

A NOTE OF THE SIZE COMPOSITION BY SEX OF YELLOWFIN TUNA CAUGHT BY
JAPANESE LONGLINE FISHERY IN THE ATLANTIC OCEAN

by

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SUMMARY

Differences in size composition and sex ratio between male and female are often noticed in catch samples of tuna species. These differences must be the result of some sex-specific natures relating to growth rate, natural mortality and availability for fisheries, etc., which should have influence on the population dynamics in various ways.

In this report the differences in size composition between both sexes of Atlantic yellowfin tuna were examined by area (10° Lat. x 20° Long.) and by quarter, based on the data sampled by Japanese longliners since 1956.

The results show that (1) the size frequency distribution range of the male is larger than that of the female; (2) the male becomes remarkably dominant at sizes larger than 150 cm.

RESUME

Des différences de composition par taille et de sex ratio entre mâles et femelles s'observent souvent dans les échantillons de prises de thonidés. Ces différences proviennent sans doute de certaines caractéristiques spécifiques du sexe concernant le taux de croissance, la mortalité naturelle, la disponibilité dans la pêcherie, etc, et qui influent certainement de diverses façons sur la dynamique de la population.

Le présent rapport contient un examen des différences de composition de taille entre les sexes en ce qui concerne l'albacore atlantique, par zone (10° de latitude x 20° de longitude) et par trimestre, à partir de données relevées par les palangriers japonais depuis 1956.

Les résultats montrent que: (1) l'éventail de distribution de fréquences de taille des mâles est plus étendu que celui des femelles, (2) les mâles prédominent de façon sensible dans les tailles au-dessus de 150 cm.

RESUMEN

A menudo se observan diferencias en la composición por tallas y sex ratio entre machos y hembras en las muestras de capturas de túnidos. Estas diferencias provienen sin duda, de algunas características específicas del sexo, que conciernen a la tasa de crecimiento, mortalidad natural, disponibilidad para las pesquerías, etc. que en varias formas influenciarían la dinámica de la población.

En este informe se examinaron las diferencias en la composición por tallas entre los sexos del rabil del Atlántico, por área (10° lat. x 20° long.) y por trimestre, basándose en los datos de muestreo de los palangreros japoneses desde 1956.

Los resultados muestran que (1) la escala de distribución de frecuencias de tallas en los machos, se extiende más que la de las hembras; (2) los machos predominan sensiblemente en las tallas superiores a los 150 cms.

It has been noted by a number of authors that the size frequency distribution of male yellowfin tuna reached larger than that of female and the proportion of male increased remarkably in size group larger than 120 (or 140) cm in fork-length (Nakamura, 1949, 1965; Schaefer and Orange, 1956; Yabuta and Yukinawa, 1959; Mimura et al., 1963; Suda and Schaefer, 1965; Murphy and Shomura, 1972; etc.). Although such differences by sex are considered to be due to some of sex-specific natures of (i) growth rate, (ii) mortality, (iii) behavior which is revealed as a difference of availabilities for fisheries (Nakamura, 1965), studies on relevant subjects have not been made in details. For instance, the growth of yellowfin tuna has been estimated by scale reading and modal progression of length frequency distribution by various authors, but most of them have not been taken the sexual difference into consideration. Especially, for the Atlantic yellowfin tuna it might be said that even such essential information as the sex ratio and size compositions by sex have scarcely been published. Fortunately, length measurements by sex of yellowfin tuna have been obtained from some of Japanese longline catches in the Atlantic Ocean. In the present paper we report preliminary analyses on sex-specific size composition and sex ratio basing on these data.

MATERIALS

Sex determination and fork-length measurement of yellowfin tuna have been made on random sampling basis aboard some of Japanese longliners operating in the Atlantic Ocean since 1956. All available data were combined and compiled into fork-length frequency distributions by sex, 10°(Lat.) X 20°(Long.) area and quarter. Thus, the data cover a wide range from 50°N to 40°S (Fig. 1). In addition, a Japanese purse seiner collected the same biological data in the Gulf of Guinea and off Angola in 1973, which were used for comparison with longline data.

RESULTS

(1) DIFFERENCE OF SIZE COMPOSITION BY SEX OF LONGLINE YELLOWFIN CATCH

Honma and Hisada (1971) noted that the Atlantic yellowfin catches by longlines were principally from the South Equatorial Current area and they were consisted of two migratory groups, western and eastern groups. Therefore, size compositions

by sex were summarized by three principal areas, A, B and C (Tab. 1; Figs. 1 and 2). Here, it is assumed that fish in Area A represent the western migratory group and those in Area C the eastern one, and Area B is overlapped by the both groups. In general, substantial part of longline catch is consisted of fish larger than about 100 cm in fork-length and several distinct modes, which are considered to indicate presence of several age groups, are seen in each length frequency distribution.

Substantial recruitment to the longline fishery in Area A seems to occur at about 100 cm in the second quarter (April-June), while in Area C it seems to occur at about 110 cm in the fourth quarter (October-December). It is not very clear in Area B.

Le Guen and Sakagawa (1973) summarized the results of growth studies of yellowfin tuna made by various authors as follows. According to their results the recruitment of 100- 110 cm in fork-length correspond to about 2.5 years old fish.

Observed and estimated size at various ages of yellowfin tuna from the Atlantic and Pacific Oceans. Length (cm) is shown for most ages, and weight (Kg) in parentheses for a few ages. Estimated length is based on the von Bertalanffy growth function.

Age (years)	Source of data											
	Yong et al., 1969		Le Guen et al., 1969				Present study			Davidoff, 1963		
	Atlantic Ocean		Eastern Atlantic		Eastern Atlantic			Eastern Pacific				
	Observed	Estimated	Pointe-Noire		All regions		São Tomé-Angola		All regions			
1.0	—	54.0	—	33.2	—	32.2	—	17.3 (0.1)	—	26.5 (0.4)	—	34.6
1.5	66.1	75.8	84.6	82.9	83.8	80.0	61.5	53.9 (3.0)	62.2	60.0 (4.2)	—	61.9
2.0	86.1	94.9	84.6	86.6	79.5	83.1	77.6	82.0(10.5)	82.3	85.3(11.7)	83.0	84.7
2.5	104.1	111.5	108.3	105.6	103.9	102.0	111.0	103.6(21.1)	105.0	104.3(22.7)	105.0	103.8
3.0	120.0	125.9	—	120.9	124.0	117.7	116.1	120.2(32.8)	125.0	123.0(35.1)	122.0	119.7
3.5	132.9	138.5	132.2	132.1	132.2	130.6	132.2	131.0(44.3)	140.6	136.6(48.0)	136.0	132.9
4.0	—	149.4	—	142.9	—	141.3	135.6	142.8(54.7)	—	147.6(60.5)	141.0	144.0
4.5	—	158.9	147.0	150.7	143.6	150.1	147.0	150.3(63.8)	153.4	154.6(72.0)	—	153.3
5.0	—	167.2	152.0	157.0	152.0	157.4	153.7	156.1(71.3)	164.8	163.8(82.4)	—	161.0

(quoted from Le Guen and Sakagawa, 1973)

Sexual dimorphism in length frequency distribution does not seem to occur till fish grow to three years old. However, after then some changes in growth (or possibly, in behavior) seem to appear between the both sexes. Thus, the modal length and distribution range of males attain to larger size than those of females, especially in four years old and older fish.

(2) SEX RATIO OF YELLOWFIN TUNA CAUGHT BY LONGLINE FISHERY

Nakamura (1949) and Schaefer and Orange (1956) noted that the sex ratio of the Pacific yellowfin tuna beyond 120 cm in fork-length greatly outnumbered females. Murphy and Shomura (1972) pointed out that the remarkable difference in sex ratio occurred beyond 140 cm. Suda and Schaefer (1965) found in the longline yellowfin catch from the eastern tropical Pacific Ocean that there was a moderate but highly significant excess of males up to about 150 cm and above 151 cm male remarkably increased. As was already shown in Fig. 2, the same phenomena were also found in the Atlantic yellowfin tuna.

For further examination, all the samples of yellowfin tuna caught by Japanese longliners in the Atlantic Ocean were divided into four categories, males and females smaller than 120 cm, males and females larger than 121 cm. The percentage compositions of fish belonging to each category are shown by quarter and 10°X 20° area in Fig. 3. It is indicated that (i) large sized fish (larger than 121 cm) are, as a whole, predominant in the longline catches, (ii) the proportions of male in the large-sized fish are remarkably high in the low latitudinal waters, (iii) in the high latitudinal waters the proportions of small-sized fish and females tend to increase, as was noted by Mimura et al. (1963) for Indian yellowfin tuna.

Because the principal yellowfin catches by longline fishery are obtained from the low latitudinal waters, in spite of the fact pointed out in (iii) above, the length frequency distributions by sex in the main fishing ground (Area A, B and C combined) are used here in order to estimate a general relationship between the length and sex ratio of longline catch in the Atlantic Ocean (Tab. 2). Fig. 4 also shows the proportion of males in terms of moving average for three length classes. It is noticeable that males outnumber females even in such small size as 60-80 cm and a conspicuous difference of sex ratio occurs in larger size than about 150 cm. This finding seems to be quite similar to that by Suda and Schaefer (1965).

(3) SIZE COMPOSITION BY SEX OF YELLOWFIN TUNA CAUGHT BY PURSE SEINE

Because tuna longline boats catch much larger yellowfin than purse seine or live-bait boats, data of smaller yellowfin should depend on the catch samples by the latter. Length measurements by sex for the surface catches were obtained by a Japanese purse seine boat operated in the eastern Atlantic Ocean from July to November, 1973 (Tab. 3). Fig. 5 shows the fork-length frequency distributions by sex of those catch samples. Although the number of fish sampled were not sufficient, it is indicated that (i) in the lower latitudinal waters off C. Three Points and off Tema males tend to outnumber females in larger size group and males attain larger size, (ii) in the higher latitudinal waters off Angola females and smaller fish tend to

increase relatively. It appears that the general tendencies of those phenomena are similar to those of longline catches.

DISCUSSION

The present paper dealt with size composition by sex of yellowfin tuna principally caught by longlines in the Atlantic Ocean. Because all the data from 1956 to 1974 were combined, yearly fluctuation were not taken into consideration.

The general pictures of sex-specific size composition and size-specific sex ratio observed in the longline yellowfin catches in the Atlantic Ocean are fundamentally identical to those in the Pacific and Indian Oceans.

The modal progression indicated an apparent difference of growth rate between the both sexes, especially for the fish older than three years old. At present stage, however, it does not seem adequate to attribute simply the observed difference to that of the growth rate by sex. Considering the extreme decrease of large females in the catch samples, such factors as differences of mortality and availability for the fishery can also not be excluded.

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