Secretariat of the Pacific Community

FIELD REPORT No. 8

on

SMALL-SCALE TUNA LONGLINING

ASSISTANCE AND TRAINING FOR THE

REPUBLIC OF NAURU

5 to 31 October 2000

by

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SUMMARY

SPC's Fisheries Development Officer, Mr William Sokimi, undertook a technical assistance project in Nauru from 5–31 October 2000, following a request from the Nauru Fisheries and Marine Resources Authority (NFMRA). The objectives for this project were to undertake a review of the fishing operation on their tuna longline vessel, F/V *Victor Eoaeo II*, and provide suggestions on possible improvements to the vessel, gear and fishing operation; to work with and train the skipper and crew of the vessel in areas that could be improved; and to maintain records on the catch and effort during fishing operations.

Fuel and water shortages on the island restricted the fishing activities of the project vessel. Unfortunately, only two short fishing trips could be undertaken close to the island, with four sets of 900 hooks made. The catch rate was very low at 11.25 kg/100 hooks for saleable species, with this catch amounting to 17 fish weighing 404.9 kg.

Training was the main focus of the work in Nauru. In this regard, 600 new branchlines were made as a training exercise, to replenish the gear on the project vessel. Training was also provided in the correct on-board handling and processing of the catch, with several recommendations made to improve this process. Training is also needed for the skipper and crew of F/V *Victor Eoaeo II*, in the areas of sea-survival, fire fighting, first aid and basic seamanship skills.

F/V *Victor Eoaeo II* is an 18 m tuna longliner, which is too large to be hauled out of the water in Nauru. The infrastructure requirements on Nauru to service a vessel of this size are lacking, and it is recommended that NFMRA look at a smaller tuna longliner in future, if they are to replace their current vessel or purchase a second vessel. One vessel that could be suitable is the new 12.2 m *super alia* design developed in Samoa, and NFMRA may wish to seek more information on this vessel from the Samoan Fisheries Department.

There is potential for Nauru to develop tuna longlining, although there needs to be more private sector participation, which is lacking at present. This could occur in future through NFMRA training up people to become crew on tuna longline vessels, and these people starting out in their own ventures.

RÉSUMÉ

M. William Sokimi, chargé du développement de la pêche à la CPS, a réalisé une mission d'assistance technique à Nauru, du 5 au 31 octobre 2000, à la demande du Service des pêches et des ressources marines et halieutiques de Nauru (NFMRA). Ce projet avait une triple finalité : évaluer les opérations de pêche du seul palangrier thonier de Nauru, le F/V Victor Eoaeo II, et suggérer des améliorations pouvant être apportées au navire, aux engins et aux opérations de pêche; travailler aux côtés du capitaine et de l'équipage et leur dispenser une formation dans les domaines perfectibles; et, enfin, consigner des données de prises et d'effort au cours des opérations de pêche.

Les pénuries de carburant et d'eau que connaît Nauru ont limité les opérations de pêche du navire. Malheureusement, il n'a pu réaliser que deux brèves sorties en mer, à proximité de la côte et effectuer quatre poses de 900 hameçons. Le taux de prise a été très faible (11,25 kg d'espèces commercialisables pour 100 hameçons), en l'occurrence, 17 poissons d'un poids total de 404,9 kg.

L'essentiel du temps passé à Nauru a été consacré à la formation. Six cents nouveaux avançons ont été fabriqués lors d'une séance de formation afin de regarnir les engins du navire. Le chargé de mission a donné des cours sur les bonnes méthodes de manipulation et de transformation du poisson à bord et a formulé plusieurs recommandations sur la façon d'améliorer l'ensemble du processus. Le capitaine et l'équipage ont encore besoin de formation complémentaire dans les domaine suivants : survie en mer, lutte contre l'incendie, premiers soins et rudiments de matelotage.

Le palangrier thonier F/V Victor Eoaeo II, qui fait 18 mètres, est trop grand pour être mis au sec à Nauru. Comme l'île ne dispose pas des installations nécessaires à l'entretien de navires de cette taille, il est recommandé que le Service des pêches et des ressources marines de Nauru fasse l'acquisition d'un navire plus petit, lorsque le bâtiment actuel sera remplacé ou si l'achat d'une seconde unité est envisagé. À cet égard, le nouveau super alia de 12,2 mètres conçu au Samoa semble convenir aux besoins de Nauru, et le Service des pêches et des ressources marines est invité à solliciter des informations complémentaires auprès du Service des pêches du Samoa.

La pêche du thon à la palangre à Nauru présente un certain potentiel de développement, si toutefois le secteur privé y prend part, ce qui n'est pas le cas à l'heure actuelle. Afin de favoriser une telle évolution, le Service des pêches et de ressources marines de Nauru pourrait envisager de former des membres d'équipage de palangriers thoniers, qui seraient ensuite en mesure de créer leur propre entreprise de pêche.

CONTENTS

A.Vessel specifications, electronics and safety equipment carried on F/V *Victor Eoaeo II*

1. INTRODUCTION AND BACKGROUND

1.1 The Republic of Nauru

The Republic of Nauru (Figure 1) is a small isolated singular landmass that is located at 0˚ 32' S latitude and 166˚ 55' E longitude (Anon 2000b). It has a total land area of 21.1 km^2 (6 km x 4 km — 5,263 acres), with a population of 11,500 people and an annual growth rate of 1.8 per cent (SPC 2000). The island has an average height of 50 m above sea level, and a coral 'belt' ranging from 150 to 300 m wide surrounds the 19 km circumference of the island (Williams and MacDonald 1985).

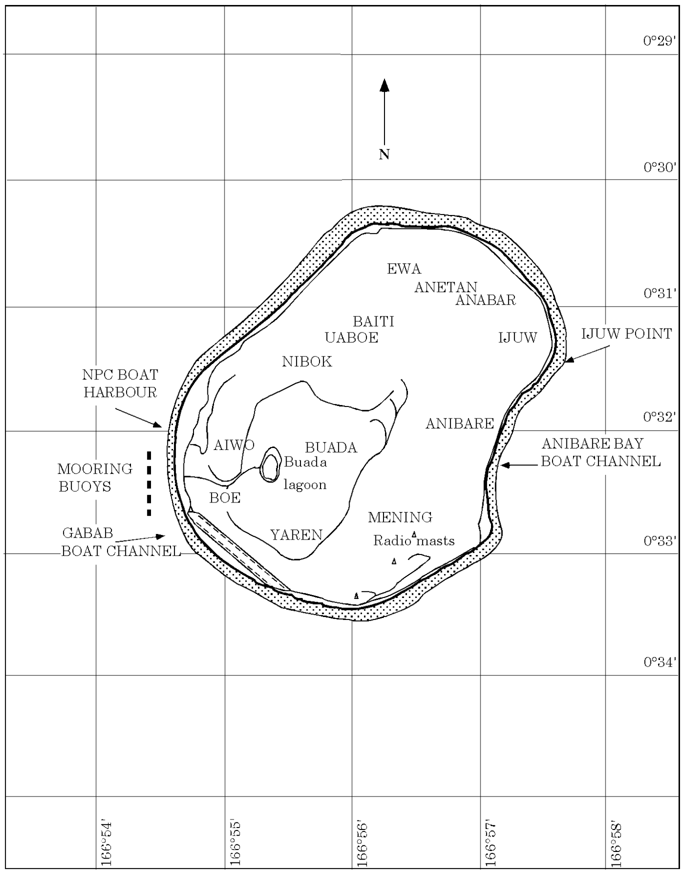


Figure 1: Nauru Island

Daily temperatures range from 24˚ C to 34˚ C. The Island has a tropical climate with northeast trade winds that blow from March to October, and a monsoon season from November to February. The average annual rainfall is 2060 mm and occurs unpredictably (Anon 2000c).

The island is comprised mainly of raised coral limestone with rich deposits of guano phosphate, resulting from seabird droppings over the centuries. Because of the agricultural demand overseas and the economic viability of guano phosphate as a fertilizer, much has been mined and exported to supply overseas markets over the years. This has also been the main source of income that has propped up the Nauruan economy since the island obtained independence in January 1968 (Anon 2000a).

Continuous mining over the decades has resulted in the depletion of phosphate reserves, and since guano phosphate is not an easily replaceable resource, the leaders of Nauru are now looking to other natural resources to develop, to aid in the recovery of an ailing economy.

1.2 Fisheries

Nauru, being an island nation surrounded by ocean, relies heavily on the harvesting of marine resources to provide food, and more recently, a source of income for its inhabitants. Traditionally, Nauruans gleaned the limited reef areas and fished outside the reef. Nauru has no lagoon.

Phosphate mining is the main industry on Nauru. In support of this, a small harbour (Figure 2) was constructed in 1904 to allow the launching of small vessels (Williams and MacDonald 1985). More recently, two other passages have been blasted through the reef, as there are no naturally-occurring harbours or passages. These passages provide local fishermen with access to the open ocean. The passages are located on opposite sides of the island, to provide protection from prevailing weather, so fishermen can launch their trailer vessels at either location.

Figure 2: Small harbour

The mingling of I-Kiribati and Tuvaluan migrant phosphate mining workers with the Nauruans has resulted in the sharing of fishing ideas and techniques that have been used successfully to supplement their earnings and provide for a protein diet at home. Since the island is surrounded by fringing reefs that slope off into the ocean, several methods have been adopted to target the bottom species and mid-water pelagic species. Fishing off the island is mainly 'close-offshore' or within sight of the island except for those fishermen who do leisure cast fishing using rods from the edge of the fringing reef at low tide, or from vantage points that enable them to cast into deeper waters. Several fishermen who have hand-held GPS sets tend to venture further out than normal to troll surface tuna schools.

Bottom fishing is done by handlining, or fishing with a 'Christmas' tree (a small multi-hook rig made from wire). Spearfishing is conducted when diving. The mid-water pelagic species are caught mainly by drop-stone fishing and trolling. Flying fish are caught using nets.

The main fishing area off Nauru is the mooring buoys anchored in the vicinity of NPC's Phosphate Cantilever loading facility (Figure 3). These deep-water moorings are used to tie the bulk carriers during the loading of phosphate. The buoys are good fish aggregating devices (FADs), especially for fishermen doing scatter-bait (drop-stone) fishing and trolling (Cusack 1987). The target species for these fishermen are rainbow runner (*Elegatis bipinnulata*), yellowfin tuna (*Thunnus albacares*) and wahoo (*Acanthocibium solandri*). All fish taken by these methods are for domestic consumption.

Figure 3: Mooring buoys used for tying up bulk carriers when loading phosphate

In the late 1970s, the Fisheries Department explored avenues for commercial development of fisheries in Nauru. Their first attempt towards establishing an offshore commercial fishing industry was in 1980, when two 948 GRT purse seine vessels, F/V *Austin Bernicke* and F/V *Victor Eoaeo*, were bought from Peru with Peruvian skippers, engineers and crew. At this time, the Nauru Fishing Corporation was formed to manage and pilot the industry. Unfortunately this ventured failed, as it was realised the nets were too shallow for fishing in the region. F/V *Victor Eoaeo* sank off Nauru in a storm in the mid-80s, and the F/V *Austin Bernicke* was chartered to a company in the Philippines in 1987-88 and later sold (Chapman et al. 1998), ending the venture.

Nauru's Fisheries Department in the late 1980s, reassessed their development direction, and decided to focus more on the private sector. Their focus turned towards FADs, and in 1990 they requested assistance from SPC. Between 1990 and 1997, SPC conducted four projects in Nauru that culminated in the deployment of several FADs around the island (Chapman et al. 1998). These FADs assisted the local fishermen greatly, especially in the capture of pelagic fish such as billfish, mahi mahi, wahoo and tuna; but the continued exposure to open ocean and weather elements resulted in a continuous loss and replacement exercise that proved expensive.

Successful FAD sites were found to be those around 2 to 3 nm from the island, and the depth at these areas were from 2000 m to 3500 m. The mooring ropes used in these depths are very expensive, making these deep-water mooring systems very costly.

The Fisheries Department became the Nauru Fisheries and Marine Resources Authority (NFMRA) in the mid-1990s. NFMRA's development team has been trying to identify the main cause of the short life of FADs, but to date only weather has been identified as the most likely course. Other factors such as shark bite, the FAD mooring slipping into deeper waters, and the FAD buoy being hit by passing vessels, have been considered. The development team is now trying to develop suitable FAD designs that are more resistant to weather and less expensive to construct. Several designs have proved more resilient than others, but the lifespans are still not long enough to single out a distinctive design. Several FADs that were deployed closer to the reef lasted for longer periods but these were not as successful in fish catches as the more offshore FADs.

NFMRA received two 4.5 m vessels, F/V *Imiyeb* and F/V *Eaimar*, and two 7.5 m vessels, F/V *Dogua* and F/V *Dabage*, under Japanese grant-in-aid schemes, for use by trained fisheries staff. The two larger vessels (Figure 4) alternate between fishing trips, port clearance transport duties, search and rescue, and FAD site surveying. These vessels are used for trolling, vertical longlining and bottom dropline fishing.

Figure 4: F/V Dogua *and F/V* Dabage

In 1998, SPC was requested to undertake a feasibility study on the infrastructure requirements and vessel parameters for tuna longlining in Nauru (Chapman 1998). The study made suggestions on vessel parameters for two types of tuna longliners, a small 11 m vessel that could be hauled out of the water in the event of bad weather, and a larger 20–22 m vessel that would need to be moored offshore.

In an endeavour to develop fish production and increase fish quality, NFMRA looked at the marketing of fish in Nauru. A fish market, funded by Japanese Aid, was opened in mid 1999 to provide a centralised, hygienic outlet for the local fishermen. The fish market was initially intended for local sales, however, it will not be sufficient to maintain and manage the fish market expenses, provide incentives for fishermen to invest in fishing or to contribute to the economy of the country. The fish market is purchasing fish from the fishermen at AUD 2.00 to 3.00/kg depending on the fish species.

In support of the fish market, and to increase the throughput of fish, NFMRA purchased an 18 m tuna longline vessel, F/V *Victor Eoaeo II*, to begin small-scale tuna longlining to supply local demand and develop overseas markets. The vessel is equipped with a monofilament longline system, with 25 nm of mainline. The instigation of the tuna longline project is another support project that is expected to boost interest in the private sector, as a means to provide quality fish that can be sold on overseas markets, particularly the fresh fish markets in Japan, US mainland, and Hawaii.

NFMRA also generates income from issuing licenses to foreign purse seiners and tuna longliners to fish within Nauru's EEZ. The current licensing policy for foreign vessels may change as NFMRA develops their domestic tuna longlining capacity, including expansion in the private sector.

1.3 Initiation of the project and its objectives

NFMRA commenced its tuna longlining project with the purchase of an 18 m vessel from Australia. To assist the project, a consultant skipper was recruited from Australia to operate the vessel and train up local crew on fishing operations. The initial skipper left and a second skipper recruited, although the catch rates achieved by the vessel remained low.

To try and increase the catch rate on F/V *Victor Eoaeo II*, NFMRA requested technical assistance from SPC. The objectives of the project were: to undertake a review of the fishing operation and provide suggestions on possible improvements to the vessel, gear and fishing operation; to work with and train the skipper and crew of the vessel in areas that could be improved; and to maintain records on the catch and effort during fishing operations.

Fisheries Development Officer, Mr William Sokimi, was assigned to this project, which ran from 5 to 31 October 2001.

2. TUNA LONGLINE VESSEL — F/V *VICTOR EOAEO II*

The fishing vessel F/V *Victor Eoaeo II* (Figure 5) is an aluminium catamaran 18 m in length by 5.2 m beam. The vessel was built at Lakes Entrance, Victoria, Australia, and was originally a deep-sea bottom dropline vessel, before being converted to a tuna longliner. It was bought by the NFMRA to initiate small-scale/medium-scale tuna longline fishing within the Nauru EEZ.

Figure 5: Nauru's tuna longliner, F/V **Victor Eoaeo II**

The vessel has a forward wheelhouse and has a separate control station on the starboard side of the after deck (Figure 6). A Morse control system connects the control station to the wheelhouse controls. The system installed on the vessel is a KE – 4 Electronic Control System manufactured by Morse Controls Pty, Ltd. / NHK Morse Company Ltd, Japan.

Figure 6: Control station on starboard side of the after deck

There is ample working space on the aft deck for setting, hauling and fish processing operations. It has a removable rail aft for gaffing and boarding fish. The vessel has elongated bulbous bows on both catamaran hulls that contain tanks for extra fuel. It is also fitted with ample electronics. Appendix A summarises the vessel specification, electronics and safety equipment carried.

2.1 Mainline reel and line shooter

The vessel’s mainline reel and shooter are products of Leahy Engineering of Cobargo, NSW, Australia. Both are solidly constructed and capable of heavy-duty work. The reel can hold up to 35 nm of 3.0 mm mainline, but had around 25 nm of 3.0 mm mainline at the time of the project. It is mounted on the aft deck in a fore-and-aft position slightly off to port of the centre of the vessel (Figure 7). A cover encloses the level wind drive wheel pulley and the mainline reel pulley, so the level wind moves continuously along the worm gear during setting as well as hauling. The reel does not have a by-pass valve on the hydraulics to allow the spool to free wheel.

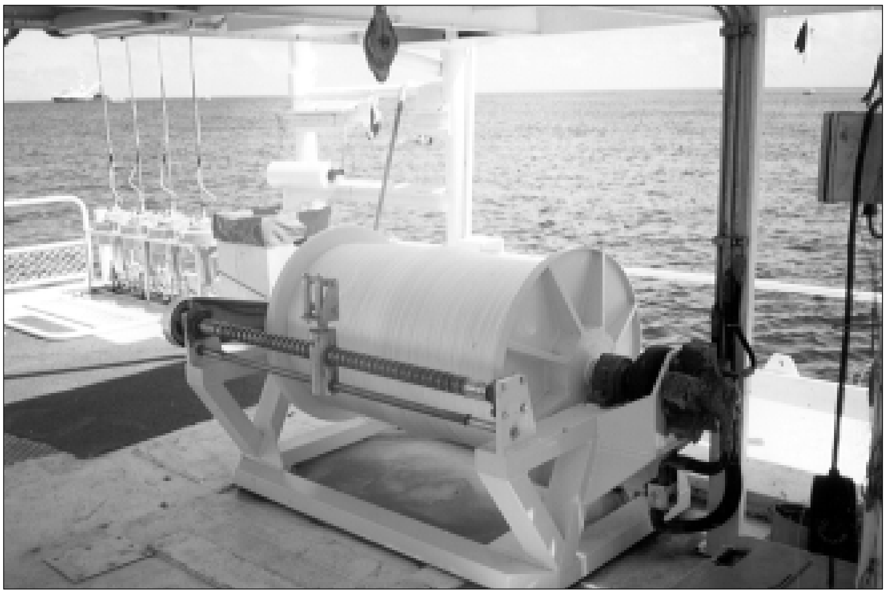


Figure 7: Mainline reel on F/V Victor Eoaeo II

An electric pump that is run by the vessel's generator/auxiliary engine drives the hydraulic system. The reel and line shooter operate on separate hydraulic lines, and have to be coordinated every time the line is set. The reset between reel and shooter has to be tended to several times as the mainline diameter reduces on the reel drum while setting.

The vessel's line shooter is mounted on the stern of the vessel, and is positioned slightly off to starboard. The line shooter drive wheel faces in a fore-and-aft line, or at a 90˚ angle to the beam of the vessel.

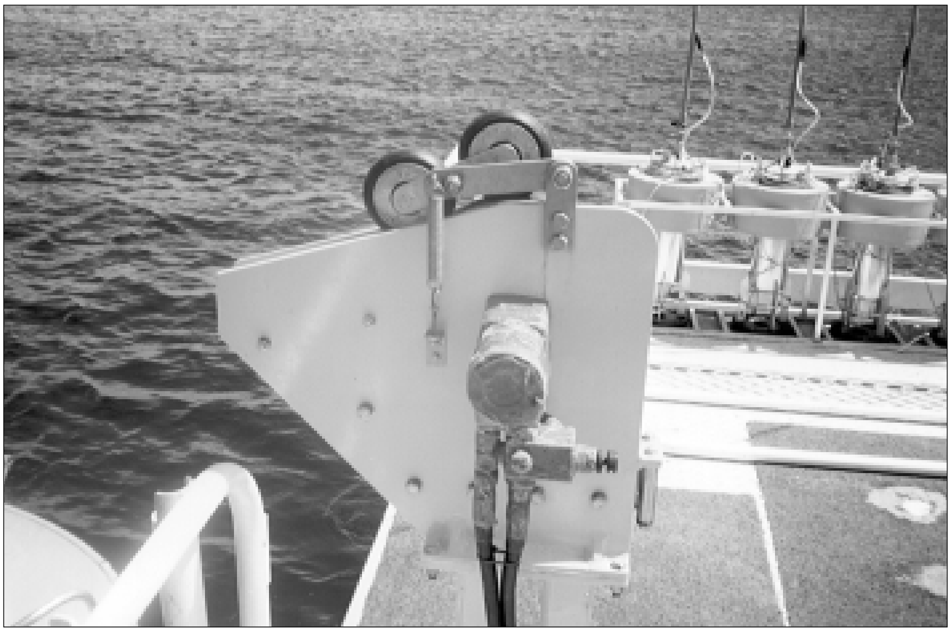


Figure 8: Line shooter mounted on stern of vessel

Although the vessel can travel at speeds greater than 6 knots, line setting is restricted to this speed, with the line shooter set at 240 RPM. The reel and shooter lose coordination at faster speeds. This system is very limiting as deeper sets cannot be achieved at faster speeds. To achieve deep sets the vessel has to slow to around 4 knots. This inadequacy is due to the hydraulic system, where the maximum speed obtainable from the hydraulic drive is insufficient to match vessel speeds greater than 6 knots.

2.2 Fish hold and cool storage system

There are two fish holds and a 7 m^3 walk-in freezer on the vessel. The combined fish holds can hold up to 7 t of fish. The holds are rectangular and have no longitudinal or transverse partition boards. The system employed for chilling fish at sea is refrigerated sea water (RSW—Figure 9).

Figure 9: Fish hold with RSW

This method of preserving fish at sea is ideal for the situation in Nauru. The RSW system reduces the effort or need of having to cart ice out to the vessel. Chilling of the sea water begins at the start of each trip. The water is chilled to a temperature of 0˚ to –2˚ C, by the time hauling commences. The temperature is regulated according to the rate of fish intake, so the water temperature remains constant.

There are many methods of managing the manner in which the water is chilled and how the holds are loaded with fish. The simplest method would be to fill both fish holds to around 50–75 per cent capacity, and commence chilling one fish hold first. When the first chilled hold is almost full with fish, the second fish hold can be chilled and used.

This method can affect the fish quality depending on the state of the sea. If only a few fish are put into the spacious tank of chilled water, they will tend to move around in the tank and this will cause bruising and abrasions as the fish rub the sides of the tank and collide with other fish. It is essential to keep the RSW slightly above the level of the fish.

The machinery for the walk-in freezer was in perfect running order, but it was shut down and used as a resting area for the crew. With the doors wide open, there was ample ventilation and space to accommodate three crew. The vessel was not being utilised to its full capacity. Only short trips had been attempted and there was still space on the reel to top-up an extra 10 nm of 3.0 mm monofilament mainline. Once the trip duration and frequency increases, the walk-in freezer will have to be used to store bait, frozen food supplies, and freeze and store bycatch.

3. FISHING OPERATIONS AND RESULTS

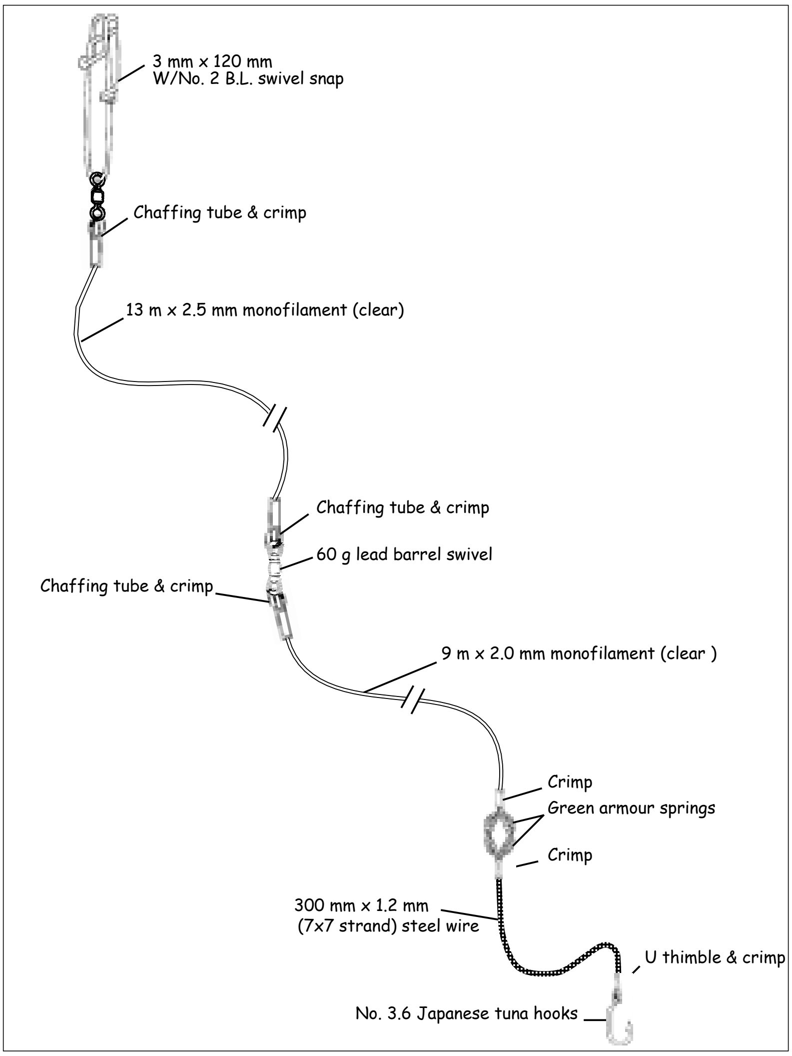
3.1 Fishing gear

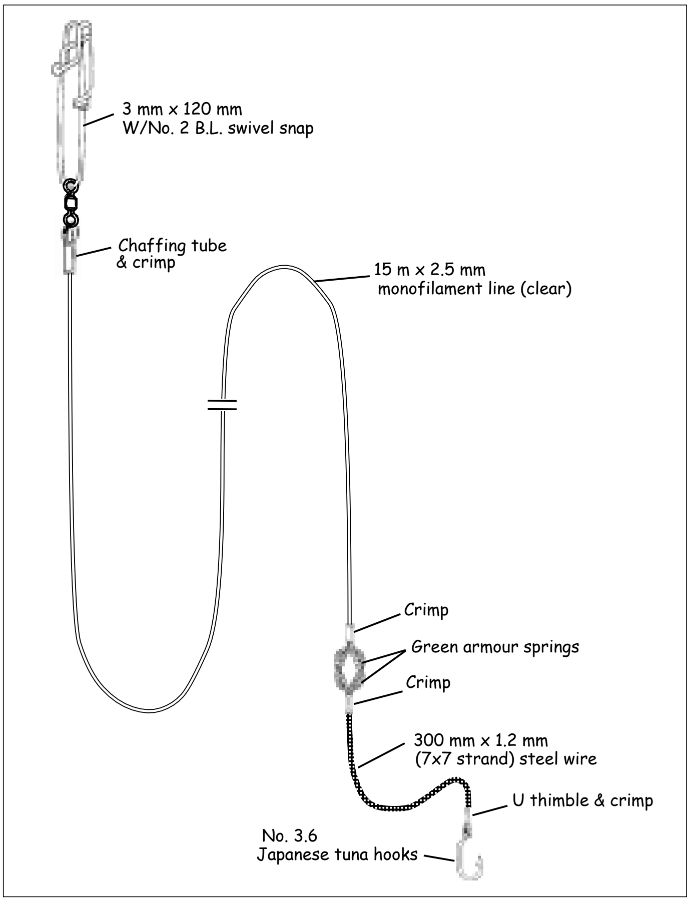
The vessel had four branchline bins that were constructed of 2.5 mm aluminium sheeting welded together to form a fully enclosed box. There were drain holes in the bottom and lifting slots in two opposite sides. Four angled posts were welded in each of the top four corners to support two rows of 3.0 mm monofilament line that was rove through them. These were the hanging lines for the branchline snaps.

Each bin holds up to 300 branchlines. At the time of this project, around 600 branchlines were in the four bins. The crew and the Fisheries Development Officer (FDO) made up an extra 300 branchlines before the vessel went out fishing. The lack of branchlines was a result of a shortage of fishing gear in stock. One week after the arrival of the FDO, stocks of replacement fishing gear arrived, enabling the crew to construct an additional 300 branchlines. Because of a lack of time these were made differently from those on board.

The branchlines on F/V *Victor Eoaeo II* consisted of a 3.0 mm x 120 mm W/No.2 B.L. swivel snap, 13 m x 2.5 mm clear monofilament, 60 gram lead barrel swivel, 9 m x 2.0 mm clear monofilament, 300 mm x 1.2 mm (7 x 7 strand) steel wire, No. 3.6 Japanese tuna hooks, clear vinyl chaffing tubes, green armour springs, aluminium U thimbles, and crimps for the different sizes of monofilament (Figure 10).

Figure 10: Construction of branchlines on F/V Victor Eoaeo II





The replacement branchlines were constructed only of the snap, 15 m x 2.5 mm monofilament line and the No. 3.6 Japanese tuna hooks (Figure 11). These were put together using the U thimbles and chaffing gear in the appropriate places. These branchlines were faster to construct and would be of little difference to the fishing operation, especially when mixed with the leaded branchlines.

Figure 11: Construction of the replacement branchlines

Floatlines were constructed from 15 m x 7 mm red polypropylene ropes (Figure 12). One end of a floatline rope was spliced onto a 3.2 mm x 120 mm W/No.2 B.L. swivel snap, while the other end had a 150 mm open splice for attaching floats.

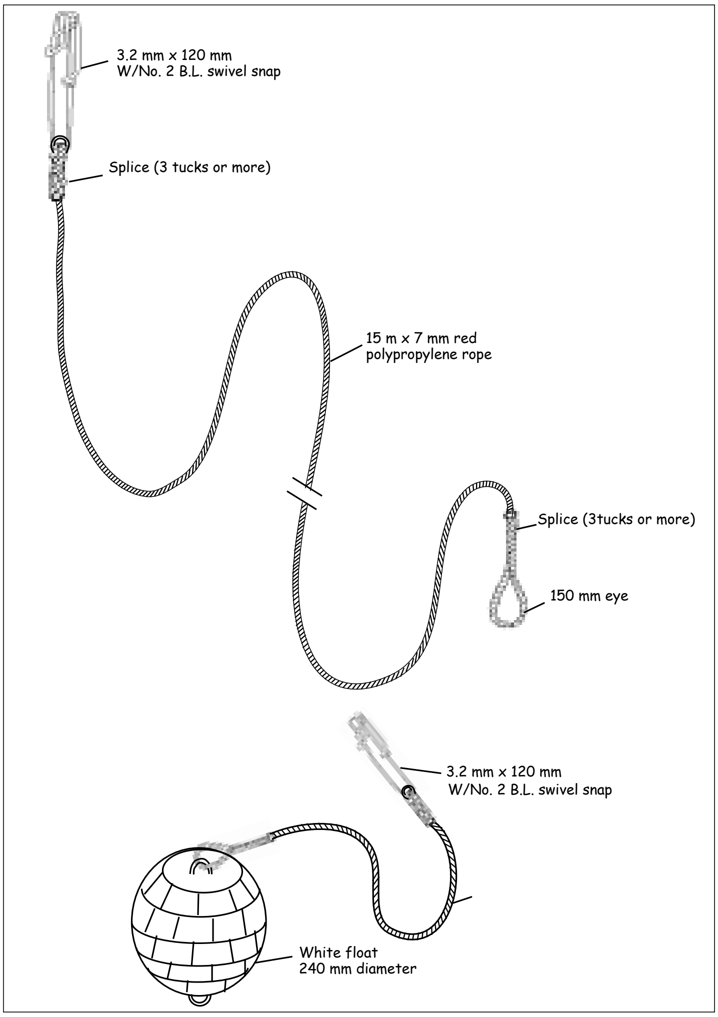


Figure 12: Construction of floatlines

The floats were hard plastic, white in colour and 240 mm in diameter. These floats have a working depth of up to 300 m. The floats had a 300 mm x 10 mm green polypropylene rope spliced onto the ear, with a 3.2 mm x 120 mm W/No.2 B.L. swivel snap spliced onto the other end of the rope (figure 13).

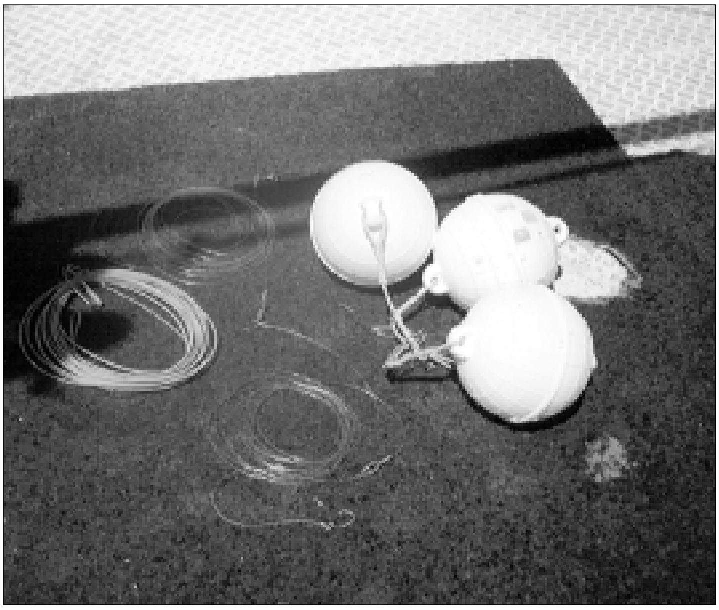


Figure 13: Floats and branchlines used during the project

3.2 Fishing trips

Prior to the arrival of the SPC Fisheries Development Officer in Nauru, the normal fishing trips carried out by F/V *Victor Eoaeo II* ranged from two to three days, with one set per day. The FDO's plan was to take the first trip to observe the operations, then to comment later on improvements. One of these improvements was to increase the number of fishing days (length of trip).

Several unforeseen problems contributed to the vessel not being able to complete more fishing trips than it did during the FDO's time in Nauru. A fuel shortage on the island resulted in only two short fishing trips with only four sets carried out: three on the first trip and one on the second.

On both trips, the closer fishing grounds were chosen to minimise the use of fuel and to get more sets in. However, on the second trip, the vessel had drifted farther than anticipated after the first set and the remaining fuel would not sustain another longline set, so the trip was cut short.

It would have been preferable to do fishing trips of at least 5 to 10 sets per trip. This would have enabled better determination of potential fishing grounds around Nauru, and develop a better system to overcome the hydraulic system limitations. The vessel has the capabilities to perform longer trips.

The two trips were sufficient to observe the fishing method used and to make an assessment for improvements. However, two trips were insufficient to make a more in-depth assessment on the performance of the vessel, and to recommend improvements in the machinery and other equipment on board.

3.3 Fishing method

On both trips the vessel departed at dawn, and line setting was started around 0900 hours. The fishing method employed by the crew was typical of any small-scale tuna longliner using the reel and monofilament mainline system.

While setting, the mainline was led out from the reel to the line shooter via an overhead block. The line shooter speed was gradually increased as the line was paid out. This enabled the shooter and reel to work in unison, resulting in a smooth setting operation.

Only one branchline bin at a time was used while setting (Figure 14). The vessel's speed of four knots did not require the crew to deploy branchlines at a fast speed. Two crew worked the single bin, one to unhitch and bait while the other snapped the branchlines onto the mainline. For a vessel travelling at speeds of six knots or more during line setting, two branchline bins can be used simultaneously. This is because the pace is faster and two crew are needed to maintain a proper distance between the branchlines.

Figure 14: Line setting operation on F/V **Victor Eoaeo II**

Branchlines were spaced around 40–50 m apart on the mainline, with 25–30 branchlines between floats. Around 900 hooks were deployed on each of the four sets.

The mainline was divided into four sections. After each bin of 300 hooks was deployed a radio beacon was connected to the mainline as a marker in case of line breakage during hauling. There were four radio beacons on the line, one on each end and two in the centre.

Hauling started around 1630 hours each day. The full hauling operation took up to 6 hours.

The hauling system on F/V *Victor Eoaeo II* was similar to the setup on a forward deck vessel, where the person steering the vessel is sitting in the wheelhouse looking forward at the operations on deck. On F/V *Victor Eoaeo II*, the steering console was on the aft deck but separate from the unsnapping position (Figure 15). The unsnapping position was forward of the person steering. The advantage here is that everyone was on the working deck and communication was immediate. The skipper had better control of his work surroundings.

Figure 15: Hauling arrangement with unsnapping position forward of steering console

3.4 Bait

Sardine bait (*Sardinops* sp) was used during the fishing trials as this was the only bait available in Nauru. Even though the bait was firm at the time it was used, there were signs that it had previously been defrosted and refrozen for use. Some of the bait was also flattened during defrosting then refrozen in that shape, plus there were some signs of spoilage.

Sardine has proved itself to be good bait in several areas around the region but its tendency to soften within a short period is a disadvantage. The advantage of using sardine is that it is less expensive, and when used in good fishing grounds, it attracts fish within a short period. The preferable bait for tuna longline fishing would be squid or a mixture of squid and finfish such as milkfish (*Chanos chanos*), muro aji (*Decapterus macarellus*) or sanma (*Cololabis saira*) and several others. The choice of bait depends on the fisherman's preference and his experience on the fishing grounds being worked.

Squid lasts well and has a slow deterioration rate compared to fish bait on a hook. The disadvantage though is that it is much more expensive to purchase, and this discourages vessel operators who prefer to opt for the cheaper fish baits.

3.5 Fish catch and sales

The total catch for the four sets amounted to 17 saleable fish (Table 1), of which 4 were yellowfin tuna weighing 113 kg, with one bigeye tuna weighing 51.4 kg. The unsaleable catch (Table 1) was mainly made up of snake mackerel (13 fish weighing 24.1 kg).

Table 1: Catch taken during the current project, with values (in Australian dollars) for saleable species

Species	Number	Weight (kg)	Price/Kg (AUD)	Value
Saleable species				
Yellowfin tuna	4	113.0	3.00	339.00
Big-eye tuna	1	51.4	3.00	154.20
Blue marlin	1	47.9	2.00	95.80
Barracuda	1	10.9	2.00	21.80
Rudder fish	2	6.2	2.00	12.40
Blue shark	4	77.5	2.00	155.00
Thresher shark	1	54.7	2.00	109.40
Bronze Whaler	3	43.3	2.00	86.60
Sub-total	**17**	**404.9**		**974.20**
Unsaleable species				
Snake Mackerel	13	24.1	Discarded	
Lancet fish	8	19.8	Discarded	
Pelagic ray	2	5.8	Discarded	
Sub-total	**23**	**49.7**		
TOTAL	**40**	**454.6**		**974.20**

The saleable fish were all gilled and gutted and sold in chunks (including head) on the local market, except for the sharks, where the heads were discarded. The unsaleable fish were weighed and discarded.

Total hooks set for the four sets was 3600. The catch per unit of effort (CPUE) per 100 hooks for saleable fish was 11.25 kg, while the CPUE for the total catch was 12.62 kg/100 hooks. This is a very low catch rate, reflecting the limited fishing effort and the poor catches recorded close to the island.

The prices that the fish market used to purchase fish from the project vessel and local fishermen were:

- tuna AUD 3.00/kg
- deep sea fish AUD 5.50/kg
- wahoo AUD 2.50/kg
- black trevally AUD 7.00/kg
- others AUD 2.00/kg

4. DISCUSSION AND CONCLUSIONS

4.1 General

A range of issues need to be addressed if development of Nauru's tuna fishery is to progress. Given the difficulties that arose during this assignment, much of the observations listed here have to do with general ship operations and are based on the FDO's observations around the region that is comparable to the Nauru situation.

The areas observed were:

- the relationship of the vessels size in comparison to the infrastructure available on the island for its maintenance and dry docking;
- the crews competence in processing and handling the fish catches;
- the crews seamanship abilities in maintaining the vessel;
- the suitability of the fish hold and refrigeration system in maintaining catches;
- the marketing arrangements for processing and sale of fish; and
- the suitability of the equipment on F/V *Victor Eoaeo II* to carry out tuna longline fishing.

4.2 Vessel size and maintenance infrastructure

The infrastructure available on Nauru to support a medium-scale tuna longliner like F/V *Victor Eoaeo II* is limited. Maintenance of this vessel will be difficult, as there is no mechanism to remove the vessel from the water when work is needed. A smaller size vessel, monohull or catamaran, would be more appropriate for the Nauru situation, and NFMRA should consider this in the future. The size of vessel suitable for Nauru would be one that is manageable when the time comes for maintenance purposes or for uplifting in times of rough weather. The vessel should be large enough to fish Nauru's EEZ. Suitably sized vessels to meet these criteria would be vessels between 11 and 13 m in length (Chapman 1998).

A smaller vessel should have lifting lugs incorporated into the design or some form of trailer for quick and easy retrieval from the sea. The lifting area has to be strong in construction and capable of taking the weight of the fuel, water and any other necessary load that might have to be uplifted in an emergency.

SPC has recently tested a new design 12.2 m aluminium catamaran fishing vessel in Samoa (Sokimi and Chapman 2000), powered by twin diesel inboard engines. The general design of this vessel would be ideal for the situation in Nauru provided several modifications were made. These modifications would include the incorporation of solid lifting points or trailer handling qualities into the present design, the provision of an RSW system, and the addition of an aft hauling station would be a major advantage. This vessel proved its seaworthiness and fishing ability during the trials. It would be in the best interest of NFMRA to contact the Samoa Fisheries Division for an appraisal of this design, and a costing including the changes suggested here.

If NFMRA wishes to continue using vessels the size of F/V *Victor Eoaeo II*, or slightly larger, then the infrastructure needed for vessels of this size should be constructed on the island. Under the current situation, should bad weather approach Nauru, the vessel's options would be to remain tied to the buoys under full manning, steam to the leeward side of the island, or steam away from the island until the weather passed. For dry-docking purposes, the current infrastructure is not sufficient for the vessel's size, therefore the vessel will have to have maintenance undertaken in Kiribati, Fiji, the Solomons or one of the neighbouring islands that has adequate services available. Although NPC has heavy lift cranes, there are no lifting lugs on the vessel that would prevent it from being damaged. Even then, the overall configuration of the vessel will not fit into the NPC's workshop area, where their barges and tugboats are kept.

The ongoing maintenance of F/V *Victor Eoaeo II* is essential to keep the vessel fully operational. Therefore, maintenance procedures should be put in place to ensure the vessel's longevity. This should include the fishing gear as well as the vessel itself and its machinery. In addition, there is a need for training of the crew to undertake maintenance procedures, plus the need to train up Nauruan skippers for this and future vessels.

There is one piece of preventative maintenance that should be implemented immediately. During the setting process, the mainline is fed from the reel to the line shooter via a guide block. However, the guide block is not directly in line with the line shooter, putting strain on the portside roller guide, creating undue wear. This strain can easily be eliminated by repositioning the guide block in line with the centre of the shooter drive wheel, or by angling the shooter slightly to the starboard quarter.

In the long term the fishing industry will progress faster with the necessary backup infrastructure in Nauru, such as trained personnel in the support services, good marketing facilities, and reliable transportation to export markets. NFMRA should consider having staff trained up in different support professions, such as engineering (refrigeration, diesel, hydraulic) and electrical, realising that some of these staff may leave their employment to start up private sector businesses.

4.3 On board handling of fish

The on-board system for landing and chilling fish makes it easier for the crew to handle their catch, but does not prevent abrasions and bruising. As soon as a fish was landed it was immediately stunned, spiked and bled, with a flexible wire run down the spine of the fish to kill the nerves (called the Taniguchi method). The fish was then gilled and gutted, put into a plastic bag to protect the skin from abrasions, and placed in the RSW (Figure 16).

Figure 16: Catch in plastic bags in the RSW

The crew of the F/V *Victor Eoaeo II* were proficient in preparing the fish for chilling, however, several practices should be eliminated. The crew landed and processed their fish on a carpet that was spread on the deck to cover exposed areas of the slip-proof grids. The fish, when gaffed, were landed on this carpet but after gilling and gutting the fish should immediately be put into the RSW. Although plastic is used for storing fish in the holds, more care should be taken when moving the fish around on deck and when storing the fish in the fish holds.

The fish holds did not have baffles or partitions in them to lessen the free surface effect. This allowed fish to float freely around in the hold, and even though they were covered in plastic, fish rubbed against the fins and protruding bones of other fish. To maintain fish quality in these holds, especially to guard against abrasions and bruising, the fish holds have to be partitioned. The fish holds should at least be divided into four sections with movable partitions. Fish that are longer can be put into one of the sections where the centrepiece can be removed to give the fish the full length to lie in. Care should be taken when constructing the partitions so that no rough edges are exposed. All corners should be rounded off.

If this is not a possibility, another simpler and cost effective method can be tried, with observations made to determine its effectiveness. Construct bars or lines in the hatch area of the fish holds where fish can be hung from them by tail ropes into the RSW for preservation. When the hanging space of both holds are full, all fish can be released and pooled together in one fish hold.

4.4 Transfer and handling of fish from the vessel to shore fish market

The present method of transferring fish from F/V *Victor Eoaeo II* is by loading the fish onto the deck of a launch to take ashore, carting it across to the docks to be loaded onto a transfer truck, which then transports the fish to the market for processing. The main item to note is that the fish must be kept in a cold medium throughout its transition from the vessel to the markets, which was not happening. This method of transferring fish exposes the fish to long periods of warm air. If a large consignment is to be dealt with, the fish will lose its quality along the way.

To correct this, proper chilled water tanks or ice chests have to be constructed and used on the transfer vehicles — the launch and the transfer truck. In this way fish is taken out from one chilling medium and stored in another until it reaches the processing room.

The washing down of fish at the processing plant also needs to be undertaken with chilled water. An icebox with copper coils running on the inside will solve this problem. The icebox has chilled water or an ice slurry in it to chill the copper piping. A hose from the tap to the icebox will supply the clean water, with it passing through the copper pipe inside the icebox. The water coming out will be chilled and be used for washing down the fish.

Everyone working in the processing plant should wear clean clothing, especially when filleting and processing fish. It was noticed that proper boots and clothing were supplied to the factory workers but these remained on the workers whether they were in the processing plant or outside. Anytime the workers leave the processing plant their work clothing should be removed and hung in a hygienic locker.

4.5 Marketing views

Nauru has the potential to market its fish overseas. It has its own national airline, Air Nauru, with a Boeing 737 400 series aircraft that flies to destinations such as Australia, Fiji, Guam and the Philippines, where the fish can be transshipped through to Japan or US markets (Hawaii and mainland). Not only will the fishing industry gain in having this access, but also the airline itself will gain revenue from the additional cargo.

At this stage, only the development of the fisheries operations is being concentrated on. That is, fishing vessel operations and maintenance, fishing technique development, processing and quality control. The marketing section is being addressed but cannot proceed on a fully commercial scale unless the fishing operation picks up and larger catches are taken.

While the industry is at this early stage, NFMRA and the Government of Nauru should work at identifying a workable solution to train up personnel to be proficient at marketing procedures. While they have capable people already in place, several other people should be identified to be trained in the tuna marketing industry, within the region or at marketing destinations, so they understand the many procedures required to get the best arrangement for marketing the fish.

4.6 Seamanship

The crew of the F/V *Victor Eoaeo II* need to develop their seamanship skills. Their performance on board was sufficient to conduct the crew's duties, but for safety reasons they need to undergo sea-survival, fire fighting, first aid and basic seamanship training. Most of these fishermen were first time sailors who had begun sailing on a commercial vessel within the last six months.

At the time of this project, several of the crew were undergoing first aid training. This is a positive start to the training needs of the crew, and this approach should be encouraged and expanded.

The attachment skipper has attended the Extension Fisheries Officers course in New Zealand and can perform the duties required to skipper the vessel, but will need to build his confidence over several trips. NFMRA should also look at further training for this skipper, so that he gains a suitable skippers qualification to operate the vessel.

One of the issues that must be addressed by the NFMRA is the training of crew and skippers for future vessels in an expanding industry. If the initial number of vessels can be identified to develop the tuna fishing industry in Nauru, then the training needs for the required number of fishermen can be addressed as well. Provided there are a number of trained and experienced personnel, the future training needs of the industry can be dealt with much more easily as these trained people spread themselves among the future fleet and share their knowledge.

4.7 Workstation comments

As a training vessel for new tuna longline crew, the present setup of having the aft steering station and the branchline unsnapping station separate from each other is ideal to get crew use to the different duties. For professional longlining though, where the fewer crew a vessel has the more money each crew shares, combining the unsnapping and steering stations saves an extra crew on board or allows for the crew to have rest periods.

The option is open for the F/V *Victor Eoaeo II*. The workstations can be combined at the next dry docking or remain as it is for training purposes. For smaller vessels in the 11 to 13 m range, it would be ideal to have the outside steering and hauling stations combined. These vessels operate with four to six crew so combining duties will assist all on board.

5. RECOMMENDATIONS

Based on the results of the current project, it is recommended that:

- NFMRA consider purchasing a smaller tuna longliner (11–13 m in length), monohull or catamaran design, for operations within Nauru's EEZ;
- if NFMRA purchases a smaller longliner, it be fitted with lifting lugs or have a trailer constructed to support the vessel weight, so the vessel can be hauled out of the water when needed;
- NFMRA contact the Samoan Fisheries Division and seek a costing for the new 12.2 m aluminium catamaran, including the addition of lifting lugs, an RSW system and an aft hauling station;
- if NFMRA wishes to continue using vessels the size of F/V *Victor Eoaeo II*, then the infrastructure needed for vessels of this size be constructed on Nauru;
- NFMRA establish maintenance procedures for F/V *Victor Eoaeo II*, to keep the vessel fully operational, including the maintenance of the fishing gear as well as the vessel itself and its machinery;
- the guide block that guides the mainline from the reel to the line shooter be lined up with the centre of the shooter drive wheel, or the line shooter be slightly angled to the starboard quarter;
- NFMRA should train the crew of F/V *Victor Eoaeo II* to undertake maintenance procedures, plus they need to train up Nauruan skippers to command this and future vessels;
- NFMRA consider having some of their staff trained up in different support professions, such as engineering (refrigeration, diesel, hydraulic) and electrical;
- the crew of F/V *Victor Eoaeo II* take care when handling the catch during and after gilling and gutting, and place the fish, once placed in plastic bags, immediately into the RSW for chilling;
- the fish holds on F/V *Victor Eoaeo II* be partitioned to cut down the free surface effect, thus reducing abrasion and bruising of the fish, resulting in a better quality product being landed;
- the fish holds should at least be divided into four sections with removable partitions, with care taken so that no rough edges are exposed and all corners are rounded off;
- if the fish holds are not partitioned, the method of constructing bars or lines in the hatch area of the fish holds where fish can be hung from them by tail ropes into the RSW for preservation, be tried;
- proper chilled water tanks or ice chests be constructed and used on the transfer vehicles — the launch and the transfer truck, to ensure fish quality;
- NFMRA chill the water used for washing down fish in the processing area, by place some copper piping in an ice box with chilled water or ice slurry, and running the tap water through this copper pipe to chill it;
- when workers leave the processing plant, their work clothing should be removed and hung in a hygienic locker and not be worn outside the processing plant;
- NFMRA train up people in the procedures necessary to export and market fish internationally;
- NFMRA ensure that the crew on F/V *Victor Eoaeo II*, as well as others who may become crew on fishing vessels, undergo training in sea-survival, fire fighting, first aid and basic seamanship skills;
- NFMRA provide additional training for the current vessel skipper, plus others who may become the skipper of a fishing vessel, so they gain a suitable skippers qualification to operate a longline vessel; and
- if NFMRA gets a second vessel, the outside steering and hauling stations be combined to allow one person to perform both functions.

6. REFERENCES

Anon. 2000a. CIA – the World Factbook (8 pages), retrieved February 23, 2001 from the web: http://www.cia.gov/cia/publications/factbook/geos/nr.html

Anon. 2000b. Air Nauru – Company Profile. The Republic of Nauru (6 pages), retrieved February 23, 2001 from the web: http://www.airnauru.com.au/naurumain.html

Anon. 2000c. The Republic of Nauru (5 pages), retrieved February 23, 2001 from the web: http://www.earth.nwu.edu/people/emile/nauru.html

Chapman, L. 1998. Feasibility study on infrastructure requirements and vessel parameters for tuna longlining in Nauru (17–22 November 1997). Unpublished Report No. 29, South Pacific Commission, Noumea, New Caledonia. 19 p.

Chapman, L., P. Watt, P. Wellington and P. Mead. 1998. Capture Section Report of Fish Aggregating Device (FAD) site surveys, construction and development assistance to the Republic of Nauru (4 April to 2 May 1990; 15–26 October 1991; 6–14 March 1993; 28 April to 2 May 1993; and 14–23 November 1997). Secretariat of the Pacific Community, Noumea, New Caledonia. 42 p.

Cusack, P. 1987. Phosphate, FADs and fish. South Pacific Commission, Fisheries Newsletter No. 43, Noumea, New Caledonia. pp 34–40.

Sokimi, W and L. Chapman. 2000. Fisheries Development Section Report of sea and fishing trials on board the Samoan Fisheries Division's new 12.2 m *super alia*. Secretariat of the Pacific Community, Noumea, New Caledonia. 64 p.

SPC. 2000. Pocket statistical summary. Brochure produced by the Secretariat of the Pacific Community, Noumea, New Caledonia.

Williams, M & B. MacDonald. 1985. The phosphateers. Melbourne University Press, Carlton, Victoria, Australia. 586 p.

Vessel specifications, electronics and safety equipment carried on F/V *Victor Eoaeo II*

Year built: 1993
Dimensions: 18 m x 5.2 m
Hull material: Aluminium
Main engine: Twin 6BTS 6 Series Cummins diesel
Auxiliary engine: 4 cylinder Isuzu
Generator: 26 kVa Mako Alle Spa generator
Freezers: 2 fish holds — capacity 7 t
Cool room/freezer: 1.8 m x 1.8 m x 2 m
Radios: 1 x Wagner SSB radio
1 x GME Electrophone GX558A VHF radio
Echo sounder: JRC JFV-120 colour echo sounder 200 & 50 kHz frequency, Hummingbird.
Autopilot: TMQ Electronics
GPS and plotter: JRC GPS & plotter (C – Plot) with Omega Computer. (At the time of this assignment, this equipment was removed from the vessel for repairs and replaced with a Magellan hand held GPS.
Radio direction finder: Koden KS – 511
Domestic fridge & freezer
Microwave oven
Anchor winch
Boom winch
Six-person liferaft
Flares
Eight lifejackets