LENGTH AND AGE COMPOSITION OF SKIPJACK TUNA FROM THE ATLANTIC OCEAN, 1968-73

by

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SUMMARY

In 1974, the International Commission for the Conservation of Atlantic Tunas recommended that a common data base on the age composition of skipjack tuna be compiled and made available in order that all scientists would have comparable data to base assessments on the status of the stocks. The task was undertaken by the Southwest Fisheries Center. Estimates of age and length composition of the skipjack catch in 1968-1973, for the eastern Atlantic, along with the procedures used to obtain the estimates are presented in this paper. Estimates for the western Atlantic are not presented due to the lack of data.

Catches of skipjack tuna in the eastern Atlantic for the surface and longline fisheries are between 13 and 34 million fish annually. The dominate age is 1-year old which accounts for between 19 and 27 million fish annually.

RESUME

En 1974, la Commission Internationale pour la Conservation des Thonidés de l'Atlantique a recommandé qu'un fonds commun de données sur la structure démographique du listao soit rassemblé et mis à la disposition de tous les scientifiques afin de leur fournir des statistiques comparables sur lesquelles baser leur évaluation de l'état des stocks. Le "Southwest Fisheries Center" s'est chargé de ce projet. Le présent document contient des estimations de la composition par âge et par taille de la prise de listao de 1968 à 1973 pour l'Atlantique Oriental, ainsi qu'une description de la procédure suivie pour arriver à ces estimations. Le manque de données n'a pas permis d'établir des estimations concernant l'Atlantique Occidental.

Les prises de listao des pêcheries de surface et à la palangre dans l'Atlantique Oriental vont de 13 à 34 millions de poissons par an. L'âge qui prédomine est celui de 1 an, qui s'élève de 19 à 27 millions de spécimens par an.

RESUMEN

En 1974, la Comisión Internacional para la Conservación del Atún Atlántico, recomendó la recopilación y puesta en circulación de una base común de datos sobre la composición por edades del listado, para que todos los científicos tuviesen datos equiparables sobre los que basar sus evaluaciones sobre el status de los stocks. De esta tarea se hizo cargo el "Southwest Fisheries Center". En el presente documento se presentan estimaciones de la edad y composición por tallas de la captura de listado en el Atlántico oriental de 1968-1973, así como los procedimientos empleados para obtenerlas. No se hacen estimaciones sobre el Atlántico occidental por falta de datos.

Las capturas de listado en el Atlántico oriental, tanto en pesca de superficie como de palangre, van de 13 a 34 millones de peces anualmente. La edad domiante es de 1 año, aplicable a una cantidad entre 19 y 27 millones de peces por año.

The skipjack tuna fishery in the Atlantic Ocean essentially began in the mid 1950's by French and Spanish baitboats that fished off Africa for yellowfin tuna; skipjack was taken as an incidental catch. Market demand for skipjack tuna increased in the 1960's, and the fishery grew in importance. It produced a record catch of 87,400 MT in 1971 (ICCAT, 1975a). This record appears to have been exceeded by approximately 18,000 MT in 1974, according to preliminary statistics.

Approximately 96% of the annual catch is made by baitboats and seiners (surface fishery), 1% by longliners (longline fishery), and 3% is unclassified. The surface catch is landed principally by the Japanese, Spanish, United States, and FIS (French-Ivory Coast-Senegalese) fleets operating in the eastern Atlantic (Figure 1). Longline catches are taken throughout the Atlantic and are landed principally by the Japanese and Taiwanese fleets.

This expanding fishery has generated considerable interest in ICCAT (International Commission for the Conservation of Atlantic Tunas). In 1974, ICCAT recommended that a common data base of the age composition of skipjack be compiled and made available in order that all scientists would have comparable data to base assessments on the status of the stocks (ICCAT, 1975b). The task of compiling the data base was undertaken by the SWFC (Southwest Fisheries Center). The purpose of this report is to describe the data and procedures used to estimate the catch in numbers of skipjack tuna. Results on age composition of the skipjack catch 1968-73 are also presented and discussed. The availability of adequate length-frequency samples from the catches of major fleets limited the study to years 1968-73.

SOURCES OF DATA

Data on total catch of skipjack tuna by country, gear, and region (eastern and western) for 1968-73 (Table 1) were obtained from the ICCAT Statistical Bulletin (ICCAT, 1975a). In some cases, the catch by region was not given and information on fishing activities of the fleet or comparable fleets was used to determine the probable region of the catch. This was done for the following catches:

Cuba - all purse seine catches are assumed to be from the eastern Atlantic. Longline catches were divided between regions based on Japanese longline catch-effort data (Fisheries Agency of Japan, 1970-73). The Japanese data are in numbers of fish whereas the Cuban longline catches are in weight. In using the Japanese data, I therefore assumed that the average size of skipjack caught is the same in the western and eastern regions.

Japan - all baitboat catches are assumed to be from the eastern Atlantic. Longline catches were divided into eastern and western regions based on Japanese longline catch-effort data.

Korea - all baitboat catches are assumed to be from the eastern Atlantic. Longline catches were divided between regions based on Japanese longline catch-effort data.

Panama - all baitboat catches are assumed to be from the eastern Atlantic. Longline catches were divided between regions based on Japanese longline catch-effort data.

Spain - all catches are assumed to be from the eastern Atlantic.

Taiwan - longline catches were divided between regions based on Japanese longline catch-effort data.

Unclassified catches by country were assigned to region and fishery (longline or surface) based on information of the fleets.

Data on length-frequency samples of skipjack tuna were collected from many sources (Table 2). The most complete series of data is from the FIS, Japanese, and United States fleets. Measurements were in fork length except for the FIS fleets which were in predorsal length. Data from the FIS fleets were converted to fork length using the equation,

$$L_f = 2.752\ L_d^{1.009}$$

where L_f = fork length in cm and L_d = predorsal length in cm. (Pianet, MS[1]).

[1]Pianet, R., MS. Relations Poids-Longueur des Listaos (*Katsuwonus pelamis*) Peches dan le Secteur de Pointe-Noire. ICCAT Collective volume of scientific papers, Volume 2 (SCRS-1973): 126-133.

DATA PROCESSING

A computer data base was created to efficiently handle the data on catch and length frequency. In the base, catch was referenced by keys such as: country, year, species, gear, area and quarter. Length-frequency samples were referenced by similar keys except that the smallest time stratum (e.g., monthly, bi-monthly, quarterly, or yearly) was used.

Data for each year were processed through the following steps using various computer programs on file at SWFC:

Step 1: Each length-frequency sample was standardized into 2-centimeter intervals.

Step 2: All length-frequency samples were weighted by the catch in number of fish from which the sample was taken.

The length-weight relation,

$$W = 0.000005611\ L_f^{3.31497}$$

where W = weight in kg and L_f = fork length in cm (Lenarz, 1974), was used to convert length frequencies into weight frequencies and average weight of fish in the sample. This average weight was then used to obtain number of fish in the sampled tonnage.

Step 3: Catches by gear, country and area (Table 1) were divided into quarters using available catch-effort data of the specific country. Catches for countries without catch-effort data were divided using data from comparable fleets.

All baitboat catches from the eastern Atlantic were distributed according to the quarterly distribution of catches of FIS baitboats. All purse seine catches from the eastern Atlantic, for which there were no catch-effort data, were distributed according to the quarterly distribution of catches of FIS purse seiners, except for the Canadian catches. Here, the catches were assumed to be distributed as the United States catch.

Step 4: For each country, all length-frequency samples were stratified by gear, area and quarter. For the eastern Atlantic ICCAT sub-areas or NMFS sub-areas were used as the area strata (Figures 1 and 2). The western Atlantic was not subdivided into area strata but considered as a whole. For quarters or areas in which there were catches but no length-frequency samples, samples from adjacent quarters or areas were substituted.

Length-frequency samples for the catch of some fleets were unavailable, e.g., western and eastern Atlantic longline catches. Length-frequency samples were available for the Canadian purse seine catches for 1970 and 1971 (Table 2), and for the 1973 Japanese baitboat catches made in the western Atlantic. However, because of sparse data on length frequencies from the western Atlantic, I elected not to estimate the length composition of the catch from that region, instead concentrating on the eastern Atlantic catches. Samples from the eastern Atlantic surface catches were substituted for missing samples from the eastern Atlantic longline catches. For other catches from the eastern Atlantic with missing length-frequency samples, samples from comparable fleets for the same year were substituted (Table 3). Substitution was as follows: length-frequency samples from FIS baitboats were substituted for missing samples from baitboat catches, except for 1973 catches by Japanese, Korean, Panamanian and Ghanaian baitboats. These baitboats operate out of Ghana, and 1973 length-frequency samples for the Ghana-based baitboats were used for the 1973 catches of these fleets. Samples from FIS purse seiners were substituted for missing samples from purse seine catches, except for all Canadian catches and 1973 catches of Japanese and Ghanaian purse seiners (Table 3). Samples from the U.S. catch were substituted for missing Canadian samples (Sakagawa et al., MS[2]), and 1973 samples from Ghana-based seiners were substituted for missing samples from the Japanese and Ghanaian purse seine catch.

Step 5: Length and age composition of the catch for both the surface and longline fisheries in the eastern Atlantic were estimated[3]. The age composition estimates were increased by a factor to account for the unclassified catches. Ages were designated using the growth equation of Joseph and Calkins (1969). The following is a table of age and corresponding approximate size of skipjack tuna used in the study.

Age group	Age interval (year)	Length interval (cm)
0	0.01-0.97	1-30
1	0.97-2.01	30-51
2	2.01-3.01	51-64
3	3.01-4.09	64-73
4+	4.09+	73+

LENGTH AND AGE COMPOSITION OF THE CATCH

Estimates of number of fish by 2-cm interval in the eastern Atlantic longline and surface catch for 1968-73 were made. The range of lengths of fish caught in the 1968-73 longline and surface fisheries in

[2]Sakagawa, G.T., A.L. Coan, and E.P. Holzapfel. MS. Length composition of yellowfin skipjack, and bigeye tunas caught in the eastern tropical Atlantic by American purse seiners. Administrative Report No. LJ-75-71. Southwest Fisheries Center, La Jolla, Calif.

[3]Tabulated estimates by 2-centimeter intervals are available from the author.

the eastern Atlantic is 21 to 91 cm with the fisheries concentrating on fish between 30 and 70 cm (Figure 3), or 1-, 2-, and 3-year-old fish (Table 4). In most years the dominate age group was 1-year-olds.

LIMITATIONS OF RESULTS

Complete data on catch and length frequencies are lacking for some fleets (Tables 2 and 3) that catch significant quantities of skipjack tuna in the Atlantic. Assumptions were made about the spatial-temporal distribution of the catch and sizes of fish caught by these fleets and data from comparable fleets were substituted in order to estimate the length composition of the total catch from the eastern Atlantic. The accuracy of the assumptions and substitutions, therefore, essentially determine how accurate the estimates are.

Length-frequency samples were substituted and used for certain catches. The percentage of the annual eastern Atlantic catch requiring substitutions ranges from 51% in 1971 to 68% in 1969 for the surface and longline fisheries (Table 5). This is only a rough index of the accuracy of my estimates. It does not imply that the fraction of the catch sampled was sampled adequately. For some fleets, only a few samples were taken from a limited spatial-temporal stratum to be representative of the entire fleet's catch. Yet in Table 5 the entire catch is listed as sampled.

There are some refinements to the processing of the data which may result in more accurate estimates. First, if missing data, especially length-frequency or catch-effort data, should become available substitutions would be required for a smaller percentage of the total catch was by the growth equation of Joseph and Calkins (1969), which is based on skipjack from the Pacific Ocean. If the growth of skipjack in the Atlantic is not the same as growth of skipjack in the Pacific, then a growth equation for Atlantic skipjack tuna should be used. Finally, the longline catch for some countries for 1972 and 1973 were separated into regions using the 1971 catch-effort data from the Japanese fleet. Catch-effort data are currently available for 1972 and 1973 and should be used instead.

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Table 1. Catch (metric tons) of skipjack tuna from the Atlantic Ocean for 1968-1973

Country	Region	1968	1969	1970	1971	1972	1973
Longline							
Argentina	Western						16
Brazil	Western				400		
Taiwan	Eastern	5	4	6	7	21	41
	Western	2		7	2	7	14
Cuba	Eastern				1,184		
	Western				416		
Korea	Eastern				35	33	
	Western				12	12	
Panama	Eastern						6
	Western						36
Japan	Eastern	20	6	2	1	2	
	Western	10		3	1	1	
Sub-total longline		37	10	18	2,058	76	113
Baitboat							
Cuba	Eastern						1,500
Japan	Western						421
	Eastern	7,306	4,926	7,481	11,730	10,149	12,980
Korea	Eastern						922
Morocco	Eastern	850	145	1,115	118	1	72
Portugal	Eastern						1,959
Spain	Eastern	10,200	14,016	15,254	13,028		4,252
Ghana	Eastern						128
Panama	Eastern					676	159
FIS	Eastern	7,940	4,600	4,800	5,700	3,800	3,663
Angola	Eastern	10,600	4,600	900	2,000	1,500	
Purse seine							
Canada	Eastern		146	317	205		1,189
	Western	923		268	1,025	7	13
Cuba	Eastern				200	100	
Japan	Eastern	6,255	679	3,519	6,222	3,386	1,544
Spain	Eastern	8,900	4,284	6,946	15,000	18,617	17,840
U.S.	Western			374	401	10	61
	Eastern	3,314	4,849	11,378	15,823	12,280	21,113
Ghana	Eastern						160
FIS	Eastern	5,060	3,800	9,200	13,800	16,700	8,693
	Western					900	332
Venezuela	Western						276
Unclassified	Eastern	1,600	1,200	1,900		8,150	1,600
	Western	800	400	400			
Sub-total Baitboat and purse seine		63,748	43,645	63,852	85,252	76,276	78,877

Table 2. Sources of length-frequency samples of skipjack tuna from the Atlantic Ocean

Country	Gear	Area	1968	1969	1970	1971	1972	1973
FIS	Ice baitboat	ICCAT III	1	1	1			
	Freezer baitboat	ICCAT III		1	1			
	Purse seine	ICCAT III		1	1			
	Purse seine	ICCAT I	1	1	1	6	6	6
	Freezer baitboat	ICCAT I	1	1	1			
	Large purse seine	ICCAT I		1		6	6	6
	Baitboat	Eastern				6	6	6
	Surface	ICCAT III			7	7		
Bhana-based	Baitboat	Eastern						2
	Purse seine	Eastern						2
Japan	Purse seine	Eastern	3	3		3	2	
	Baitboat	Eastern					2	5
	Surface	Eastern			4			
U.S.	Purse seine	NMFS 51	8	8	8	8	8	8
	Purse seine	NMFS 52	8	8	8	8	8	8
	Purse seine	NMFS 53			8	8		8
Canada	Purse seine	Western			4	4		
	Purse seine	Eastern		4	4	4		
	Purse seine	ICCAT I						2
Canary Islands	Baitboat	ICCAT III						3
	Troll	ICCAT III						3

[1]ORSTOM, 1971

[2]ICCAT, 1974

[3]ICCAT, 1973a

[4]ICCAT, 1973b

[5]ICCAT, 1975c

[6]Pianet, R., and Y. Le Hir, 1972; Pianet, R., et al, 1973; Pianet, R., and Y. Le Hir, 1974

[7]Champanat, C., and R. Le Marrec, 1972

[8]Sakagawa, G.T., A.L. Coan, and E.P. Holzapfel, MS. Length composition of yellowfin, skipjack and bigeye tunas caught in the eastern tropical Atlantic by American purse seiners. Administrative Report No. LJ-75-71. Southwest Fisheries Center, La Jolla, Calif.

Table 3. Available length-frequency samples (X) and substituted samples (footnotes) for the surface fishery for skipjack tuna in the eastern Atlantic

Country	1968	1969	1970	1971	1972	1973
Baitboat						
Cuba						2
Japan	2	2	2	2	2	1
Korea						1
Morocco	2	2	2	2	2	2
Portugal						2
Spain	2	2	2	2	2	2
Ghana						1
Panama					2	1
FIS	X	X	X	X	X	X
Angola	2	2	2	2	2	
Purse seine						
Canada		5	5	5		5
Cuba				3	3	
Japan	X	X	3	X	X	4
Spain	3	3	3	3	3	3
U.S.A.	X	X	X	X	X	X
Ghana						4
FIS	X	X	X	X	X	X

[1]Ghana-based baitboat 1973

[2]FIS baitboat same year

[3]FIS purse seine same year

[4]Ghana-based purse seine 1973

[5]U.S. same year

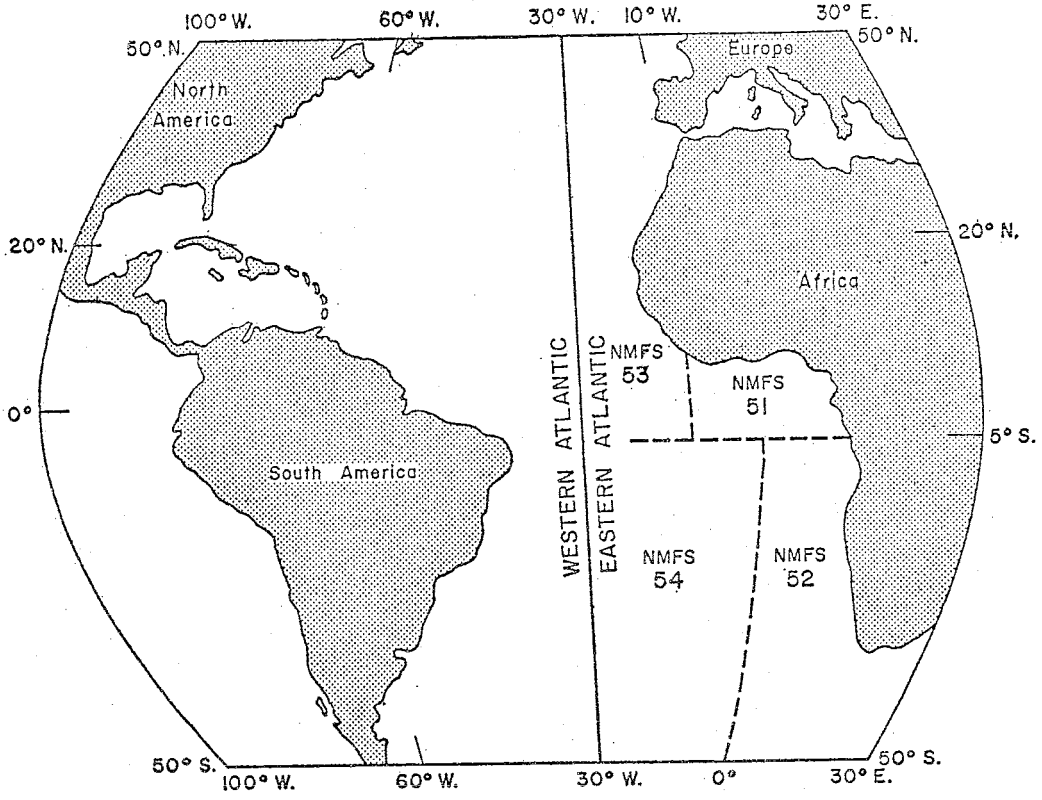

Figure 1. Atlantic Ocean regions (eastern and western) and NMFS sub-areas. The western Atlantic region includes the Caribbean and the Gulf of Mexico

Table 4. Age composition ($X10^3$ fish) of skipjack tuna caught in the eastern Atlantic, 1968-73

Age (years)	Approx. length interval (cm)	1968	1969	1970	1971	1972	1973
0	1-30	<1	3		112	10	
1	30-51	8,866	6,057	19,451	20,473	15,829	26,876
2	51-64	12,119	7,041	7,041	11,430	10,827	7,177
3	64-73	147	104	214	416	944	422
4+	73+	5	1	2		6	
TOTAL		21,137	13,206	26,708	32,431	27,616	34,475

Table 5. Length-frequency sample coverage of the skipjack catch from the eastern Atlantic, 1968-73

Year	Tonnage substituted		Total tonnage (m tons)
	m tons	%	
1968	39,481	63	62,050
1969	29,327	68	43,255
1970	37,440	60	62,818
1971	43,508	51	85,053
1972	39,249	52	75,415
1973	44,352	57	77,821

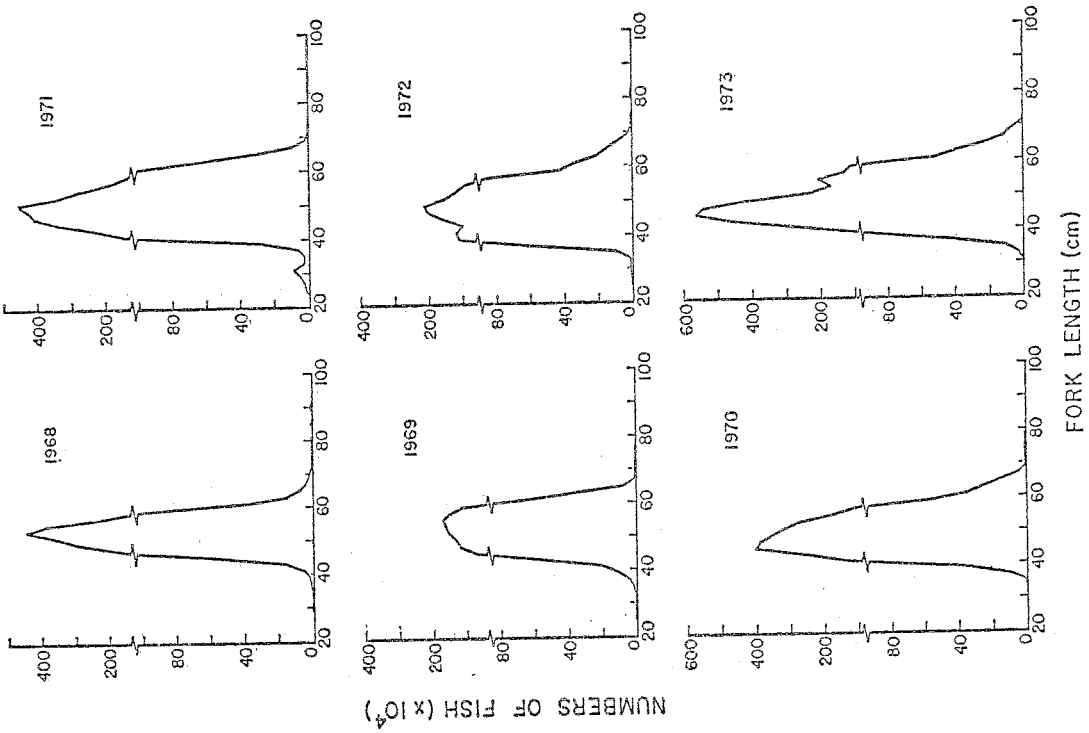

Figure 3. Length composition of the skipjack tuna catch from the eastern Atlantic Ocean

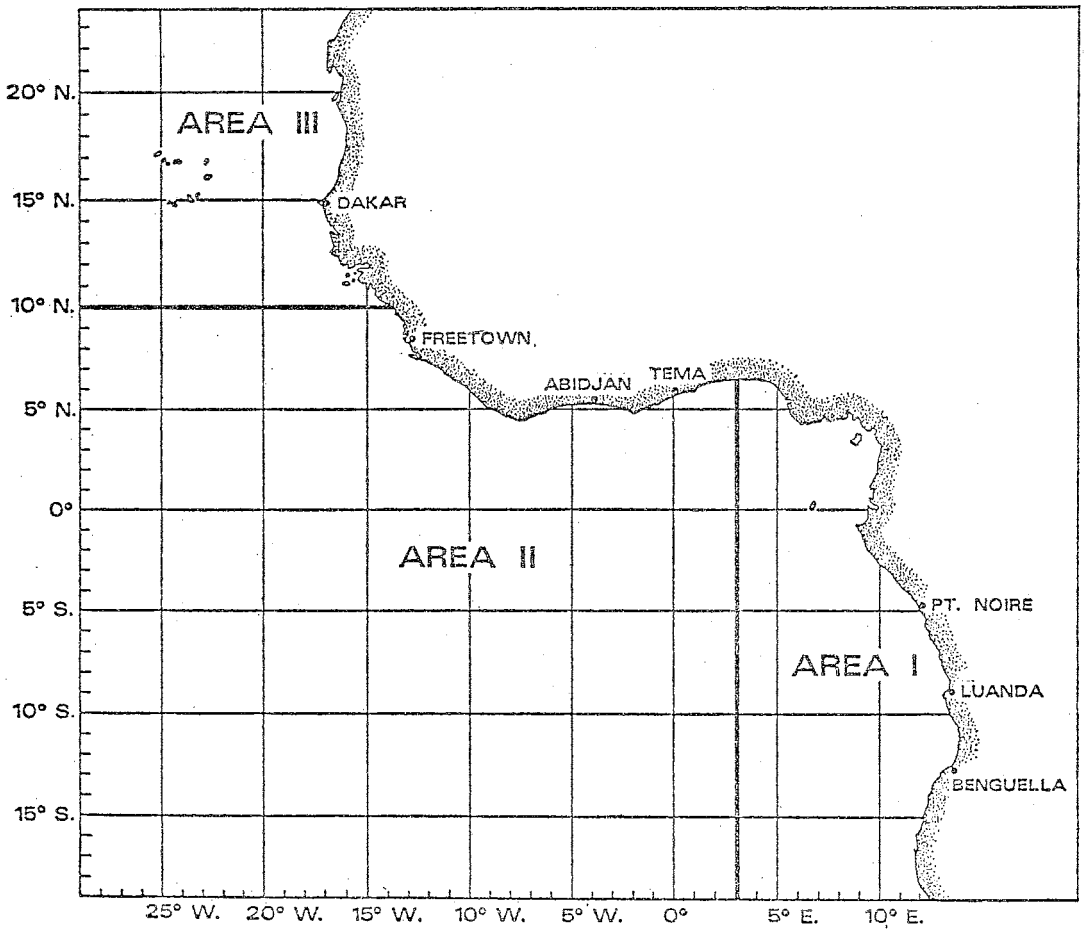

Figure 2. ICCAT sub-areas for the eastern Atlantic region