

Species Composition of Tuna Schools Caught by a Baitboat Fishery in the Gulf of Guinea

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Most tuna schools (85%) encountered by chartered Japanese baitboats in the Gulf of Guinea during the third quarters of 1980 and 1981 were mixed schools of skipjack and yellowfin tunas, or these two plus bigeye tuna. Data from commercially operated baitboats indicated a higher proportion of pure schools (as high as 73% pure schools of skipjack in the second quarter of 1978), but this trend was exaggerated because schools were not recorded as mixed unless the catch of the second species exceeded 0.1 MT. Catches by number or by weight were greatest from schools containing all three species.

All three species showed similar frequencies of individual fork lengths. When weights were estimated from these lengths, few individuals of any species exceeded the 3.2 kg minimum weight limit on yellowfin and bigeye tunas.

The results indicated that if fishermen were to avoid fishing schools of yellowfin or bigeye tunas which did not contain skipjack, the catch of yellowfin and bigeye would be reduced by only 1% to 2%, but if they were to stop fishing schools of these species which also contained skipjack, the catch of skipjack would be reduced by 95%. The possibility of reducing catches of undersized yellowfin or bigeye tunas by selectively fishing schools is therefore not a practical one.

La plupart (85%) des bancs de thonidés observés par les canneurs japonais en location dans le golfe de Guinée au cours du troisième trimestre de 1980 et 1981 étaient des bancs mixtes de listao et albacore, avec lesquels se trouvait dans certains cas du thon obèse. Les données fournies par les canneurs commerciaux indiquent un plus fort pourcentage de bancs monospécifiques (jusqu'à 73% de bancs intégraux de listao pendant le deuxième trimestre de 1978), mais cette tendance se trouve exagérée du fait que les bancs mixtes n'étaient pas enregistrés comme tels lorsque les prises de l'espèce secondaire étaient inférieures à 0,1 TM. Les prises, numériques et en poids, étaient plus importantes dans le cas de bancs rassemblant les trois espèces.

Les individus des trois espèces montraient des fréquences similaires de longueur (fourche). Une fois estimé le poids à partir de ces longueurs, il s'avéra que peu de spécimens de ces espèces dépassaient la limite de 3,2 kg imposée pour l'albacore et le thon obèse.

Ceci permet de déduire que si les pêcheurs évitent les bancs d'albacore et de thon obèse qui ne contiennent pas de listao, les prises des deux premières espèces ne se verraient diminuées que de 1 à 2%, alors que le fait d'éviter les bancs contenant les trois espèces entraînerait une réduction de 95% des prises de listao. La possibilité de réduire les prises d'albacore et thon obèse sous-taille en pratiquant une pêche sélective des bancs n'est donc pas réaliste.

La mayor parte de los cardúmenes hallados por los barcos de cebo japoneses en el Golfo de Guinea durante el tercer trimestre de 1980 y 1981 estaban compuestos de listado y rabil, o de estas dos especies y patudo. Los datos de barcos de cebo comerciales indicaron una mayor proporción de cardúmenes puros (cifras tan altas como el 73% de listado en el segundo trimestre de 1978) si bien esta tendencia resultaba exagerada, debido a que los cardúmenes no se registraban como mixtos a menos que la captura de las especies secundarias excediese de 0,1 TM. Las capturas más abundantes correspondían a cardúmenes que contenían las tres especies.

Por individuos, los ejemplares de rabil, patudo y listado mostraron frecuencias similares de talla a la longitud horquilla. Al efectuar la estimación de peso de estas tallas, pocos peces de las tres especies excedían de 3,2 kg, peso mínimo legal del rabil y patudo.

Los resultados indicaron que si los pescadores debían evitar pescar cardúmenes de rabil y patudo que no contuviesen ejemplares de listado, la captura de rabil y patudo se reduciría únicamente un 1 o 2%, pero si debían dejar de pescar cardúmenes de estas especies que contuvieran listado, la captura de esta última especie disminuiría en un 95%. La posibilidad de reducir las capturas de rabil o patudo con talla inferior a la reglamentada seleccionando los cardúmenes no parece, por tanto, muy práctica.

1. Introduction

Atlantic skipjack tuna is known to be highly productive in the tropical and sub-tropical waters of the Atlantic Ocean (see "The International Skipjack Year Program, Origins and Organization", this volume) and the International Skipjack Year Program was initiated in 1979 by the International Commission for Conservation of Atlantic Tunas (ICCAT) to better assess the status of stocks and to examine feasibility of further exploitation of the skipjack while obtaining

more accurate information on the fishery and population parameters.

Skipjack (SKJ) is a small tuna, the majority of individuals taken in the fishery weighing between 1.0 and 3.0 kg. Skipjack is often caught together with juvenile yellowfin (YFT) and bigeye (BET) tunas (Suzuki 1981). Because there is a minimum size limit on these latter two species of tuna of 3.2 kg, the sizes of tuna in mixed schools, and the frequency and species composition of mixed schools are important pieces of information for use in deciding what are practical management alternatives.

This paper presents observations on surface tuna schools obtained from Japanese research cruises and from detailed records of the operation of commercial Japanese baitboats. These observations are analyzed to provide information on the species composition of schools, and the catch by species in schools of one species (pure schools) or more than one species (mixed schools).

2. Material and Methods

Japanese research cruises were conducted in the Gulf of Guinea (Fig. 1) by research personnel aboard a chartered baitboat during July 28 to September 24, 1980, and July 8 to August 26, 1981. Data on commercial operations were collected at Tema, Ghana, from two baitboats fishing in the Gulf of Guinea (Fig. 2) from April 1979 to March 1980.

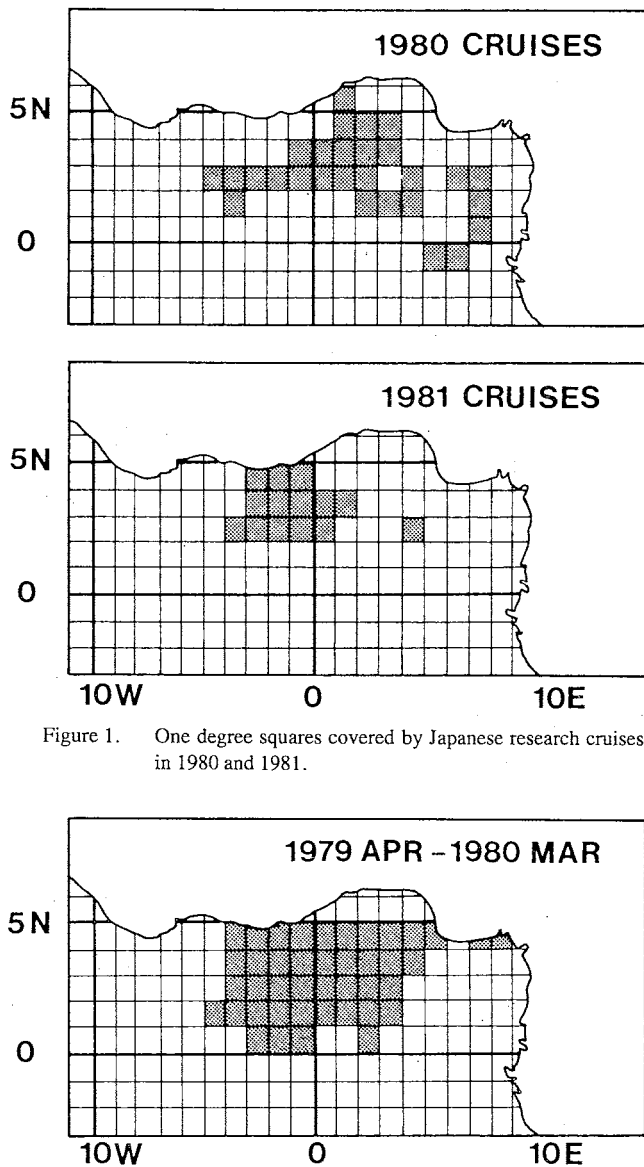


Figure 1. One degree squares covered by Japanese research cruises in 1980 and 1981.

Figure 2. One degree squares covered by two Japanese baitboats observing schools between April 1979 and March 1980.

During research cruises, the number of each species caught was recorded for every school fished. During commercial operations, however, the catches of each species were recorded in tenths of metric tons (MT), so that catches of less than 20-30 individuals of a species were not recorded. For the purposes of the analyses which follow, schools were classed as pure skipjack or yellowfin or bigeye when only one species was recorded, although in fact in commercial catches there may have been a few unrecorded individuals (less than one tenth MT) of other species. Mixed schools were classed according to the mix of species caught: one of three different pairs of species (SKJ + YFT, SKJ + BET, YFT + BET), or all three species together. Again the research and commercial data differed slightly in degree of discrimination between these school types.

3. Results

3.1 SIZE FREQUENCIES OF EACH SPECIES

The fork-length (FL) frequencies of all three species caught during research cruises were similar, with most individuals ranging between 36 cm and 51 cm regardless of species (Fig. 3). The modal lengths were smaller in 1980 (38-41 cm FL) than in 1981 (42-44 cm FL) for all three species (Fig. 3).

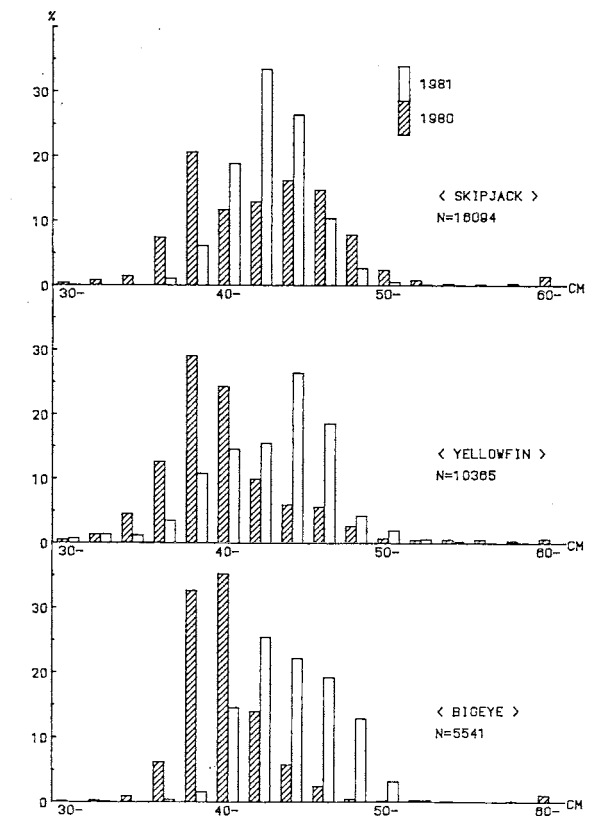


Figure 3. Size frequency distributions (in 2 cm intervals) of skipjack, yellowfin and bigeye tunas caught during Japanese research cruises in 1980 and 1981.

Length-weight relationships for the three species are similar (Table 1), and change little through the year (ICCAT 1979). They indicate that all three species must exceed 54 cm FL to surpass 3.2 kg in weight. Very few of the skipjack caught during research cruises would have exceeded this weight.

Table 1. Length — weight relationships for three species of Atlantic tunas. Equation: $W(\text{kg}) = A \times 10^{-6} \times L(\text{cm})^B$

Species	Skipjack	Yellowfin	Bigeye
A	5.611	21.804	21.500
B	3.315	2.970	2.984
38 cm	1.0 kg	1.1 kg	1.1 kg
40	1.1	1.2	1.3
42	1.3	1.4	1.5
44	1.6	1.7	1.7
46	1.8	1.9	2.0
48	2.1	2.1	2.2
50	2.4	2.4	2.5
52	2.7	2.7	2.8
54	3.1	3.0	3.2
Reference	Lenarz 1974	Lenarz 1974	ICCAT 1980 ^b

3.2 FREQUENCY OF THE VARIOUS PURE AND MIXED SCHOOLS

About 85% of the schools fished during research cruises in 1980 and 1981 were composed either of all three species of tuna mixed, or were mixed skipjack and yellowfin (Fig. 4). The majority of the schools, therefore, were composed of skipjack and yellowfin, sometimes with bigeye added. Bigeye were less frequent in 1981 than in 1980. Schools of pure skipjack were relatively infrequent, about 10-12%. The occurrence of other school types, that is, bigeye mixed with skipjack or with yellowfin, or pure schools of yellowfin or bigeye, were rare (Table 2).

In the case of catches from commercial vessels, the majority were classified as either pure skipjack, or skipjack and yellowfin mixed (Fig. 5). This, however, is at least in part an artifact of the method,

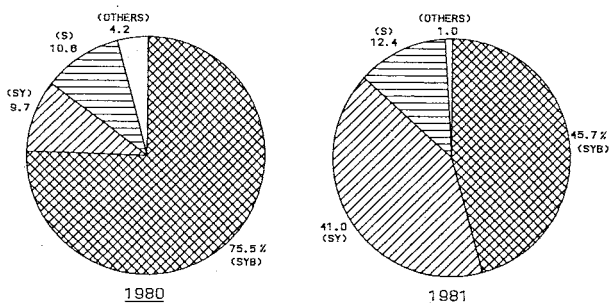


Figure 4. Percent frequency occurrence of schools by school type in the Gulf of Guinea baitboat fishery, during research cruises in the third quarter of 1980 and 1981. Number of schools observed was 331 and 210 in 1980 and 1981, respectively. School type: SYB = SKJ + YFT + BET, SY = SKJ + YFT, S = SKJ

which took no account of a species if it comprised less than 0.1 MT. The frequency of the scarcer species (bigeye) was under-represented.

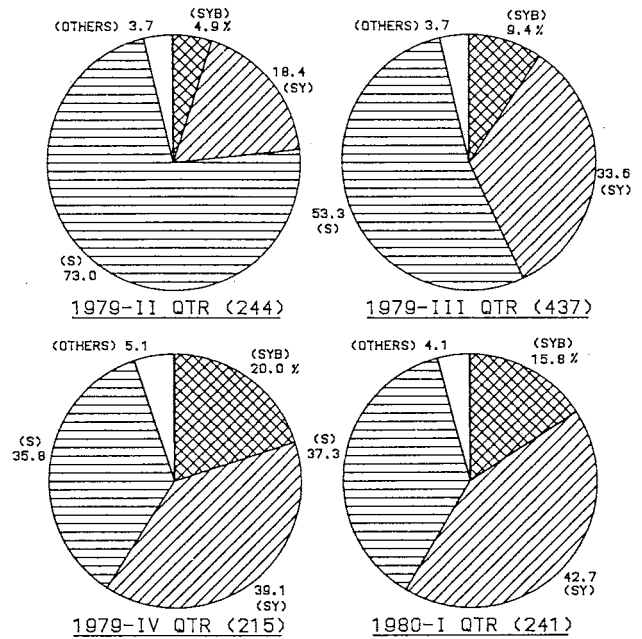


Figure 5. Percent frequency occurrence of schools by type in the Gulf of Guinea baitboat fishery, during 1979 April — 1980 March, by quarter of the year (commercial data). Number of schools observed is indicated in parentheses for each quarter. See Fig. 4 for school type notation.

Despite the bias in data from commercial catches, they are useful for giving an indication of changes in frequency of school types with season, since commercial fishing, in contrast to research cruises, was conducted all year round. Pure schools of skipjack, which may have included small numbers of yellowfin and bigeye, were more common in the second and third quarters of the year (73% and 53%, respectively) than in the first and fourth quarters (37% and 36% respectively), when mixed schools of skipjack and yellowfin, or all three species together became more prevalent (Fig. 5). These data cover only one year. Research cruises, however, covered two years, and the frequency of pure skipjack schools was almost constant between years; only the frequency of schools with bigeye varied (Fig. 4). The seasonal fluctuation observed in commercial catches between pure skipjack schools and mixed schools may therefore be truly representative of seasonal changes in species composition of schools. Further data are needed to confirm this.

3.3 CATCH BY SPECIES BY SCHOOL TYPE

To investigate apparent school size by school type, and the contribution by species to the school, catches from individual schools were analyzed for the number and weight of each species in them. Data from

research cruises (Table 2) show that most individuals of all three species are caught in mixed schools which contain skipjack. About 95% of skipjack themselves were caught in schools mixed with yellowfin, or with both yellowfin and bigeye. Ninety-eight to 99% of yellowfin were caught in schools mixed with skipjack, or with skipjack and bigeye, and more than 99% of bigeye were caught in schools with all three species. Only 1% to 2% of yellowfin or bigeye were caught from schools that did not contain skipjack.

Table 2. Frequency in occurrence of schools and catch in number by type of school in the Gulf of Guinea baitboat fishery during the summers of 1980 and 1981, based on Japanese research cruises.

1980	- SCHOOL TYPE -							Total
	SYB	SY	SB	YB	S	Y	B	
Frequency	250	32	0	9	35	5	0	331
SKJ	94,201	3,981	0	0	5,102	0	0	103,284
YFT	48,901	1,778	0	597	0	137	0	51,413
BET	23,764	0	0	93	0	0	0	23,857

1981	- SCHOOL TYPE -							Total
	SYB	SY	SB	YB	S	Y	B	
Frequency	96	86	0	0	26	1	1	210
SKJ	87,010	58,627	0	0	8,869	0	0	154,506
YFT	28,308	15,529	0	0	0	200	0	44,037
BET	3,350	0	0	0	0	0	20	3,370

School type: SYB = Skipjack, yellowfin and bigeye mixed
 SY = Skipjack and yellowfin mixed
 SB = Skipjack and bigeye mixed
 YB = Yellowfin and bigeye mixed
 S = Pure skipjack
 Y = Pure yellowfin
 B = Pure bigeye

Of the various types of schools fished during research cruises in 1980 and 1981, those with all three species were the most productive in terms of numbers of fish caught (Fig. 6), followed by mixed skipjack and yellowfin schools, and finally pure skipjack schools. In 1981, the average number of fish

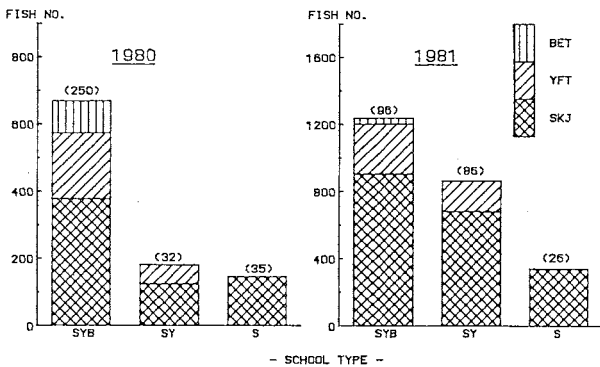


Figure 6. Catch in number per school type in the Gulf of Guinea baitboat fishery during research cruises in the third quarters of 1980 and 1981. Figures in parentheses indicate the number of schools observed. See Fig. 4 for school type notation.

caught per school was double that for 1980 for schools of all three species and for pure skipjack schools, and was four times greater for mixed skipjack and yellowfin schools (Fig. 6; note scale on abscissa for 1981 is doubled).

The same trend to larger catches in mixed schools was apparent in catches from commercial fishing (Fig. 7), although because mixed schools with catches less than 0.1 MT of the less frequent species were classed as "pure" schools, or mixed with two rather than three species, the differences would be expected to be diminished, and in fact they were (compare Fig. 6 with Fig. 7 III QTR). Commercial catches by weight were biggest (about 5 MT per school), from mixed schools in the second quarter (Fig. 7), when such mixed schools were comparatively rare (23%) (Fig. 5). Catches per school were smallest in the fourth quarter when mixed schools were more common (59%), but no more common than in the first quarter (59%). The species composition of schools by weight was about the same in the first and third quarters (Fig. 7).

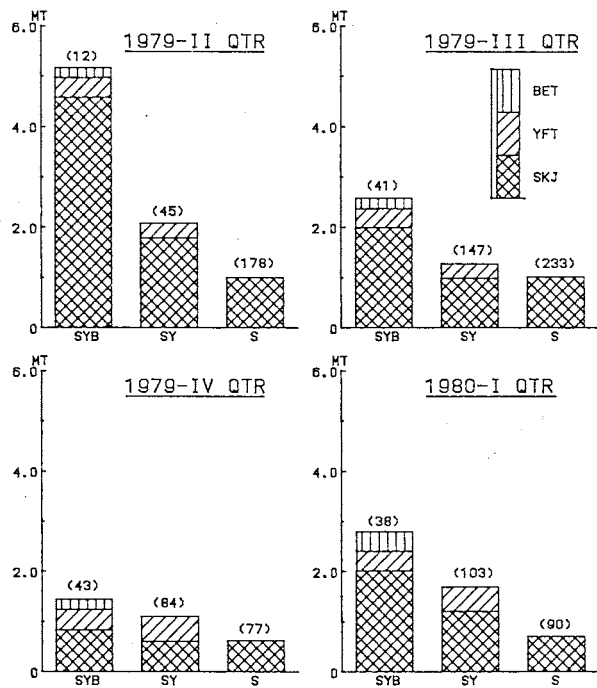


Figure 7. Catch in MT per school type in the Gulf of Guinea baitboat fishery during 1979 April - 1980 March, by quarter of the year (commercial data). Figures in parentheses indicate the number of schools observed. See Fig. 4 for school type notation.

The suggestion that mixed schools are more productive than pure schools must be interpreted with caution, because this could be an artifact: if individuals of a second species are present in a school in a very low proportion, the chances of catching some of that second species are low when the catch from that

school is small compared with chances when the catch from that school is large. Therefore, the probability of a mixed school being classed as mixed rather than pure increases with the size of the catch, and small catches from mixed schools could be classified incorrectly as "pure", decreasing the apparent average size of pure schools.

4. Discussion

The results are of immediate relevance to the problem of applying minimum size regulations to catches of yellowfin and bigeye tuna when these species are mixed with skipjack. The information on length frequencies of each species confirms that the yellowfin and bigeye caught with skipjack are of approximately the same average size. Furthermore, few individuals of any species exceed 54 cm FL which, when converted to weight (Table 1), means that most individuals of all species caught in this fishery are below 3.2 kg, the minimum weight limit for bigeye and yellowfin.

The results from research cruises indicate that catches of undersized yellowfin and bigeye could not in practice be reduced by not fishing or by stopping fishing schools containing those species. If pure schools of yellowfin or bigeye, or mixed schools of these two species were avoided, the catch of undersized yellowfin and bigeye could be reduced by only 1% to 2%. If schools of these species mixed with skipjack were to be avoided, the catch of skipjack would be reduced by 95%. That is, the savings by not fishing schools of yellowfin or bigeye when not mixed with skipjack would be insignificant, and the loss to the fishery of not fishing schools of skipjack mixed with one or both of those two species would be unacceptable (ICCAT 1980^b). Furthermore, these results were obtained in the season of the year when pure schools of skipjack were relatively common; the indicated savings in yellowfin and bigeye, and losses to catches of skipjack would be even more extreme at other seasons. The possibility of reducing catches of undersized yellowfin and bigeye tuna by refraining from fishing schools of skipjack mixed with these species is not a practical alternative for management.