SIZE FREQUENCY OF BIGEYE TUNA (Thunnus obesus) IN THE CATCH OF THE ATLANTIC SURFACE FISHERY, 1967-1975

by

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SUMMARY

Length-frequencies from the bigeye tuna catches for 1967-1975 are presented for baitboat and purse seine gears to assess the possible impact of the 55 cm yellowfin tuna minimum size limit on the bigeye tuna catch. Available length-frequencies of bigeye tuna by gear and fleet are used to estimate the length composition of bigeye tuna in purse seine catches for 1967-1974 and baitboat catches for 1972-1975. For 1967-1974, an average of 10.3% of the purse seine bigeye catch was less than 55 cm. The percentage of baitboat caught bigeye tuna less than 55 cm for catch years 1972, 1973, 1974 and 1975 was 30%, 98%, 70%, 93%, respectively. Length-frequencies for 1972 and 1973 FIS baitboat caught bigeye and yellowfin tunas are compared and show a shift toward smaller bigeye tuna sizes in 1973 and little change in yellowfin tuna sizes. Length-frequencies for yellowfin and bigeye tunas are compared for combined 1976 single landings data from Tema-based baitboats. The limited data show a coincidental peak in the catch size frequency slightly below 55 cm for both bigeye and yellowfin tunas.

RESUME

Le présent document fait état des fréquences de taille du thon obèse, 1967-75, canne et senne coulissante, dans le but d'évaluer les répercussions que la limite de taille minimum de 55 cm de l'albacore peut avoir sur les prises de thon obèse. Les fréquences de taille du thon obèse disponibles par engin et par flottille sont utilisées pour estimer la composition de longueur du thon obèse dans les prises des senneurs (1967-74) et des canneurs (1972-75). Pour les années 1967-74, 10,3% en moyenne des thons obèses pris à la senne mesuraient moins de 55 cm. Pour les canneurs, ce pourcentage s'élevait à 30% pour 1972, 98% pour 1973, 70% pour 1974 et 93% pour 1975. La comparaison des fréquences de taille du thon obèse et de l'albacore pris par les canneurs FIS en 1972 et 1973 montre un déplacement vers de plus petites tailles de thon obèse en 1973 et peu de changement dans la taille de l'albacore. Les fréquences de taille du thon obèse et de l'albacore ont été comparées pour les données combinées de débarquements isolés en 1976 en provenance des canneurs basés à Téma. Les données limitées montrent une valeur maximum superposée dans la fréquence de taille légèrement en-dessous de 55 cm, aussi bien pour le thon obèse que pour l'albacore.

RESUMEN

Presenta las frecuencias de talla en las capturas de patudo, de 1967 a 1975, desglosadas por arte (cebo y cerco) con el fin de evaluar la repercusión potencial de la regulación de talla mínima para el rabil (55 cms.) sobre la captura de patudo. Para estimar la composición por talla del patudo en las capturas con cerco, de 1967 a 1974, y con cebo, de 1972 a 1975, se emplean las frecuencias de talla de patudo disponibles, por arte y por flota. De 1967 a 1974, una media de 10,3% del patudo capturado por cerco medía menos de 55 cms. El porcentaje de peces de menos de 55 cms. en las capturas de patudo de los barcos de cebo, fue: 30%, 98%, 70% y 93% en los años 1972, 73, 74 y 75 respectivamente. Comparando las frecuencias de talla de rabil y de patudo, capturado por los barcos de cebo de la flota FIS en 1972 y 1973, se observa un cambio de orientación en lo que respecta al patudo, hacia tallas menores en 1973, si bien respecto al rabil el cambio es insignificante. Se comparan las frecuencias de talla de rabil y de patudo, correspondientes a los datos combinados obtenidos de los desembarques individuales, efectuados en 1976 por los barcos de cebo con base en Tema. Los escasos datos muestran un valor máximo superpuesto en las frecuencias de talla de la captura ligeramente inferior a 55 cms., tanto para el rabil como para el patudo.

BACKGROUND

Bigeye tuna (Thunnus obesus) is primarily caught with longline gear and is generally not available in large quantities to surface gears. In the Atlantic, bigeye tuna were once taken almost exclusively by longliners, but in the 1970's the longline catch leveled off and the catch by surface gears increased (Table 1). Statistics for 1975 show that about 33% or 16,700 tons of bigeye tuna were landed by the surface fishery and 67% or 33,900 tons were landed by the longline fishery. Although the catch in weight of the surface fishery is relatively small, it represents several million fish, since primarily small fish are caught by the surface fishery.

In 1972 ICCAT adopted a minimum size limit of 3.2 kg (about 55 cm) for yellowfin tuna along with a tolerance limit for retention of incidental catches of undersized fish. The tolerance limit is 15% of the total number of fish per landing. Since the regulation went into effect, there has been several reported cases in which undersized yellowfin tuna have been landed by baitboats and purse seiners as bigeye tuna. These reported cases have created suspicion that mislabeling of yellowfin tuna landings as bigeye tuna landings to circumvent the regulation is a widespread practice which has specifically caused the total bigeye tuna catch to increase. Furthermore, because most of the catch of the surface fishery is small fish, the yellowfin tuna regulation is suspected to be directly responsible for increased catches of small bigeye tuna.

Intentional and unintentional labeling of yellowfin tuna landings as bigeye tuna landings, or vice versa, can easily occur, because small yellowfin and bigeye tunas look quite similar and are difficult for the inexperience to differentiate. Sampling of 1977 import landings in Puerto Rico, for example, showed that 19% of the yellowfin tuna landings sampled were actually bigeye tuna and 34% of the bigeye tuna landings sampled were actually yellowfin tuna (Tillerson, Coan and Holzapfel, MS)[1].

Similar sampling at other Atlantic landing ports have not been conducted, so we cannot estimate the full extent of the mislabeling problem. However, from the results at Puerto Rico, we can conclude that mislabeling is a serious problem that could seriously affect the accuracy of stock assessments of both yellowfin and bigeye tunas.

Small bigeye tuna and yellowfin tuna frequently school together and fishermen are not able to accurately determine the species composition of the school before fishing. Fishermen, however, are able to determine the general sizes of fish in a school before fishing; thus, they are able to avoid fishing schools of predominantly small fish. The yellowfin tuna minimum size regulation has so far been ineffective and in fact, greater numbers of undersized yellowfin tuna are being caught now than in years before the adoption of the regulation (Coan, MS)[2]. This is suspected to be directly responsible for increased catches of small bigeye tuna. In this report we examine the length composition of bigeye tuna in the catch of the surface fishery and assess the impact that the yellowfin tuna minimum size regulation has on the sizes of bigeye tuna caught by the surface fishery.

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[1] Tillerson, W.E., A.L. Coan, and E.P. Holzapfel. MS. 1977. Sampling of imported Atlantic-caught tunas for size and species composition in Puerto Rico, U.S.A., 1976-1977. Administrative Report No. LJ-77-18. Southwest Fisheries Center, La Jolla, CA.

[2] Coan, A.L. MS. 1977. Length and age composition of yellowfin tuna (Thunnus albacares) from the Atlantic Ocean, 1966-1976. Administrative Report No. LJ-77-20. Southwest Fisheries Center, La Jolla, CA

DATA SOURCES AND ANALYTICAL PROCEDURES

Catch statistics

Total catch of Atlantic bigeye tuna by country for years 1960 to 1976 (Table 1) were taken from ICCAT Statistical Bulletins 2 and 6 (ICCAT; 1972, 1976). Preliminary 1976 data were obtained from the ICCAT Secretariat (pers. commun., Madrid, Spain). Catches of bigeye tuna by longliners increased at a moderate rate from 1960 until 1971 when the longline fleet caught slightly over 36,000 tons. From 1971 through 1975 the longline catch remained at a relatively high level, fluctuating between 31,000 tons and 36,000 tons. In contrast to the longline catch trend the reported bigeye tuna catch by surface gears has shown peak catches slightly over 16,000 tons in 1974 and 1975. Before these two peak years the catch of the surface fishery exceeded 7,000 tons only in 1971 and 1973. In other years the catch ranged from 0 in 1960 and 1961 to 3,900 tons in 1972.

Annual catches by surface gear and country were partitioned into quarterly catches using reported catch and effort statistics. Quarterly catches for countries not reporting catch and effort data were estimated using FIS (French-Ivory Coast-Senegalese) yellowfin tuna catch and effort data for each surface gear (Coan, 1977) as both yellowfin and bigeye tunas are caught by the fleets.

Length-frequency statistics

Length-frequency statistics for bigeye tuna were obtained from various sources (Table 2). Japanese and United States fleets provided almost all of the purse seine catch and length-frequency samples. FIS and Japanese fleets provided the best series of usable baitboat length-frequency samples. All samples used in our analysis contained at least five fish; most samples had considerably more fish.

Many fleets reporting catch did not provide length-frequency samples of their catches. For quarters with purse seine catches without length-frequency samples the Japanese length-frequency samples were substituted for the missing samples. If no Japanese length-frequency sample was available for a quarter, FIS or U.S. length-frequency samples were used.

FIS and Japanese baitboat length-frequencies were used for quarters when countries reported baitboat catches but no length-frequencies.

Single landings length-frequency data for bigeye and yellowfin tunas captured by Tema-based baitboats were made available by ICCAT (pers. commun., Madrid, Spain). These were used in analysis of single boat landings.

Data treatment

The estimated annual catch length-frequency for each year and country was obtained by weighting each quarter's length-frequency sample by that quarter's catch and summing over quarters and countries. This proceeding was used for both baitboat and purse seine catches. The procedure used is described in detail in Coan (1977) and Coan and Sakagawa (1976), differing only in that the bigeye tuna length-weight relation was used (Lenarz, 1974):

$$W = 1.2494 \times 10^{-5} L^{3.12082}$$

where W = weight in kg
L = fork length in cm

The size composition of fish in the Tema-based baitboats single landings were estimated in a manner similar to that used for baitboat and purse seine annual catches. Each boat's sample was weighed by the boat's catch using the procedure described previously. The weighted length-frequencies of all boats were then combined to give the composition for the total sampled landings. This procedure was used for both yellowfin and bigeye tunas.

LENGTH COMPOSITION OF CATCHES

There are very few available length-frequency samples to work with in estimating the length composition of the bigeye tuna catches; consequently, depending on the level of analysis, the results can range from very poor precision to reasonably high precision.

Here we present three different analyses ranging from low precision for total catches by gear, to moderately high precision for individual boat landings.

Total catch by gear

Length composition of bigeye tuna in the catches of the combined baitboat fleets were estimated for 1972-1975 (Figure 1). Bigeye tuna less than 55 cm comprised 30%, 98%, 70% and 93% of the catches for the respective years 1972, 1973, 1974 and 1975. These percentages are higher than estimates of undersized yellowfin tuna in baitboat catches, suggesting that small bigeye tuna are more often caught and retained than small yellowfin tuna (Figure 2).

Length composition of bigeye tuna in the catches of the combined purse seine fleets were also estimated (Figure 3). The results suggest that a relatively small percentage, average 10.3%, of the catches consist of bigeye tuna less than 55 cm, and a higher percentage of undersized yellowfin tuna is caught and retained than small bigeye tuna (Figure 2). We note that sampling coverage of bigeye tuna in purse seine catches is poor and these results could very well be biased because of this.

Catch by fleet

In both 1972 and 1973, the sizes of bigeye and yellowfin tunas in the French-Ivory Coast-Senegalese baitboat catch were sampled reasonably well (ORSTOM; 1972, 1973). The length composition of both species in the catches were estimated (Figure 4). In 1972, the year ICCAT adopted the yellowfin tuna minimum size limit, the size composition of bigeye tuna and yellowfin tuna in the FIS baitboat catch was almost identical. In the following year, however, the compositions were entirely different with 98% of the bigeye tuna less than 55 cm whereas only 16% of the yellowfin tuna were less than 55 cm. Either a strong year class of bigeye tuna was available that year or the FIS baitboats retained a higher percentage of small bigeye tuna than small yellowfin tuna because of the yellowfin tuna minimum size regulation.

Single boat landing

Individual boat landings of Tema-based baitboats were made available by ICCAT for analyses. Records for only 1976 indicated adequate sampling of both yellowfin tuna and bigeye tuna from individual boat landings. The data were used to estimate the length compositions of the sampled landings (Figure 5).

The modal length for both yellowfin tuna and bigeye tuna is the same at about 50 cm but the percentage of bigeye tuna less than 55 cm is 97%, whereas it is 79% for yellowfin tuna. It appears that the Tema-based baitboats catch and retain a higher percentage of bigeye tuna under 55-cm long than yellowfin tuna.

THE IMPACT

With the sparse size-frequency data, both current and historic, available from bigeye tuna catches, there is not enough evidence to adequately evaluate the impact of the yellowfin tuna minimum size limit on the catch and sizes of bigeye tuna being caught. For sure, the regulation has caused deliberate mislabeling of undersized yellowfin tuna as bigeye tuna, but unintentional mislabeling of bigeye tuna as yellowfin tuna does occur and this, in part, offsets the deliberate actions.

Our results suggest that a larger proportion of small (less than 55 cm) bigeye tuna is retained than yellowfin tuna. Whether this is because of differences in schooling behavior and availability of the two species rather than the result of the regulation is not known. We suspect that a combination of these factors including variability in year class strength are responsible for the differences in proportion of small fish in the catches.

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Table 2. Data Sources of Bigeye Tuna Length-Frequency Samples

Fleet	Catch Year	Source
FIS, purse seine	1972	ORSTOM, 1973
" "	1973	ORSTOM, 1974
baitboat	1972	ORSTOM, 1973
"	1973	ORSTOM, 1974
Japan, purse seine	1967	ICCAT, 1973a
	1968	" , 1973a
	1969	" , 1973a
	1970	" , 1973b
	1971	" , 1973a
	1972	" , 1975a
	1973	" , 1975b
	1974	" , 1975b
baitboat	1974	" , 1975c
United States, purse seine	1968	Unpublished data, NMFS, La Jolla, CA
	1971	" " " " " "
	1972	" " " " " "
	1973	" " " " " "
	1974	" " " " " "
Spain, baitboat	1974	ICCAT, 1975c
	1975	" , 1975c
Ghana, baitboat	1973	ICCAT, 1974
Canaries, baitboat	1973	ICCAT, 1973a

Table 1. Bigeye catch by country and year in tons

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976[1]
Longline																	
Argentina	100	200	200	200	200	400	200	100	300	200	100	0	0	25	17	100	
Brazil						0	0	0	0	0	0	0	0	68	175	129	
Taiwan	0	0	18	41	48	0	595	2231	5344	7483	7555	5479	4990	3818	3097	3950	3274
Cuba	0	0	0	0	0	0	0	0	0	0	0	3200	2000	2600	2400	1900	1900
Japan	2904	11044	15720	14490	17336	28538	17576	8549	10286	10266	8993	20772	18525	20259	21356	17664	10000
Korea						0	289	320	263	1857	4732	7353	5730	5829	7376	10162	10200[3]
S. Africa						0	0	0	0	0	0	0	0	1	0	0	0
Panama						0	0	0	0	0	0	0	64	2684	1792		
Sub-total	3004	11244	15938	14731	17584	28938	18660	11200	16193	19806	21380	36804	31309	35284	36213	33905	
Surface																	
Japan	0	0	26	15	30	125	2	463	1059	474	124	249	308	192	721	328	4000
Spain						0	0	0	0	1100	1200	6991	3080	4422	3170	6855[2]	7200
United States									18	148	195	544	212	113	865	67	31
FIS						0	0	0	0	0	0	0	300	2456	1321	1448	1450
Korea																1750	1212
Morocco												0	0	0	0	15	
Portugal						0	0	0	0	0	0	0	0	0	9079	4844	4700
Ghana															5	280	165
Panama													2	0	978	1105	750
Sub-total	0	0	26	15	30	125	2	463	1077	1722	1519	7784	3902	7183	16139	16692	
Unclassified																	
Cuba						100	300	300	900	1000	4100	0	0	0	0	0	
S. Africa				200	200	0	0	0	0	0	0	0	0	0	0	0	
FIS				2700	2800	0	0	0	0	1600	1200	500	0	0	0	0	
Sub-total	0	0	0	2900	3000	100	300	300	900	2600	5300	500	0	0	0	0	
TOTAL	3004	11244	15964	17646	20614	29163	18962	11963	18170	24128	28199	45088	35211	42467	52352	50597	

[1]Incomplete reporting

[2]Estimated

[3]Korea and Panama combined

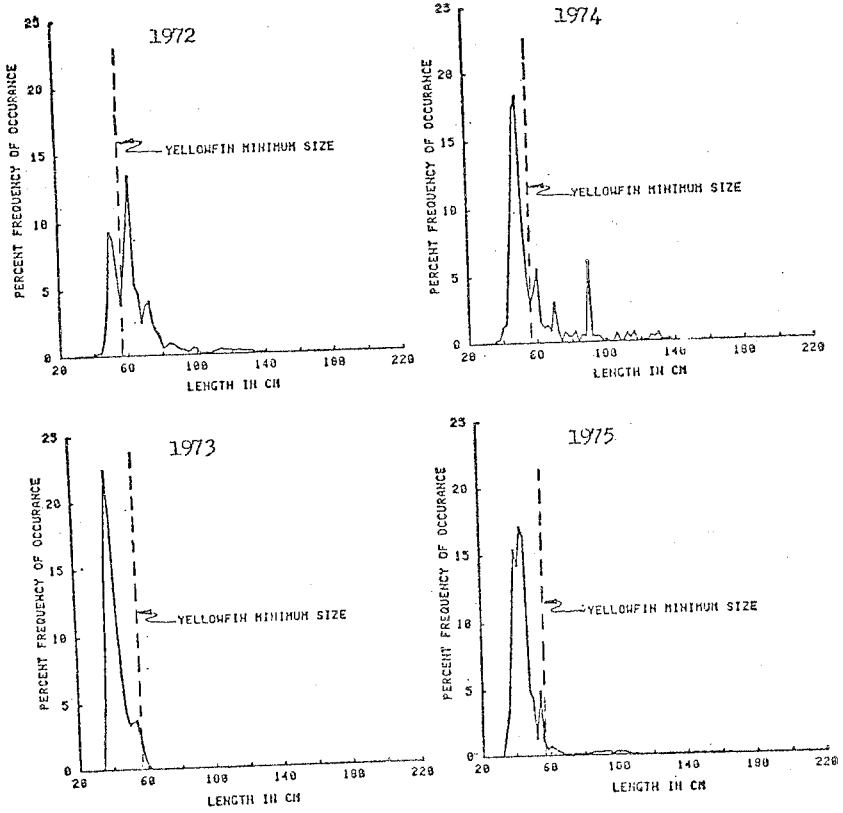

Figure 1. Eastern Atlantic baitboat catch length-frequencies of bigeye tuna for 1972-1975

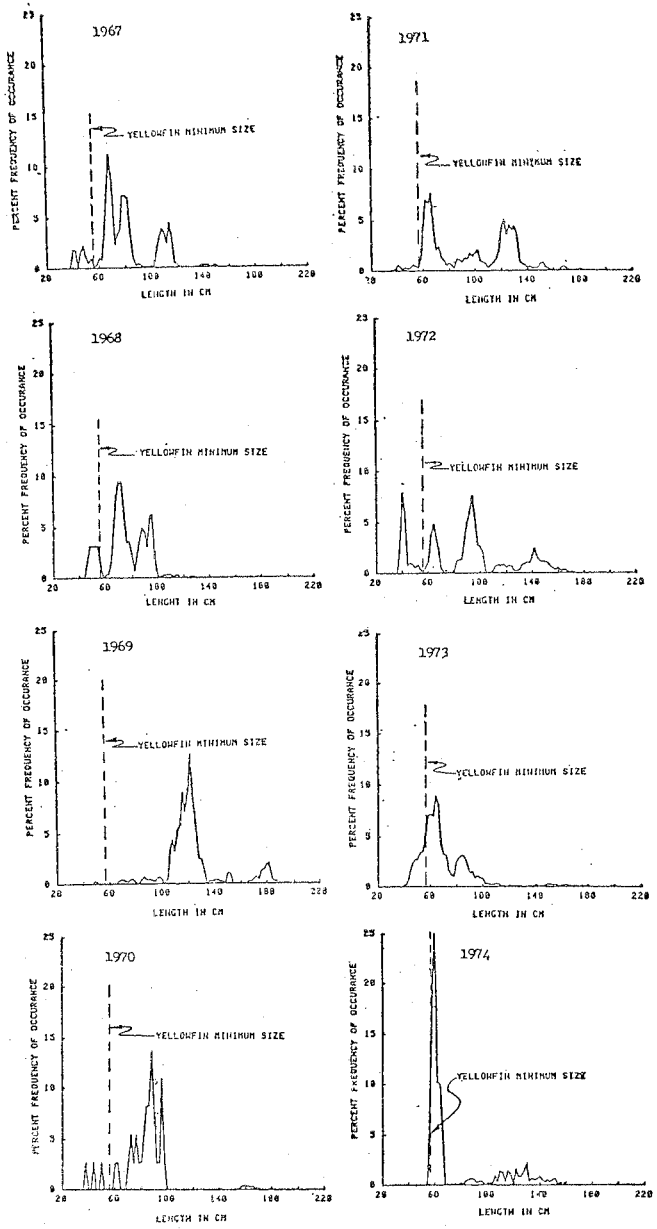

Figure 3. Eastern Atlantic purse seine catch length frequencies for bigeye tuna for 1967-1974

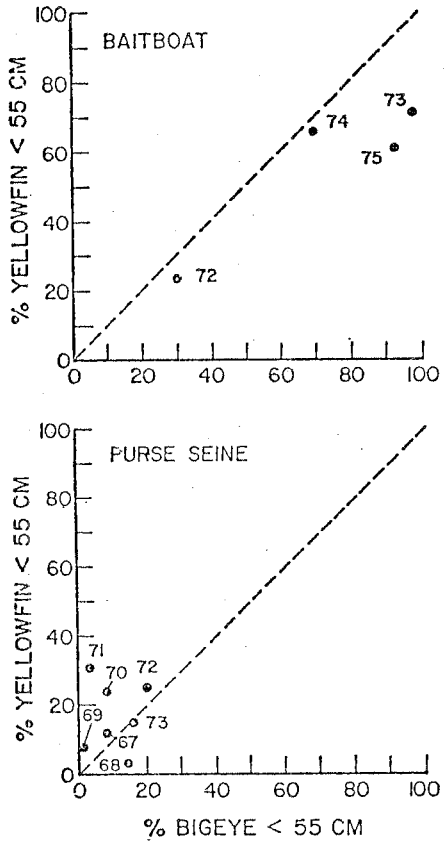

Figure 2. Percent of catch of yellowfin and bigeye tunas less than 55 cm for baitboats and purse seine fleets by year

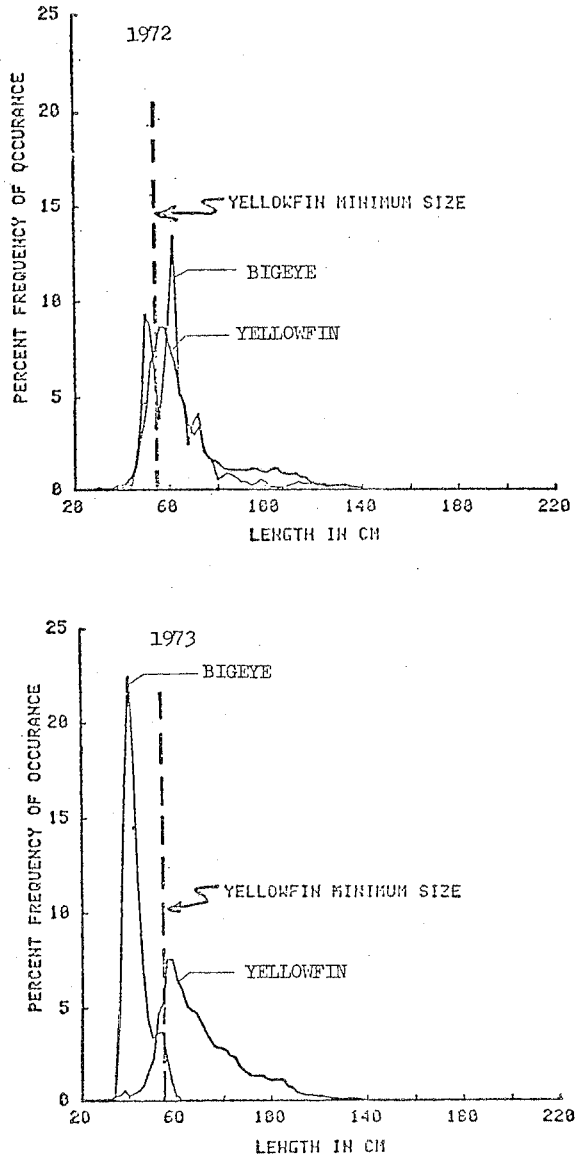

Figure 4. Percent frequency of occurrence of yellowfin and bigeye tunas in FIS baitboat catches in 1972 and 1973

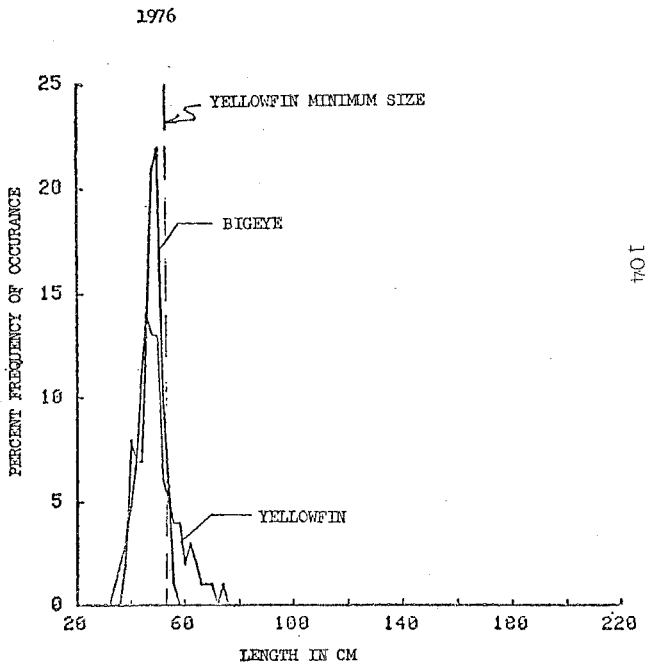

Figure 5. Percent frequency of occurrence of bigeye and yellowfin tunas less than 55 cm in the 1976 Tema-based baitboat single-landings data (pers. commun., ICCAT, Madrid, Spain)