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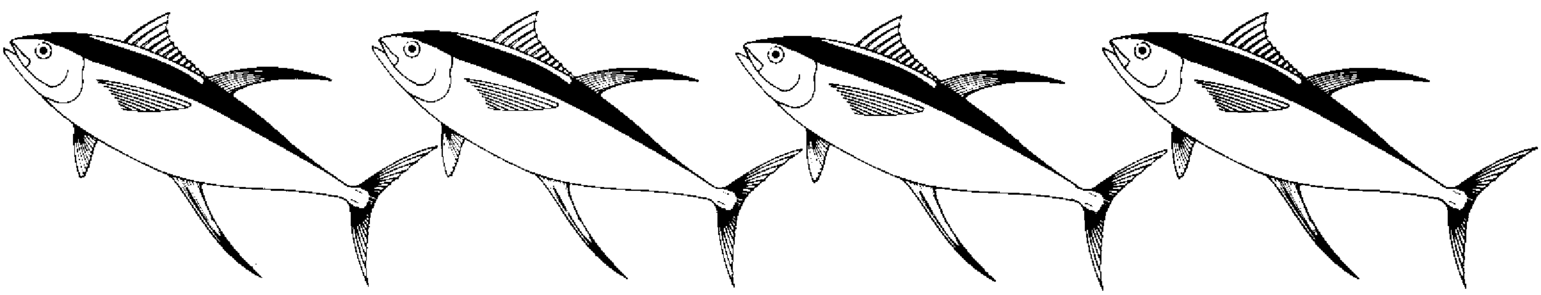
April 1988

SGR-91

Yellowfin Tuna

Fishing Gear, Production and Quality



Florida Sea Grant College Program

IMPORTANT

Accompanying information is available in videotape form. Two 15 minute programs combined on one tape are:
Part I - Fishing Methods and Gear for Yellowfin Tuna
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This tape is available at production/distribution cost from the Florida Sea Grant Program, Bldg. 803, University of Florida, Gainesville, FL 32611, phone (904) 392-2801

YELLOWFIN TUNA:
Fishing Gear, Production and Quality

A compilation of papers by:

Florida Sea Grant College
Sea Grant Extension Program Staff

in conjunction with

Federal Saltonstall-Kennedy Funds
Project No. NA85-WC-H-06174
Grant No. NA86AA-D-SG068

Sea Grant Report No. 91

Florida Sea Grant College Program
June 1988

Price $2.00

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YELLOWFIN TUNA:
Fishing Gear, Production and Quality

INTRODUCTION

W. Steven Otwell

Tuna fisheries have been rapidly expanding along the southeastern coasts of the United States. This domestic harvest includes albacore (Thunnus alalunga), bigeye (T. obesus), blackfin (T. atlanticus), bluefin (T. thynnus) and yellowfin (T. albacares). Current production and predicted availability suggest the yellowfin are most abundant, plus they are not restricted by harvest regulations such as the two fish per boat limit on bluefin. In the Gulf and South Atlantic region annual landings of yellowfin alone have increased dramatically since 1980 to exceed 6.4 million pounds valued in excess of $8.4 million on the dock in 1986. A major portion of this production occurs in Florida with landings recorded in Fort Pierce, Pompano Beach, Key West, Fort Myers, Madeira Beach, Panama City, Destin and Pensacola.

This growing commercial activity has evolved partially as an alternative to the declining catch of swordfish and in response to the popularization of high value sashimi and sushi (raw fish). Catering to these markets, the fishermen must land a high grade, top quality fresh tuna. The preferred large tuna, primarily bluefins, are destined for Japan, while most yellowfin remains in domestic markets. Before any fresh tuna is accepted for the raw market it must pass the discrimination of dockside buyers trained to set premium prices depending on a sensory evaluation of meat quality. Ex-vessel prices have ranged from $0.90 to $3.50 per pound and complete rejection of whole fish or fish portions is common. Although supply and demand appear to play a major role in the price structure, the subjective evaluations for quality are suspected to cause price variations on a per day and per fish basis. Quality concerns also influence consumer acceptance. Likewise, particular product safety concerns are related to the unique chemical attributes of tunas.

Quality control problems have occurred in developing tuna fisheries elsewhere in the United States and the South Pacific. Research and extension efforts have assisted these fisheries with information pertinent to the Japanese sashimi standards. Fishery development programs have prepared market overviews (1,2) and "how-to" manuals (3,4) for New Zealand and Australian bluefin fishermen. The New York Sea Grant Program applied the New Zealand work for New England fishermen (5,6); the Hawaiian Sea Grant Program (7,8) combined forces with the National Marine Fisheries Service, Southwest Center (9) and Pacific Tuna Development Foundation (10) to assist commercial fishing for Hawaiian yellowfin tuna; and the West Coast Fisheries Development Foundation partially funded a market development program for California albacore (11). These efforts established that tuna quality was paramount to the success of any new tuna venture.

Thus, this publication and accompanying industry workshops have responsed to a rapidly developing fishery for fresh yellowfin tuna in the Gulf of Mexico and South Atlantic region. Preliminary field work began as a Federal Saltonstall-Kennedy Project No. NA-85-WC-H-06174 from November 1985 through August 1987.. The work culminated into publications, videotapes and four industry workshops. The intent was to provide development guidelines for the emerging tuna fishery in the southeast with emphasis on product quality and economic profiles to enhance the efficiency, value, and long term stability in the production and processing sector. The developing southeastern tuna fisheries were characterized by some different fishing methods, unique harvest and market logistics, and environmental conditions which warrant specific considerations. Thus, the following information is most specific for fresh yellowfin tuna from said region.

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ECONOMIC OVERVIEW OF YELLOWFIN TUNA PRODUCTION AND VALUE TRENDS

Chuck Adams

Few domestic fisheries have experienced as dramatic an increase in production as the yellowfin tuna (Thunnus albacares) fishery in the Gulf of Mexico and South Atlantic region of the U.S. Domestic landings in the region increased ten-fold during the 1983-86 period, with the most growth occurring in the Gulf of Mexico. This increase took place at the same time that the overall market for seafood experienced growing strength, with record per capita seafood consumption being reached each year from 1984 to 1986 (National Marine Fisheries Service (NMFS),a). An apparent strong market for fresh finfish products gave rise to stable or rising prices for fresh yellowfin tuna -- a newcomer to the U.S. fresh fish market.

Coupled with the growing market strength for fresh finfish products, the production of yellowfin tuna in the Gulf of Mexico and South Atlantic region of the U.S. continues to grow as more vessels enter the yellowfin longline fishery anew or diversify from primarily targeting swordfish. The purpose of this paper is to briefly describe the trends in production, prices, and value of yellowfin tuna in the Gulf of Mexico and South Atlantic of the U.S. region, virtually all of which is destined for the fresh market. Yellowfin production activities in the Gulf of Mexico and South Atlantic region of the U.S. will be addressed with respect to world and total U.S. yellowfin landings. In addition, recent trends in fresh/frozen yellowfin tuna imports will be examined. Throughout this document, unless otherwise stated, the "South Atlantic" region refers to the area from North Carolina to the east coast of Florida.

World Yellowfin Production

Total world production of tuna in 1985 totaled 5,236 million pounds (Food and Agricultural Organization of the U.N.) (Table 1). The major species was skipjack (Euthynnus pelamis), which accounted for 1,968 million pounds and represented 38 percent of the total landings volume. Yellowfin was the second most important species, accounting for 1,632 million pounds, or 31 percent of the total. Species such as bluefin (Thunnus thynnus), albacore (T. alalunga), bigeye (T. obesus), and others shared in the remaining 31 percent.

Approximately 64 percent of the yellowfin were caught in the Pacific in 1985 (Figure 1), with an almost equal split between the eastern (FAO fishing area 77) and western (FAO fishing areas 61 and 71) Pacific regions (Table 2). Areas which have exhibited relatively large percentage increases in landings since 1980, however, are in the western, central Atlantic, from Cape Hatteras to the southern coast of South America (Food and Agricultural Organization of the United Nations (FAO)

TABLE 1

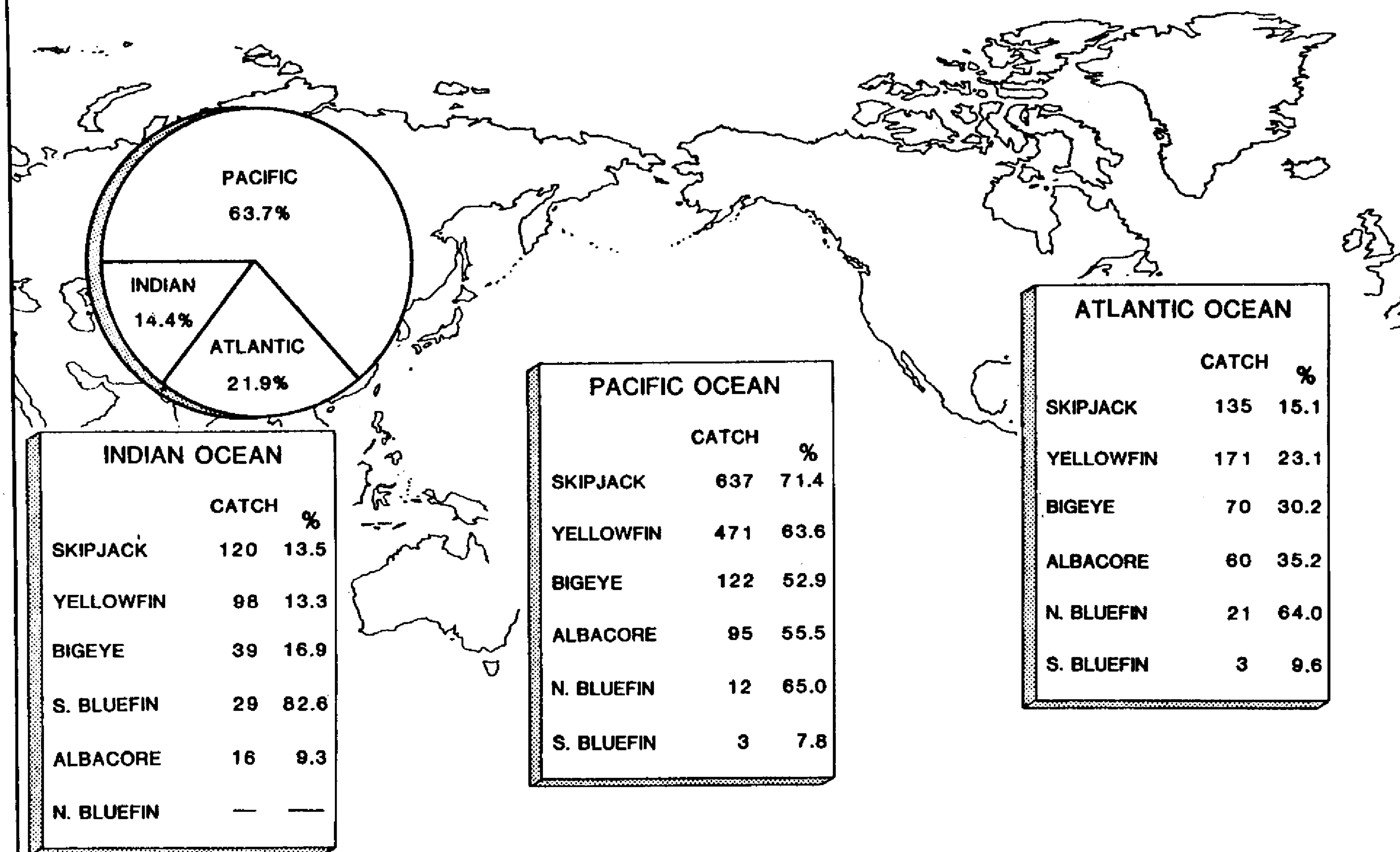
TOTAL WORLD TUNA PRODUCTION[1] BY SPECIES 1976 - 1985

Year	Skipjack	Bluefin	Albacore	Bigeye	Yellowfin	Other	Total
1976	1,418	154	523	410	1,162	291	3,960
1977	1,396	168	434	472	1,213	375	4,055
1978	1,746	157	492	459	1,206	324	4,381
1979	1,541	146	443	410	1,288	362	4,192
1980	1,715	159	406	456	1,166	423	4,328
1981	1,616	176	412	397	1,261	412	4,274
1982	1,724	196	439	490	1,246	545	4,640
1983	1,998	185	370	481	1,297	662	4,993
1984	2,324	157	366	452	1,330	653	5,283
1985	1,968	150	377	509	1,632	600	5,236

[1]Million pound units

SOURCE: FAO AND IATTC

FIGURE 1: CATCHES OF PRINCIPAL MARKET SPECIES IN THOUSANDS OF METRIC TONS, 1985*



INDIAN OCEAN

	CATCH	%
SKIPJACK	120	13.5
YELLOWFIN	98	13.3
BIGEYE	39	16.9
S. BLUEFIN	29	82.6
ALBACORE	16	9.3
N. BLUEFIN	—	—

PACIFIC OCEAN

	CATCH	%
SKIPJACK	637	71.4
YELLOWFIN	471	63.6
BIGEYE	122	52.9
ALBACORE	95	55.5
N. BLUEFIN	12	65.0
S. BLUEFIN	3	7.8

ATLANTIC OCEAN

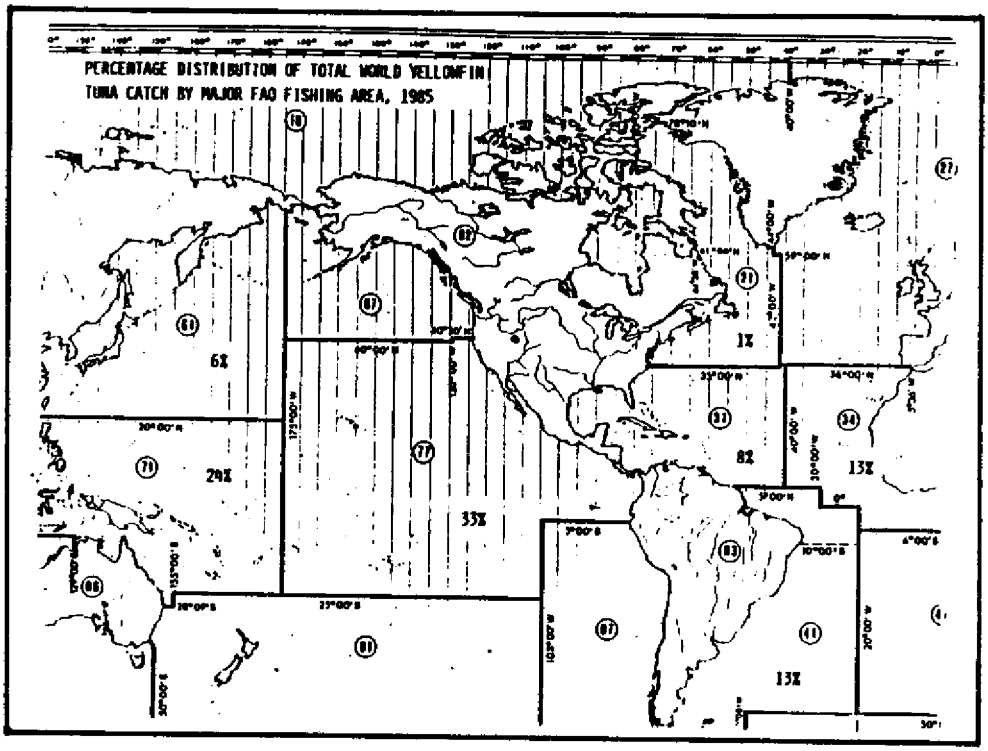
	CATCH	%
SKIPJACK	135	15.1
YELLOWFIN	171	23.1
BIGEYE	70	30.2
ALBACORE	60	35.2
N. BLUEFIN	21	64.0
S. BLUEFIN	3	9.6

SOURCE: IATTC

*Values represent the volume and percentage of worldwide total of each species caught in the respective ocean region.

TABLE 2

DISTRIBUTION OF TOTAL WORLDWIDE YELLOWFIN TUNA CATCH BY MAJOR FAO FISHING AREA, 1980 AND 1985



REGION	Mil. lbs 1985	Mil. lbs 1980	% Total YF 1985	% Total YF 1980
77	547	333	33	29
71	384	315	24	27
34	221	249	13	22
41	219	6	13	<1
51	198	51	12	4
31	128	1	8	<1
61	98	93	6	8
57	20	26	1	2
21	14	<1	1	<1
47	6	7	<1	1

SOURCE: FAO AND IATTC

and the Inter American Tropical Tuna Commission (IATTC)). FAO fishing areas 31 and 41 have experienced increases in yellowfin tuna production of 8 and 13 percent, respectively, during 1980 to 1985 (Table 2). These were the largest percentage increases among all major FAO production regions.

Japan, the U.S., Spain, and Mexico were the major producers of yellowfin tuna in 1985, landing a combined total of 58 percent of the world catch (e.g. 18, 17, 12, and 11 percent, respectively) (Table 3). The largest percentage increase in landings among the top ten countries producing yellowfin tuna during the 1980-85 period were Mexico and Venezuela (FAO). Japan and the U.S. each reported a three percent decrease in the worldwide share of yellowfin landings during the same six-year period.

Although the actual percentages are not readily available, the majority of the yellowfin tuna produced worldwide, as well as other major tuna species, is destined for the canning industry. A relatively larger share of species such as bluefin and bigeye tuna may ultimately be directed to the fresh market. Of the total world tuna catch for all species, the U.S. reportedly consumes about 35 percent (National Marine Fisheries Service,c).

U.S. Yellowfin Production: Worldwide and Domestic Landings

The geographic distribution and magnitude of worldwide U.S. yellowfin tuna production have been altered by the recent structural change that occurred within the domestic tuna canning industry. The relocation of major canning operations and portions of the purse seine fleet to American Samoa and Puerto Rico resulted in the closing of all but one major California tuna cannery. Causes for this change are primarily attributed to foreign competition in canned production and economic problems of the fleet during 1984 (Herrick and Koplin, 1985; U.S. International Trade Commission, 1986). U.S. worldwide landings of yellowfin tuna fell from 384 million pounds in 1976 to 221 million pounds in 1984 (Table 4). Production increased slightly to 293 million pounds in 1986 (NMFS,a). Yellowfin has historically represented about 50 percent of the total worldwide U.S. tuna catch.

The eastern, central Pacific (i.e., east of 175 W longitude) continues to be the major region of U.S. yellowfin tuna production (FAO). However, this region, represented by FAO fishing region 77, declined slightly in importance from 1980 to 1985, with the region accounting for 89 and 72 percent, respectively, of the U.S. catch (Table 5). In contrast, the western, central Pacific experienced a dramatic increase in importance during the same period. That region's share of the total worldwide U.S. yellowfin tuna catch, represented by FAO fishing sector 71, increased from 1 to 23 percent. This shift in production has paralleled the shift in U.S. tuna canning activities to American Samoa. The western, central Atlantic region south of Cape Hatteras to the northern coast of South America and west of 40 W longitude, represented by FAO fishing region 31, also exhibited an increase from less than 1 to 4 percent of the total worldwide U.S.

TABLE 3

WORLD YELLOWFIN TUNA CATCH BY COUNTRY, 1980 AND 1985

	Mil. lbs		% Total YF	
COUNTRY	1985	1980	1985	1980
1. JAPAN	295	241	18	21 (1)*
2. USA	276	232	17	20 (2)
3. SPAIN	194	71	12	6 (6)
4. MEXICO	187	44	11	4 (7)
5. PHILLIPINES	141	106	9	9 (3)
6. VENEZUELA	106	5	6	- (-)
7. FRANCE	97	88	6	8 (5)
8. INDONESIA	75	37	5	3 (8)
9. KOREA REP.	57	98	3	9 (4)
10. ECUADOR	24	28	1	2 (10)
OTHER L.A.	40	18	2	2

*Numbers in parentheses are country rankings in 1980

SOURCE: FAO AND IATTC

TABLE 4

WORLDWIDE U.S. YELLOWFIN TUNA PRODUCTION, 1976-1986

Year	Mil. lbs	% Total Tuna
1976	384	58
1977	286	61
1978	268	47
1979	278	55
1980	232	46
1981	250	51
1982	224	51
1983	242	41
1984	221	38
1985	276	53
1986	293	53

SOURCE: NMFS,a

TABLE 5

WORLDWIDE U.S. YELLOWFIN TUNA PRODUCTION BY MAJOR FAO FISHING AREA, 1985 AND 1980

	Mil. lbs		% Total YF	
AREA	1985	1980	1985	1980
77	200	208	72	89
71	63	2	23	1
31	12	1	4	-
21	1	-	<1	-
87	-	19	-	8
34	-	2	-	1
81	-	1	-	-

SOURCE: FAO AND IATTC

yellowfin tuna catch from 1980 to 1986, respectively. This area, which includes the Gulf of Mexico, South Atlantic coast of the U.S., and Caribbean region, has exhibited a growing importance in U.S. and total worldwide yellowfin tuna production.

U.S. yellowfin tuna landings in domestic ports (i.e., within the 50 states) have declined dramatically over the last few years (Table 6). These "domestic" landings decreased from 276 million pounds in 1976 to 58 million pounds in 1986 (NMFS,a). Yellowfin tuna has historically accounted for approximately 50 percent of the total volume of these domestic tuna landings. Dockside value increased from $82 million in 1976 to $115 million in 1980. However, dockside value then declined rapidly to $32 million in 1986. Again, this decline reflects the relocation of the domestic tuna canning industry, as the majority of the reported domestic landings is destined for canned products.

The collapse of the U.S. west coast tuna cannery production has important implications for the domestic market for fresh tuna. At the start of 1985, approximately 26, 25, and 10 percent of the purse seiners, trollers, and baitboats, respectively, in the domestic fleet were idle (Herrick and Koplin, 1985). Fresh tuna may be a viable alternative for some of these producers, especially the smaller near-shore vessel operators who have been particularly hard hit by the reduction in canning activities. The developing domestic market for fresh tuna destined for the retail and food service trade (i.e tuna steaks and "sushi"), of which yellowfin is particularly suitable, may provide an important opportunity for some of these idle west coast producers. Given the relatively well developed transportation services for fresh finfish products, production on the U.S. west coast may play an important role in the market for fresh tuna products on the U.S. east coast, including the market for fresh yellowfin produced in the Gulf of Mexico and South Atlantic region of the U.S. The reverse may also be true. Therefore, producers, processors, and marketing agents of fresh tuna should be aware of production activities (i.e., landings, prices, trends, etc.) on both coasts.

Southeast U.S. Regional Yellowfin Industry

Although the southeastern U.S. region has not been a major domestic tuna producing region, considerable growth in regional landings has occurred in the past few years. This section summarizes these trends in production, prices, and dockside value of the yellowfin tuna industry from Texas to North Carolina. All data utilized were obtained from the National Marine Fisheries Service state and county reported landings statistics (NMFS,c) and "Green Sheet" Market News Reports (NMFS,b).

Annual Regional and State Production of All Tunas, 1980-86

Total landings in the Gulf and South Atlantic region of all species of tuna during the 1980-86 period amounted to 19.7 million pounds, with yellowfin and blackfin (*T. atlanticus*) tuna accounting for 59 and 21 percent of the volume, respectively (Table 7). The remaining volume was represented primarily by bluefin, little tunny (*Euthynnus*

TABLE 6

U.S. YELLOWFIN TUNA PRODUCTION LANDED IN DOMESTIC PORTS, 1976-1986

Year	Mil. lbs	Dockside Value*	Dockside Price	% Total Tuna
1976	276	82	$0.30	57%
1977	203	86	.42	59
1978	204	76	.37	50
1979	210	92	.44	58
1980	192	115	.60	48
1981	170	103	.61	50
1982	139	80	.58	53
1983	135	72	.53	48
1984	86	47	.55	41
1985	40	22	.55	48
1986	58	32	.55	67

*Million dollar units.

SOURCE: NMFS,a

TABLE 7

TOTAL TUNA LANDINGS IN THE GULF AND SOUTH ATLANTIC REGION BY SPECIES, 1980 - 86

Species	Pounds
Yellowfin	11,620,128
Blackfin	4,107,872
Bluefin	990,634
Little	823,050
Bigeye	376,230
Other	1,771,908
Total	19,686,098

SOURCE: NMFS,c

alletteratus), and bigeye tuna. The largest share of this total seven year volume, 83 percent, was landed during the 1984-86 seasons, with the largest increase in landings exhibited by yellowfin (Table 8).

The major tuna producing states were Florida, Louisiana, and North Carolina. Florida was the leader in terms of volume landed, producing the majority of yellowfin, bluefin, and bigeye tuna (Table 9). However, Louisiana was a major producer of yellowfin and bluefin, and was the leading producer of blackfin tuna. North Carolina produced significant quantities of yellowfin, blackfin, bigeye, and little tunny. The remaining states in the Gulf of Mexico and South Atlantic region of the U.S., with the exception of Mississippi which was the leading producer of little tunny, produced smaller relative quantities of all species.

Until about 1983-84, most tuna landings in the Gulf of Mexico and South Atlantic region of the U.S. were reportedly a by-catch from swordfish longlining. The market for fresh tuna products began to grow significantly in the early part of this decade. A market outlet for fresh yellowfin tuna that has received much attention has been the raw consumption of "sushi" grade product. However, the demand for high quality raw tuna steaks for the restaurant and retail market has also reportedly increased significantly. As prices for tuna, especially yellowfin, increased relative to the price of swordfish, some swordfish longline operators began directing more effort toward tuna. This diversification was facilitated by the similarity in longline gear used for the two species. A few operators reportedly direct efforts primarily toward yellowfin tuna. However, many will switch between tuna and swordfish, depending on relative market conditions and prices. Thus, the effort directed toward tuna longlining is likely to be seasonal, as dockside and wholesale prices for tuna and swordfish can fluctuate on a monthly basis. Effort will also depend on the relative abundance of yellowfin. For example, the Gulf of Mexico yellowfin season runs from spring to early fall. During the remaining months effort is directed toward a mix of species including swordfish, yellowfin, bluefin, etc. The number of vessels engaged in the yellowfin tuna fishery in the Gulf of Mexico and South Atlantic region of the U.S. is estimated to be about 250 and is believed to be growing.

Annual Regional Production of Yellowfin Tuna

Yellowfin tuna landings in the Gulf of Mexico and South Atlantic region of the U.S. increased from 119,000 pounds in 1980 to 6.4 million pounds in 1986. Dockside value increased from $164,000 to $8.4 million during the same period (Figure 2). Production has increased most dramatically since 1984. Florida has been the leader in yellowfin production, with landings increasing from 76,000 pounds in 1980 to 3.6 million pounds in 1986 (Figure 3). Louisiana has also experienced a rapid increase in yellowfin landings, with virtually zero landings reported until 1985 (i.e., 227,000 pounds), and then increasing to 2.4 million pounds in 1986. North Carolina's landings of yellowfin increased from a reported 4,000 pounds in 1980 to 359,000 pounds in 1986 (a large portion of these landings are reportedly caught by

TABLE 8

TUNA LANDINGS* IN THE GULF AND SOUTH ATLANTIC REGION BY SPECIES, 1980-86

Year	Yellowfin	Bluefin	Bigeye	Blackfin	Little	Other	Total
1980	119	20	1	1,036	117	97	1,389
1981	79	34	--	213	93	120	540
1982	131	89	16	11	145	186	577
1983	321	137	31	166	109	176	940
1984	1,091	231	67	15	101	384	1,889
1985	3,451	224	107	27	88	379	4,285
1986	6,419	255	155	2,641	170	429	10,066

*Thousand pound units

SOURCE: NMFS,c

TABLE 9

TOTAL TUNA LANDINGS[1] BY STATE[2] IN GULF AND SOUTH ATLANTIC FOR MAJOR SPECIES, 1980 - 86[3]

State	Yellowfin lbs	%	State	Bluefin lbs	%	State	Blackfin lbs	%
FL	8,039	69	FL	743	75	LA	2,628	64
LA	2,662	23	LA	196	20	TX	1,240	30
NC	633	5	TX	44	4	NC	166	4
O	349	3	O	10	1	FL	51	1
						O	41	1

State	Bigeye lbs	%	State	Little lbs	%
FL	323	86	MS	419	51
NC	51	14	NC	403	49

[1]Thousands pound units

[2]States are Texas (TX), Louisiana (LA), Mississippi (MS), Florida (FL), North Carolina (NC), and Other (including A labama, Georgia, South Carolina, and others).

[3]Values in lbs represent total for seven year period, 1980-86.

SOURCE: NMFS,c

FIGURE 2

YELLOWFIN TUNA PRODUCTION AND VALUE IN THE GULF AND SOUTH ATLANTIC 1980–86

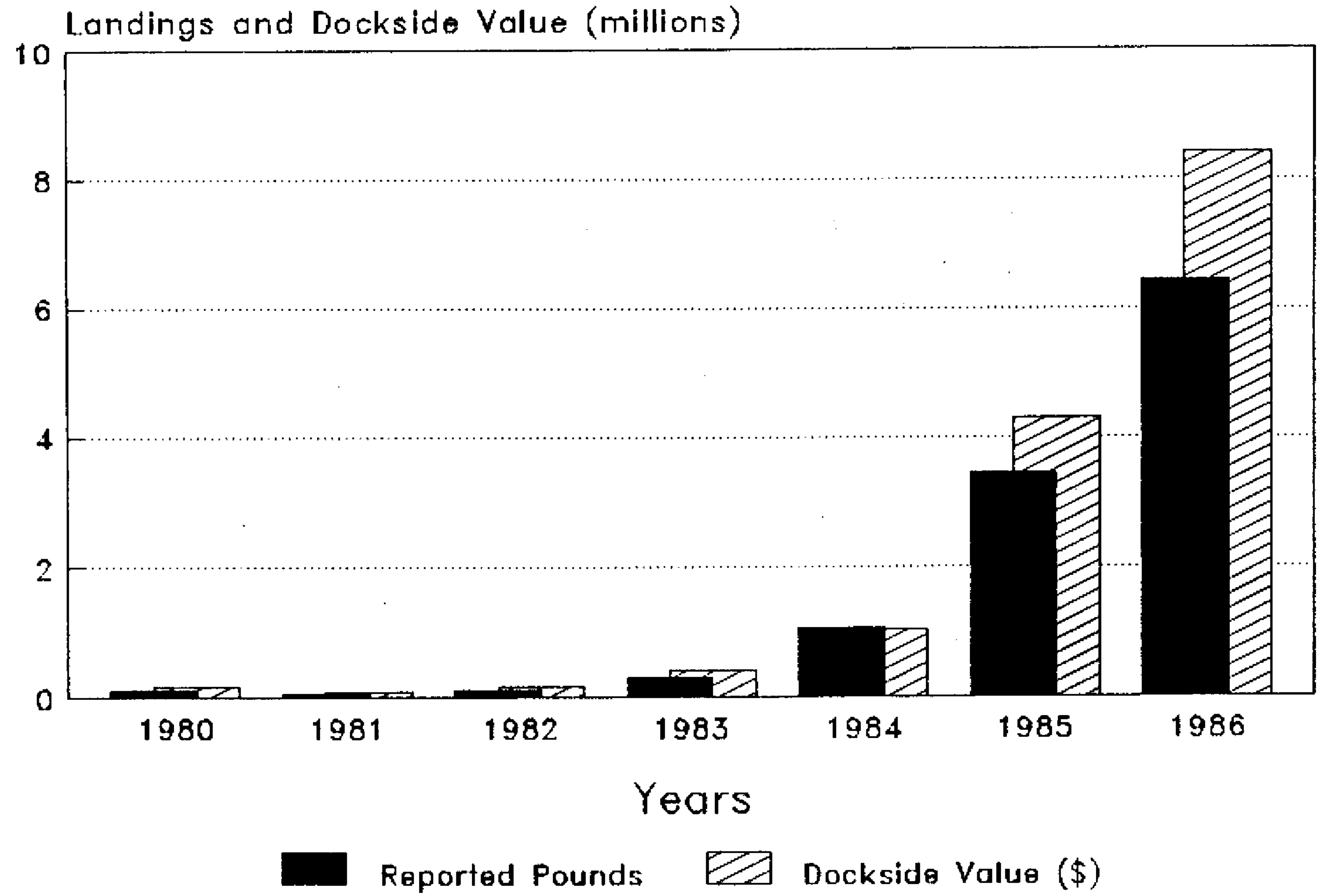
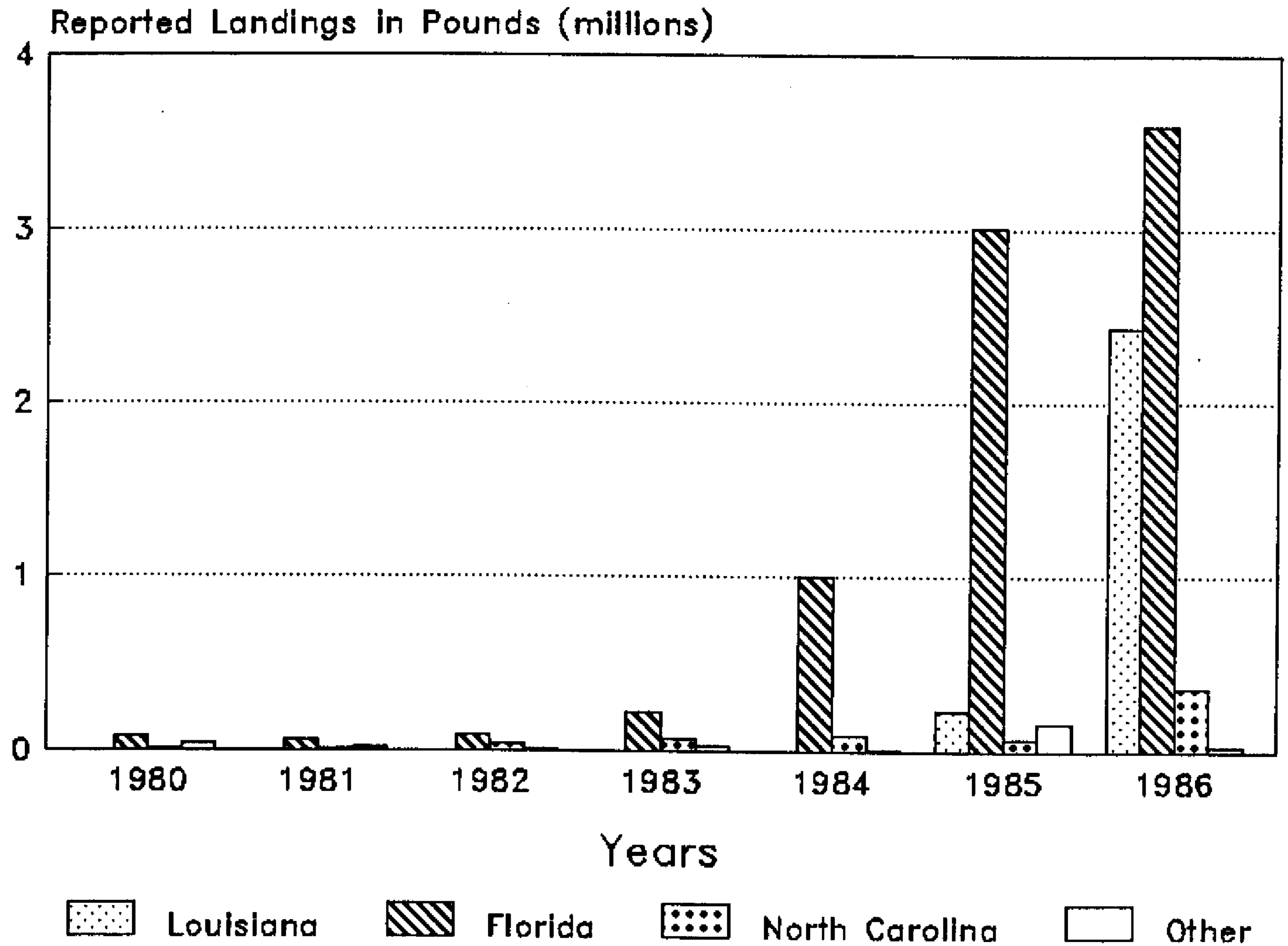


FIGURE 3

GULF AND SOUTH ATLANTIC YELLOWFIN TUNA PRODUCTION BY STATE 1980–86



charterboats). Texas, Alabama, Georgia, and South Carolina reported relatively minor volumes of yellowfin during the 1980-86 period. Mississippi did not report any landings of yellowfin during this seven-year period. Preliminary studies have indicated that the yellowfin stocks off the Carolinas may not be sufficiently aggregated to support a commercial fishery as has developed in the northern Gulf of Mexico (Cunningham, 1986). However, potential may still exist in the Carolinas for other high valued species, such as bigeye tuna (Table 7).

Annual Florida East and West Coast Production of Yellowfin Tuna

The west coast of Florida has reported the majority of the yellowfin tuna landings in the region (Figure 4). The west coast of Florida reported 3.4 million pounds of yellowfin in 1986, valued at $4.6 million dockside. The east coast of Florida reported 167,000 pounds, valued at $277,000 dockside during 1986. For the east coast, this represented a decline from the landings and dockside value reported in 1984. Approximately 95 percent of the 1986 Florida yellowfin catch was reportedly from the Florida west coast. West coast landings and dockside value have exceeded those for the east coast since 1982. Note that suggesting that all of this reported yellowfin volume was actually off-loaded from vessels at Florida west coast ports may be misleading. Some of these landings were initially reported by NMFS in Florida only after the product had actually been landed in Louisiana and then trucked to a Florida west coast port for further processing. At any rate, the regional significance of this rapid increase in production to the northern Gulf region should not be ignored.

The distribution of Florida landings by county indicates that the majority of the landings are reported in the panhandle region. In 1986, Bay County reported 65 and 67 percent of the total landings and dockside value, respectively (Figure 5). Okaloosa, Gulf, and Broward Counties reported 18, 9, and 4 percent of the total 1986 landings, respectively. The remaining counties reported 5 percent of the total landings. Again, the actual importance of the panhandle region in terms of "landings" may be distorted due to an unknown quantity of product not being reported until it was trucked from Louisiana ports to Florida ports, such as Panama City and Destin.

Monthly Trends in Production

The production of yellowfin tuna appears to be seasonal in nature. Given that the fishery is relatively new and at best only three years of data for a targeted yellowfin fishery exist, findings regarding seasonal catch patterns are preliminary. As the fishery matures and more data become available, representative seasonal patterns will emerge. In addition, the relationships between production, biology (e.g., migration patterns), and economic factors within the fishery and market system will become better understood. However, the monthly data that do exist seem to suggest that production in the Gulf region is characterized by peaks in the summer and early fall months. Average monthly landings for the 1980-85 period indicate that Florida west

FIGURE 4

YELLOWFIN TUNA LANDINGS AND DOCKSIDE VALUE, FLORIDA EAST AND WEST COASTS 1980–86

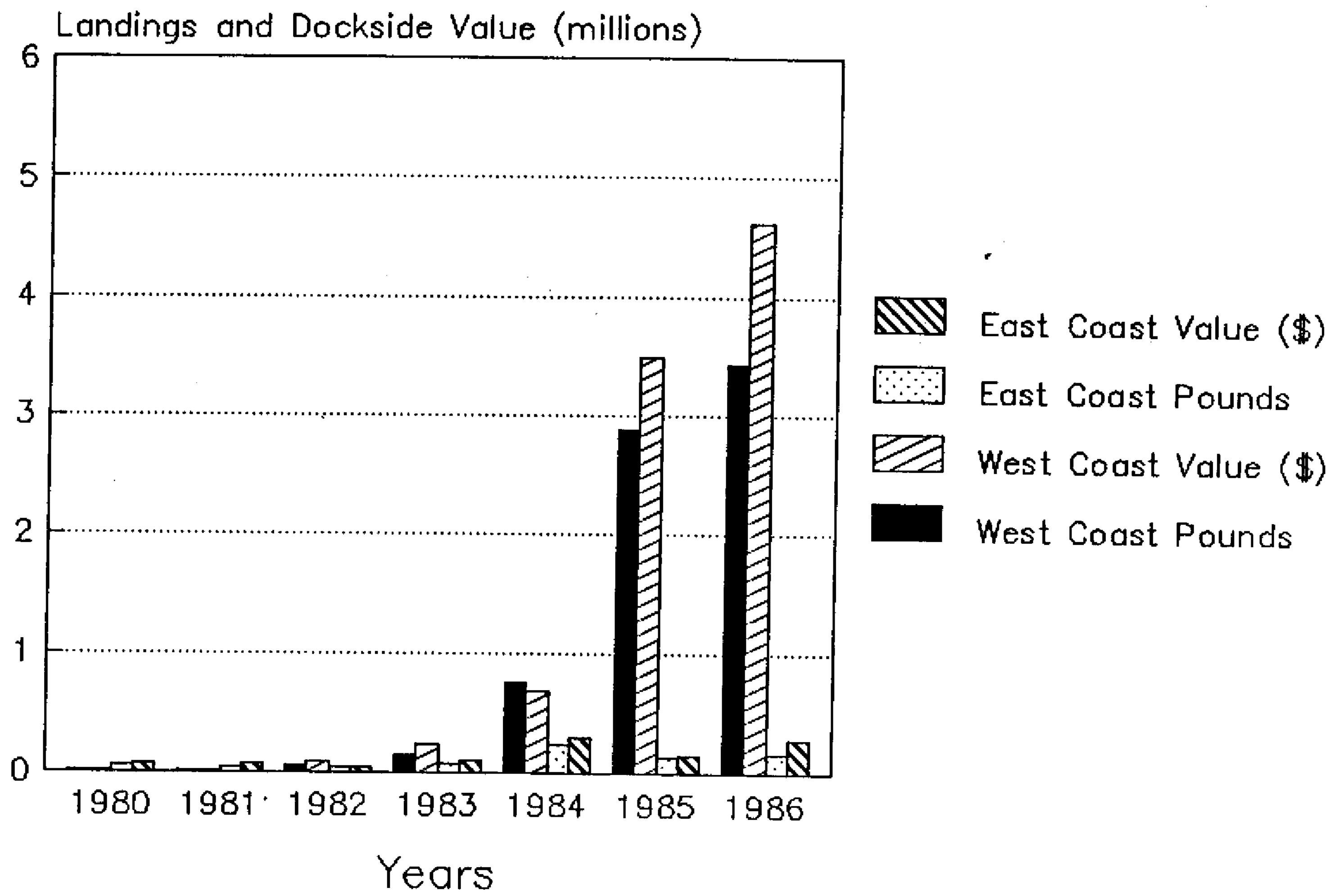
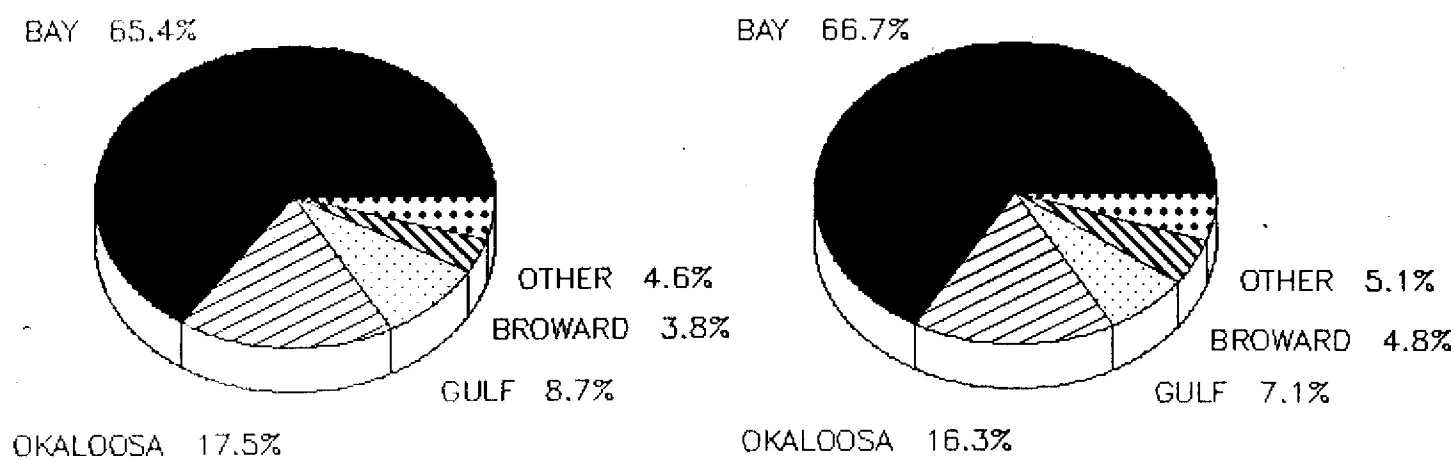


FIGURE 5

YELLOWFIN TUNA PRODUCTION IN FLORIDA

By County, 1986



Total 3,597,000 pounds

Total Value $4,889,000

coast production peaked in the mid-summer and again in the early fall (Figure 6). Production is lowest during the late winter and spring months. Monthly production in Louisiana for 1986 appears to be similar (Figure 7). Monthly landings data in 1986 for the Florida west coast indicate that production peaked in the summer without a peak in the fall. When taken in total, however, production in the Gulf region is primarily from summer to fall.

Landings in the South Atlantic region of the U.S., on the other hand, exhibit no clear seasonal patterns (Figure 8). Average monthly landings for the 1980-85 period for the Florida east coast suggest that production peaked in the late summer, yet this is not supported by the reported monthly landings data for 1986 (Figures 6 and 7). North Carolina landings for 1986 appeared to peak in the spring and began to rapidly increase in the fall. This variability and inconsistency may be due to the production for the South Atlantic region of the U.S. being more dependent on by-catch and charter effort.

Monthly Trends in Dockside and Wholesale Prices

Monthly dockside and wholesale prices for fresh yellowfin tuna tend to exhibit considerable fluctuations from month to month. This variability is likely related to a number of factors, such as those associated with the supply (i.e., biology, environment, imports, and effort) and demand (i.e., consumer incomes, availability of substitute species, and prices). Only limited data exist on prices at dockside and wholesale market levels for fresh yellowfin tuna. The market at the dock in the Gulf and South Atlantic region is characterized by several grades: grade 1, grade 2, grade 3, and "boat-run". This grading scheme, which rewards the producer with a higher per pound price for a higher quality product (i.e., grade 1), may vary across local markets in the region. It has also been suggested that the nature of this grading scheme may change with market conditions. In addition, the rather subjective methods used for identifying a specific grade may lead to similar fish being graded differently by different dockside and/or wholesale buyers. These elements all contribute to the difficulty in collecting representative prices for fresh yellowfin tuna. However, the data that do exist allow some general relationships to be recognized.

Dockside prices for yellowfin tuna in the Gulf region appear to be indirectly related to seasonal abundance. For example, monthly dockside prices for the Florida east and west coasts during the January 1984 - December 1986 period indicate that prices tend to be higher from November to March and lower in June to October (Figure 9). Recall that production was highest in the Gulf region from summer to early fall. Therefore, an expected general pattern emerges with higher prices occurring during periods of lower abundance, and vice versa (the fact that east coast prices follow west coast prices, without similar patterns existing for the two regions in terms of monthly production, may be due to the west coast production dominating the market in the region). In addition, a slight upward trend in reported monthly dockside prices can be seen from 1984 to 1986. For example, each year the high, low, and year-end prices are slightly higher.

FIGURE 6

AVERAGE MONTHLY YELLOWFIN TUNA LANDINGS, FLORIDA WEST AND EAST COASTS, 1980-85

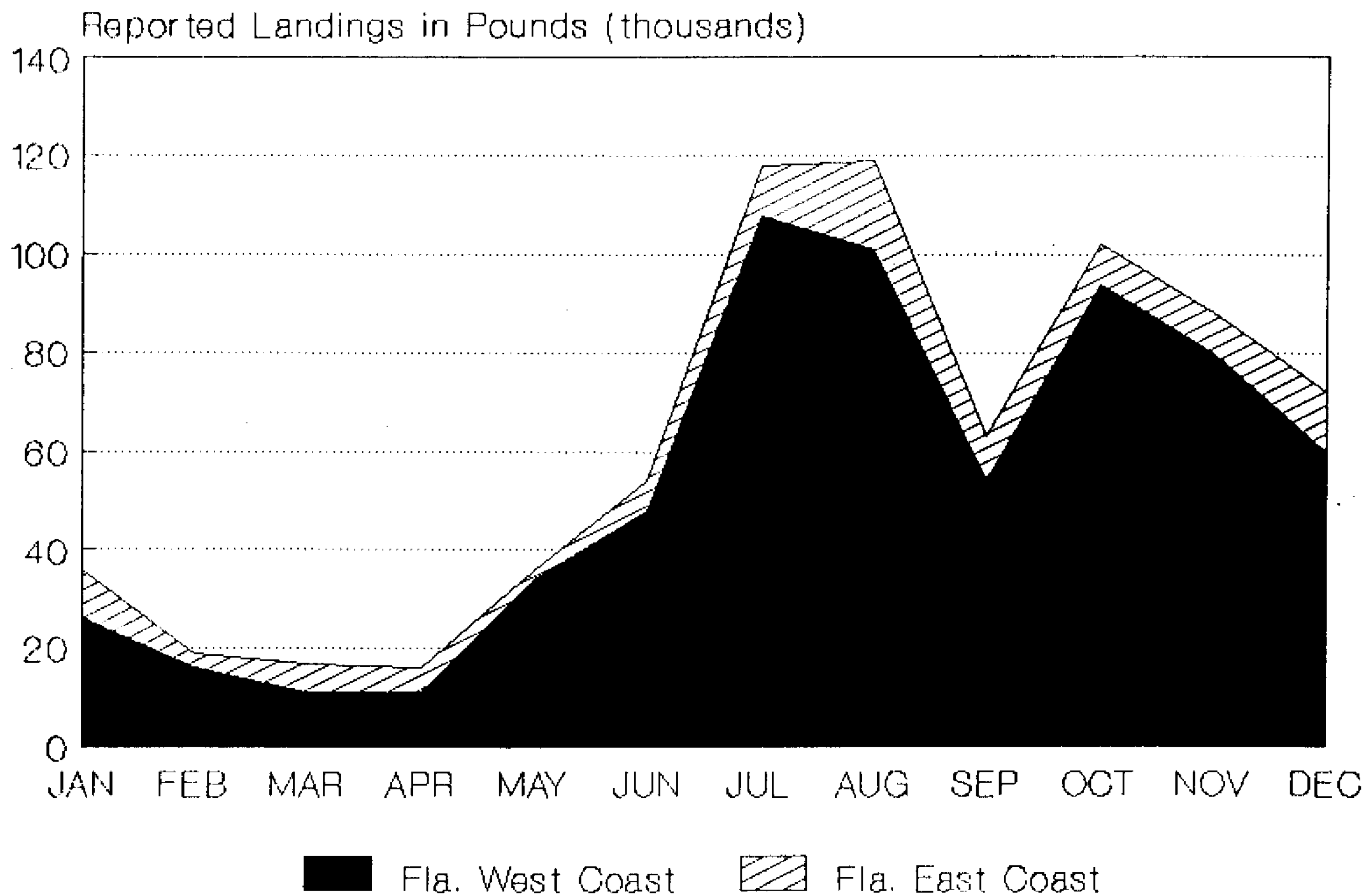


FIGURE 7

MONTHLY YELLOWFIN TUNA
LANDINGS FOR LOUISIANA AND FLA.
WEST COAST, 1986

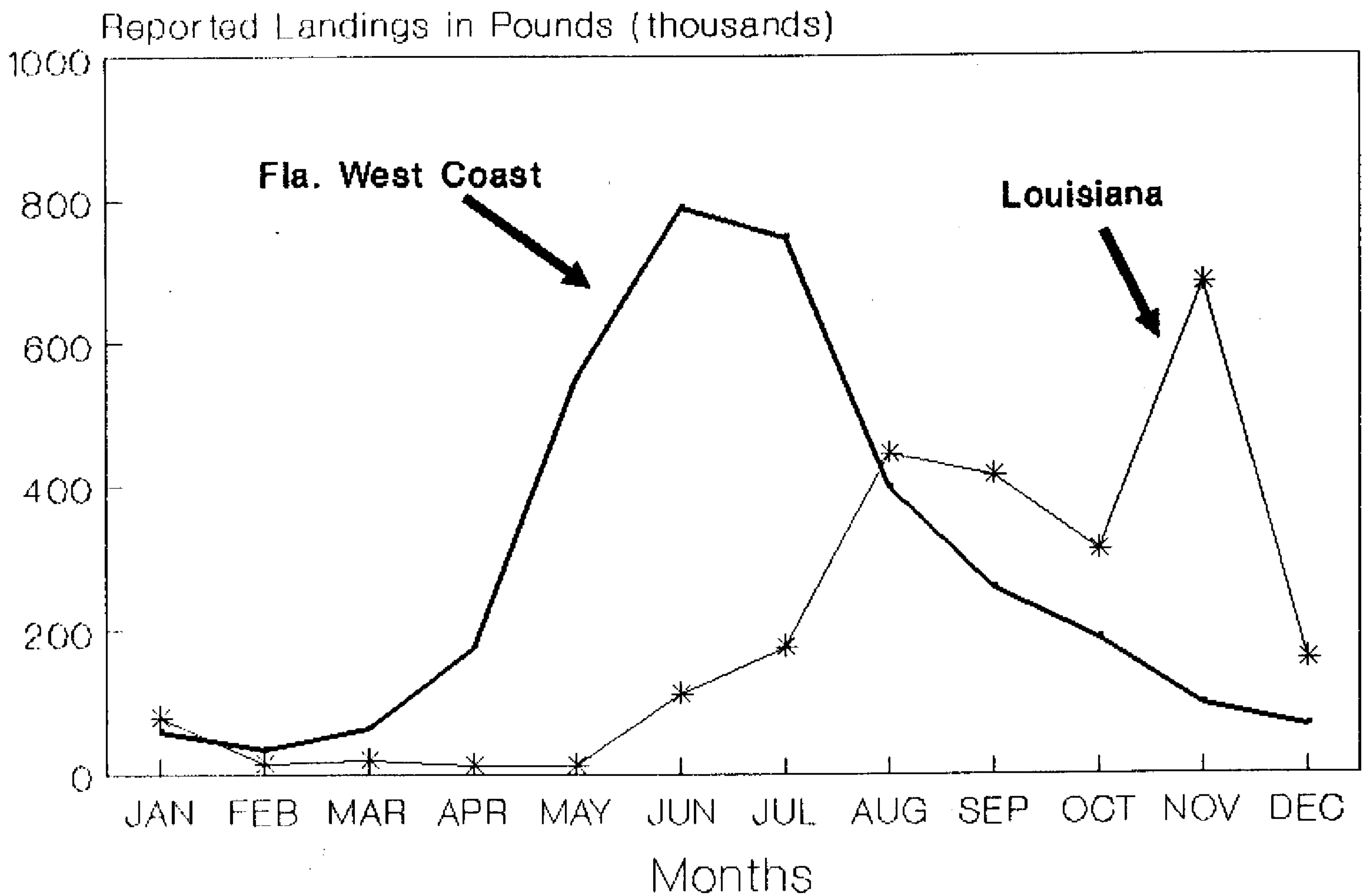


FIGURE 8

MONTHLY YELLOWFIN TUNA LANDINGS FOR NORTH CAROLINA AND FLORIDA EAST COAST, 1986

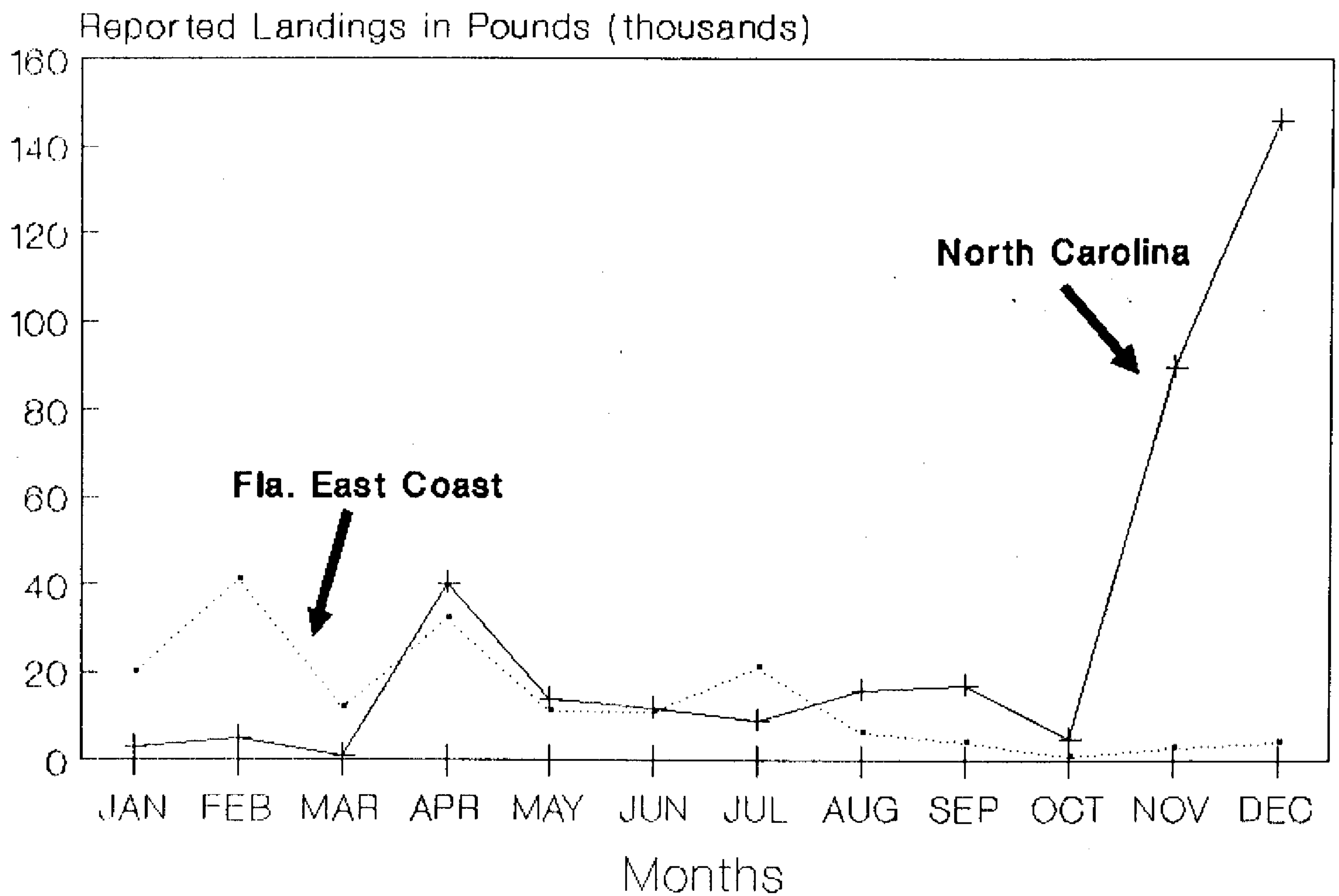
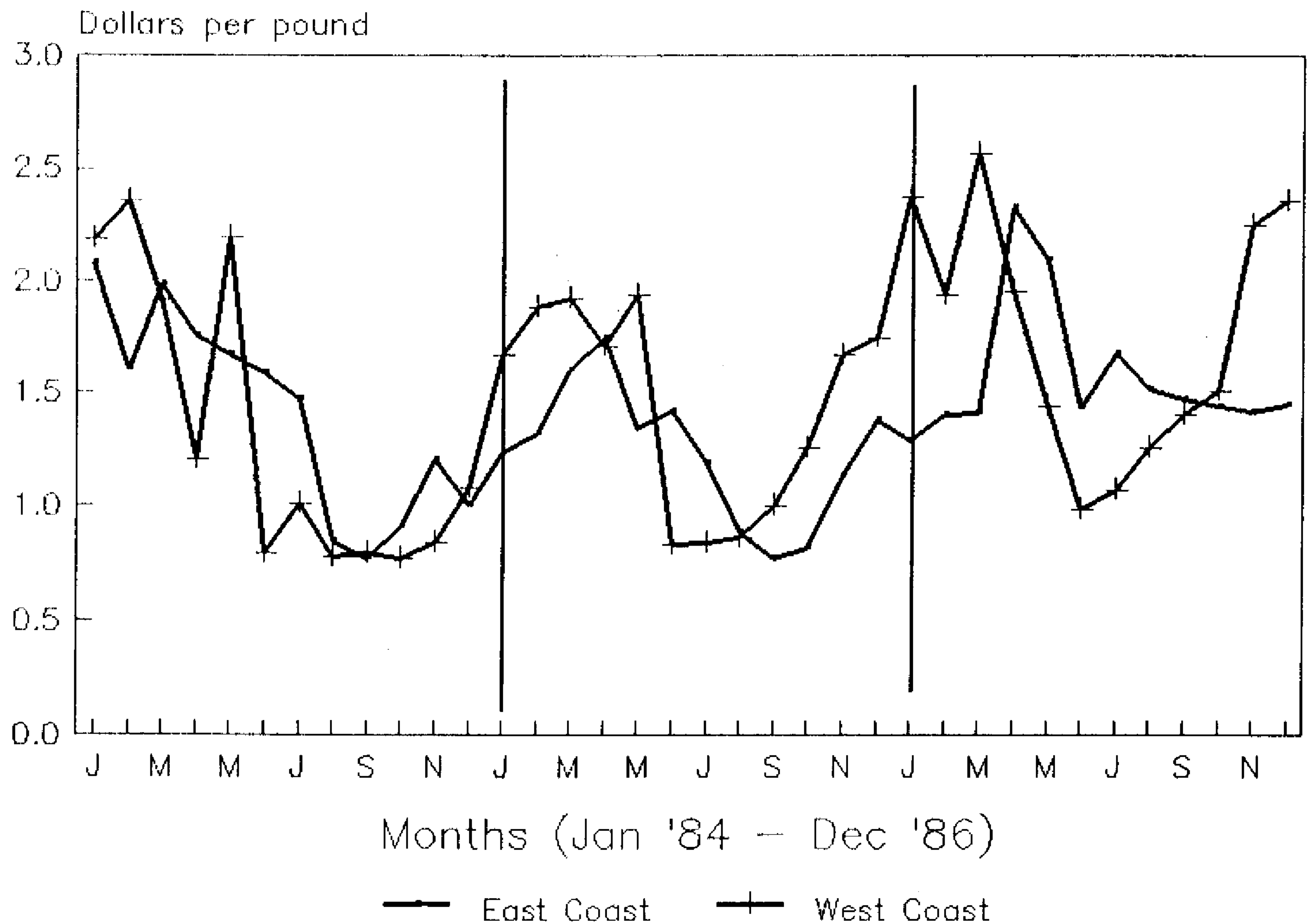


FIGURE 9

Dockside Prices for Yellowfin Tuna
Florida East and West Coast, 1984–86



Reports of dockside prices up to $3.75 and $5.00 per pound for boat-run (i.e., ungraded) and grade 1 tuna, respectively, are not reflected by the available price data. However, the data do suggest that prices are generally stable or increasing on a yearly basis, even as production continues to increase. Even though an indirect relationship may exist between prices and landings on a month to month basis, the upward trending dockside price from year to year implies a strong demand and a relatively stable market for fresh yellowfin tuna. This is also supported by the available wholesale price data for Florida yellowfin tuna at the New York Fulton Fish Market. Per pound prices for Florida yellowfin tuna "by the fish" (i.e., heads off/eviscerated) and "cuts" (i.e., loins) have, in general, trended upward from August 1985 - March 1987 (Figure 10). The margin between whole fish and cuts has been approximately $1.50 to $2.00 per pound. Highs of $5.50 and $7.50 per pound were reached in March 1987 for whole fish and cuts, respectively. Prices then turned downward as production increased. Therefore, wholesale prices are also seasonal in nature.

Variability in Historical Production

An obvious question would be whether or not the recently achieved levels of production can be sustained by the fishery. Is there inherent variability in the stock that has yet to be realized by the current domestic fleet, particularly in the Gulf region? The answer to this question certainly has important implications for the long term viability of the Gulf and South Atlantic region serving as a consistent source of high quality fresh yellowfin tuna. If the current levels of production cannot be maintained, other sources of product, such as imports, should be examined closely.

Prior to 1982, the Japanese were harvesting yellowfin tuna in the Gulf of Mexico in significant numbers. The available data are in terms of individual fish caught and the catch per 100 hooks set (Table 10). These data exhibit considerable variability. The total catch of individual fish reached a high of 73,429 in 1964, but a low of 2,242 in 1969. When multiplied by the current predominant size fish being caught (approximately 80-90 pounds heads-off and gutted), the Japanese were possibly reaching and exceeding current levels of production. The catch per 100 hooks was as high as 5.81 in 1963, but followed a downward trend to .22 in 1981. The standard deviations of these series (i.e., 22,762 for individual fish caught and 1.68 for catch per 100 hooks) indicate a significant amount of year to year variability in the Japanese production. The exact reasons for this fluctuation are not known. However, the current domestic processor and wholesaler in the Gulf of Mexico and South Atlantic region of the U.S. may wish to hedge their bets that regional domestic sources of product will be sufficient to meet the future demand for fresh yellowfin tuna.

FIGURE 10

MONTHLY WHOLESALE PRICES (FULTON) FOR FLORIDA YELLOWFIN TUNA AUGUST 85 - MAY 87

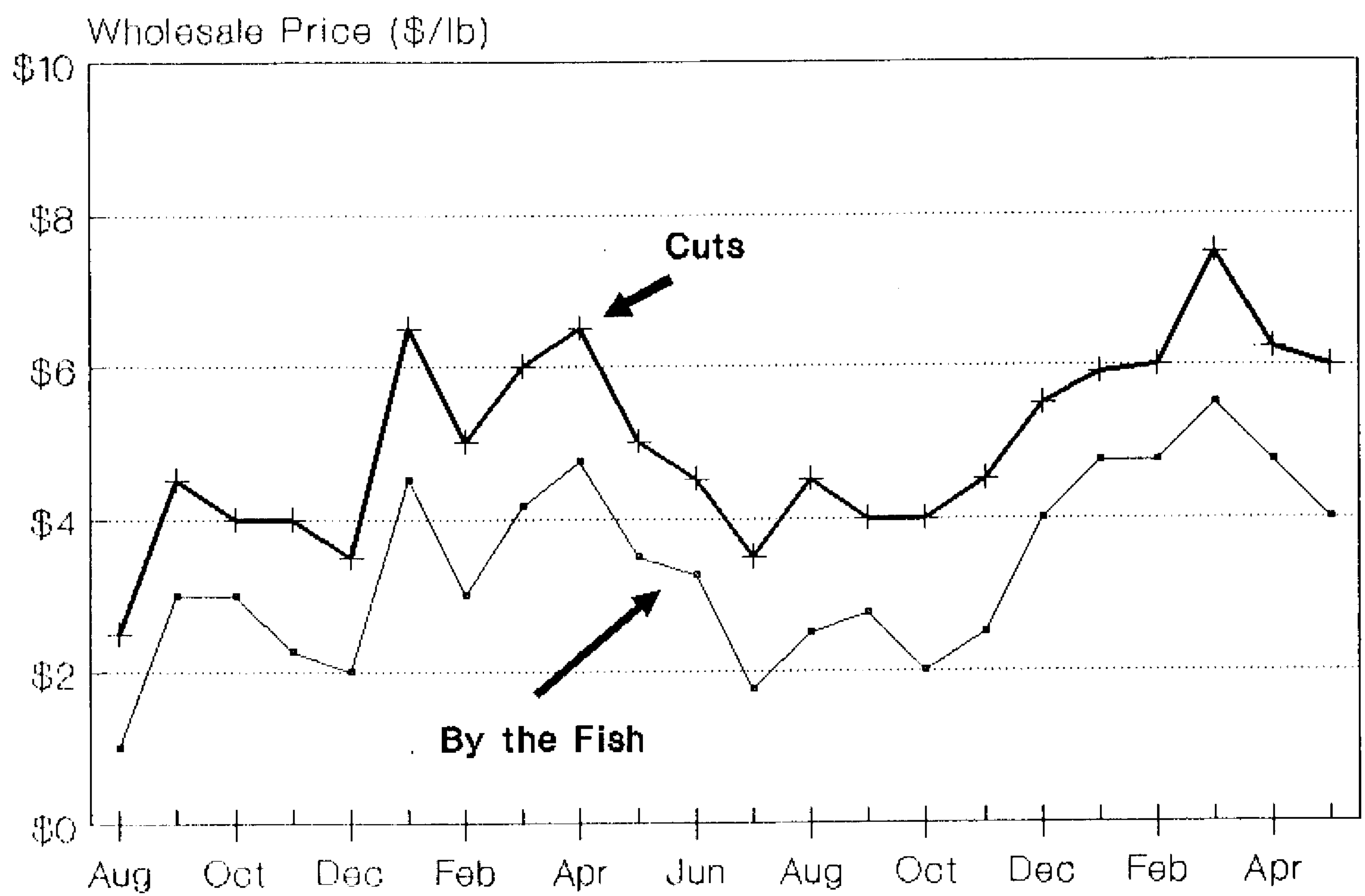


TABLE 10

JAPANESE YELLOWFIN TUNA PRODUCTION IN THE GULF OF MEXICO, 1963-1981

Year	Fish	Fish Per 100 Hooks
1963	25,183	5.81
1964	73,429	3.41
1965	5,201	1.17
1966	4,662	2.44
1967	16,100	4.66
1968	22,349	3.68
1969	2,242	1.42
1970	62,378	4.39
1971	72,598	3.15
1972	20,488	1.72
1973	23,323	2.23
1974	25,277	2.09
1975	42,288	1.09
1976	45,904	.99
1977	15,849	.35
1978	12,288	.39
1979	6,278	.17
1980	7,525	.42
1981	8,778	.22

SOURCE: NMFS,c

Yellowfin Tuna Imports

The U.S. imported 108 million pounds of fresh and frozen yellowfin tuna into domestic ports and Puerto Rico in 1986. Of this total, 96.1 percent was shipped to Puerto Rico, 3.1 percent to the U.S. west coast, and .8 percent to the U.S. east coast (NMFS,c)(Table 11). The major sources of yellowfin tuna imported into the U.S. east coast in 1986 were Japan, Taiwan, and the Latin American and Caribbean region (Table 12). The Latin American and Caribbean (LAC) region increased its share of the east coast import market from 5 percent in 1983 to 19 percent in 1986, becoming second only to Japan. Panama, Venezuela, Mexico, Ecuador, Trinidad and Tobago are leading producer countries in the region (NMFS,c). Taiwan, though a source of growing importance on the west coast, has fallen considerably in its share of the east coast import market.

Existing data do not allow for the accurate tracking of yellowfin imports destined specifically for the fresh market. However, the yellowfin that is imported into east coast ports, such as Miami and New York, is assumed to be destined for the fresh market. No tuna canning facilities exist on the east coast and estimations are that little of this product is being transshipped to canning facilities elsewhere. The picture is less clear for the west coast, since some canning operations still exist in California.

The importance of the LAC region as a source of yellowfin is growing. However, this situation may be a double-edged sword for the Gulf of Mexico and South Atlantic region of the U.S. industry. The LAC region may serve as a future source of product for processors and wholesalers wishing to keep plant capacity stable when production in the Gulf region is low. However, the LAC region also exported 88.2 million pounds of yellowfin into Puerto Rico in 1986, primarily for canning (NMFS,c). Depending on the versatility of the region's production methods and market channels, if only 10 percent of this total were redirected into the lucrative U.S. fresh market, significant downward pressure on prices at the domestic dock might be felt. This, of course, would depend on the strength of the domestic demand for fresh yellowfin tuna. Currently, no research has been initiated to assess these demand and supply relationships.

Summary

The fresh tuna industry in the Gulf of Mexico and South Atlantic region of the U.S. is still developing. Though considerable growth has been witnessed since 1984, uncertainty exists regarding the stability of current production levels, demand, issues regarding quality, and foreign sources. Yellowfin tuna has been established as the most important species in the region, yet potential may still exist for other species. Many questions arise for the producer, processor, or wholesaler considering becoming involved or expanding operations in the fresh tuna industry. Given the recent trends in production and prices, the market for fresh yellowfin tuna appears to be stabilizing.

TABLE 11

U.S. IMPORTS[1] OF FRESH AND FROZEN YELLOWFIN TUNA BY PORT OF ENTRY REGION,[2] 1983-86

Year	East Coast	West Coast	Puerto Rico
1983	345	10,299	45,181
1984	301	4,486	39,757
1985	429	2,234	84,202
1986	868	3,381	104,041

[1]Thousand pound units

[2]Includes air freight, ship borne, trucked and transshipment cargo

SOURCE: NMFS,c

TABLE 12

PERCENT U.S. IMPORTS OF FRESH AND FROZEN YELLOWFIN TUNA BY PORT OF ENTRY REGION,* 1983-1986

Year	East Coast	West Coast	Puerto Rico
1983	.6%	18.4	81.0%
1984	.7	10.1	89.3
1985	.5	2.7	96.8
1986	.8	3.1	96.1

*Includes airfreight, shipborne, trucked, and transshipment cargo

SOURCE: NMFS,c

However, the yellowfin fishery in the Gulf of Mexico and South Atlantic region of the U.S. has been recognized separately from the swordfish fishery for only about four years. Truly representative trends and variability in the production and marketing sectors of the industry may have yet to reveal themselves. Careful consideration by producers, processors, and wholesalers of the many elements of the industry, from the dockside market and beyond, may be necessary to avoid an unwise investment.

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TUNA FISHING METHODS AND GEAR IN THE GULF OF MEXICO AND SOUTH ATLANTIC

Frank Lawlor and Chuck Adams

U.S. tuna fishermen are involved in the most primitive type of production, yet use the most modern technologies, including satellite data and information systems. As new areas of tuna abundance or availability are discovered or new migratory passages are identified, tuna fleets shift fishing effort from one area of the globe to another. Some tuna fishermen travel all over the world on fishing trips that last up to three months aboard vessels that represent a multimillion dollar investment. Tuna fishermen also have historically competed on the high seas with tuna fleets from many nations and target on a natural resource that migrates through great expanses of ocean, passing across national boundaries and between oceans. Recently, however, increased effort has been directed toward tuna stocks found within the U.S. Exclusive Economic Zone (EEZ), particularly in the Gulf and South Atlantic region of the U.S. (South Atlantic refers to the fishing areas from North Carolina to the Florida east coast).

Harvest Methods

Tunas are taken with a variety of different gear types. The most common type of gear utilized are purse seines, pole and line, and long-lines, although some are also harvested by trollers and handliners. The optimal gear varies with the species sought, local ocean currents, weather conditions, and the economic capabilities of the fishery participants.

Purse-seining produces 30 percent of the global tuna harvest, but accounts for over 90 percent of U.S. tuna landings (National Marine Fisheries Service). Purse-seining involves encircling tuna with a net and relies on the tendency of most tuna species to periodically form schools near the surface. In recent years this method has been used successfully in conjunction with fish aggregation devices (FADs), which enhance the surface schooling behavior of tuna. Large "superseiners" which can freeze and store up to 1,500 tons of fish and travel up to 10,000 miles during a single fishing trip are the most common type of vessel in the U.S. tuna purse-seine fleet. Skipjack and yellowfin are the targeted species.

Pole and line fishing from baitboats produces 40 percent of the global tuna harvest, but accounts for only 4 percent of U.S. tuna landings. With this method, fish are attracted to the vessel with bait and taken by fishermen using poles and lines. To a large extent, this method has been replaced by purse-seining in the U.S. fleet. Again, primarily skipjack and yellowfin are targeted.

Trolling accounts for less than 1 percent of the global tuna harvest and only 5 percent of U.S. tuna landings. U.S. trollers, however, produce virtually all of the U.S. take of albacore tuna which is the preferred species among U.S. consumers and is the only tuna that can be labelled "whitemeat" in U.S. canning markets. With this method, lines are towed through presumed areas of tuna abundance by relatively small vessels that venture as far as 3,000 miles from port on trips that last as long as 45 days. Albacore is the primary species sought by U.S. trollers.

Longlining accounts for most of the commercial catch of tuna taken in the Gulf and South Atlantic region of the U.S. The number of vessels actively involved in longlining for tuna in the region varies with the time of year, catch rates for other species (especially swordfish), local abundance, catch rates for tunas, and general market conditions. Basically, longlines consist of a mainline that is 20 to 50 miles long, which is supported in the water column by floats and from which baited hooks are suspended. Yellowfin and bigeye are the preferred target species.

Longline Gear Currently Employed

Longline gear used in the Gulf and South Atlantic region of the U.S. swordfish and yellowfin tuna fishery has undergone an evolutionary process during the past few years. Materials used for mainlines, hook and buoy drops, and hook styles and sizes have undergone the most change.

The type of mainline used can affect the performance of the gear and will to a large degree determine the depth that the line will fish. Currently, small diameter monofilament line of 700 to 900 pounds breaking strength seems to be the most preferred. The small diameter of the line and its ability to stretch when under stress are the reasons for its preference. Most vessels fish between 20 and 50 miles of monofilament mainline. However, tarred and braided nylon is still used for mainlines on some vessels.

Deck machinery and longline components consist of a hydraulically operated mainline spool (or reel) capable of holding 20 to 50 miles of mainline and backing and equipped with a level wind. Proper backing material is particularly important when using monofilament line because monofilament has a tendency to stretch when hauled, which can cause strain on the drum. Without proper backing the drum can be crushed by this strain. The spool is positioned on the vessel to allow the mainline to be fair-led off the stern during the setting operation and fair-led to the spool while being retrieved.

Buoys are a combination of single, double, or triple high density foam bullet buoys and inflatable polyethylene balls. Buoy lines usually consist of 300- to 500-pound strength monofilament. The length of the line attaching the buoys to the mainline, called the float or buoy line, determines the depth of the mainline. The length of buoy lines varies with certain environmental conditions (e.g., the phase of the moon), current conditions, and the preference of the captain. The length can range from 10 to 20 fathoms. They are attached to the mainline with snap-on connectors. Inflated polyballs (60 inch) and high flyers are periodically placed on the mainline to assist in locating the gear and providing additional support. High flyers are composed of 15 to 20 foot aluminum pipe placed through a spar buoy. Radar reflectors are attached to the top of the pole and the bottom is weighted to provide stability while in the water. High intensity battery operated strobe lights are attached as an aid to visually locating the line. Radio beacons are used as an additional aid in locating the line. These beacons consist of radio transmitters mounted on a specially configured buoy with an antenna.

Hooks are suspended from the mainline with hook lines called "gangions", which usually consist of 400- to 500-pound test monofilament. The hook lines often are made of two sections connected with a weighted swivel to help sink the hook and avoid tangles. The first section is 20 to 30 fathoms in length and is attached to the mainline by snap-on connectors. The second section is usually 1 to 10 fathoms in length and is attached to the hook and swivel. When hook lines are made of a single section they vary in length from 20 to 40 fathoms. All monofilament connections are made with crimps and a specifically designed crimping tool. Fishermen commonly use 8/0 to 12/0 extra strong or hollow point ringed tuna hooks in 8/0 to 10/0 sizes.

Length of the buoy line, plus the length of the gangions, the distance between gangions, and the speed at which the mainline is set will all determine the depth that the baits will fish. Length of the buoy line must allow safe passage for ships. All other dimensions may vary.

Longlining Methods

Many longline vessels in the Gulf and South Atlantic region of the U.S. target for swordfish and consider tunas a by-catch. However, an increasing number of vessels are concentrating effort on yellowfin tuna. The gear used for both species is very similar. However, fishing operations, bait, the use of chemical light sticks, hooks and hook drops often are different. The description of fishing methods that follows is based on techniques reportedly used by vessels that are targeting yellowfin tuna in the Gulf and South Atlantic region of the U.S.

The most important aspect of the fishing operation for yellowfin is the decision on where to set the gear. Experienced captains use a number of techniques to determine areas that may be productive fishing grounds. Many times these decisions are made intuitively and involve past experiences or subtle weather conditions that are not obvious to the casual observer. However, there are several factors which can influence the probability of a successful trip.

Tunas often congregate along ocean fronts. These fronts occur along current boundaries in the Gulf of Mexico and South Atlantic regions of the U.S. The loop current in the Gulf and the Gulf Stream in the Atlantic change positions constantly and also develop eddy systems that change on a daily basis. Fishermen who know the location of these currents and associated eddies can better decide on where to fish.

Fishermen are also able to access periodically available satellite generated water surface temperature data produced by the National Oceanic and Atmospheric Administration's Earth Satellite Service in Miami. Anyone with a telecopier machine can obtain timely information in printed form by calling the local Miami office. Two charts on the Gulf Stream can be received:

(1) chart of Florida and the Atlantic side of the Gulf Stream and
(2) chart of Florida and the Gulf of Mexico side extending from New Orleans to Palm Beach depicting the path of the loop current.

Additionally, reports on the loop current are available by using a radio facsimile receiver on board the vessel.

Tunas are also associated with certain temperatures. Tables 1 and 2 give the temperatures that are most commonly associated with different species of tunas. It is important to note that one set of these temperatures are subsurface temperatures. These subsurface temperatures can be determined in several ways. First, thermometers can be towed at depth by the fishing vessel. Care must be taken to know the depth of the thermometer and not just the amount of line deployed. Current, vessel speed, and drag caused by the thermometer will determine this depth. Second and more reliable and expensive, is the use of expendable bathythermograph probes (XBT's). These probes can cost $10-$50 each. In addition, the on-deck recording equipment can cost up to several thousand dollars. However, these probes will give the fisherman a recording of the temperature vs depth that can be very useful in making decisions on where to set the gear.

The configuration of the gear, depth of the mainline, and depth of the hooks depends on many factors. For example, the distance between buoys, spacing of hooks, the diameter of the mainline, and the sinking time for the line will determine the arc that develops in the mainline. The configuration of this arc, or catenary, in the line and the relationship of the prevailing current and waves will determine the effectiveness of the baited hooks. Hooks drifting near the mainline are usually less effective than when fished farther away. These difference can be very subtle, but the success or failure of the fishing trip can depend on them.

The setting operation for yellowfin can begin at any time. However, most vessels begin setting the longline in early morning (around 4:00 AM). The mainline is fair-led off the spool and a high flyer is clipped to the end and cast overboard. As the vessel moves forward, the mainline is fed off the spool with the brake partially engaged. This provides some tension on the line. The amount of tension on the line is important. Too much or too little tension will cause gangions to tangle on the mainline. Hooks are baited and gangions are clipped to the mainline as the mainline passes astern. The type of bait can vary. However, small squid, alewives, sardines, and other types of fish are commonly used. Hook spacing is variable and depends on several factors including captain's preference, success of previous sets, and the number of hooks between buoys. Hook spacing ranges from 250 to 500 feet and the number of hooks between buoys varies from 2 to 15. Buoy lines

TABLE 1

NORTHWEST ATLANTIC OCEAN SURFACE AND DEEP[a] TEMPERATURE (°C) MEANS AND RANGES FOR TUNAS

Species	Temperature °C Means Surface	Depth[a]	Ranges Surface	Depth[a]
Yellowfin Tuna	25.2	22.2	18.4-28.8	10.0-26.9
Skipjack Tuna	25.3	23.6	21.5-26.7	19.4-26.4
Bigeye Tuna	18.7	13.3	13.5-27.3	8.7-26.9
Bluefin Tuna	16.2	15.5	6.4-28.8	6.5-26.9
Albacore	20.8	17.5	11.5-28.3	8.7-26.7

[a]Estimated depth of fishing is 52.7 m.

Source: Squire (1963)

TABLE 2

WORLD SEA SURFACE TEMPERATURE (°C) MEANS AND RANGES FOR TUNAS

Species	Temperature °C Mean	Range
Yellowfin Tuna	23	18-31
Skipjack Tuna	21	17-28
Bigeye Tuna	20	11-28
Bluefin Tuna	19	14-21
Albacore	18	14-23

Source: Squire (1963)

are attached to buoys and clipped on the mainline at the proper intervals as the line passes astern.

High flyers are usually placed 3 to 4 miles apart and radio buoys are usually attached at 5 to 10 mile intervals. The setting operation may take from 2 to 5 hours depending on the amount of gear being set. The haul back begins around midafternoon. The high flyer is picked up and the mainline is fair-led to the spool. As the boat moves along the line, hook lines and buoy lines are removed as they come aboard. Buoys are unsnapped and the buoy lines are stored on the leader cart by clipping the snaps to one another. At least two leader carts are used to store, deploy, and retrieve leaders used for buoy lines and hook gangions. Leader carts may be mechanically, electrically, or hydraulically operated. Hook lines are also stored on a leader cart by attaching the snap on the line to the hook of the previous line. When the hook is reached, the bait is removed and the hook is then ready to be fastened to the next snap.

When hooked tunas are brought along side, the vessel is stopped until the fish is gaffed and brought aboard. The haul back operation can take as long as 12 hours depending on the amount of gear set and the number of fish caught. After hauling is completed gear repairs are made onboard and the captain positions the vessel to make the next set. If catches are small, the vessel will move to a different area for the next set. This routine is repeated for 5 to 10 days depending on fishing success, weather, fuel use, equipment needs, size of the vessel, and maintenance requirements.

Operational Costs

The actual cost of outfitting and operating a yellowfin tuna longline vessel will depend on a number of factors. These include size of vessel, length of longline, duration of trips, captain experience, and others. The "typical" operation currently employed in the Gulf and South Atlantic region of the U.S. includes a 60- to 80-foot Fiberglas-hull vessel outfitted for a 30-mile longline. Trips may be 7 to 10 days in length depending on season of the year, market conditions, and others. Average crew size is 5 people, including the captain.

Longline Expenses

The costs for a vessel being rigged for yellowfin longlining include expenses for deck gear, longline (wet gear), terminal tackle, and other miscellaneous supplies required for setting and retrieving the longline and initially processing the landed fish. The total cost of rigging a vessel for fishing a 30-mile longline may exceed $30,000 (Table 3). Note that this includes only those items specifically associated with longlining activities. Electronics, for example, are not included. The actual cost may also depend on the previous operational configuration of the vessel. If deck redesign and hydraulic/electric retrofitting are needed, the initial cost may be substantially greater. Individuals considering entry into the longline fishery should consider these costs carefully.

TABLE 3

ESTIMATED COST OF RIGGING-OUT* A 30-MILE YELLOWFIN TUNA LONGLINE

Category	Quantity	Price	Cost
- Deck Gear			
Spool, Standard Duty 36X60	1	8,875.00	8,875.00
Anti-Cavitation Valve	1	320.00	320.00
Leader Cart Spool, Aluminum	4	265.00	1,060.00
Hydraulic Pumps, Hoses, Fittings, Electric Clutches (approx.)			975.00
Hauling Block	1	165.00	165.00
Subtotal			11,395.00
- Longline Gear			
Main Line 730#	1170 lbs	6.50	7,605.00
Leader Mono 400#	300 lbs	7.50	2,250.00
Radio Beacon Buoy	3	995.00	2,985.00
50" Bar Buoy	8	28.50	228.00
Alum. Pipe, Sched. 40, 20'	8	32.00	256.00
Radar Reflector w/insert	8	32.00	256.00
Net Buoy, 60"	10	22.50	225.00
Bullet Buoy, 8"	350	4.95	1,732.00
Orange Strobe	8	14.95	119.00
Batteries (D-Cell)	16	1.00	16.00
Single Alum-Alloy D Sleeve	10	6.00	60.00
Double Alum-Alloy 2 Sleeve	500	.10	50.00
12/0 O'Shaughnessy Buoy Prop	3 boxes	21.95	65.85
20 lb. High Flier Anchor	8	21.00	168.00
Tape	5 rolls	62.50	312.50
Subtotal			16,328.95

continued

TABLE 3 (continued)

Category	Quantity	Price	Cost
- Terminal Tackle			
4/0 Medium Snaps	300	.55	165.00
8/0 Heavy Snaps	600	.82	492.00
D Sleeves	3,000		180.00
7698 B 9/0 Hooks	10 bags	44.25	442.50
80 gm. Leaded Swivel	500	.69	345.00
Lobster Bands	1 lb.	5.95	5.95
Clear Tubing Chaf	100 ft.	.10	10.00
Dk. Red Sparkle Octopus	10	4.95	49.50
Silver Octopus	20	4.95	99.00
Fluorescent Squid	20	4.95	99.00
Cyalume Sticks, Green	2 pails	280.00	560.00
Subtotal			2,447.95
- Other Gear			
Meat Saw	1	39.95	39.95
Meat Saw Blade	4	3.95	15.80
Bench Crimper w/o Dies	1	105.00	105.00
Bench Crimper Dies 2	1	7.95	7.95
Crimper	1	69.00	69.00
Gloves			120.00
Sheep Skinner	4	10.25	41.00
Sliming Knife	4	8.95	35.80
Gaff	2	20.95	41.90
Box Hook	2	22.95	45.90
Subtotal			522.30
Grand Total			30,694.20

*Does not include major retrofitting for hydraulic systems or deck redesign from a non-longlining configuration. Information obtained from four major longlining supply firms.

TABLE 4

ESTIMATED MAJOR PER TRIP[1] EXPENSE ITEMS FOR YELLOWFIN TUNA LONGLINING VESSELS[2] IN THE GULF AND SOUTH ATLANTIC REGION[3]

Expense Item	Quantity	Unit Price	Cost
Fuel (Diesel) and Lubricants	852 gal.	$ .60	$511.00
Groceries			515.00
Ice	80 Blocks	6.50	520.00
Bait	Squid and baitfish		730.00
Mono, Longline Gear and Misc. Supplies			684.00
Total			$2,960.00

[1]Represents a seven day trip.

[2]Data from seven full-time vessels in the 60-70 foot size class fishing an approximate 30-mile longline.

[3]Does not include crew shares, hull and engine repairs, and any pro-rated overhead (i.e., insurance, interest, depreciation, etc.).

Trip Expenses

The magnitude of per trip expenses are determined by a number of factors, such as trip length, captain's experience, size of vessel, and others. Major categories of per trip expenses are fuel, bait, groceries, ice, longline supplies, crew shares, and miscellaneous supplies. The expenses can approach $3,000 in total for a given trip (Table 4), excluding crew shares and other pro-rated overhead costs. Some reports place these expenses as high as $4,000 to $5,000 (Pollack, 1987). Experience and efficiency in fish location, gear setting/retrieval, and on-board product handling can serve to minimize these costs.

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National Marine Fisheries Service, U.S. Department of Commerce. Unpublished tuna landing data.

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Squire, J.L. 1963 "Thermal Relationships of Tuna in the Oceanic Northwest Atlantic." Proceedings of the World Society Meeting on the Biology of Tuna and Related Species. FAO Fisheries Report No. 6, Vol.3.

*This article is complemented by a 15 minute video tape (VHS ½ inch) available through the Florida Sea Grant College Program, University of Florida, Gainesville, FL 32611.

POST-HARVEST HANDLING CONSIDERATIONS FOR FRESH YELLOWFIN TUNA

W. Steven Otwell

Tunas are unique amongst the vast variety of food fishes. Differences in their physical structure and metabolism, obvious in the live state, also influence methods for handling and preparing tuna as a food item. Thus, a better understanding of these differences is essential to assuring product quality and safety for fresh tuna.

Quality Considerations

Tunas are rapid swimming, long-distance migratory fish requiring a constant and large supply of energy to sustain their activity. Basic muscle metabolism provides the essential energy, and numerous studies have demonstrated that tunas exhibit one of the highest metabolic rates amongst all fishes. This metabolism generates body heat which for most fish is lost to the surrounding water. Thus, most fish are cold-blooded (poikilothermic) lacking the ability to maintain their body temperature above ambient. In contrast, the veins and arteries of tuna are structured such that a portion of the body heat is retained. A counter-current blood vessel arrangement gives tunas the ability to maintain body temperatures above that of the surrounding water. The advantage is more heat for more efficient (powerful) muscle metabolism. In terms of harvest and handling, elevated body temperatures can enhance the onset and progression of spoilage.

Elevated body temperature is detrimental to quality of fresh tuna in that it can accelerate bacterial growth and chemical degradation. Adverse consequences are initially noted by changes in the muscle color and clarity, and a softened, watery texture. These gradual changes are the basis for subjective judgments used to grade the quality of tuna meat destined for the raw fish market (see Tuna Product Quality Code). The expression of these changes is further enhanced by increasing acid in the muscle. In the struggling and eventually dead fish, metabolic by-products such as lactic acid accumulate to decrease the muscle pH. A lower pH is a measure for increased acidity. This acid condition will influence the structure of the muscle proteins and pigments such that the meat becomes less rigid, more watery, pale and soft. Advanced stages are known as 'burnt' tuna, which can be unacceptable for marketing (or consumption). Elevated body temperatures accentuate the adverse effects of increased acidity. Thus, the lack of adequate chilling for a large, vigorously struggling tuna can present the most adverse conditions for tuna quality.

Tuna will not chill in the same manner as similar sized fish. In addition to the circulatory system which retains body heat, the tuna size and shape provide additional insulation. The robust, streamlined shape has a low surface area to body mass ratio. Covered with a thick skin, a tuna carcass is difficult to chill thoroughly or rapidly. Additional ice and/or circulating chilled water (slush) are helpful, yet the internal body temperature can require 12 to 48 hours to chill below temperatures that provide effective preservation for fresh fish. Attempts to butcher the carcass so as to chill portions are possible, but the resulting product form may not suit existing markets and on-board butchering methods introduce additional quality concerns.

Cutting and/or puncturing the tuna carcass to remove blood is a necessary and accepted form of initial butchering. As for most fish, 'free' blood contributes to spoilage and later development of off-flavors and off-colors in the meat. Fish blood and muscle contain precursors and by-products of metabolism that, unlike red meats and poultry, have a higher proportion of nonprotein nitrogen constituents that contribute toward rapid bacterial growth. Thus, fish are more prone to rapid spoilage than other domestic meats. Bleeding helps to reduce these adverse constituents. Likewise, bleeding decreases the concentration of blood and muscle pigments which influence the color of the meat. In time, the red pigments will be reduced to a darker brownish form. Thus, bleeding can also help to decrease the development of off-colors.

Most tuna muscle constituents are good. The basic composition of tuna is uniquely ranked as a source of very high protein with moderate to low fat. In contrast to most raw seafoods which have 15 to 18 percent protein by weight, tuna protein content can range from 20 to 28 percent. Tuna are recognized as a protein rich food. The fat content will vary per species, season, location of harvest, body section, etc. The composition of the fat provides the typical complement of omega-3 fatty acids. In general, the yellowfin tunas from the Gulf of Mexico and South Atlantic region have a fat content of 1.5 to 3 percent by weight of meat. These yellowfin tuna are surprisingly lean despite local market declarations and purchasing grades which claim decisions based on high fat content. When overcooked the dry taste and texture for these yellowfin tuna attest to the lower fat content. Although still suitable for the popular sashimi (raw fish) trade, the leaner yellowfin tuna is not as highly valued as bluefin tunas from the same region with larger fat content (4 to 8 percent). In terms of the fresh and frozen domestic markets, the tunas with higher fat content could be more vulnerable to development of rancidity as a consequence of oxidation of the larger portion of polyunsaturated fatty acids.

Continuing discussion could specify the actual elements and additional sequences of spoilage, but the solutions would be the same and are obvious from this condensed outline: reduce struggle, bleed, rapidly and thoroughly decrease body temperature, and minimize meat exposure to air or water.

Product Safety Considerations

Tunas belong to the large family of fishes known as Scombridae which includes the mackerels. These fish and some non-related species (e.g., dolphins or mahi-mahi) all contain a large amount of free histidine. The occurrence of this compound is natural and functions in basic muscle metabolism. Unfortunately, free histidine can be chemically converted to free histamine. The primary conversion is a consequence of a specific type of bacterial growth which provides the particular enzymes necessary for the chemical reaction. This unique production of histamines in tuna results from the natural spoilage phenomena (bacterial growth) common for all fish.

Histamines have been associated with allergic reactions. Consumption of foods containing elevated amounts has resulted in toxic responses such as nausea, vomiting, facial flushing, headaches, burning sensations in the throat, etc. These symptoms usually occur within hours after consumption and rarely persist beyond one day. Although non-severe, these irritable results warrant careful consideration when handling tuna destined for fresh, frozen or canned use. To assure safe products, the U.S. Food and Drug Administration limits histamine levels to 50 mg histamine per 100 g edible fish.

Lower temperature is the most effective control of bacterial growth. Freezing will stop the growth of the particular bacterial culprits and refrigeration below 40°F, preferably below 35°F, is sufficient. If thermal controls are not immediate and consistent, bacterial growth could produce histamines which will remain in the meat regardless of subsequent thermal treatment (hot or cold). Thus, proper icing/refrigeration at the dock will not prevent potential poisonings caused by histamine production due to prior mishandling on the vessel. Toxic histamine levels have been produced in scombroid-type fish within 8 to 12 hours of thermal abuse on fishing vessels. The control of histamine production is simple, low temperature, but the practice demands commitment.

Likewise, a commitment for proper refrigeration and handling should continue through processing and distribution. The tunas are potentially vulnerable to this bacterial problem through all market channels. Vacuum packaging as an emerging method of processing deserves special mention. Vacuum packaging is attractive, offers odor control and can extend shelflife under specific conditions, but scombroid-type fish in vacuum packs could still be vulnerable to histamine production if not kept cold. Although the vacuum atmosphere retards most bacterial growth, certain anaerobic bacteria can still grow even at near refrigeration temperatures. Research to address this issue is not complete, and detection of histamine production prior or during vacuum packaging would be difficult. Thus, processors are cautioned on the use of modified atmospheric packaging for fresh or frozen tuna.

On-Board Handling and Grading

This section concerns handling and grading for yellowfin tuna as they are produced in the Gulf of Mexico and South Atlantic waters. Longlining is the primary method of harvest, each fish receiving individual attention from the moment of catch. This individual attention is a unique feature necessary to preserving quality.

Quality begins with preparation of the workspace on deck. The deck should be wet and padded to prevent skin damage or bruising of the fish. Foam floor mats (1/2 to 3/4 inch) have been used and are easy to clean between sets. This will allow easier and careful handling of each fish. Also, the deck should be arranged for a convenient one-way flow of fish from catch to butchering to icing.

A large supply of clean ice should be available for maintaining chill tanks and for icing the individual butchered carcasses. A good rule of thumb is to carry at least 3 pounds of ice for every expected pound of fish. This rule sounds somewhat unrealistic for many large catches. Fishermen must rely on experience to dictate initial ice purchases. Remember, fish without ice invite spoilage and potential problems.

The longlining gear is typically retrieved within 24 hours after the initial set. The total soaktime and amount of line and hooks deployed are critical factors which influence retrieval time and the initial quality of the landed fish. The best situation is to harvest the tuna alive and minimize their struggle on the hook. In some instances tending the line is recommended to remove obvious early catches. Average meat quality is usually higher for tuna landed alive with minimal struggle.

Lively tunas may require some stern persuasion to slow their activity on deck so that they are not bruised or damaged. A firm blow with a bat or blunt instrument should be aimed at the soft spot located atop the head slightly behind the eyes. After stunning, the fish should be cut to remove blood which would otherwise discolor the meat, impart strong flavors, and contribute to further spoilage. A lateral puncture directly behind the pectoral fin is often used, but this cut alone is not enough. Additional cuts into the tail or caudal peduncle (not through the vertebra) and through the gills are necessary to thoroughly remove more blood.

A recommended method to kill the fish is "reaming" to destroy the nerve tissues along the spinal column. This task is simple and should be done before the fish is butchered. A plastic or metal rod (1/8 inch diameter) is inserted into the cranial cavity, then easily pushed the length of the spinal nerve channel, destroying all nerve tissue and completely relaxing the fish. The opening to this channel is located with a 90 degree notch cut (1 to 1 1/2 inches deep) behind and into the soft spot above the eyes. A padded cradle is very useful in positioning the fish, and quick-release straps can hold the fish in place for killing and butchering.

Butchering begins with a head cut just behind the eyes to remove the 'face' or the front portion of the head. A large hacksaw or meat saw is the preferred tool. One pectoral fin is removed to mark the best or favored side of the fish. The fish will henceforth be stored, handled and shipped with the favored side up. The down side may slightly deform and contain more blood (discoloration), but still represents a highly acceptable portion.

The gill plates and gills are carefully removed, leaving the 'collar' bones intact. This collar of bones forms a rigid support to maintain the shape and condition of the tuna meat. If these bones were broken or cut the elongated tuna muscle could deform and separate during the onset and resolution of rigor.

Next, the intestine is cut from the anus with a small belly cut. Then the viscera can be withdrawn through the opening at the head. Avoid spilling any contents from the stomach or intestines on the fish. This lengthwise belly cut (tail to head) need only be wide enough to insert one hand for cutting the intestine attachment at the anus.

All the remaining connective tissues and the blood line (kidney) at the top of the belly cavity should be scraped free. A firm nylon brush is good for this job. After scraping and washing the body cavity, the tuna should be carefully placed in a cold ice slurry. An ice slurry in an insulated tank should be maintained to contain a generous portion of ice for rapid chilling of the tuna carcasses.

Studies of storage time in chill tanks indicate the ice slurry only initiates the cooling process. The initial internal temperature near the center of the tuna carcass can range from 90 to 60°F. After 2.5 to 3.0 hours of submerged storage in the chill tank, the internal temperature only drops to 75 to 55°F. The preferred internal temperature is below 35°F. Naturally, the initial temperature of the tuna and length of storage in the chill tank influences the cooling rate, but prolonged storage in ice water is not recommended. Submerged storage only initiates the chilling process and eliminates abuse conditions if fish were allowed to accumulate and remain on deck.

Direct icing below deck will complete the cooling process. When removed from the chill tank each fish should be immediately iced in the hold of the vessel. Ice is packed in the belly cavity, then each carcass is carefully stacked and surrounded with ice. Do not stack more than two layers of fish before providing some bridge of support for additional layers. The stack of ice will eventually melt about each fish leaving air space. This ice should be tamped down in direct contact with the fish and more ice added to cover the fish. Initial cooling in a chill tank, followed by proper storage in ice should produce an internal temperature near or below 35°F within 24 hours after the time of catch.

Between sets and especially between trips, the deck, chill tank and all surfaces in contact with tuna should be thoroughly washed to remove blood, debris, and used chill water. Continued use of the same chill bath will introduce bacteria and defeat the benefits from special care in handling and butchering.

On return to the dock, prior planning should continue to emphasize quality considerations. Pre-chilling and icing of trucks is essential before off-loading the fish. All the fisherman's efforts can be compromised by a warm truck, delays in icing, or thoughtless handling. Again the fish should be handled with care to prevent bruising and separation of the meat. Stacking should not exceed 2 layers of fish without additional support. Duration of the transport will dictate the necessary amount of clean, crusted ice. Never depend on cold air alone to chill tuna.

Grading for quality and price can occur at the dock and again at the wholesale/processing house. Grading involves coring to remove samples of muscle tissue from the lateral side (the favored side) of the tuna. The coring tool is pushed perpendicularly to a depth just above the vertebra. The core of meat is examined in sunlight for clarity, color, and other subjective measures of quality.

The practice of coring to grade tuna is a carry-over from oriental methods used to judge tuna sashimi destined for the raw fish market. The most common scale has three grades, numbers 1, 2 and 3 (see Tuna Product Quality Code for more details). Grading is real and is based on obvious differences in appearance of the cores, but these differences depend on an experienced subjective evaluation. The no. 1 grade has pink, ruby translucent coloring and a noticeable sheen or iridescences. The core is firm and the muscle tissue may separate into distinct sections. Odor and taste are clean. In contrast, the no. 3 grade is less translucent with darkening or pale (washed out) coloring. The core is softer, mushy and wet. Odor and taste are more obvious.

Grading can also include cores taken from the belly, and half moon slices taken from the tail. These grades still reference the 3 point system. After grading, each fish is tagged and stored for later distribution or further butchering to loins or steaks.

Thus each tuna is individually handled from the moment of catch, through butchering, to grading for sale. Careful individual handling is the most important quality attribute for yellowfin tuna.

TUNA PRODUCT QUALITY CODE

Southeastern Fisheries Association

This code is provided courtesy of the Southeastern Fisheries Association (SFA) based in Tallahassee, Florida. The SFA Seafood Product Quality Code (SPQ) is a new educational and promotional concept intending to catalog the industry's recommended measure for product quality which can be used to better inform buyers thus building confidence in domestic production. Likewise, the Code can encourage more industry quality compliance through facilitating communications between buyer and seller.

Every pertinent State and Federal seafood program and complementary trade association has had an opportunity to participate in some phase of developing the SPQ Code. Participation has come through preliminary group meetings, as invited testimony during formal SFA Product Quality Committee meetings, by surveys and unsolicited letters of opinion, and during regional workshops. The proposed Code is not intended to replace, compete with or duplicate any existing or proposed effort of similar structure.

The existing SFA Product Quality Committee develops the Code in accordance with the voting regime and guidelines in their by-laws. Prior group meetings are organized by the Committee Coordinator to gather input for species and/or product(s) forms. Group participation includes SFA members, invited industry members from other trade associations or regions, and any invited government support group, both academic and regulatory. Their cumulative input is condensed into one Code entry per species, and then presented to the standing product Quality Committee for final action. The Committee actions can be approved, redrafted, or not approved. All approved entries are compiled in the SPQ Code.

Quality, by Code definition, includes any product attribute (sensory, microbial, chemical, packaging, labeling, forms, size, etc.) which can influence the buyer's judgment for accepting or utilizing a southeastern seafood item. Such attributes must be based on actual experience and/or documented research and/or regulations. The Code is not intended to be more lenient or in conflict with any existing regulations. Use of this Code is entirely voluntary and is the sole discretion of individual buyers and sellers involved in particular transactions.

Copies of the complete SFA Code including crustaceans, mollusks and other fish can be obtained through SFA, 312 East Georgia St., Tallahassee, FL 32301.

TUNA

PRODUCT DESCRIPTION:

This code describes tunas harvested in the Gulf of Mexico and South Atlantic waters destined for the fresh and frozen market. This information will apply to tuna purchased for cooking, but inference can be applied to tuna used in raw or sashimi markets. The principal species of concern is yellowfin tuna with some comparisons to bluefin, bigeye, and albacore tuna.

PRODUCTION:

The most productive tuna fishery in the southeastern region is yellowfin tuna (Thunnus albacares), followed by bigeye (Thunnus obesus), northern bluefin (Thunnus thynnus), and albacore (Thunnus alalunga). Originally harvested for the raw market, yellowfin has increased in popularity as a broiled, baked or grilled entree. Bigeye and bluefin tunas are preferred for the raw market and are excellent when cooked. Currently bluefins are the only tuna under strict management guidelines to limit harvest. A modest albacore harvest in the southeast occurs along the Atlantic coast of Florida. Harvest for all species is annual with some noticeable decrease in production occurring in March-April and winter months depending on weather.

Live tuna are harvested with longline gear which deploys a line of baited hooks at variable depths. The lines are usually retrieved within one day of initial setting. Thus, each tuna receives immediate and individual attention. This practice continues as each fish is bled, butchered, and chilled immediately after landing on the deck. Individual attention from catch, through butchering and eventual delivery, is a necessary quality attribute for these large fish.

PRODUCT TYPES:

The tunas can be purchased fresh or frozen. Certain suppliers can provide smoked tuna which typically comes fresh. Unlike most fish, the raw meat of tuna has a more distinct ruby-pink to red and some dark red color, which turns white to ivory when cooked.

PRODUCT FORMS:

Whole (carcass): commonly purchased fresh with head, gills and viscera removed. A small belly cut at the anus assists removal of the viscera, yet assures a closed belly cavity to retain ice for internal chilling. One pectoral or lateral fin may be removed to identify one side used for positioning the carcass during storage. This practice is thought to improve meat quality and color due to drainage of blood from the elevated side and limits any slight body deformation to the down side. The skin and 'collar' bone should remain intact to protect the flesh, prevent gaping within the meat, and avoid textural problems caused by rigor or shrinkage of the muscle tissues.

Loins (quarters): a quarter portion of the whole tuna or half of one side portion. Loins can be provided as full loins, which run the full length of the carcass, or half loins, which are half of the full loin. All loins, fresh or frozen usually come with skin-on to protect the flesh and prevent gaping. The skin is easily removed with a knife.

Steaks (slabs): usually cut from loins. They are provided fresh or frozen, usually with skin removed and packaged for protection from air or water exposure and physical damage during handling. Steaks can be cut from the different loin forms or as cross-sections of the whole tail portion ('wheels').

SPECIES IDENTIFICATION:

The tunas are best identified from the whole or carcass form. These whole tunas have a dark blue back without any dorsal striped pattern and no black spots on the body. (Note, the pectoral fin is the fin on the lateral side of the fish.) The following descriptions accompany illustrations in Reference 2.

Yellowfin: moderate length pectoral fin extending to the front of the mid-carcass position of the second dorsal fin. Second dorsal fin elongated to equal nearly 1/3 to 1/2 the length of the carcass. Finlets yellow.

Bigeye: moderate length pectoral fin extending beyond the front of the mid-carcass position of the second dorsal fin. Comparatively,larger eye per fish size. Narrow white margin on posterior edge of tail.

Bluefin: shorter length pectoral fin does not reach mid-carcass position of the second dorsal.

Albacore: longer length pectoral fin extending beyond end of the mid-carcass position of the second dorsal fin. Narrow white margin on posterior edge of tail.

Identification from loins or steaks can be confusing and depends on color differences per species which is influenced by region, season of harvest, and fish age (chronological and post-harvest). In general the albacore has a pale or whiter color meat, the bigeye and bluefins have a richer or darker meat color, and yellowfin meat appears intermediate within this color range.

SIZE: Carcass Weight (Average observed)

Yellowfin Gulf of Mexico -- 50-100 lbs; there is no legal limit and catches have exceeded 100 lbs/fish
East Coast -- normally smaller - 20-50 lbs/fish

Bigeye	50-200 lbs; catches have exceeded 500 lbs/fish
Bluefin	300-600 lbs; catches have exceeded 1000 lbs/fish
Albacore	10-50 lbs; along Florida's southeast coast

YIELDS:

Based on the original whole, headless carcass weights, the total weight yield of loins (skin-on and no trimming) can range from 65-70%. The yield is less for smaller tuna and depends on careful cutting and trimming. Trimming may be requested to remove bones (primarily ribs from belly loins). Skin should remain on loins to protect the meat. Skinless steaks should be properly packaged for protection. Trimming and skinning require extra labor thus increasing wholesale costs.

GRADES:

Current grading of tuna is a consequence of the traditional judgments used for the purchasing of fresh tuna for sashimi (raw fish) markets. This form of subjective evaluation has been carried over to judgments for tuna destined for a 'to be cooked' market. Although the methods for judgement are the same, the implications for eventual use are substantially different.

The true number 1 tuna has the distinct clarity, color and texture expected by the raw fish connoisseur. Likewise, iridescences and fingered-feel suggest the preferred higher oil content which denotes flavor.

Table 1 Subjective evaluations used in reference to the grades for raw, fresh tuna meat.

	GRADES		
	No. 1	No. 2	No. 3
Color	pink ruby	darker shades	red and/or some noticeable initial beige
Clarity	more translucent	less translucent	more opaque
Sheen	iridescent	pale	paler
Moist	firm with sectioning	softer	softer moist
Odor and Taste	clean	obvious	more obvious

In general, the number 1 grade can be considered the 'sashimi grade', although number 2 grade is used for sashimi. All grades can be used for the so-called 'cooked grade'. A true number 3 cooked tuna can be difficult to distinguish from so-called number 1 grade tuna. IMPORTANT! A true number 3 grade can represent a good edible selection. Any inferior connotation is a consequence of the sashimi grading system or unacceptable fish being given a no. 3 grade.

Naturally, the chemical attributes responsible for the perceived grade differences will likewise yield a longer shelf life for the number 1 vs. number 3 grade tuna. For all seafoods, the method and length of time in storage will influence the duration of the grade. A shift downward in grades is more likely for a number 2 or 3 fish, especially if mishandled or stored at elevated temperatures.

Special Note! As long as a grading system is dependent on subjective evaluations, the grades are liable to human error, inexperience, and manipulation. Since there are no definitive guidelines by which to gauge these grades, buyers must learn from experience and the experienced, remembering a distinction between 'sashimi' and 'cooked' grades.

QUALITY ATTRIBUTES:

Color and Taste of the tuna meat depend on species and condition of the meat per species (see Identification). All tuna species have a darker lateral strip of muscle. This energy rich muscle used for sustained swimming power has a higher portion of minerals, fats (including omega-3 fatty acids), and blood pigments which impart the distinct color, stronger flavors, and a more rapid tendency to change color and flavor. This meat can be trimmed from the loins or steaks, but it does represent a nutritious portion.

The meat should be protected during fresh storage to minimize the progressive changes in color or development of off-flavors. The culprits are exposure to air (oxygen) and warm temperatures. Oxidation can darken blood pigments and alter flavor of the fats. Tuna should never be stored above 40°F and preferably below 35°F. Ice or water should not come in direct contact with the meat; otherwise, the water soluble blood pigments are leached from the meat resulting in a washed-out or watery bleached appearance.

In frozen storage the meat should be tightly packaged to prevent exposure and stored below -10°F and never above 0°F. A rapid freezing method will assure better quality and maintenance of grades.

Texture for raw tuna meat should be firm and there should be no gaping between the sections (myomeres) of muscle. When cooked these sections are called 'flakes'. Tuna looks and can feel very similar to beef steaks, but it will cook much faster than beef. Over-cooking is often the cause for complaints of 'dry texture'. Despite tuna's reputation for being high in oil or fat, the meat is relatively lean and will have a dry taste if overcooked. Properly cooked tuna meat has a firm, pork-chop consistency which is firmer than that of canned tuna. Leftovers are ideal for tuna salads, casseroles and sandwiches.

Odor from fresh or fresh-frozen tuna is not strong, fishy or oily. It does not emit the same odor associated with other high fat content fish, e.g, mackerels, etc.

Damage can occur if the fish is mishandled. Cuts and large punctures in the skin, and distinct areas of flesh discoloration and separation indicate poor handling and bruising of the whole fish. The skin, although easily removed, should be firmly attached to the carcass or loins.

PACKAGING:

Fresh tuna should be packaged to maintain temperatures below 40°F, preferably below 35°F. Plastic bags or linings should prevent direct meat contact with water or ice. Frozen tuna must be packaged to prevent exposure to air and to minimize partial thaw. A -10°F frozen storage is recommended when possible.

LABELING:

Tuna are packaged as individuals (whole, carcass), groups or portions depending on the order, packaging and destination. Labeling information on the package and/or accompanying invoice should include:

Product Name specifying tuna species, i.e., Bluefin, Yellowfin, Bigeye, etc.
Name and Address of the manufacturer, packer or distributor. The seller is advised to maintain records of source traceable to the vessel as an internal reference for variations in quality.
Net Weight as specified with reference to the original order.

REFERENCES:

1. Code of Federal Regulations, Title 50, Part 285 - Atlantic Tuna Fisheries.

2. National Marine Fisheries Service, Southeast Fisheries Center (Miami), ABT Tech Sheet 4.