

STOCK ASSESSMENT AND UTILIZATION OF MEDIUM AND LARGE SIZED BLUEFIN TUNA
IN THE ATLANTIC OCEAN

by

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SUMMARY

In recent years, the Japanese longline fishery has extended the new bluefin fishing grounds in the Atlantic Ocean, especially in the northeastern Atlantic. Relatively high hook rate (number of fish caught per 1,000 hooks) was observed in the Bay of Biscay and the Mediterranean Sea in 1974. In 1975 up to now, the Japanese longline fleet has been operating almost the same bluefin fishing in the northeast Atlantic as in the preceding year, except in the Mediterranean Sea, which was closed to fishing by national action during its best fishing season.

Using the age composition supplemented for the data of Caddy (1974) by catch data on medium- and large-sized fish (Sakagawa and Coan, 1973), cohort analyses were made to estimate amounts of recruitment at ages 1 and 8, respectively. Annual recruitment at age 1 has fluctuated widely, ranging from 0.6 to 2 million. On the other hand, the decreasing trend of annual recruitment at age 8 is recognized from 1960 through 1968. It was also observed that fishing mortalities for ages 1-4 showed a downward trend from 1964 to 1969 (F: 1.0 to 0.2) and those for ages 8-13 were stable up to 1968 (F: about 0.1), except for 1965.

An attempt was made to estimate the recruitment to the longline fishery since 1969. The results indicated a recent increase of recruitment at age 8 from the low level in 1967-68.

RESUME

Ces dernières années, la pêche palangrière japonaise a pénétré dans de nouveaux secteurs de pêche au thon rouge dans l'Atlantique, surtout au nord-est. Un taux par hameçon (nombre de poissons capturés par millier d'hameçons) relativement élevé a été observé dans le Golfe de Gascogne et en Méditerranée en 1974. En 1975, à la date du présent rapport, la flottille japonaise avait presque effectué la même pêche au thon rouge que l'année précédente dans l'Atlantique Nord-Est, exception faite de la Méditerranée où la pêche avait été suspendue par décision nationale au cours de l'époque de pêche la plus favorable.

Des analyses de cohortes ont été effectuées, à partir de la composition par âge fournie par les données de Caddy (1974) et complétée par des données de capture sur les poissons de taille moyenne et ceux de grande taille (Sakagawa et Coan, 1973), afin d'estimer l'importance du recrutement aux âges 1 et 8 respectivement. Le recrutement annuel à l'âge 1 variait de façon importante, de 0,6 à 2 millions. D'autre part, une tendance à la baisse du recrutement annuel à l'âge 8 a été observée de 1960 à 1968. On a également remarqué que la mortalité par pêche des âges 1 à 4 montrait une tendance à la baisse de 1964 à 1969 (F: 1,0 à 0,2), et que celle des âges 8 à 13 demeurait stable jusqu'à 1968 (F: environ 0,1), exception faite de l'année 1965.

On a tenté d'estimer le recrutement de la pêcherie palangrière depuis 1969. Les résultats indiquent qu'il y aurait quelque évidence d'un accroissement récent du recrutement à l'âge 8 depuis le niveau médiocre de 1967-68.

RESUMEN

En los últimos años, la pesca palangrera japonesa ha ampliado las nuevas zonas de pesca de atún en el Atlántico, en especial en su parte nordeste. En 1974, en el Golfo de Vizcaya y en el Mediterráneo, se observó una tasa por anzuelo (número de peces capturados por 1.000 anzuelos) relativamente alta. En 1975 y hasta la fecha del presente informe, la flota palangrera japonesa ha estado efectuando en el nordeste del Atlántico, casi la misma pesca de atún que el año anterior, exceptuando el mar Mediterráneo que estuvo cerrado a la pesca por decisión nacional durante su mejor temporada.

Se hicieron análisis de cohortes para calcular las cantidades de reclutamientos en las edades 1 a 8 respectivamente, empleando la composición por edades, y como suplemento a los datos de Caddy (1974), los datos de captura de peces de tamaño medio y grande (Sakagawa y Cohan 1973). El reclutamiento anual de la edad 1 ha fluctuado mucho, variando de 0,6 a 2 millones. Por otra parte, se ha observado una tendencia decreciente en el reclutamiento anual de la edad 8, de 1960 a 1968. Asimismo se observó que la mortalidad de pesca en las edades 1-4, mostraba una tendencia decreciente de 1964 a 1969 (F: 1,0 a 0,2), y que, en cuanto a las edades 8-13 se mantuvo fija hasta 1968, exceptuando 1965.

Se hizo un intento para calcular el reclutamiento de la pesca palangrera desde 1969. Los resultados indican que parece haber un reciente aumento en el reclutamiento de la edad 8, partiendo del bajo nivel en 1967-68.

Figures 1 - 4 and Table 1 reproduced in Data Record Vol. 7.

Figures 1 à 4 et Tableau 1 reproduits dans le Vol. 7 du Recueil de Données.

Figuras 1 a 4, y Cuadro 1 reproducidos en Vol. 7 de la Colección de Datos Estadísticos.

1. Fishing conditions of bluefin tuna in recent years since 1971 in the Atlantic longline fishing grounds

Longline fishing areas for bluefin tuna operated by Japanese longline vessels in recent years have been separated in both western and eastern sides of the Atlantic Ocean. Main fishing grounds are in the southern offshore waters of Newfoundland and Gulf of Mexico for western side and in the waters off Iberian Peninsula including the Bay of Biscay and western Mediterranean Sea for the eastern side. Fishing efforts have been increased in the latter waters year by year as is shown in the following table.

Number of hooks in the major fishing areas of bluefin tuna exerted by Japanese longliners, 1971-74. (Unit 1000 hooks)

Area* Year	1	2	3	4	5	6
1971	1,063	4,987	40	1	-	-
1972	949	1,327	74	16	43	74
1973	652	2,489	23	-	18	126
1974**	472	1,752	474	366	341	514

* See Fig. 1 for division of area. ** Preliminary

Hook-rates (catch in number per 1000 hooks) of longline caught bluefin by month and by area (Fig. 1) are illustrated in order to see the yearly change of density of fish (Fig. 2). There appears no tendency to suggest the decline of hook-rate in all areas, showing the highest value in 1974 throughout the preceding years in the Area 2, 4 and 5. According to the preliminary calculation for the fishing conditions in 1975, average catch per boat in April-July for Gibraltar-Biscay areas are about 70 % of those for 1974 season and catch per boat in May for Gulf of Mexico is four times of that of 1974 season. Because the data collection of catch and effort for 1975 is not completed yet, further analysis of fishing conditions of 1975 in comparison of hook-rate with those of the preceding years must be left in the future.

2. Size composition of fish caught by longline fishery

Since the previous report (Shingu et al, 1974), size composition data sampled by Japanese longline vessels were obtained in the fishing areas off Gibraltar and Newfoundland (Fig. 3). The catch in the former waters during April through June in 1975 consists principally of fish of 11-14 ages. There appears approximately 2 years difference in modal length in comparison with the size composition of 1973 season in which main constituents were 9, 12 age fish. On the other hand, the catch from the Newfoundland waters includes much smaller sized (age 2-5) fish. As was shown in the previous report (Shingu et al, 1974), two fishing seasons of summer and winter are recognized in this waters and smaller sized fish is likely to be predominant in winter fishing season.

The scarcity of occurrence of medium sized fish (5-8 age) in any fisheries of whole Atlantic Ocean seems to be characteristic for this species.

③ Hook-rate in 1974 was estimated basing on the sample data of log book collected by July 1975.

3. Estimation of recruitment and fishing mortality by cohort analysis

The estimates of catches by age (by all fishing gears) used in this paper are the revised ones of those estimated by Caddy (1974 SCRS/74/52, Tables 2-3). Because his estimates on the large sized fish of longline catch is considered to be insufficient judging from our data, being shown the modal age group in age 7 or 8, we re-estimated the size composition of longline catch and completed the age composition of fish taken from the whole Atlantic (Fig. 4 and Table 1).

As the population parameters, we adopted 0.2 for natural mortality coefficient and applied the growth equation by Mather and Jones (1972).

Considering that the fish are exposed to the surface fishery from 1 age and considerable portion of them are removed by this fishery for several years before they are recruited into the longline fishery, we carried out cohort analysis to estimate the recruitments at age 1 as well as at age 8, assumed average recruiting age to longline fishery. The results are shown in Fig. 5. Annual recruitment at age 1 has fluctuated widely, ranging from 0.6 to 2 millions. Comparing to the Caddy's result (Caddy, 1974), our figures are about 20 % larger than his estimates although the tendency of annual fluctuation is similar to each other. On the other hand, the decreasing trend of annual recruitment at age 8 is recognized from 1960 through 1968. The recruitment in 1960-61 was 0.5 millions, 0.1-0.15 millions in 1964-65, and lowered to 25-30 thousands of fish in 1966-68.

As is observed from Fig. 4, the catch in successive 2-3 years is likely to be large when recruitment at age 1 was high. Therefore, the fishing intensity in the younger ages as well as the year class strength should be considered for the estimation of recruitment at age 8.

Fishing mortality coefficient were estimated for small sized fish (1-4 age) and for large sized fish (8-13 age). The estimates for the former were high ranging from 0.8 to 1.1 (much larger for age 2-3) in 1964-67 and decreased to 0.2 (0.4 for age 2-3) in 1968-69, while the estimates for the large sized fish were levelled at around 0.1 since 1960 to 1968, except for 1965 (Fig. 6).

4. Estimation of recruitment to the longline fishery since 1969

Yields of medium and large bluefin by longline fishery were 800 tons (including 100 tons in Mediterranean Sea) in 1972, 1700 tons (250 tons) in 1973, and reached 5600 tons (2300 tons) in 1974. For 1975, yield is assumed to be similar with recent level because of catch regulation implemented this year. As was aforementioned, hook-rate in the principal fishing grounds were on high level in 1974. In connection with those fishing conditions, much concerns are paid to the possible large recruitment to the longline fishery.

The yield per recruitment (Y/R) expected theoretically is shown with the population size per recruitment (P/R) in Fig. 7. Y/R for the type of fishery capturing 8-14 ages is indicated to increase rapidly with the increment of fishing mortality up to around 0.3, and beyond this level of F the increasing rate of Y/R becomes very small.

Such an increase as was observed in 1974 might not be explained alone by the increase of fishing mortality from assumed $F = 0.1$ in 1967-68 to 0.3-0.4 in the subsequent years. Supposing the recruitment at age 8 in the years from 1969 on remain at low level of 1967-68, yield could be only 1750 - 2100 tons (25-30 thousands \times 70 kg) even if F is assumed to have increased to 0.4. Yield of large bluefin in 1974 was 3300 tons (excluding the yield in the Mediterranean), and this can not be explained unless the increase of recruitment since 1969 is considered.

It is thought that the recent increase of yield of large bluefin tuna must be reflected by relatively large potential of recruitment. To examine this, recruitment at age 8 from 1969 onward was estimated by catch simulation, since the back calculation method of cohort analysis can not be applicable in this case. We calculated the recruitment at age 8 from those at age 1 (Fig. 5, 1962-1968) and relevant catch data by age (Table 1). The results are shown in Table 2 and seem to prove the increase of recruitment at age 8 from the low level (25-30 thousands) in 1967-68.

Table 2. Estimates of recruitment at age 8 from catches less than age 7 and recruitment at age 1. (Unit 1000 fish)

Year	1969	1970	1971	1972	1973	1974	1975
Recruitment	27	64	32	41	60	45	51

There seems another probable interpretation to explain the increasing in longline catch of large bluefin in recent years.

The total annual yields of medium and large sized bluefin tuna in the whole Atlantic Ocean including Mediterranean Sea are considered to be at least around 5000 tons or more during recent ten years. Considering the decline in recent catches of small bluefin in the coastal waters, the catch of 5,000~6,000 tons by longline fishery could be expected without significant intensification of fishing mortality.

It is also likely that the recruitment to longline fishery will probably be greater than the estimates from the present cohort analysis based on Table 1, provided that both the Atlantic and the Mediterranean are taken into consideration.

References

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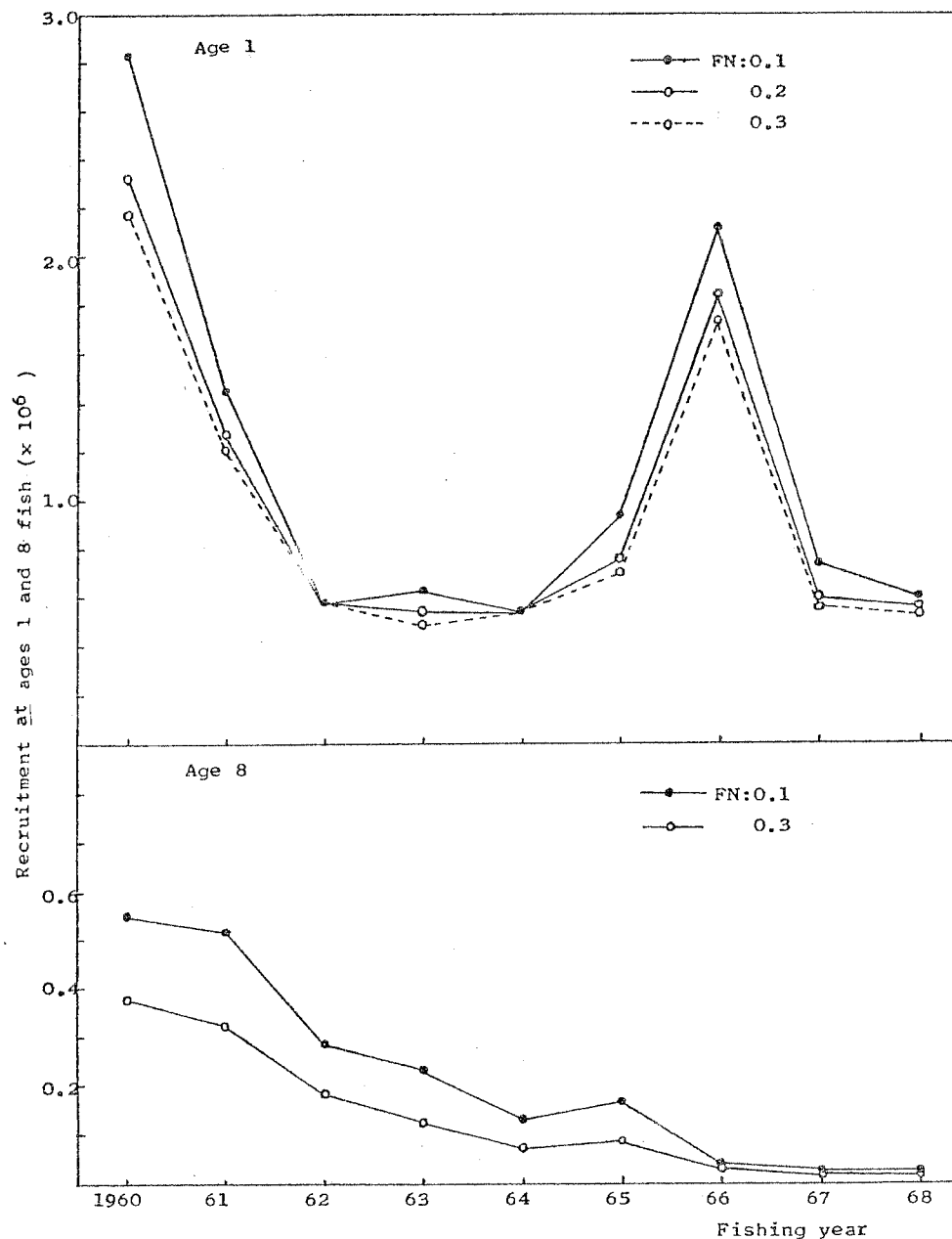


Fig. 5. Recruitment estimates of bluefin tuna at ages 1 and 8 from cohort analysis.

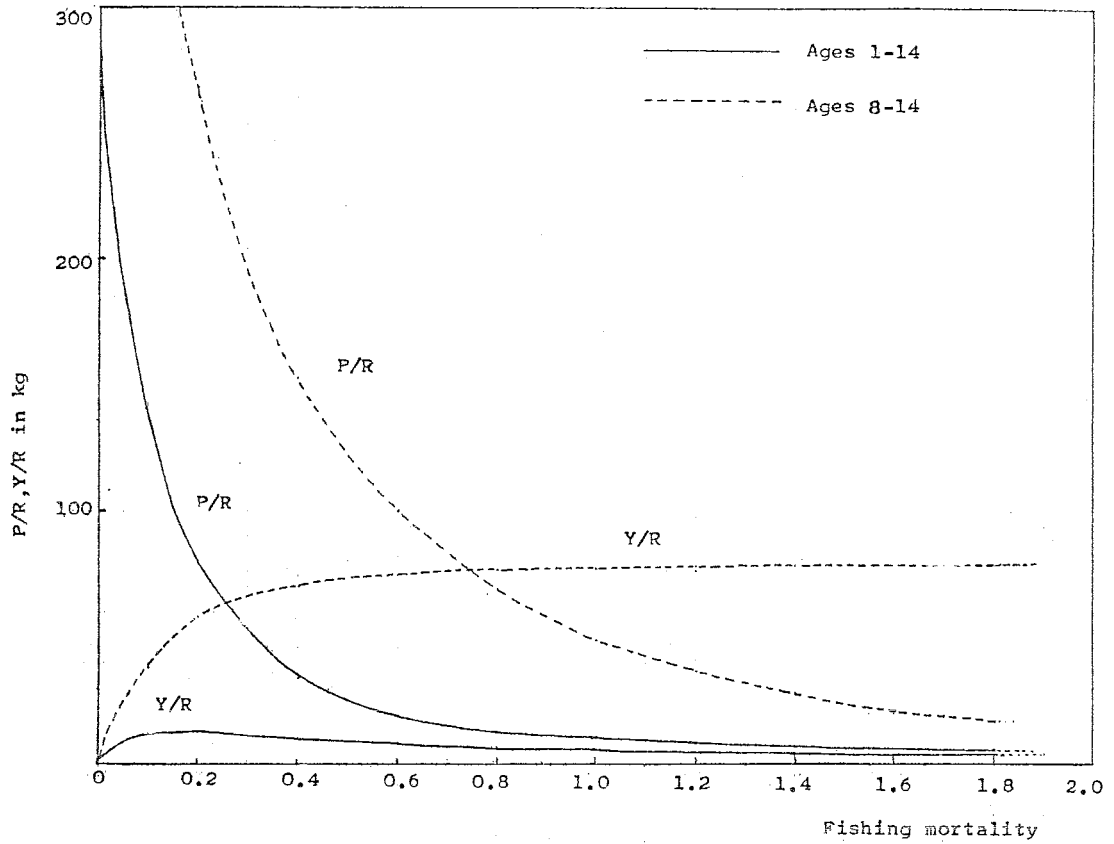


Fig. 7. Relationship of population size per recruitment(P/R) and yield per recruitment(Y/R) to fishing mortality for two types of fisheries, capturing ages 1-14 fish and ages 8-14 fish.

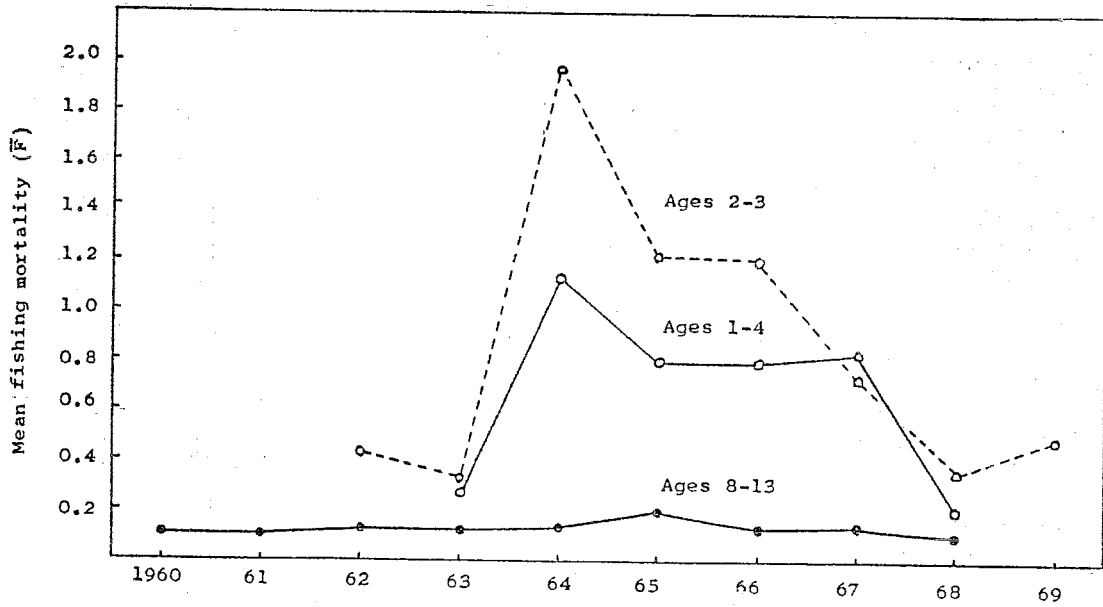


Fig. 6. Estimates of mean fishing mortality for three age groups from cohort analysis.