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STARTING UP A SMALL-SCALE TUNA LONGLINING PROJECT – A CASE STUDY FROM PAPUA NEW GUINEA

Introduction

Papua New Guinea's large Declared Fishing Zone (DFZ) is an area known to harbour a rich tuna resource. Various fleets have fished tuna in these waters including domestic and foreign pole-and-line fleets and a foreign longline fleet, but the current operations are dominated by purse-seine fishing vessels from Korea, Taiwan, USA and the Philippines. Annual catches exceeded 200,000 mt in 1989 and are thought to have continued to expand since then. There has been no domestic tuna fishery since a joint-venture pole-and-line fishery ceased in 1987. In the same year Japanese vessels ceased longline fishing.

The Government of Papua New Guinea (GPNG) has adopted a policy of promoting the establishment of domestic tuna fisheries and various initiatives are currently in train. In line with this policy, GPNG in 1992 requested the assistance of the South Pacific Commission, on behalf of the Government of East New Britain Province (GENB) in assessing the feasibility of establishing a domestic longline fishery targeting sashimi grade tunas.

The project which evolved, known as the East New Britain (ENB) Pilot Tuna Longline Project is a collaborative arrangement involving GPNG, GENB, SPC and the United States Agency for International Development (USAID). It operates through the GPNG's Kokopo Fisheries Project based near Rabaul in East New Britain Province. At the national level PNG's Department of Fisheries and Marine Resources (DFMR) has provided support through assignment of fisheries staff to Project operations, provision of the Project base office, and all communications. GENB has provided support staff including the crew of the Project vessel, the Project vessel, F.V. *Kuriap*, all operating costs and accommodation and transport for the SPC Master Fisherman. SPC has provided overall management and coordination of Project operations and, with the funding support of USAID, has been able to outfit the Project vessel with monofilament longline fishing gear, install some fish handling equipment, provide bait, and furnish the services of a Master Fisherman for twelve months to supervise fishing operations.

The aims and goals of the project are to demonstrate that sashimi grade yellowfin (*Thunnus albacares*) and bigeye (*T. obesus*) tunas with export market potential can be landed consistently and economically in ENB using a small (15 m) vessel fitted with a monofilament longline reel and manned by a local crew. The longer term goals are to market tuna internationally and eventually to privatise the operation or generate enough local interest so that the private sector develops a fresh-chilled sashimi export venture.

Project fishing operations to date have been very successful - far better than expectations. Historical catch data for the area collected by SPC's Oceanic Fisheries Programme gives cpue for longlining operations of around 50-60 kg/100 hooks. Project operations so far have produced a cpue of over 100 kg/100 hooks. On the first trip out in August 1993 over 1.2 tonnes was landed from one set of just 300 hooks. The average weight of yellowfin caught has been just over 44 kg.

This high cpue is likely to be at least partly due to the fact that no one has fished using longline techniques in PNG for almost a decade. However, the success of the Project so far must also be attributed to the introduction of monofilament longline fishing techniques as developed in the USA and now increasingly used in the Pacific. Tables 1 and 2 give summary information on Project catch, effort and cpue.

The focus of this paper is limited to the technical aspects of monofilament fishing on a small-scale including selection of a suitable vessel, mechanical gear installation, gear rigging, and setting and hauling techniques.

The Project vessel

F.V. *Kuriap* was built in Japan by the Yanmar Diesel Engine Co. for the East New Britain Government in March 1984. The boat was part of an aid project of Japan's Overseas Fishery Cooperation Foundation. Kuriap (the local name for porpoise) is an FRP mini-longliner design. (For specifications see Appendix A). Kuriap was under-utilised by ENB Fisheries Division. At the time of the arrival of the Master Fisherman in PNG it had not been to sea for almost six months. GENB was thus keen to see it involved in a project, especially one that might generate some income to offset operating costs. The vessel was, however, maintained in good condition over the years. In fact, the Japanese Ambassador to PNG, Mr Masui, expressed surprise at seeing an aid vessel still floating after 10 years.

As the vessel was out of survey slipping and repairs to survey requirements were the first task. This work was completed in June 1993. The engine was partially overhauled, the shaft and shaft bearings replaced, and all safety gear was either serviced or replaced. Additionally, wheelhouse electronics had to be upgraded or replaced. A colour echo-sounder, a Global Positioning System (GPS) navigator, a radio direction finder, and a new SSB radio were installed. The GPS and the radio direction finder are basic necessities for longline fishing. Since that time a sea surface temperature monitor has been added. This is a useful item although not essential for longline fishing.

The next task was to install the longline gear. Fortunately, *Kuriap* was fitted with a power-take-off hydraulic unit that previously ran a small net/line hauler, two bottom fishing reels and an anchor capstan. All but the anchor capstan were removed prior to installing the longline reel. The hydraulic unit operates from a belt driven power-take off coming off of the main engine via a 24 V electric clutch that is wheelhouse operated. The system includes a 50 l tank with a filter system and a pressure regulator with an adjustable by-pass valve. The hydraulic lines exit the engine room through the starboard deck and go fore and aft via 1/2 inch stainless steel pipes. The entire system was found to be in fair condition and needed only a good servicing; including replacement of the filter system and replacement of all deck hoses and hose fittings. The stations that formerly supplied the bottom reels and anchor capstan were blanked off by looping a small hose to connect in and out ports.

Mounting the reel and valve

The monofilament longline reel selected for the *Kuriap* was a Lindgren-Pitman hydraulic 27 inch x 30 inch aluminium 13.2 mile reel. (See Appendix B for a complete list of fishing gear and costs). It is 41 inch high and has a `footprint' of 47 inch x 29 inch. The hydraulic requirements for the reel are 12 gpm (gallons per minute) at 1200 psi (pounds per square inch). It has a vane type hydraulic motor, a manual by-pass valve for setting, and an adjustable pressure-relief valve built in. It holds 13.2 miles (21 km) of 3.0 mm monofilament and weighs 830 pounds (377 kg) fully loaded. It has a fairlead mechanism, or level winder, that is belt driven from the main shaft and operates on a pawl mechanism. A separate control valve for operating the reel is provided.

Actual installation of the reel was simple after a suitable mounting site on the vessel was selected. The first site considered was on top of the house, just aft of the wheelhouse. This position was rejected for two reasons; the operator would not be able to see the reel during setting and hauling, and it might make the boat unstable to have such a weight high above the center of gravity. The second position considered was the main deck on the port side (hauling is done from the starboard side). This position would eliminate the need for routing the line through a series of blocks during hauling, as the line could go directly from the main block on a davit to the reel. *Kuriap*, however, has very limited deck space and this space is needed for fish handling. In addition, after setting the reel in this position to check the boat's stability it was found that the weight of the reel caused a slight port list.

The final position considered was the raised foredeck. Two disadvantages to using the raised foredeck were that the reel would interfere with the operator's dead-ahead field of vision and the anchor capstan would have to be re-located. (The anchor capstan could not be removed as it is a survey requirement.) After placing the reel on the raised foredeck with a boom truck it was found that the boat's load line was not affected, so this position was selected. Most of the crew stand watch on the fly bridge when steaming so the diminished forward visibility is not a great problem.

The reel has four footpads each with two 1/2 inch holes for mounting. Eight 1/2 inch holes were drilled through the fibreglass foredeck and the reel bolted in place using 1/2 inch x 4 inch stainless steel bolts with flat washers and lock washers. Before final fitting of hydraulic connections the boat was taken on a test run to ensure that the ride would be stable with the reel in this position.

Then, before connecting the hydraulic system to the reel, the control valve had to be mounted on the starboard rail so that all hoses could be measured accurately. The valve was bolted to a plate of 1/4 inch aluminium which was in turn bolted to the rail. This gave sufficient height for easy operation. It was mounted adjacent to the position of the davit. The control valve handle has three positions; forward, reverse and neutral. Forward and reverse also operate through a range of positions from slow to full speed. There are four ports in the control valve; line in and line out from the hydraulic pack, and line in and out to the reel. Short lengths of hose were used to connect the hydraulic line-in and line-out to the valve.

The davit was to be located where the net hauler had previously been located so ports were available. Longer hoses were used to connect the valve to the reel. All hoses used were 1/2 in two-wire high pressure hoses and all fittings on hose ends were re-usable type fittings. Re-usable fittings are preferred as at sea repairs are simple, requiring only a hacksaw and two shifting spanners (crescent wrenches). It is a good idea to always carry spare hydraulic hose and spare re-usable fittings. All hose fittings, the valve and all steel parts on the reel were coated with red lead and marine enamel after installation was completed.

The L.P. reel and the control valve each have adjustable pressure relief valves. However, the existing hydraulic pack was also fitted with an adjustable pressure relief valve with a by-pass. This is an important feature on a hydraulic monofilament system as it allows for the reel to automatically stop if too great a load is placed upon it. It is similar to the drag setting on a game fishing reel; it prevents the line from breaking if a very large marlin or shark runs with the line.

The by-pass is adjusted by first tying the mainline off so it cannot move and then putting a load on the reel by opening the control valve and revving the engine. An adjusting nut is then turned so that the by-pass valve opens at about 1200 psi on the gauge. *Kuriap*'s by-pass was actually set at 800 psi to provide a safety margin and, to date, several marlin over 100 kg have been landed without any difficulties. After the reel was tested, line guides and a davit for the main block had to be fabricated.

The line guides, or open chocks, are used in setting and route the line from the foredeck back to the stern where baiting takes place. These were fabricated by a local welding company from 3/4 inch round-stock stainless steel. Three of these chocks were needed. Two on the starboard rail and one on the wooden bench at the stern. In addition to these chocks, two 4 inch aluminium blocks are used to guide the line during setting. These were purchased along with the reel. One of these is also used on the davit during hauling. The blocks have ball bearing sheaves and grease fittings for lubrication. They can be used as open or closed blocks by reversing their position.

The davit was fabricated locally from 3 inch galvanised pipe. It was made so that it could be swivelled inboard when not in use to avoid contact with the wharf. The base of the old net hauler was actually used as the base for the new davit. Pad-eyes were welded on the end of the davit for attaching the block. A flood light was mounted on the davit to illuminate the line during night hauling.

A wooden bench on the stern, originally fitted to deploy FAD anchors, proved to be a good baiting table so it was left in place for longline fishing. Also, the main fish hold hatch was replaced with a wood and fibreglass hatch as damage was caused to the fish by the sharp edges on the existing hatch and by the hatch dogs. The new wood and fibreglass hatch is now the landing platform for tunas.

Fishing gear

After fitting the reel and rigging the boat for setting and hauling the line, the fishing gear had to be made up. With a monofilament system this is a relatively easy process. The same can be said for crew training and for actual fishing. This is in contrast to longline fishing with Japanese style basket gear comprising tarred mainline and tarred branch lines with wire leaders where it typically takes two or three years of training for a crewman to become proficient.

Branchline bins, each holding up to 240 hooks, had to be filled. Branchline bins can be made from wooden boxes, barrels, or plastic rubbish bins. In this case purpose-built bins were purchased from Hawaii. They are plastic bins with stainless steel racks attached to the rim. The racks have two rows of 3/16 inch stainless steel rod going all the way around. These are for hanging the swivel snaps that connect the branchlines to the mainline.

The branchlines are very simple. Each consists of a six fathom (12 m) length of 2.1 mm clear monofilament with a swivel snap at one end and a 3.6 tuna hook with ring at the other. The snaps and hooks are attached to the monofilament with an aluminium sleeve. A short (1 inch) length of plastic tubing is put over the loop end of the mono to prevent chafing. A bench press crimper was used to crimp the aluminium sleeves. A crewman can be trained in this task in about one hour and preparing this many branchlines takes one or two days.

When storing the made-up branchlines in the bins the same procedure should be adhered to every time, whether new lines are being made or if hauling is taking place. The first snap is attached at the bottom right-hand side and subsequent snaps are attached going to the left, or in a counter-clockwise direction. The mono is `coiled' using a hand-over-hand motion, letting the line fall naturally. The hook is then placed in the lower end of the snap with the point facing to the left so the next hook covers the point. This helps prevent tangles when setting. After one row all the way around is full the last snap is turned upside-down so the setter or baiter, knows where to start, also a space of about 2 inches should be left at the end of each rod so the snaps do not jam up on each other. When setting, the lines leave the bin in a right-hand, or clockwise, direction. First hook in is the last hook out and vice-versa.

The snaps used for the branchlines are size 8/0. This refers to the size of the swivel. The jaws of the snaps also come in different sizes to accommodate different diameter mainlines. A 9/0 snap is used for floater lines. It has a larger swivel but the same size jaw. The larger swivel is needed to accommodate the 6.4 mm tarred kuralon that is used for floater lines.

Float lines were made up using 15 fathoms (30 meters) of 6.4 mm tarred kuralon. A 9/0 snap was eye-spliced on one end and an eye-splice 4-6 inches long was formed in the other end. The snap end attaches to the mainline and a float is attached to the other. The floats, or buoys, used are 300 mm orange plastic floats with two ears for line attachment. They are pressure-resistant to 300 m. A short piece of tarred kuralon was used to attach a swivel snap to each float. In addition reflective tape was attached to each float for visibility at night. This is particularly important if the line should part. Some floats were rigged to bamboo flag poles with flags and battery-powered strobe lights. These were attached to the mainline at about every fifth basket and are likewise important to help locate the line if it should part.

Fifteen fathoms is a typical length for float lines, but other lengths can be used for different purposes. For targeting broadbill swordfish float lines of 5 to 10 fathoms are used. If the target species is bigeye tuna then longer floater lines of 25 or 30 fathoms could be used. An additional item made from the tarred kuralon was lead lines used to sink the mainline deeper. A snap was spliced onto one end of a one fathom piece of line and one or two kg of lead on the other.

All floats are stored on top of the house on *Kuriap* just aft of the wheelhouse. On some boats a special cage is made for this purpose. Float lines are tied in coils using a quick release longline knot for easy uncoiling during setting. The coiled float lines are stored in plastic bins.

Radio buoys (placed in each end of the line) need to be prepared before use. A netting similar to that found on Japanese glass ball floats has to be tied around the float collar. The float collar, as it comes from the factory, is not very strong and if left as is would soon part causing the buoy to sink and be destroyed. Also a bridle has to be attached to the radio buoy for attachment to the mainline. The bridle should have a heavy-duty longline snap at its end.

Actually, it is a good idea to put a kuralon tag line at each end of the mainline. These should be 4-6 fathoms long with an eye splice at each end. A loop is tied into the monofilament mainline using two figure-eight knots and the kuralon is looped through the knot. The tag line makes it easier to attach the bitter end of the mainline to the drum of the reel. A timber hitch is a good knot for this purpose. A kuralon tag line on the other end makes it easy to secure the last end to the full drum.

Aside from the hooks and lines several miscellaneous tools and bits and pieces are necessary to have on board for longline fishing. These include; cutters (garden shears work well on monofilament), gaffs, knives, sharpening stone, a tee spike for killing fish, a wooden club for stunning fish and removing hooks, wet weather gear, gum boots, V-line gloves (nylon gloves with plastic webbing), a saw for removing fins, and a foam pad to land fish on. Some of these items can be purchased locally, e.g. garden shears, or made in a workshop, e.g. tee spike.

Setting technique

This discussion is limited to how to fish and will not deal with where and when to fish, except to say that, in general, setting is in the morning and hauling is in the afternoon or evening.

Before fishing operations start the deck has to be laid out properly. This includes removing the right number of boxes of bait from the ice hold, stringing the mainline from the reel back aft to where baiting takes place, and arranging all floats, float lines, flags, radio buoys and branchline bins in their proper places. In addition, rubber shock cord or short lengths of line need to be stretched over the racks on the branchline bins so as to create a small hole for the branch lines to fly out of. This prevents the lines from tangling on hooks or snaps when the baited hook is thrown. A pair of cutters should be placed within reach of the baiter so tangles can be cut before a hook flies back into the boat, or worse. It is best to simply cut off any fouled hooks.

After the boat is under way in the setting zone on the desired course and speed the first radio buoy is thrown over. The reel has to be set on free spool at this time. This is done by opening the cross-over valve located just below the hydraulic motor on the reel. As the mainline goes out over the stern float lines and baited branchlines are clipped on at appropriate intervals. The spacing used is usually about 40 hooks per mile, and 10-15 hooks per basket. A basket is the length of mainline between float lines, determined by the number of hooks attached, which can range from five up to thirty or more. At 40 hooks per mile the interval between hooks is about 25 fathoms (50 m). The branch lines need to be far enough apart so that they can not tangle with each other, and so that during hauling one can be coiled before the next one comes up.

Kuriap does not have a line shooter or setter, so the distance the boat travels is the same as the length of line paid out. This is called `towing' the line. On small boats of 15 m or less with small reels holding 10-15 miles of line, shooters are impractical and not usually recommended. To get the hook spacing right while towing the line is a simple matter. At 5 knots, for example, and setting 40 hooks per mile it takes about two and a half hours to set 450 hooks in 30 baskets of 15 hooks each with a total of 480 intervals (Actually, more space is given between the last hook in a basket and a floater to allow more time for coiling floater lines during hauling). So about 500 intervals need to be spaced over two and a half hours. This allows 18 seconds per interval, or 18 seconds between hooks and 36 seconds from the last hook in a basket to a float line. As the crew becomes more experienced the boat can be speeded up and the interval shortened accordingly. Some boats use a timer with a beeper to set the pace but with practice this is not necessary.

The line is towed off the starboard side of the stern and baited hooks and float lines are thrown off the port side. The branchline bin is positioned between two crewmen at the stern. One man, the baiter, removes the hook from its snap, baits it by piercing the hook down through the top of the head of the sanma (saury) baitfish and forward under the gills, and then throws the baited hook at the proper interval.

The baiter sets the pace. The other man, the snapper or clipper, then clips the snap, which he has removed from the rack, onto the mainline. It is important that the snapper snaps the clip just as the baiter throws the bait. If he snaps ahead of time the baiter could be injured. If he waits too long the branch line may become tangled with the mainline. To avoid tangles branch lines should be set perpendicular to the mainline. A third man can hand floats and float lines to the baiter. These are set in the same way as the branchlines. This man's job is also to bring up more bait as needed, as well as more branch line bins.

To achieve a deeper set without a line shooter several things can be done. Baskets can be increased to 30 hooks or more, lead weights can be attached to the line in the middle of a basket, or float lines can be lengthened to 25 fathoms or more. A combination of two of these techniques can also be used. On the *Kuriap* all three methods have been used with success. Care must be taken, however, not to get the line so deep that it can not be recovered.

When all hooks are thrown or when the reel is empty, the last radio buoy is thrown. The boat must be stopped for this and a loop must be tied into the mainline unless the bitter end has been reached. It is a good idea to leave an empty basket at both ends of the line. Otherwise a shark or a sailfish could tie the line in knots. Positions at the start and finish should be taken from the GPS or from radar fixes to landmarks and written down or marked on the chart. In addition, current, boat drift, and wind direction should be noted. This will help in locating the line after six or seven hours of soaking. If the wind and current are particularly strong, it is a good idea to drive back to the line at least once during the soak. Also, before the line gets out of sight, the signal from the radio buoys should be checked.

Lastly, it is easier to set going downhill, or with the wind, and it is easier to haul going uphill, or against the wind. When hauling the wind should, if possible, be kept slightly on the starboard bow (hauling is on the starboard side) as the wind acts as a brake to stop the boat when pulling fish in. Therefore, the last buoy out is the first buoy in. This gives the first hooks a much longer soak than the last hooks, but it also gives the crew a chance to rest without having to backtrack to the first buoy.

Hauling technique

After a soak of 5-8 hours the line is recovered. Usually the deck has to be re-arranged somewhat and tools laid out. On *Kuriap*, since all fish are brined, the seawater/ice slurry has to be prepared. This is done by adding sea water to the crushed ice in the fish hold and breaking up clumps of ice until a slurry is formed. The blocks used in setting are rearranged for hauling in such a way that the mainline is guided from the first block on the davit, which hangs over the starboard side, to the level winder on the reel. The buoy is then recovered and the end of the line is passed through these blocks and secured to the reel. If the mainline was cut at the end of the set a blood knot is used to re-attach the two ends. Blood knots are also used if any bad tangles or shark-damaged sections of the line need to be cut out. Once the line is secured hauling commences.

One man, the roller man, operates the control valve for the reel. His job is to control the speed at which the line is recovered and to unsnap all branch lines and floater lines as they appear. The boat operator controls the forward motion of the boat. These two men must work in tandem in perfect coordination for a smooth haul. Another crewman, the coiler, stands directly behind the rollerman. He takes each snap from the roller man and coils the branchlines into the branchline bin.

Yet another man stands behind the coiler. His job is to pull in all float lines, coil and stow the lines, and stow the floats. In addition, this man tends to all fish; spiking, bleeding and icing.This whole process can be done without stopping (until a branchline holding a fish is reached) as the snaps can be removed from the mainline while it is still moving. The rollerman keeps one hand on the line (this also allows him to feel if a fish is on the line) and the other hand on the control valve. The rollerman can signal the boat operator via hand signals to speed up, slow down, go to port, go to starboard, or stop.

When a fish is encountered, the rollerman yells `fish'. This is the signal for the boat operator to stop the boat and turn to port (so the boat does not go over the line). The coiler usually stands by with a gaff as the rollerman pulls the fish in by hand. The snap is not removed from the mainline until the fish is on board, unless a `lazy line', or play line, has been used as is required with a very active fish. After the fish is on the deck, hauling can resume. If the floater man is still busy with the fish when the next float line comes up, the coiler can attend to it. It is better to keep the boat and line moving once hauling has started as stopping could bring enough tension on the line to break or twist it into tangles. After the final radio buoy is hauled, the end of the line is secured on the reel. If the trip is over a cover should be put over the line on the reel to protect against sun damage. Branchline bins should also be covered. All blocks should be stowed or lashed down.

It is a good practice to grease all fittings on the reel and level winder and all blocks with high-speed waterproof grease just prior to hauling. Also, the V-belt that controls the level winder should be removed during setting operations.

Basic requirements for starting up a longline operation

A small-scale tuna longline fishery can be started up even in a remote location employing boats ranging from 10 to 15 m in length. However, such an operation requires certain minimum equipment and infrastructure.

Vessel requirements

Crew accommodation for four, an operating range of 1000 miles or more, insulated fish holds capable of holding several tonnes of fish (including fish up to 2 m in length), ample deck space for tending fish, and seaworthiness in even extreme conditions. If a vessel is deemed to be suitable it may need upgrading by addition of the following minimum equipment: a hydraulic unit with a capacity of at least 12 gpm at 1200 psi; a seawater pump with a deck hose for washdown; a GPS navigation unit; a radio direction finder; and the usual complement of other wheelhouse electronics (radar, SSB radio, VHF radio, compass, etc.).

It is also helpful, but not necessary to have an autopilot. Autopilots can be used in setting, thus freeing one man to help on deck, and during hauling. Using an autopilot for hauling longline gear, however, is an acquired skill that takes some time to learn.

Boats taken from other fisheries can be readily adapted to longline fishing. These include bottom fish boats, pole-and-line boats, cray boats, trawlers, or fisheries research boats. Most longline boats in the Pacific fleet including those in Hawaii, Fiji and Tahiti (but not including Japanese, Korean, or Taiwanese vessels) started out as something other than a longline boat. If a vessel was formally a successful snapper boat for instance, it could be easily converted to longlining.

Shoreside facilities

In addition to vessels a longline fishery needs shore support facilities. Minimum requirements include a suitable wharf, freezer space for bait supplies, and ice supplies. A wharf can be shared by several boats including vessels engaged in activities other than fishing, but a longline operation must have access on short notice to a wharf or pier suitable for loading ice, stores, and fishing gear, and for unloading fish onto a truck. It is also helpful, but not mandatory, to have shoreside electrical power and fresh water supplies.

If a fuelling dock is not located within a reasonable distance of the operation, fuelling will also have to be done at the wharf either by truck or with drums. Water can also be carted if none is available dockside. A suitable building or covered area for processing fish for marketing is also helpful but not 100% necessary. Some small operations have started successfully in the past by packing fish on the deck of the boat or on the bed of a truck.

Other shoreside facilities to consider when looking at the feasibility of longline fishing in a given locality are: proximity to an international airport; cargo space on international flights; availability of ship's stores; crew housing; medical facilities; recreation for crew; spare parts for boat repair services, including slipways and engineering companies; and availability of a trainable crew. And, lastly unless marketing is to be handled by another concern, an office with phone and fax should be available.

Ice supplies can be crushed block ice, shell ice, flake ice, or (if made on the vessel) refrigerated seawater (RSW) or slurry ice. It takes about 2 kg of ice to chill 1 kg of fish so ice requirements for a boat are about twice what the fish holding capacity is for each trip, eg., a boat that can handle 5 t of fish will need about 10 t of ice. Fish can be put into a brine, or slurry, if the boat has several smaller brine tanks, or fish can be buried in crushed, flake, or shell ice, if the boat has one large fish hold. Brine can be made from any ice, but blocks need to be crushed or fish will be damaged.

In the case of this Project crushed block ice has been used (2 t per week is currently available), but a 5 t/day shell ice plant will soon be in operation in support of the Project. This will be capable of supplying up to five small longline vessels. In addition, the Project will be getting a newer vessel with a 10 t fish holding capacity. It is expected that these developments will enable fishing effort to be stepped up substantially and that export marketing trials may then be undertaken.

Table 1. **Summary of longline catch and effort for all sets made between August 1993 and February 1994.**

EFFORT			CATCH									
			Yellowfin Tuna		Bigeye Tuna		Billfish		Others retained		Discards	
Trip No.	Set No.	No. Hooks	No.	Kg	No.	Kg	No.	Kg	No.	Kg	No. Tuna	No. Shark
AUGUST												
1	1	300	28	1260.0			5	150.0			1	2
2	2	300	6	271.0			2	104.0	5	32.0	4	4
"	3	300	3	119.0							2	14
3	4	360	20	963.0			6	217.0	4	25.0	1	2
4	5	400	10	476.0			3	86.0	2	4.0		4
SEPTEMBER												
5	6	400	13	465.6			1	29.0			6	6
6	7	450	13	499.5			3	86.5	2	11.5	4	2
7	8	450	1	49.5							6	2
8	9	450	5	261.0			6	146.6	3	16.0	1	4
OCTOBER												
9	10	450	6	271.4	1	55.0			2	54.0	1	2
10	11	550	19	727.0	1	33.0			1	3.0		7
11	12	600	5	115.0			2	59.0	2	14.0	2	2
NOVEMBER												
12	13	500					1	20.0				1
"	14	300	13	511.0			3	127.0	1	30.0		
13	15	450	14	694.0			2	50.0	4	27.0	6	20
14	16	450	8	294.0			7	227.0	2	14.0	3	7
DECEMBER												
15	17	450	18	650.0			5	200.0	3	10.0		10
JANUARY												
16	18	459	2	95			7	215	4	38	5	9
FEBRUARY												
17	19	450	4	207			3	152	6	44	1	
"	20	450	9	472	1	17	1	77	5	38	2	5
18	21	450	12	593					5	44	1	7
19	22	450	4	403			1	19	3	27	1	4
TOTALS:	**22**	**9419**	**213**	**9397.0**	**3**	**105.0**	**58**	**1965.1**	**54**	**431.5**	**47**	**114**

Table 2. Overall cpue figures for all longline sets made between August 1993 and February 1994.

No. per 100 hooks		Kg per 100 hooks	
All species *	Tuna	All species *	Tuna
3.5	2.3	126.3	100.9

* Excluding sharks and discards

APPENDIX A

F.V. Kuriap specifications

Length overall	14.8 m
Beam	3.4 m
Draft	1.9 m
Length on water	11.98 m
Gross tonnage	8.5
Speed	10.0 knots

Hull type	Fibreglass reinforced plastic (FRP)
Engine	Yanmar 6 CHK 4-cycle, 130 hp at 2600 rpm.

Fish holds	No.1	1.3 m^3
	No.2	2.0 m^3
	No.3	2.3 m^3
	Total	5.6 m^3
Fish carrying capacity		2.5 t
Fuel oil capacity		1600 l
Fresh water capacity		450 l
Crew complement		4

Built by Yanmar Diesel Engine Co. Ltd., Japan, March 1984.

APPENDIX B

Initial gear order for F.V. *Kuriap*'s longlining operation.

Qty.	Item	Cost (US$)
1	27 inch X 30 inch LP spool	6,205.00
	freight in on spool Florida-Honolulu	500.00
450 lbs	3.00 mm monofilament on spool @ 5.65/lb	2,542.50
450 lbs	3.00 mm monofilament, wooden spool @ 6.25/lb	2,812.50
10 spools	2.1 mm on 23 lb spool @ 172.75	1,737.50
5 coils	1.5 mm Vast mono, 5 lb coil @ 31.08	155.40
1000	.148 x 1/8 inch snap with 8/0 swivel @ 0.90	900.00
400	.148 X 1/3 inch snap with 9/0 swivel @ 1.14	455.00
3	Small grey branchline bins @ 220.00	660.00
2000	Taiwan 3.6 hook with ring @ 48.18/100	963.60
2	Small swedish fid @ 7.67	15.34
2	Wire cutters @ 9.06	18.12
2	Radio buoy, size medium @ 1,000.95	3,001.90
1	Taiyo RDF Model TD-L1100	2,995.00
10	Opi strobe @ 69.07	690.70
40	Assorted clones @ 43.50/10	170.00
4	Mustad gaff head @ 9.17	36.68
3	LP 4 inch block @ 156.00	468.00
8	LP 4 inch block bearing @ 13.55	108.40
1	Brand valve 234.60	234.60
3	Helly Hansen pant med. @ 55.45	166.35
3	Helly Hansen pant lg. @ 55.45	166.35
3	Helly Hansen jacket med.@ 57.27	171.81
3	Helly Hansen jacket lg. @ 69.27	171.81
4 pairs	Bata boot @ 22.00	88.00
1 pair	X-tra Tuff boot @ 55.00	55.00
5 dozen	V-line glove @ 20.56	102.80
5	Dozen v-line glove lg 20.56	102.80
5 coils	6.4 mm tarred mainline @ 155.63	778.15
20	Pigtail swivel @ 1.76	35.20
1	6 ft length Red Link belt @ 7.8 ft	46.86
1	Guide roller @	152.00
2	LP pawls @ 49.95	99.90
48	300 mm plastic floats @ 20.00	960.00
	TOTAL:	**26,017.27**