PN-ABQ-434

Consultancy Report
Tuna Export Marketing

Tonga: Pacific Islands Marine Resource Project
***Contract Number*: 879-0020-C-00-1229**

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1.0 EXECUTIVE SUMMARY

Export of fresh fish to overseas markets involves considerable risk and expense. Fishermen and exporters in Tonga have experience in catching and exporting deepwater bottomfish to Hawaii. This experience is not, however, completely transferrable to tuna fisheries for several reasons: (a) greater complexity of the pelagic resource base in terms of diversity of habitat, species harvested, sizes and grades of fish; (b) greater difficulty in properly handling, storing and shipping large tuna; and (c) greater variability and complexity in market conditions, product requirements, distribution systems and price structures.

The Pacific Islands Marine Resource Project Technical Assistance to the Kingdom of Tonga (PIMAR/Tonga) was established to thoroughly assess all elements of tuna harvesting, handling and marketing through a pilot longline fishing project in Vava'u before major investments are made in new fishing fleets and shoreside facilities.

The present report evaluates potential tuna markets, marketing requirements and prices and describes procedures for handling, grading, packing and shipping fresh tuna to voerseas markets. It is recommended that tuna be exported in two forms: headed and gutted (semi-processed) and loined (fully processed). Fresh fish should be shipped in ice to Nukalofa, where it would be processed, packed and air freighted to Hawaii by private seafood exporters. Although flights from Nukalofa to Hawaii and Fiji are limited, there is some service by wide-body aircraft which can handle container loads (1,000 kg) of fresh fish. The freight compartments of the smaller aircraft flying from Vava'u usually cannot accomodate tuna boxes. Utilization of existing seafood processors in Nukalofa will avoid competition with the private sector and will encourage privatization of the tuna fishery after completion of the PIMAR/Tonga trial project.

Recommendations are made for PIMAR/Tonga shipping and marketing trials to be conducted in 1993-94:

° Grade the Vava'u tuna catch according to industry standards. Export Grade A tuna to Hawaii in headed and gutted form. Export Grade B tuna to Hawaii as loins. To the extent possible, sell Grade C tuna locally or in Nukalofa. Export surpluses of Grade C tuna if market conditions are favorable in Hawaii. Utilize all Grade D tuna locally. Include incidental (non-tuna) species in shipments to Hawaii if market conditions are favorable.

° Route the fish catch from Vava'u to Nukalofa to Hawaii (and possibly onward to more distant markets) so that the product reaches markets no later than 10 days after it is harvested. Schedule fishing so that ferry transportation from Vava'u to Nukalofa will deliver exportable fish in time for air shipment to Hawaii on the Tuesday flight operated by Air New Zealand. Develop a steady market for Grade B fresh tuna loins in Hawaii through which the product can be distributed within one or two days of arrival.

° Control the handling, storage and packing of fish so that core temperature is close to 0°C when from Vava'u and is no higher than 4.4°C when received in Nukalofa. Core temperatures should be similar when product is air freighted from Nukalofa and received in Hawaii.

° Utilize private seafood exporters in Nukalofa for processing, packing and shipping fish. They have ready access to suitable shipping cartons and plastic liners but will need technical assistance from PIMAR/Tonga in acquiring the proper material for insulating and chilling boxed fish.

2.0 INTRODUCTION

Seafood markets once considered too distant to be supplied by Pacific island fishermen are becoming more accessible with the improvement of air transport systems for perishable goods. Tuna, as the islands' most abundant marine resource, is one of the products most available for export. Even the largest tuna producing nations cannot claim self-sufficiency in supplying their populations' demand for tuna products, and most are becoming increasingly reliant on imports from foreign tuna bases.

Longlining for tuna has been a profitable fishery for distant-water fishing nations (principally Japan, Taiwan and Korea) and for U.S. fleets based on the east coast of the continental U.S. and in Hawaii. During the past decade and particularly over the last 5 years, the longline fishery has expanded substantially in the central and western Pacific. Until recently, the involvement of Pacific island nations in the fishery was limited primarily to licensing foreign vessels to fish within exclusive economic zones. Awareness of the potential for tuna export to generate new income and improve trade balances has caused the islands to seek more direct involvement in the fishery. Many Pacific islands, therefore, have ambitions to establish longline fishing fleets and export bases. There are many obstacles to success, however, and the future of newly-emerging island-based tuna fisheries is by no means assured.

All elements of tuna harvesting, handling and marketing should be thoroughly examined before major investments are made in new fishing fleets and shoreside facilities to supply overseas markets. This is the purpose of the Pacific Islands Marine Resource Project Technical Assistance to the Kingdom of Tonga (PIMAR/Tonga), which is assessing the potential for a tuna longline fishery in Vava'u. Initial investigations focus on:

1. Assessing the size and availability of the pelagic fishery resource base

2. Estimating potential catches available for marketing

3. Identifying potential markets for the species, sizes and grades of fish harvested

4. Handling, processing and grading of the catch to meet marketers' requirements for product quality and to prolong shelf life

5. Packing of tuna products to endure the time and handling in transit to export markets

6. Shipping of tuna products to export markets via the most reliable and cost-effective channels

3.0 RESOURCE ASSESSMENT

The starting point for fishery development is an assessment of the resource base in terms of species composition, relative abundance and availability. PIMAR/Tonga is accomplishing this task through test fishing. Highly mobile pelagic fish change their distribution in response to environmental conditions. Large variations in catch rates that have occurred in test fishing are presumably related to seasonal variations in the ocean environment. Fish availability and catch rates increase during the southern hemisphere summer.

The information collected thus far suggests that at least two species of tuna are available in commercial abundance:

Yellowfin tuna	Thunnus albacares
Albacore tuna	Thunnus alalunga

Bigeye tuna (Thuunus obesus) have not yet been taken in significant quantities, but it is reasonable to expect, because of the geographical location of Vava'u near 20°S latitude, that this species is also available in offshore waters.

Size composition of the tuna population is not well defined as yet, because most of the test fishing has been conducted near fish aggregation devices (FADs), where small fish tend to congregate. Most of the tuna catch have been 15-25 kg fish (whole weight), with a few fish as large as 45 kg.

The Vava'u fishery is likely to produce, in addition to tuna, small quantities of species that are the by-catch of tuna fishing and that could have export potential:

Mahimahi	Coryphaena hippurus
Wahoo	Acanthocybium solandri
Striped marlin	Tetrapturus audax
Moonfish	Lampris regius
Swordfish	Xiphias gladius

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4.0 PRODUCTION OF FISH

In any fishery, the marketing strategy should be tailored to the consistency and size of the fish catch. Fish production is constrained by fleet size, fishing range and seaworthiness of boats, as well as by the efficiency of the fishing gear.

Longlining is a relatively inefficient fishing method. Even in the most productive areas, hook rates (all species) rarely exceed three fish per 100 hooks and daily catch rates are seldom more and often less than one metric tonne/day, even on large vessels. Inefficiency is actually the preferred situation for many Pacific islands because (a) there is little risk that longlining alone could deplete fish stocks; and (b) limited shoreside facilities and transportation systems can usually accomodate longline fishery catches.

Most of the test fishing in Vava'u thus far has been conducted by small vessels using "vertical longlining" techniques or dropline fishing techniques adapted from Hawaii. The Hawaii techniques are known as ika shibi and palu ahi. Ika shibi involves nighttime fishing. Vertical lines are deployed to hook tuna, most often yellowfin, in the upper 20-30 fathoms of the water column. The fish are landed alive but skilled fishermen can bring their catch into the boat in just a few minutes, before the fish can fight. Palu ahi involves daylight fishing. Vertical lines are deployed and chum is released to attract and hook yellowfin and bigeye tuna at water depths from 70 to 100 fathoms. Tuna are usually fighting when landed.

Test fishing has been concentrated around anchored fish aggregation devices (FADs). FAD-associated fishing is a low cost method for catching tuna and is well suited to the types of vessels available in Vava'u. The results thus far suggest that when fish are available, one boat may land 200 to 1,000 kg of tuna and associated species per trip. This first approximation is adequate for planning marketing trials, but substantial fluctuation in landings should be anticipated because of seasonal trends in fish availability.

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5.0 MARKETING STRATEGY

5.1 Export versus local sale

Export of fresh tuna involves considerable risk and expense. Vava'u is already a base of operations for a small-boat fishery targeting deepwater bottomfish, principally snappers and groupers. Experience in harvesting and marketing bottomfish, however, is not completely transferrable to the tuna fishery for several reasons: (a) greater complexity of the pelagic resource base in terms of diversity of habitat, species harvested, sizes and grades of fish; (b) greater difficulty in properly handling, storing and shipping large tuna; and (c) greater variability and complexity in market conditions, product requirements, distribution systems and price structures.

Exporting fish to overseas markets is justifiable only if the net economic return to the exporter and fishermen is greater than the return from marketing the same catch locally. Before incurring the higher risks and costs of exporting, seafood marketers should thoroughly examine domestic sales opportunities.

There are major export markets for fresh tuna in Japan, Hawaii and the continental U.S. At present, the fresh tuna market in the European Community is small, although there is potential for expansion. Most fresh tuna are shipped to these markets on consignment for sale by auction or negotiation. In consignment sales, the price is not pre-determined but is based on competitive bidding or negotiation for the product. When tuna exporters ship fish on consignment, they carry all the risks through to the final sale. Caution should be exercised when exporting fish of questionable quality because the return may be lower than the cost of export.

It is unrealistic for new tuna fishing operations to develop assuming that all of the catch will be tuna or that all of the tuna will be of premium quality. Market prices vary depending on supply and demand for various species, sizes and grades of tuna. A broad marketing strategy is needed to market all grades and sizes of fish, including those which do not meet the quality and size requirements of the sashimi market. It is often more reasonable to manufacture tuna jerky or other value-added products from the lower-quality fish which are rejected for export. The processing and marketing requirements for tuna jerky are complex and are beyond the scope of this report.

Sales of by-catch (non-tuna species) are also important for supplementing revenue. Depending on area of fishing operations, by-catch such as marlin, wahoo, mahimahi, and other species may comprise a significant percentage of the total longline catch. Revenue from the sale of effectively marketed by-catch can sometimes make the difference between profit and loss for a longline fishery. The availability of incidental species in the Vava'u fishery is difficult to forecast. Whenever they are landed, however, spot marketing opportunities should not be overlooked.

6'

5.2 Potential markets

5.2.1 Vava'u

The population of Vava'u is small and the economy is based largely on subsistence. There is limited cash available for purchasing food. The small commercial market is easily saturated by even moderate fish landings. The ex-vessel price for whole fish presently averages 2.20 Tongan $/kg (1.69 US$/kg) regardless of species. Based on average conditions in the local market, tuna could be exported from Vava'u if the net return to fishermen and exporters has the potential to exceed 2.00 US$/kg. There may be occasions, however, when a lower return from tuna export might be acceptable.

5.2.2 Nukalofa

Nukalofa is the commercial and population center of Tonga. This market is well supplied by a local fleet of small boats which land bottomfish as well as pelagic species, including tuna. There is little price differentiation among fish species and the ex-vessel price for most fresh fish averages 2.50 Tongan $/kg (1.92 US$/kg). Heavy landings of tuna can easily saturate the Nukalofa market and drop prices to 0.50 Tongan $/kg.

Most of the demand is for whole fish which is sold directly to the public by small-boat fishermen. Wholesalers fillet some of the catch for sale to restaurants. The only large-scale tuna fishing is by a company that is operating two longline vessels. This company plans to export sashimi-grade tuna, while processing the remainder of the catch for local sale. If this plan is implemented, tuna loins and loin sections would become available on a larger scale than at present.

Nukalofa is the most accessible export market for small amounts of tuna harvested in the Vava'u fishery, but large catches by either Nukalofa or Vava'u fishermen would flood this market. Other export markets are needed to absorb large tuna production from the Vava'u fishery.

5.2.3 Japan

Japan is the largest and potentially most profitable market for premium grades of tuna exported from the Pacific islands. Prices in Japan are extremely sensitive to the quality and supply of fresh tuna. The premium product in the sashimi market is tuna (usually bluefin or bigeye) with high fat content. Longline fisheries at the latitude of Vava'u (20°S latitude) rarely produce more than a small percentage of tuna which receive price premiums for their fat content.

The Japanese sashimi market has become very sensitive to changes in supply. This relationship is illustrated in Fig. 5-1, which compares recent trends in the supply and price of large bigeye (> 40 kg), small bigeye (< 40 kg), and large yellowfin (> 25 kg) in the Tokyo market. Excessive imports of low-grade tuna from foreign producers (especially in Taiwan, Indonesia, Micronesia and the Phillipines) have had a detrimental effect on price, particularly for yellowfin tuna. The Japanese market is presently flooded with low-value tuna and "...not all of it is well worth the name of 'sashimi tuna'" (Narasaki, 1991). It is reported that about one-third of the fresh yellowfin exported to Japan by air freight are sold below the breakeven cost for the producers. Another one third of the fish are sold more or less at cost. A profit is realized only if the last one third of the catch can be sold at high enough prices to cover the losses from the sale of the first one third (Narasaki 1991).

Fresh yellowfin tuna exported to Japan from Tonga would enter a market that is already oversupplied, with prices at the lowest levels in several years. Table 5-1 projects the net return to Tongan exporters for the sale of yellowfin tuna in Japan for a range of prices. Yellowfin under 25 kg typically sells for only about half of the price paid for larger fish. The analysis suggests that export is economically feasible only for large Grade A yellowfin, which could return 1,500 Y/kg or more and only if a fishing trip produces enough Grade A fish (at least 225 kg) to qualify for bulk air freight to Japan.

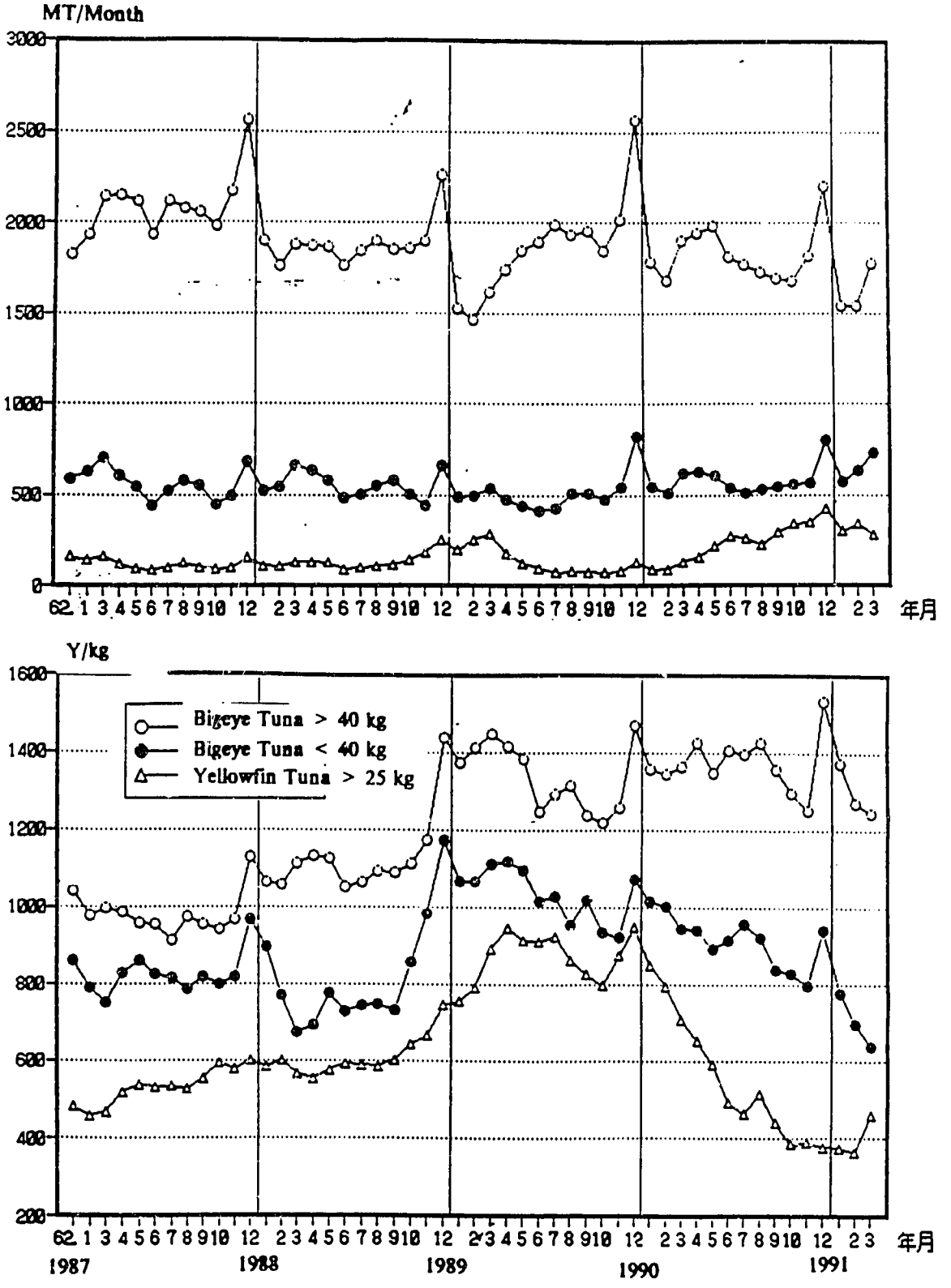
Bigeye tuna is more valuable than yellowfin in the Japanese sashimi market. Large bigeye (>40 kg) sold at auction in Tokyo have generally maintained high price levels since the end of 1988, while the prices for small bigeye (< 40 kg) have declined from the peaks reached in 1989-1990 (see Fig. 5-1). Albacore tuna is not utilized in the Japanese sashimi market.

Table 5-2 projects the net return to Tongan exporters for the sale of bigeye tuna in Japan based on a range of prices. The analysis indicates that export is economically feasible for large bigeye (> 40kg) of Grade B + or A quality and for smaller bigeye (> 25 kg) of Grade A quality, which could return 1,500Y/kg or more. To qualify for bulk air freight rates to Japan, however, a fishing trip would have to produce at least 225 kg of such high quality fish. Marketing costs are high in Japan, especially for small-scale exporters who usually pay 18-24% of the tuna auction price.

Fresh tuna is usually exported to Japan is shipped in headed and gutted or gilied and gutted form. Most of the fish is sold through the complex auction system which dominates the Japanese sashimi market. Some exporters have begun to bypass the auction system and sell fish directly to Japanese processors. Direct sales have created opportunities to export fresh tuna loins as well as headed and gutted fish.

FIG 5.1

Fig 5.1.a: Supply Trends for Fresh Bigeye and Yellowfin Tuna, Tokyo Auction
Fig 5.1.b: Price Trends for Fresh Bigeye and Yellowfin Tuna, Tokyo Auction)



Source: Japan Ministry of Agriculture, Forestry and Fisheries

Table 5-1 Examples of Japan Consignment Sales of Fresh Yellowfin Tuna for a Range of Market Prices

Assumptions: Quantity of tuna per shipment > 225 kg but less than 1,000 kg
Shipments routed to Japan through Hawaii
125Y = US$

(a) Average Price Received at Japan Auction:	400 Y/kg	800 Y/kg	1,200 Y/kg
Variable Expenses Deducted in Japan:			
(b) Auction commission (5.5% of a)	22Y/kg	44Y/kg	66Y/kg
(c) Importer commission (2.5% of a)	10Y/kg	20Y/kg	30Y/kg
(d) Inland transportion (variable with market location)	30Y/kg	30Y/kg	30Y/kg
(e) Customs duty (5% of declared value)	10Y/kg	20Y/kg	30Y/kg
(f) Consumption tax (2.5% of a)	10Y/kg	20Y/kg	30Y/kg
Fixed Expenses Deducted in Japan:			
(g) Customs clearance and documentation (per airway bill)	25,000Y	25,000Y	25,000Y
(h) Money transfer charge	5,500Y	5,500Y	5,000Y

Average Price Received at Japan Auction:	400 Y/kg	800 Y/kg	1,200 Y/kg
Fixed Expenses in Tonga/Hawaii:			
(i) Packing materials and labor, fish grading, ice, airport trucking, customs	1.40US$/kg	1.40US$/kg	1.40US$/kg
(j) Freight	4.00US$/kg	4.00US$/kg	4.00US$/kg
NET RETURN TO EXPORTER:	- 3.94US$/kg	- 1.65US$/kg	1.65US$/kg

Table 5-2 Examples of Japan Consignment Sales of Fresh Bigeye Tuna for a Range of Market Prices

Assumptions: Quantity of tuna per shipment > 225 kg but less than 1,000 kg
Shipments routed to Japan through Hawaii
125Y = US$

(a) Average Price Received at Japan Auction:	800 Y/kg	1,500 Y/kg	2,200 Y/kg
Variable Expenses Deducted in Japan:			
(b) Auction commission (5.5% of a)	44Y/kg	83Y/kg	121Y/kg
(c) Importer commission (2.5% of a)	20Y/kg	38Y/kg	55Y/kg
(d) Inland transportion (variable with market location)	30Y/kg	30Y/kg	30Y/kg
(e) Customs duty (5% of declared value)	20Y/kg	38Y/kg	55Y/kg
(f) Consumption tax (2.5% of a)	20Y/kg	38Y/kg	55Y/kg
Fixed Expenses Deducted in Japan:			
(g) Customs clearance and documentation (per airway bill)	25,000Y	25,000Y	25,000Y
(h) Money transfer charge	5,500Y	5,500Y	5,000Y

Average Price Received at Japan Auction:	800 Y/kg	1,500 Y/kg	2,200 Y/kg
Expenses in Tonga/Hawaii:			
(i) Packing materials and labor, fish grading, ice, airport trucking, customs	1.40US$/kg	1.40US$/kg	1.40US$/kg
(j) Freight	4.00US$/kg	4.00US$/kg	4.00US$/kg
NET RETURN TO EXPORTER:	- 1.15US$/kg	3.70US$/kg	9.05US$/kg

5.2.4 Hawaii

Hawaii is the second largest market for sashimi tuna but consumption is small compared to Japan. Hawaii is well supplied with fresh tuna by domestic fishermen, as well as by fish imported from Fiji, Micronesia, Indonesia, Philippines and other areas. Much of the fresh tuna air freighted to Hawaii from the Pacific basin is transshipped to seafood marketers in the continental U.S.

There are windows of opportunity for profitable export of fresh tuna to the Hawaii market, but good timing is critical to success. Hawaii is often the most attractive market for non-tuna species which are the by-catch of longline fisheries: mahimahi, ono, striped marlin. Like the rest of the U.S., Hawaii is suffering from economic problems. Resident and tourist spending for luxury foods, including higher-priced seafood products, has dropped and demand for fresh tuna has become unstable. The market is strongest when holidays and sporting events create high demand that cannot be satisfied by the domestic harvest. Generally, the period from November through March offers the best opportunities for marketing fresh tuna in Hawaii.

Not only is the Hawaii tuna market smaller and less stable than that in Japan, but the transportation and marketing system employed by Hawaii seafood wholesalers may delay the sale of fish for several days. Thus, there is a potential for loss of quality and revenue if fish are sold in Hawaii rather than in Japan, where sale is usually completed within 48 hours after arrival of fish.

As in Japan, Hawaii tuna marketers have a strong preference for fish over 25 kg and smaller tuna are sold at discounted prices. Most of the demand in Hawaii is for tuna that is headed and gutted. Bigeye tuna receives higher prices than yellowfin. The condition of the fish body is a factor in determining the sale price, but the most important concern for buyers is the flesh color and transparency.

When the market is strong, it will be simpler and less costly to market high quality fish in Hawaii than in Japan. Lower-grade fish can also be sold in Hawaii but at much lower prices than premium tuna. Market prices in Hawaii are directly related to the overall supply available, as well as to the quality of particular fish. Table 5-3 projects the average net return to Vava'u exporters from shipments of headed and gutted bigeye/yellowfin tuna of mixed grades (A,B,C) to the Hawaii tuna market. Tuna prices are extremely volatile in Hawaii, so the price received for any single shipment can deviate substantially from the average.

Table 5-3 Examples of Hawaii Sales of Fresh Bigeye or Yellowfin Tuna (Headed and Gutted) for a Range of Grades

(a)	Fish Grade	Grade A	Grade B	Grade C
(b)	Average Market Price	8.80US$/kg	6.00US$/kg	4.00US$/kg
(c)	Packing Costs (Tonga)	0.40US$/kg	0.40US$/kg	0.40US$/kg
(d)	Air Freight (Tonga-Hawaii)	2.35US$/kg	2.35US$/kg	2.35US$/kg
(e)	Marketing Costs (Hawaii)	1.00US$/kg	1.00US$/kg	1.00US$/kg
NET RETURN TO EXPORTER:		5.05US$/kg	2.25US$/kg	0.25US$/kg

The analysis indicates that, for average market conditions, it would worthwhile to export Grade A tuna to Hawaii. Grade B tuna, however, would generate a net return only marginally better than sales in Tonga. Grade C fish would only breakeven against costs and could be sold for a higher return in Tonga. Nevertheless, it may be necessary to include Grade C fish in some shipments to obtain enough weight to qualify for special air cargo rates. Grade D (cannery grade) tuna should not be exported because transportation and marketing costs will be greater than the return, which is generally less than $1.65 US$/kg.

Wholesale prices for fresh albacore tuna fluctuates substantially depending on supply, whole fish may sell for as low as 1.20US$/kg to as high as 4.40US$/kg. Albacore is marketed mostly as whole or headed and gutted fish.

Fresh yellowfin tuna loins have been imported from the Philippines but their quality is inconsistent. As chilled tuna loins can be stored for only a short time without a loss of quality, importers make every effort to distribute the product within a day or two of their arrival in Hawaii.

When tuna is loined, pigment proteins in the flesh are exposed to air and combine with oxygen to form oxymyoglobin, which lends sashimi tuna its attractive red coloration. After the red-colored flesh is exposed to air over an extended period, the oxymyoglobin transforms into metamyoglobin through autooxidation, causing discoloration of the tuna flesh from red to brown (Suzuki 1985).

Hawaii wholesalers are reluctant to purchase high-priced Grade A tuna that is already loined because of its short shelf life. There is greater acceptance of Grade B loins and there is growing market for Grade C loins, especially among small retailers and food caterers. Table 5-4 projects the average net return to Vava'u exporters from shipments of bigeye or yellowfin tuna loins of mixed grades (A,B,C) to the Hawaii tuna market. Tuna prices are extremely volatile in Hawaii, so the price received for any single shipment can deviate substantially. The analysis indicates that, for average market conditions, it could be relatively profitable to export Grade B tuna loin to Hawaii. Loins should weigh at least 2.25 kg and the flesh should have red pigmentation and firm texture. Because of the short shelf life of the product, weight should not exceed 250 kg per shipment for the Hawaii market. In spite of the lower transportation cost, the net return for Grade C tuna loins would still not equal the return from local sale in Tonga. When the Tonga market is weak or when additional fish weight is needed for a shipment to Hawaii, there may be good reason to include up to 250 kg of Grade C tuna loins per shipment.

Hawaii seafood processors import frozen tuna loins from the Philippines in ocean container quantities but the price is far less than for fresh loins. The frozen product is utilized by fish driers, smokers and steakers.

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Table 5-4 Examples of Hawaii Sales of Fresh Bigeye or Yellowfin Tuna Loin for a Range of Grades

(a)	Fish Grade	Grade A	Grade B	Grade C
(b)	Average Market Price	no demand	9.90US$/kg	6.00US$/kg
(c)	Packing Costs (Tonga)	n.a.	1.00US$/kg	1.00US$/kg
(d)	Air Freight (Tonga-Hawaii)	n.a.	2.35US$/kg	2.35US$/kg
(e)	Marketing Costs (Hawaii)	n.a.	1.00US$/kg	1.00US$/kg
NET RETURN TO EXPORTER:		n.a.	5.50US$/kg	1.65US$/kg

5.2.5 Continental U.S.

There are substantial markets for fresh tuna on both coasts of the continental U.S. All but the lowest grades (cannery or Grade D) fish are utilized. The more specialized west coast buyers are those who supply the sashimi market. They purchase higher grades of tuna with flesh that has bright red pigmentation. Larger tuna (> 25kg) are strongly preferred for this market niche. The sashimi market is not as well developed elsewhere in the U.S. (except for the more culturally diverse and cosmopolitan cities on the east coast). In most areas, the popularity of fresh tuna for grilling is expanding rapidly and developing a broader-based market.

Tuna steaks are being promoted as healthier food than meat yet similar to beef in appearance and ease of handling. Restaurants which grill fresh tuna are less concerned about flesh pigmentation than about freshness. While pink flesh (characteristic of Grade C fish) is acceptable, fish with body damage are not. Brown or discolored flesh is unacceptable in all fresh tuna markets. Larger fish (> 25kg) are preferred because they can be steaked into uniform dinner portions. Fish as small as 15 kg (headed and gutted weight) can be utilized as long as they yield quarter loins larger than 2.25 kg. The few tuna marketers who are interested in 10-14 kg tuna (headed and gutted weight) buy at prices too low (less than 1.00US$/kg net return) to justify export. As in Japan, the sashimi market pays more for bigeye tuna than for yellowfin, but most restaurant buyers use the two species interchangeably for grilling.

Some east coast buyers purchase fresh tuna loins, usually in conjunction with larger orders of headed and gutted tuna. Loins are used to fill immediate orders, while headed and gutted fish, with a longer shelf life, can be stored for several days before processing. Large quantities of frozen yellowfin tuna loin are imported for steaking into meal-sized portions. The raw material is supplied with skin and blood meat removed. Loins are usually frozen, glazed and bagged in plastic bags for ocean shipment to major processors in California and Seattle. The minimum size loin that can be utilized for steaking is 2.25 kg (from fish > 15 kg). The typical price is 3.30US$/kg landed west coast in ocean container quantities (10,000 kg).

Fresh albacore tuna is popular in California but there is little market demand elsewhere in the U.S. Prices for headed and gutted fish are comparable to those in Hawaii. A large portion of the fresh albacore market is supplied the Fiji longline fishery.

Fish processors in Seattle buy large quantities of frozen albacore loin for steaking into meal-sized portions. The minimum size of loin utilized by steakers is 2.25 kg (from > 15kg fish). The raw material is purchased with skin off and blood meat removed, at prices averaging $5.50US/kg landed in Seattle by sea freight. Smokehouses in the Pacific Northwest buy smaller quantities of frozen albacore loin at higher prices ($6.60US/kg landed west coast).

Fresh tuna markets in the continental U.S. are supplied by many countries, including the Pacific islands. The high cost of air freight to these markets is a deterrent to export. When the Hawaii market is strong, prices for sashimi-grade tuna will always be higher than on the U.S. mainland. The larger U.S. market, however, is able to absorb greater quantities of lower grade (Grade B, C) tuna that may be difficult to sell when Hawaii is well supplied with fish. There is also less price volatility for these grades of fish than in Hawaii. Tuna under 25 kg is more difficult to market in the continental U.S. than in Hawaii.

5.2.6 Europe

Frozen tuna still predominates over fresh in European seafood markets, although fresh tuna consumption is increasing as marketers become more discriminating in purchasing. Most of the present demand is supplied by low-grade yellowfin tuna loin imported from Oman at a cost of 8.00-9.00US$/kg. There is some seasonal demand (March-November) for higher-grade tuna imported in headed and gutted form at a cost of 7.50-8.00US$/kg. Limited amounts of fresh yellowfin tuna loin are exported from Hawaii. This is primarily Grade C fish sold at 5.00-5.75US$/kg, f.o.b. Hawaii.

The major obstacles to expanding fresh tuna export are (a) the traditional European preference for white-fleshed fish; (b) the high cost of air freight from the Pacific; and (c) the high import duty (24%) levied by the European Community on imported tuna.

5.2.7 American Samoa

The canneries in American Samoa are a ready market for whole frozen albacore. Fish over 10 kg with core temperatures less than 10°C sell for an average of 1.20US$/kg. This is an attractive price for unprocessed fish. Without a suitable blast freezing and storage facility in Vava'u, however, it would be difficult to deliver frozen fish with acceptable core temperatures to American Samoa. It would be uneconomical to air freight fresh albacore to the canneries and infeasible for small boats to deliver their catch to American Samoa.

5.3 Recommendations for marketing

Tuna production in Vava'u is too low and the cost of air freight is too high to make small fish shipments to a diverse customer base. The most cost-effective method for small producers to gain access to the broadest customer base is by consignment to a tuna wholesale specialist in Hawaii. One shipment of fish can be split, by species, size and grade, among several dozen different secondary wholesalers and retailers, including buyers in Japan and the continental U.S.

Fish cargo splitters can provide a higher level of service than auction houses, which are concerned with a much larger variety of marine products. Hawaii tuna importers compete by offering exporters high standards of service, low commissions and rapid terms of payment. These middlemen have commitments to supply standing orders of regular customers and they also make spot market sales.

The selected importer should have a good reputation and should accept and sell all products consigned to them without discrimination and irrespective of quality and quantity. The company should provide ready access to detailed market price and sales information for each shipment and forecast market conditions for planning future shipments. There should be rapid feedback on product quality and financial settlements for each shipment.

The following procedures are recommended for marketing trials:

1. Grade, weigh and mark the tuna catch as it is landed in Vava'u.

2. Export Grade A tuna to Hawaii as headed and gutted fish. There is no limit on the quantity of Grade A fish per shipment. The best grades of fish can be transshipped to Japan from Hawaii. Shipments containing as little as 225 kg of fresh tuna qualify for relatively low air freight rates.

3. Process Grade B tuna into loins immediately before shipping. Initially, export no more than 250 kg of loin (= 350 kg h&g) per shipment. Increase the quantity per shipment as the market in Hawaii expands and buyers become more familiar with the product.

4. If market conditions permit, sell Grade C tuna and albacore tuna in Tonga. If local market demand is weak, process Grade C tuna and albacore into loins immediately before shipping. Initially, export no more than 250 kg of loin (= 350 kg h&g) per shipment. Increase the quantity per shipment as the market expands and buyers become more familiar with the product.

5. If non-tuna species are landed on any fishing trip, assess whether there is a marketing "window" in Hawaii before shipping the by-catch with tuna exports.

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6. Sell as much Grade D tuna and albacore tuna as possible in the Tonga market. Process excess Grade D fish into loins. Freeze, glaze and bag the product in plastic tubing. Frozen loins could be could be accumulated in sufficient quantities (10,000 kg) for ocean container shipment to tuna steakers in Hawaii or on the U.S. west coast. Although tuna loining is labor intensive, the processing line can be relatively simple and inexpensive to establish. Blast freezing and storing the finished product, however, until there is a sufficient quantity to ship by ocean container involves a large capital investment in a freezing facility (approximately 3.50 US$ per cubic foot) and high operating costs for electric power (.015US$/cubic foot/month). It is more reasonable to encourage seafood processors in Tonga to manufacture a line of dried tuna or other value-added products. Processing and marketing requirements for value-added tuna products are not addressed in this report.

6.0 EXPORT MARKET REQUIREMENTS

6.1 Grading fresh tuna

If the Vava'u tuna fishery is to become competitive in the export market, it has to develop a reputation for producing fish of a quality at least as high as fish exported from other localities. The suitability of fresh tuna for export marketing is determined by "grading" each fish. The better grades (Grade A, B) are sold to the more discerning and high-priced raw fish (sashimi) buyers. Grade C tuna rejected for the sashimi market is most often sold at substantially discounted prices as a raw material for fresh cooked or processed products. Cooking tends to mask defects that would be readily detected by raw fish consumers. Grade D tuna has almost no value in fresh tuna markets and is usually frozen for canning or other types of processing.

Accurate grading is essential to meet the expectations of overseas tuna buyers. The grader determines the best market destination for each fish, depending on species, size and quality. Grading criteria may be more or less rigorously imposed, depending on the skill of the grader and on market conditions. When low supply and strong demand combines, inferior quality tuna that would normally be rejected by the sashimi market may be profitable to export. Conversely, when low demand and large supply creates weak market conditions, it may be inadvisable to export even better quality tuna.

If misgraded (non-export quality) fish are shipped, there is a risk that they will be rejected after they have reached export markets and that a net loss will be incurred after transportation and marketing costs are deducted from the sales price. For any expectation of economic success, tuna exporters should learn to recognize and reject fish of poor quality before they are shipped.

Grading, although a subjective process, is relatively standardized in the sashimi tuna industry. Criteria include body condition, as well as coloration, transparency, texture and fat content of the flesh (see Table 6-1). A common understanding of tuna grade specifications simplifies communications between fresh tuna sellers and buyers, facilitating product assessment and sorting for different markets and end uses. Grading is also useful in resolving disagreements between sellers and buyers and in providing performance feedback to sellers and fishermen.

6.2 Grade characteristics

The first consideration in grading is fish size and body condition in terms of the yield of usable flesh. Equally important are characteristics that relate to appearance and taste of the flesh exposed when the fish is processed into sashimi.

The most important characteristics for an attractive appearance are:

COLOR: Flesh should have bright red pigmentation.

TRANSPARENCY: Flesh should be translucent and glossy.

The most important taste characteristics are:

FRESHNESS: Flesh should be firm

FAT CONTENT: High fat content is desirable because it gives tuna flesh a "melting" texture when eaten. Fat is evident as a distinct marbled layer under the skin which extends up into the tuna loin (see Figure 6-1).

Tuna which are identical in species, size, tima and area of capture may sell for markedly different prices because some fish have the desired flesh characteristics but others do not. Larger fish receive higher market prices than smaller fish of the same quality. Fish exporters and buyers assess these characteristics by inspecting flesh exposed by cutting a notch near the tail of a fish, by removing a wedge of flesh from this notch, or by sampling the deep muscle tissue obtained by inserting a coring tool (about one cm in diameter) vertically under the dorsal fin of the tuna and pushing it into the interior of the fish to remove a cylindrical sample. The core sample is examined for freshness, fat content, color and other characteristics. Readings are accurate only if the fish core temperature is stabilized near 0°C.

Table 6-1 Grade Specifications for Fresh Sashimi Tuna

MARKET PRICE:	Highest Price	> > > > > >	Lowest Price
BODY SIZE:	> 40 kg	25-40 kg	< 25 kg
BODY CONDITION:	Body firm and intact; skin unblemished or minor blemishes not penetrating to flesh	Body mostly firm and intact; local damage due to bruising, scarring, shark bite, or gaffing	Body mostly soft; major damage due to bruising, scarring, shark bite or gaffing
FLESH COLOR:	Bright red pigmentation	Pale red or dark red pigmentation	Distinctly brown, gray or white pigmentation; "rainbow" color pattern
FLESH TRANSPARENCY:	Very glossy, translucent	Less glossy	Dull, opaque
FAT CONTENT:	Visible marbled layer under skin	No marbled layer but fat apparent as globules	No visible fat
FRESHNESS:	Flesh firm textured	Flesh somewhat soft textured	Flesh mushy, watery; gaping; pus pockets

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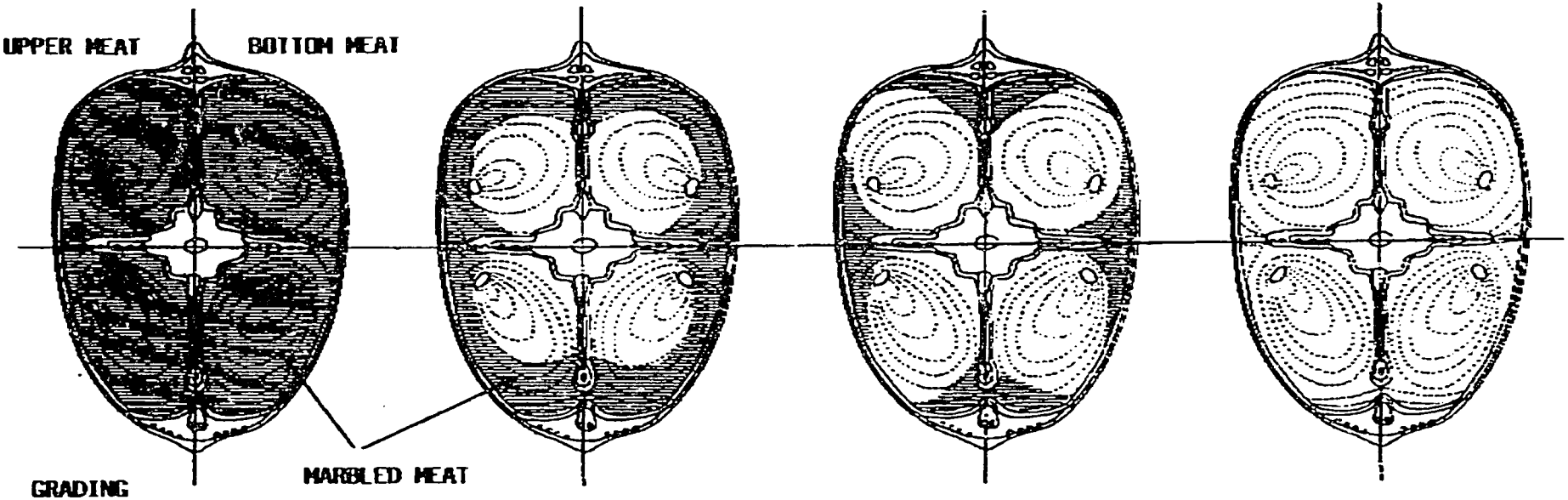
TUNA GRADING BASIS

FAT CONTENT



GRADING	A	B	C	D
	GOOD FAT	FAIR FAT	LIGHT FAT	NO FAT

CHUO GYORUI CO., LTD.
[illegible]
[illegible]
TEL [illegible]
TELEX [illegible] CHUGYO J

6.3 Quality control

Tuna may struggle during capture and build up high body temperatures that present problems in chilling the deep muscle layers near the center of the fish. Special handling procedures from capture to final sale increase the likelihood that tuna will exhibit the desired flesh characteristics when processed for sashimi. The general principles that are recommended to improve quality and market value of fresh tuna are to minimize fish stress during capture and landing, to kill and bleed the fish quickly, to cool fish quickly to a core temperature of 0° C and to keep them at that temperature.

Step-by-step procedures are recommended for proper handling of fresh tuna for the sashimi market (see Nakamura, et al. 1987, Gibson 1981). These procedures have to be adapted to particular situations. Proper handling of tuna catches is far more practical on large vessels with adequate deck space, hold capacity and crew than on small boats. The inadequacies of small boats usually prevent careful handling of every fish and force fishermen to be selective. For example, larger tuna (> 40kg) that have potentially greater market value and are more difficult to chill to the core are treated with more care than small fish. Fish that are landed after long fight times require more care than fish landed dead or in a sluggish state of activity.

Because of the high cost of air freight to export markets, a portion of the Vava'u tuna catch will probably be processed into fresh loins before shipping. Loins are far more perishable than headed and gutted tuna. To extend the shelf life of loins exported to Hawaii and beyond, it is advisable to adhere closely to the recommended procedures for handling fresh tuna.

Tuna loining, although labor intensive, does not require an elaborate or costly processing facility. The basic requirement is for a processing room that is enclosed from the open air (preferrably air conditioned) and that is easy to clean. Whole fish is moved into the room on plastic pallets and is quartered on a pallet at floor level or on a plastic cutting table. The room should be equipped with running hot water to clean pallets, tools and cutting surfaces. A covered dumpster is needed to hold waste until disposal. All cutting and packing of fish should, ideally, be done in refrigerated areas but this is not always possible.

Quality control efforts should be focused on: (a) sanitizing fish holds and processing areas after use; and (b) rapid chilling of fish to 0°C core temperatures, beginning immediately after capture.

6.4 Tuna import inspection

Chilled tuna entering the U.S. in Hawaii is subject to cursory inspection at the port of entry but, until recently, were exempted from extensive sample testing. This speeded passage of the product through the system without a loss of quality. The U.S. Food and Drug Administration (FDA) recently changed its policy and is phasing in a testing program for fresh seafood products being imported into Hawaii. The new procedures will require that the consignee hold shipments selected for sampling until samples can be sent to San Francisco, the results of analyses returned, and the shipment cleared for entry. South Pacific fresh seafood exporters are concerned about the potential for economic losses which could result from delaying the sale of highly perishable fresh seafoods while waiting for laboratory test results. High value products, such as sashimi tuna, are especially vulnerable to unrecoverable loss of value if marketing is delayed (Teegan 1992).

According to the Pacific Regional Food and Drug Director, FDA only samples a small percentage of the shipments offered for entry into the U.S. Most analyses, except for microbiological examinations, can be finished in one or two days. FDA will use electronic communication to provide reports of analysis to speed product release when the the results allow that to happen. The likely waiting period before FDA release is expected to be no more than 72 hours from arrival of imported seafoods in Honolulu. Although microbiological samples are rarely collected from fresh tuna, if a lot is selected for microbiological sampling, the Regional Director concedes the waiting period for release could take as long as two weeks and that there will be an adverse impact on the importer. "The unfortunate lot selected for such (microbiological) sampling might need to be reexported to another country in lieu of trying to wait out such a delay" (Healton 1992).

In response to several outbreaks of histamine (scombroid) illness traced to imported tuna, FDA is monitoring tuna (and mahimahi) more closely for histamine. Since histamine is produced in certain species of fish when time-temperature abuse occurs, the FDA is spot checking the core temperatures of selected tuna imports. If a shipment is tested and all core temperature readings are below 4.4°C, the fish are released for sale. Lots containing fish which are at 4.4-7.2°C must be held pending histamine analysis. Temperature readings above 7.2°C are considered unsatisfactory and shipments are rejected if any reading exceeds this level.

6.5 Recommendations for handling/processing

The following recommendations are made for handling:

1. Kill struggling fish as they are brought on board the fishing vessel; if necessary to kill large fish, push a sharp probe (e.g., ice pick) into the brain and down the middle of the spinal column (known as "spiking" or "pithing") to destroy the nervous system and shut down all heat-generating bodily functions.

2. Bleed the fish for a few minutes immediately after killing.

3. Start chilling immediately after bleeding, giving highest priority to large fish (> 40 kg) and fish landed after long fighting times. Cooling of large fish is a two-stage process. In the first stage, the fish is immersed in an ice-seawater slurry ("brine") for rapid lowering of body temperature. This slush is colder than freezing temperature because of the salt in seawater. After 12 to 24 hours of cooling in brine, the fish is put in the hold and covered with ice. Core temperatures of large fish can be reduced to 0°C after 24 to 48 hours of cooling. As the ice melts, air pockets may form around the fish, so the hold is checked periodically and repacked with ice if necessary. It is important to minimize movement of fish both in the slurry tank and in the fish hold to prevent bruising of the flesh. Small boats making fishing trips of short duration may drain off the water in the slurry tank once internal body temperature of the fish has cooled to 0°C and leave the fish in ice to minimize extra handling. Small tuna may be rapidly chilled without brining, but experience in the Hawaii small-boat tuna fishery, however, indicates the brining step is essential to firm the flesh texture of small tuna.

4. Large fish can be gilled and gutted to facilitate rapid chilling on fishing vessels. Small fish do not need to be gilled and gutted at sea, but dockside processors in Hawaii have been able to extend the shelf life of small bigeye tuna by gilling and gutting. The belly cavities of gilled and gutted fish should be filled with crushed ice.

5. At dockside, fish should be transported without delay from the boat to a storage area where they can be re-iced in refrigerated rooms or in well insulated containers until marketing or export. Internal body temperatures of 0°C can be maintained by storing fish in ice, either on pallets in a refrigerated room or in well-insulated containers in an air-conditioned or refrigerated room. Even without refrigerated storage, fish core temperatures can be maintained near 0°C by adding salt to the bins and by covering them with thermal barrier insulating material.

6. Extend periods of storage in ice can bruise and soften fish. To protect against skin damage, each fish should be covered with a meat sock.

7. Fish should never be shipped to market until their core temperatures are near 0°C. Long-stemmed thermometers are used to monitor internal temperatures of fish.

7.0 PACKING REQUIREMENTS

Tuna quality and market prices can be severely affected if fish are not properly packed for air shipment. When fish is exported in gilled and gutted or headed and gutted form, there are three packing components: master box and plastic liner, box insultation and coolant. It is recommended that PIMAR/Tonga utilize private seafood exporters in Nukalofa for processing and packing Vava'u fish catches for export. These exporters regularly ship bottomfish to Hawaii and have ready access to tuna shipping cartons made in Fiji.

To eliminate the risk of damage to aircraft from leaking boxes, most airlines require that wax coated master boxes be used to ship fresh fish. For maximum strength and durability, boxes should be one piece, 350 grade double wall with double full flap top and bottom. When boxed fish is shipped in LD-3 airline containers, the internal box dimensions that will maximize the payload are 54 inch length x 18 inch width x 14.5 inch height. A standard shipping carton for tuna is available from a Fiji manufacturer.

Tuna should never be shipped unless the core temperature is near 0°C. Even so, unless shipping boxes are insulated in some way, there is a high risk that fish will arrive at overseas destinations with elevated body temperatures. Importers usually reject shipments if the fish arrives with core temperatures exceeding 7.2°C and most importers prefer that the core temperatures of fish not exceed 4.4°C when fish are received.

The most commonly used insulation is styrofoam cut into sheets to line shipping cartons. Styrofoam "peanuts" can be placed in bags to form a layer of insulation around fish. Another form of insulation used in place of or in conjunction with styrofoam is thermal barrier material, similar to a "space blanket", which has better insulating properties than 0.5-inch styrofoam. Thermal barrier material is sold in rolls, which can be cut to line shipping cartons of many sizes. Neither styrofoam nor thermal barrier material is available in Tonga or Fiji. It is more cost-effective to ship in thermal barrier material than styrofoam because sea freight charges for the latter product would be based on volume rather than weight.

Coolant is placed in shipping cartons to maintain cold temperature while fish is in transit to overseas destinations. The materials which can be utilized are dry ice (in block or snow form), wet ice in sealed bags or "gel" ice that has been frozen in sealed bags. Dry ice is not available in Vava'u. Airlines discourage the use of wet ice because of the risk that leaking water could damage aircraft.

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It would be prohibitively expensive to ship pre-manufactured gel bags to Vava'u. A low-volume gel bagging and sealing machine could be obtained to manufacture gel coolant in Vava'u. The empty bags and gel material would still have to be imported, however.

Gel is also available in lightweight strips which can be hydrated in water and then frozen into blankets of gel ice. This is probably the most practical form of coolant material for PIMAR/Tonga shipping trials. Over the long term, it would be more cost-effective to obtain low-output gel bagging and sealing equipment.

8.0 SHIPPING REQUIREMENTS

Fresh fish is exported to overseas markets by air freight. Vava'u is served by two airlines, one flying to and from Nukalofa and the other flying to and from Pago Pago, American Samoa. Both carriers use small aircraft (KingAir, Twin Otter) that have limited capacity for fish cargo, especially large fish boxed in cartons which do not easily fit the cargo compartments of small planes. Fresh bottomfish and other species that can be boxed in 25 kg cartons is regularly air freighted from Vava'u to Pago Pago and Nukalofa but larger fish such as tuna cannot be accomodated.

Even if arrangements could be made to air freight large boxes of fresh tuna to Pago Pago, the cost would likely be prohibitive. For example, small fish is shipped from Vava'u to Pago Pago at a cost of 1.80US$/kg (assuming that packing accounts for 20% of the gross weight). To transship from there to Hawaii would cost an additional 1.95US$/kg. The air freight service from Pago Pago to Hawaii is not reliable and the number of flights is being reduced.

It is more practical to ship the fish catch from Vava'u to Nukalofa by ferry (at a cost of approximately 0.25US$/kg). Once in Nukalofa, the lower-grade fish can be sold in the local market, while the higher-grade fish can be exported overseas. Container loads of fresh fish (1,000 kg) can be shipped to Fiji and Hawaii on widebody aircraft operated by at least two carriers. Air New Zealand offers once a week service (Tuesday) to Hawaii through Auckland. Air Fiji and Air Pacific provide freight service between Nukalofa and Fiji, but fish cargoes shipped there would have to be transferred to other carriers which fly to Hawaii.

For shipping trials, it is recommended that fishing be scheduled so that catches can be landed in Vava'u and routed by ferry to Nukalofa over the weekend. Processing and packing can take place early in the week to allow shipment to Hawaii via the Tuesday flight operated by Air New Zealand. The cargo can be received in Hawaii on a Tuesday, which is optimal for Wednsday through Friday marketing.

Air shipment from Nukalofa has another advantage. Private seafood processors already in operation in Nukalofa can be involved in the shipping and marketing trials. They can provide processing and packing services which would incur additional expense if duplicated in Vava'u by PIMAR/Tonga. Furthermore, their involvement would allow the PIMAR/Tonga project to avoid competing with the private sector and would encourage eventual privatization of the trial project.

Fresh tuna shipped from Nukalofa has to be cleared by the U.S. Customs and the U.S. Food and Drug Administration in Hawaii before it can be released to the importer. To avoid delays in import customs clearance, correct documentation must accompany each shipment to the U.S. and also should be faxed ahead to the importer:

- Proforma invoice (with unit price stated as some value for purposes of customs clearance)

- Packing list

- Airway bill

Customs brokerage is handled by the wholesale importer, who is responsible for product care and handling from the time it lands in Hawaii through the sale.

9.0 SUMMARY OF RECOMMENDATIONS

The following recommendations are made for shipping and marketing trials to be conducted by PIMAR/Tonga during 1993-94:

° Grade the Vava'u tuna catch according to industry standards. Export Grade A tuna to Hawaii in headed and gutted form. Export Grade B tuna to Hawaii as loins. To the extent possible, sell Grade C tuna locally or in Nukalofa. Export surpluses of Grade C tuna if market conditions are favorable in Hawaii. Utilize all Grade D tuna locally. Include incidental (non-tuna) species in shipments to Hawaii if market conditions are favorable.

° Route the fish catch from Vava'u to Nukalofa to Hawaii (and possibly onward to more distant markets) so that the product reaches markets no later than 10 days after it is harvested. Schedule fishing so that ferry transportation from Vava'u to Nukalofa will deliver exportable fish in time for air shipment to Hawaii on the Tuesday flight operated by Air New Zealand. Develop a steady market for Grade B fresh tuna loins in Hawaii through which the product can be distributed within one or two days of arrival.

° Control the handling, storage and packing of fish so that core temperature is close to 0°C when from Vava'u and is no higher than 4.4°C when received in Nukalofa. Core temperatures should be similar when product is air freighted from Nukalofa and received in Hawaii.

° Utilize private seafood exporters in Nukalofa for processing, packing and shipping fish. They have ready access to suitable shipping cartons and plastic liners but will need technical assistance from PIMAR/Tonga in acquiring the proper material for insulating and chilling the fish boxes.

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11.0 APPENDIX: Characteristics of Fresh Tuna Grades

11.1 Tokyo Grade A

The tuna flesh is firm, bright red in pigmentation and highly transparent, with visible marbled fat.

11.2 U.S. Grade A

The tuna flesh is firm, bright red in pigmentation and highly transparent, but there is no visible fat.

11.3 Grade B

The tuna flesh is firm, red in pigmentation but dull in transparency.

11.4 Grade C

The tuna flesh is firm, pink in pigmentation and dull in transparency.

11.5 Grade D (Cannery Grade)

The tuna flesh is soft, brown or gray in pigmentation, and opaque. Other defects are evident, including gaping of flesh, pus pockets.