vessels returned to port (Figure 38), everyone assisted in unloading and stowing the gear at the Fisheries Department and in icing the fish in an old insulated chest freezer.

Figure 38: MMR skiff returning to port with trainees after the first day of fishing trials

Day three of the workshop commenced with a review of the previous day's fishing activities. This was followed by discussions on the correct handling and processing procedures for export-quality tunas. After morning tea, the Masterfisherman gave a practical demonstration of stunning, spiking, bleeding and cleaning (gill-and-gut) tuna for export. The fish that had been caught the previous day were used for this. Participants were then invited to practise these procedures on the remainder of the fish available (Figure 39). Finally, the Masterfisherman demonstrated how to grade a tuna and then butchered this fish into sashimi blocks and sashimi slices for the participants to try.

Figure 39: Participants learning to gill and gut tuna properly for export

After lunch, the Harbour-master, Don Silk, gave a presentation on safety at sea. This was an excellent presentation as he drew on the actual experiences in the Cook Islands and how most of the problems encountered by fishermen could have been overcome if they had had the correct safety equipment and a radio. The final session for the day was to make up additional gear for the vessels for fishing trials the next day. The Masterfisherman, FDA and staff of the FDU were also available to answer questions and assist some fishermen with their own gear they brought in.

Day four of the workshop was a fishing day, with the remainder of the workshop participants fishing on board the same fishing vessels. Conditions were fine, although there was a strong current that made palu-ahi fishing difficult. Participants were given the opportunity to use the different gear.

The final day of the workshop commenced with a review of the previous day's fishing. The Masterfisherman then presented a session on marketing and the economics of operating a small fishing business. The final sessions in the morning were on the new Value Added Tax and how it would affect fishermen and their businesses and investment; and on how to obtain finance from CIDB. The morning sessions were very well attended (Figure 40) and many questions were asked by the participants.

After lunch, there was a concluding session conducted by MMR staff. The Secretary for Fisheries, Mr Raymond Newnham, closed the workshop. MMR hosted a barbeque for the participants, resource personnel and helpers, during which several speeches were made, and certificates presented to participants.

Figure 40: Participants on the final day attending the workshop

4.3 AITUTAKI WORKSHOP

The Aitutaki workshop was held over four days (21–24 April 1997). The format of the workshop was similar to the Rarotonga workshop, with two days in the classroom and two days of practical fishing. Over 20 interested fishermen participated in the workshop.

The necessary fishing gear to construct several types of vertical longlines was freighted from Rarotonga to Aitutaki. Participants constructed the different styles of vertical longlines and palu-ahi lines on the first day of the workshop. The theories on how to use these gear types were also presented.

On the second day of the workshop the participants fished around the FADs on three local vessels, using the gear that had been constructed the previous day. All participants were given the opportunity to use the different types of gear. The catch was retained whole on ice for the following day's practical session.

The third day of the workshop focussed on the correct on-board handling and icing of the catch. The fish from the previous day's catch were used so that the Masterfisherman could give a practical demonstration. In the afternoon, the main topic was safety at sea and the necessity to carry appropriate safety equipment including a VHF radio for communication. During the remaining time in the afternoon, additional fishing gear was made up. The fourth day was spent fishing.

5. Fishing Effort and Catch

During the course of tuna longlining operations, it was difficult to define a 'trip' as the vessels often returned to port after setting but before hauling. Therefore, each set will be considered to be a trip—but will be referred to as a 'set'.

5.1 TUNA LONGLINING ACTIVITIES

A total of eight longline sets (Appendix G) were made from F/V *Farquest* during the four-week period from 11 February to 7 March. More sets were planned but bad weather (nearby cyclones) precluded any fishing activity during the week of 10–16 March. All of the sets were made within 30 nm of 21° S and 160° W (a seamount, approximately 10 nm west of Rarotonga, was targetted regularly). A total of 7,460 hooks (Appendix G) were set using mostly sanma bait (old squid bait was used on the set of 3 March). The average set was 932 hooks, usually set in 20-hook baskets (the set of 11 February used all 15-hook baskets). Floatlines were a mix of 14–16 m and 30 m lines.

During the three-week period of 17 March to 2 April on board F/V *Peka-Anne*, a total of eight longline sets were made (Appendix G). All of the sets were done within 20 nm of 21° S and 160° W. More longline sets were scheduled, however, the level winder (pawl mechanism) on the longline reel broke on the set of 2 April, which left the reel inoperable. A total of 1,740 hooks were set in 12-hook baskets; the average set was 218 hooks. The set of 17 March used 15 m floatlines but the balance of the sets used 30 m floatlines. Sanma bait was used on all the sets. On the set of 19 March, 200 chemical light sticks (green) were used and were attached to the branchlines approximately two metres from the bait. This was the only night set, all the others were morning sets.

Table 1 summarises the catch and effort for tuna longlining activities conducted during this project. On F/V *Farquest* a total of 90 saleable fish were caught weighing 2,757 kg, with 37 discards (unsaleable species and sharks—there is no shark-fin market on Rarotonga). The catch of saleable fish on F/V *Peka-Anne* was 25 fish for a weight of 685 kg, with 18 discards including sharks.

Table 1: Total catch retained and number of hooks set during the project longlining activities for all species, yellowfin tuna and bigeye tuna

Vessel	No. of hooks set	All saleable species		Yellowfin tuna		Bigeye tuna	
		No. of fish	Weight (kg)	No.	Weight (kg)	No.	Weight (kg)
F/V *Farquest*	7,460	90	2,757	20	637	1	75
F/V *Peka-Anne*	1,740	25	685	10	317	0	0
Total	**9,200**	**115**	**3,442**	**30**	**954**	**1**	**75**

Table 2 summarises the catch per unit of effort (CPUE) for the main species. The overall CPUE recorded was 37.4 kg/100 hooks (1.25 fish/100 hooks). This compared favourably to the catch rates recorded in 1996 by the project in Pohnpei (Beverly & Chapman, 1997), where the CPUE was 36.1 kg/100 hooks (1.31 fish/100 hooks). However, it should be noted that this CPUE is low compared to other fisheries in the region. For instance, an extrapolated CPUE can be made from Anon (1994) for the Hawaii fishery, which would give an overall CPUE of 56 kg/100 hooks.

Table 2: CPUE, percentage of catch and average weight for all species, yellowfin tuna and bigeye tuna

Vessel	CPUE (kg/100 hooks)			Yellowfin tuna		Bigeye tuna	
	Total catch	Yellowfin tuna	Bigeye tuna	Per cent by wt.	Ave. wt. (kg)	Per cent by wt.	Ave. wt. (kg)
F/V *Farquest*	37.0	8.5	1.0	23.1	31.9	2.7	75.0
F/V *Peka-Anne*	39.0	18.2	0.0	46.3	31.7	0.0	0.0
Combined	**37.4**	**10.4**	**0.8**	**27.7**	**31.8**	**2.2**	**75.0**

Only one bigeye tuna of 75 kg was caught during the project, and this represented 2.7 per cent of F/V *Farquest's* catch by weight. Yellowfin tuna was more prolific, with this species making up 23.1 per cent of F/V *Farquest's* and 46.3 per cent of F/V *Peka-Anne's* catch by weight. The average weight of yellowfin tuna caught by the two vessels only varied by 0.2 kg, as shown in Table 2.

The fishing operations for both vessels rendered all fish (except discards) target species, as all of the fish caught were readily saleable on the domestic market.

5.2 OTHER PROJECT FISHING ACTIVITIES

As stated in the previous section, the level winder (pawl mechanism) on F/V *Peka-Anne's* long-line reel broke on the set of 2 April, which left the reel inoperable. As a result, the Masterfisherman made up several vertical longlines to use around the two FADs, one at Ngatangiia and the other at Black Rock, from this vessel. In addition, the MMR's 7 m Yamaha skiff was used by the Fisheries Development Adviser prior to the workshop to check out the rig-ging of the vessel.

A total of seven trips were made using vertical-longline and palu-ahi gear during the period 5–12 April. Five of these trips were made on F/V *Peka-Anne* and two on MMR's skiff. Table 3 summarises the catch and effort for these fishing methods whilst trip records can be found at Appendix H. Overall the catches were quite low, except for one trip when over half of the ver-tical-longline and palu-ahi catch (11 fish weighing 184 kg) was taken in around 20 per cent (5.25 and 4.25 hours respectively) of the fishing time for each of these methods.

Table 3: Summary of catch by fishing method for other project fishing activities (VLL = vertical longline in 10 hooks/hour, PA/DS = palu ahi and drop stone in single hooks/hour and trolling is in line-hours)

Method	Effort by Method	All saleable species		Yellow tuna		Albacore tuna	
		No. of fish	Weight (kg)	No.	Weight (kg)	No.	Weight (kg)
VLL	94.01	9	160.5	7	120.5	2	40.0
PA/DS	50.25	9	168.5	9	168.5	0	0
Trolling	2.00	0	0	0	0	0	0

Table 4 summarises the CPUEs for the different fishing methods. The catch rate achieved for vertical longlining (1.71 kg/10 hooks/hour) was low when compared to the catch rates achieved by the SPC around Rarotonga in 1985/86 (Chapman & Cusack, 1997) at 6.6 kg/10 hooks/hour. However, the catch rate was higher than that recorded by the SPC around Rarotonga in 1983 (Mead, 1997) at 0.8 kg/10 hooks/hour. Catch rates for the palu-ahi and drop-stone methods were consistent with the catch rate recorded off Rarotonga in 1985/86 (Chapman & Cusack, 1997) at 3.4 kg/hook-hour.

Table 4: Summary of CPUE by method for other project fishing activities (VLL = ver-tical longline in 10 hooks/hour, and PA/DS = palu ahi and drop stone in single hooks/hour)

Method	CPUE			Yellowfin tuna		Albacore tuna	
	Total catch	Yellowfin tuna	Albacore tuna	Per cent by wt.	Ave. wt. (kg)	Per cent by wt.	Ave. wt. (kg)
VLL	1.71	1.28	0.43	75.1	17.2	24.9	20.0
PA/DS	3.35	3.35	0	100.0	18.7	0	0

5.3 WORKSHOP FISHING ACTIVITIES

During the two workshops, four days were spent at sea demonstrating mid-water fishing techniques to the participants. During these fishing demonstrations at Rarotonga, strong currents were encountered that hindered the effectiveness of the mid-water fishing methods, especially the palu-ahi and drop-stone techniques. Table 5 summarises the catch and effort whilst Table 6 summarises the CPUE for fishing activities during the Rarotonga workshop. Catch records for the Rarotonga workshop can be found at Appendix I .

Table 5: Summary of catch by fishing method for Rarotonga workshop fishing activities (VLL = vertical longline in 10 hooks/hour, PA/DS = palu ahi and drop stone in single hooks/hour and trolling is in line-hours)

Method	Effort by Method	All saleable species		Yellow tuna		Albacore tuna	
		No. of fish	Weight (kg)	No.	Weight (kg)	No.	Weight (kg)
VLL	64.34	5	106.0	1	27.0	4	79.0
PA/DS	67.00	3	36.0	2	16.0	1	20.0
Trolling	1.00	0	0	0	0	0	0

Both the overall catch and CPUE recorded during the Rarotonga workshop were less than in the fishing trials conducted as part of the project, just prior to the workshop. This was mainly attributed to the strong currents experienced at the time and the visible absence of tuna on the surface compared to observations made during project fishing activities.

Table 6: Summary of CPUE by method for Rarotonga workshop fishing activities (VLL = vertical longline in 10 hooks/hour, and PA/DS = palu ahi and drop stone in single hooks/hour)

Method	CPUE			Yellowfin tuna		Albacore tuna	
	Total catch	Yellowfin tuna	Albacore tuna	Per cent by wt.	Ave. wt. (kg)	Per cent by wt.	Ave. wt. (kg)
VLL	1.65	0.42	1.23	25.5	27.0	74.5	19.8
PA/DS	0.54	0.24	0.30	44.4	8.0	55.6	20.0

The catch taken during the Aitutaki workshop fishing trials was greater than that in Rarotonga. One 18 kg yellowfin tuna was caught trolling, six yellowfin tuna taken on vertical longlines (113 kg) and two yellowfin tuna weighing 38 kg taken with palu-ahi and drop-stone gear. Detailed records of the fishing effort by method were not kept, so a comparison of catch rates can not be made.

6. Discussion and Conclusions

6.1 GENERAL

The Cook Islands have only a limited potential for developing a domestic export fresh-chilled tuna longline fishery. The EEZ, although large, is not as productive as EEZs to the west or east. The most productive area in the EEZ is in the Northern Cook Islands while the main population centre and most of the infrastructure is in the Southern Cook Islands. This fact poses a dilemma for operators as they must have fishing vessels that are capable of travelling three or four days to and from the good fishing grounds. A fishing trip could last as long as three weeks. Suitable vessels are needed that have sufficient range and fish-holding capacity, while being affordable to operate. Beverly (1996) provides guidance on longline-vessel parameters for Pacific Island countries and territories.

Fuel, as well as most other commodities on Rarotonga, is expensive. There are no marine slipways, very limited wharf and harbour space, and very limited and expensive air cargo service to overseas markets. Furthermore, there is a shortage of technical expertise on Rarotonga (captains, engineers, electronic technicians, refrigeration engineers, hydraulic engineers, etc.); and MMR staff have no experience or expertise in longline fishing or fish exporting. Parts and services for marine applications are generally not available. Probably most constraining, however, is the limited finance available to Cook Island entrepreneurs. Cook Islands Development Bank (CIDB) offers only relatively small, short-term, high-interest loans that do not meet the needs of domestic longline operators. Longline operators are also burdened with relatively high import duties on vessels, fishing gear, and bait.

In spite of all the constraints and difficulties, a domestic tuna longline fishery did start up on Rarotonga in 1994. Unfortunately, it got off to a bad start by bringing some unsuitable vessels into the fishery. F/V *Kona Wind*, for instance, at 181 GRT, was too big and too expensive to operate viably. This vessel and others have all failed and left the Cook Islands. F/V *Farquest*, which was brought in in 1996, was too old and too limited in capabilities to ever be a viable commercial longline vessel. F/V *Farquest* could not get to the good fishing grounds, and even if it was somehow able to steam north to Penrhyn, could not hold enough ice or fish to make the trip profitable. Nothing could change the fact that F/V *Farquest* has failed. The financial structure of Seaquest Ltd (CIDB loan) was based on export earnings. The domestic market on Rarotonga alone could not support a longline vessel. The fact that F/V *Farquest* was still fishing and selling fish locally, does not mean that the operation had survived. Eventually CIDB would tire of receiving interest only on the loan and would be forced to foreclose, in which case they might be reluctant to finance any new longline ventures.

The domestic export operation on Rarotonga had also failed as there were no vessels left in the Cook Islands to support it. Even if it had continued exporting into 1997, exports to USA markets would have been jeopardised by the fact that the physical plant would not have been able to meet requirements for a Hazard Analysis and Critical Control Point (HACCP) plan (a requirement in the USA as of December 1997 for all seafood companies exporting product to the USA).

F/V *Peka-Anne* was too small to be considered a commercial longline vessel. F/V *Peka-Anne* remained what it was designed to be, a small-scale artisanal near-coastal fishing vessel. Nothing could change that. Unlike F/V *Farquest*, however, F/V *Peka-Anne* had a very good chance of surviving and thriving by supplying fish to the domestic market and doubling as a charter fishing vessel for tourists. The big difference between the two vessels was that F/V *Peka-Anne* was more affordable to operate and was allowed to fish within the six-mile limit.

Does all this mean that domestic longline fishing for export-grade sashimi tunas and broadbill swordfish is doomed forever in the Cook Islands? Not necessarily. Historical records indicate as much as 6,000 t of fish were caught annually in the vicinity of Cook Islands' EEZ, which means that there are fish there. The fact that longline fleets are operating successfully out of neighbouring Pacific Island countries, indicates that it can be done. Hawaii, to the north, is almost a geographical mirror image of the Cook Islands. Honolulu lies at 21° N and 158° W while Rarotonga lies at 21° S and 159° W. In 1993, 95 of Hawaii's longline vessels landed about 8,400 mt of fish worth about US $48 m (calculated from data in Hamilton et al., 1996). The Cook Islands' EEZ, like Hawaii's EEZ, may harbour a rich broadbill swordfish resource.

As an aside, there is a well developed albacore troll fishery to the south of the Cook Islands' EEZ in the sub-tropical convergence zone (STCZ). During the 1991–92 season about 4,000 mt of albacore tuna was caught by 71 vessels, mostly from the US (Labelle, 1993). The Cook Islands are geographically closer to this fishery than any other country. Any new entrant vessels into commercial fishing in the Cook Islands could be encouraged to fish tunas in the winter months, broadbill swordfish in the spring, and albacore in the troll fishery from December to April. The respective seasons for each fishery are opposite to those in Hawaii and the northern

hemisphere, so markets in America may be strong during the northern 'off season' for each species. Pago Pago in American Samoa, where the two American canneries buy fish from the southern albacore fleet, is relatively close to Rarotonga. Cook Island-based albacore troll vessels would have a logistic advantage over American and Canadian vessels. Joint ventures could be formed so that these vessels could longline fish for tuna and broadbill swordfish in the Cook Islands' EEZ. Appendix J lists the contacts for albacore troll fishery vessel owners.

Fiji and Hawaii are both earning export currency from their tuna and swordfish resources. French Polynesia has a well developed domestic tuna longline fishery. Hundreds of people are employed in these fisheries, and local economies are benefiting in a number of ways. Central and Western Pacific fisheries so far have not been over-exploited or fished out, and tuna stocks remain healthy in the Pacific. All of this indicates that it may be possible for the Cook Islands to have a viable commercial export tuna and broadbill swordfish fishery, albeit not on the scale of Hawaii, French Polynesia, or Fiji.

A management approach that eliminates the obvious mistakes of the recent past and borrows on the successes of operations in other Pacific Island countries may be able to turn the situation around, if investors and lending institutions can be convinced that tuna longlining in the Cook Islands is viable.

6.2 SEAQUEST LTD AND F/V *FARQUEST*

Seaquest Ltd's vessel, F/V *Farquest*, while generally in good order, seaworthy and sound, and generally reasonable at catching longline fish, was not suitable as a commercial sashimi tuna or broadbill swordfish export fishing vessel. The limited fish-holding capacity alone rendered the vessel too small to be viable. F/V *Farquest's* fish hold was capable of holding only about 2 mt of iced fish. Longline vessels in the Pacific, where EEZs are enormous and trips may last up to three weeks, need to have fish-holding capacities of 10–15 mt. For example, the average longline vessel in the Hawaii-based fleet in 1993 landed 18,021 pounds, or 8.2 mt per trip (Hamilton et al., 1996). Presumably their holds were capable of holding even more as they would not always come back to port full. The insulating properties of F/V *Farquest's* fish hold were very poor and ice melted quickly. A trip of more than six or seven days would not be possible on F/V *Farquest* as all of the ice would be melted by the seventh day.

Furthermore, the fuel capacity (9000 l) limited the F/V *Farquest's* operating range. The best fishing grounds in the Cook Islands' EEZ are in the north, about a 3.5–4 day steam from Rarotonga. Assuming that a longline vessel would fish for about ten sets, a trip to the north from Rarotonga would take about 18 days dock to dock. This is not an unusual or lengthy trip for a typical longline vessel in the Pacific. Longline vessels in the Hawaii-based fleet had average trip lengths of 22.2 days in 1993. The Hawaii boats travelled for 9.6 days per trip and fished for 10.6 days per trip (Hamilton et al., 1996). Assuming that F/V *Farquest* would burn close to 1000 l per 24-hour day of continuous service, a trip of only about nine or ten days duration was possible. (A turbo-charged diesel engine burns about 155–180 grams of fuel/horsepower/hour (Prado, 1990). F/V *Farquest* has two engines (main and auxiliary) with an estimated combined horsepower of about 250 (Masterfisherman's estimate). In 24 hours of continuous operation F/V *Farquest* would burn 167.5 g x 250HP x 24hrs = 1,005,000 g or 1,005 l). In other words, the Northern Cook Islands were out of range of F/V *Farquest*. The albacore tuna troll fishery to the south of the Cook Islands' EEZ was also out of range for this vessel.

F/V *Farquest* was only capable of fishing in close proximity to Rarotonga and all of the fish caught were sold on the domestic market—none were being exported. This situation was contrary to the main impetus of developing domestic longline operations in Pacific Island countries. One aim of developing a domestic longline fleet is to take the pressure off inshore and nearshore fisheries. Fishing within a limited range, F/V *Farquest* was not really relieving the fishing pressure from the nearshore tuna fishery around Rarotonga.

The biggest contradiction to fisheries development policy was that none of the fish were being exported. The principal reason that Pacific Island countries are seeking to develop domestic tuna longline fisheries is so that they can export product and earn foreign currency. F/V *Farquest* was, however, contributing to the local economy, albeit in a small way. Locally sold fish and fish fillets were, to some extent, import substitutions for frozen fish fillets, tinned fish, tinned beef, and chicken. F/V *Farquest* was also helping the economy with job creation. About eight to ten people were employed, either on the vessel or on shore, on either a full-time or part-time basis. However, looking at the overall situation, F/V *Farquest* was probably a net drain on the Cook Islands' economy when fuel, bait, and fishing gear had to be imported to support the vessel.

The owners of F/V *Farquest* had unrealistic expectations of the vessel's capabilities, and placed far too much economic burden on the vessel. One vessel catching fish for the domestic market was supporting management, crew, fish processors, fish retailers, a pack-house/retail shop, an ice machine, support vehicles, an office with phone and fax, and interest and loan payments. Furthermore, because of F/V *Farquest's* limitations (fish-holding capacity, range limits, and crew capabilities) and the limited fishing effort during the project that resulted, no conclusions (based on F/V *Farquest's* performance) could be made on the potential of the fishery in the Cook Islands.

If F/V *Farquest* and Cook Islands Seafoods Ltd are to become commercially viable and contribute to the economy, they will have to begin exporting to foreign markets again. More vessels are needed for this to be possible. Care should be taken that any new entrant vessels into the fishery are suitable for longline fishing in Pacific Island countries (Beverly, 1996). In the longer term, the only future for F/V *Farquest*, as an export fishery vessel, is that it become part of an export operation involving more vessels. Eventually, however, F/V *Farquest* should probably be phased out of the longline fishery in the Cook Islands.

Notwithstanding the above comments, F/V *Farquest* was basically sound and seaworthy—just not suitable for export longline fishing in the Cook Islands' EEZ. However, if F/V *Farquest* is going to continue to fish, there are several things that could be done to improve the vessel and to improve fishing performance. For instance, the vessel was originally equipped with a 240 volt alternating current (240 VAC) generator that had been removed and replaced by 12 volt direct current (12 VDC) and 24 VDC alternators. Both of these systems ran off the same auxiliary engine. The system was inadequate for operating the machinery on board. The autopilot, for example, was powered by a 12 VDC motor that depended on the alternators for power. During hauling operations, the autopilot motor was constantly running and changing directions as the course was adjusted. While hauling the gear, all machinery, including the main engine, hydraulic system, and autopilot, were under more strain than during normal steaming conditions. As a consequence, the batteries on F/V *Farquest* were constantly going flat. The alternators could not keep up with the demand. When the batteries were flat, the outside steering station could not be used (during hauling) and one man had to steer from the wheelhouse.

Another problem with F/V *Farquest* was the fact that there was no captain or qualified engineer. The authority and responsibilities of command were shared by at least two crew. Engineering while at sea was done on a trial-and-error basis. The result was that mistakes were often made but no one was accountable. Both periodic and routine maintenance tasks were often neglected (L. Matapuku, in addition to his other duties ashore, was often pressed into being engineer while the vessel was in port).

There were pieces of gear that needed servicing or replacing as discussed in previous sections; and some that just needed to be switched on and used. These are covered in the recommendations under Section 7.2. One such item was the need to install a new 'Brand' valve with new hydraulic hoses for controlling the reel (see Appendix K for a list of all hydraulic spares needed for the reel). It should be installed on the rail in the current position of the old valve. The 'Brand' valve recommended is a manually (lever-) operated sliding spool, three-way valve (forward, neutral, reverse—open centre) with a detent for neutral position only. Therefore, it can be left in the operating positions, either forward or reverse, at variable

speeds without manual pressure on the control lever, and neutral can easily be found. Rotary valves or spring-operated valves are not recommended for longline reels. Rotary (closed-centre) valves are more suited to applications with small flow rates at low pressures (Czekaj, 1989), and spring-operated valves require that the operator's hand remains on the control lever.

6.3 Cook Islands Seafoods Ltd

Cook Islands Seafoods Ltd had many problems: an absentee 50 per cent partner, only one vessel supplying fish, no export earnings coming in, poor design and layout of the plant—no GMP (Good Manufacturing Processes) or SSOP (Sanitation Standard Operating Procedures) in place, no HACCP plan in place, evidence of cross-contamination, no exclusion of pests, no proper product flow, limited ice-making capabilities, etc. The one thing that the company had going for it was a dedicated and hard-working management team, and a few good employees, all working under very difficult circumstances.

It would be easy to say that Cook Islands Seafoods Ltd should shut down as they can not possibly operate at a profit with just one vessel supplying fish, and they will not be able to meet standards for a HACCP plan by 18 December 1997. However, the Matapuku team have learned a lot since they started, at great expense, and, rather than waste this experience gained, together with their energy and talents, what is probably needed is a fresh start. To improve the existing facility and operation would require a major effort, so major in fact, that it would be like starting over. If more vessels come into the fishery, a new facility will be needed.

6.4 Fisher's Fishing Tours and F/V *Peka-Anne*

When B. Fisher bought the vessel from MMR, having refurbished and renamed it, he envisioned using it as a commercial longline and bottom-fishing vessel only. Towards the end of the month's fishing on F/V *Peka-Anne*, when the longline reel was broken and fishing was switched to vertical-longline and palu-ahi fishing, B. Fisher decided to take tourists out on F/V *Peka-Anne*. He conferred with the Masterfisherman first, to ensure that there would be no conflict with project parameters. As it turned out, paying tourists accompanied B. Fisher and the Masterfisherman on two vertical-longline/palu-ahi trips. The tourists were very pleased with the afternoon's fishing and seemed to have had a good time. A non-paying guest also went along on one trip (as a tourist). All fish caught were sold by B. Fisher so he got paid two ways during that week.

F/V *Peka-Anne* was small by industry standards and probably could not make it as a commercial longline vessel—its range and fishing capabilities were very limited and fishing around Rarotonga was not spectacular. The bottom fish resource around Rarotonga was very limited and probably would not support a viable fishery (Taumaia & Preston, 1985; Mead, 1997). However, given Fisher's Fishing Tours experience in what could be called artisanal fishing tours, and their newly gained experience in surface-longline, vertical-longline, and palu-ahi fishing, F/V *Peka-Anne* could be successful if commercial fishing and fishing tours were combined. If the vessel is to be used for commercial fishing there are several things that could be done, at sea and ashore, to improve fishing effort and quality of the catch.

When the fishing season and the market are good, F/V *Peka-Anne* could longline for tunas and broadbill swordfish. When the weather is right and there are lots of bookings, F/V *Peka-Anne* could take tourists along. When longline fishing is less productive, F/V *Peka-Anne* could take tourists to vertical-longline and palu-ahi fish at the FADs or to bottom fish on the deep slopes. (Most charter fishing operations concentrate on big-game trolling for marlin and other surface fish. Charter fishing using other techniques may prove not only to be unique, but to be very popular.) Whether or not the visitors would enjoy surface longline or deep-bottom fishing remains to be tested.

To assist the charter side of fishing operations, some small changes could be made to F/V *Peka-Anne* to accommodate tourists. If a vertical-longline trip is made, all surface-longline gear

(floaters) should be removed from the forepeak so that the bunks could be used. Small benches or seats should be fabricated so that tourists can sit down (one in the wheelhouse and one on the deck). They could be fold-away or removable seats. A portable cooler (chilly bin, esky) should be taken on all trips for cold drinks and food. A rack or bracket should be built so the cooler does not shift when the vessel rolls.

The line currently on the reel was 4.0 mm and could accommodate only about 250 hooks maximum—about 5 nm of line and 50 hooks per mile. More of this line could have been added but the reel might not have been able to haul more line with an increased drum diameter. Equal weights of 3.0 mm monofilament would have a much greater length than 4.0 mm line. As many as 400 branchlines might be able to be accommodated with 3.0 mm mainline—up to 8 nm of line. Since 3.0 mm line offers less resistance during hauling than does 4.0 mm line, the hydraulic system might be able to operate with a full drum. Therefore, even more mainline and more than 400 branchlines might possibly be used.)

All fish should be slurried rather than iced. The fish hold should be filled completely with ice before leaving on a longline trip. Just before hauling is started, sea water should be mixed with the ice, and ice chunks broken up, making an ice-sea-water slurry. Properly bled, gilled-and-gutted, and cleaned fish could then be lowered into this slurry. (Excess water displaced by the fish will overflow the hatch and drain off the deck. Not only will the fish be in better condition using this method, as they are handled less, but more fish will be able to be stored in the fish hold. Fish can stay in a slurry for several days.) Slurried tunas should probably be put in a mutton-cloth or plastic bag (Blanc, 1996). Before using the slurry method, care must be taken to ensure that the fish hold does not leak into the bilges—it must be made water-tight.

This vessel had a radar, and this should be re-installed and kept in working order and switched on as a regular routine. Most electronic devices have a longer life if they are turned on and used periodically. Radar can be invaluable for navigation during times of poor visibility. Radar can also be used to obtain fixes for locating the two ends of the longline set. All of the sets made during the project were within radar range of Rarotonga. All navigation and fishing operations could have been carried out using radar only and not GPS. In this case, radar is a good backup in the event the GPS unit fails. Radar transmissions also allow other vessels to be aware of another vessel's presence when their radars pick up radar interference. A passing ship may not see F/V *Peka-Anne* but will keep a sharper lookout if radar interference is noticed on the radar screen.

Similarly, the SSB radio that was taken off the vessel should be re-installed and monitored as a regular routine. The SSB radio is a good back-up, should the VHF radio fail. Also, it should be kept on during steaming to monitor emergency frequencies (2182, 4125, or 6215 Mhz).

All machinery (engine and marine gear) and hydraulic fittings in the engine room should be de-rusted and painted. The engine and marine gear should be painted with high-temperature marine-engine enamel; all hydraulic-hose ends and fittings should be painted regularly with cold-galvanise spray paint. Also, the rudder should be repaired so that it has no play, and, additionally, an emergency tiller arm should be fabricated so that the vessel can be steered in the event the hydraulic steering fails. This can easily be done with an 'arm' that extends over the stern rail and attaches to the top of the rudder. This could be made from galvanized pipe.

6.5 FAD FISHING TECHNIQUES AND TRAINING

The use of FADs in the southern Cook Islands is essential as a means of assisting artisanal fishermen locate tuna schools, especially around Rarotonga. MMR has an ongoing FAD Programme, with limited funding which means that limited numbers of FADs can be deployed and maintained. Given the importance of FADs to local fishermen, it is essential that the current funding for FADs be maintained, or increased.

Cook Island fishermen are well versed in trolling techniques. However, other mid-water techniques targetting the deeper-swimming tunas are used less. As a means of encouraging the use of vertical-longline and palu-ahi fishing methods, two workshops were held—one in Rarotonga and one in Aitutaki. The MMR's Fisheries Development Unit (FDU) staff assisted in the running of these workshops and will continue to conduct similar workshops in other locations around the Southern Cook Islands.

To run future workshops the FDU will require funding for the purchase of appropriate gear to use during workshop presentations. Funds will also be required for the FDU staff to travel to different locations in the Southern Cook Islands to conduct workshops.

During the course of the workshop it became apparent that ice was not used on a regular basis by artisanal fishermen. Also the tunas in many cases were not being cleaned, but rather sold whole and unchilled. To increase the shelf life and quality of tunas, fishermen need to chill them straight after capture and keep them chilled. Cleaning is not so critical if the catch is being chilled properly from capture to selling.

7. Recommendations

Given the objectives and focus of this project, there are many recommendations—both general and more specific—covering different areas in the fishing operation. The recommendations presented here follow the same headings as Section 6 for ease of reference, and are based on the observations and experience of the Masterfisherman.

7.1 General

It is recommended that:

(a) MMR formulate a feasible domestic tuna and broadbill swordfish longline fisheries development plan that includes inputs and technical assistance from regional organisations (particularly SPC and FFA), and includes coordination with CIDB, CIMB, and other relevant government Ministries. MMR should also study and examine closely the well developed longline fisheries in Hawaii, Fiji, and French Polynesia, and use some aspects of their development histories as models.

(b) A specific staff position be created at MMR for a Fisheries Officer to deal solely with longline fisheries development and policy formulation. Someone from the industry outside the Cook Islands, with hands-on experience, should be recruited for this position. The position could be funded by money from the *Treaty on Fisheries with USA* (Multilateral Treaty).

(c) MMR, CIDB, and CIMB identify suitable parameters for longline fishing vessels, for fishing strategies, and for processing and export operations. These parameters should then be used as guidelines for providing information to prospective entrepreneurs, and for granting licences and giving financial assistance.

(d) The Ministry of Health conduct a thorough inspection of Cook Islands Seafoods Ltd's plant and operation and work with Cook Islands Seafoods Ltd to come up with a plan to improve conditions with a view to eventually formulating a HACCP plan for either the present facility, or any new facility.

(e) Health certificates, export licenses, and business plans be approved only for fish processing and packing operations that attempt to meet HACCP requirements.

(f) MMR not increase licence fees, especially for locally owned vessels, and that licence fees be billed quarterly, not annually.

(g) Locally owned vessels over ten metres not be allowed to fish within the 12-mile limit—locally owned vessels should only be allowed to fish where locally based foreign vessels are allowed to fish.

(h) CIDB seek new funding sources so that more money can be made available (up to $500,000.00) on friendlier terms (lower interest rates and longer loan life) for domestic longline ventures.

(i) The Cook Island Government either reduce duties on fishing vessels, fishing gear, bait, and fuel, or grant five-year 'tax holidays' to new ventures.

(j) The Cook Island Government promote schemes to entice overseas entrepreneurs to invest in longline fishing as locally based foreign vessels or as joint-venture partners. Reduced duty, tax holidays, and guaranteed repatriation of some of the profits should be offered to locally based foreign vessels and joint-venture operations.

(k) Foreign operators be required to train local counterparts, not just as deckhands and longline fishermen, but as engineers, captains, and operators of fishing vessels as small businesses.

(l) New entrants into the fishery be encouraged to explore fisheries other than sashimi tuna, i.e., the broadbill swordfish fishery and the albacore troll fishery.

(m) MMR and local entrepreneurs make contacts with foreign-vessel owners and operators in the southern albacore troll fishery with the aim of enticing some of them to stay on in Rarotonga after the albacore season is finished, possibly through joint-venture arrangements (see Appendix J).

7.2 SEAQUEST LTD AND F/V *FARQUEST*

It is recommended that:

(a) Seaquest Ltd continue to use F/V *Farquest* to fish in Rarotongan waters and continue to supply fish to Cook Islands Seafoods Ltd for the domestic market, but only in the short term.

(b) Cook Islands Sealords Ltd and/or Cook Islands Seafoods Ltd bring more suitable longline vessels into the fishery in the Cook Islands' EEZ, by purchase, charter, or joint-venture.

(c) If (b) above is not feasible, the Cook Island Government should seek out distant-water fishing companies that could be licensed to fish in the Cook Islands' EEZ in a bilateral arrangement where fish are exported by a locally owned company, and local crews are trained on the vessels.

(d) The 240 VDC generator be re-installed and the alternators that supply 12 VDC and 24 VDC power as the main power source be eliminated. Also, 240 VAC pumps could be installed for bilges, fish hold, and hydraulic back-up.

(e) All hydraulic fittings and sea-water plumbing that formerly supplied the RSW system in the fish hold be removed.

(f) A new plug for the fish hold be fabricated from plywood, foam, and fibreglass.

(g) More bin boards (pound boards) be installed in the fish hold.

(h) A pump be installed in the fish-hold sump. If the crew cannot be relied upon to switch the pump off when it is dry, a float switch should be installed.

(i) The line-setter be repaired and a supply of spares kept on board at all times (especially the drive wheels) and the line-setter be used, especially if the target species are tunas.

(j) A new 'Brand' valve and new hydraulic hoses be installed for controlling the reel. It should be installed on the rail in the current position of the old valve.

(k) The vessel be supplied with a good stock of spares for the engine room and for deck machinery.

(l) The SSB radio be repaired and the captain/crew instructed to monitor the proper frequency at all times when underway (2182, 4125 or 6215 MHz).

(m) All floatlines be replaced with 30 m x 6.4 mm tarred Kuralon floatlines.

(n) All unsuitable branchline swivel snaps be replaced with proper snaps (for 3.0 mm line).

(o) Leaded swivels be used on all branchlines, and the branchlines be kept relatively short (10–12 m).

(p) A suitable captain be recruited with longline experience in the Pacific, who also has engineering capabilities. This person should have full command of the vessel, with all of the authority and responsibility usually accorded a captain. (Seaquest Ltd should eliminate their policy of having two captains or a shared captain position.)

(q) The maintenance checklist supplied by Tulagi Group Ltd be used. Copies of this list should be made, and the crew should check, date, and sign all periodic maintenance items.

(r) More ice should be taken on fishing trips. Ice should be increased from the usual two tonnes per trip to five or six tonnes.

(s) Bait stored in the centre hold of the fish hold (slaughter bin) should be iced. (Bait would be fresher if iced, especially bait that is not used and is saved for the next trip.)

(t) All ice and bait should be removed from the fish hold after unloading. No ice should be re-used as old ice is a source of contamination (blood and fish slime). The fish hold and bin boards should be cleaned and sanitised after each unloading.

(u) The branchline bins should be cleaned at least once, usually at the end of each trip. Odour from fish blood and slime left in the bins may transfer to branchlines. This odour may repel fish or attract unwanted fish (sharks).

(v) The plotter function of the GPS should be used both for general navigation and for fishing. Valuable information can be learned from monitoring the plotter, such as current set and drift and the presence of eddies. Catch information should be entered into the plot. Additionally, the location of reefs, channels, and navigational (and FAD) buoys should be included in the plot.

(w) The colour echo-sounder should be switched on and monitored both for general navigation and for the location of bait schools. The sounder should be on when entering or leaving port, or when approaching any reef or island. (The presence of bait schools—usually at depths of between 100–200 m—may indicate the presence of tuna schools.)

(x) The sea-surface temperature (SST) monitor should be switched on and monitored when steaming to and from fishing grounds, and when searching for fish. Temperatures should be recorded at intervals when steaming and during fishing. (There may be small temperature edges near the seamounts, current convergences, and current eddies around Rarotonga. SST edges may be an indication of the presence of bait schools and tunas.)

(y) The captain and crew of F/V *Farquest* should be instructed to follow all Marpol Convention pollution regulations, especially the prohibition on discarding plastic at sea.

7.3 COOK ISLANDS SEAFOODS LTD

It is recommended that:

(a) Cook Island Sealords Ltd divest itself of its interest in Cook Islands Seafoods Ltd and/or dissolve its partnership with Tulagi Group Ltd; and seek other partners to establish a more manageable and suitable plant for processing fish for local sales and for packing fish for export markets.

(b) Every effort be made to follow guidelines for GMP, SSOP, and HACCP so that USA markets can be accessed after 18 December 1997.

(c) Technical assistance be sought before plant design and equipment needs are decided.

(d) Value-added products, such as vacuum-packed loins, fish burgers, and smoked fish be considered as optional products for the plant.

(e) A suitable location be found, such as the wharf at Avatiu Harbour, possibly in the building occupied by Avatapu Ltd, or in MMR's building, for locating a new processing plant/pack-house.

(f) A larger flake-ice machine (10–15 mt per day) be installed in the new facility as close to dock-side as possible (best would be a back-up plan with two smaller machines). Ice could be supplied to a longline fleet and to small-scale artisanal fishermen. (It would be difficult to attract other vessels into the fishery with the existing 3 mt per day machine.)

(g) The retail market be expanded to assist small-scale artisanal fishermen with sales of their catch.

7.4 FISHER'S FISHING TOURS AND F/V *PEKA-ANNE*

It is recommended that:

(a) F/V *Peka-Anne* be used as both a small-scale commercial fishing vessel and a charter fishing vessel by mixing the operations to suit demand/weather.

(b) Modifications be made to F/V *Peka-Anne* to accommodate tourists within the fishing operations of the vessel.

(c) New 3.0 mm monofilament mainline be purchased and installed on the longline reel to allow more hooks to be set, thus increasing the potential catch of the vessel.

(d) The ice hold be made water-tight and a slurry of ice-sea-water be used in preference to just icing the catch.

(e) If an ice slurry is used, each individual fish should be cleaned properly and placed in mutton cloth or a plastic bag for protection from abrasion before being placed in the slurry.

(f) The radar be re-installed and kept in working order and switched on as a regular routine during all operations at sea.

(g) The SSB radio be re-installed on the vessel and monitored as a regular routine, especially the emergency frequencies (2182, 4125, or 6215 MHz).

(h) All machinery (engine and marine gear) and hydraulic fittings in the engine room be derusted and painted.

(i) The rudder be repaired so that it has no play, and additionally, an emergency tiller arm be fabricated so that the vessel can be steered in the event the hydraulic steering fails.

(j) Technical assistance be sought before the small fish-processing room at B. Fisher's place of residence is constructed, or before any equipment or supplies are purchased.

(k) Value-added fish products such as smoked fish and fish burgers be considered as optional products for Fisher's Fishing Tour's fish-processing operation.

7.5 FAD FISHING TECHNIQUES AND TRAINING

It is recommended that:

(a) The Fisheries Department continue the FAD Programme as a high priority, especially around Rarotonga.

(b) The FDU continue to encourage the use of mid-water fishing techniques with local fishermen.

(c) The FDU be provided with sufficient funding to purchase necessary materials for training and to allow workshops to be run.

(d) Materials necessary to make up mid-water fishing gears be made available to fishermen exempt of tax and duty.

(e) Fishermen be encouraged to use ice to chill their catch when fishing, to increase the shelf life and quality of their catch.

8. References

ANON. (1994). Amendment 7 to the Fisheries Management Plan for the Pelagic Fisheries of the Western Pacific Region. Western Pacific Regional Fishery Management Council, Hawaii.

BEVERLY, S. (1996). Notes on longline vessel parameters for Pacific Island countries. South Pacific Commission Fisheries Newsletter No. 79. 22–35.

BEVERLY, S. & L. CHAPMAN. (1997). Capture Section Report of tuna longline fishing assistance to the National Fisheries Corporation (Pohnpei Division) Federated States of Micronesia. South Pacific Commission, Noumea, New Caledonia. 34 p.

BLANC, M. (1996). On-board handling of sashimi-grade tuna. A practical guide for crew members. South Pacific Commission, Noumea, New Caledonia. 27 p.

CHAPMAN, L. & P. CUSACK. (1997). Report of fourth visit to the Cook Islands (Part I, 17 November 1985 – 29 July 1986, and Part II, 14 November – 23 December 1986). Capture Section, Unpublished Report No. 6. South Pacific Commission, Noumea, New Caledonia. 51 p.

CZEKAJ, D. (1989). Engineering applications: 3. Hydraulics for small fishing vessels. FAO Fisheries Technical Paper 296. 179 p.

DELCROIX, T., G. ELDIN, M.H. RADENAC, J. TOOLE & E. FIRING. (1992). Variation of the western equatorial Pacific Ocean, 1986–1988. Journal of Geophysical Research 97: 5423–5445.

DOUGLAS, N. & N. DOUGLAS. (1989). Pacific Islands Yearbook. Angus and Robertson. 35–57.

FOOD AND AGRICULTURAL ORGANISATION. (1987). Artisanal fishing craft of the Pacific Islands, based on the work of O. Gulbrandsen and M. Savins. FAO/UNDP Regional Support Programme, Suva, Fiji, Document 87/5 (RAS/87/002). 78 p.

HAMILTON, M., R. CURTIS & M. TRAVIS. (1996). Cost-Earnings Study of the Hawaii-Based Domestic Longline Fleet. University of Hawaii and Joint Institute for Marine and Atmospheric Research (JIMAR). JIMAR Contribution No. 96–300. 59 p.

LABELLE, M. (1993). A review of albacore tagging in the South Pacific. Tuna and Billfish Assessment Programme Technical Report No. 33. South Pacific Commission, Noumea, New Caledonia. 22 p.

LAWSON, T. (1996). South Pacific Commission Tuna Fishery Yearbook, 1995. South Pacific Commission, Noumea, New Caledonia. 92 p.

LAWSON, T. & A.D. LEWIS. (1996). Distant-water longline catch and effort in the vicinity of the Cook Islands. Oceanic Fisheries Programme, Internal Report No. 30. South Pacific Commission, Noumea, New Caledonia. 26 p.

LEVITUS, S. (1982). Climatological Atlas of the World Ocean. US Department of Commerce National Oceanic and Atmospheric Administration, NOAA Professional Paper No. 13. 173 p.

MEAD, P. (1997). Report on third visit to the Cook Islands (16 February – 20 July 1983). Capture Section, Unpublished Report No. 5. South Pacific Commission, Noumea, New Caledonia. 33 p.

MITCHELL, J. (1996). Country Report: Cook Islands. Ninth meeting of the Standing Committee on Tuna and Billfish (SCTB9), 22–23 July 1996. South Pacific Commission, Noumea, New Caledonia. 2 p.

PRADO, J. (1990). Fisherman's Workbook. FAO. 180 p.

REYNOLDS, R.W. & T.M. SMITH. (1994). Improved global sea surface temperature analyses using optimal interpolation. J. Climate 7: 929–948.

STANLEY, D. (1986). South Pacific Handbook (third edition). Moon Publications. 157–186.

TAUMAIA, P. & G. PRESTON. (1985). Deep Sea Fisheries Development Project, report of visit to Cook Islands (10 September 1981 to 29 March 1982). South Pacific Commission, Noumea, New Caledonia. 31 p.

Appendix A

Expanded MMR policy statement made in April 1997

Presently MMR has policies aimed at developing and improving the fisheries sector at all sub-sector levels:

- Locally owned fishing vessels—100% local ownership
- Joint-venture type operations—locally based foreign fishing vessels
- Distant-water fishing nations—e.g. US purse seiners

However, as this sector develops and expands, so will MMR policy. Currently, MMR has a policy of maintaining the status quo, as well as actively expanding all three levels to enhance further productivity.

1. The offshore fisheries sector will inevitably face more regulation as more information is accumulated with respect to the resource, and interest in the industry increases. (ie implementing Total Allowable Catch and quota system, or TAC). Currently also the licence fees are set at a nominal lower figure to encourage investment and commitment within the commercial industry, this may change however if or when the fleet increases within the CIEEZ.

2. MMR also intends to continue a 'hands-off' form of policy for the commercial sector, avoiding any direct intervention in areas such as marketing, purchasing, and reselling within the industry, but rather letting the sector drive itself as it grows.

3. MMR will however maintain strict monitoring, control and surveillance initiatives to prevent illegal harvest of fish within the waters of the Cook Islands. This will continue through regional initiatives, as well as coordinated aerial and surface patrols of the CIEEZ.

4. As part of its commitment to developing this sector, MMR will continue to provide access to regional training schemes and workshops for potential and current investors within the sector, to further develop and enhance industry skills and knowledge on all matters relating to the fishery.

5. MMR intends to pursue concerns raised from the industry with Government, as part of its policy of involving the sector in its policy development process. Some concerns raised in a recent workshop included the possibility of exemptions or subsidies within the areas of fuel costs, interest rates, import levies. These are viewed by the industry as major constraints to any future development within the industry. Operating costs as they are, are just too high for a viable fishery. This is to some extent shown by the loss of several fishing ventures from the Cook Islands, as they moved on to more economically viable fisheries in other countries.

6. MMR is aware that any policy in this regard should be part of an overall policy of Government to encourage investment and development within the Cook Islands over all sectors. Hence any policy relating to this area should be in line with Government policy as a whole.

Appendix B

Formation of Cook Islands Sealords Ltd and Cook Islands Seafoods Ltd

In November 1993, Cook Islands Sealords Ltd (Sealords) applied to the Cook Islands Monetary Board and to the MMR for permission to conduct trial longline fishing with the intention of eventually operating a full fishing venture in the Cook Islands, depending on the outcome of the trial period. Sealords was a partnership consisting of Lucky Matapuku, Michael Burns, Tuaine Rata, Royden Mitchell, and Rima Tuarae. They proposed to eventually become a fully locally owned and operated fishing business. However, since they were classified as a high-risk, no-credit company with little commercial fishing experience, they were compelled to go into a joint venture with a New Zealand consultant (Allan Mills of Tulagi Group Ltd) and a New Zealand fishing company (Southern Ocean Trawlers Ltd).

Subsequently, licences were issued for two vessels—F/V *Southern Progress*, which was owned and operated by Southern Ocean Trawlers, and F/V *Kona Wind*, which was on charter (owned and operated by Prime North Pacific Ltd). These two vessels fished in Cook Island waters during 1994 and 1995. Two other vessels fished during 1996 as a part of this joint venture, the F/V *Suzanne M* and F/V *Edna Kate*. The terms of the licences for the foreign vessels were for 12 months with non-renewable fees of $5,000.00 for each licence. The vessels were not permitted to fish inside the 12-mile limit (Territorial Seas) and had to be on good standing on the Regional Registry of Foreign Fishing Vessels administered by FFA in Honiara (personal communication by Lucky Matapuku). By the end of 1996 however, none of these vessels were fishing in Cook Island waters, and Southern Ocean Trawlers had pulled out of the joint venture. Despite this, the business relationship between Sealords and Tulagi Group Ltd had remained in effect.

Sealords and Tulagi Group Ltd formed a partnership to run a pack-house (fish-processing and exporting) on Rarotonga under the name Cook Islands Seafoods Ltd (Sealords 50% and Tulagi Group Ltd 50%). During 1995–96 Cook Islands Seafoods Ltd processed, packed, and exported fish to foreign markets in Japan, Hawaii, and New Zealand for the vessels fishing under their banner. There were no exports after November 1996 when the last of the foreign vessels, F/V *Edna Kate*, left the Cook Islands to fish in the broadbill swordfish fishery in Australia. By the terms of the joint venture, Sealords was responsible for licensing, export permits, importing bait, fuel purchases, and other agent functions while Tulagi Group was responsible for providing vessels—either their own or on charter.

Cook Islands Sealords Ltd, although 50 per cent partner in Cook Islands Seafoods Ltd, did all of the day-to-day management and work to keep the company going. The other 50 per cent partner, Tulagi Group Ltd, was not involved in the operational side of the business, at least during the project. Lucky Matapuku, Manager at Cook Islands Seafoods Ltd, was also employed full-time at Air New Zealand. Adrienne Matapuku managed the books for Seaquest Ltd and Cook Islands Seafoods Ltd. There was only one vessel, F/V *Farquest*, supplying fish to Cook Islands Seafoods Ltd, and none of the fish was being exported. The domestic market in Rarotonga was limited, although prices for fish, both wholesale and retail in the Cook Islands, were found to be high in comparison to other Pacific Island countries. Revenues at Cook Islands Seafoods Ltd were just barely keeping up with expenditures.

Appendix C

Specifications for F/V *Farquest* taken from two different survey reports

- Builder—Sims Engineering Ltd, Port Chalmers, New Zealand
- Year built—1970
- Hull—chine
- Construction—steel
- Length over all— 54.5 feet (16.75 m)
- Beam—14.9 feet (4.58 m)
- Draft—7 feet (2.1 m)
- Gross registered tonnes—30
- Main engine—Caterpillar D334
- Auxiliary engine—Isuzu four cylinder
- Electric power—24 VDC alternator on main engine, 12 and 24 VDC alternators on auxiliary
- Fuel capacity—9,000 l
- Fresh-water capacity—1200 l
- Fish-hold capacity—7 tonnes
- Maximum speed—9.3 knots
- Accommodation—four crew
- Electronics—Koden GPS, JRC sounder, Kaijo Denki sounder, Koden radar, AWA weather fax, Furuno SSB radio, Pilot VHF radio, Furuno sea-water temperature monitor, Taiyo radio direction finder, and TMQ autopilot
- Fishing gear—Allstan (NZ) alloy reel (also called a winch or drum) with 40 kilometres (21 nm) of 3.0 mm monofilament mainline, Allstan line-setter, 800 branchlines, floats with floatlines, four Sea Star radio buoys
- Safety gear—four-man life raft, two life rings, one emergency position-indicating radio beacon (EPIRB) in liferaft, one EPIRB in wheelhouse, four life jackets (PFDs), flares, rockets, smoke signals, fire extinguishers, and first aid kit.

Appendix D

Specifications for F/V *Peka-Anne*

Most of these specifications for the Ton-7 (except for the electronics, fishing gear, and safety gear) were taken from *Artisanal Fishing Craft of the Pacific Islands* (FAO, 1987):

- Design—Tonga 8.8 M Diesel: Ton-7
- Length over all—29 feet (8.8 m)
- Beam—2.94 m
- Draft—1.5 m
- Engine—Yanmar 3QM diesel, 30 HP
- Weight no load—2,800 kg
- Weight loaded—3,800 kg
- Maximum speed—6.5 knots
- Fuel consumption—seven l/hour
- Fish-hold capacity—1.8 cubic m3
- Crew complement—four
- Electronics—Codan SSB radio, Shakespeare VHF radio, Furuno colour echo sounder, Furuno radar, Koden RDF, and Garmin GPS
- Fishing gear—Spencer-Carter hydraulic longline reel with 5.0 nm (9.25 km) of 4.0 mm monofilament mainline, Spencer-Carter hydraulic pot hauler, 220 branchlines in a bin, floats with floatlines, one Seastar radio buoy, and two electric (12 VDC) bottom fish gurdies
- Safety gear—six-man life raft, EPIRB, life ring, strobe light, six life jackets (PFDs), rockets, flares, smoke signals, fire extinguishers and first aid kit

Appendix E

Fishing gear and bait ordered for the project including the workshops

The following gear was purchased from Ocean Producers International in Hawaii for the project. An initial order was placed for tuna longlining operations, and a second order placed for materials needed for the workshops. These materials have been combined into the following list:

Mainline, tarred red, 3.0 mm x 900 m coils	10 coils
Mainline, tarred, 6.4 mm x 550 m coils	8 coils
Monofilament, 2.0 mm 25 lb (11.5 kg) spools	5 spools
Monofilament, 1.5 mm 5 lb (2.2 kg) coils	3 coils
Handline, sunset, 350 lb (160 kg) test	6 spools
Snap with swivel, 148 x 3/16 in (4.5 mm) x 8/0	1,000 pieces
Snap with swivel, 148 x 3/16 in (4.5 mm) x 9/0	50 pieces
Snap with swivel, mini 1/8 in (3.0 mm) x 4/0	200 pieces
Crimp, Technos D x 500 per bag	5 bags
Crimp, Dbl Lock for 1.5 mm	500 pieces
Crimp, Toyo Lok 6	500 pieces
Crimp, Toyo Lok 3, 500 per bag	5 bags
Crimp, Mono size L for 3.6 mm	500 pieces
Hooks, ring Mustad 9190DKR 6/0, 100 per box	10 boxes
Hooks, Mustad 39960ST, 13/0 circle	100 pieces
Hooks, Mustad 39960ST, 14/0 circle	100 pieces
Hooks, albacore 78923/3021	50 pieces
Hook ring and grommet	100 pieces
Thimbles, plastic, 500 per packet	4 packets
Floats, hard plastic, 300 mm diameter	25 pieces
Floats, hard plastic, 360 mm diameter	5 pieces
Handtool bench crimper CT–1000	1 piece
Chip D (one set) for CT–1000	1 piece

Chip 2-3 (one set)	1 piece
Handtool, Swedish fid, small	2 pieces
Handtool, wire cutters, 180 mm	2 pieces
Swivels, lead, 60 gram	550 pieces
Swivels, branch, 4/0	100 pieces
Swivels, branch, 1/0	100 pieces
Swivels, triangle, 1 x 1	100 pieces
Swivels, corkscrew pigtail, 9 mm	10 pieces
Lure, tuna clone, 6.5 in (160 mm)	20 pieces
Strobe light	5 pieces
Light stick LP, 4 in (100 mm) green	1000 pieces
Red work gloves (one size)	60 pair
Wire, stainless steel, 3/64 in (1.2 mm) diameter	5 spools
Tee spike	1 piece
Tape, reflective 3M 79941	1 roll
Tubing, clear	3 rolls
Gaff meat hook, orange handle	1 piece

Three hundred 10 kg cartons (3 t) of sanma bait (*Cololabis sairi*, or saury) was ordered from King Exports (New Zealand), for the project. The bait arrived at the start of the project and was stored in several locations, where there was freezer space.

Appendix F

Timetable used during workshop in Rarotonga

Time	Monday 14 April	Wednesday 16 April	Friday 18 April
0800-0900	Opening	Recap of Tuesday's fishing activities	Recap of Thursday's fishing activities
0900-1015	Introduction to FADs and fishing methods associated with FADs	Fish-handling theory session	Marketing and economics of a small fishing business
1015-1030	Morning tea	Morning tea	Morning tea
1030-1200	Make up mid-water fishing gear	Fish-handling practical session	Value added tax, taxation and investment
1200-1300	Lunch	Lunch	Wrap-up/conclusions and closing of the workshop
1300-1430	National Fishery Assessment presentation	Safety-at-sea presentation	Barbeque and presentation of certificates
1430-1445	Afternoon tea	Afternoon tea	
1445-1600	Ministry of Marine Resources policy discussion	Making up of spare gear for fishing trials	

Note: Tuesday 15 April and Thursday 17 April were fishing days when participants in the workshop used the gear that was made and put the theories they received into practice.

Summary of catches taken during tuna longline fishing activities

Summary of catches taken during tuna longline fishing activities in the waters off the Cook Islands.
On F/V *Farquest*, weights for all marlins and broadbill swordfish were headed and gutted, while all other species were gilled-and-gutted weights.
On F/V *Peka-Anne*, weights for all marlins and broadbill swordfish were headed and gutted, while all other species were whole weights.
Other saleable catch consisted of skipjack tuna, one 75 kg bigeye tuna, wahoo, sailfish, shorbill spearfish, and larger barracuda.
Unsaleable species consisted of sharks, lancetfish, snake mackerel, escolar, pelagic ray, small barracuda and small broadbill swordfish.
* On this set line hauling commenced at 1700 the day of set for one hour and resumed at 0630 the following morning due to hydraulic problems.

Trip and set No.	Position Lat (S)	Position Long (W)	Hook Nos	Time set	Time haul	Catch by species: Yellowfin tuna No.	Yellowfin tuna Weight (kg)	Albacore tuna No.	Albacore tuna Weight (kg)	Blue marlin No.	Blue marlin Weight (kg)	Br. swordfish No.	Br. swordfish Weight (kg)	Mahi mahi No.	Mahi mahi Weight (kg)	Other saleable No.	Other saleable Weight (kg)	Total No.	Total Weight (kg)	Unsaleable species No. only
Tuna longline trips on-board F/V *Farquest*																				
1	21°12′	159°57′	830	0800	1840	3	121	4	73	1	50			2	23	1	6	11	273	7
*2	21°12′	160°03′	1080	0515	0630	4	39	1	18	6	305	1	62					12	424	4
3	21°07′	159°57′	1080	0610	1610			2	40	4	218			3	26	2	21	11	305	5
4	21°24′	159°32′	1140	0610	1700					4	249			6	61	1	15	11	325	6
5	20°57′	159°31′	1080	0620	1820					2	97			2	16	1	25	5	138	3
6	21°23′	159°53′	350	1745	0300	1	40											1	40	
7	21°20′	159°56′	900	0630	1630	7	247			7	373			8	63	4	36	26	719	6
8	21°30′	159°43′	1000	0820	1700	5	190			5	255					3	88	13	533	6
Total			**7460**			**20**	**637**	**7**	**131**	**29**	**1547**	**1**	**62**	**21**	**189**	**12**	**191**	**90**	**2757**	**37**
Tuna longline trips on-board F/V *Peka-anne*																				
1	21°19′	159°53′	220	0445	1900	2	90	3	62									5	152	5
2	21°12′	159°38′	200	1445	0630			1	20			1	10					2	30	5
3	21°18′	159°46′	220	0610	1930	2	58									1	10	3	68	
4	21°18′	159°52′	220	0610	1940													0	0	
5	21°03′	159°44′	220	0420	1940	3	60			1	70					1	8	5	138	4
6	21°07′	159°46′	220	1120	2030	1	35	1	15	3	145					1	10	6	205	4
7	21°07′	159°47′	220	1120	2220	2	74											2	74	
8	21°04′	159°54′	220	0445	1810											2	18	2	18	
Total			**1740**			**10**	**317**	**5**	**97**	**4**	**215**	**1**	**10**	**0**	**0**	**5**	**46**	**25**	**685**	**18**

Appendix H

Summary of catches taken around FADs during project fishing activities

Summary of catch taken around FADs during project fishing activities
All catch weights are whole weights
VLL = Vertical-longline and PA/DS = Palu-ahi/drop-stone
Effort: VLL = 10 hooks/hour; PA/DS and Trolling = hook-hours

Trip No.	Vessel	Fishing method	Hours fished	Effort by method	Catch by species						
					Yellowfin tuna		Albacore tuna		Total		Sharks
					No.	Weight (kg)	No.	Weight (kg)	No.	Weight (kg)	No. only
1	F/V *Peka-Anne*	VLL	1.75	5.25	1	20.0			1	20.0	
2	F/V *Peka-Anne*	VLL	3.00	9.00	1	18.0	1	20.0	2	38.0	
		PA/DS	2.00	2.00							
3	MMR vessel	Trolling	1.00	2.00							
		VLL	5.25	12.08	5	82.5			5	82.5	
		PA/DS	4.25	17.00	6	101.5			6	101.5	
4	F/V *Peka-Anne*	VLL	3.00	13.50							1
		PA/DS	2.00	4.00	1	22.0			1	22.0	
5	MMR vessel	VLL	7.25	16.68			1	20.0	1	20.0	
		PA/DS	6.25	18.75	1	20.0			1	20.0	
6	F/V *Peka-Anne*	VLL	6.00	27.00							1
		PA/DS	3.00	6.00							
7	F/V *Peka-Anne*	VLL	3.50	10.50							
		PA/DS	2.50	2.50	1	25.0			1	25.0	
	Total	Trolling	1.00	2.00							
		VLL	29.75	94.01	7	120.5	2	40.0	9	160.5	2
		PA/DS	20.00	50.25	9	168.5	0	0.0	9	168.5	

Appendix I

Summary of catches taken around FADs during Rarotonga workshop

Summary of catch taken around FADs during Rarotonga workshop
All catch weights are whole weights
VLL = Vertical-longline and PA/DS = Palu-ahi/drop-stone
Effort: VLL = 10 hooks/hour; PA/DS and Trolling = hook-hours

Vessel	Fishing method	Hours fished	Effort by method	Catch by species						
				Yellowfin tuna		Albacore tuna		Total		Sharks
				No.	Weight (kg)	No.	Weight (kg)	No.	Weight (kg)	No. only
Day 1 of fishing										
Vessel 1	Trolling	0.75	1.50							
	VLL	5.75	12.08			1	19.0	1	19.0	
	PA/DS	5.00	15.00	2	16.0			2	16.0	
Vessel 2	VLL	5.50	12.65			2	40.0	2	40.0	
	PA/DS	4.50	18.00			1	20.0	1	20.0	
Vessel 3	VLL	1.50	2.25	1	27.0			1	27.0	1
	PA/DS	1.00	1.00							
Day 2 of fishing										
Vessel 1	Trolling	0.25	0.50							
	VLL	3.75	7.86							
	PA/DS	2.50	10.00							
Vessel 2	VLL	5.00	11.50			1	20.0	1	20.0	
	PA/DS	4.50	18.00							
Vessel 3	VLL	6.00	18.00							
	PA/DS	5.00	5.00							
Total	Trolling	1.00	2.00							
	VLL	27.50	64.34	1	27.0	4	79.0	5	106.0	1
	PA/DS	22.50	67.00	2	16.0	1	20.0	3	36.0	

Appendix J

Contacts for albacore troll vessels operating in the southern albacore fishery

Star Kist Samoa
Buck Huff, Fleet Manager
PO Box 368
Pago Pago 96799
American Samoa
Fax: 684-6442440
Phone: 684-6444231

Western Fishboat Owners Association
Wayne Heikkila, General Manager
PO Box 138
Eureka, California 95502,
USA
Fax: 1-707-4431074
Phone: 1-707-4431098

VCS Samoa Packing Company
Dennis Chamberlain, Fleet Manager
PO Box 957
Pago Pago 96799
American Samoa
Fax: 684-6442290
Phone: 684-6445272

Appendix K

Hydraulic spares needed for F/V *Farquest*

These spares are for the reel only. If the line setter is repaired, spares will also be needed for it. This is also true for the other hydraulic equipment on the vessel.

- One 'Brand' control valve—page 17 of the Ocean Producers International catalogue (same as Pacific Ocean Producers) Hawaii. Cost US$234.60.
- One four inch (100 mm) longline block—page 18 in same catalogue. Cost US$179.00.
- 2 x $\frac{1}{2}$ inch (12 mm) x 48 inch (122 cm) two-wire hydraulic hose with $\frac{1}{2}$ inch (12 mm) 90° female swivel JIC re-useable hose ends. These go from the ports on deck exiting the engine room to the control valve.
- 2 x $\frac{1}{2}$ inch (12 mm) x 24 feet (61 cm) two-wire hydraulic hose with $\frac{1}{2}$ inch (12 mm) straight female swivel JIC re-useable hose ends. These go from the control valve to the reel.
- 4 x $\frac{1}{2}$ inch (12 mm) female swivel JIC re-useable hose ends. These are for at-sea repairs of broken hoses.
- 2 x $\frac{1}{2}$ inch (12 mm) male to male JIC nipples. These are to be used with the above hose ends for at-sea repairs.
- One bottle of hydraulic sealant (eg. LocNut).

The fittings on the old control valve, on the bulkhead exiting the engine room, and on the reel motor were all in good condition and can be re-used. There were also some fittings on the control valve for the old RSW system that could be used on a new control valve.