FIELD REPORT No. 12

on

THE FISHERIES DEVELOPMENT
SECTION’S TECHNICAL ASSISTANCE
TO THE NEW IRELAND COMMERCIAL
FISHING ASSOCIATION, KAVIENG,

PAPUA NEW GUINEA

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SUMMARY

The Government of Papua New Guinea requested technical assistance from the Fisheries Development Section in March 2001. The main aims of the assistance were to: work with and train the skipper and crew of the National Fisheries College’s fisheries training vessel, and interested fishermen from the New Ireland Commercial Fishing Association, to undertake site surveys in different locations around Kavieng to locate suitable FAD deployment sites and deploy FADs if materials were available; conduct fishing trials around FADs and hold workshops to introduce using mid-water fishing techniques such as vertical longlines, palu-ahi and drop-stone handlines, and single hook drift lines using the National Fisheries College’s vessels; hold workshops to introduce deep-water snapper fishing techniques to interested local fishermen from the Association, with practical demonstration of the gears at sea; experiment with small-scale tuna longlining from small vessels using hand-crank gear if time permitted; and provide training in the correct handling processing and chilling of the catch, especially larger tunas, for menced this three-month assignment.

Site surveys were conducted in four areas in the waters around Kavieng. Two suitable FAD deployment sites were identified, one in 900 m and the other in 1400 m. FADs were assembled to suit these two depths and deployed using the Indian ocean buoy design, three-strand ropes for the mooring line and old engine blocks for the anchor. After deployment, strong currents were observed in the northwest deployment area, which at times pulled around 75 per cent of the buoys underwater. The southeast FAD deployment area had normal currents.

Three workshops were conducted to introduce mid-water fishing techniques associated with FADs, as well as deep-water bottom fishing techniques. Originally two workshops were to be conducted. However, after the first workshop the interest was so high by local fishermen, that an extra workshop was added, although for a shorter period. In total, 51 local fishermen received training, both theory and practical, through the three workshops. Fishing trials using three outboard-powered fibreglass banana boats produced encouraging results, and workshop participants were very pleased with the new skills they acquired.

In addition to the workshops, additional activities were undertaken by the Fisheries Development Officer at the request of the local fishermen and/or the staff at the National Fisheries College (NFC). These activities included: assisting with the practical tuna longline fishing demonstrations for the college’s Certificate in Fishing Operations 1 course; re-building two arrowhead traps and using them for a brief trial period; and the construction of two types of bait fishing nets, including some trial fishing activities.

The project also included the trial shipment of fresh fish to Japan for export. Specific fishing trips were undertaken to catch and handle the fish for this trial shipment. The NFC’s training vessel, FTV Leilani, was used to catch tuna, while a local fisherman who was a participant in the first workshop was assigned the task of catching deep-water snappers. In all, 1115 kg of tuna and 73 kg of deep-water bottom fish were exported with encouraging results. Prices for tuna ranged from ¥ 200 to 2300/kg (Kina 5.25 to 60.36/kg or USD 1.59 to 18.32/kg) and for the deep-water bottom fish from ¥ 100 to 800/kg (Kina 2.62 to 21.00/kg or USD 0.76 to 6.37/kg). Overall the value of the export fish came to ¥ 856,890 (Kina 22,488 or USD 6827), and was above average for fish exported out of Papua New Guinea at the same time.

Local fishermen were keen to learn the new techniques being introduced through the workshops. Many fishermen missed out on the training as the workshops could only cater to 17 participants at a time. Therefore, there is a need for further training in these fishing techniques, so that other fishermen in the New Ireland Province, and elsewhere in Papua New Guinea, can gain the skills and knowledge to make their fishing operations more viable.
RÉSUMÉ

En mars 2001, le gouvernement de Papouasie-Nouvelle-Guinée a sollicité l’assistance technique de la section Développement de la pêche. La section était invitée à prêter son concours pour les tâches suivantes : collaborer avec le capitaine et l'équipage du bateau-école de l'Institut national d'études halieutiques et avec les pêcheurs intéressés de l'Association des professionnels de la pêche commerciale de Nouvelle-Irlande pour repérer des sites de la région de Kavieng se prêtant au mouillage de DCP et en mouiller si on disposait du matériel pour les construire; effectuer des essais de pêche autour de DCP; organiser des ateliers d'initiation aux techniques de pêche à mi-profondeur (palangres verticales palu ahi, pierre perdue, lignes dérivantes monohameçon) à bord des bateau-écoles de l'Institut national d'études halieutiques, ainsi que des ateliers sur les techniques de pêche du vivaneau en eau profonde à l'intention de pêcheurs locaux intéressés de l'Association, avec démonstrations pratiques de l'utilisation des engins en mer; expérimenter la pêche artisanale de thon à la palangre à l'aide d'engins à manivelle depuis de petites embarcations, si le temps imparti le permettait, et dispenser une formation à la manipulation, la transformation et la réfrigération des prises, en particulier de thons de grande taille, destinées à l'exportation pour les marchés de poissons de qualité supérieure ou de sashimi. Le chargé du développement de la pêche, William Sokimi, a entrepris cette mission de trois mois en avril 2001.

Des études de site ont été faites en quatre endroits dans les eaux entourant Kavieng. Deux sites ont été jugés comme propices au mouillage de DCP ont été repérés, par 900 et 1400 m de profondeur respectivement. Des DCP ont été confectionnés en fonction de ces deux profondeurs, puis mouillés à l'aide de la bouée de type océan Indien, de bouts à trois torons pour la ligne de mouillage et de vieux blocs moteurs pour le corps mort. Après le mouillage des DCP, on a observé, dans la zone de mouillage nord-ouest, de forts courants qui ont parfois tiré environ 75 pour cent des bouées sous l'eau. Dans la zone de mouillage sud-est, les courants étaient normaux.

Trois ateliers d'initiation aux techniques de pêche à mi-profondeur autour de DCP et aux techniques de pêche profonde ont été conduits. À l'origine deux ateliers seulement devaient être organisés. Mais, après le premier, les pêcheurs locaux ont manifesté tant d'intérêt qu'un atelier supplémentaire, moins long, a été réalisé. En tout, 51 pêcheurs locaux ont suivi cette formation, à la fois théorique et pratique. Les essais de pêche, effectués à bord de trois des pirogues moulées en fibre de verre, propulsées par un moteur hors bord, ont donné des résultats encourageants, et les participants aux ateliers ont été très heureux d'acquérir de nouvelles compétences.

Outre les ateliers, le chargé du développement de la pêche a mené d'autres activités à la demande des pêcheurs locaux et du personnel de l'Institut national d'études halieutiques : participation aux démonstrations de pêche de thon à la palangre effectuées dans le cadre du cours débouchant sur un certificat d'aptitude à la pêche, niveau 1, dispensé par l'Institut; reconstruction et utilisation de deux pièges en forme de pointe de flèche pour un bref essai; construction de deux types de filets de pêche d'appâts et essais de pêche.

Le projet portait également sur l'exportation expérimentale de poisson frais au Japon. Des sorties ont été spécialement organisées pour capturer du poisson et le manipuler à cet effet. C'est à bord du bateau-école de l'Institut national d'études halieutiques, le Leilani, que le thon a été pêché, tandis qu'un pêcheur local, qui avait participé au premier atelier, a été chargé de pêcher des vivaneaux. En tout, 1 115 kg de thon et 73 kg de poissons d'espèces profondes ont été exportés, avec des résultats encourageants. Le prix du thon allait de 200 à 2 300 yens le kilo (soit 5,25-60,36 kina le kilo, ou 1,59-18,32 USD/kg) et celui des poissons d'espèces profondes de 100 à 800 yens le kilo (2,62-21,00 kina ou 0,76-6,37 USD). Le montant total de l'exportation de poisson s'est élevé à 856 890 yens (22 488 kina, soit 6 827 USD), soit plus que le montant moyen des exportations de poissons depuis la Papouasie-Nouvelle-Guinée à cette date.

Les pêcheurs locaux se sont montrés empressés d'apprendre les nouvelles techniques qui faisaient l'objet des ateliers. Nombre d'entre eux n'ont pas pu suivre la formation parce que le nombre de places à un atelier était limité à 17. Il faudra donc organiser d'autres sessions de formation à ces techniques de pêche, de manière à ce que d'autres pêcheurs de la province de Nouvelle-Irlande et d'autres régions de...
Papouasie-Nouvelle-Guinée puissent acquérir ces savoir-faire et ces connaissances pour rendre leurs opérations de pêche plus rentables.
CONTENTS

1. INTRODUCTION AND BACKGROUND 1
   1.1 Papua New Guinea 1
   1.2 New Ireland Province 2
      1.2.1 The New Ireland Commercial Fishing Association 2
      1.2.2 The National Fisheries College (NFC) 3
   1.3 Previous technical assistance provided to Papua New Guinea 4
   1.4 Initiation of the current project and its objectives 5

2. VESSELS USED DURING THE PROJECT 6
   2.1 NFC’s fisheries training vessel FTV Leilani 6
   2.2 Banana boats used for small-scale fishing activities 7

3. PROJECT ACTIVITIES AND RESULTS 7
   3.1 FADs: site selection, site surveys, construction and deployment 7
      3.1.1 General information 7
      3.1.2 Selecting FAD survey sites and conducting the surveys 8
      3.1.3 FAD mooring materials, construction and cost 10
      3.1.4 Deploying the project FADs 12
   3.2 Workshops for small-scale fishermen 15
      3.2.1 General 15
      3.2.2 Sea safety and basic navigation 16
      3.2.3 Fishing gears to be used around FADs 17
      3.2.4 Gear for deep-water bottom fishing 19
   3.3 Results of workshop practical fishing trips 21
      3.3.1 Boat preparation 22
      3.3.2 Results of FAD fishing trials 23
      3.3.3 Results of deep-water bottom fishing trials 25
      3.3.4 On board handling and preservation of the catch 27
   3.4 Fishing for and conducting overseas export trial 27
      3.4.1 Tuna longline fishing trip for export trial 28
      3.4.2 Deep-water bottom fishing trip for export trial 28
      3.4.3 Processing and marketing the trial shipment of export fish 28
3.5  Additional activities undertaken as part of the project 29
   3.5.1  Tuna longline training for the CFO 1 students 29
   3.5.2  Constructing and using arrowhead traps 31
   3.5.3  Bait fishing gear and techniques 32

4.  DISCUSSION AND CONCLUSIONS 35
   4.1  General 35
   4.2  Fishing activities 36
   4.3  Maintaining an ongoing FAD programme 37
   4.4  Workshops and training 38

5.  RECOMMENDATIONS 39
   5.1  General 39
   5.2  Fishing activities 39
   5.3  Maintaining an ongoing FAD programme 40
   5.4  Workshops and training 41

6.  REFERENCES 41

APPENDICES
   A.  Specifications of FTV Leilani including gear and electronics 43
   B1.  Data recorded by waypoint for FAD survey area 1 45
   B2.  Data recorded by waypoint for FAD survey area 2 46
   B3.  Data recorded by waypoint for FAD survey area 3 47
   B4.  Data recorded by waypoint for FAD survey area 4 48
   C.  Mooring calculations for the two FADs 49
   D.  Approximate cost of materials used to construct the two FADs 55
   E.  Itinerary for the six-day workshops 57
   F.  List of workshop participants 59
   G.  Checklists developed for different fishing techniques 61
   H.  Japan market results on prices paid on exported fish 63
1. INTRODUCTION AND BACKGROUND

1.1 Papua New Guinea

Papua New Guinea (PNG) is an independent island nation located on the eastern half of the second largest Island in the world — New Guinea. The country lies between the latitudes from the equator to 14° S and longitudes 141° to 160° E (Figure 1). PNG gained its independence on 16 September 1975, and has a population of approximately 4,790,800 (SPC 2000). The territory includes 19 provinces plus the National Capital District and encompasses the Bismarck Archipelago of New Britain, Manus and New Ireland, the islands of Bougainville and Buka, and numerous smaller islands and atolls. The western part of New Guinea is the Indonesian governed territory of Irian Jaya. PNG has a total land area of approximately 462,840 km² that is covered in a diverse range of flora and fauna, and a sea area that covers 1,900,000 km² (Anon. 2001a).

![Figure 1: Map of Papua New Guinea showing the Declared Fishing Zone](image)

Papua New Guinea has a generally tropical climate in which December to March is the wet season, although occasional rain falls throughout the year. The main island is covered with tropical rain forests consisting of vegetation that is a mixture of Asian and Australian species. The islands are also the habitat for a remarkable variety of exotic birds, including all the known species of the birds of Paradise (Anon. 2001b).

The people of Papua New Guinea can be divided into four ethnic groups. These are the New Guineans from the north of the main island, the Papuans from the south, the Highlanders and the Islanders. There is a diverse cultural difference across the country with almost 800 indigenous languages spoken. Although English is the official language, Pidgin English is the main spoken language (Anon. 2001b).

Papua New Guinea is rich in natural resources, but development of these resources is hampered by the harsh terrain and the high cost of infrastructure. The mass of the population depends largely on agriculture to sustain their subsistence livelihood. Seventy two percent of the export earnings come from mineral deposits such as oil, copper and gold (Anon. 2001c).
1.2 New Ireland Province

New Ireland Province is spread over 230,000 km² of sea and consists of 149 islands north of New Britain (Figure 2). It has a land area of approximately 9600 km² and a population of approximately 86,741 citizens and 258 expatriates. Nineteen distinct languages are spoken throughout the New Island Province. The main island is 350 km long and is as narrow as 5 km in some areas, and is widest in the mountainous south at 50 km (Anon. 2001a).

![Map of New Ireland](image)

**Figure 2: Map of New Ireland**

The island groups that make up New Ireland Province constitute Mussau — Emirau (St. Mathias), 16 islands; Lavongai (New Hanover) and east islands, 9 islands; Tabar, 6 islands, Lihir, 5 islands; Tanga, 11 islands and Fendi (Anir), 3 islands (Anon. 2001a).

Most of the flat land and coastal areas of New Island Province is covered by coconut plantations. The demand for land to carry out subsistence and commercial gardening and the introduction of the logging industry has seen the rain forests being replaced by secondary growth forests and grasslands. Mangroves and sago palms are still evident in coves along the coasts of most of the islands, and at Balgai Bay near Kavieng. Timber and copra are leading export items for the New Ireland Province, with Gold and tuna being looked at for further development. Gold is mined at Lihir Island and is also found on nearby islands. Coconuts, cocoa, betelnut, pigs, vegetables, bananas, fruit and fish are among the main sources of income for the villagers (Anon. 2001a).

1.2.1 The New Ireland Commercial Fishing Association

The New Ireland Commercial Fishing Association (NICFA) was established in early 2000, to unify local fishermen and businessmen involved in fishing industries in New Ireland Province. The association has several other objectives currently on its agenda. These are to promote fishing activities and related industries, and to establish interactions with the PNG Fisheries and Marine Resources Authorities and other parties interested in the development of fisheries in PNG.

The Association began with around 240 registered members and has grown steadily to 400 members.
within its first year. The majority of the members are mainly small-scale artisanal and commercial fishermen and people involved in seafood purchasing, processing and exporting companies.

The members are anticipating that the formation of the association will provide them with the initiative and the avenue to cultivate their fishery into a more developed commercial entity that will eventually figure prominently in Papua New Guinea’s economic growth.

The association has a project working group that is comprised of representatives from the National Fisheries Authority, the Provincial Government and from the association members. Several projects are currently being planned as ‘progress steps’ in the development of the association and the Kavieng fishery.

**Proposed NICFA activities for 2001**

Focusing mainly on developing from basics, the planning committee has agreed to several projects that should be in line with the immediate development requirements of the New Ireland fishermen. Using funds that are currently available, the association hopes to construct ice boxes and make them obtainable to the fishermen on payment of a deposit; construct and deploy at least three fish aggregation devices (FADs) with the aid of the National Fisheries College (NFC) and SPC; and train local fishermen in fishing methods that target fish species suitable for commercial export markets.

Other plans include: having the association act as the recruitment agent for students intending to attend the Certificate in Fishing Operations 1 (CFO 1) course at the NFC; prepare a small grant application to AusAID for the provision of an ice machine to supply ice to the small boat fishermen; develop a fisheries facilities at the Bagail fisheries wharf site; act as managers of the planned artisanal fishing wharf site; establish a VHF and SSB radio network; and provide a contact point for development activities proposed under the EU and ADB coastal fisheries projects, as well as with the present AusAID and ADB wharf development projects.

*1.2.2  The National Fisheries College (NFC)*

In 1977, the Japanese Government provided financial assistance through contribution to the construction of the NFC. This was carried out with the explicit aim of providing a trained workforce to supplement the increasing demands of the steadily developing domestic fishing industry. An industry that has set about to exploit its own rich fisheries resources, thus contributing to Papua New Guinea’s social and economical development.

A series of training courses were designed to provide skilled employees for the domestic pole-and-line industry that was operating from the early 1970s until 1981, when the industry closed down. Since then, up until the end of 1996, NFC offered a course for a Certificate in Tropical Fisheries, conducted over a two-year period and divided into four semesters of eighteen weeks each. The Tropical Fisheries Course was set up to provide training for Fisheries Extension Officers and related positions within the industry.

Several reviews made by organisations such as the UNDP, ADB, and JICA in the 1980s and early needs of the fishing industry. Hence, the development of the Fishing Cadet Course, designed to meet the impending needs of the industry and comply with the competency standards set out by the International Maritime Organisation under the 1995 STCW Convention (Standards of Training, Certification and Watch-keeping) (Watt 1999). The Fisheries Cadet Course was run in three stages over a nine-month period.

The first phase was conducted at the Madang Maritime College, where the students attend basic seamanship, safety at sea and safe working practice courses. The second phase was conducted at NFC, where students were introduced to fishing operations using different fishing methods and targeting various species. Fish quality and handling was stressed during this stage. The fishing methods concentrate...
mainly on horizontal tuna longline fishing, FAD fishing methods such as vertical longline and trolling; and deep-water bottom fishing techniques using FAO designed handreels. The third and final stage was conducted in Port Moresby or served on vessels operating within the countries EEZ. Here the students put into actual practice all that they learned in the earlier two stages, and under real commercial working conditions. The student’s attachment to the fishing companies could eventuate into full time employment if their performance was satisfactory (NFC 2001). The last Fisheries Cadet Course was conducted in 2000, before the new Certificate in Fishing Operations course was developed and implemented in 2001.

National Fisheries College Strengthening Project (NFCSP)

The Australian Agency for International Development (AusAID) is currently funding the Papua New Guinea, National Fisheries College Strengthening Project (NFCSP), directed at reinforcing the national fisheries provider with a durable base to develop and deliver properly accredited fisheries training that is responsive to the industry’s needs. The project is being implemented over four years (2000 to 2003).

The NFCSP expects to attain its objectives through institutional strengthening and personnel management, training development, student support and facilities development. The project currently has two consultants on hand (NFCSP Team Leader and Fishing Operations Adviser) to provide full-time support that should lead to effective skills transfer and combined development of technological improvements. Other specialists will be engaged to carry out short-term work as the stages of the project progress (ACIL 2000).

The NICFA Projects Committee has readily capitalised on the situation, and acquired assistance from the two NFCSP consultants who played a major role in volunteering advice and their free time towards the progress and development of the association.

While the NICFA project is a separate operation from the NFCSP project, the advice of the two consultants were much sought after by the local fishermen and businessmen, who were hoping to advance the state of fisheries in New Ireland. As the concept of catching and exporting tuna for the fresh fish sashimi market is new to the New Irelanders, no proper guidance could be attained from anyone on island except from the AusAID advisers. The correlation between the NFC and NICFA will complement each other as the fishing industry develops, so the involvement of the consultants in the NICFA project will benefit the College in the long term.

Certificate in Fishing Operations 1 (CFO 1)

The CFO 1 course is principally targeted at endowing participants with sufficient basic skills to perform the duties expected of a fishing deckhand on board commercial fishing vessels operating within the PNG exclusive economic zone (EEZ).

The course modules cover subjects relating to the development of deck hand skills, safe working practices, safety at sea and on-board handling and fish preparatory for export to potential overseas markets. The course is in two phases. The first phase is based at the NFC, where the students live-in and receive five weeks of continuous and intense coursework, with allowances for recognition of current competence. The second phase has the students working in industry under commercial conditions, putting into practice what they had learned during the first phase. If the students performed well, they could gain employment on some of the commercial fishing vessels in PNG.

1.3 Previous technical assistance provided to Papua New Guinea

The first technical assistance was provided to Papua New Guinea by the Deep Sea Fisheries Development Project (DSFDP) in 1979 (Fusimalohi and Crossland 1980). This project focused on an assessment of the outer-reef slope fish stocks, and the introduction of deep-water snapper fishing techniques, in the area of West New Britain, from Kimbe to Cape Gloucester. The second DSFDP
The DSFDP conducted a third visit in 1984 (Chapman 1998) with fishing activities in West New Britain province, Manus Province and East Sepik Province. Trial fishing and training in deep-water snapper fishing techniques were the main objectives of this project, with secondary objectives of constructing and deploying FAD off Wewak in the east Sepik Province, and trolling for tunas and other coastal pelagic species.

The fourth and final project undertaken by the DSFDP was conducted in 1988 (Wellington and Cusack 1998). The project worked in three locations during a six-month period. In the Oro Bay area of Northern Province and around Rabaul in East New Britain Province, the objective was to promote the development of small-scale artisanal deep-bottom fishing. At Kavieng in New Ireland Province, assistance was provided to NFC, where students at the college were trained in deep-bottom snapper gear rigging and the fishing technique itself.

During the 1990s, the focus of fisheries development in the region moved away from the deep-water snapper resource, and focused more on harvesting the region’s large tuna resource. In line with this new development focus, the Capture Section (formerly the DSFDP) was requested to provide technical assistance to PNG in 1992 and 1993 (Beverly and Chapman 1996). This project was split into two phases. The first phase was to deploy FADs in the area around Rabaul and the Duke of York Islands, with the intention of assessing the tuna resource in the area and stimulating development of an artisanal tuna fishery. The second and most important phase was to demonstrate that sashimi-grade tuna with export market potential could be consistently and economically landed in East New Britain (Kokopo) using a small 15 m vessel fitted with monofilament tuna longline gear and manned by local crew. Both phases were successful, with Phase II recording catch rates as high as 118 kg/100 hooks for all species, and 92 kg/100 hooks for yellowfin tuna alone.

Assistance was again requested for the NFC by the PNG government in 1998/99, when difficulty was encountered in locating a suitably skilled person to teach the practical fishing module of the Fishing Cadet Course (Watt 1999). Over a six-month period, two groups of students were training in a range of commercial fishing methods and gear fabrication, including: trolling, vertical longlining, deep-bottom fishing, handlining, tuna longlining, gillnetting, beach seining and prawn trawling. In addition, students received hands-on training in identifying fishing areas, deployment and retrieving methods for different gears, repairs and storage of gears, and proper handling, processing and chilling of the catch. Students also assisted with the construction and deployment of one FAD off Kavieng.

1.4 Initiation of the current project and its objectives

The Government of Papua New Guinea has had a major restructure in the National Fisheries Authority (NFA) and the NFC. This restructuring has been funded by the ADB (NFA) and AusAID (NFC). Part of the restructure is the government passing on the role of fisheries development to the provinces, and the support for fishermen to get together to form fishing associations or cooperatives.

The first major fishing association to become functional in PNG is the New Ireland Commercial Fishing Association (NICFA). NICFA, with assistance from the staff at NFC, approached the SPC’s Fisheries Development Section for technical assistance to introduce different fishing techniques to members of the association. NICFA also put their request through government channels, and technical assistance was formally requested in March 2001, for this work to be undertaken. In early April 2001, a Memorandum of Agreement (MoA) was signed between SPC, the Principal of NFC and the Chairman of NICFA. The MoA set out the roles and responsibilities of all parties, and the objectives of the project, which were to:

- work with and train the skipper and crew of the National Fisheries College’s fisheries training vessel, and interested fishermen from the New Ireland Commercial Fishing
Association, to undertake site surveys in different locations around Kavieng to locate suitable FAD deployment sites;

• train the same staff plus others in correct FAD construction and deployment techniques, and deploy one or two FADs depending on the availability of materials;

• conduct fishing trials around FADs using mid-water fishing techniques such as vertical longlines, palu-ahi and drop-stone handlines, and single hook drift lines using the National Fisheries College’s vessels;

• hold workshops to introduce mid-water fishing techniques around FADs to interested local fishermen from the Association, with practical demonstration of the gear at sea;

• hold workshops to introduce deep-water snapper fishing techniques to interested local fishermen from the Association, with practical demonstration of the gears at sea;

• experiment with small-scale tuna longlining from small vessels using handcrank gear if time permitted; and

• provide training in the correct handling processing and chilling of the catch, especially larger tunas, for export as sashimi/high grade fish.

On 20 April 2001, Fisheries Development Officer, William Sokimi, arrived in PNG to commence this project of technical assistance in Kavieng, with the project concluding on 12 July 2001.

The NFC’s facilities and equipment were used as the base for conducting the NICFA project. The progress and success of the NICFA project was due largely to the co-operation of the NFC in providing this backup.

2. VESSELS USED DURING THE PROJECT

Practical fishing activities were undertaken to demonstrate a variety of fishing gears and techniques. During these fishing trials, several vessels were used.

2.1 NFC’s fisheries training vessel FTV Leilani

FTV Leilani (Figure 3) was built in Taree, New South Wales, Australia in 1994, with European Union funding. This 17.1 m fibreglass-reinforced plastic (FRP) vessel has a semi-planing hull with hard-chines. The vessel came from Australia equipped with an array of electronic equipment and fishing gear. Appendix A summarised the specifications and equipment on FTV Leilani.

![Figure 3: FTV Leilani at sea during the project](image)
2.2 Banana boats used for small-scale fishing activities

Three fibreglass banana boats were used for most of the fishing operations during the project. Two of these boats were 5.8 m (19 feet) in length and powered by a 25 HP Yamaha outboard, while the third boat was 7.0 m (23 feet) in length and powered by a 55 HP Yamaha outboard (Figure 4). Each of the banana boats was fitted with a 1.2 m by 0.7 m hard mounded plastic icebox, and an assortment of fishing gear.

![Figure 4: Banana boats used during the project](image)

3. PROJECT ACTIVITIES AND RESULTS

A range of activities were undertaken by the project during the three months in Kavieng. Most activities were focused on achieving the agreed objectives, although additional related activities were undertaken at the request of NFC staff and association members.

3.1 FADs: site selection, site surveys, construction and deployment

The construction and deployment of one or two FADs was a major objective of this project. Therefore, given the limited time of the project, this was one of the first tasks undertaken, to allow time for the FADs to mature for fishing operations later in the project.

3.1.1 General information

Trolling for skipjack tuna and other pelagic species is one of the main fishing activities undertaken by the fishermen of New Ireland Province. This is mostly performed from paddling canoes, outboard powered banana boats (moulded fibreglass skiffs), and plywood constructed punts. This mode of fishing is more often centred on the outer reef edges, inshore waters and the open sea.

Earlier introduction of FADs in the area aroused the curiosity of local fishermen, and led them to pursue methods that would effectively catch fish aggregated around these devices, mainly trolling and drift-handlining. Other mid-water fishing methods such as vertical longline, small boat horizontal longline, drop-stone and palu-ahi fishing were yet to be introduced.
Previous FAD deployments were carried out in the vicinity of Kavieng by NFA and SPC. In 1996, a FAD was deployed, which proved to be productive but mainly for mahi mahi, frigate mackerel, skipjack tuna and small yellowfin tuna in the 10–20 kg range. Information collected from local fishermen verified that larger sized fish were rarely caught around this FAD. Part of the reason for this is probably related to the positioning of the FAD in a depth of 350 m, about 3 nm offshore. A second FAD was deployed by SPC in 1998, 12.5 nm offshore at latitude 02˚ 20.60' S, longitude 150˚ 48.60' E in a depth of 1000 m. Yellowfin and skipjack tuna were the main species caught (Watt 1999).

Unfortunately, both FADs were lost without yielding prolonged benefits, the first disappeared after extreme bad weather was experienced in the locality, while the second FAD was thought to have been vandalised by local hooligans after only four months in the water.

3.1.2 Selecting FAD survey sites and conducting the surveys

To get an idea of suitable sites to survey for possible FAD deployment, discussions were held with representatives of NICFA. The factors considered were local knowledge, preferred offshore trolling areas, areas with regular sightings of tuna or pelagic fish schools, distance from home bases, currents, and the depth of water to be found in potential areas. As a result of these discussions, four sites were identified as suitable areas that are easily accessible by fishermen and had a history of fish schools congregating or travelling through.

The FAD survey sites were labelled 1, 2, 3 and 4. A 2.0 nm square (2.0' of latitude x 2.0' of longitude) survey pattern was allotted for each site. All surveys began from west to east and north to south. Depths were plotted at intervals of every 0.25 nm (0.25' of latitude and 0.25' of longitude grids) within the survey area.

FTV Leilani was used to conduct the four site surveys, using the vessel’s deep-water echo sounder and GPS unit. Soundings were recorded at each 0.25 nm interval within the survey area. After the surveys were complete, they were plotted using an Excel software programme. The recorded data for each survey area is at Appendix B, while Figures 5 to 8 provide a graphed plot for each of the survey areas. The survey areas or boxes were as follows:

**Site 1**: 02˚ 22.00' S, 150˚ 39.00' E / 02˚ 22.00' S, 150˚ 41.00' E / 02˚ 23.00' S, 150˚ 39.00' E / 02˚ 23.00' S, 150˚ 41.00' E (data can be found at Appendix B1, with Figure 5 showing a graphed plot of the survey area);

**Site 2**: 02˚ 23.00' S, 150˚ 50.00' E / 02˚ 23.00' S, 150˚ 52.00' E / 02˚ 25.00' S, 150˚ 50.00' E / 02˚ 25.00' S, 150˚ 52.00' E (data can be found at Appendix B2, with Figure 6 showing a graphed plot of the survey area);

**Site 3**: 02˚ 45.00' S, 150˚ 25.00' E / 02˚ 45.00' S, 150˚ 27.00' E / 02˚ 46.00' E, 150˚ 25.00' E / 02˚ 46.00' S, 150˚ 27.00' E (data can be found at Appendix B3, with Figure 7 showing a graphed plot of the survey area); and

**Site 4**: 02˚ 49.00' S, 150˚ 40.00' E / 02˚ 49.00' S, 150˚ 42.00' E / 02˚ 51.00' S, 150˚ 40.00' E / 02˚ 51.00' S, 150˚ 42.00' E (data can be found at Appendix B4, with Figure 8 showing a graphed plot of the survey area).
Note that the survey of site one and three were terminated after five legs were completed. This was due to adverse weather conditions that affected the depth readings obtained from the echo sounder. The five survey runs conducted for each of the two areas was sufficient to derive information on the sea bottom layout. Of the four sites surveyed, FAD sites two and four were selected as areas for deploying the FADs. The seabed details of FAD site two (Figure 6) was not the best for locating the FAD but with careful deploying, the FAD should settle well at a position around 02° 24.25' S, 150° 51.00' E in a depth of around 900 m. The area is a well-known trolling ground where several fish schools frequent throughout the year. The factors at FAD site four were more in favour of being an ideal FAD site. Reasonable bottom configurations (Figure 8) for anchoring the FAD and current from between 0.1 to 1.5 knots pass through the area. For this FAD, a position of 02° 49.00' S, 150° 41.25' E was chosen with an approximate depth of 1400 m.
3.1.3 FAD mooring materials, construction and cost

The three SPC FAD manuals (Anderson and Gates 1996; Gates et al. 1996; and Gates et al. 1998) were used throughout all stages of the FAD site surveys, FAD construction, and FAD deployment. Unfortunately, many of the materials for the FAD mooring construction were not those recommended in the FAD manuals. This was due to the unavailability of the correct materials at the time orders were placed and the time constraints the project was working within. The noted differences in the materials used were:

- 20 mm three-strand polypropylene rope used instead of 22 mm by eight or twelve strand rope;
- 16 mm three-strand nylon rope used instead of 19 mm by eight or twelve strand rope;

![Figure 7: Bottom contour map for survey area 3](image1)

![Figure 8: Bottom contour map for survey area 4](image2)
- 15 m of chain with 13 mm links used instead of chain with 19 mm links;
- 16 mm steel swivel used instead of 19 mm;
- 16 and 26 mm thimbles used instead of 19 and 32 mm thimbles;
- 16 and 26 mm anchor-type safety shackles used instead of 19 and 32 mm shackles;
- 16 mm galvanised wire rope of 6 x 19 construction rove through PVC tube coating to 25 mm used instead of 16 mm, seven strand steel wire rope with 8 mm of PVC coating bringing the diameter to 32 mm; and
- 26 mm cable clamps used instead of 32 mm clamps.

The floats used in the construction of both FADs were second hand floats that were collected by fishermen from around the island. These were mainly floats that came from the fishermen’s own collections over the years. Instead of the 50 floats recommended by the SPC FAD manual, 57 floats were used for the FAD buoy system for site number two (Figure 9) and 68 floats were used for the FAD buoy system for site number four. The additional floats were placed on the FAD as a precaution. Although ninety percent of the floats were in reasonable shape, it was unknown as to how long and in what manner the floats were exposed to the weather elements and how much soaking time it had already been through. Some of the floats also had slashes on them but were still buoyant so these were also included as additional buoyancy instead of being discarded.

The anchors used for mooring the FADs were old engine blocks and a winch contraption that had previously been discarded at the waterfront jetty area. The first FAD to be deployed had two engine blocks coupled together using shackles and chain (Figure 10). The second FAD had an old engine block and the winch contraption coupled together with chains and shackles. In both cases, the approximate weight of the anchors was around 1000 kgs. One of the main features considered when shackling the engine blocks together was the need to have it as tightly bound as possible, so that there would be less chance of the engines separating on the way down to the seabed. The securing chains were doubled up through secure ports to ensure this.

![Figure 9: Purse seine floats threaded on PVC-coated wire cable to make buoy system](image1)

![Figure 10: Engine blocks used as the anchor for the FADs](image2)
The two site depths chosen for deploying the FADs were 900 m and 1400 m. The buoy systems were made up along the Indian Ocean design, and the anchors to be used were engine blocks chained together. The last part of the mooring was the ropes and connecting hardware. The full calculations for each mooring system are presented in Appendix C. In summary, the rope lengths were:

FAD for 900 m depth: 319 m of 16 mm 3-strand nylon rope; and 806 m of 20 mm 3-strand polypropylene rope.

FAD for 1400 m depth: 413 m of 16 mm 3-strand nylon rope; and 1337 m of 20 mm 3-strand polypropylene rope.

Note that no supplementary buoyancy was needed to lift bottom hardware.

The cost of the FADs were kept down, as the used purse seine floats (Kina 5.00 each or USD 1.50 each) cost around one ninth the cost of a new one. This coupled with the use of smaller diameter ropes of a three-strand construction, which is much cheaper than the eight-strand or twelve-strand plated ropes, in slightly larger diameters, also contributed to the relatively low cost of the devices. The complete FAD for 900 m cost approximately Kina 4000 (USD 1250), while the one for 1400 m cost approximately Kina 5400 (USD 1650). Appendix D lists the costs for the different materials used to construct the project FADs.

The costs were based mainly on the gear used. Labour was provided free by volunteers of NICFA who were interested in working on FAD construction, and the NFC provided the FTV *Leilani* for FAD deployments as their contribution to the FAD assignment. The placement of the two FADs will be of mutual benefit to the two organisations — NICFA for the livelihood of its members and the NFC for FAD fishing training for its students.

3.1.4 Deploying the project FADs

The FAD mooring systems were made up in the shed at NFC, ready to be loaded on board FTV *Leilani* for deployment. To facilitate the deploying of the FAD anchor, a pad was constructed at the stern of FTV *Leilani* to act as a carriage bed and a launching device. A wooden apparatus that had previously been constructed for other purposes was used for this function. This was made of two longitudinal hardwood beams with a flat longitudinal plank in between. These were connected by three crossbeams (forward, centre and aft) holding it together to form a holding bed for the engine-block anchor.

The pad was secured to the net rollers aft of FTV *Leilani*, so that it would act as a pivoting point for tipping the engine blocks into the ocean (Figure 11). The anchors were lashed to the carriage bed, which in turn was lashed to the vessel (Figure 12). A ‘stopper’ rope was connected to the forward end of the bed to prevent it from over tipping.

Figure 11: Pad arrangement used for launching the FAD anchor blocks.
On the day of deployment, the FAD materials were loaded onto FTV Leilani. The anchor blocks were secured to the pad and the bottom chain connected. The polypropylene rope was connected to the bottom hardware, and the rope flaked back and forth along the side, followed by the nylon rope (Figure 13). The buoy system was then loaded on board and connected to the nylon rope. Once everything was on board, the vessel headed to the deployment site (Figure 14).
At the deployment site, the position and deployment depth was checked with the echo sounder and GPS. FTV Leilani then motored down current to a point around two-thirds of the rope length from the desired deployment spot. The buoy system was placed in the water at this point and the vessel slowly motored towards the deployment spot (into the current) with the rope being paid out (Figure 15). The vessel passed over the intended deployment spot and continued in a straight line until all the rope was paid out. At this point, which was about one-third the length of rope past the intended deployment site, the lashings that were holding the anchor blocks in place were untied, and the anchor deployed from the pad (Figure 16).

Figure 15: Nylon rope being paid out during the FAD deployment

Figure 16: Anchor blocks being deployed from the pad arrangement
Once the anchor was deployed, the vessel waited for it to reach the bottom and the FAD to settle (Figure 17). The position of each FAD was recorded at this time. The first FAD was deployed on 15 May 2001, with its position recorded as 02˚ 24.25’ S, 150˚ 51.00’ E, in a depth of around 900 m. The second FAD was deployed on 25 May 2001, with its position recorded as 02˚ 49.07’ S, 150˚ 41.20’ E, in a depth of around 1400 m. It should be noted that the position of the buoy will change based on the direction of current, and the ‘watch circle’ or distance from one extremity to the opposite is approximately 1350 m for the first FAD (in 900 m) and 2100 m for the second FAD (in 1400 m).

Figure 17: FAD on station after the anchor and mooring was settled

3.2 Workshops for small-scale fishermen

The running of workshops to introduce new small-scale fishing gears and techniques, sea safety requirements for small boats, and correct handling of the catch, were several of the main objectives of this project.

3.2.1 General

The workshops were formulated and developed to train artisanal fishermen in small-boat safety requirements, plus additional skills to use banana boats to carry out FAD fishing and deep-water fishing techniques, to catch and supply fish of export quality, beneficial to support a commercial fishing industry.

Initially, this assignment was to be implemented in two workshops of ten working days each. However, the large turnout of participants after the first workshop, saw the need to have a third workshop, and an evaluation of the itinerary to accommodate it. After the first workshop the remaining two workshops were rescheduled to be covered in six days each. The demonstration exercises were eliminated in favour of moving directly to actual fishing operation exercises. Appendix E provides the schedule for the six-day workshops.

Because of time limitations, a large number of other interested fishermen had to be listed on a standby list for future consideration. The workshops attracted fishermen from outlying islands in the province as well as New Ireland mainland. The three workshops were completed over four weeks with 51 participants trained. Each workshop had 17 participants, as these were sufficient to man the three banana boats made available by the NFC for the practical components of the workshops. Appendix F
provides a list of the participants for all three workshops.

The participants were given a general briefing and video viewing of the different types of fishing methods that would be conducted during the workshops. These included FAD fishing methods such as vertical longline, trolling, and a fifty hooks horizontal longline; and deep-water bottom fishing using the FAO designed wooden handreel. Other fishing methods such as palu-ahi, drop-stone fishing and ika-shibi were mentioned briefly, just so the participants were aware of these fishing methods.

The different types of fishing gear, tools and accessories were introduced to the participants. These were mainly gears that they were likely to encounter when performing the fishing operations introduced and practised during the workshops.

3.2.2 Sea safety and basic navigation

Small boat safety issues were first to be discussed at the commencement of the workshop, to encourage each fisherman to safeguard himself when proceeding on fishing trips. The issues covered included sessions on small boat safety awareness focussing on topics listed in the SPC small boat safety check list. This dealt with the necessity of checking out the weather before going on the fishing trip, informing someone of the intended destination, ensuring that the engine is in good working order, carrying spare fuel, engine tools and spares, anchor and rope, sea anchor, alternative propulsion, compass, signalling device, floatation device, drinking water, food, First Aid kit, knife, bailing device and canopy for shade.

The SPC video on small boat safety was shown to the participants, followed by an open discussion session. A display of sea safety equipment and fishing gear (Figure 18) was also set up for fishermen to look at, so they could associate this back to the discussions.

Figure 18: Display of sea safety equipment and fishing gear

This in turn was followed by a session on briefing the participants on compass reading and taking visual bearings using compass and landmarks, another very important part of sea safety and basic navigation.

The conclusion to the artisanal fishermen’s workshop was a morning briefing on the importance of small craft management and how each of the boat operators can implement this to effectively run their vessel.
3.2.3 Fishing gears to be used around FADs

The participants were given hands-on training in constructing vertical longlines, a horizontal longline, and trolling lines to be used at the FAD sites. Several methods of gear construction were demonstrated to the participants of the workshop. This included methods for constructing basic gear using hook and line only (only knots used for attachment), then hook, line and crimps, and finally methods using all the modern amenities for constructing gear. This will encourage fishermen to use material that are available to them.

The main equipment to have on hand is hooks and monofilament line. All other accessories are trimmings that enable a smoother fishing operation. The use of modern fishing appliances for the construction of gear has the advantage in that the constructed gear should produce better fishing performance. There should be less chance of line kinking, easier handling of the gear, faster turn around in getting the line back into the water, and stronger line joints. The absence of these appliances should not dissuade fishermen from continuing to go on fishing trips. Therefore the basic methods were demonstrated as a back up for when these appliances are not immediately available to them.

Construction of vertical longlines

Vertical longlines were constructed to have a branchline every 22 m, and to fish to a maximum depth of 462 m. The mainline was made up from 21 lengths of 3.0 mm monofilament nylon, each 22 m long, with leaded swivels crimped in place to join each of the lengths of monofilament together. Branchlines were attached above the swivel along the length of the vertical longline, with the last branchline attached just above the 3 kg sinker. Construction was based on the suggestions in SPC’s technical manual on fishing methods associated with FADs (Preston et al. 1998).

The branchlines were constructed with 6 m of 2.0 mm monofilament line, with a No. 17 tuna circle hook crimped onto one end, and a 0.148 snap with a 9/0 swivel crimped on the other end. The vertical longline was suspended in the water from a 300 mm longline float and a bamboo flag pole marker. Figure 19 shows some workshop participants making up vertical longlining gear, while Figure 20 depicts the vertical longlines constructed during the workshops.

The vertical longlines were wound onto FAO-design wooden handreels, and stored on board the banana boats ready for use. The branchlines were stored in plastic milk crates that made it easier to store on the banana boats.
Construction of fifty-hook horizontal longline gear

The gear configuration for the fifty-hook horizontal longline was much the same as that used in the monofilament basket gear longline system. The mainline was 3.0 mm monofilament with ringed swivels tied on to green polypropylene ropes (Figure 21) at 66 m intervals. This was the mark where a branchline was snapped on. The floatlines were made from nylon rope 10 m long, and was already connected to the mainline, with the coiled rope laid on top of the mainline as it was stacked aboard. The mainline was gathered into a fibreglass drum and stored in the centre part of the banana boat. This allowed for easy deployment and hauling.

The branchlines were constructed of 1.5 m x 5 mm nylon rope from the snap (0.148 snap with 9/0 swivel) to a monofilament join, 20 m of 2.0 mm monofilament line with a swivel after 18 m, and 1.5 m of wire from the end of the monofilament to the No. 17 tuna circle hook (Figure 22). The floats used were 200 mm white plastic longline floats. These were stored separately in the forward part of the banana boat. Each float had a 50 cm nylon rope spliced onto it with a Japanese longline snap on the other end. Floatlines were made from 7 mm nylon rope, 12 m long.
3.2.4 Gear for deep-water bottom fishing

The deep-water bottom fishing gear was made up with a mainline of 500 m x 2.0 mm (180 kg or 400 lb test) monofilament nylon wound onto the spool of an FAO-type wooden handreel. The terminal rig used was made up from 4 m x 2.0 mm (180 kg or 400 lb test) monofilament with three, three-way swivels spaced one metre apart. Individual snoods were 40 cm long, made from 1.1 mm (45 kg or 100 lb test) monofilament, with a sinker weighing 1.5 kg (Figure 23). The snoods were constructed with the hook tied on at one end and a crane swivel with interlock snap at the other end (Figure 23). Hook sizes ranged from No. 14 to No. 17 tuna circle hooks. Two spare terminal rigs were made for each line.
The sectionalising of the mainline, terminal rig, sinker and snoods were meant as a quick turn around or quick change fishing method. This can work in several ways. When the terminal rig and snoods are tangled due to fish action, the whole rig can be removed and a new set snapped on with baited snoods. The line can then be lowered into the water in a short time and fishing resumed while the tangled terminal rig is straightened out and made ready. The snoods with interlock snaps also serve the same purpose. As soon as fish is hoisted onto the vessel the snoods are unsnapped and new baited snoods snapped on. The fisherman is again ready to fish. Alternatively, figure 24 shows the two methods demonstrated to workshop participants, using a “butterfly knot in the terminal rig, or tying the snoods directly onto the terminal rig. The SPC manual on deep-bottom fishing techniques (Preston et al. 1999) provides more information on this fishing technique.
3.3 Results of workshop practical fishing trips

Each of the three workshops had two days devoted to conducting fishing trips, using the gear that was made during the practical sessions, and the techniques covered in the theory sessions. The fishing operations were carried out with the aim of providing the fishermen with practical hands-on experience in using the different fishing methods in real commercial situations.

During the course of the fishing operation, the participants were briefed on the importance of being attentive to the weather conditions. As with all fish of the sea, deep-water bottom fish and pelagic species have a feeding pattern that may differ in areas across the country, and the region. Some of the factors that the fishermen were told to be aware of were the moon phase, tide, wind and the time of day. The fishermen of New Ireland will eventually be able to fully assess the habits of the fish in their area — if they keep careful notes and records of these factors.

A successful fishing trip is one where the value of the fish caught during the trip covers the expenses for that trip, and if possible, makes a bit of money for the fishermen in return. While this is common knowledge to all, most of the fishermen who attended the workshops revealed that their fishing pattern was centred mainly on providing fish for the household or for community functions. Sales of fish only came about as a result of excess fish being caught or the necessity to purchase items for the home. Consistency is lacking in carrying out regular scheduled fishing trips, and this is quite understandable with the absence of a reliable market. Although vessels are bought with the intention of using them for fishing purposes, this is not done on a full-time basis. Most of the banana boat owners use their boats for transportation purposes and part-time fishing.

Figure 24: Alternate ways to make up terminal rigs without swivels
3.3.1 Boat preparation

During the course of the workshops, a gear checklist was developed while the participants proceeded with their work. A small-boat safety checklist was also developed during the course of the workshops. The checklists (Appendix G) included everything that was needed to be stored on the vessel before a fishing trip was pursued. The participants used the gear checklist and the small-boat safety checklist to ensure that the guidelines laid down in these lists were followed. The actual fishing trips were undertaken once all the requirements were met. This applied equally to tuna fishing trips and deep-water bottom fishing trips.

Prior to each fishing trip, the banana boats were prepared with all the fishing gear and equipment necessary for a safe and successful fishing trip (Figure 25). For FAD fishing trips, the two 5.8 m fibreglass vessels were loaded with vertical longline gear, while the 7.0 m fibreglass vessel had the horizontal longline gear loaded on board. For the deep-water bottom fishing trips, the equipment for bottom fishing replaced the FAD fishing gear on all vessels. Deep-water bottom fishing was done with the aid of FTV Leilani, providing backup in the way of being a shelter vessel (mother boat) and the use of the echo sounder for determining better fishing grounds.

![Figure 25: Banana boats ready to head off on a fishing trip as part of the workshop](image)

The participants were instructed on the importance of keeping an orderly system to store and maintain their gear for the different fishing methods. Each item for a FAD fishing trip and a deep-water bottom fishing trip was listed and checked before departing on the trip. The loading of the vessel was done according to these lists. The items for the fishing trips were packed into containers that were easy to carry and were sectioned according to its functions on board. These were: first aid kit, distress kit, food container, water container, anchoring gear, tools, oars, ready constructed fishing gear, spare fishing gear, etc.

At the end of each trip, the gear was returned to the storeroom and again restored methodically. The outboard engines were flushed with fresh water and put back on their rack.

The fishermen were encouraged to maintain this system when handling their own private operation. In this way they will be able to keep track of the equipment they have and know when to replace or repair gear that is damaged. This reduces the chance of a fisherman running short of gear or working with inferior gear while out on a fishing trip.
3.3.2 Results of FAD fishing trials

The quick aggregation of fish around the FADs enabled the FAD fishing methods to be carried out successfully. This was mainly trolling and vertical longline fishing. During the entire FAD fishing trips, the vertical longlines were set before daybreak and left to soak for two hours before they were hauled up for checking and resetting.

The participants tried two methods for setting the vertical longlines. The first method required deploying the float and flag first, before snapping on the branchlines as the mainline was paid out with the banana boat drifting downwind (Figure 26). After all the mainline had been paid out, the sinker was attached to the end and deployed. The line was then left to settle for two hours before it was inspected for fish.

The other method involved releasing the sinker first, then snapping on the branchlines as the mainline was slowly unwound off the reel. At the completion of deploying the mainline, the float and flag were attached and the line left to drift. Each of the 5.8 m vessels deployed three vertical longlines per fishing trip, with these checked at two hourly intervals. At least three hauls were done during the day to check the line.

While the line was soaking, chum bait was scattered up current of the line and this drifted down and past the area where the line was deployed to attract fish to the area. Trolling activities were also undertaken around the FADs.

Vertical longline fishing around FADs resulted in a catch of five yellowfin tuna weighing a total of 212 kg, one bigeye tuna weighing 62 kg, 1 bronze whaler shark of 30 kg, 1 hammerhead shark of 30 kg and one sunfish weighing 60 kg.

Trolling around the FADs produced a catch of 57 skipjack tuna weighing 106.5 kg and 3 mahi mahi (dolphin fish) weighing 6 kg. All weights are whole weights before gilling and gutting. Each banana boat was rigged with two trolling lines, although there was no set schedule when these were used and much of the trolling was opportunistic and left to the discretion of each boat and the person in charge.

Fifty-hook horizontal longline operation

The 50-hook horizontal longline fishing trials were conducted about 2 nm away from the FAD, to eliminate the possibility of snagging the mainline on the FAD mooring. The larger of the banana boats (7.0 m) was rigged to perform the horizontal tuna longline operation. The 3.0 mm mainline was collected into a fibreglass drum-like container, which was a discarded live bait chumming tank for a...
pole-and-line vessel. This made it easier to manage the deploying and hauling in of the line.

Because the line was hand-hauled, the fishing method used was slightly different to that used on larger vessels. Instead of having 20 to 30 branchlines between floats, only four branchlines were connected at a spacing of 66 m. The line was deployed down-wind, with the baited branchlines connected to the mainline as the vessel motored slowly forward (Figure 27). Hauled the line could be conducted from either end, however, at the time of the trials, hauling down-wind (Figure 28) was more advantageous, as it was easier to pull the line in with a slight wind blowing.

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**Figure 27:** Setting the 50-hook horizontal longline from the 7.0 m banana boat

**Figure 28:** Hauling the mainline of the 50-hook horizontal longline
This required less engine manoeuvring. With a strong wind, hauling down-wind may prove difficult, especially when those in the vessel can not keep up with the rate of drift. Hauling up-wind or angled to the wind was not too difficult, but required more engine manoeuvring.

The line was deployed at the same time as the vertical longlines — just before daybreak. Soaking time was between two and four hours and two sets were made during the day. Three sets of horizontal longline with 50 hooks per set resulted in a total catch of 5 yellowfin tuna weighing 211 kg, and one barracuda weighing 9 kg.

3.3.3 Results of deep-water bottom fishing trials

Selecting a good deep-water bottom fishing ground using a small boat without electronic aids, especially an echo sounder or fish finder, can be a wearisome process if a fisherman wants to explore new territories. Two ways to determine whether the fishing ground was productive or not would be to go through a trial process that involved actual fishing and recording of weather conditions and fish catches, or, to consult with the local fishermen of that area. Since this type of fishery is new to New Ireland Province, the second option might not produce any useful information. During the workshop trainings, the echo sounder on FTV Leilani was used to locate suitable fishing locations for the banana boats.

Another dilemma for the fisherman is the selection of fishing depth. Without the use of an echo sounder, it would be difficult for a fisherman to know the depth of water beneath him. Most of the deep-water bottom species targeted for the export market can be found at depths from 100 to 400 m depending on the species. During the workshops, the participants were instructed to have at least 400 m of anchor rope on board their vessels. Depending on the depth preferred by the fisherman, the anchor rope can then be let down to this depth then secured. If the fisherman is still in shallow water the rope can be shortened and tied off, while the fisherman moves the vessel further offshore, towing the rope and anchor.

Deep-water bottom fishing was conducted using FAO designed wooden handreels. The baited terminal rig was lowered to the bottom, and when a fish was hooked, the line wound back onto the reel. As soon as a fish was landed, the snood was unsnapped and a new, baited snood connected, and the terminal rig lowered. The fishing team had a person free to tend to unhooking the fish, spiking and icing them, and preparing baited snoods. This allowed the fishing operation to be conducted at a faster pace and less time was spent in having the line out of the water.

Fishing times were mainly from just before daybreak, and throughout the day until 2300 hours at night. Chum bags were attached to the top of the terminal rig, to allow chum bait to be lowered down with the line and scattered at the bottom. The target species were the Etelis and Pristipomoides species.

Deep-water bottom fishing trials resulted in 126 fish being caught with a total weight of 499.6 kg of mixed species. The iced catch was unloaded from the banana boats to FTV Leilani (Figure 29) for storage on the way back to port after the fishing trials. The four most common species in the catch were also the most valuable for export, with 35 short-tail red snapper (Etelis carbunculus) weighing 175.3 kg, 4 long-tail red snapper (Etelis coruscans) weighing 23.0 kg, 38 goldband snappers (Pristipomoides filamentosus) weighing 112.9 kg and 8 small-tooth jobfish (Aphareus rutilans) weighing 34.3 kg.

Figure 29: Deep-water bottom catch being unloaded from the banana boats to FTV Leilani
One of the deterrents that the fisherman faces in deep-water fishing is the task of hauling up the anchor. To hand-haul 200 to 400 m of rope with anchor and chain is a tiring process. This may result in the fisherman being hesitant to change fishing spot when fishing is poor. To overcome this problem, the participants of the workshop were shown how to use a Polyform float and the outboard engine to make this a simple task.

The float was attached to the anchor rope using a snap shackle. At the end of the rope, before the rope/chain connection, a no return barb was lashed onto the anchor rope. The banana boat was then put into motion in the direction of deeper water, and the float allowed to run down the length of the anchor rope until it was snagged by the no return barb (Figure 30). This allowed the anchor to hang just below the surface from the float, and the floating rope easily collected with the banana boat running down the line.

**Figure 30: Anchor retrieval method**
3.3.4 On board handling and preservation of the catch

One of the main points emphasised to the fishermen is the preparation of the vessel prior to making the fishing trip. Personal hygiene and vessel cleanliness was stressed. The use of clean tools and petroleum free working area were other matters to be considered. This is especially so on outboard operated vessels, where petrol fuel tends to spread throughout the vessel, especially after siphoning fuel from a storage container to the main fuel tank.

Each vessel was equipped with an icebox and sufficient ice to keep fish for the day. For bottom fishing, fish were spiked just behind the eyes (ike jime) as soon as they were boated, and a cut was made in the gill membrane to allow for bleeding. The use of ice slurry was encouraged. For tuna fishing, the fish were boated by gaffing them through the head and landing them on a sponge mattress. The fish were then spiked and bled by making an incision slightly behind the pectoral fin and below the lateral line. The tanaguchi method is then applied. This involves running a monofilament line along the fish’s spine so that it kills the nerves, thus immobilising the fish. The fishermen were instructed to handle all fish carefully to avoid bruising and abrasions.

The iceboxes used on the banana boats during the project were made of hard moulded plastic, approximately 1.2 m long and 0.7 m wide. These iceboxes were suitable for chilling bottom fish species (less than 1.0 m in length) but were too short for the larger pelagic species. Most of the tuna caught during the project could not properly fit into the ice boxes, but were put into the boxes head down to prevent the flesh from spoiling (Figure 31). This meant the lid could not be properly placed on the ice box and the tuna became bent. To satisfy the overseas tuna sashimi market however, this method is not acceptable, as the fish will have a tendency to be bent around the centre.

![Figure 31: Yellowfin tuna slightly bent, as it is too large for the small ice box on the banana boats](image)

3.4 Fishing for and conducting overseas export trial

Another of the objectives for this project was to conduct at least one overseas exporting trial, to test the feasibility and economics of conducting such an activity from Kavieng.
3.4.1 Tuna longline fishing trip for export trial

The final operation for the project was to attempt a tuna export operation out of Kavieng, to markets in Japan or Hawaii. A special tuna longline trip was scheduled to procure tuna for the shipment. Two sets of 300 hooks each were made during the trip and were sufficient to land enough tuna for the export trial.

The first set started at 2100 hours, with the line in the water by 2200 hours. The line was then left to soak all night. Hauling began at 0600 hours the next morning. During line setting, chum bait was also thrown over the side to attract fish to the area. Two methods were used during the longline set. The first line laid out was that on the hydraulic reel. Thirty hooks were set between floats. Branchlines were 15 m long and the floatlines were 20 m long. The line was streamed out the stern of the vessel without the use of the line shooter. After setting all the line on the reel, another 50 hooks were laid out using bag gear. These had four hooks between floats, 15 m branchlines and 10 m floatlines.

The second set was made at 1600 hours and left to soak all night. Hauling of the second set began at 0600 the next day. The same gear configuration was used.

Nine yellowfin and one bigeye were caught on the first set while twenty four yellowfin tuna and six bigeye tuna were caught on the second set. The fish weight came to 1190 kg of which 1115.5 kg of tuna was suitable for export.

3.4.2 Deep-water bottom fishing trip for export trial

NICFA representatives were also interested in having bottom fish exported to the Japanese market, so that an evaluation could be made of its potential as an export commodity from Kavieng. A local fisherman who was one of the leading participants in the first workshop was assigned the task of catching bottom fish species such as *Etelis carbunculus*, *Etelis coruscans* and *Pristipomoides filamentosus*.

Eight *Etelis Coruscans* and eight *Pristipomoides filamentosus* were caught for the export trial, using the same gear as demonstrated during the workshops. This had a total weight of 73.8 kg. Due to lack of space available on the plane, the rest of the fish from this trip had to be sold on the local market by the fisherman.

3.4.3 Processing and marketing the trial shipment of export fish

Marketing of the fish was done through Independent Seafood Producers Pty Ltd of Australia. The fish was channelled to Japan through the companies established network. Prior to attempting the export trial, the company’s Managing Director — Mr David McAtamney was contacted for details on how the export was to be executed. After this initial contact, proper packing cartons or fish coffins were obtained for transporting the fish. With this in place, the fishing trips were scheduled to coincide with the arrival of the transport plane. Details on customs clearance and the paperwork involved were part of the information gathering exercise.

Processing and packing of the fish was scheduled to begin at 0500 hours in the morning. This allowed sufficient time to have the fish packed, labelled and taken to the airport. Because Kavieng has no proper facilities for packing and processing, all the work was done on site at the Jetty. The cool morning air was also good for processing the fish compared to having the sun high overhead.

The fish were carefully taken from the fish hold on FTV *Leilani* and weighed. They were then cleaned with chilled water via a hose running through an Eski with ice slurry, and transferred to the fish boxes. The packing boxes had plastic and Styrofoam insulation lining the inside. The fish were carefully wrapped in the plastic lining with gel-ice packs inside. A gel-ice pack was packed into the gill cavity of every fish. Since the destination market was Japan, the fish were left whole instead of being headed.
Only the tail fins of the longer fish were cut off so that they would be able to fit into the box. The boxes were labelled and taped, then loaded onto the transport vehicle. Packing took one hour and forty-five minutes to complete. The 13 cartons contained 6 bigeye tuna weighing 239 kg and 20 yellowfin tuna weighed 876.5 kg (total fish weight of 1115.5 kg).

In addition to the tuna, one carton was packed with deep-water snappers. The carton contained 73.8 kg of fish, made up of 8 Etelis coruscans (40 kg) and 8 Pristipomoides filamentosus (33.8 kg).

At 0900 hours, the fish was loaded onto the chartered aircraft then transported to Japan via Port Moresby and Cairns.

The result from the trial shipment of tuna and deep-water bottom fish was encouraging. Prices for bigeye tuna ranged from ¥ 300–1800/kg (Kina 7.87 to 47.24/kg or USD 2.39 to 14.34/kg), for yellowfin tuna from ¥ 200 to 2300/kg (Kina 5.25 to 60.36/kg or USD 1.59 to 18.32/kg) and for the deep-water bottom fish from ¥ 100 to 800/kg (Kina 2.62 to 21.00/kg or USD 0.76 to 6.37/kg). Six of the tuna attracted prices of ¥ 250/kg (Kina 6.56/kg or USD 1.99/kg) or less, mainly due to bad flesh colour. Overall the value of the export fish came to ¥ 856,890 (Kina 22,488 or USD 6827), and was above average for fish exported out of Papua New Guinea at the same time. Appendix H summarised the market details and prices paid for the exported catch.

3.5 Additional activities undertaken as part of the project

The Fisheries Development Officer was requested to undertake some additional activities to those originally planned for the project. Most of these activities were undertaken as the local fishermen were keen and interested to learn about other methods that could be used to catch fish in their area, while one activity was to assist NFC with providing back-up training for the CFO 1 students.

3.5.1 Tuna longline training for the CFO 1 students

On arrival in Kavieng, the NFC was running a CFO 1 course. The on board practical fishing is the final stage of the CFO 1 course, where the students were expected to link the theories of fishing, construction of fishing gear, and on board safety practices with the actual fishing operation. The NFC’s training vessel FTV Leilani was used as the platform for carrying out the tuna longlining exercise, in which the Fisheries Development Officer was asked to provide technical backup and support.

Two tuna longline training trips were undertaken, with a group of ten students taken per trip. This number was sufficient to comfortably demonstrate the operation and accommodate the students on board. The two trips were also designed to be intensive so that the students would experience the reality of actual commercial operations before entering the second phase of their training — attachment to commercial operators.

Each trip was programmed to last at least 28 hours in which three sets were expected to be made. This meant the crew would have little time for rest, with the main resting period taken after the third set, expected to be completed by 2230 hours. Line soaking periods during the day were filled in with trolling skipjack and yellowfin tuna schools in the area.

The first group of students were unfortunate not to have experienced the gruelling task that had been planned for them. The trip was cut short after the first set when a fault developed in the mainline reel. The rubber coupling connecting the reel to the drive shaft sheared due to normal wear and tear. Unfortunately, no spares were on board and a proper repair would need to be done in port.

The fault occurred during the line hauling process, which meant the remaining line in the water had to be hand-hauled. This required some students to haul the line, while others wound the mainline onto the reel (Figure 32). Total fish caught from the single set of 200 hooks came to 110 kg — gilled and gutted weights. This consisted of four yellowfin tuna, one broadbill swordfish and a snake mackerel (discarded).
After a day in port and having completed the repairs to the reel, the training vessel departed with the second group of students and successfully completed the round trip as planned. After 3 sets of 200 hooks each, the gilled and gutted weight of fish caught was 9 yellowfin tuna weighing 125 kg, one sailfish of 25 kg, three barracuda weighing 20 kg, and two blue sharks weighing 100 kg.

The CFO 1 students were given hands on training in all aspects to do with a full tuna longline operation. The group of ten students was divided into smaller groups so that each group would begin by performing one duty at the start of the tuna longline operation. The duties would be rotated upon deployment or retrieval of a longline float. After an initial demonstration, the students were given the full responsibility of handling all the duties required for a tuna longline operation.

For the line setting operation the duties performed by the students included:

- Unsnapping and freeing the branchlines from the bins;
- Baiting the hook and completely deploy the branchline before snapping it on to the mainline;
- Prepare floats for deployment;
- Deploy floats and ensure that the floatline is clear of the vessel before snapping onto the mainline;
- Ensure that the bait bin has a constant supply of bait;
- Ensure that a consistent spacing is kept between hooks, approximately 50 m;
- Ensure that the same number of hooks are maintained between floats as per instruction of the skipper;
- Keep the working area clear of obstructions and in a clean state; and
- Ensure that the radio beacon is in good working order before deploying.

During the hauling operation, the students performed all the duties required for retrieving the line and storing it for the next line setting operation. Fish handling and on board storage was also one of the important roles practised by the students (Figure 33). The duties performed during the hauling operation included:
• Preparing the hydraulic gear for line hauling;
• Prepare the deck for receiving fish — lay out rubber mats, sponge mattress and all the necessary tools;
• Connecting up the mainline prior to hauling;
• Line hauling operation;
• Unsnapping the branchlines and relocating them to the branchline bins;
• Disposing of returned bait into the chum bin;
• Retrieving and storing floats and float lines;
• Use proper line hauling techniques to pull the fish alongside the vessel ready for gaffing;
• Use proper gaffing techniques to land fish;
• Handle and treat the fish with the standard methods for sashimi grade tuna; and
• Repair all fishing gear for the next operation.

3.5.2 Constructing and using arrowhead traps

The frames of two arrowhead traps were revived to be used in the deeper waters surrounding New Ireland Province, especially the Kavieng area. The traps were constructed previously as part of a fisheries research project for shallow water species. The traps were left to deteriorate after the project had finished. The frames for the traps were re-welded and smoothed over with a grinder. Chicken coop mesh wires (25 mm) were secured over the frames and a single cone vent was made at the arrow tail end for fish to enter. An opening was cut into the top end of the trap and the door secured in place. This was to allow fish to be removed from the trap and for placing and securing bait in the trap. One of the traps was made to lure only larger fish species while the other trap was designed to catch fish and possibly deep-water prawns or shrimps. This had a fine meshed nylon net covering over the wire mesh (Figure 34). Bridle ropes were spliced onto the forward part of the arrowhead and sinkers were secured to the bottom of the trap to enable it to settle well on the sea bottom.

Figure 34: Arrowhead trap with attachment bridle
Unfortunately, the traps were only set for short periods and could not be left in the water longer due to the tight schedule that was in place for the Fisheries Development Officer. En route to carrying out the FAD site surveys, the two arrowhead traps were deployed in depths ranging from 200 to 400 m. The traps were left to soak for up to 5 hours and collected on return to the NFC jetty. Nothing was caught during the time the traps were in the water, but the possibility of testing the trap’s effectiveness for catching deep-water bottom species remains. The traps need to be left in the water longer with a careful watch being kept on the marker floats. Local fishermen and transport boats tend to pick these up when passing.

3.5.3 Bait fishing gear and techniques

At the request of several members of NICFA, the Fisheries Development Officer demonstrated two baitfish catching techniques that might be of interest to them, bouke-ami and small boat purse seine. These were done after hours in the Fisheries Development Officer’s spare time since the provision for bait catching techniques was not included in the initial objectives. The methods that were demonstrated were mainly for being used off small craft such as the banana boats.

Large schools of bait species were observed in the area around Kavieng. Several bait species were readily identified that could be used as prospective tuna longline bait, or bait for other fishing operations. These are the barred garfish (*Hemirhamphus far*), bigeye scad (*Selar crumenophthalmus*), and especially the yellow-lined scad (*Selaroides leptolepis*).

Bait catching exercises could not be conducted in their ideal form, as several factors prevented this. The deteriorating weather and lack of the right type of equipment were some of the deterring factors. Despite this, baiting exercises were demonstrated to give the interested parties a fair idea on how each operation worked.

Bouke-ami

The net used for bouke-ami baiting was 10.3 m in length and 8.3 m wide. This was a suitable size to be used off a 7 m banana boat. The demonstration exercise though, was conducted from an 11 m fishing vessel, so that more hands could participate in the operation and benefit from the exercise. The bouke-ami gear (Figure 35) was made up of the net (8 mm stretched-mesh kurolon material), 6 bamboo poles, 12 mm ropes, 2 lengths of chain (11 m x 12 mm) for sinkers and 7 mm lashing ropes. The net itself can be used in several lift net baiting techniques.

![Figure 35: Bouke-ami net showing the main components](image-url)
The outside edge of the net was secured to two bamboo poles that were lashed together to accommodate the length of the net (Figure 36). A length of chain was secured across the centre of the net and ran the full width. This chain acted as the holding-down weight of the centre bag part of the net. This allowed a bag to be formed when the net was closed and pulled in. If this weight wasn’t allowed for, the centre net area may swell upward with the push of the current and scare the bait out of the net before it could be closed. Two bamboo poles secured to each other acted as the forward and aft holding arms of the net. These poles were used to push the net to its full distance away from the vessel before it is set, then shortened when the net was closed after the bait had been lured in.

![Figure 36: Lashing the end of the net to bamboos](image)

A 1000-watt underwater light and bright overhead lights on the vessel were used to attract the baitfish to the area. The underwater light was streamed out at sunset. Unfortunately, the bait light dimmer did not function, as its amperage was too small to handle the 1000 wattage used. The baiting exercise was done anyway to demonstrate to the participants the reaction of the baitfish when entering the net without adequate dimming, the effects of the current on the net when it is set with the current still running, and the use of a kerosene lantern to lure bait into the net.

To perform a proper bouke-ami baiting operation the bait light should be gradually dimmed so that the baitfish area of circulation around the lights is lessened. All other lights on the vessel should be turned off. When the bait master is satisfied with the aggregation and movement of bait around the light he may request that the net be lowered into the water and given time to settle. Once this is achieved the light can again be dimmed to about 60 watts and the fish lured into the net. Dimming can be done to as much as 20 watts. This all depends on the bait master’s observance of the bait activity. With the light at the centre location, between the outer floating bamboo and the vessel, the bait master should again check on the bait behaviour and if satisfied the call to raise the net should be given.

However, the practice set conducted with the participants at this time demonstrated the behaviour of bait and its reaction to the net as it was lifted. All the normal procedures were carried out except for the dimming of the light. This gave the participants an insight into how the bait reacted and demonstrated the importance of properly aggregating the bait around a dim light before the call is given to lift the net. The bait followed the bright light to the centre of the net but was scattered. As soon as the net was lifted, the approaching bottom of the net scared the bait out the front and stern ends.

The second set demonstrated the importance of the current and its effects on the baiting operation. Again, following all the normal procedures for a bouke-ami baiting operation except for the dimmer,
the net was lowered while the current was running. The participants had a difficult time trying to control the net position and found it tiring trying to pull in the sinkers to close the net. In most bouke-ami operations this mostly led to the bait escaping, except for baiting masters with experience who position the anchor rope so that it could be used to advantage.

The third set was done with an overhead lantern and the normal procedures for bouke-ami. Although this went well, the bait aggregated at the closing of the net were only of the smaller species and were not suitable for tuna longlining. The bigger bait such as scad and garfish were not entrapped, probably due to lack of time spent in getting them to aggregate before closing the net.

**Small-boat purse seine for baitfish**

Another effective method of entrapping bait is the use of a purse seine net. A small-scale beach seine net was modified and tried out as a pursing net to be used off a banana boat. The net was 150 m in length and 15 m at its deepest section, which was around the bag area. The beach seine bag was cut out and the section mended with a net covering (Figure 37). The net mesh was 30 mm. Extra floatation was added to the floatline and purse rings were lashed along the footrope section of the net to pass the pursing line through (Figure 38).

![Diagram of small-scale purse seine net](image)

**Figure 37: Making up a small-scale purse seine net from an old beach seine net**

**Figure 38: The construction of a small-scale purse seine net**

Due to a shortage of time, the Fisheries Development Officer could not perform a full baiting operation with the participants, however, a trial set was done with a group selected from the Nanovaul Islands. The trial set was successful in demonstrating how the method could be used. The Nanovaul Islanders volunteered to try the method out and to adjust the system as the need arose. Discussions were carried out with the islanders on the methods they could use.

The small-scale purse seine net can be used in several ways. One way is to chase up on a bait school and surround it with the net, purse the net to close the bottom, and haul the net in. This will require the banana boat to do a searching trip then execute the set when a school is spotted. This may work well with a net that has a deeper centre section, at least to 30 m. In daylight, the pursing section of the net
will easily be spotted by the baitfish. To speedily deploy the net, the vessel should be designed in such a way to have the net running freely over the stern as the school is being surrounded. The outboard engine on a banana boat will be an obstruction in this case. The net can be deployed off the bow with the vessel going astern, but for daytime pursing, speed is the factor to consider, for both surrounding and pursing.

Another method can be done along the same principles as the bouke-ami method. This will require a vessel to attract bait by drifting with an overhead lantern or an underwater light with a dimmer switch. Once sufficient bait has aggregated around the vessel, the second vessel with the purse seine net on board can surround the aggregated bait and haul it in. Several variations to the use of lights can be implemented but the method works on the principle of the light attracting the baitfish while the net vessel purses the aggregated bait. The advantages of this system are that it can be performed on the open sea and there would be less chances of the baitfish spotting the pursing section of the net. The aggregated bait can be surrounded at a much slower pace. A banana boat can be used in this case. The vessel can be driven astern with the net running off the bow until the bait is surrounded.

4. DISCUSSION AND CONCLUSIONS

The technical assistance provided to members of the NICFA, with assistance and support provided by staff of NFA, was timely and very successful. The project covered many areas of interest, including some specific to members that were not part of the original objectives.

4.1 General

The geographical position of New Ireland gives the islanders access to fishing grounds that are rich in pelagic fish resources and the option to fish different grounds as seasonal changes occur. Deep-water bottom species are also obtainable throughout the waters surrounding the islands in the province, with some fishing grounds yielding more of a particular species than others. As commercial fishing gets further established, a better understanding of fish movements and species location will develop and hopefully fisheries management plans will be developed and put in place to control the exploitation of bottom and pelagic species. When management plans are developed, all stakeholders in the industry should be consulted to ensure that all interests are considered. With management in mind, the NICFA will have the task of continuing to educate and train their fishermen to work towards maximising catches and benefits, however, at the same time ensuring that development is sustainable for future generations.

NFA currently has a radio monitoring station in place. This system should be fully used for radio communications between ship and shore. As the industry develops, NICFA should arrange with the college to have the monitoring station operational around the clock to increase safety for the NICFA fishermen. A cost sharing arrangement for the operation of the radio facility will need to be developed and agreed upon by NFC and NICFA.

NICFA should explore the possibility and options for putting in place a strategy for making funds available to its members to equip themselves with the appropriate gear to pursue deep-water bottom fishing and small-scale tuna fishing activities. Loan repayments would probably be easier on the fishermen if it is deducted as a percentage of their catch per trip instead of a fixed rate per week or month. Options include the NICFA acting as a cooperative to market the catch of members, or one or several of the local fish buyers offering this service. This strategy should be investigated and activated if the results of the analysis prove viable and workable. The fishing gear required for pursuing commercial fishing can be expensive to procure when initially setting up a vessel, but as fishermen establish themselves, only small amounts of replacement gear will be needed.

NICFA should look at compiling a full safety gear kit for issue to fishermen in the association. The cost of the safety gear kit can be deducted along the same system as suggested for the issue of fishing gear, if a workable option can be found.
The fishermen of New Ireland should be able to have a reliable and consistent means of obtaining regular information on the weather and tide movement. NICFA should liaise with NFC staff for providing the means to supply this information. The NFC is also connected to the countries Internet system and can use this to download a daily tide table for the New Ireland region from the Admiralty Tide Tables. Updated weather information can also be obtained through an appropriate web page on the Internet and provided to members of the NICFA, through a central point.

4.2 Fishing activities

The current project has revealed the genuine desire of the New Ireland fishermen to develop their industry to be competitive with similar industries around the country and within the region. The turnout and input of the small-scale fishermen at the three workshops was indicative of the village people’s hopes that an industry be formed to be of economic benefit to them.

Small-scale horizontal longlining, vertical longlining and deep-water bottom handreel fishing methods were mainly considered for pursuing a fishery targeting the export sashimi and bottomfish supply markets. While some of the fishing methods were known to the New Irelanders, doing it on a commercial scale to supply export markets was a new experience for most of them. The necessity of maintaining quality was not lost on the participants who understood that their efforts would be rewarded by the state of the market at the time of fish sale, and by the quality of the fish they produced. On board handling of fish and the methods applied to produce quality fish instilled a lot of awareness in the participants as to how selective the overseas buyers can be. Fish quality will need to be maintained at a high level if export markets are to be developed and maintained.

The concept of having a mother boat or catcher boat system should be encouraged for deep-water bottom and small-scale tuna fishing when considering the use of banana boats. The mother boats can be a vessel of 10–15 m in length, with an enclosed superstructure for shelter. The mother boats can carry the bulk of the ice, fuel, bait, spare fishing gear and food, etc; to be supplied to the banana boats when out on a fishing trip. Hot meals and a sheltered resting place should be on hand for the banana boat fishermen. A mother boat with an echo sounder and radio communications would be a perfect base. When travelling to and from fishing grounds the banana boats can be towed. At the fishing ground, the mother boat can use its echo sounder to spot potential areas where a banana boat can be anchored for deep-water bottom fishing. Each banana boat should be equipped with a hand-held VHF radio for communications, with regular radio contact with the mother boat. The fishermen from the banana boats can stay out for the full week and return with a good payload instead of having to do daily trips that may not give good returns compared to the cost of the trip. A group of three or four banana boats should constitute a manageable group when working with the mother boat.

The potential for a bait fishery in New Ireland seems promising and should be further explored to determine the range of bait species available and whether this can be successfully and sustainably exploited on a commercial scale, to supplement the bait requirements for the tuna longline industry and other fishing activities. A baitfish survey could be conducted around New Ireland waters, with methods developed so that the open sea area can be fished for bait species as well. Fishing the open sea area will give all fishermen equal opportunities compared to inshore waters where territorial rights may pose a problem in the future.

While bouke-ami is an effective bait catching method, it requires a lot of skill and is susceptible to currents. The baiting vessel will have to be anchored and should have an underwater light with a dimmer. The power supply for this will have to be drawn from a portable generator capable of generating power to illuminate 1000 watts. The small vessel (banana boat) purse seining method that was instigated during the project is a better option for the islanders. This should be pursued so that a proper net design can be adopted and recommendations put forward for developing the technique.

The use of banana boats is a good start to a commercial export fishery, although it is not sufficient to develop the industry to a large scale or at least provide sufficient fish to support the cost of flights out
of Kavieng to the export markets. More attention should be given to developing and using small-scale tuna longliners in the 10–20 m length range, and the training of the islanders to man these vessels. Infrastructure is currently being planned and implemented by NFC to cater for ship repairs, onshore processing and export requirements. These facilities will be leased out to the private sector with arrangements made to give the students industrial training in real life operations. NICFA should capitalise on this arrangement and consider putting in place a plan to attract larger boat owners to be based in New Ireland or work out a boat-purchasing scheme that will benefit the Islanders and the Association. A team should be selected to explore possible options or ways of developing the fish export industry using 10–20 m vessels, and the planned infrastructure.

**4.3 Maintaining an ongoing FAD programme**

Part of the strategy for developing the New Ireland fishermen to contribute to the export industry is the installation of FADs in appropriate locations that are accessible to them and suitable for aggregating pelagic species. The installation of the FADs before the workshops began was crucial for the success of the workshops in that the participants could carry out FAD fishing methods under real conditions. Now that several FADs are in place and fishermen have been trained in fishing techniques to maximise the use of these devices, and ongoing FAD programme needs to be implemented by the NICFA for its members. Such a programme should include the purchase of materials for new or replacement FADs, and the carrying out of routine maintenance of the FADs in the water, to maximise their lifespan. NICFA will need to explore options for funding and ongoing FAD programme, and work in with NFC for possible technical support when needed.

Another option that has already been suggested by the NFCSP team leader, is the installation of cheap FADs along the coast. These should be simple in design and with lighter gauge materials. Observations of these FADs could be carried out and the outcome of durability, lifespan and cost compared to the more expensive FAD designs.

Four site surveys were conducted during the project, with two FADs deployed at the most suitable sites. The method used for initial selection of sites to be surveyed was to talk to local fishermen who trolled for tunas. Charts were also consulted to look at the slope of the seabed and the depth in the areas identified by local fishermen. This worked well and the same process should be followed for future selection of sites to be surveyed.

Several problems were identified during the site surveys, FAD deployments, and observations during fishing trials, which will need to be considered in the selection of future FAD deployment sites. The main problem was current strength in some locations. Tests for current movement were carried out during the site surveys, however, it was later observed that several FAD survey sites had extremely strong currents passing through the area, although this was not readily apparent during the times that the site surveys were carried out.

One of the reasons for this was that only the surface current was assessed during the survey using a floating bucket with a float attached. The current recorded at the time was around 0.5 to 1.5 knots, which was considered an acceptable level. With an anchored object, the full brunt of the current is felt on the mooring system. The movement of water passing the mooring rope is felt at all levels. From the appearance of the wake of water passing the buoys of the FADs deployed, it seemed that the stronger force of the current was at a much deeper level than that tested during the surveys.

It is difficult to overcome the issue of strong currents, especially those deep in the water column. Sometimes local fishermen are aware of areas with strong currents, which they have learned from their fishing activities. Another rule of thumb is to stay away from passages in reefs, where water is funnelled through, thus increasing current or tide strength.

The problem with strong currents is that they can pull all or part of the buoy system underwater. At the time of deployment of the first FAD, the current was at its lowest velocity so 52 of the 57 floats in the
buoy system were visible floating on the surface. As the tide started to change, the current velocity picked up and the floats started to gradually disappear beneath the waters’ surface. This continued until only 15 of the 57 floats were visible on the surface.

In stronger currents or tide flows, more of the floats in the buoy system could have been pulled under. The pressure on these purse seine floats, which are not pressure floats, as they go deeper, will often crush the floats, so they lose some of their buoyancy. Over time the buoy system loses its total buoyancy as the individual floats are crushed more as they go deeper. The best approach to reduce the chance of this happening is to modify the design of the buoy system, and incorporate some pressure floats into the system, so that adequate buoyancy is provided. This change should be incorporated into any new FADs that are deployed in this area.

Although the areas where the FADs were deployed were well known fishing areas for the fishermen who engaged in troll fishing, the quick aggregation of fish around the FADs was exceptional. It took only two weeks for the FADs to successfully aggregate fish. Possibly, the effects of soaking the stripped net aggregators in seawater two weeks before deploying the FADs may have contributed to this. Both areas may also be natural baitfish aggregating grounds. Given the success of the FADs to aggregate fish so quickly, all future FADs should have an aggregator attached, and the current FADs should have the aggregator maintained on a regular basis.

The FAD deployment sites were recorded and relayed to the Safety Officer at the Papua New Guinea Maritime Division of the Department of Transport and Civil Aviation. A mention of this was also included in the Weekly Notice to Mariners warning vessels passing through the area to keep at least one nautical mile away from the positions. This procedure should be followed for all future FAD deployments as well.

4.4 Workshops and training

The number of interested fishermen who turned up during the course of the first workshop to register for the other workshops indicates the interest of the New Ireland fishermen to advance their fisheries knowledge. Comments made by the fishermen who attended the first workshop inspired other fishermen to register their names with the NICFA.

The success of the three workshops was mainly due to the enthusiasm shown by these fishermen. Careless fishing techniques and fish handling methods were eliminated towards the end of the workshops. The fishermen were made aware of the necessity of producing high quality fish for higher prices on the export market. Safety issues that used to be taken for granted were made a priority on the fisherman’s checklist to be sorted before embarking on a fishing trip. Gear wasting attitudes were corrected so that the fishermen would be able to save money on fishing gear. The fishermen were also encouraged to communicate with each other and to share fishing information whenever possible so that a better appraisal of the choice of fishing grounds can be made before they set out on a fishing trip.

The decision to have only seventeen participants per workshop was mostly based on the accessibility of only three banana boats made available by NFC. Fishermen who owned boats were invited to put together a team and participate in the workshops but they were not able to do so as their boats were engaged in community obligations. Unfortunately, the three workshops were insufficient to accommodate the number of people interested in attending. Over one hundred names were registered but only 51 could be selected. The selection was based on the order of registration. Given the interest of local fishermen, and the number who were unable to be accommodated in the workshops, additional workshops could be organised through the NFC with assistance of the NICFA. This would allow more fishermen to be trained in the different mid-water tuna fishing methods and deep-water bottom fishing.

The NICFA should continue to work closely with the NFC to develop the fishing industry in New Ireland. The NFC has the facilities and the staff to train, advise and assist members of the association in commercial fishing requirements. Workshops or specific trainings could be organised on different
topics as needed or identified by fishermen or the fish buyers and processors. Fishermen from as far away as Namatanai were interested in attending workshops or receiving training. Thought should be given to having workshops or trainings on location around the New Ireland Province. This would give the New Ireland sectors equal opportunity in having their fishermen trained.

The next topic for training that needs to be looked at by both NICFA and NFC is in the area of business management, or operating a small business. If artisanal fishermen are going to make the move to commercial fishing, then they will need business management skills. Possibly NICFA and NFC could look at this jointly, and develop a one-day course to introduce the basics to prospective commercial fishermen in the province.

5. RECOMMENDATIONS

The following recommendations are made based on the results of the current project, and the experience of the Fisheries Development Officer. The recommendations are presented under the same headings as for the discussion and conclusions, for ease of reference.

5.1 General

It is recommended that:

(a) NICFA work with staff of the National Fisheries Authority to develop management plans for different species, such as tunas and deep-water snappers, especially in the area around New Ireland, to ensure sustainable harvesting of these resources;

(b) In the development of management plans, consultations need to be held with relevant industry groups and other stakeholders, to ensure their views are considered in the development of each plan;

(c) NICFA works with NFC to expand the use of their radio facility, so it is operational around the clock, with a cost sharing arrangement worked out between the two groups;

(d) NICFA explore the possibility and options for putting in place a strategy for making funds available to its members to purchase fishing equipment, and/or kits of sea safety equipment, with loan repayments deducted as a percentage of their catch per trip; and

(e) NICFA liaise with NFC staff to work out an arrangement where daily tide and weather information can be obtained and forwarded to NICFA members through a central point.

5.2 Fishing activities

It is recommended that:

(a) The fishermen of New Ireland, through NICFA or their fish buyers, ensure that they produce a high quality product that can develop and maintain exports markets now and in the future;

(b) Fishermen in New Ireland look at the option of fishing three or four banana boats to a mother boat, with the group fishing for a week at a time to reduce operating costs, provide a sheltered resting place for banana boat fishermen, and increasing the chance of a good catch and higher profits;

(c) If a mother boat approach is taken, the banana boats have hand-held VHF radios and keep regular radio contact with the mother boat for safety reasons;
(d) A baitfish survey be undertaken in the waters around New Ireland to assess the species composition of the catch and the possibility of developing a sustainable fishery;

(e) The baitfish survey include trials in the open sea where there are no traditional rights restricting access;

(f) Both the bouke-ami and small-scale purse seine fishing methods should be trials during any baitfish survey, ensuring the correct materials are used to maximise the effectiveness on the gear; and

(g) NICFA set up a team to explore possible options and ways of developing a tuna longline export fishery using 10–20 m vessels in the New Ireland area, using the planned infrastructure at Kavieng to support this development.

5.3 Maintaining an ongoing FAD programme

It is recommended that:

(a) NICFA implement an ongoing FAD programme in support of its members ensuring that materials are purchased for new or replacement FADs, with options explored for funding this programme;

(b) NICFA also implement an ongoing maintenance programme for the FADs in the water to maximise their lifespan;

(c) NICFA work with NFC and seek technical assistance when needed to support the ongoing FAD programme;

(d) NICFA consider deploying a series of light design FADs that cost considerably less, and compare their durability, lifespan and cost to the more expensive ones;

(e) When looking at possible new locations to survey for potential FADs sites, local fishermen with tuna trolling experience in the area be consulted to help identify the areas to be surveyed, with a chart consulted to check seabed slope and depth;

(f) When an area is identified for surveying for a possible FAD site, local fishermen are consulted to check if they are aware of strong currents in the area;

(g) For all future FADs deployed in the New Ireland area, the buoy system be changed to incorporate several pressure floats to assist in maintaining buoyancy of the buoy system in areas with strong current;

(h) All future FADs should have a aggregator attached to assist in reducing the time it takes to aggregate fish, and the current FADs should have the aggregator maintained on a regular basis;

(i) Aggregators should be pre-soaked in seawater for several weeks before being attached to FADs; and

(j) The Safety Officer at the Papua New Guinea Maritime Division of the Department of Transport and Civil Aviation be notified of the position for all future FADs deployed in the New Ireland area.
5.4 Workshops and training

It is recommended that:

(a) NICFA in association with NFC, arrange similar workshops to those conducted during this project, so that those that missed out can receive the same training;

(b) NICFA in association with NFC look into other areas of training that local fishermen need, and set up workshops or specific trainings as identified by the association of local fishermen;

(c) Future trainings be organised for implementing in other areas within New Ireland Province, so that fishermen from other areas have equal access to relevant training; and

(d) NICFA and NFC should look at developing a one-day course to introduce basic business management skills to prospective commercial fishermen in the New Ireland Province.

6. REFERENCES


Appendix A

Specifications of FTV Leilani including gear and electronics

Specifications

- Moulded length: 15.9 m
- Overall length (bowsprit and landing platform): 17.1 m
- Beam at transom: 4.2 m
- Beam midships: 4.9 m
- Dimensions of shaft: 7 cm stainless steel
- Dimensions of the propeller: 4 blade 94 x 86 cm
- Main engine: Caterpillar 3406B
- Main engine HP: 491 HP
- Main engine voltage: 24 V DC
- Electrical generator: 12 kVA
- Gearbox ratio: 2.636 : 1
- Fuel tank capacity: 4 x 1,100 l and 2 x 500 l
- Water tank capacity: 1 x 800 l
- Oil tank capacity: 1 x 230 l

Equipment

- Zeigra-Eismaschwen salt-water ice machine
- Leahy 7 nm capacity hydraulic longline reel with side-mounted longline guide
- Hydraulic line shooter
- Branchline hauler
- Two trawl winches with net drum and transom roller
- Trap hauler
- Three steering stations
- Deck wash pump
- Bunks for 9 people
- Cooking and washing facilities, refrigerator and toilet.

Wheelhouse electronics

- JRC colour plotter model NWU–52 A; Appendix B1
- Data recorded by waypoint for FAD survey area 1
- JRC global positioning system (GPS) model JLR–4500;
- JRC radar model JMA–320K;
- JRC paper echo-sounder model JFF–620;
- JRC video colour echo-sounder model JFV–120;
- Taiyo Simrad automatic digital direction finder (RDF) model TD–L1100;
- GMZ Electronics VHF marine transceiver model GX558; and
- Barrett VF transceiver model 550.
## Appendix B1

Data recorded by waypoint for FAD survey area 1

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| WP28: $02^\circ 45.75^\prime$ S $150^\circ 27.00^\prime$ E | 1070 | WP29: $02^\circ 45.75^\prime$ S $150^\circ 26.75^\prime$ E | 1064 | WP30: $02^\circ 45.75^\prime$ S $150^\circ 26.50^\prime$ E | 1060 |
| WP31: $02^\circ 45.75^\prime$ S $150^\circ 26.25^\prime$ E | 1064 | WP32: $02^\circ 45.75^\prime$ S $150^\circ 26.00^\prime$ E | 1060 | WP33: $02^\circ 45.75^\prime$ S $150^\circ 25.75^\prime$ E | 980 |
| WP34: $02^\circ 45.75^\prime$ S $150^\circ 25.50^\prime$ E | 983 | WP35: $02^\circ 45.75^\prime$ S $150^\circ 25.25^\prime$ E | 990 | WP36: $02^\circ 45.75^\prime$ S $150^\circ 25.00^\prime$ E | 993 |
| WP37: $02^\circ 46.00^\prime$ S $150^\circ 25.00^\prime$ E | 997 | WP38: $02^\circ 46.00^\prime$ S $150^\circ 25.25^\prime$ E | 1000 | WP39: $02^\circ 46.00^\prime$ S $150^\circ 25.50^\prime$ E | 1000 |
| WP40: $02^\circ 46.00^\prime$ S $150^\circ 25.75^\prime$ E | 996 | WP41: $02^\circ 46.00^\prime$ S $150^\circ 26.00^\prime$ E | 1043 | WP42: $02^\circ 46.00^\prime$ S $150^\circ 26.25^\prime$ E | 1064 |
| WP43: $02^\circ 46.00^\prime$ S $150^\circ 26.50^\prime$ E | 1062 | WP44: $02^\circ 46.00^\prime$ S $150^\circ 26.75^\prime$ E | 1052 | WP45: $02^\circ 46.00^\prime$ S $150^\circ 27.00^\prime$ E | 1017 |
Data recorded by waypoint for FAD survey area 4

<table>
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<tr>
<th>Position</th>
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<th>Position</th>
<th>Depth (m)</th>
<th>Position</th>
<th>Depth (m)</th>
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<td>WP2: 02° 49.00' S 150° 40.25' E</td>
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<td>WP5: 02° 49.00' S 150° 41.00' E</td>
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<td>WP6: 02° 49.00' S 150° 41.25' E</td>
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<td>WP8: 02° 49.00' S 150° 41.75' E</td>
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<td>WP11: 02° 49.25' S 150° 41.75' E</td>
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<td>WP12: 02° 49.50' S 150° 41.50' E</td>
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<td>WP14: 02° 49.25' S 150° 41.00' E</td>
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<td>WP16: 02° 49.25' S 150° 40.50' E</td>
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<td>WP17: 02° 49.25' S 150° 40.25' E</td>
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<td>WP18: 02° 49.25' S 150° 40.00' E</td>
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<td>WP20: 02° 49.50' S 150° 40.25' E</td>
<td>1511</td>
<td>WP21: 02° 49.50' S 150° 40.50' E</td>
<td>1497</td>
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<td>1518</td>
<td>WP27: 02° 49.50' S 150° 42.00' E</td>
<td>1518</td>
</tr>
<tr>
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<td>WP30: 02° 49.75' S 150° 41.50' E</td>
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<td>WP32: 02° 49.75' S 150° 41.00' E</td>
<td>1485</td>
<td>WP33: 02° 49.75' S 150° 40.75' E</td>
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<tr>
<td>WP34: 02° 49.75' S 150° 40.50' E</td>
<td>1502</td>
<td>WP35: 02° 49.75' S 150° 40.25' E</td>
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<td>WP36: 02° 49.75' S 150° 40.00' E</td>
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<tr>
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<td>WP38: 02° 50.00' S 150° 40.25' E</td>
<td>1523</td>
<td>WP39: 02° 50.00' S 150° 40.50' E</td>
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<tr>
<td>WP40: 02° 50.00' S 150° 40.75' E</td>
<td>1489</td>
<td>WP41: 02° 50.00' S 150° 41.00' E</td>
<td>1483</td>
<td>WP42: 02° 50.00' S 150° 41.25' E</td>
<td>1475</td>
</tr>
<tr>
<td>WP43: 02° 50.00' S 150° 41.50' E</td>
<td>1475</td>
<td>WP44: 02° 50.00' S 150° 41.75' E</td>
<td>1463</td>
<td>WP45: 02° 50.00' S 150° 42.00' E</td>
<td>1466</td>
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<tr>
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<td>1461</td>
<td>WP47: 02° 50.25' S 150° 41.75' E</td>
<td>1449</td>
<td>WP48: 02° 50.25' S 150° 41.50' E</td>
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<tr>
<td>WP49: 02° 50.25' S 150° 41.25' E</td>
<td>1413</td>
<td>WP50: 02° 50.25' S 150° 41.00' E</td>
<td>1442</td>
<td>WP51: 02° 50.25' S 150° 40.75' E</td>
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<tr>
<td>WP52: 02° 50.25' S 150° 40.50' E</td>
<td>1478</td>
<td>WP53: 02° 50.25' S 150° 40.25' E</td>
<td>1477</td>
<td>WP54: 02° 50.25' S 150° 40.00' E</td>
<td>1509</td>
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</tbody>
</table>
Mooring calculations for the two FADs

Information on FAD gear

- Polypropylene rope: 220m x 20mm x 40.8 kg.
- Nylon rope: 220m x 16mm x 37.9 kg.
- Thimble: 16mm x 0.4 kg
  : 26mm x 1.1 kg
- Wire Rope: 16mm (6 x 19) galvanised with PVC tube coating to 25mm. 30m x 34.4 kg.
- Wire rope grips: 26mm x 1.3 kg
- Safety Bow shackle:
  16mm (SWL 2t) x 0.6 kg.
  26mm (SWL 6t) x 1.8 kg.
- Steel swivel: 16mm x 0.9 kg.
- Galvanised chain:
  13mm links x 15m x 48.5 kg.

Buoyancy and weight of hardware in air and seawater.

- 20mm Polypropylene: Weight in air is 0.18545 kg/m. Buoyancy in SW is 0.18545 x 0.1163 = 0.0216 kg/m.
  (0.1163 kg is the weight lifted in seawater by 1kg of polypropylene rope).
- 16mm Nylon rope: Weight in air is 0.1723 kg/m.
- 13mm Chain: weight in air is 3.23 kg/m.
- Weight in seawater of Bottom hardware to be lifted: 12.2 kg x 0.869 = 10.6 kg + 5 kg safety margin = 15.6 kg (3 m chain = 8.42 kg, steel swivel = 0.78 kg, 2 x 16 mm shackle = 1.0 kg, 16 mm thimble = 0.35 kg, 5 kg safety margin).

Minimum 20mm polypropylene rope required to lift 3m of 13mm chain and hardware

Weight of hardware to be lifted = 15.6
Buoyancy of rope = 0.0216

722 m
**Calculation of rope lengths for 900m site depth**

<table>
<thead>
<tr>
<th>AB (Nylon rope)</th>
<th>150M</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCDE (Catenary curve)</td>
<td>25% of site depth = 225m</td>
</tr>
<tr>
<td>BCD (Nylon rope)</td>
<td>75% of BCDE = 169m</td>
</tr>
<tr>
<td>Total Nylon rope ABCD</td>
<td>319m</td>
</tr>
<tr>
<td>DE (Polypropylene rope)</td>
<td>25% of BCDE = 56m</td>
</tr>
<tr>
<td>EF (Polypropylene rope)</td>
<td>Site depth – AB = 750m</td>
</tr>
<tr>
<td>Total polypropylene rope DEF</td>
<td>806m</td>
</tr>
<tr>
<td>Total rope used</td>
<td>806 + 319 = 1125m</td>
</tr>
</tbody>
</table>

**Approximate length of chain lifted**

\[
\text{EF Polypropylene (pp) length } \times \text{ pp buoyancy} = \frac{\text{weight of total hardware lifted - accessories}}{\text{Weight of polypropylene kg/m}}
\]

\[
750 \times 0.0216 = 15.6kg - (0.78 + 1.0 + 0.35) =
\]

\[
\frac{13.47kg}{3.23 \text{ kg/m}} = 4.17\text{m of chain lifted}
\]

Approximate Total Mooring length

\[
806 + 319 + 4.17 + 15 \text{ (approximately)} = 1144.17\text{m}
\]

Or 1145m

**Summary of buoyancy calculations**

<table>
<thead>
<tr>
<th>Weight in Air of bottom hardware</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 16mm thimble</td>
</tr>
<tr>
<td>2 16mm bow shackles</td>
</tr>
<tr>
<td>1 16mm steel swivel</td>
</tr>
<tr>
<td>3m x 13mm link chain</td>
</tr>
<tr>
<td>Total weight in air</td>
</tr>
</tbody>
</table>

50
Weight in air of 20mm Polypropylene rope

220m of 20mm polypropylene weighs 40.8kg, therefore 1m of Polypropylene =

\[
\text{weight of rope} = \frac{40.8}{220} = 0.18545 \text{ kg/m}
\]

Buoyancy of EF polypropylene segment

Length of EF x 0.0216 = 16.2 kg

Calculation to determine the requirements for supplementary buoyancy

<table>
<thead>
<tr>
<th>Weight to be lifted</th>
<th>15.6 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buoyancy of EF Polypropylene segment</td>
<td>16.2 kg</td>
</tr>
</tbody>
</table>

If buoyancy EF is less than the weight to be lifted then supplementary buoyancy is needed, therefore in this case, no supplementary buoyancy is needed.

Additional information for calculating supplementary buoyancy should this be required

Supplementary buoyancy = weight to be lifted – EF buoyancy of polypropylene

(1 litre of buoyancy lifts 1 kg of weight)

No. Of floats = \frac{\text{supplementary buoyancy}}{\text{Float buoyancy}}

Placement of supplementary floats on (EF) polypropylene segment

Placement of the shallowest float from the bottom hardware:

Distance = EF - (50% of the catenary curve BCDE) – 30m safety margin

Placement of the deepest float along EF

Maximum Depth = half the depth rating = 1/2 depth rating

Placement = Site depth - (3m chain length + max depth for deepest float)

Floats can be placed anywhere on EF between minimum depth placement and maximum depth placement.
### Calculation of rope lengths for 1400m site depth

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB (Nylon rope)</td>
<td>150M</td>
</tr>
<tr>
<td>BCDE (Catenary curve)</td>
<td>25% of site depth = 350m</td>
</tr>
<tr>
<td>BCD (Nylon rope)</td>
<td>75% of BCDE = 262.5m</td>
</tr>
<tr>
<td>Total Nylon rope ABCD</td>
<td>412.5m</td>
</tr>
<tr>
<td>DE (Polypropylene rope)</td>
<td>25% of BCDE = 87.5m</td>
</tr>
<tr>
<td>EF (Polypropylene rope)</td>
<td>Site depth – AB = 1250m</td>
</tr>
<tr>
<td>Total polypropylene rope DEF</td>
<td>1337.5m</td>
</tr>
<tr>
<td>Total rope used</td>
<td>1337.5 + 412.5 = 1750m</td>
</tr>
</tbody>
</table>

#### Approximate length of chain lifted

EF Polypropylene (pp)length x pp buoyancy = \( \frac{\text{weight of total hardware lifted} - \text{accessories}}{\text{Weight of polypropylene kg/m}} \)

\[
1250 \times 0.0216 = 27.0\text{kg} - (0.78 + 1.0 + 0.35) = \\
\frac{24.87\text{kg}}{3.23\text{kg/m}} = 7.70\text{m of chain lifted}
\]

Approximate Total Mooring length \( 1337.5 + 412.5 + 7.70 + 15 \) (approximately) = 1772.7m

Or 1773m

### Summary of buoyancy calculations

#### Weight in Air of bottom hardware

<table>
<thead>
<tr>
<th>Item</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 16mm thimble</td>
<td>0.4</td>
</tr>
<tr>
<td>2 16mm bow shackles</td>
<td>1.2</td>
</tr>
<tr>
<td>1 16mm steel swivel</td>
<td>0.9</td>
</tr>
<tr>
<td>3m x 13mm link chain</td>
<td>9.7</td>
</tr>
<tr>
<td>Total weight in air</td>
<td>12.2</td>
</tr>
</tbody>
</table>
### Weight in air of 20mm Polypropylene rope

220m of 20mm polypropylene weighs 40.8kg, therefore 1m of Polypropylene = 

weight of rope  = 40.8 = 0.18545 kg/m

length of rope m  220

#### Buoyancy of EF polypropylene segment

Length of EF x 0.0216 = 27.0 kg

#### Calculation to determine the requirements for supplementary buoyancy

<table>
<thead>
<tr>
<th>Weight to be lifted</th>
<th>15.6 kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buoyancy of EF Polypropylene segment</td>
<td>27.0 kg</td>
</tr>
</tbody>
</table>

If buoyancy EF is less than the weight to be lifted then supplementary buoyancy is needed, therefore in this case, no supplementary buoyancy is needed.
### Appendix D

**Approximate cost of materials used to construct the two FADs**

(a) FAD for deployment in 900 m depth

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Cost per unit (Kina)</th>
<th>Total cost (Kina)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purse seine floats</td>
<td>57</td>
<td>5.00</td>
<td>285.00</td>
</tr>
<tr>
<td>16 mm shackles</td>
<td>2</td>
<td>16.53</td>
<td>33.06</td>
</tr>
<tr>
<td>26 mm shackles</td>
<td>3</td>
<td>39.78</td>
<td>119.34</td>
</tr>
<tr>
<td>16 mm steel swivel</td>
<td>2</td>
<td>40.76</td>
<td>40.76</td>
</tr>
<tr>
<td>16 mm thimbles</td>
<td>2</td>
<td>11.93</td>
<td>23.86</td>
</tr>
<tr>
<td>20 mm thimbles</td>
<td>2</td>
<td>13.82</td>
<td>27.64</td>
</tr>
<tr>
<td>16 mm gal wire</td>
<td>30 m</td>
<td>13.33/m</td>
<td>399.90</td>
</tr>
<tr>
<td>Wire rope grips</td>
<td>6</td>
<td>18.03</td>
<td>108.18</td>
</tr>
<tr>
<td>13 mm chain</td>
<td>15 m</td>
<td>18.80/m</td>
<td>282.00</td>
</tr>
<tr>
<td>16 mm nylon rope</td>
<td>319 m</td>
<td>3.11/m</td>
<td>992.09</td>
</tr>
<tr>
<td>20 mm p/prop rope</td>
<td>806 m</td>
<td>1.84/m</td>
<td>1483.04</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
<td></td>
<td>200.00</td>
</tr>
<tr>
<td><strong>Total cost</strong></td>
<td></td>
<td></td>
<td><strong>3994.87</strong></td>
</tr>
</tbody>
</table>

(b) FAD for deployment in 1400 m depth

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Cost per unit (Kina)</th>
<th>Total cost (Kina)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purse seine floats</td>
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<td>340.00</td>
</tr>
<tr>
<td>16 mm shackles</td>
<td>2</td>
<td>16.53</td>
<td>33.06</td>
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<tr>
<td>26 mm shackles</td>
<td>3</td>
<td>39.78</td>
<td>119.34</td>
</tr>
<tr>
<td>16 mm steel swivel</td>
<td>2</td>
<td>40.76</td>
<td>81.52</td>
</tr>
<tr>
<td>16 mm thimbles</td>
<td>2</td>
<td>11.93</td>
<td>23.86</td>
</tr>
<tr>
<td>20 mm thimbles</td>
<td>2</td>
<td>13.82</td>
<td>27.64</td>
</tr>
<tr>
<td>16 mm gal. wire</td>
<td>30 m</td>
<td>13.33/m</td>
<td>399.90</td>
</tr>
<tr>
<td>Wire rope grips</td>
<td>6</td>
<td>18.03</td>
<td>108.18</td>
</tr>
<tr>
<td>13 mm chain</td>
<td>15 m</td>
<td>18.80/m</td>
<td>282.00</td>
</tr>
<tr>
<td>16 mm nylon rope</td>
<td>413 m</td>
<td>3.11/m</td>
<td>1284.43</td>
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<tr>
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<td>1338 m</td>
<td>1.84/m</td>
<td>2461.92</td>
</tr>
<tr>
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<td>200.00</td>
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<td><strong>Total cost</strong></td>
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<td></td>
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</table>
Appendix E

Itinerary for the six-day workshops

Day 1:
0800 to 1200 hrs (10.00 to 10.15 — tea break)
Talk on aspects of Safety at Sea. Video viewing of Safety at sea tapes.
1200 to 1300 hrs (Lunch)
1300 to 1500 hrs
Discussion on Fishing methods to be used during the workshop, i.e. 50 hooks tuna longline from banana boats, vertical longline, deepwater bottom fishing and trolling.
1500 to 1515 (Tea break)
1515 to 1630
Viewing of video tapes on the different fishing methods.

Day 2:
0800 to 1500 hrs (10.00 to 10.15 — tea break, 12.00 to 13.00 — lunch break).
Construction of vertical longline and 50 hooks horizontal longline gear for fishing around FADs.
15.00 to 15.15 (Tea break)
1515 to 1630 hrs
Outfit the three fishing vessels with all the appropriate gear required for a FAD fishing trip.

Day 3:
Vertical longline and 50 hooks longline fishing around FADs. Depart at 0300 hrs and return at 1700hrs. Restore fishing gears to their appropriate places upon return from fishing trips.

Day 4:
0800 to 1430 hrs (same tea and lunch breaks as previous days)
Reflect on the previous days fishing and construct deep-water bottom fishing gear. Outfit the three vessels for deepwater bottom fishing trip.

Day 5:
Deep-water bottom fishing trip with roughly the same schedule as for the FAD fishing trip on day three.

Day 6:
Reflect on previous days fishing trip and small boat management class in the morning. Award of attendance certificate for the workshop in the afternoon.

NOTE: The initial itinerary had Day 2 as a day for preparing vertical tuna longline gear, the 50 hooks horizontal longline gear and trolling gear for the demonstration exercise. Demonstration vertical longline, horizontal longline and trolling were done on Day 3. During the demonstration exercises, the fishing methods were set and retrieved without adequate soaking time. The participants were given practice in working the different methods. Days 4 and 5 applied the same work for deep-water bottom fishing. These four days were eliminated from the workshop schedule to allow a shorter period to accommodate the three workshops.
## List of workshop participants

<table>
<thead>
<tr>
<th>Workshop 1</th>
<th>Workshop 2</th>
<th>Workshop 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Johnson Elijah</td>
<td>Banabas Orogasi</td>
<td>John Konga</td>
</tr>
<tr>
<td>2. Samuel Smith</td>
<td>Gadson Lee</td>
<td>Steven Ngamakan</td>
</tr>
<tr>
<td>3. Elias Levi</td>
<td>Nas on Unga s</td>
<td>Litau Polume</td>
</tr>
<tr>
<td>4. Abram Kaup</td>
<td>Peter Sairua</td>
<td>Komet Kisokau</td>
</tr>
<tr>
<td>5. Warren John</td>
<td>Ilua robin</td>
<td>Douglas Peter</td>
</tr>
<tr>
<td>6. Cornilias Jonah</td>
<td>Jerry Sio</td>
<td>Andrew Seeto</td>
</tr>
<tr>
<td>7. Anton Cornilias</td>
<td>Esikiel Witus</td>
<td>Russell Waking</td>
</tr>
<tr>
<td>8. Malachai Jonah</td>
<td>Joshua Kosep</td>
<td>Jonathan Milun</td>
</tr>
<tr>
<td>9. Joses Kare ke</td>
<td>John Pukina</td>
<td>Daniel Kuambom</td>
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<td>17. Donald James</td>
<td>Nicholas Yepta</td>
<td>Ronald Symang</td>
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Appendix G

Checklists developed for different fishing techniques

The standard gear per vessel taken on each fishing trip included the following:

1 icebox with ice;
15 kg squid bait;
10 kg chum bait;
2 gaffs;
2 pair hand gloves;
2 sharp knives;
1 truncheon;
1 outboard engine and fuel tank;
75 litres outboard fuel;
Outboard tools;
First aid kit;
Oars;
Container of drinking water;
Anchor and 400 m of anchor rope; and
Food for three meals.

The following vertical longline gear was loaded onto the banana boats in addition to the standard gear for each trip:

1 FAO wooden handreel;
3 spools for the handreel, with 3.0 mm vertical longline lines wound on;
70 branchlines in a single ex-milk crate;
3 x 300 mm longline floats;
3 bamboo flag poles with weighted bottom; and
3 x 3 kg sinkers.

For horizontal longline fishing, the following gear replaced the vertical longline gear:

Drum containing 3.0 mm horizontal mainline;
Branchline bin with 60 branchlines;
12 x 200 mm white floats;
2 flag poles with weighted bottoms; and
12 floatlines.

Bottom fishing gear included the following:

3 x FAO designed handreels and stands, each with 500 m x 2.0 mm monofilament line;
50 spare circle hooks, No. 14 to No. 17;
6 sinkers x 1.5 kg each;
One Polyform float for retrieving anchor; and
Spare 45 kg (100 lb) test line for snood construction.
## Appendix H

### Japan market results on prices paid on exported fish

<table>
<thead>
<tr>
<th>Market</th>
<th>Fish species</th>
<th>Fish weight (kg)</th>
<th>Price paid per kg (Yen)</th>
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