

AN ANALYSIS OF ATLANTIC BIGEYE TUNA (THUNNUS OBESUS) GROWTH

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SUMMARY

The growth rate of Atlantic bigeye tuna (Thunnus obesus) was estimated by examining modal progressions in length-frequency data from longline and surface gears. A least-squares Von Bertalanffy growth model was fit to length-at-age data. The resulting growth curve approximates those reported for this species by previous workers.

RESUME

Le taux de croissance du thon obèse de l'Atlantique (Thunnus obesus) est estimé au moyen de l'examen des progressions modales des données de fréquences de taille sur les engins palangriers et de surface. Un modèle de croissance de Von Bertalanffy par moindres carrés est ajusté aux données sur la taille à un âge

donné. La courbe de croissance qui en résulte se rapproche de celles qui avaient été signalées auparavant pour cette espèce par d'autres chercheurs.

RESUMEN

La tasa de crecimiento del patudo del Atlántico (Thunnus obesus) fue estimada a través de exámenes de progresión modal en datos sobre frecuencias de talla de palangreros y artes de superficie. Un modelo de crecimiento de Von Bertalanffy (por mínimos cuadrados) fue ajustado a los datos de talla a la edad. La curva de crecimiento resultante se aproxima a la información para estas especies de trabajos precedentes.

INTRODUCTION

Bigeye tuna (*Thunnus obesus*) is a major component of the Atlantic tuna fishery catch with 43,000 MT, worth an estimated (U.S.) \$40 million, landed in 1977. Historically, longline has been the principle gear used to harvest bigeye tuna. In recent years surface gears have become increasingly more important and accounted for 33% (14,000 MT) of the total 1977 bigeye catch (ICCAT, 1978a).

Recently the International Commission for the Conservation of Atlantic Tunas (ICCAT) has been concerned with the effective management of multi-species, multi-gear fisheries. Of particular interest at the present time is assessing the effects of implementing a bigeye minimum size regulation. Such a regulation would be directed at eliminating the bigeye/yellowfin misidentification problem (ICCAT, 1978b) as well as increasing the yield-per-recruit of bigeye tuna. Management issues such as these have focused attention on the need to increase research effort on some basic aspects of biology of this species (ICCAT, 1978c).

The purpose of this study is to provide estimates of the growth rate and length-at-age of Atlantic bigeye tuna and to compare the results with those of similar studies.

DATA AND ANALYTICAL PROCEDURES

Length-frequency data from various countries, gear types and time periods were used to estimate Atlantic bigeye tuna growth rates. These data were separated into two gear categories, longline and surface, and combined within these categories by quarter years. Data used by quarters, country and gear category are shown in Table 1. Years in which heavy sampling occurred were selected for analysis.

Each combined quarterly length frequency was examined for modes to which ages were assigned. Quarterly length frequencies, by gear category, are shown in Figures 1, 2, and 3 for years 1973, 1974, and 1975 respectively.

RESULTS AND DISCUSSION

The Von Bertalanffy growth model was fit to length-at-age data using the least squares model of Tomlinson and Abramson (1961) (Figure 4). The Von Bertalanffy growth curve is defined as follows:

$$L_t = L_{\infty} (1 - e^{-k(t-t_0)}) \text{ where}$$

L_{∞} = 491.6 cm, the mean asymptotic length;
 k = 0.0135, the Brody growth coefficient; and
 t_0 = 3.808 the hypothetical age when length = 0.

Time t is on a quarterly basis

The value for L_{∞} (mean asymptotic length) appears unrealistically high. However, for the purpose of stock assessment the actual value of L_{∞} may not be of importance except as a fitting parameter. The values of length-at-age predicted from the growth curve are shown in Table 2.

The fitted growth curve is similar to that of Champagnat and Pianet (1974), which is also based on Atlantic length-frequency data. However, their analysis indicates a slightly faster growth rate (Figure 5). The other growth curves in Figure 5 are based on data from the Pacific Ocean and suggest that Pacific bigeye tuna grow at a faster rate, but to a smaller mean asymptotic length, than Atlantic bigeye tuna. No explanation is given for this apparent difference in growth rates.

LITERATURE CITED

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Table 1. Time periods represented in the Atlantic bigeye tuna growth analysis by country and gear category.

	YEAR AND QUARTER											
	1973				1974				1975			
Country	1	2	3	4	1	2	3	4	1	2	3	4
Japan												
Surface	X	X	X		X	X	X		X			
Longline					X	X			X	X	X	
FIS ^a	X	X	X									
(surface)												
Guinea Biana		X	X									
(surface)												
Canary Is.		X										
(surface)												

Table 2. The length-at-age of Atlantic bigeye tuna predicted from the von Bertalanffy growth equation. Values in parentheses are outside the range of fishery data.

Year	QUARTER			
	1	2	3	4
0	(31)	(37)	43	49
1	55	61	67	72
2	78	84	89	94
3	100	105	110	115
4	120	125	130	135
5	140	145	149	154
6	158	163	167	172
7	176	180	184	188
8	(193)	(197)	(200)	(204)

^a France, Ivory Coast and Senegal

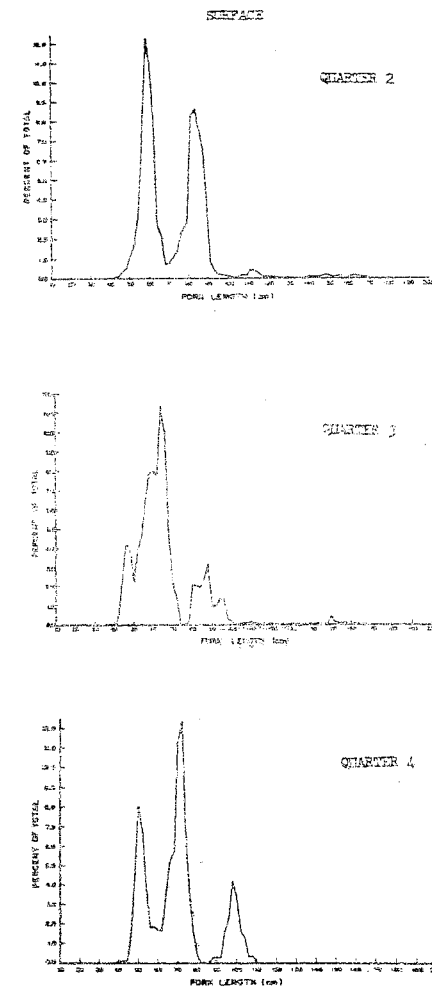


Fig. 1. Combined length frequencies for longline and surface gears, by quarter, for Atlantic bigeye tuna for 1973.

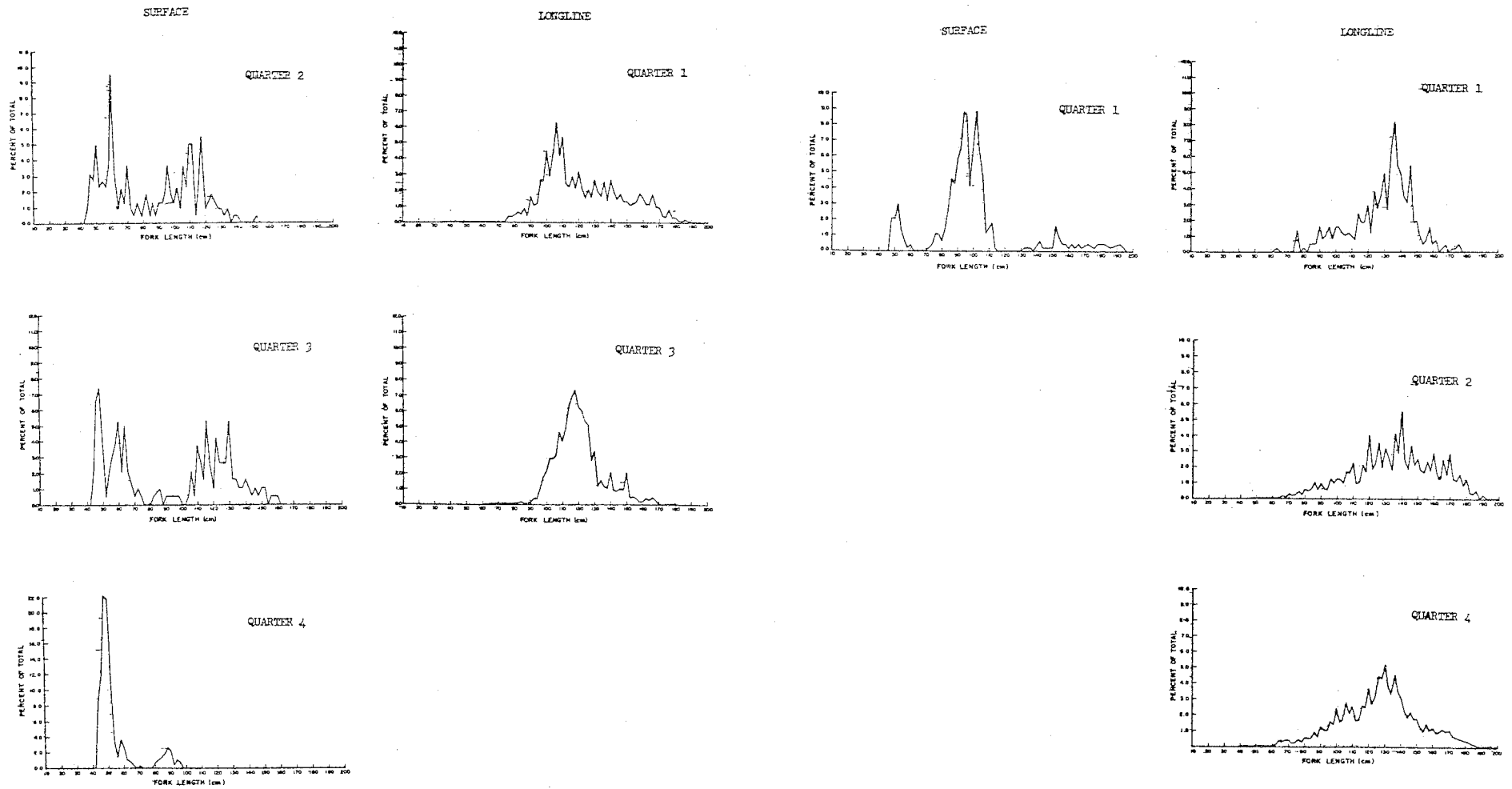


Fig. 2. Combined length frequencies for longline and surface gears, by quarter, for Atlantic bigeye tuna for 1974.

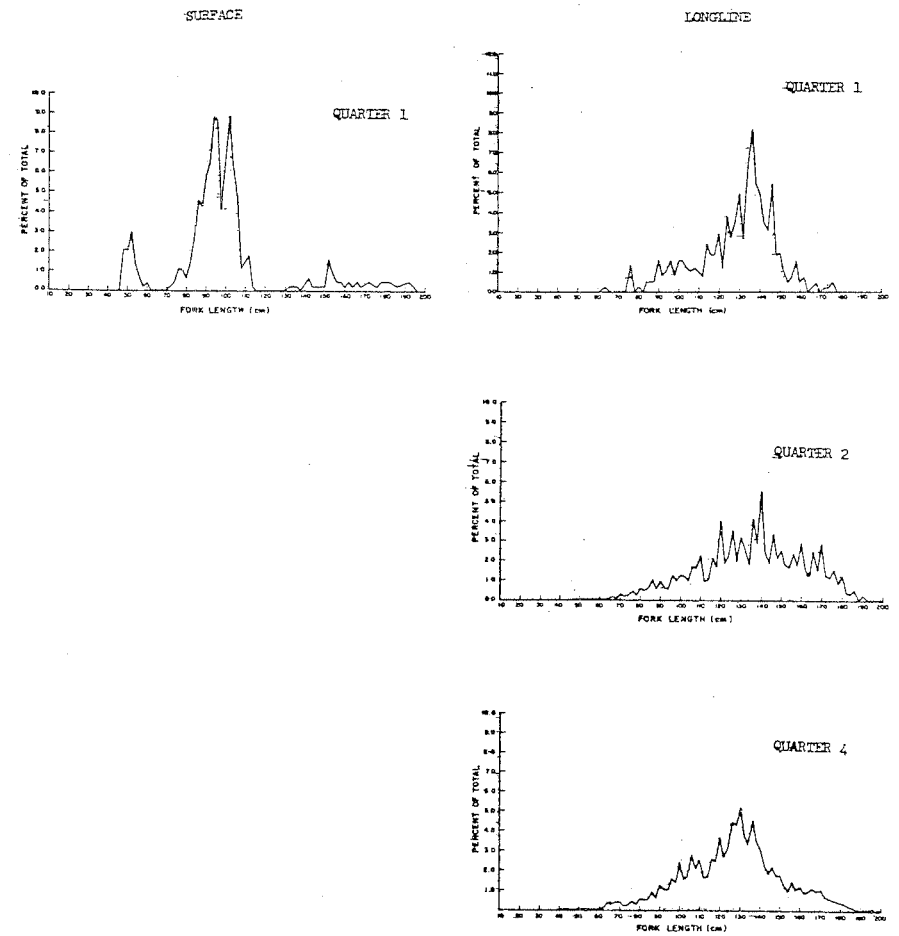


Fig. 3. Combined length frequencies for longline and surface gears, by quarter, for Atlantic bigeye tuna for 1975.

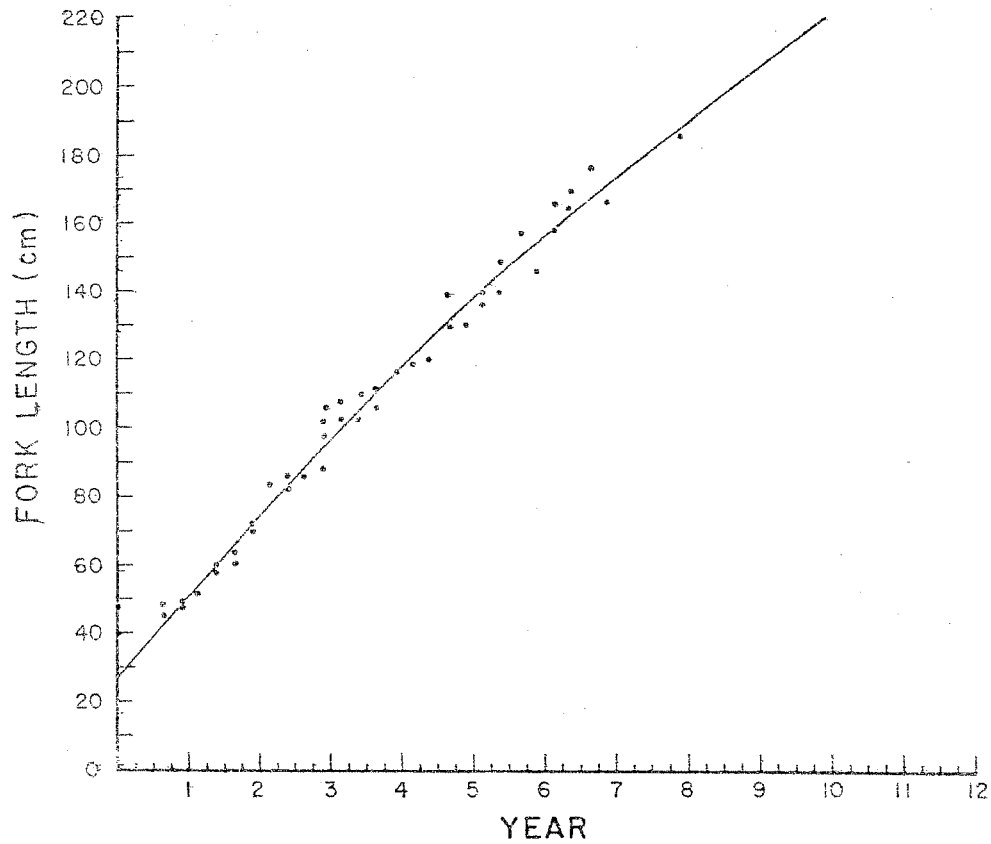


Fig. 4. Length-at-age data from length frequency modal progression analysis and the resulting least-squares Von Bertalanffy growth curve.

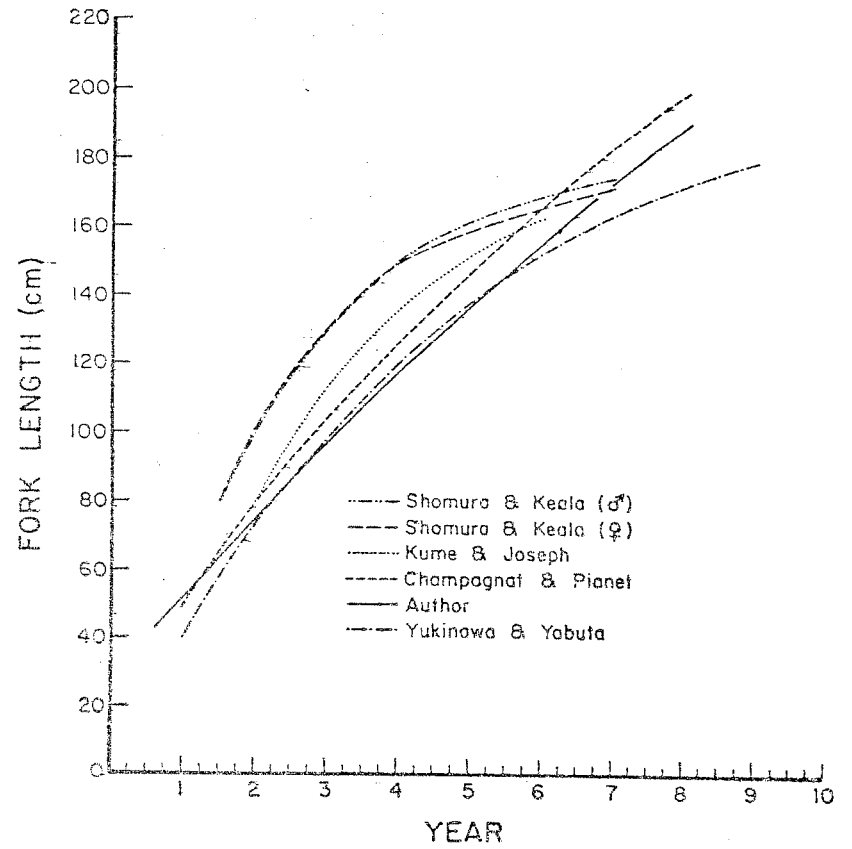


Fig. 5. A comparison of various growth curves for Atlantic and Pacific bigeye tuna from analyses by the author and others. (see text)