

## GROWTH AND AGE OF BIGEYE AND YELLOWFIN TUNA IN THE CENTRAL ATLANTIC AS PER DATA GATHERED BY R/V "WIECZNO"

B. Draganik, W. Pelczarski

## SUMMARY

The age of 171 yellowfin and 77 bigeye tunas, caught in the central Atlantic in 1982, was determined by reading annual rings on cross sections of the first dorsal fin rays. Four- and five-year-old fish prevailed.

The parameters of von Bertalanffy's growth equation were calculated on the basis of age-length and age-weight relationships.

For yellowfin tuna:  $L_{\infty} = 192.4$  cm;  $K = 0.37$ ;  $t_0 = -0.003$   
 $W_{\infty} = 89.6$  kg;  $K = 0.49$ ;  $t_0 = 0.170$

For bigeye tuna:  $L_{\infty} = 218.8$  cm;  $K = 0.23$ ;  $t_0 = -0.020$   
 $W_{\infty} = 206.4$  kg;  $K = 0.24$ ;  $t_0 = -0.030$

## RESUME

L'âge de 171 albacores et 77 thons obèses capturés en 1982 dans l'Atlantique central a été déterminé par la lecture d'anneaux de croissance annuels sur des coupes de rayons de la première dorsale.

Les poissons de 4 et 5 ans se sont avérés être les plus nombreux.

Les paramètres de l'équation de croissance de von Bertalanffy ont été calculés à partir des rapports âge-taille et âge-poids.

Pour l'albacore:  $L_{\infty} = 192.4$  cm;  $K = 0.37$ ;  $t_0 = 0.003$   
 $W_{\infty} = 89.6$  kg;  $K = 0.49$ ;  $t_0 = 0.170$

Pour le thon obèse:  $L_{\infty} = 218.8$  cm;  $K = 0.23$ ;  $t_0 = 0.020$   
 $W_{\infty} = 206.4$  kg;  $K = 0.24$ ;  $t_0 = 0.030$

## RESUMEN

Se determinó la edad de 171 ejemplares de rabil y 77 de patudo, capturados en el Atlántico Central en 1982, mediante la lectura de los anillos de las secciones transversales de los radios de la primera aleta dorsal.

Abundaron los peces de cuatro y cinco años.

Los parámetros de la ecuación de crecimiento de von Bertalanffy se calcularon en base a las relaciones edad-talla y edad-peso.

Para rabil:

$L_{\infty} = 192.4$  cm;  $K = 0.37$ ;  $t_0 = -0.003$   
 $W_{\infty} = 89.6$  kg;  $K = 0.49$ ;  $t_0 = 0.170$

Para patudo:

$L_{\infty} = 218.8$  cm;  $K = 0.23$ ;  $t_0 = -0.020$   
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The paper presents the results of age investigations in bigeye and yellowfin tuna. Materials for the investigations were taken from longline catches of the Polish research vessel, WIECZNO /765 GRT/, made in the central East Atlantic between 8 April and 2 July, 1982. The vessel put out daily a set of 1000-1200 hooks at depths of 70-125 m. The operating regions was 3 -15°N and 17-30°W. A total of 67,211 hooks was placed and 4,133 kg of bigeye tuna and 19,863 kg of yellowfin tuna were taken. The distribution of catches is presented in Fig. 1.

#### Material and method

Fork length /FL/ and weight /kg/ were recorded and sex determined for all fish taken. First spiny rays of the dorsal fin were taken out of 77 bigeye tunas and 171 yellowfin tunas in order to determine their age.

In the laboratory, the rays were cut into sections by means of a thin-blade saw, the thickness of the sections ranged from 1.0 to 1.5 mm. They were polished with a polishing disc and then placed on a micro slide 2 mm thick in a drop of "Eukitt" resin. Readability of preparations was of the order of 80-90 %. The use of rays for age determination is a simple and accurate method, which does not damage the commercially valuable material.

Age of fish was determined on the basis of the number of concentric rings visible on the cross-section under penetrating light. /Fig. 2/. The method is based on the assumption that each year two growth zones grow on the outside of the ray, forming an annual ring visible on the cross-section and a kind of annual cone in the case of the whole ray. Although the authors have no evidence to support this hypothesis, the method was used by Cayre /1979/, Compean-Jimenez and Bard /1980/, Gaikov and Char /1980/. It is not known, however, whether these zones appear at the same time irrespective of the size /age/ of fish. A shift in time in any group makes age comparison impossible. Therefore, the authors were forced to make another simplifying

assumption: the time of zone growth is constant irrespective of the age of fish.

The von Bertalanffy equation was used to characterize growth: its parameters were estimated separately on the basis of age-length and age-weight relationships. Data on age readings are presented in Tables 1 and 2. The age of bigeye tuna ranged from 1 to 7 years; for yellowfin tuna the range was 2-8 years. For both species, the exploited population was based on specimens belonging to age-groups IV and V /53-51 %/. In some fish, age was not determined because of difficulties in reading of the annual rings. The difficulties in determining the age of yellowfin tuna were proportionally two times greater than in bigeye tuna /Tables 1 and 2/.

It was also observed that the percentage of fish in which a dark zone was visible at the ray edge decreases with age in the following way:

Age	Yellowfin tuna	Bigeye tuna
2	60	60
3	32	42
4	23	32
5	14	14
6	15	25
7	33	0
8	0	-

This indicates an uneven growth of growth zones in time, depending on the age of fish.

Weight and length measurements enabled the determination of weight-length relationship according to the formula:  $w = a l^b$  where:  $W$  = weight in kg,  $l$  = fork length /FL/,  $a$  and  $b$  = co-efficients determined on the basis of empirical data.

The graphic representation of this relationship for both species is presented in Fig. 3.

Growth rate characterization was based on mean lengths of fish in age-groups, calculated on the basis of the materials collected /Gulland 1969/.

The recorded weight of fish in age-groups and the values of the co-efficient  $b$  from the function determining length-weight relationship enabled the estimation of the von Bertalanffy equation /Szypuła 1979/. The values of the parameters  $K$ ,  $L_{\infty}$ ,  $W_{\infty}$  and  $t_0$  were the following:

Parameter	Data used for calculation			
	Bigeye tuna		Yellowfin tuna	
	mean length	mean weight	mean length	mean weight
$L_{\infty}$	218.8 cm	-	192.4 cm	-
$W_{\infty}$	-	206.4 kg	-	89.6 kg
$K$	0.23	0.24	0.37	0.49
$t_0$	- 0.02	- 0.03	0.003	0.17

Growth curves for both species are presented in Figures 4 and 5.

The linear growth of yellowfin tuna is faster until age 7 than in bigeye tuna. As far as weight increments are concerned, the same regularity is observed in individuals younger than age 4.

We would like to point out that the above observations are based on not-too-numerous materials and should be treated as suggestions and not final evidence. That they should be treated in this way is supported by the fact that there are considerable differences in the magnitude of  $K$  for yellowfin tuna, depending on the initial data used.

### Literature

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Fig 1 Distribution of total catch(t) of tuna and tuna-like fishes in squares 1X1°

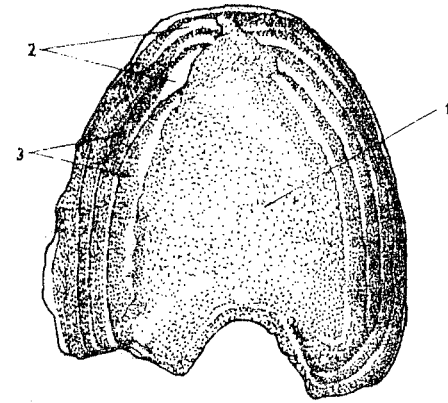
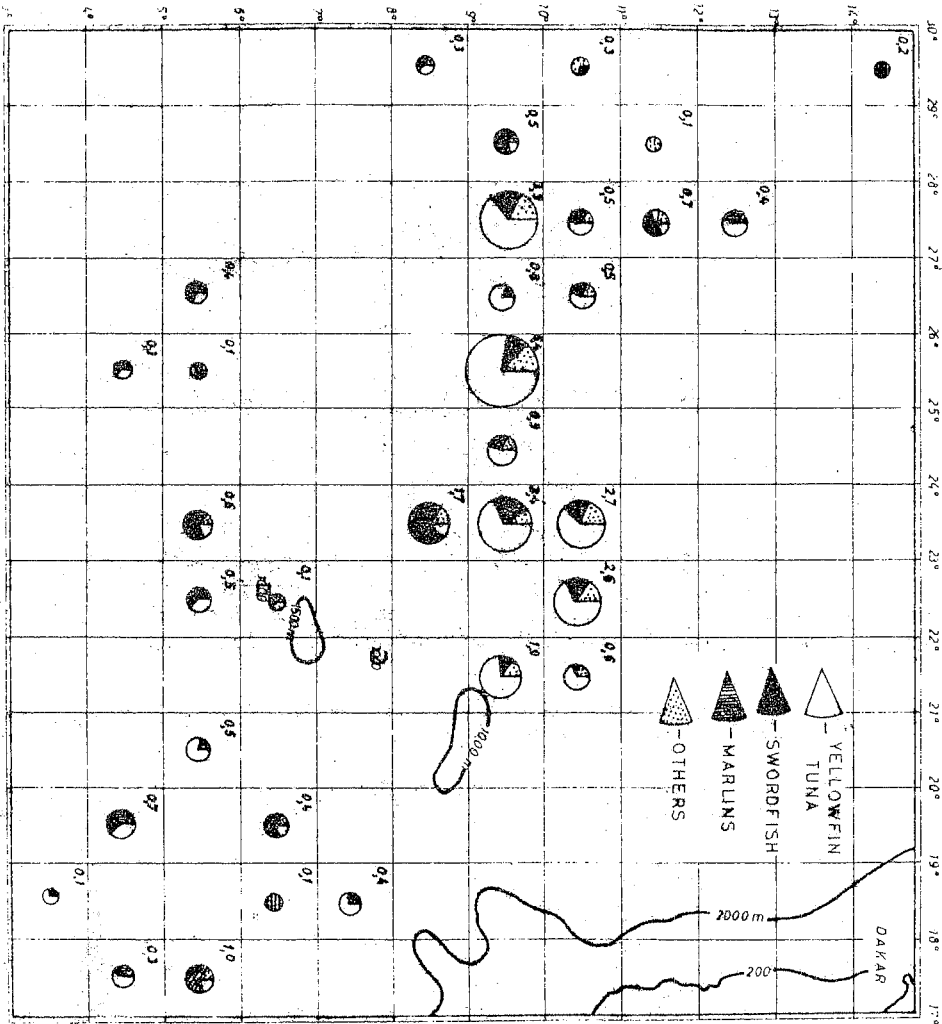


Fig. 2 Cross-section of spiny ray  
/1-porous central part; 2-light  
growth zones; 3-dark growth  
zones/.

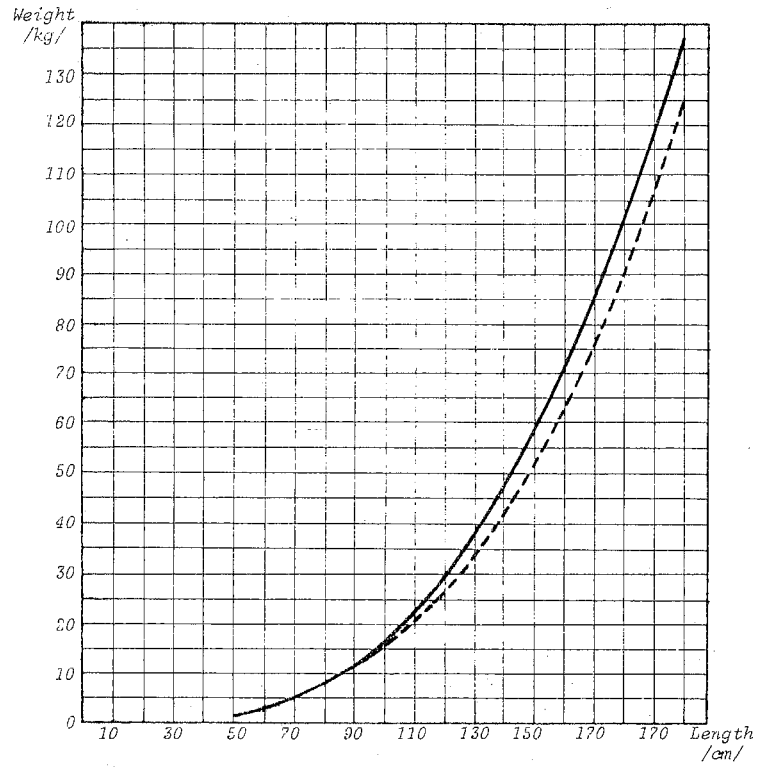


Fig.3.Length - weight relationship for Yellowfin tuna----- and Bigeye tuna-----

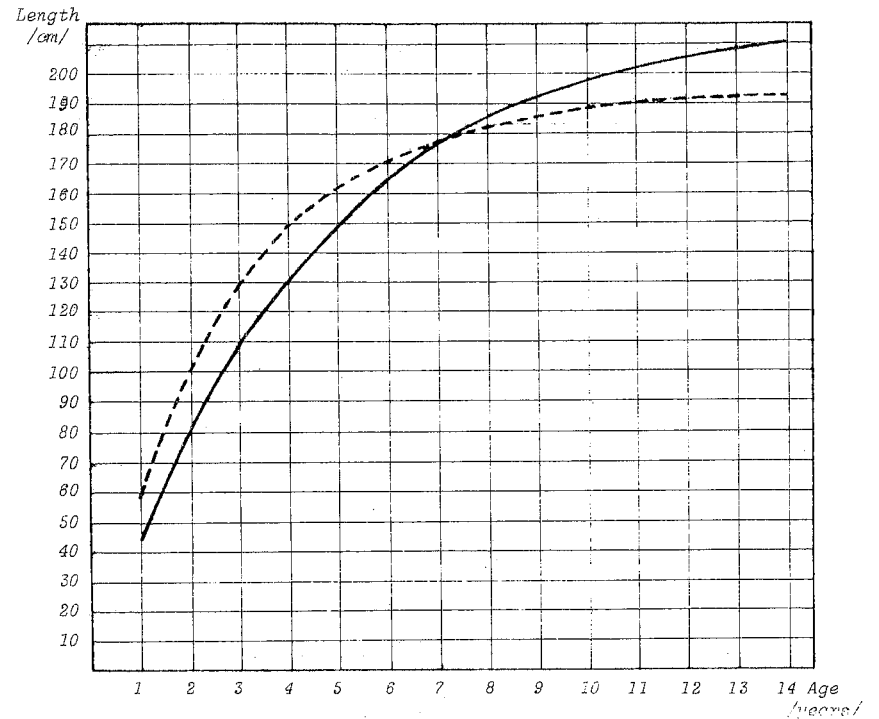


Fig.4: Curves of linear growth for Yellowfin tuna----- and Bigeye tuna-----

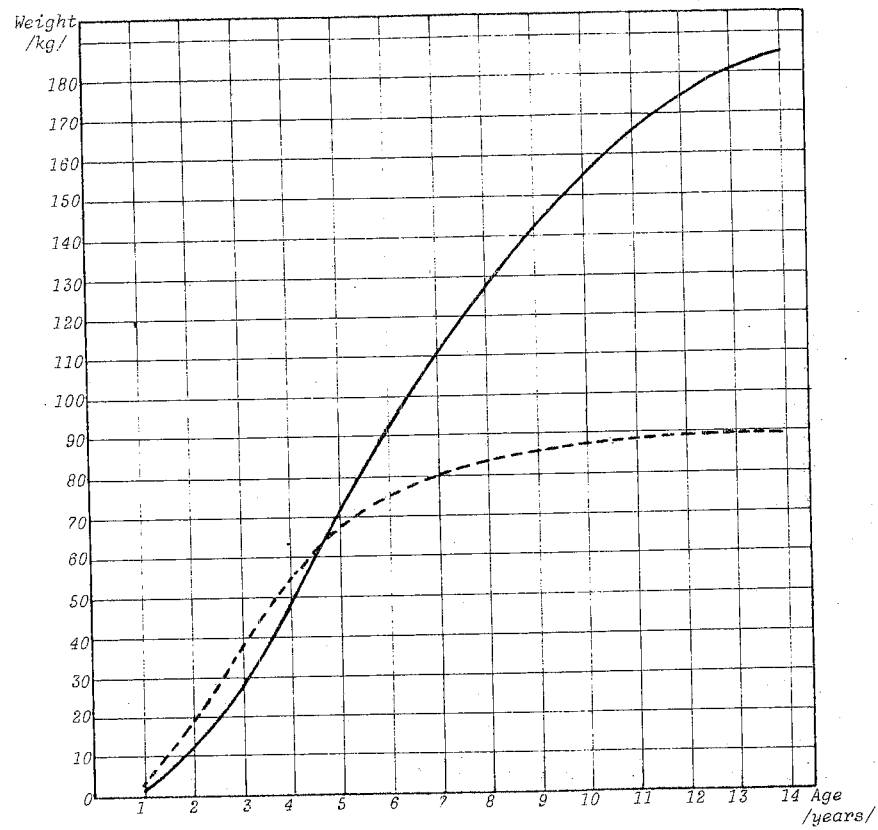


Fig.5. Curves of growth in weight for Yellowfin tuna-----  
and Bigeye tuna —————



Table 2.

Yellowfin tuna

Length class /cm/	Age of sample								Total	Mass measur- ement	Measure- ment /oo of fish	Age of investigated population							
	2	3	4	5	6	7	8	Undeter- mined				2	3	4	5	6	7	8	Undeter- mined
56-60								1	1	1	2.8								2.8
96-100	1								1	2	5.6								-
101-105	1								1	1	2.8	5.6							-
106-110	4	1						2	7	8	22.5	12.9	3.2						6.4
111-115								-	-	-	-								-
116-120								-	-	-	-								-
121-125		4						2	6	6	16.9		11.3						5.6
126-130		4						-	4	5	14.1		14.1						-
131-135		7	1					4	12	19	53.5		31.2						17.8
136-140		5		1				3	14	27	76.1		27.2	4.4					16.3
141-145		3		6	3			1	20	45	126.8		19.0	32.6					6.3
146-150				12	3			4	16	49	112.7			82.4	19.0				28.2
151-155				16	3	1		4	24	47	132.4			84.5					22.1
156-160				3	7	1		-	11	49	138.0			88.3	16.5	5.5			-
161-165				1	9	1	1	1	13	29	81.7			37.6	87.8	12.5			-
166-170					9			-	13	29	81.7			56.6	6.3			6.3	6.3
171-175				10	4			-	18	30	84.5			6.3	46.9				-
176-180				4				1	16	35	98.6			43.1	24.8			24.7	6.2
181-185				2				-	6	9	25.4			8.5				16.9	-
								1	1	2	5.6							5.6	-
$\bar{x}$	6	24	52	36	20	9	1	23	171	355	1000.0	21.3	106.0	336.1	251.6	113.5	47.9	5.6	118.0
%	3.5	14.0	30.4	21.0	11.70	5.3	0.6	13.5	100.0										