Secretariat of the Pacific Community

FIELD REPORT No. 25

on

TECHNICAL ASSISTANCE PROVIDED TO THE LONGLINE FISHING VESSEL, F/V *TEKOKONA III*, CHRISTMAS ISLAND, REPUBLIC OF KIRIBATI

21 October to 16 December, 2003

by

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This field report forms part of a series compiled by the Fisheries Development Section of the Secretariat of the Pacific Community's Coastal Fisheries Programme. These reports have been produced as a record of individual project activities and country assignments, from materials held within the Section, with the aim of making this valuable information readily accessible. Each report in this series has been compiled within the Fisheries Development Section to a technical standard acceptable for release into the public arena.

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Units used

cm — centimetre
HP — horsepower
kg — kilogram (equals 2.2 lb)
km — kilometre
l — litre
lb — pound (equals 0.454 kg)
m — metre
mm — millimetre
m^3 — cubic metre
mt — metric ton
mHz — megahertz
VDC—volts direct current

SUMMARY

In September 2003, the Fisheries Development Section was requested by the Republic of Kiribati to provide technical assistance in the form of training the crew on board the Central Pacific Producers Ltd's (CPPL) tuna longline vessel based in Kiritimati. A Memorandum of Agreement (MoA) was signed later in the same month, and this clearly set out the roles and responsibilities of both parties. The MoA also outlined the objectives of the project, which were to: work with and train the skipper, crew, staff of CPPL and other interested fishermen in the making up of tuna longline gear, and the correct use of this gear through conducting fishing trials in the waters adjacent to Kiritimati Island; conduct an assessment of CPPL's vessel, F/V *Tekokona III*, used for the tuna longline trials and make suggestions that may improve the fishing operation of the vessel; provide training in the correct handling processing and chilling of the catch, especially larger tunas, for export as sashimi grade fish; and assist staff of CPPL to conduct exporting trials with the catch of tuna to Hawaii, including the correct grading, packing and handling of the catch for export.

The project commenced on 21 October 2003 with the arrival of Fisheries Development Officer, Steve Beverly, in Kiritimati. Several weeks were spent getting the boat ready for fishing, as most of the tuna longline gear had been lost several months earlier and make-shift gear was being used. Some problems were also encountered with the vessel: some repairs were carried out and the bottom of the hulls were scraped and cleaned.

A depressed market for tunas in Hawaii changed the focus of initial fishing trials from tuna longlining to trolling for wahoo. Two trips were undertaken with a reasonable catch of around 450 lb (205 kg) on each trip, most of this being wahoo. Once the market improved in Hawaii, three longline sets were undertaken. Good size yellowfin tuna (around 50 kg each) and bigeye tuna (around 30 kg each) were caught, with one shipment (8 yellowfin tuna, 1 bigeye tuna and 3 big-scale pomfrets) exported to Hawaii.

The F/V *Tekokona III* was found to be a seaworthy vessel, although there were limitations to its fishing capabilities. Oceanographic conditions in the vicinity of Kiritimati indicate this is not the most productive fishing location. Therefore, the best fishing grounds would be one to two days travel either north or south of Kiritimati, outside the real fishing range of F/V *Tekokona III*. That being said, there was scope for this vessel to work close around Kiritimati trolling for wahoo in season and tuna longlining when the market was good in Hawaii. However, there was little scope for increased numbers of similar size vessels fishing around Kiritimati due to the resident tuna population being fished and the potential for declining catch rates as these were fished down.

F/V *Tekokona III* also needed some work done to bring it back into full fishing operation. Several recommendations are made in this report on maintenance work that needs to be carried out, plus a list of fishing gear that needs to be purchased. There are also recommendations for the skipper and crew on procedures that need to be followed to improve the fishing operation of the vessel and maintain the quality of catch being landed.

RÉSUMÉ

En septembre 2003, la Section Développement de la pêche a été sollicitée par la République de Kiribati en vue de fournir une assistance technique consistant à former les membres de l'équipage du palangrier thonier de la *Central Pacific Producers Ltd (CPPL)* basé à Kiritimati. Un protocole d'accord a été signé le même mois, dans lequel les rôles et les responsabilités des deux parties ont été clairement énoncés. On y décrit également les objectifs du projet, à savoir former le capitaine, les membres de l'équipage et le personnel de la CPPL, ainsi que d'autres pêcheurs, à la fabrication et à l'utilisation d'engins de pêche thonière à la palangre, en effectuant des essais de pêche dans les environs de Kiritimati; procéder à l'évaluation du navire de pêche *Tekokona III* de la CPPL utilisé pour ces essais, et suggérer des mesures qui pourraient en améliorer l'efficacité; offrir une formation sur les bonnes techniques de manutention, de transformation et de réfrigération du poisson, notamment dans le cas des prises de grande taille, à des fins d'exportation du thon de qualité sashimi; aider le personnel de la CPPL à faire des essais d'exportation de thon à destination d'Hawaii, notamment en ce qui concerne les méthodes correctes de classement, d'emballage et de manutention des prises.

Le projet a commencé le 21 octobre 2003 avec l'arrivée, à Kiritimati, de Steve Beverly, Chargé du développement de la pêche. Plusieurs semaines ont été consacrées à la préparation du bateau. La plupart des engins de pêche thonière à la palangre avaient, en effet, été perdus quelques mois auparavant et remplacés par de l'équipement de fortune. D'autres problèmes ont également dû être réglés : quelques réparations ont été effectuées et les carènes ont été raclées et nettoyées.

En raison du marché déprimé du thon à Hawaii, on a décidé de modifier la nature des essais de pêche initiaux et de cibler plutôt le thazard du large à la traîne. Deux sorties ont été effectuées et, dans chaque cas, l'on a enregistré des prises d'un volume raisonnable totalisant 205 kg, la plupart d'entre elles étant constituées de thazards du large. On a ensuite effectué une sortie en mouillant trois palangres, le marché d'Hawaii s'étant raffermi. Des thons jaunes (environ 50 kg chacun) et des thons obèses (environ 30 kg chacun) d'une bonne taille ont été capturés, et un certain nombre de prises (8 thons jaunes, 1 thon obèse et 3 brèmes noires) ont été exportées à Hawaii.

Le *Tekokona III* a été déclaré en bon état de navigabilité, malgré ses capacités limitées. Les eaux environnantes de Kiritimati ne sont pas les plus productives en raison des conditions océanographiques qui leur sont propres. Les meilleurs lieux de pêche se situent donc à un ou deux jours de mer, au nord ou au sud de Kritimati, en dehors du champ d'action réel du *Tekokona III*. Cela dit, il est possible que ce navire puisse être utilisé près de Kiritimati pour la pêche du thazard du large en saison ou la pêche thonière à la palangre lorsque le marché est bon à Hawaii. Toutefois, l'on ne peut guère envisager la présence d'un nombre accru de navires de pêche de la même taille dans les environs de Kiritimati en raison du déclin possible des taux de prise lié à l'exploitation des populations locales de thon, déjà appauvries par la pêche.

Le *Tekokona III* devra également faire l'objet de travaux pour qu'il puisse être de nouveau entièrement opérationnel. Le présent rapport comporte plusieurs recommandations sur les travaux d'entretien qui s'imposent, ainsi qu'une liste d'équipement de pêche qu'il importe d'acheter. On y trouve également des recommandations à l'intention du capitaine et de l'équipage sur les mesures à prendre en vue d'améliorer les capacités de pêche du navire et de maintenir la qualité des prises.

CONTENTS

1. INTRODUCTION AND BACKGROUND

1.1 General

The Republic of Kiribati has a large exclusive economic zone (EEZ) that straddles the equator in three different places in the central and western Pacific Ocean (Figure 1). The island groups that make up Kiribati are the Gilbert group to the west, the Phoenix group in the middle, and the Line Islands group to the east. The distance between the western and eastern extremes of Kiribati is over 4500 km. The total land area of Kiribati is only 811 km^2 while the EEZ is 3,550,000 km^2. The land area of Kiribati consists of 33 low lying coralline islands with fringing reefs that make up atolls surrounding lagoons (Stanley 1992). The mid-year 2002 population estimate for Kiribati was 86,900 people (SPC 2003).

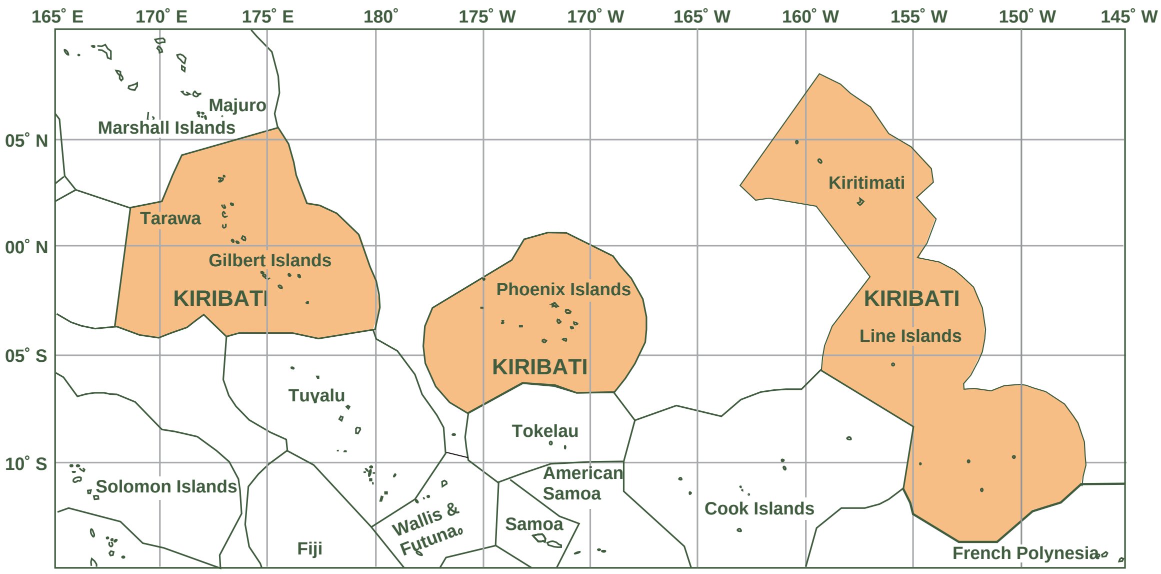


Figure 1: The Republic of Kiribati, its EEZ and neighbouring countries

Kiribati has an 'equatorial maritime' type of climate, with temperatures that vary throughout the year between 25º and 33ºC. The islands are located in the dry belt of the equatorial oceanic climate zone. The wet season extends from December to May and rainfall variation is high in most of the islands. Rainfall can be very irregular and at times long periods of drought can be experienced. The north-easterly and south-easterly winds are predominant throughout the year and provide a welcome cooling effect from the hot sun (Anon 2000). The drier months are from June to November. During the dry periods, winds are generally from the southeast while in the wetter months winds are predominantly from the north and east.

1.2 Kiritimati

Kiritimati, or Christmas Island, is part of the Line Islands group. The Line Islands group EEZ extends from 8ºN to 14ºS latitude and 147º to 164ºW longitude. There are eight islands and atolls in the Line Islands group, from north to south they are: Tabuaeran (Washington Island), Teraina (Fanning Island), Kiritimati (Christmas Island), Malden Island, Starbuck Island, Caroline Island, Vostok Island, and Flint Island. There are three other islands in the group that are not part of Kiribati: Kingman Reef, Palmyra Island, and Jarvis Island — all US possessions. Kiritimati lies at 2ºN latitude and 157º 25'W longitude. It is the largest island in Kiribati and comprises most of the land area of Kiribati.

There are some significant ocean currents that run through the Line Islands' EEZ that could influence a tuna fishery. The Line Islands group is influenced predominantly by the westward flowing equatorial currents (Figure 2), BEN and SEC in the figure.

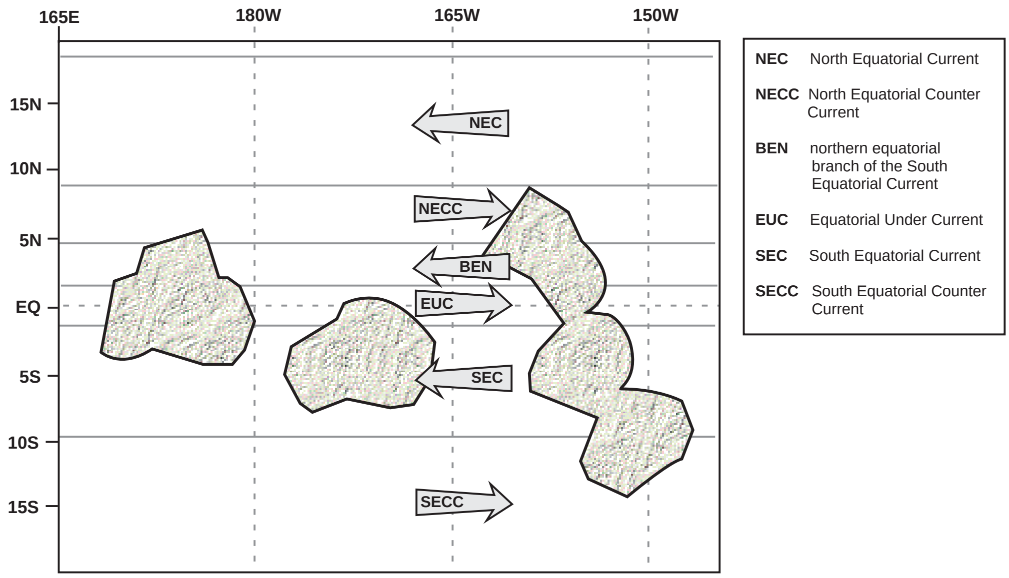


Figure 2: Major currents influencing the Kiribati EEZ

These currents run roughly between 5ºN and 10ºS (SPC 1993). There is also a counter current that runs easterly — EUC in the figure. This counter current is strongest during mid-year, when it rises to the surface and separates the westward current into two currents. The two westward currents straddle the equator and are deflected towards the poles on either side by the Coriolis Effect. The divergence of these two currents causes a strong upwelling, which brings nutrient rich water up from the depths. The best fishing areas, however, are to the north and south of the divergences, where currents come together (convergences) and water sinks again (Grandperrin 1978).

This relation between currents and productivity can be seen in Figure 3 that was produced by SPC's Oceanic Fisheries programme (OFP) for this report (Lehodey 2004). The data in this figure indicates that the most productive areas for tuna (not associated with the nutrient rich upwellings) are to the north and south of the divergence in the areas of convergence. This is true because there is a time lag between primary production and the appearance of large predator species. Aside from primary production (colour), Figure 3 also shows currents (arrows), and average sea surface temperatures (SST — isotherm lines). The white dot on the chart is at the approximate position of Kiritimati. What this means is that Kiritimati is situated in the zone of high primary productivity but not in the zone of high tuna forage. Better fishing grounds would more likely be found to the north and to the south of Kiritimati within the Line Islands EEZ.

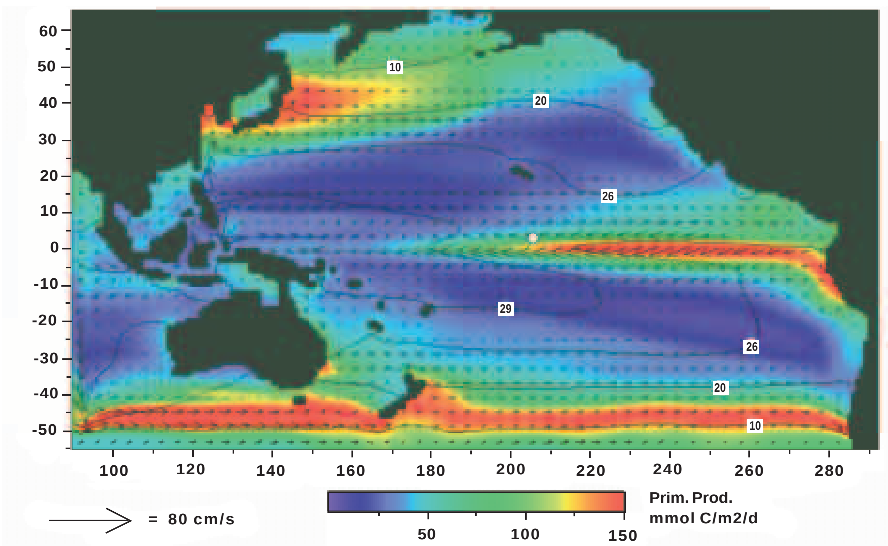


Figure 3: Average primary production, currents and SST isotherms in the Pacific Ocean.

1.3 Previous SPC visits to Tarawa and Kiritimati related to this project

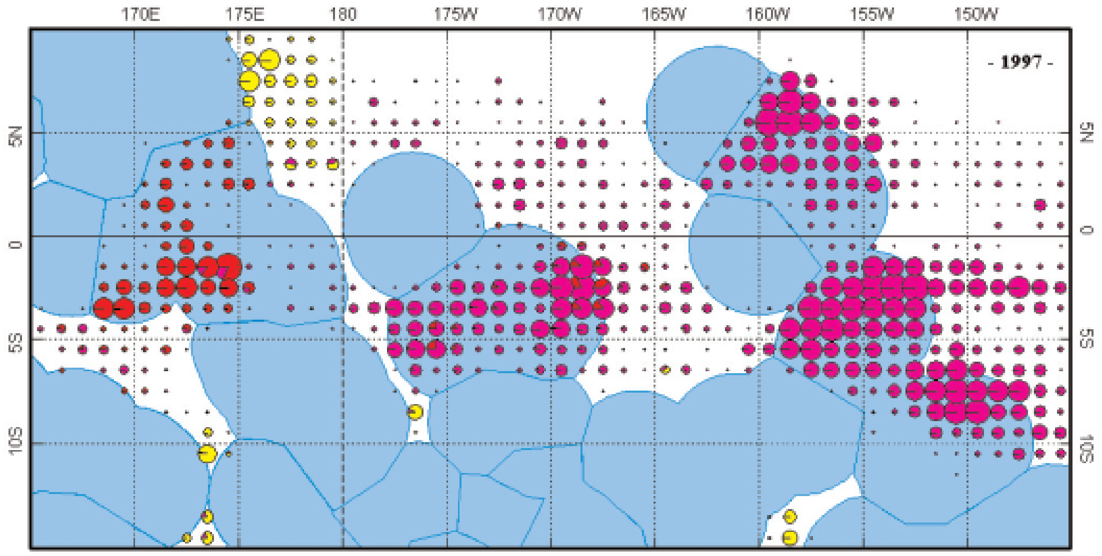
SPC's Fisheries Training Advisor, Michel Blanc, and Fisheries Development Officer, Steve Beverly, conducted a workshop on tuna handling and grading and on small-scale tuna fishing techniques — FAD fishing methods and small-scale horizontal longlining, in Kiritimati, Kiribati in 1998. No formal report was written after that workshop but a written summary along with some recommendations was provided to the management of Kiritimati Marine Exports Ltd (KMEL) at the time, and the workshop was reported in SPC's Fisheries Education and Training Information Bulletin (SPC 1999). Among other things, the SPC team recommended that further efforts be made to develop tuna longlining and small-scale fishing around FADs; and that more attention be paid to safety at sea, especially considering the remoteness of Kiritimati and the lack of any search and rescue vessels or aircraft.

Between 1998 and 2000, SPC visited Tarawa several times in conjunction with a small-scale tuna longline project conducted by the Ministry of Natural Resource Development (MNRD) using a 12 m plywood outrigger canoe, F/V *Tekokona II* (Sokimi et al 2001). The main objectives of the project were to assist with fishing gear construction, to conduct fishing trials, to train counterpart Fisheries Division staff and interested local fishermen in longline fishing techniques, to make an assessment of the vessel, and to train crew on proper on-board handling and processing of tunas. Many problems were encountered during that project but eventually the vessel got out fishing and overall results produced a CPUE of 54.9 kg/100 hooks of all saleable fish. Records were kept of all transactions and the results were that the vessel suffered a net loss of AUD $2351 during the project. Revenue was AUD $7786 against operating costs of AUD $10,138. The vessel was determined to have some limiting factors such as being underpowered, having a small fuel carrying capacity, and having limited fish carrying capacity. Recommendations were given to improve the design for the next generation *Tekokona* and to improve fishing operations and infrastructure requirements for processing and packing sashimi grade tunas.

In 2002 Fisheries Development Advisor, Lindsay Chapman, visited Tarawa and Kiritimati to report on development options, training needs, and infrastructure requirements within the tuna fishing industry (Chapman 2003). It was reported that Kiribati has a good potential for a domestic longline fishery and it was recommended that the government's role should be to provide an enabling environment. Tarawa and Kiritimati both could use dedicated fishing ports with safe anchorages for medium-scale vessels, processing facilities, slipways, etc. Airfreight capacity was identified as a limiting factor in domestic tuna fishery development. It was suggested that small-scale vessels such as F/V *Tekokona III* (which was under construction at the time) be encouraged if they proved to be suitable. A potential for a baitfish operation was identified. It was suggested that the government should set up an ongoing FAD programme to support small-scale tuna fisheries. Value added products were identified as one potential for marketing tuna. Finally, it was pointed out that to implement a tuna development and management plan, training needs would have to met in the areas of boat skippers, engineers, hydraulic systems, and refrigeration systems as well as for surveillance, compliance, and observer coverage of longline operations.

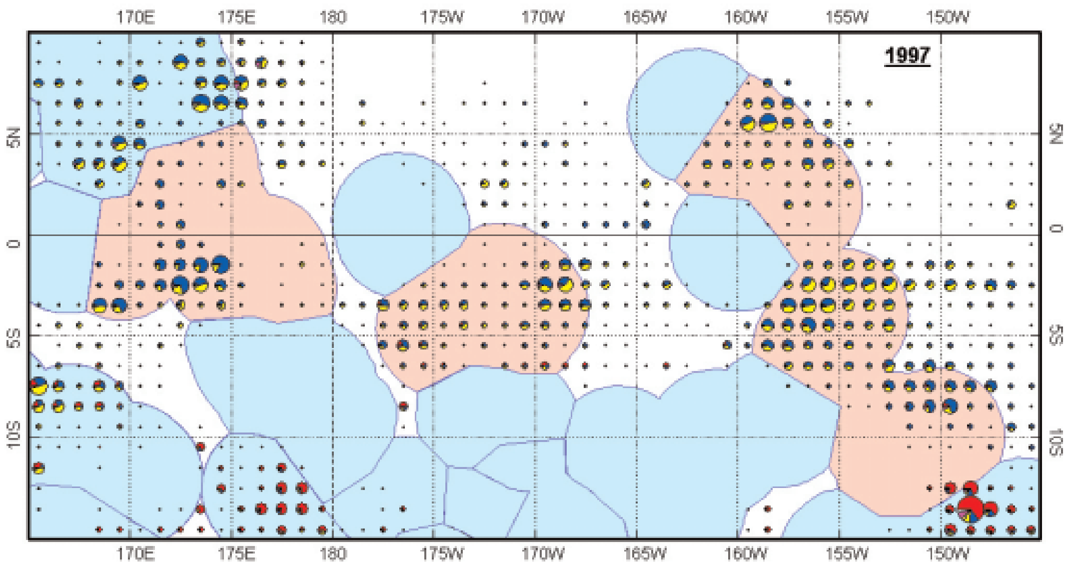
SPC's, OFP visited Tarawa and Kiritimati in December 2002 and subsequently produced a report on the status of the tuna fishery in Kiribati (Langley 2003). The purpose of the report was to characterise the current tuna fisheries in the EEZ and to consider management issues in the context of stock assessment for the main commercial tuna species. Among other things, the report summarised that the longline fishery has been increasingly dominated by the Korean fleet, which has principally fished in the Line Islands EEZ area. The species composition of the longline catch varied between the EEZ areas, with bigeye tuna accounting for the highest proportion of the catch from the Line Islands EEZ. Modest increase in total yellowfin catch attributable to any development of the domestic longline fishery would unlikely significantly increase exploitation for the stock, but the situation would be different for bigeye tuna. The development of a domestic longline fishery may require the phased reduction in fishing effort by the foreign fleet. There is some potential for increased catches of albacore tuna, particularly in the southern portion of the Line Islands and Phoenix Islands EEZs.

Skipjack tuna catches (not normally caught by longliners) are heavily influenced by El Niño and La Niña conditions. High purse seine catches of skipjack occur around the Line Islands during El Niño years — 1997 for example. Bigeye catches also show increases during El Niño years. CPUEs increased during 1997/98. There was no relation between yellowfin catch rates and El Niño for the same periods. The figures in the appendices of the OFP report (see Figures 4 and 5 below) reveal some important information regarding potential for fisheries development around Kiritimati. The figures show that effort and catch have been minimal in the vicinity of Kiritimati even in good years (1997, for example). According to the data, there is a band of inactivity going from about 2ºN to 1ºS latitude in the Line Islands EEZ (Kiritimati is situated right on the two degree north line of latitude). This revelation corresponds with the predictions made based on the oceanographic information (above) and will have some implications for development of a small-scale tuna fishery based in Kiritimati.



Source: SPC logsheet data

Figure 4: Annual distribution of fishing effort (number of hooks set) by degree of latitude and longitude for 1997. Effort is displayed in Kiribati EEZs and international waters; effort in other EEZs is excluded. Red is Japanese fleet, purple Korean fleet, yellow Taiwanese fleet. Big circles 120,000 hooks, medium circles 60,000 hooks, small circles 12,000 hooks.



Source: SPC logsheet data

Figure 5: Annual distribution of longline catch by degree of latitude for 1997. Red is albacore, blue is bigeye, yellow is yellowfin. Big circles 500 mt, medium circles 250 mt, small circles 50 mt.

1.4 Initiation of this project and its objectives

The construction of the F/V *Tekokona III* was completed in late 2002, with sea and fishing trials conducted off Tarawa in late 2002 and early 2003. The vessel was then moved to Kiritimati to undertake fishing trials there. The reason for this was the once a week direct air service with Hawaii, a good export market for tuna caught and shipped from Kiritimati. Based on the results of the initial fishing trials that took place in mid 2003, the government of Kiribati decided to request technical assistance from SPC, with the request made in September 2003.

A Memorandum of Agreement (MoA) was developed for this project in September 2003, with the objectives being to:

- Work with and train the skipper, crew, staff of the Central Pacific Producers and other interested fishermen in the making up of tuna longline gear, and the correct use of this gear through conducting fishing trials in the waters adjacent to Kiritimati Island;

- Conduct an assessment of the Central Pacific Producer's vessel, F/V *Tekokona III*, used for the tuna longline trials and make suggestions that may improve the fishing operation of the vessel;

- Provide training in the correct handling processing and chilling of the catch, especially larger tunas, for export as sashimi grade fish; and

- Assist staff of Central Pacific Producers to conduct exporting trials with the catch of tuna to Hawaii, including the correct grading, packing and handling of the catch for export.

On 21 October 2003, Fisheries Development Officer Steve Beverly arrived on Kiritimati to undertake this assignment. The assignment concluded on 16 December 2003 with the departure of the Fisheries Development Officer.

2. PROJECT OPERATIONS

The project was based in London, Kiritimati, from 21 October to 16 December 2003. The Fisheries Development Officer was required to leave the assignment for one week in November for personal reasons.

2.1 Project vessel

F/V *Tekokona III* was a 13 m wood outrigger canoe powered by a small inboard diesel engine (Figure 6). The vessel was designed by Oyvind Gulbrandsen. The design is called a KIR-16. F/V *Tekokona III* was built by Mike Savins at Betiraoi Boatbuilding in Tarawa, Kiribati. The vessel construction was financed by the government of Japan. It is the property of the government of Kiribati and is operated by Central Pacific Producers Ltd (CPPL), a Government of Kiribati enterprise. Figures 7 and 8 provide a side view, and plan view with vessel specifications.

Figure 6: F/V **Tekokona III** *at the wharf at Kiritimati*

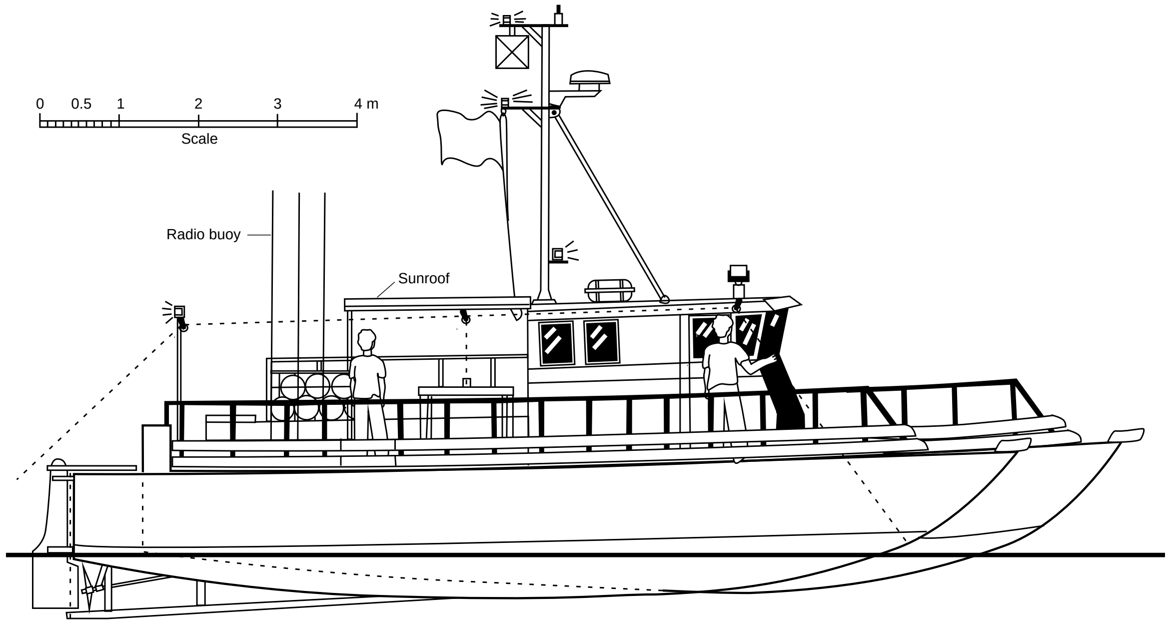


Figure 7: Side view of F/V Tekokona III

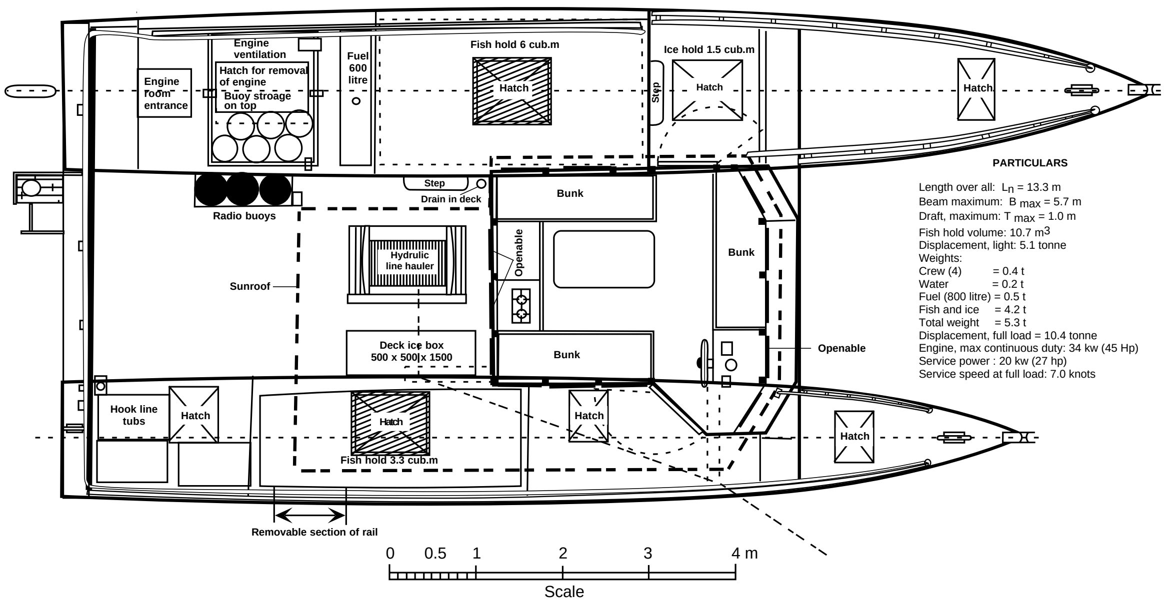


Figure 8: Plan view with vessel specifications for F/V Tekokona III

The main engine was a Yanmar 4JH-YE four-cylinder diesel rated at 45 HP. It was mounted in the engine room of the port hull, the larger of the two hulls. It consumed about 3.5 l of fuel per hour. The fuel tank held 600 l, giving F/V *Tekokona III* a range of about seven days continuous steaming. The engine had a forward shaft driven power-take-off that ran a hydraulic pump, a generator for the auxiliary battery bank, and a seawater wash-down pump. The engine was cooled with seawater going through a wet exhaust system.

The wheelhouse had a full assortment of electronics for a vessel its size including: single side band (SSB) radio, very high frequency (VHF) radio, echo sounder, radar, and radio direction finder (RDF). There was no autopilot. Steering was done by hand with a helm wheel linked to a hydraulic pump and cylinder on the single rudder, which was on the port hull. There were six berths in the wheelhouse although the crew compliment was usually eight. Cooking facilities consisted of a two-burner gas stove, pots and pans, and an assortment of cutlery. There was no galley on F/V *Tekokona III* and cooking had to be done in the wheelhouse. There was a 200 l fresh water tank mounted above deck on the port side hull. Usual practice was to take along several plastic jugs of water as reserve and a 200 l plastic barrel of water for bathing.

Safety gear consisted of a six man inflatable life raft, numerous life jackets, a life ring, a 121.5 mHz EPIRB, two fire extinguishers, and a first aid kit. There were no distress signal devices aboard at the start of this project but two rocket flares were subsequently purchased for the boat.

There were three insulated holds on F/V *Tekokona III*, two in the port hull and one in the starboard hull. The main fish hold on the port side had a volume of 6 m^3. The starboard side hold had a volume of 3.3 m^3 while the ice hold on the port side had a volume of 1.5 m^3. This gave the boat a total insulated hold capacity of just over 10 m^3. Fish were iced on the boat. Total maximum fish capacity would probably be around 1.5 to 2 mt under the best of circumstances. In addition to the fish holds there were three separate dry store holds, two on the starboard side and one on the port side.

2.2 Fishing gear

F/V *Tekokona III* was equipped with a Seamech Smart Reel made in Fiji. The reel had a capacity of about 20 km of 3.0 mm monofilament longline, although it had only 10 km during the project, (all fishing gear had been lost prior to the project). The line setter on the boat was a Lindgren-Pitman LS-3 model. The rest of the fishing gear consisted of approximately 800 monofilament branchlines loaded into three separate branchline bins, about 40 x 30 m floatlines, 40 floats (and lots of spare floats), and some spare hooks, snaps, sleeves, protective tubing, wire leader, and cutters and crimpers. There were also three working radio buoys and several buoy lights that attached to special floats.

Two different styles of branchlines were made up during the project. One style had an American snap, 10 m of 2.0 mm monofilament, a 38 gram leaded swivel, a 30 cm piece of monofilament, a 30 cm wire trace, and a 3.6 Japan tuna hook. The wire trace and hook connected to the rest of the branchline with an eye-to-eye connection, making it easy and quick to replace damaged hooks. The other style of branchline consisted of a Japanese snap, 10 m of 2.0 monofilament, and a 3.6 Japan tuna hook. This second type was not as suitable as the first because the Japanese snaps were actually made for rope gear and tended to slide on monofilament mainline. During the project the crew was instructed in rigging branchlines, floats, floatlines, and radio buoys. Also during the project, material for making up trolling gear was acquired and several hand trolling lines were made up using braided tuna cord, 2.0 mm monofilament, stainless steel wire leader, and hexhead tuna jigs with stainless steel 10/0 double trolling hooks. The crew became proficient at crimping, splicing, and knot tying, as well as rigging longline and trolling gear.

2.3 Safety

Safety should be a priority for CPPL because of the remoteness of Kiritimati and because of the lack of any kind of search and rescue organisation there. The nearest Rescue Co-ordinating Centre (RCC) was in Honolulu, three hours away by aircraft and several days away by boat. There were no aircraft on Kiritimati, other than a weekly round-trip flight from Honolulu, and no vessels capable of carrying out search and rescue work. There were some ship to shore radio communications but radio watches were not kept on a 24-hour basis either on shore or on fishing vessels. F/V *Tekokona III* was equipped with most of the safety gear required for a small fishing boat, but some items were lacking or insufficient. CPPL had both SSB and VHF radios, but conditions were not ideal for communications.

F/V *Tekokona III* was equipped with a six-man inflatable life raft. Two problems were seen with this. First, the liferaft was due for servicing (expired May 2003). Second, the crew compliment on F/V *Tekokona III* was usually eight men. A six-man raft was inadequate. F/V *Tekokona III* was equipped with both SSB and VHF radios. However, the normal practice was to leave these appliances off unless a call was being made to another vessel or to shore. F/V *Tekokona III* had two fire extinguishers — a foam extinguisher good for Class A and B fires (wood and flammable liquids) and a CO2 extinguisher good for Class A, B, and E (electrical) fires. However, at the time of the project neither of these extinguishers was working as the handles for the control valves had rusted away. F/V *Tekokona III* had no distress signals. Minimum requirements for a vessel its size would be two rocket flares, two smoke signals, and six hand held flares. F/V *Tekokona III* had a 121.5 mHz EPIRB, a first-aid kit, a life ring, and an adequate number of life jackets.

There were two radios observed in the CPPL office in London — a SSB radio and a VHF radio. The VHF radio was used mostly for communicating with small fishing vessels and canoes. The VHF could be used to communicate with F/V *Tekokona III* providing that the boat stayed within range (probably about 20 miles). The SSB radio was presumably for communicating with F/V *Tekokona III* and other vessels when they were fishing farther away from Kiritimati. The SSB in CPPL's office was not working properly during the project, however. Fisheries Sub-division also had an SSB radio that was in working order at the close of the project. There were also VHF and SSB radios at the Marine Guard station in London, not far from the CPPL office. The problem with the radios at CPPL and at the Fisheries Sub-division was that if they were monitored at all, it was only during normal office hours (not at night or on weekends). The Marine Guard radios were presumably monitored 24 hours per day, seven days per week, but in reality this was not the case. In any case, it was not the usual practice for CPPL to keep a regular radio schedule with F/V *Tekokona III*.

3. FISHING TRIALS AND RESULTS

During the project, fishing effort was minimal. Two short trolling trips were made and only three longline sets were made. On 22 November the Fisheries Development Officer accompanied F/V *Tekokona III*, trolling along the east side of Kiritimati using the recently acquired trolling gear. Three lines were trolled for approximately twelve and-a-half hours along the 50 to 100 m curves (depths). The catch totalled 28 fish weighing 451 lb (205 kg) as follows:

Wahoo (*Acanthocybium solandri*)	13
Green jobfish (*Aprion viriscens*)	1
Trevally (*Caranx spp*)	7
Yellowfin tuna (*Thunnus albacares*)	3
Rainbow runner (*Elagatis bipinnulata*)	1
Barracuda (*Sphyraena spp*)	3

On the weekend of 06 to 07 December F/V *Tekokona III* made another trolling trip with roughly the same results: 13 wahoo and various other species. The trolling trips were made at the request of the fish buyer in Honolulu who had indicated that demand would be higher for wahoo than for tuna at the time, so prices would be better for wahoo. The thirteen wahoo from the first trip ended up not being exported, however, as the Honolulu market was poor that week. The thirteen wahoo from the second trolling trip were exported as the market had improved. The Fisheries Development Officer did not accompany the crew on the second trolling trip.

The first longline set was made on 03 December starting at 0630 hours. The set was made going west from 02º 07.88'N and 157º 39.50'W. A total of 349 hooks were set in 25 hook baskets. The bait was all milkfish (*Chanos chanos*) either whole or cut in half. The bait had all been caught previously in a government pond on Kiritimati and frozen whole at CPPL in the blast freezer. Initially there were some problems with setting the gear as it was difficult to match boat speed, reel speed, and line setter speed. The reel and line setter were different brands and were not necessarily compatible. There was no free-spool valve on the Seamech reel so line had to be driven off of the reel during setting. This was a difficult operation as the reel had to be speeded up periodically as the diameter of line on the reel decreased. Eventually everything went smoothly. The set was finished at 0810 hours.

Hauling began at 1300 hours and was finished at 1630 hours. One problem encountered during the haul was the crew's inability to keep up with coiling branchlines into the bin. This was partly due to there being only one branchline bin. The catch from the first set was five fish weighing a total of 327.35 lb (148.8 kg) as follows:

3 bigeye tuna (*Thunnus obesus*) — 59.95, 69.95, and 64.65 lb (27.2, 31.74 and 29.33 kg)
2 yellowfin tuna (*Thunnus albacares*) — 115.6 and 17.2 lb (52.45 and 7.8 kg)

In addition, one silky shark (*Carcharhinus falciformis*) was also caught. The tunas from this set were sold locally as the Honolulu market had not yet improved. The shark was retained by the crew for home consumption.

On 12 December the second longline set was made starting at 0600 hours at 01º 59.56'N and 157º 32.00'W going south (Figure 9). The set was finished at 0710 hours. A total of 378 hooks were set in 25 hook baskets using milkfish bait. No problems were encountered during setting.

Figure 9: Setting the longline gear at first light

Hauling started at 1145 hours and finished at 1420 hours (Figure 10). No problems were encountered during the haul as the branchlines had all been shifted to two separate branchline bins. Two men could now work simultaneously coiling branchlines with no interruptions. The catch was four yellowfin tuna, one bigeye tuna, four big-scaled pomfrets, one silky shark, one thresher shark, and one sunfish.

Figure 10: Hauling the longline from F/V **Tekokona III**

On 13 December the third set was made starting at 0620 hours at 01º 59.44'N and 157º 32.05'W going south again. A total of 395 hooks were set in 25 hook baskets using milkfish bait. No problems were encountered during the set.

Hauling started at 1200 hours and finished at 1500 hours. The line parted during the haul and a search was carried out to find the next float so hauling could be resumed. This was a good lesson for all, including the captain. They learned how to properly haul back in the broken section of mainline, and then recover the remaining section afterwards. This was done by cutting the line at the next float and attaching a radio buoy. The broken part was hauled in after the radio buoy was thrown. Then the radio buoy was recovered and the balance of the line hauled in. The catch for the third set was four yellowfin tuna and one blue marlin. Catch for both sets was a total of 14 saleable fish weighing 1063 lb (483 kg), with all weights being for gilled and gutted fish. Weigh-in for the two sets was as follows:

8 yellowfin tuna (*Thunnus albacares*)	109.25, 100.25, 101.85, 106.7, 103.55, 112.7, 108.65, and 101.85 lb (49.57, 45.49, 46.21, 48.41, 46.98, 51.13, 49.3, and 46.21 kg)
1 bigeye tuna (Thunnus obesus)	61.95 lb (28.11 kg)
4 big-scaled pomfret (Taractichthys longipinnis)	14.1, 16.55, 16.85, and 8.7 lb (6.4, 7.51, 7.65, and 3.95 kg)
1 blue marlin (Makaira nigricans)	100 lb (45.37 kg — estimated)

For all three tuna longline sets during the project there was a total of 1122 hooks set catching 19 saleable fish weighing 1390 lb (632 kg). CPUEs for the three sets were therefore 1.7 fish per 100 hooks and 56 kg per 100 hooks. This is similar to the CPUE for F/V *Tekokona II* in Tarawa (Sokimi et al 2001) and is about the same as the average in the Pacific. The bigeye tuna were all around 30 kg and the yellowfin were all very uniform at around 50 kg (Figure 11). It could be assumed from this that the yellowfin were probably resident fish, or what are sometimes called 'reef' tunas. These are fish that stay in a particular area for years, growing to full size.

Figure 11: Gaffing a 50 kg yellowfin tuna

During the fishing trials the crew were given instruction on some techniques to improve setting, hauling, and fish handling. The setting operation was smoothed out so that, with each consecutive set, more hooks were thrown using the same length of mainline. This indicated that proficiency was improving. Hauling also improved as can be seen by the subsequent shorter hauling times, even though hook numbers increased. The biggest improvements were in fish handling on deck (Figure 12) and in the fish hold. Instruction was given in proper gaffing, spiking, bleeding, gilling and gutting, and icing (Beverly et al 2003) — copies of the SPC longline manual were given to all crew for reference.

Figure 12: On-board handling

Fish from sets two and three were exported to Hawaii on 16 December. The fish buyer from Honolulu, Mr. Kazu Inakoshi of Fresh Island Fish, was in Kiritimati at the time and accompanied the crew on the second set (12 December). When all of the fish were unloaded he graded the tunas just before they were packed for export. Grades ranged from #3 to #2+ (Beverly, et al 2003). Fish exported included eight yellowfin tuna, one bigeye tuna, and three big-scaled pomfrets.

4. DISCUSSION AND CONCLUSIONS

The captain and crew of F/V *Tekokona III* were found to be hard working and conscientious. When looking at the minimal fishing effort (three longline sets for a two month project) one may get a different impression. However, the constraints to fishing activity were generally due to the remoteness of Kiritimati, logistics, communication problems, and the fact that there was no manager on duty at CPPL during the project. The captain and crew worked very well with the Fisheries Development Officer and were always eager to learn something new.

F/V *Tekokona III* was a well-constructed and seaworthy multi-purpose fishing vessel. SPC had offered advice on how to improve the basic design parameters of the Kiribati fishing boats in Sokimi, et al (2001), and some of the recommendations from that report were incorporated into the new design including: shortening the superstructure, increasing height of side rails, installing a line setter, choosing an engine with more horse power, increasing fuel carrying capacity, increasing ice carrying capacity, and reconfiguring the engine room so there is more room for auxiliary pumps and a generator. However, some of the recommendations from that report were not incorporated into the new design including: changing to an RSW system and adding an auxiliary engine. In spite of that, the changes made in F/V *Tekokona III* made it a much more suitable vessel than F/V *Tekokona II* although there were still some deficiencies. One of the major changes was that the larger of the two hulls was now the port side rather than the starboard side as on F/V *Tekokona II*.

One of the objectives of this small-scale longline project was to give an assessment of F/V *Tekokona III* and to evaluate its suitability as a small-scale tuna longline vessel. F/V *Tekokona III* and its predecessor, F/V *Tekokona II*, were designed with the thought of having a small vessel that had the advantages of both a catamaran and a mono-hull boat. The advantages of catamarans are that they provide very stable working platforms with large working decks. They can also navigate in shallow water as they generally have shallow drafts. The disadvantages of a catamaran, at least for a fishing boat, are that they have twin engines and are thus more expensive to build, operate, and maintain; and that they have limited fuel, fresh water, and fish hold capacities because of the relatively small volumes of their hulls. F/V *Tekokona III* was not exactly a catamaran. The port hull was larger than the starboard hull so that F/V *Tekokona III*, like F/V *Tekokona II*, was actually an outrigger canoe. F/V *Tekokona III* had only one engine, gearbox, shaft, propeller, and rudder, much like most mono-hull fishing boats.

F/V *Tekokona III* was very stable even in the trough and in moderate seas. It did not roll much with the swell and provided a good working platform. However, some deck space was lost because of the difference in the heights of the two hulls. The larger hull on the port side had a higher deck than the starboard side hull, which was level with the main deck. Because of this the entire port side of the boat was not used as part of the working deck. In addition, there were several raised hatch coamings on both hulls that further eliminated working deck space. The result was that the actual working deck on F/V *Tekokona III* was about the same size that one would expect to find on a mono-hull boat the same length.

Figure 13: Water accumulating on flat deck

Another problem was that the deck was flat with no crown or camber. When the port fish hold started filling with fish the boat listed slightly to port. It was not possible to compensate for this by shifting fuel or by flooding a hold as would normally be done on a mono-hull boat. The list, in any case, did not interfere with the seaworthiness of the boat. What it did do, however, was to cause seawater and fish blood to accumulate on the deck where the working deck meets the port hull (Figure 13). This created a dangerous situation as the deck became very slippery. Another problem was that this water eventually found its way into the wheelhouse in this area. After hauling was completed seawater was discovered in the wheelhouse under the bunks. This would damage anything stored in the storage space under the bunks and would eventually cause problems with wood rot. Unsealed wood that is wet and dry continually will suffer from dry rot. A small drain hole (weep hole) was cut in this area at one time (see Figure 8) but a larger drain hole with screen was needed.

Having only one engine has some obvious advantages over a twin-engine design: lower initial cost, less maintenance, lower operating costs, etc. However, the main engine on F/V *Tekokona III*, at 45 HP, was too small. During hauling operations the engine would bog down, as it was not able to support the drive train, the hydraulic pump, the seawater wash-down pump, and the generator. This was evident especially when fish were being cleaned. Often, hauling had to be stopped until cleaned fish were put on ice and the seawater wash-down pump could be turned off. Also, if the boat was caught with the wind side-on during hauling, the engine had difficulty pushing the boat back around into the wind and hauling the line at the same time.

The choice of a wood boat for a remote island fishery was right in some respects but may not have been the best choice in other respects. Wood is relatively easy to work with and repairs can be made with simple hand tools, if materials are available. Wood also does not require fancy two-part paint systems or gel coats. Most maintenance and above waterline repairs could probably be handled on Kiritimati. However, F/V *Tekokona III* was too large to be hauled out of the water in the manner that the Kiribati canoes can be hauled out on Kiritimati; and there is no slipway on Kiritimati. Because of that, F/V *Tekokona III*'s hulls were suffering from neglect. The bottoms were heavily fouled with marine growth and there was some sign of toredo worm damage. The Fisheries Development Officer inspected the bottom and subsequently supervised a cleaning prior to fishing trials. It was obvious that the boat had not had a bottom cleaning or haul-out since it was built. Zinc anodes needed replacing and some of the striker plates on the bottom of the hulls and at the stems needed replacing because of worm damage. Dry rot was also a problem on F/V *Tekokona III*. The sunroof (see Figure 7) needed to be replaced as it was suffering from dry rot (Figure 14). The sunroof, in addition to offering shade, was designed to support longline blocks during setting and hauling. At the time of the project the sunroof could no longer support these blocks. A fibreglass or aluminium boat would suffer from fouling but not from dry rot or worm damage.

Figure 14: Evidence of dry rot in the sunroof.

For a 13 m boat F/V *Tekokona III*'s accommodations were spartan. There were only six bunks (four originally but CPPL had added two more) and they were only large enough for children, not for adults. Half of the eight-man crew slept on deck in uncomfortable situations. F/V *Tekokona III* had no galley. Cooking was done in the already crowded wheelhouse on a two-burner gas stove. In good weather cooking could be done on deck or the hatches could be left open so there was adequate ventilation to cook in the wheelhouse. However, if the hatches needed to be closed it could be dangerous to cook inside the wheelhouse with a gas burner and no ventilation. Fresh water supply at 200 l was inadequate. Extra water was needed even for a short trip.

There were some problems with the way that the longline system was installed on F/V *Tekokona III*. The reel probably should have been aligned athwartships rather than fore and aft (see Figure 8). This would have provided more working space on the back deck. As it was, there was a dead space on the port side of the reel that could not be utilised. The other problem with the longline system was the location of the control valve for the reel. This was mounted in the wheelhouse and so was under the control of the captain during hauling. The rollerman (the man unsnapping the branchlines) was put in a dangerous situation as he could not start or stop the reel. The captain did not have the same view of the line as the rollerman and could not likely see a tangled branchline coming up in time to stop the reel. Also, the rollerman could feel fish on the line and should be able to slow the reel as necessary so as not to lose a fish. The valve should have been mounted on the rail so that the rollerman had control of the reel.

The power-take-off (PTO) shaft that was coupled to the forward end of the engine caused some problems. The shaft powered the generator, the seawater wash-down pump, and the hydraulic pump. It was connected to the main engine via a shaft flange, much the same as the propeller shaft on the aft end of the engine. The flange on the shaft, however, did not exactly match the flange on the engine. The boltholes were different diameters. Rubber bushing inserts took up the gap between the boltholes and the bolts on the flange. The problem was that these bushings wore out regularly, often not lasting more than a few days. When they wore out the shaft would vibrate and would have been severely damaged if it had been run continuously in that condition. Perhaps there was an original part that was suitable. None were available on Kiritimati, however, and the engineer had to compensate by making jury rigged bushings from scrap rubber (old hydraulic hose, for example). This problem could easily be remedied by either finding the right bushings and purchasing several sets, or by changing the shaft flange to one that matches the flange on the engine.

Considering that the best tuna fishing grounds in the Kiritimati EEZ are probably a good one or two day's steaming away from Kiritimati to the north or to the south, a small-scale vessel with the limited range and fish holding capacity of F/V *Tekokona III* may not have been the best choice for domestic tuna fisheries development. In the short term, F/V *Tekokona III* could do well fishing the resident yellowfin and bigeye stocks around Kiritimati. In the longer term, however, these stocks may become depleted. This has happened in other Pacific Island countries and territories (personal experience of the Fisheries Development Officer). F/V *Tekokona III* did not have the fuel capacity or fish hold capacity to enable it to venture into the northern and southern extremes of the EEZ. If more similar vessels are brought to Kiritimati the resident stocks of tuna will become depleted sooner. By itself, or with one or two companion vessels, F/V *Tekokona III* could probably do well as a multi-purpose fishing boat, trolling for wahoo when the season and the market are good, and longline fishing for yellowfin and bigeye at other times, but always staying in the vicinity of Kiritimati. However, for a longer-term domestic longline fishery based in Kiritimati to be sustainable, larger vessels with bigger operating ranges and bigger fish holding capacities would be needed. For this to happen, however, infrastructure improvements are needed on shore such as a deep draft harbour (Chapman 2003).

5. RECOMMENDATIONS

F/V *Tekokona III* needed immediate attention at the close of the project. The following recommendations are for works that should be carried out as soon as possible:

- The boat needs to be hauled out, cleaned, and painted with anti-fouling;
- Zinc anode on skeg needs replacing;
- Striker plates on bottom of hull need replacing;
- A bigger weep hole is needed on deck just behind the wheelhouse on the port side of the reel — cut a hole about 4 cm and put a screen on it;
- Wheelhouse needs to be sealed watertight where it joins to the deck aft. The wood beam in this area needs replacing. Water coming in here will ruin anything stored under bunks and eventually rot the timber;
- All rotten timber on sunroof cover needs to be replaced and the whole thing needs strengthening so that it can support the longline blocks during setting and hauling;
- A more permanent way to secure the gate on the starboard side is needed. During rough weather someone could fall overboard;
- All hydraulic hose ends and fittings need to be de-rusted and painted;
- Seawater wash-down hose needs replacing;

- 12 VDC submersible pumps should be moved from dry holds to fish holds;
- The shaft coupling flange on the power take off shaft needs to be replaced with one that matches the flange on the front end of the engine; and
- The longline reel control valve should be shifted from the wheelhouse to the rail on the starboard side adjacent to the longline block.

The following are specific recommendations for the captain and crew of F/V *Tekokona III* for fishing operations, general safety, and communications:

- Take bait out the night before fishing if it is frozen;
- Clean up blood, fish scales, etc, after bottom fishing or trolling and clean up blood from bait after setting. Do this before blood dries on deck;
- Prepare ice while fish are being cleaned, or before when hauling starts, not after fish are ready to go in the ice;
- Pump out melt water from fish holds regularly;
- Inspect fish holds regularly when there are fish inside;
- Re-ice fish the following day after fishing — break up air pockets around fish and cover with more ice;
- Pack all tuna, marlin, and wahoo belly down. Mahi mahi, pomfrets, and other small species should be packed on their sides but on the last layer above the larger fish;
- Turn radio buoy on before throwing during setting;
- Turn radio buoy off after pulling out of water during hauling;
- Tell the operator when the line is coming tight on the reel during setting so that he can speed up the reel;
- Always keep a knife or cutter handy when setting and hauling;
- The captain should teach some of the crew to drive the boat, especially during setting and hauling, and then work on the deck himself. Eventually everybody should know every job on the boat;
- Leave SSB radio on 6215 and VHF radio on channel 16 — 24 hrs a day when underway;
- Establish a regular radio schedule with Fisheries Sub-division and with CPPL;
- Communicate catch daily and make sure someone at CPPL informs the fish buyer;
- Do not allow the engine to idle for long periods;
- Set up a petty cash fund for the captain, engineer, and cook;
- Purchase foul weather suits, gum boots, and gloves for crew;
- Purchase a 406 mHz EPIRB to replace the 121.5 mHz model;

- Service the liferaft as soon as possible;
- Purchase another liferaft so that one is one hand while the other is being serviced;
- Cut back crew number so that only six men go on each trip on a rotational basis;
- Purchase a full set of distress signal devices;
- Purchase more fire extinguishers;
- Do not store paint or other flammable liquids on the boat. Keep them in the storeroom until needed;
- Take some emergency provisions on each trip. Lock away some tinned food in starboard side dry hold, along with rice or ship's biscuits, and bottled water. Do not use these supplies unless necessary, but re-cycle every six months; and
- Design a pre-departure checklist and fill it out before each trip (see Sokimi et al 2001).

The following gear purchases are recommended:

- Mainline (10 miles of 3.5 mm monofilament);
- 500 American snaps;
- 2500 stainless steel 3.6 tuna hooks with ring;
- 500 x 38 gram leaded swivels;
- 10 x 1000 m coils of 2.0 mm monofilament;
- 5 bags of D sleeves;
- 5 bags of #3 Toyo Lok sleeves;
- 2 coils of 1/16 inch stainless steel 7 x 7 leader wire;
- 2 packs of green springs;
- Bench crimper and jaws for D sleeves and #3 sleeves;
- 4 Mustad #8/0 gaff heads; and
- Spare hydraulic hoses and fittings (one idea is to purchase a long section of hose and several re-useable fittings and that way individual hoses can be made at sea as needed — a hacksaw and two crescent wrenches (shifting spanners) are all that is needed to make up hoses.

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