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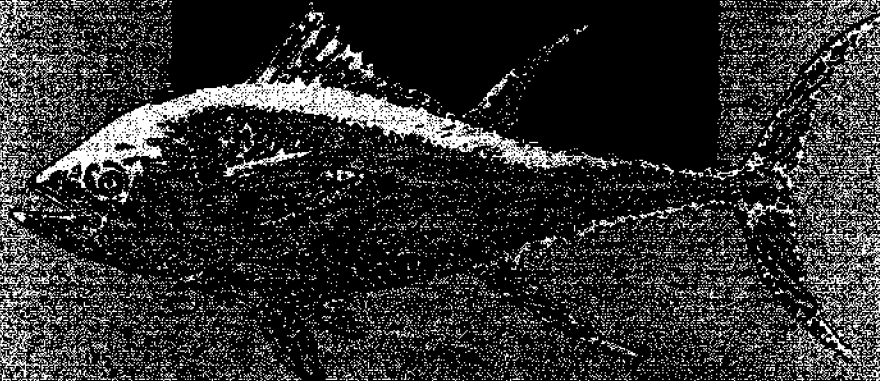
LONGLINING
for
YELLOWFIN

TUNA

in the
GULF of MEXICO

Charles A. Wilson

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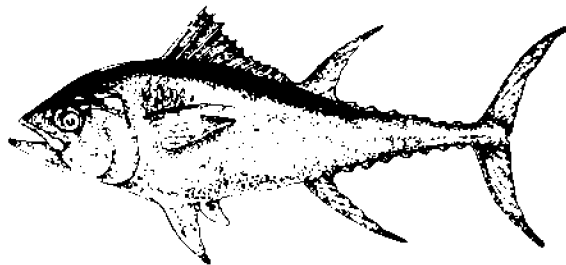
Louisiana Sea Grant College Program

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Longlining for Yellowfin Tuna in the Gulf of Mexico

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Louisiana Sea Grant College Program
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Introduction

The recent increases in Louisiana landings of yellowfin tuna by out-of-state fishing vessels and the rising dockside value of tuna have aroused the interest of the state's commercial fishing industry in the harvest of this fish. Although potentially profitable for Louisiana fishermen, yellowfin tuna longlining involves special fishing gear, fluctuating dockside prices, and user conflicts over by-catch.

This document provides a summary of historical data on yellowfin tuna landings from the Gulf of Mexico and a description of the gear and methods of longlining for yellowfin tuna.

History and Landings

Biological information about tunas in the Gulf of Mexico is scarce. Most of the general knowledge about the yellowfin tuna concerns Pacific stocks. Less is known about Atlantic yellowfin. The information available on yellowfin tuna in the Gulf is primarily the result of explorations by the U.S. Fish and Wildlife Service (FWS) between 1952 and 1963 (Iwamoto 1965).

Large numbers of yellowfin tuna were first reported in the Gulf of Mexico in 1950 by the U.S. Fish and Wildlife Service during exploratory fishing on the research vessel, Oregon I. In 1952 and 1953, the FWS tested purse-seining (Iwamoto 1965) and live-bait fishing; both methods were considered unproductive (Siebenaler 1953). A major problem then was that the fishery was too expensive to conduct profitably.

In 1954 the FWS tested Japanese-style longlining and reported it successful. Large concentrations of yellowfin were reported in the northern Gulf off the Mississippi River delta, between 500 and 1,000 fathoms deep. Tuna harvests were reported year-round, with highest concentrations occurring from July through December. Fishing trials in the Gulf of Campeche off Mexico demonstrated that commercial quantities of tuna were also available in this region year-round.

During three longline cruises in 1955 and 1956, Wathne (1959) and Bullis (1955) reported catches of up to 12.9 yellowfin per 100 hooks, with averages of 5.0, 4.4, and 4.5 fish per 100 hooks for the three cruises. Most of these fish ranged from 60 to 150 pounds each (Bullis 1955).

Following the efforts of the Oregon I, a few commercial operations began harvesting tuna with longlines. However, low longline catch rates (reported as number of fish per 100 hooks), lack of markets near landing areas, low volumes, and prevalent cannery prices made the ventures unprofitable (Iwamoto 1965).

Soon after the explorations of the Oregon I., several countries expressed interest in tuna longlining in the Gulf of Mexico. Improvements in vessel and gear technology made fishing these stocks possible for countries such as Japan and Taiwan.

Japanese longline efforts in the Gulf were first reported in 1957 and 1958 (Iwamoto 1965). By 1963, through quarterly reports required of the Japanese, the Bureau of Commercial Fisheries was collecting such information as area (5° x 5° blocks), number of fish (by species), and effort (number of hooks) by month.

The catches (number of fish) reported by the Japanese between 1963 and 1971 were highly variable, ranging from 73,429 fish in 1965 to 2,242 fish in 1967 (Table 1). The number of months during which fishing took place also varied from a total of eight in 1971 to two in 1963 and 1969. Fishing was most frequent during the period from April through July.

A plot of average fishing effort by month, reported as the number of hooks set by month for the years 1963-1973, indicated that the greatest fishing effort took place during March and April (Figure 1). October and November were the months with the least fishing activity during the reporting period.

Catch per unit of effort (CPUE) was also variable during the Japanese tenure in the Gulf. The number of fish caught per 100 hooks ranged from a high of 3.15 in 1971 to lows of 0.17 in 1979 and 0.22 in 1981, when the Japanese abandoned their fishing effort (Table 1). Although many unknown factors exist, the decline in CPUE between 1973 and 1979 may have been caused by a shift in the migratory path of the fish, over-fishing somewhere along the yellowfin tuna's migratory route, or poor year-class strength. There have been no reports of Japanese longline fishing in the Gulf of Mexico since 1981.

Until 1983, domestic yellowfin tuna landings in the southeast region came mainly from the by-catch of swordfish longliners. Between 1983 and 1986, domestic landings by the U.S. fleet in this region increased tenfold as swordfish longliners began to redirect their fishing efforts (Adams 1987). Adams (1987) reported that similarity in gear between swordfish and yellowfin longliners and increases in tuna prices led to a shift in effort. Since 1983, Florida has been the leader in U.S. tuna landings, and, like most other states prior to 1985, Louisiana yellowfin tuna landings have been negligible. However, during 1985 and 1986, Louisiana landings increased dramatically, reaching over 2 million pounds in 1986 (Table 2).

Using an average fish weight of 80 to 90 pounds (heads off and gutted), present domestic tuna production in the Gulf rivals that of the Japanese during 1964 and 1971, when they reported landings of 73,429 and 72,598 fish, respectively (Table 1). The obvious question is whether

Table 1. Yellowfin tuna landings reported for the Japanese longlining fleet (# of fish reported by NMFS) between 1963 and 1981.

Year	Total number of fish	Months of fishing effort in the Gulf (Jan = 1, Feb = 2)	Average Number of fish per 100 hooks
1963	25,183	11,12	5.81
1964	73,429	1,2,6,7,8,9	3.41
1965	5,201	6,7,8,9,10	1.17
1966	4,662	4,5,6,7	2.44
1967	16,100	6,7,8,9	4.66
1968	22,349	5,6,7	3.68
1969	2,242	6,7	1.42
1970	62,378	5,6,7,8	4.39
1971	72,598	5,6,7,8,9,10,11,12	3.15
1972	20,488	1,5,6,7,8	1.72
1973	23,323	4,5,6,7,8,9	2.23
1974	25,277	4,5,6,7,8,9	2.03
1975	42,288	2,3,4,5,6,7,8,9	1.09
1976	45,904	1,2,3,4,5,6,7,8	0.99
1977	15,849	1,2,3,4,5,6,7,8,9	0.35
1978	12,288	1,2,3,4,5,6,7	0.39
1979	6,278	1,2,3,4	0.17
1980	7,525	1,2,3,4	0.42
1981	8,778	1,2,3,4,5	0.22

Table 2. Reported yellowfin tuna landings (lb) and their value for the Gulf region, 1980-1986.

	Louisiana	Florida (West Coast)	Alabama	Texas
1980		12,830 (\$17,907)	681 (\$1,362)	38,600 (\$67,550)
1981		14,004 (\$15,968)	206 (\$309)	12,300 (\$11,070)
1982		50,086 (\$85,438)	206 (\$309)	6,800 (\$3,235)
1983		147,958 (\$237,644)	0	5,400 (\$2,629)
1984	35 (\$70)	744,003 (\$732,921)	2,249 (\$2,684)	1,500 (\$1,260)
1985	174,000 (\$221,000)	2,815,000 (\$3,265,000)	8,000 (\$14,000)	143,000 (\$232,000)
1986	*2,435,000 (\$3,233,000)	3,430,000 (\$4,612,000)	28,000 (\$36,000)	N/A

these catch rates can be sustained. Given the variability in catch rates of both the Japanese and the domestic longline fleets since 1960, it is difficult to predict any population dynamics that would be useful in fisheries management.

Monthly dockside and wholesale prices for fresh yellowfin tuna have been highly variable during recent years, although prices are generally increasing annually (Adams 1987). Price fluctuation appears to be related to season and abundance. Adams (1987) reported that dockside prices tended

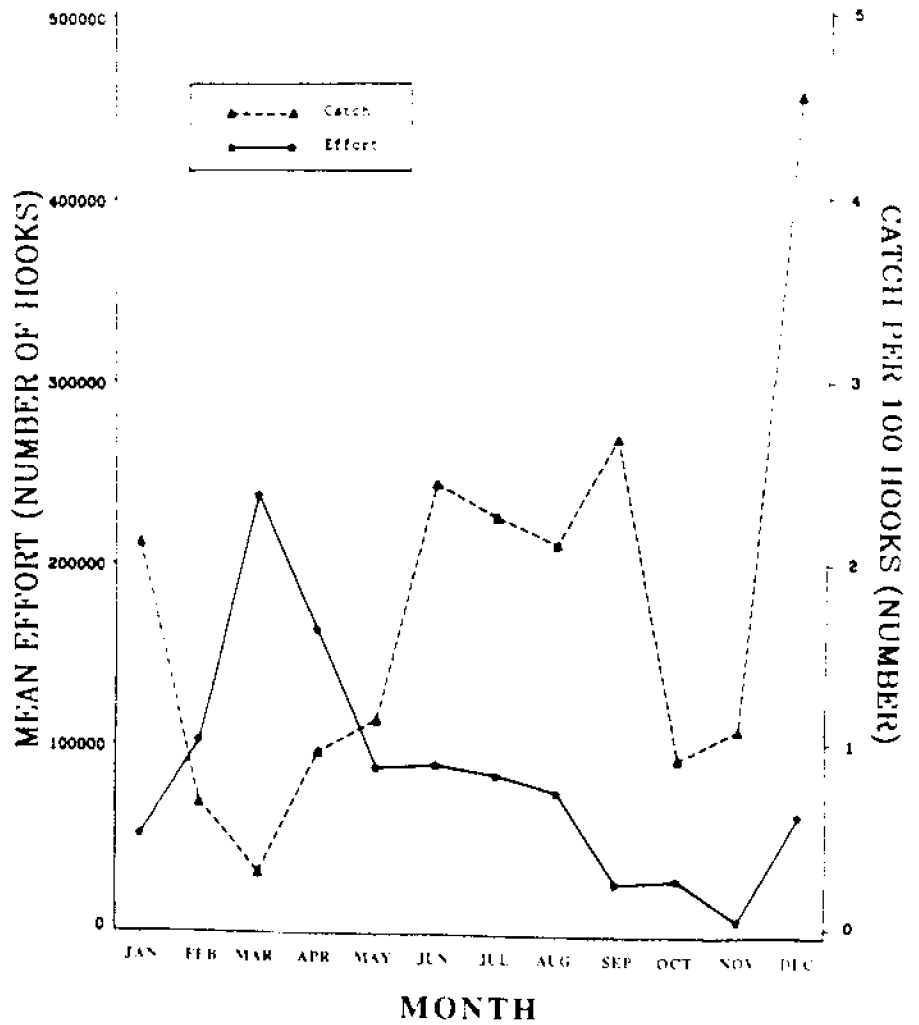


Figure 1.

to be higher from November to March, when landings were low, and lowest during the time of highest catch rates, between June and October. These observations were based solely on the two most recent years of data, January 1984 to December 1986, and may not hold true in the future.

During the last two years, exvessel prices for Florida's west coast landings have ranged from \$0.47 per pound to \$3.00 per pound (gutted weight, with the heads on). The value is determined by the quality of the fish and season of harvest, with fish landed between January and May bringing higher prices.

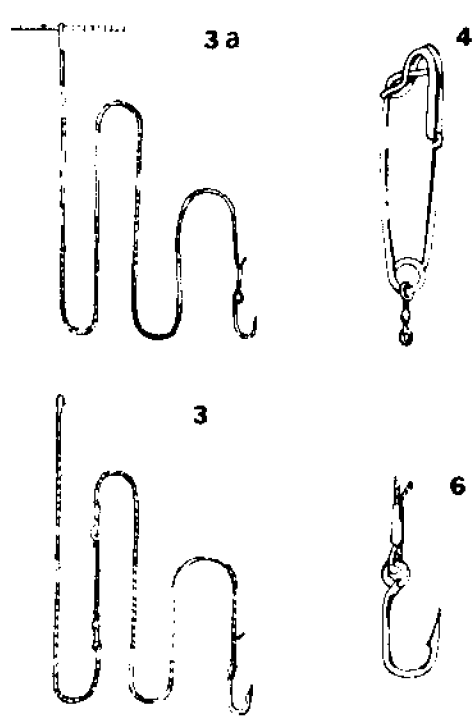
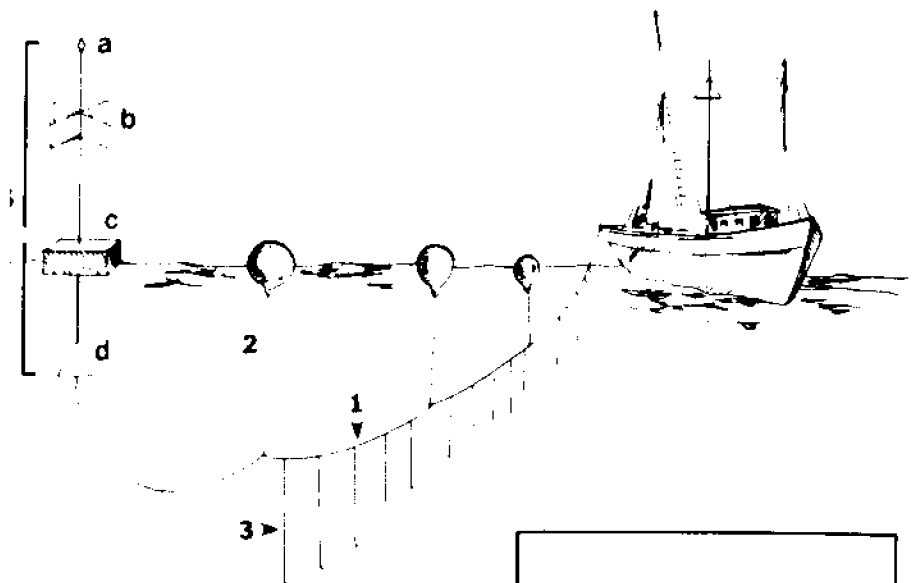
Gear Description and Operation

Fishing techniques for yellowfin tuna worldwide include purse-seine, hook and line, trolling, and longlining. The method used depends on market, vessel type, fish concentration, area fished, and economics. Longlining is the most common method used in the Gulf of Mexico.

Longline gear consists of a mainline, supported by flotation buoys, and baited hooks that hang down from a gangion clipped to the mainline. The length of the mainline depends on the size of the vessel, type of retrieval gear, target species, and fishing conditions. The length of the gangion varies according to bottom depth, target species, and preference of the boat captain (Hamade 1970). Figure 2 presents a sketch of the basic longline gear during set.

The mainline (1) is usually made of tightly braided nylon or monofilament from 700- to 2500-pound test, with 700-pound test being most commonly used by the Gulf fleet. The mainline must be strong enough to withstand the strain of the vessel's movement against the gear and the tension of hooked fish (Horuman and Yamazaki 1975). The beginning of the longline is marked with a "high flyer" (5), which consists of a float (5c) supporting a radar reflector (5b), with a blinking light (5a) and radio transmitter on the top. The whole assembly is held upright by a weight under the water's surface (5d). These high flyers are spaced out along the main line 1,000 to 6,000 yards apart and form a line that can be followed on the radar screen by the vessel while the gear is fishing. The high flyers also warn other vessels in the area of the set. The blinking beacon light and radar reflector on each high flyer provide additional sighting aids. The ability to track the set with radar also enables the captain to watch for such problems as tangles and breaks.

The buoy line (2), with a buoy, regulates the depth of the mainline. It varies in length, depending on desired depth, and is made of material similar to that of the mainline (e.g., monofilament) but is usually of lower test. Buoy lines are clipped to the mainline with longline clips (4). The distance between buoys also varies depending on target species, desired se



- | | |
|----|---------------------------|
| 1. | Mainline |
| 2. | Buoy line and buoy |
| 3. | Gangion |
| 4. | Longline Clip |
| 5. | High Flyer |
| | a. Light |
| | b. Reflector |
| | c. Float |
| | d. Weight |
| 6. | Tuna Hook |
| | a. Double-crimped sleeve |
| | b. Pivot ring |

Figure 2. Adapted from Hi Seas Longline Products, North Kingston, RI.

depth, and sea condition. The clips were developed for the longline industry and are both strong and easy to unhook.

The gangions (3) with hooks (6) are clipped to the main line at intervals of 20 to 50 yards. The gangion is usually a heavy monofilament line (500-pound test) that is strong enough to hold a hooked fish. Longline clips (4) are used to clip buoy lines and gangions to the mainline. At the end of the branch line is a size 7, 8, or 9 tuna hook (6) which may have a "pivot ring" through the eye (6b) and a double-crimped sleeve (6a) attaching the gangion to the pivot ring (6).

The length of the gangion with baited hook depends on the swimming depth of the target species, depth of the water, force of the current, and drifted angle of the branch line against the current. The length of the gangion can also depend on how close to one another the gangions are attached to prevent tangling. Most U.S. yellowfin tuna fishermen use gangions that are 100 to 300 feet long.

Depending on the target species, longline sets can be day or night. Yellowfin tuna fishermen set out once or twice during the day. Both bigeye and yellowfin tuna are believed to bite best in the early morning and at dusk. The longline is set for a period that is long enough to encounter fish, but short enough to ensure that hooked fish are still alive when brought onboard.

The longline gear onboard the vessel consists of a large drum (reel) to hold the mainline. The drum is driven by hydraulics or by a power take-off (PTO) and is placed either parallel or perpendicularly to the stern, depending on the work area. The mainline is fair-led out of a block or roller located on either side of the stern. The gangions with hooks can be stored on smaller drums by connecting the hook at the end of one gangion to the clip of the next gangion, so that one continuous line can be rolled or unrolled. A rule of thumb is that, excluding deck equipment, a longline 30 to 50 miles long costs about \$1,000 per mile.

Setting out a longline usually involves at least three people. The captain controls the vessel and the mainline drum. As the line passes out of the last block, a deckhand baits the hooks and clips them and the gangions onto the mainline. Another deckhand is responsible for clipping on float lines with buoys and high flyers. Attaching high flyers may require two or more people because of the weight.

Retrieval of the gear works in a reverse fashion. The captain picks up (hauls back) his set from the downwind side to keep the boat from crossing over the line. Usually retrieval is stopped while bringing large fish or live fish onboard to ensure proper handling.

Type of Bait

The type of bait may vary with location, time of year, and preference. In most cases, however, the type of bait depends on availability. In New England, Boston mackerel is the most common bait. Frozen mackerel (3/4 pound each) are commercially available in 50-pound boxes. The Gulf fleet uses alewives, squid, and sardines. Japanese catch rates reported by U.S. observers between 1978 and 1981 were highest with mackerel and lowest with squid (Wilson and Render 1981). Butterfish has also been reported to be a popular bait for yellowfin and bigeye tuna in the northeast. Available in 50-pound boxes, butterfish cost 15 to 20 cents per pound, but recent interest in developing a commercial fishery in butterfish may increase prices. Whole butterfish are split in half before baiting.

Handling and Quality

Because the value of the fish depends on quality, proper handling is a major factor in successful tuna fishing. During the last few years, public awareness of the health benefits of fish and acceptance of Japanese "sashimi," or raw fish, in the U.S. market have created the demand for high quality tuna.

The first step in handling fish is landing and a rapid kill. The fish can be killed by striking it between the eyes with a blunt instrument, but because of the muscular "quivering" that follows the blow, this method can result in acid waste build-up and bruised muscle tissue. Japanese tuna fishermen frequently "pith" a live fish with a Taniguchi knife (Figure 3). A hole is made with the knife in the soft spot between the eyes, and a steel cable is inserted down into the spinal cord. Although time-consuming, this process effectively stops the nerves in the body from working and thus prevents quivering.

The head is sometimes removed next (depending on intended market) by cutting the fish behind the pectoral fins. If buyers prefer to see the eyes and gills, the head is left on, and the throat and tail are cut to allow bleeding. For ease of handling, however, it is usually a good idea to leave the tail attached.

The fish is gutted by cutting upward about 4 inches from the anal vent to sever the guts from the anal portion. The guts can then be removed through the neck opening, thus preserving the belly, which is the most valuable part of the fish. The fish should be washed well in chilled seawater to remove blood and slime and placed in an ice bath or on ice (Amos 1981; Takenaka 1978).

In order for fish quality to be distinguishable at the market place, the fish is cut near the pectoral fins on one or both sides. The fish should be stored with the marked side up because any blood remaining in the body

Taniguchi Tuna Knife

1 Use cylindrical or sharp knife to stab the whitish mark (□) on the upper skull.

2 From this hole, push the knife toward the spine. Bending the tip of the tool makes it easier to push in.

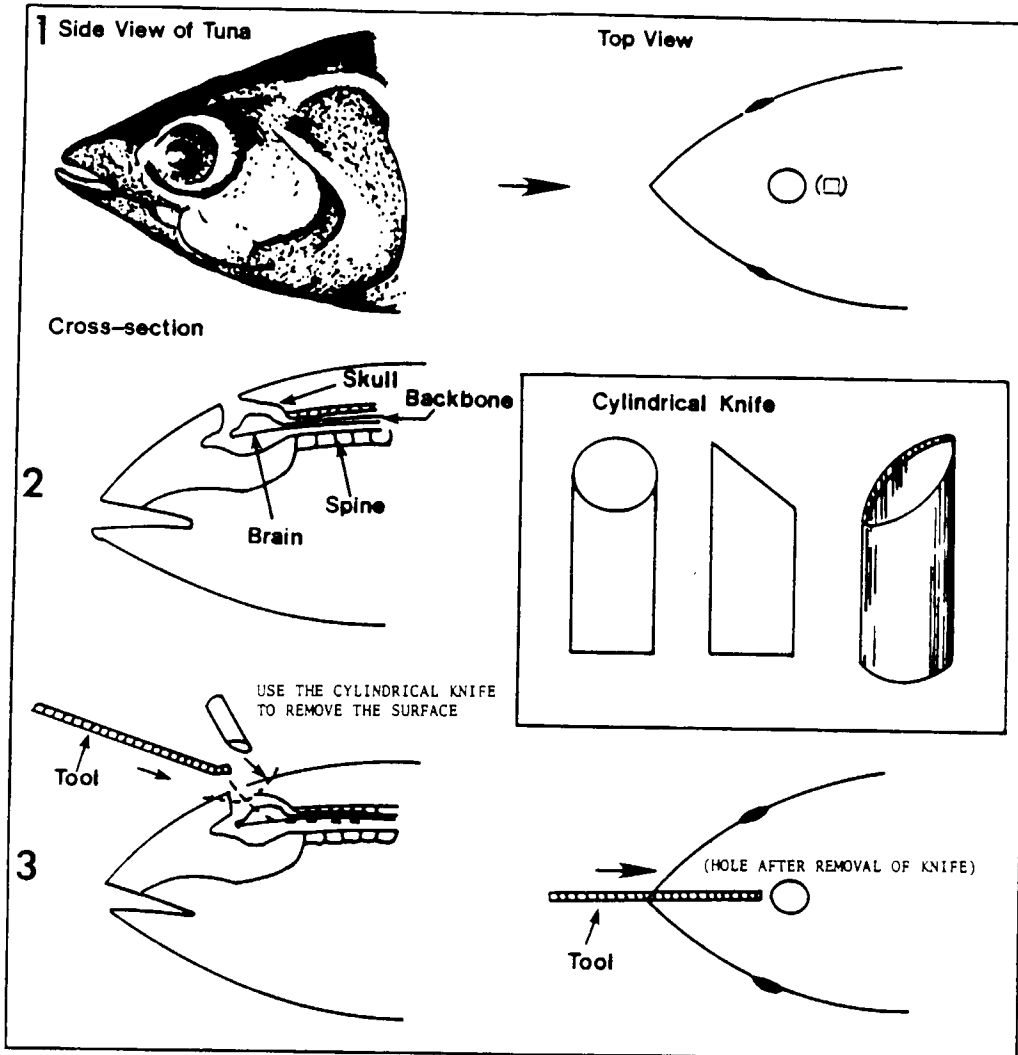


Figure 3.

after cleaning tends to settle in the down side of the fish.

Proper cooling of tuna can be accomplished with either a brine solution of ice, seawater, and rock salt or an ice pack. The most desirable temperatures are those ranging from 32 to 40°. A brine solution of 28° is possible under certain conditions but should be avoided (Holt and Hendrick 1978) because a solution that is too cold freezes the fish and increases the cooling time of the fish's interior. This is particularly important for most of the tunas because of their unusual physiology.

Tunas are considered "warm-bodied" because their internal body temperature is higher than that of the water around them. Carey and Teal (1966) showed that certain parts of the tuna, such as the lateral muscle at the thickest part of the body, were as much as 25°F warmer than the surrounding water. Konagaya et al. (1969) examined four species of live tuna (albacore, yellowfin, bigeye, and southern bluefin) and reported that body temperatures ranged from 16 to 23°F higher than the water temperature. Because of higher internal temperatures, the core (center) of the tuna is warmer than the surface and hence takes longer to cool. Therefore, fish that arrive on the vessel alive have a warmer body temperature than those that arrive dead.

A common condition in tuna that causes meat discoloration is called "yake niku," which means "spontaneously done meat" or "burnt meat" in Japanese. The "burnt" area of the fish is cloudy and dark and has a stringy texture, and the fish is graded #3 (Konagaya and Konagaya 1979). This discoloration results when high temperatures and acid wastes build up from overexertion by the live fish and actually "cook" protein in the muscle (Tanaka et al. 1974). This condition is difficult to prevent, particularly when it occurs in the water. Its frequency can be reduced by rapidly bleeding and chilling fish that arrive onboard dead and immediately killing, bleeding, and chilling live fish.

The speed of the chilling process depends on the temperature of the ice or ice slush, the size and number of the fish in the brine tank, and the temperature of the fish. During handling, the operator should keep in mind that cuts, bruises (caused by sloshing in the tank), and loss of scales speed spoiling and reduce the value of the fish (Nelson 1977). Proper and timely chilling is important because cooling slows the clotting of blood, allowing a longer time for blood to leave the body. When removed from the solution, the fish should be stiff and firm to the touch at the shoulder area and have good color and clear, full eyes (Takenaka 1978).

Storage

Depending on sea time, the fish hold should be capable of either freezing the fish (for trips over eight days) or storing the fish with ice or refrigeration (for trips up to eight days). In the Gulf region, most yellowfin

are purchased for the fresh market, and freezers are seldom used. Freezers can be added to fishing vessels, but they are expensive. Therefore, the likelihood of trips that would exceed eight days should be ascertained before a freezer is purchased (Tanaka et al. 1974).

Good storage facilities are important in maintaining catch quality. The fish hold should have smooth, durable, watertight sides so that it is easy to clean and sanitize. The hold should not be susceptible to scratching or cracking by shovel, ice, or fish, because any crevice is an ideal place for bacteria and reduces cooling efficiency (Bankston 1984). The hold must be well insulated and must not corrode, rot, or pass on any chemical flavor to the fish. The hold should allow good drainage and have a tightly sealing hatch cover (Amos 1981).

The icing technique to be used depends on whether the hold is refrigerated. If the hold is refrigerated, clean ice should be placed under, between, and on top of stored fish and in the body cavity, gills, and mouth of each. Enough ice should be used so that the ice bears some of the weight of the fish if they are stacked. Clean burlap can be placed between the layers of fish. At 33°F, ice melting is minimal. For holds without refrigeration, the same approach and more ice should be used, but burlap should be avoided, as it will trap melting ice water (Takenaka 1978). In another technique called honeycombing, the fish are placed in honeycomb-like racks so they do not touch or crush one another.

Grading

To appreciate the importance of proper handling, it is necessary to understand the standards used in grading tuna and how quality criteria differ. Having originated in Japan, the grading system is based on Japanese standards. Tuna of the highest quality is intended for the domestic and foreign raw fish, or "sashimi," markets while tuna of lesser quality is used for such cooking as barbecuing and broiling and has recently become popular in the modified Cajun dish, "blackened tuna".

While there is no official standard for grading tuna in the United States, researchers at the University of Florida are examining the commonly used standards for this grading system. Fishermen, buyers, and retailers collectively refer to the sashimi-quality tuna as #1, though criteria for #1 tuna differ according to the time of year and the market for which the catch is intended and the person doing the grading. The quality of #1 tuna can be based on appearance (color and brightness) and texture of the meat. Of these two factors, color of the meat is considered to be the more important because color is a dependable measure of fish quality and therefore affects price.

In Japan, the highest quality tuna has a bright red color and high oil content. U.S. buyers prefer bright red coloration but lower oil content.

Therefore, a bigeye tuna (which is oily compared with yellowfin) is more desirable to a buyer who sells to the Japanese market. Color and oil content vary with the season. Cold-water tuna tend to have a higher oil content in or just following winter. The fat content of yellowfin tuna in the Gulf ranges from 1 to 1-1/2 percent.

According to buyers Miles Altman of Captain's Seafood in Hilton Head, South Carolina, Lee Russell of Kissimmee, Florida, and Ken Tsukahara of the Yamoto Fish Co. in San-Leandro, California, #1 tuna should have the following characteristics when uncooked and in the round:

1. Flesh appearance--dark pink to bright red
2. Flesh texture--very firm but soft (without mushiness) when rolled and squeezed between the forefinger and thumb
3. Eyes--clear and bright, no cloudiness
4. Gills (if present)--bright red and free of odor
5. Flavor--bland and not fishy

To determine some of these factors the buyer usually inserts a small corer about 4 or 5 inches into the base of the shoulder and extracts a plug of meat 1/16 of an inch in diameter. Frequently a disc of meat is cut from the tail (caudal peduncle) and examined in a similar fashion. If the buyer is extremely careful, he may core both the right and left sides of the fish to detect variations in quality caused by storage. It takes several years of experience to grade tuna properly, and the expertise is still developing in the United States.

Although it is not desirable for sashimi, #2 tuna is excellent for cooking in a variety of ways. It has a lighter pink color and less oil than grade #1.

The lowest grade of tuna is #3. The meat is dark red to brown, which indicates that the fish was not properly cooled or the meat was "burnt" through improper handling. It can be used in the same fashion as #2 tuna.

Summary

Interest in the presence of yellowfin tuna and other tuna in the Gulf of Mexico has increased considerably since the Japanese effort of the 1960s and 1970s. The increases in landings and prices in Louisiana and along Florida's west coast may be a result of increased fish consumption in general and sashimi consumption in particular.

The effect of a significant increase in landings on Gulf stocks and on the regional fresh tuna market is not known. The dockside price of yellowfin tuna in the Gulf region could decline if the market were to become flooded or demand decrease.

Appropriate gear, harvest, and handling technologies are available to Gulf fishermen, but fishing attempts will require a significant investment of time and money. A proper appreciation of handling techniques and markets is essential for success in this fishery. It is particularly important that a fisherman understand the local production methods, be familiar with local and regional markets, recognize that properly handled fish are likely to demand a greater price, and be aware of changes in management regulations.

Yellowfin tuna longlining is a deep-water, capital-intensive fishery that requires expensive gear and should not be attempted by small or under-equipped vessels. The vessel should carry enough fuel for at least 10 days, have the proper electronic equipment (depth recorder, back-up radio systems, and Loran or satellite navigation), and be fitted with the proper gear for harvesting and handling tuna. Tuna longline gear may be adapted to existing shrimp trawlers and fishing effort planned so that neither the gear nor the season of operation will interfere with shrimping operations.

Finally, a smart captain should not be greedy. Since quality is a top consideration, it is better to catch only the fish that can be handled properly than to try to handle too much and risk loss of potential revenue.

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