Col.Vol.Sci.Pap. ICCAT, 36: 223-240 (1991)

THE U.S. LONGLINE FISHERY FOR YELLOWFIN TUNA IN PERSPECTIVE

by

Joan A. Browder, Bradford E. Brown, and Michael L. Parrack[1]

SUMMARY

Catch trends and size composition of the U.S. longline catch of yellowfin tuna in the Gulf of Mexico are examined, and various comparisons are made to other yellowfin tuna fisheries in the North Atlantic, past and present. Particular emphasis is given to comparison with the Japanese longline fishery that operated in the Gulf of Mexico until 1981. Reproductive information on yellowfin tuna in the Gulf of Mexico is presented, and tagging returns are reviewed for information concerning stock mixing.

A recognizable fishery for yellowfin tuna in the Gulf of Mexico first appeared in the early 1980's. The fishery grew from a total catch of 352 MTin 1984 to about 7500 MT in 1988. This exceeds the largest annual catch of the Japanese but is still small compared to the more than 100,000 MT caught annually Atlantic-wide (1985-1987). The size composition of the U.S. Gulf of Mexico longline catch appears similar to that of the Japanese, except that each of the two modal peaks is about 10 cm higher in the U.S. fishery.

Yellowfin tuna larvae have been collected during the fall in the area of the Mississippi River plume in the north-central Gulf of Mexico. Fish tagged in the Gulf of Mexico and recaptured after at least 346 days at large indicate that some yellowfin tuna made transatlantic migrations, whereas others either did not leave the Gulf of Mexico or returned there before capture.

RESUME

Les tendances de la capture et la composition de taille de la prise palangrière d'albacore dans le golfe du Mexique sont étudiées, en effectuant diverses comparaisons avec d'autres pêcheries d'albacore,

[1]U.S. Department of Commerce, NOAA, SEFC, Miami Laboratory, Miami, Florida 33149-1099, U.S.A.

anciennes et actuelles, dans l'Atlantique nord. L'accent est surtout mis sur la comparaison avec la pêcherie palangrière japonaise qui pêchait dans le golfe du Mexique jusqu'en 1981. Une information est fournie sur la reproduction de l'albacore dans le golfe du Mexique, et les retours de marques sont examinés pour en tirer une information sur le mélange des stocks.

Une pêcherie concrète d'albacore dans le golfe du Mexique est apparue pour la première fois au début des années quatre-vingt. Cette pêcherie s'est développée, passant d'une prise totale de 352 TM en 1984 à 7.500 TM environ en 1988. Ceci dépasse la plus forte prise annuelle des japonais, mais est encore modéré par rapport aux 100.000+ TM prises tous les ans dans l'ensemble de l'Atlantique (1985-1987). La composition de taille de la prise palangrière du golfe du Mexique paraît semblable à celle des japonais, sauf que les deux pics modaux sont environ 10 cm plus élevés dans la pêcherie américaine.

Des larves d'albacore ont été recueillies pendant l'automne dans la zone de panache du Mississippi dans le secteur centre-nord du golfe du Mexique. Les poissons marqués dans le golfe du Mexique et repris au bout de 346 jours au moins de liberté indiquent que certains albacores effectuent des migrations transatlantiques, alors que d'autres, soit n'abandonnent pas le golfe du Mexique, soit y reviennent avant leur capture.

RESUMEN

Se examinan las tendencias de la captura y composición por talla de la pesca palangrera norteamericana de rabil en el golfo de México y se establecen diversas comparaciones con otras pesquerías de rabil del Atlántico norte, tanto actuales como del pasado. En particular, se establece una comparación con la pesquería de palangre japonesa que operó en el golfo de México hasta el año 1981. Se presenta información sobre reproducción del rabil en el golfo de México y se examinan los resultados del marcado, para obtener datos sobre la mezcla entre los stocks.

A principios de los años 80 apareció en el golfo de México una pesquería de rabil ya relativamente importante. Su captura fue aumentando desde 352 t en 1984 hasta alrededor de 7500 t en 1988. Esta cifra sobrepasa la cifra de captura japonesa más importante, sin embargo, es escasa si se compara con las 100.000 t que se obtienen cada año en todo el Atlántico (1985-1987). La composición por tallas de la captura de palangre norteamericana en el golfo de México parece similar a la japonesa, aunque cada uno de los dos picos modales es unos 10 cm superior en la pesquería norteamericana.

En el transcurso del otoño, se recogieron larvas en la zona de la desembocadura del río Misisipí, en el área centro-norte del golfo de México. El hecho de haber recuperado peces marcados en el golfo de México tras permanecer un mínimo de 346 días en libertad, indica que algunos rabiles efectuaron migraciones transatlánticas, a la par que otros no abandonaron el golfo o bien retornaron allí antes de su captura.

INTRODUCTION

A productive U.S. yellowfin-tuna fishery has developed in the Gulf of Mexico, replacing the Japanese longline fleet that left the area in the early 1980's. The U.S. longline fishery along the northeastern U.S. coast also has expanded. Yellowfin tuna originally were the by-catch of U.S. swordfish longliners. Operators began to target yellowfin because of the growing market for sushi. A distinct fishery for yellowfin tuna in the Gulf of Mexico was recognized by fishery data-collection agents by the summer of 1984. This fishery may have involved as many as 200 vessels by the summer of 1988 (D. Fable 1988, unpublished memo).

A Mexican longline fishery for yellowfin tuna also developed in the early 1980's. The recreational catch of yellowfin tuna also has increased.

Yellowfin tuna catches by U.S. vessels in the northwest Atlantic are monitored by the Southeast Fisheries Center using several data collection systems. Port agents routinely collect landings data from dealers, which are recorded by state of landing. A recently-developed data collection system is based on vessel logbooks and has been developed to record the longline catch, by catch location. Trip weigh-out sheets provide size-frequency information on the longline catch. The recreational catch is estimated by surveys based on dockside and telephone interviews. Catches of Atlantic yellowfin tuna by U.S. purse seine vessels are monitored when offloaded at Puerto Rican canneries. A tagging effort involving primarily recreational anglers is a longstanding U.S. program. International cooperation in collecting and documenting tagging returns is an essential part of this effort. Ichthyoplankton surveys by the Southeast Fisheries Center provide information concerning yellowfin tuna reproduction.

The major purpose of this report is to describe the volume and size distribution of yellowfin tuna catches by the U.S. longline fishery in the Gulf of Mexico and to make various comparisons with other yellowfin tuna fisheries, both historic and current. For perspective on the possible impact of the new fishery on the stock, we compare annual catches to past Japanese catches in the same area and to total catches of yellowfin tuna in the western and eastern Atlantic. We compare the size composition of yellowfin caught by U.S. longliners in the Gulf of Mexico to that of yellowfin caught by the Japanese in the same area to evaluate whether size composition has changed. We compare size distributions of U.S. Gulf of Mexico longline-caught fish to that of yellowfin caught in other U.S. fisheries to gain some information on the size groups present in each area and susceptible to cap-

ture by the various gears. We briefly review U.S. tagging returns on yellowfin tuna and make several observations related to the reproduction of yellowfin tuna in the Gulf of Mexico.

A second purpose of this report is to document unpublished information on the reproduction of yellowfin tuna in the Gulf of Mexico and to review recent tagging data pertinent to the Gulf of Mexico group of yellowfin tuna.

CATCH HISTORY

Japanese longline catches of yellowfin tuna in the Gulf of Mexico fluctuated widely from 1963 through 1980. Years of maximum catches were 1964 and 1971, when 90,821 and 92,274 yellowfin tuna were caught respectively (Table 1). These figures were compiled from the Annual Reports of the Japanese Longline Fishery by the Fisheries Agency of Japan, which records catch in number by month, and year, by 5-degree square. The number of fish caught from 1963 through 1980 averaged 31,019 per year. The principal months of the Japanese fishery were June, July, and August, but some catches were made in every month of the year. The lowest catches occurred in November. The size frequency distribution of the Japanese catch came from ICCAT data files originally obtained from the Japanese Fisheries Agency.

The U.S. longline catch of yellowfin tuna in the Gulf of Mexico grew from 352 MT (whole live weight) in 1984 to 7,514 MT in 1988 (Table 2). Using an average weight per fish of 49.9 kg (110 lb), we estimate that the number of fish caught ranged from 7,061 in 1984 to 150,581 in 1988. (Average whole weight was 49.9 kg in 1986 and 1987 and 50.5 kg in 1988). The catch almost doubled from 1987 to 1988, possibly due to the introduction of live bait. Activity was greatest during the summer months (June-August), but catches also were made in other months.

According to Compeán (1987), the Mexican longline yellowfin catch in the Gulf of Mexico grew from 11 MT, consisting of approximately 244 fish, in 1981 to a maximum of 772 MT (18,825 fish) in 1984, decreasing to 500 MT (12,346 fish) in 1986 and less than 50 MT in 1987 (Table 3). The Mexican longliners use the same procedures as Japanese longliners (Compeán 1987) and operate in the same season and area--summer in the southern Gulf of Mexico.

Table 4 facilitates a comparison of catches during the Japanese period to those during the U.S.-Mexican period. Mexican catch volumes were not available for 1987 or for 1988, which was a year of greatly expanded catches in the U.S. fishery. The number of fish caught by U.S. longliners in the Gulf of Mexico in 1988 was almost 50% greater than the greatest annual reported Japanese catch in the Gulf of Mexico from 1963 through 1980.

The western Atlantic catch of yellowfin tuna increased from 13,775 MT to 45,852 MT between 1976 to 1986, but decreased to 23,100 MT in 1987 (Table 5). The Atlantic-wide catch fluctuated between 110,000 MT and 160,000 MT over the 12-year period (Table 5).

The Gulf of Mexico U.S. catch is a small component of the overall catch in the western Atlantic or the Atlantic as a whole. For instance, the 1987 Gulf of Mexico U.S. yellowfin-tuna catch represented only 3.2% of the catch in the entire

Atlantic Ocean that year (Table 2 and Table 5). The 1988 Gulf of Mexico catch was approximately twice as large as the 1987 catch. We do not yet have data with which to compare it to the 1988 catch for the western or entire Atlantic.

SIZE CHARACTERISTICS

The annual length-frequency distribution of the Japanese catch for the years 1971 through 1981 shows no consistent change in pattern (Figures 1-11). The position of the major mode varies between 125 cm and 135 cm. A secondary mode at 90 cm to 100 cm appears in some years but not others.

The length-frequency distribution of the U.S. longline catch in 1987 is similar to that of the Japanese in showing two modes, except that the modal positions are approximately 10 cm higher--at 110 cm and 140 cm, respectively (Figure 12). Length-frequency distributions of the June-August catch and the October-December catch were separated to determine if their characteristics differed (Figures 13 and 14). The same two modes appear in both time segments; however, the lower mode shifted from 110 cm up to 115 cm from summer to winter and the upper mode shifted from 145 cm down to 135 cm during the same time period. The upward shift in the lower mode could reflect growth. The downward shift is not so readily explained, but might represent a migration of larger fish from the fishing ground and, possibly, from the Gulf of Mexico. On the other hand, it could reflect higher fishing mortality on the larger fish, or perhaps indicate a sampling problem.

Length-frequency distributions from the Mexican fishery in 1985 and 1986 indicate modal positions at 135 cm and, possibly, at 120 cm (Figure 15, from Compeán 1987).

In order to learn more about possible gear effects and the areal distribution of various size segments of yellowfin tuna in the western Atlantic, we prepared length-frequency distributions from other U.S. fisheries. One clear mode at about 150 cm appears in a small sample from the 1987 Gulf of Mexico recreational rod and reel fishery (Figure 16). A few fish measuring 70 cm and 105-120 cm occur in this distribution.

Three distinct modes can be seen in the length-frequency distribution of the 1987 recreational rod and reel fishery off the northeastern U.S. coast (Figure 17). The smallest mode is positioned at 65 cm, the major mode is positioned at 100 cm, and the third mode is positioned at 145 cm. Clearly the size frequency distribution of the catch in this area differs from that in the Gulf of Mexico. First, the small size group (65 cm) seen in the catch from the northeastern U.S. coast is not evident in the recreational catch or any of the longline catches from the Gulf of Mexico. Second, although the upper mode (145 cm) corresponds to the upper mode of the Gulf of Mexico catch, it represents a smaller percentage of the catch. The middle mode (100 cm) is the major mode in the northeastern U.S. coast recreational fishery, whereas the upper mode (145 cm or 150 cm) is the major mode in longline catches in the Gulf of Mexico and in the recreational catch of that region.

According to 1987 size-frequency distributions, U.S. purse seiners catch smaller yellowfin tuna than the other U.S. yellowfin fisheries, and the size range is narrower (Figures 18, 19, and 20). The single mode was positioned at about 75 cm in

Caribbean catches in March and at 85 cm and 90 cm in catches off the northeastern U.S. coast in July and August, respectively. These modal positions do not exactly correspond to any in the catches of the other fisheries. They are positioned between the lower and middle modes of the recreational catch along the northeastern coast.

To conclude, the size composition of the Japanese longline catch in the Gulf of Mexico did not change appreciably during at least 11 of the last years of the operation of that fishery (1971-1981). U.S. and Mexican longline catches appear to be slightly larger fish than that caught by the Japanese longliners.

The catches of the various U.S. yellowfin fisheries have distinct size-frequency characteristics. Neither recreational nor longline catches from the Gulf of Mexico reveal the occurrence of the small fish (60-70 cm) that appear in the northeastern U.S. recreational catch. The fish captured by U.S. purse seiners are slightly larger (65-100 cm). Relatively few yellowfin less than 100 cm in length occur in the Gulf of Mexico fisheries.

REPRODUCTION

The Gulf of Mexico has not traditionally been recognized as an area of reproduction for yellowfin tuna, but Compeán (1987) reported finding both mature and spent gonads in yellowfin captured by Mexican longliners in August of 1985 and 1986. Although the Southeast Fisheries Center has conducted a number of ichthyoplankton cruises in the Gulf of Mexico, only recently were substantive numbers of yellowfin tuna larvae found. Since autumn of 1986, research cruises have concentrated on the area of the Mississippi River plume in the northern Gulf of Mexico. Over 1,000 yellowfin tuna larvae have been collected in these autumn surveys (C. Grimes, Southeast Fisheries Center, Panama City, FL, pers. comm.).

TAGGING RETURNS

Information on tagging returns has been provided by E. L. Scott (Southeast Fisheries Center, Miami, FL, pers. comm.). Recapture statistics for releases in the Northwest Atlantic (off the U.S. coast, excluding the Gulf of Mexico) and in the Gulf of Mexico are as follows:

		Years at large				
Release area	Recapture area	<1	1-2	2-3	3-4	> 5
N.W. Atlantic	N.W. Atlantic	22[1]	4	2		
	Off Africa	1	2	2	1	
Gulf of Mexico	Gulf of Mexico	3	4	1	1	1
	N.W. Atlantic		1		1	
	Off Africa			1		

[1]One of these was tagged and recaptured off Bermuda.

All of the above recaptures occurred within the period from January, 1985, to June, 1990.

Of 34 recaptured yellowfin that had been tagged in the northwest Atlantic off the U.S. coast or Bermuda, 27 were recaptured there. Six were recovered off Africa. Of these, one had been at large less than 1 year. Of the 11 fish at large more than 1 year, 5 crossed the Atlantic.

Of 13 recaptured yellowfin that had been tagged in the Gulf of Mexico, 10 were recaptured there. Two were captured in the northwest Atlantic off the U.S. coast. One was captured off the African coast. Ten of the recaptures tagged in the Gulf of Mexico were at large more than 1 year. The transatlantic migrator was at large 2-3 year. These data suggest that (1) some Gulf of Mexico fish make trans-Atlantic migrations, but (2) many fish either do not leave the Gulf of Mexico or return there, perhaps exhibiting *ortstreue*, or "faithfulness to place."

Two fish tagged off West Africa were captured off South America, demonstrating that transatlantic migration from east to west also occurs. Details of tagging returns are given in Bard and Scott (1989) and in another paper in preparation by F. X. Bard and E. L. Scott.

Stock hypotheses probably should not be based on these few recaptures. Recaptures in the same region after long times at large suggest localization (regionalization), particularly in the Gulf of Mexico. Cross-Atlantic movement is common, particularly in the Northwest Atlantic.

SUMMARY AND CONCLUSIONS

A U.S. yellowfin tuna longline fishery is currently operating in the Gulf of Mexico and exceeding the maximum catches of the former Japanese fishery there. The rapid increase in the catches of this fishery from 1984 through 1988 may be due in part to a shift to live bait. A Mexican fishery has developed in the southern Gulf of Mexico. The size range of fish caught during the U.S.-Mexican period is similar to that taken during the Japanese period. Additional evidence of spawning by yellowfin in the Gulf of Mexico has been found, although juvenile yellowfin do not occur in appreciable number in any Gulf of Mexico fishery.

Yellowfin tuna caught by recreational anglers in the Gulf of Mexico are larger on average than those taken on longlines in the same area. The modal length of the recreational catch is 150 cm, whereas modal lengths of the longline catch are 140 cm and 110 cm. The recreational fishery off the northeastern U.S. coast catches smaller fish than either Gulf of Mexico fishery. The major mode is positioned at about 100 cm, and a considerable quantity of 60-to-70-cm fish are also taken in this rod-and-reel fishery. U.S. purse seine catches in the Caribbean and along the northeastern U.S. coast are based on smaller fish than those predominating in the Gulf of Mexico fisheries.

Yellowfin tuna have been more important recently than historically in northeastern U.S. recreational catches. Recent environmental changes (e.g., ocean warming) may have increased their availability to recreational anglers in this region.

Tagging results, although limited, indicate both (1) *ortstreue*, or the faithfulness of individuals to certain areas such as the Gulf of Mexico, and (2) bi-directional transatlantic migrations of yellowfin tuna.

Hitherto, most Atlantic yellowfin tuna research has been conducted in the eastern Atlantic. Data bases now are being developed that will lead to a better understanding of yellowfin tuna in the western Atlantic, and more detailed Atlantic-wide comparisons may soon become feasible.

ACKNOWLEDGMENTS

We appreciate the tagging information provided by Edwin L. Scott and the size frequency data provided by Mark Farber, Stephen Turner, and Craig Brown. We also appreciate the advice of reviewers: J. J. Maguire, Department of Fisheries and Oceans, Quebec, Canada, and Edwin Scott and Gerald Scott, National Marine Fisheries Service, Southeast Fisheries Center, Miami.

REFERENCES CITED

Bard, F. X. and E. L. Scott, 1991. Sept traversées transatlantiques d'albacores marqués. Thons migrateurs ou sédentaires? This volume.

Compeán, G., 1987. Análisis preliminar de la pesca palangrera en el Golfo de México 1981-1986. *in*: International Commission for the Conservation of Atlantic Tunas. Col. Vol. Sci. Pap. Vol. XVI(1):42-49.

ICCAT, 1989. 1988 Species Groups Reference Document. International Commission for the Conservation of Atlantic Tunas. Standing Committee on Research and Statistics (SCRS). Madrid.

ICCAT, 1987. Statistical Bulletin. Vol. 17-1986. International Commission for the Conservation of Atlantic Tunas. Madrid.

Table 1. Number of yellowfin tuna caught per month and year in Gulf of Mexico by Japanese longline operations.[1]

Year	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual*
1963													25,178
1964													90,821
1965													28,945
1966													6,434
1967	58	19	0	0	7	1,343	10,192	3,707	879	0	0	4	16,202
1968	34	125	3	0	510	14,544	12,159	18	15	1	0	42	27,461
1969	50	305	35	2	0	2,107	149	2	0	0	0	59	2,709
1970	45	18	1	0	4,975	20,903	27,246	12,779	0	0	0	19	65,986
1971	0	7	1	0	1,781	15,086	33,918	34,034	7,231	198	18	0	92,274
1972	255	0	14	0	196	4,521	12,817	4,360	0	0	0	0	22,163
1973	0	0	7	23	715	1,548	10,042	9,884	1,112	0	0	0	23,331
1974	5	0	0	516	3,211	11,340	5,826	4,923	270	0	0	0	26,091
1975	0	29	238	1,691	3,693	15,161	15,104	6,513	563	0	0	0	42,992
1976	81	327	5,125	10,096	3,401	12,463	10,670	3,841	0	0	0	0	46,004
1977	0	217	131	294	605	4,346	4,511	3,940	1,810	0	0	0	15,854
1978	107	1,452	1,004	145	337	4,858	4,385	0	0	0	0	0	12,288
1979	519	2,597	2,379	783	0	0	0	0	0	0	0	0	6,278
1980	670	4,750	1,893	23	0	0	0	0	0	0	0	0	7,336

[1]Source: Published Annual Reports on Japanese Longline Fishery by the Fisheries Agency of Japan, 1963 through 1980.

Table 2. Annual U.S. longline catch of yellowfin tuna in the Gulf of Mexico, 1984 through 1988, in whole live weight and number of fish.

Year	Weight Metric tons[1]	Number of fish[2]
1984	352	7,061
1985	1,475	29,556
1986	3,202	64,168
1987	3,970	79,559
1988	7,514	150,581

[1]Rounded to nearest whole ton.
[2]Estimated by dividing tonnage by an average weight of 49.9 kg.

Table 3. Annual Mexican catch of yellowfin tuna in the Gulf of Mexico, 1981 through 1987, in round live weight and estimated number of fish.

Year	Gear	Weight Metric tons[1]	Number of fish
1981[2]	LL	11	244
1982[2]	UNCL	67	1,628
1983[2]	LL	574	13,998
1984[2]	LL	772	18,825
1985[2]	LL	574	14,002
1986[3]	LL	500	12,346
1987[4]	LL	< 50	< 1,235[5]

[1]Rounded to nearest whole ton.
[2]Source: Compeán 1987.
[3]Source: ICCAT Statistical Bulletin Vol. 17-1986 (ICCAT 1987).
[4]Source: ICCAT 1988 Species Group Reference Document (ICCAT 1989).
[5]Estimated by dividing tonnage by an average fish weight of 40.5 kg (Compeán 1987).

Table 4. Number of yellowfin caught on longlines in the Gulf of Mexico.

	Country			
Year	Japan	U.S.[1]	Mexico[1]	Total
1963	25,178			
1964	90,821			
1965	28,945			
1966	6,434			
1967	16,202			
1968	27,461			
1969	2,709			
1970	65,986			
1971	92,274			
1972	22,163			
1973	23,331			
1974	26,091			
1975	42,992			
1976	46,004			
1977	15,854			
1978	12,288			
1979	6,278			
1980	7,336			
1981		UNK	272	
1982		UNK	2,815	
1983		UNK	14,815	
1984		7,061	19,753	26,814
1985		29,556	13,901	43,457
1986		64,168	12,346	76,564
1987		79,559	NA	
1988		150,581	NA	

[1]Estimated from weight.
UNK Unknown
NA Not available at time of writing.

Table 5. Atlantic catch of yellowfin tuna, 1976 through 1987, in round live weight (metric tons).

Year	Catch Area: Eastern Atlantic	Western Atlantic	Total
1976	109,211	13,775	122,986
1977[1]	115,301	13,444	128,745
1978[1]	115,737	14,751	130,488
1979[1]	111,715	13,091	124,806
1980[1]	112,445	12,991	125,436
1981[1]	134,801	16,421	151,222
1982[1]	134,311	25,494	159,805
1983[1]	123,390	37,099	160,489
1984[1]	75,286	36,312	111,598
1985[1]	111,922	37,869	149,791
1986[1]	108,635	45,852	154,487
1987[2]	101,100	23,100	124,200

[1]Source: ICCAT Statistical Bulletin, Vol. 17-1986 (ICCAT 1987).
[2]Source: ICCAT 1988 Species Group Reference Document (ICCAT 1989).

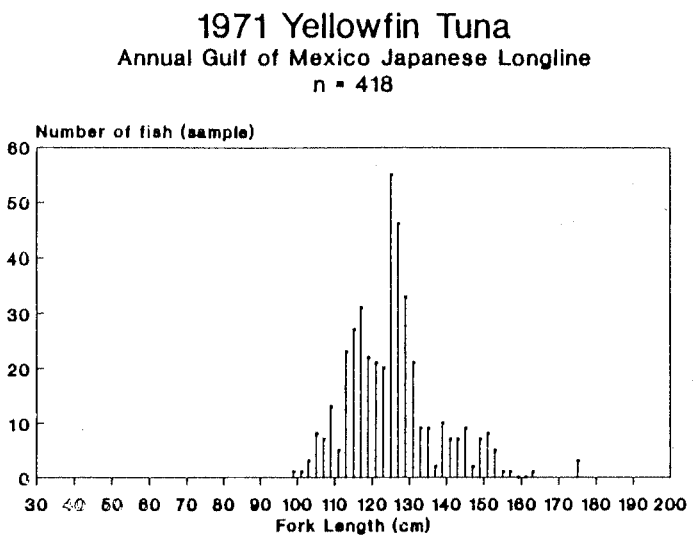


Fig. 1.

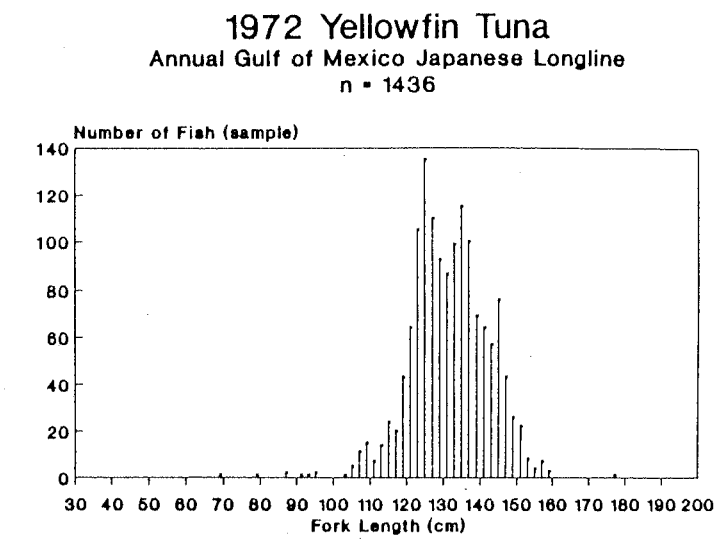


Fig. 2.

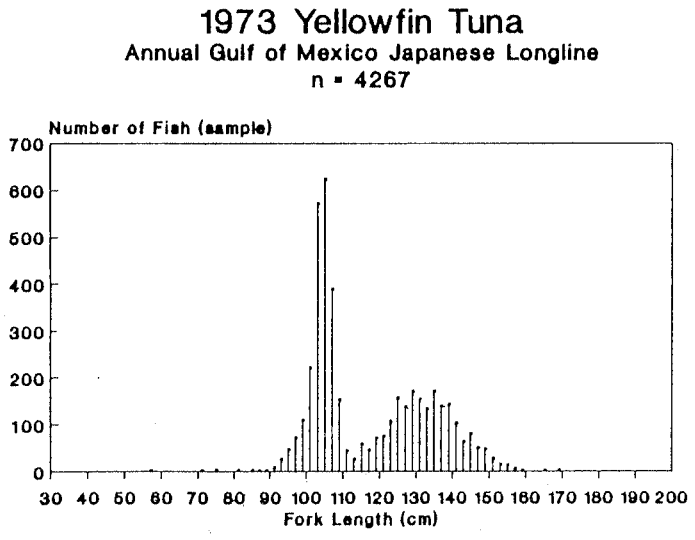


Fig. 3.

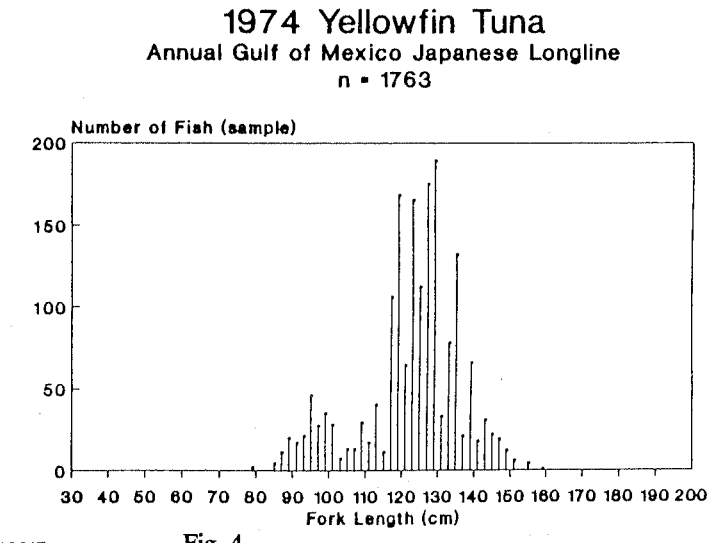
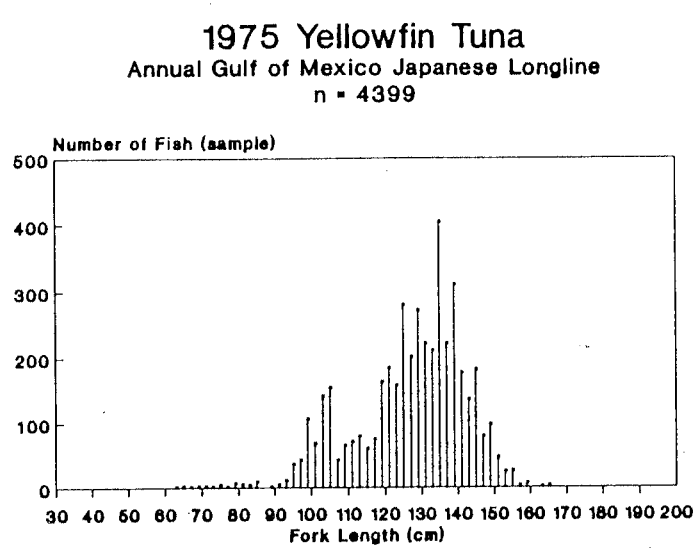
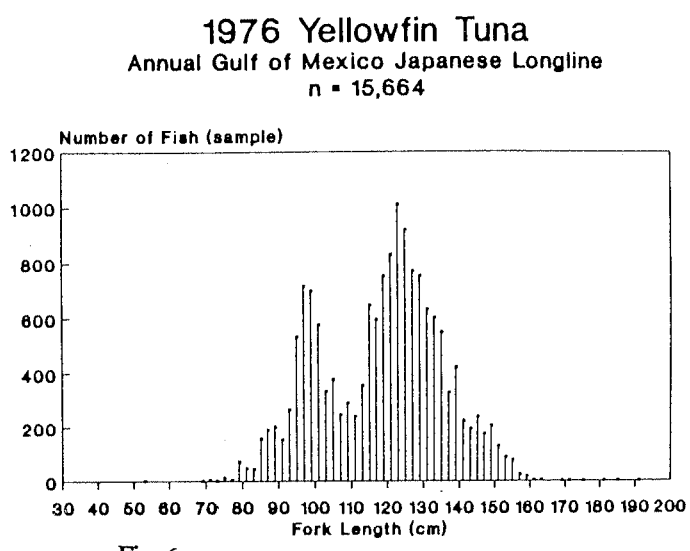


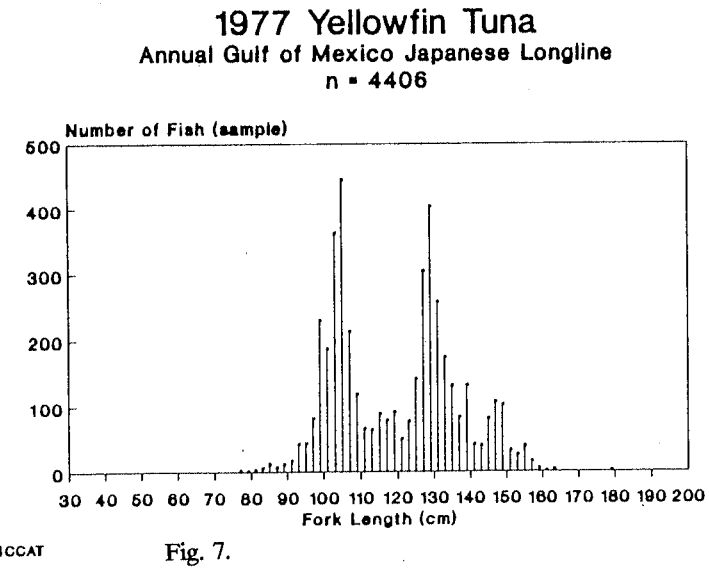
Fig. 4.



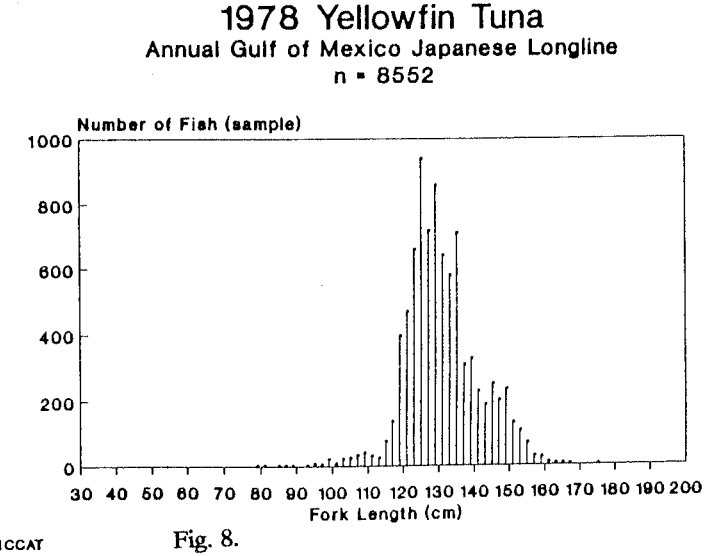
ICCAT Fig. 5.



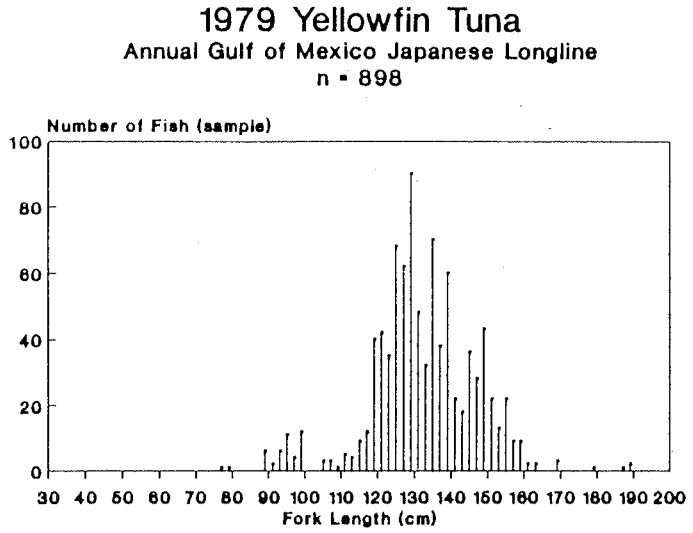
ICCAT Fig. 6.



ICCAT Fig. 7.

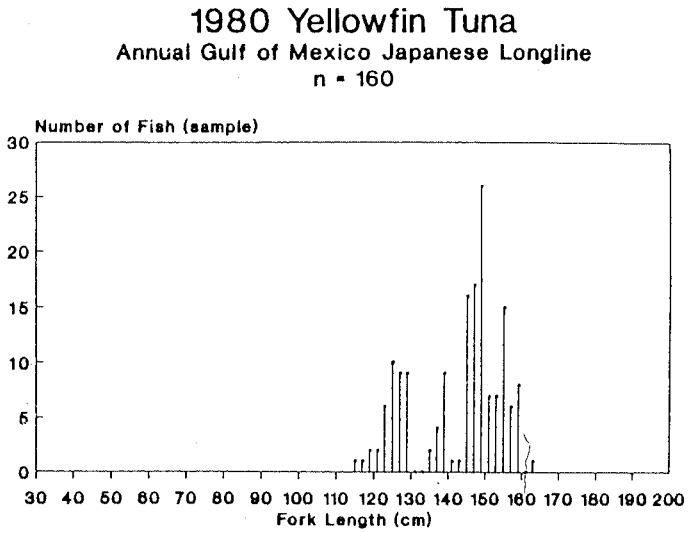


ICCAT Fig. 8.



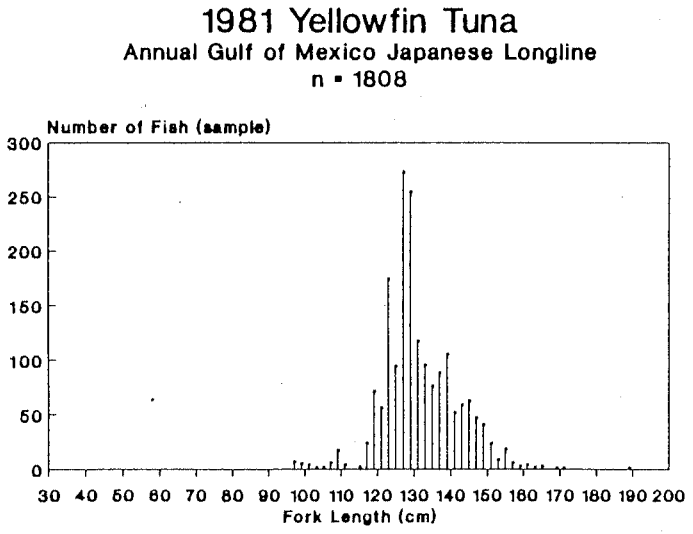
ICCAT

Fig. 9.



ICCAT

Fig. 10.



ICCAT

Fig. 11.

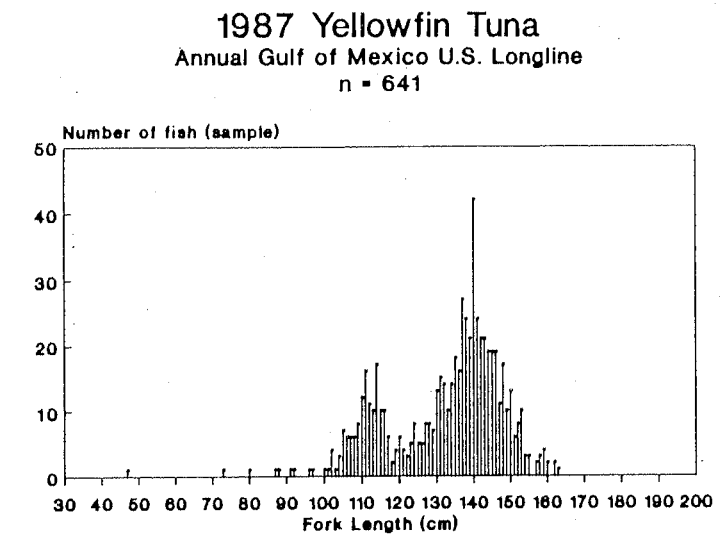


Fig. 12.

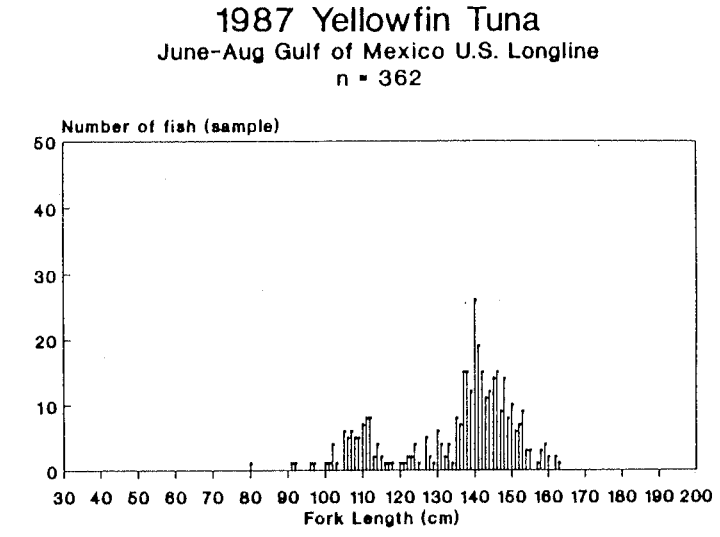


Fig. 13.

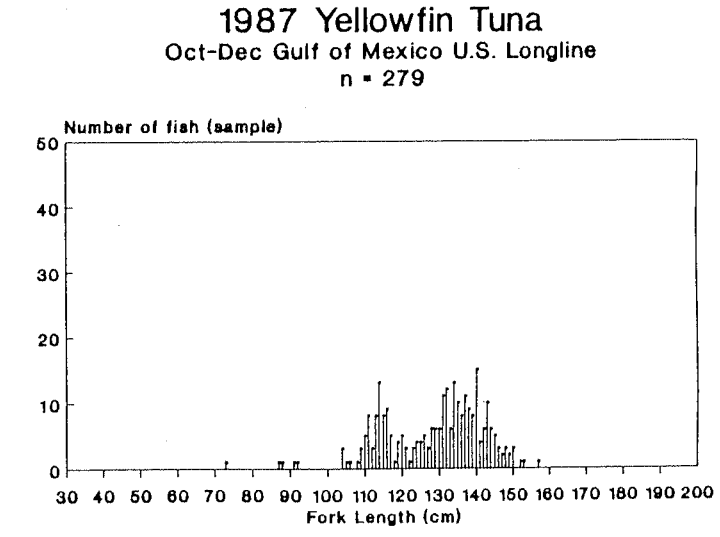
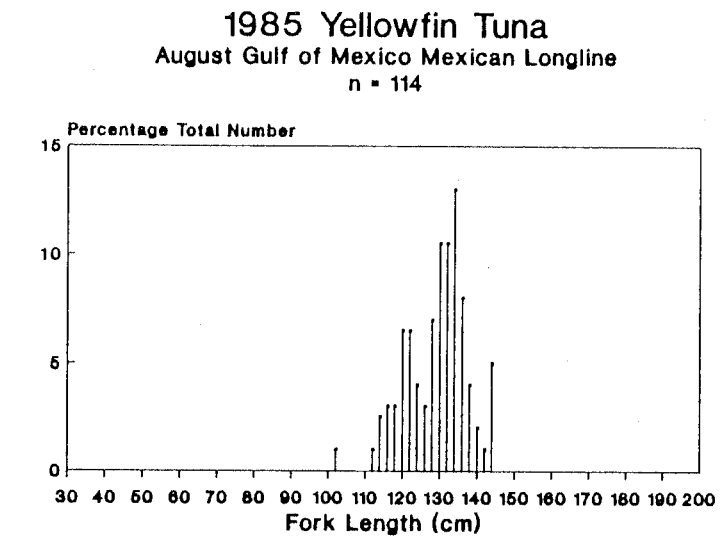


Fig. 14.



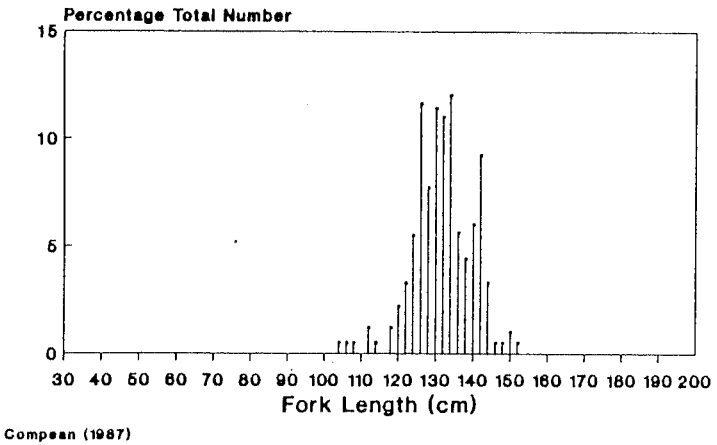


Fig. 15.

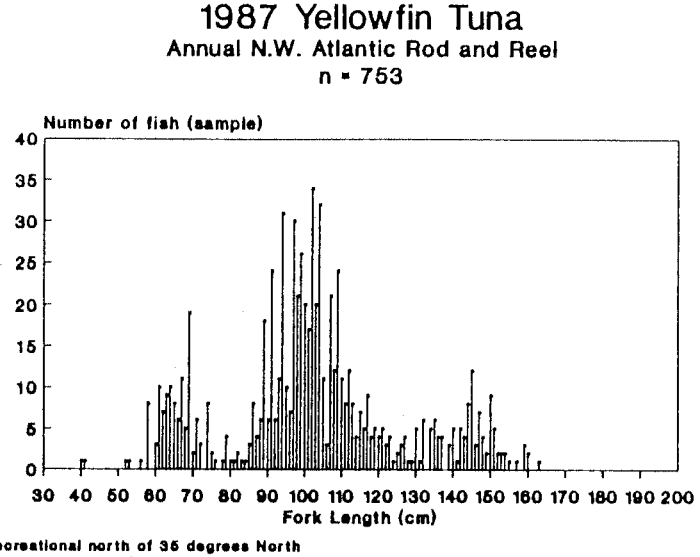


Fig. 16.

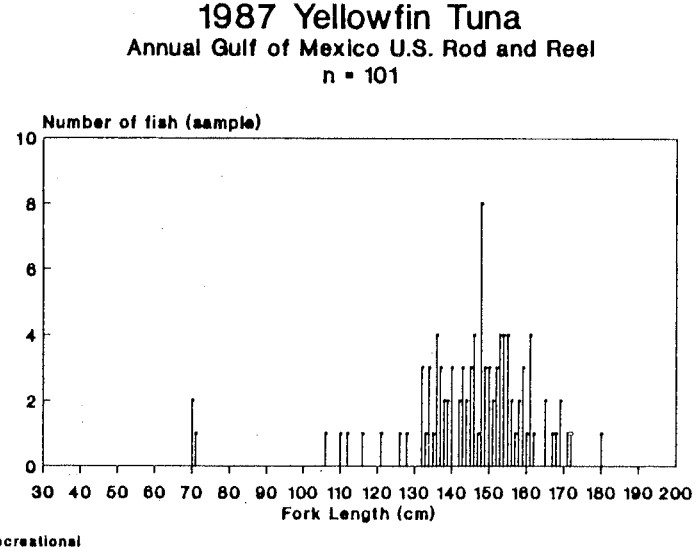


Fig. 17.

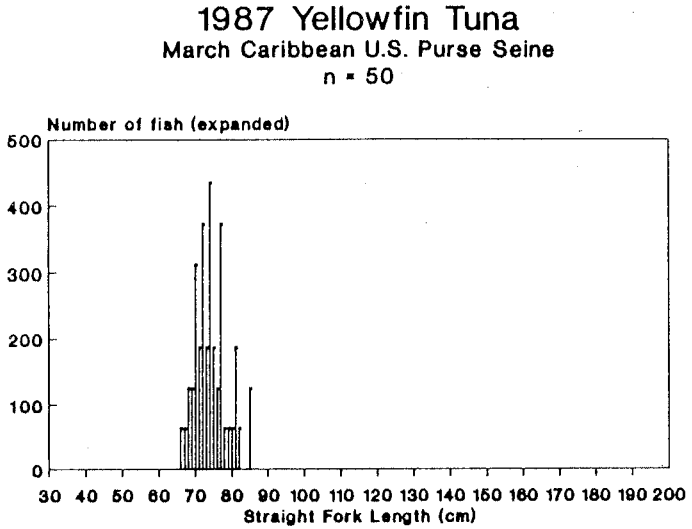


Fig. 18.

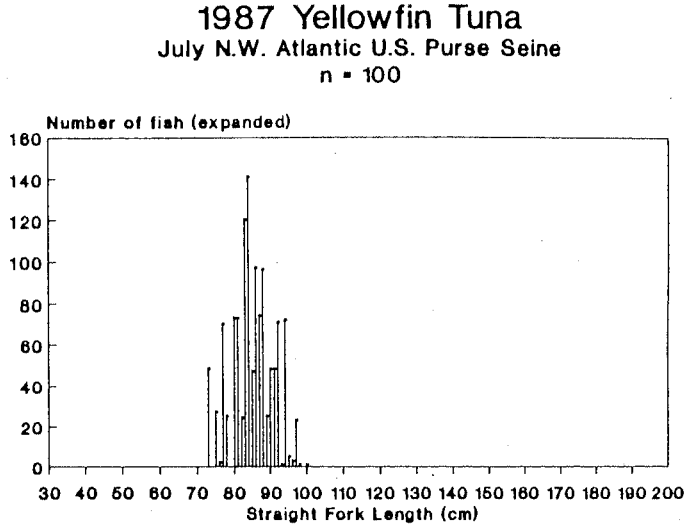


Fig. 19.

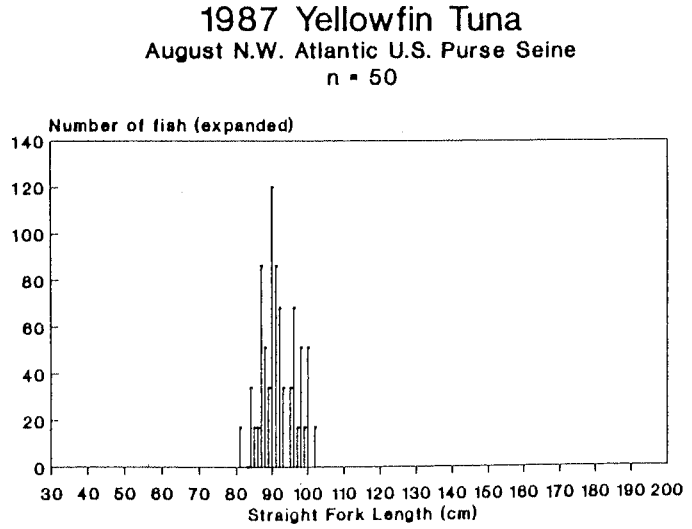


Fig. 20.