THE AGE AND GROWTH OF THE TONGUE SOLE CYNOGLOSSUS CANARIENSIS (STEIND 1882)

by

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ABSTRACT

The geometric mean regression equation for the weight; length relationship of *Cynoglossus canariensis* was $W = 0.0025\ L^{3.1770}$ The Von Bertalanffy constants $W\infty$, $L\infty$, K, and to were 507.5852g, 47.3683cm, 0.3333 and 0.1397 for males and 839.0753g, 54.4720cm, 0.3062 and 0.1737 for females. Total mortality coefficient Z ranged from 0.6482 and 0.8021.

INTRODUCTION

Studies of the age and growth of fishes contribute to reliable production estimates. These in turn are necessary for the management of fish stocks. In the Gulf of Guinea, (Williams 1968) the family Cynoglossidae is represented by *Cynoglossus canariensis*, *C. senegalensis*, *C. goreensis*, *C. monodi*, *C. browni* and *C. cadenati*. During the Guinea Trawling Survey, *C. canariensis* was one of the three pleuronectiforms widely distributed in all the transects fished (Williams 1968). Chauvet (1971, 1972) found that off Ivory Coast, 90% of the flatfishes landed were *C. canariensis* occurring between 25 and 60m. He estimated significantly different male and female von Bertalanffy parameters. Growth was higher in the male.

Off Nigeria the Cynoglossidae is an important component of the suprathermocline sciaenid community (Longhurst 1964, 1965) which supports a multi-species inshore trawl fishery. The eurybathic *C. canariensis* is the most abundant cynoglossid. It has consequently been the target of the artisanal bottom set fisheries (Longhurst 1965).

MATERIALS AND METHODS

Samples were obtained from the research vessel "Federal Argonaut" which trawled the Lagos - Escravos River grounds between January 1979 and June 1981. A total of 6053 specimens were examined for tota length, weight, sex and gonadal maturity. Weight: Length relationships for the male, female and the sexes combined were computed by geometric mean regressions. Ordinary regressions were also calculated for comparison.

Age determined by reading the annuli on otoliths and was counter-checked against rings on scales. Mean length at age was back calculated from the otoliths, and the von Bertalanffy growth equations for length and weight were then computed. The Vasnetsov growth constant CL_t (Vasnetsov 1953) modified as $CL_t = \text{Log } L_1 (\text{Log } L_2 - \text{Log } L_1)/0.4343$ was also estimated for comparison. Total mortality Z was determined according to the formula $Z = K\ (L\infty - \bar{L})/\bar{L} - Lc)$ credited to (Beverton and Holt 1956) and $Z = nK/(n + 1)\ (\bar{Y} - Yc)$.

RESULTS

Weight: Length Relationship

The geometric mean regression equation of weight on length for the male, female, and the sexes combined are shown in Table 1. Table 2 lists the length - weight equations. The differences between the ordinary and geometric mean regressions were insignificant. The linear relationship of log weight: log length is shown in Figure 1.

Growth rate and the Vasnetsov growth characteristic

Plots of length on age and length increment on age are shown in Figure 2. They indicated that while the total length increased with age, the converse was true of the age increment. The Vasnetsov specific growth rates, growth constant and the growth characteristics are tabulated in Table 3. The weighted growth characteristic for 2nd year class *Cynoglossus canariensis* was 0.6818. It ranged between 0.1515 and 0.3598 for the older year classes. The mean value for all year classes was 0.3604.

Table 1. Weight: Length relationship of *C. canariensis* male, female and the sexes combined.

	Geometric mean regression equations	
Male	$W = 0.0028\ L^{3.1384}$	$r = 0.9943$
Female	$W = 0.0020\ L^{3.2386}$	$r = 0.9986$
Both sexes	$W = 0.0025\ L^{3.1770}$	$r = 0.9979$

Table 2. Length: Weight relationships of *C. canariensis* Male, female and the sexes combined.

	Geometric mean regression equations	
Male	$L = 2.0827\ W^{0.3186}$	$r = 0.9943$
Female	$L = 6.7849\ W^{0.3088}$	$r = 0.9986$
Both sexes	$L = 6.5925\ W^{0.3148}$	$r = 0.9979$

Table 3. Vasnetsov specific growth rate, growth constant and the modified growth characteristic estimated for *Cynoglossus canariensis*.

Year Class	Speficic growth rate	Growth constant	Vasnetsov growth characteristic	Weighted Vasnetsov growth characteristic
2	0.5901	0.8852	8.4384	0.6818
3	0.2549	0.6373	6.5764	0.3598
4	0.1632	0.5712	5.4329	0.2484
5	0.0951	0.4280	0.7270	0.3604
Mean	0.2758	0.6304	3.7270	0.3604
	Bertalanffy growth coefficient (k)			0.3314

Bertalanffy parameters for growth in length

The von Bertalanffy (1938) parameters Loo K and t_o were determined by regressions from the Ford-Walford plot and the plot of the natural logarithm of (Loo - Lt) on t.

Male

The geometric mean regressions of the Ford-Walford plot and the plot of Ln (Loo - Lt) on t for male were:

$L_t + 1 = 13.4247 + 0.7166L_t$

and $Ln (Loo - L_t) = 3.8100 - 0.3454_t$

$Loo = 47.3683$

$K = 0.3333$

$t_o = 0.1397$

von Bertalanffy equation

$L_t = 47.3683 \ (1 -_e{-0.3333} \ (t - 0.1397)$

Female

The geometric mean regression of the Ford-Walford plot and the plot of Ln ($Loo - L_t$) on t for females were:

$L_t + 1 = 14.3657 + 0.7363 L_t$

and $Ln (Loo - L_t) = 3.9444 - 0.3067_t$

$Loo = 54.4720$

$K = 0.3062$

$t_o = 0.1737$

von Bertalanffy equation

$L_t = 54.4720 \ (1 -e^{-0.3062 \ (t - 0.1737)}$

Male and Female

The geometric mean regressions of the Ford-Walford plot and the plot of Ln ($Loo - L_t$) on t for both sexes were shown in figures 3 and 4. The geometric mean regressions were:

$L_t + 1 = 14.4342 + 0.7179 L_t$

and $Ln (Loo - L_t) = 3.9037 - 0.3347_t$

$Loo = 51.1683$

$K = 0.3314$

$t_o = 0.0940$

von Bertalanffy equation

$L_t = 51.1683 \ (1 - e^{-0.3314 \ (t - 0.094)}$

Bertalanffy equations for growth in weight

The von Bertalanffy equations for growth in weight according to the geometric mean regressions were:

(a) Male

$Wt. = 507.5852 \ (1 - e^{-0.3333 \ (t - 0.1397)})^{3.1384}$

(b) Female

$Wt. = 839.0753 \ (1 - e^{-0.3062 \ (t - 0.1737)})^{3.2386}$

(c) Both sexes

$Wt. = 672.1035 \ (1 - e^{-0.3334 \ (t - 0.094)})^{3.1770}$

Total Mortality (Z)

The total mortality Z estimated were 0.8124 for all males, 0.7036 for all females and 0.8021 for both sexes using Ssentongo and Larkin (1973) formula. The corresponding values according to Beverton and Holt (1956) were 0.6580, 0.5627 and 0.0482.

DISCUSSION

Although the geometric mean regressions are more appropriate (Ricker 1973), the ordinary regressions were also calculated to facilitate comparison with previous work based on the latter. The results of the weight-length relationship computations showed marginal difference between the two regressions suggesting that in *Cynoglossus canariensis* the ordinary regression could be used without appreciable loss of accuracy. The value 3.1770 which represented the weight: length regression coefficient for the combined sexes is indicative of allometric growth.

The weighted Vasnetsov growth characteristic appeared to separate *C. canariensis* into two stanzas. Fish within the 1st and 2nd year classes appeared to be in one stanza and older fish in the other coinciding with pre and post maturity stages respectively. It was also significant that the mean weighted growth characteristic 0.3604 did not differ markedly from 0.3314 estimated as the von Bertalanffy growth constant K.

The Loo and k calculated in this study compared reasonably well with those obtained by Chauvet (1972) for more male and female *C. canariensis* in Ivory Coast as shown in Table 4. Both studies agreed that females were longer lived and that the regression coefficients (Table 5) of the weight: length relationship were higher in the females.

On the other hand, Chauvet's back calculated mean lengths at age were markedly higher (see Table 4). Chauvet had justified the high estimates by concluding that the growth rates obtained were peculiar to the Ivory Coast as they were higher than those for the Congo and Sierra Leone. Furthermore, Longhurst (1965) had reported (with some reservation occasioned by probable specific mis-identification) that *Cynoglossus* spp. and some other fish off Nigeria were comparatively smaller than those from Sierra Leone. Both of these observations might explain some of the variance.

The total mortality coefficients (Z) estimated by the two methods showed higher values for males as showwn in Table 6. These were in agreement with Longhurst (1863) who recorded a higher survival rate in the females. The sexual composition of the catches suggested that the differences were probably due more to differential fishing mortality (F) than natural mortality (M). Pauly (1981) has shown that Beverton and Holt's (1956) formulation underestimates Z. This appears to be the case here. The high values of Z, (0.7036 - 0.8124) are more acceptable, being a better reflection of the heavy fishing pressure to which soles and other members of the sciaenid community are subjected.

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Table 4. Length at age and Bertalanffy parameters estimated by this study compared with Chauvet (1972).

Age (yr)	1	2	3	4	5	L_∞	K	t_o	Source
Male	15.6	23.74	32.69	35.46	-	47.3683	0.3333	0.1397	this study
	27.0	34.0	34.0	39.0	-	50.5	0.36	1.1	Chauvet 1972
Female	16.0	25.7	34.33	39.1	43.1	54.4720	0.3062	0.1737	this study
	27.0	35.0	41.00	45.0	49.0	55.0	0.32	1.0	Chauvet 1972

Table 5. The regression coefficients of the weight Length relationships in *Cynoglossus canariensis*

	Chauvet (1972)	This Study	
		Ordinary Regression	Geometric Mean Regression
Male	2.77	3.1205	3.1384
Female	2.80	3.2341	2.2386

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DISCUSSION

A. A. Olatunde: What method was used for the age determination in view of the problems usually encountered in age determination of tropical fishes especially in deciding whether the rings seen on the fish are annual or not?

T. O. Ajayi: The age determination was done using annual rings. This can be standardized using scales, and skull bones with large enough samples over the years.

S. O. Fagade: I agree with the author that tropical fishes have rings laid annually. The rings are even laid daily and can be cross-checked for age. More work should however be done on mortality as well as age frequency within the population. The age, maturation of sex and mortality rate in tropical fresh water fish is traceable to absence of nutrient. It is also possible to distinguish between annual rings and those produced as a result of spawning activities.

N. I. Azeza: Have you worked on age and maturity of fresh water fishes? Experience from studies in lakes have shown that fish maturity sets in early in some cases due to some nutrient deficiency.

T. O. Ajayi: I am only working with marine species.

V. O. Sagua: What factors are responsible for annual ring formation?

T. O. Ajayi: Rings are caused by calcium metabolism. However, what really causes the daily rings as earlier said by Dr. Fagade cannot be explained yet.

Rings as a result of calcium metabolism are laid daily. But the factors responsible are not known with certainty even in the temperate countries.

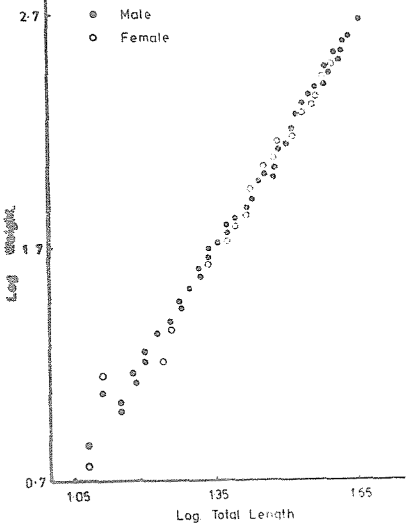

Figure 1 The linear relationship of log weight: log length.

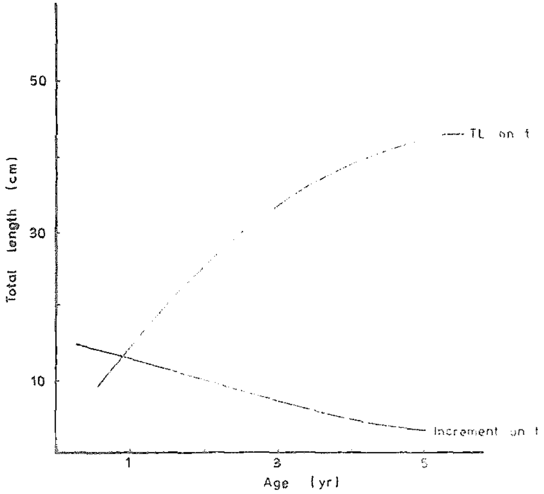

Figure 2 The plots of length on age and length increment on age.

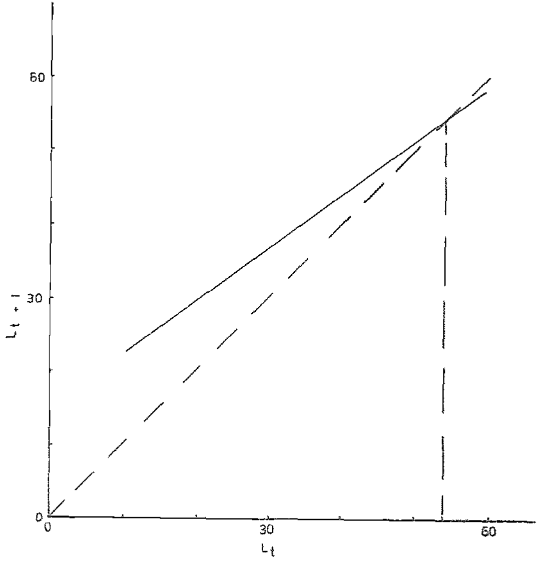

Figure 3 The Ford-Walford plot of L_t or L_t for male and female C. canariensis

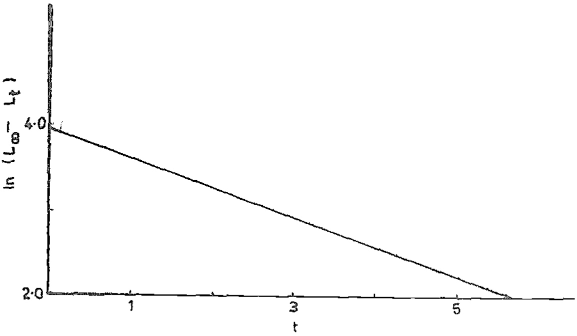

Figure 4 The Plo of Ln (L∞ -Lt) on to for male and female <u>C. canariensis</u>

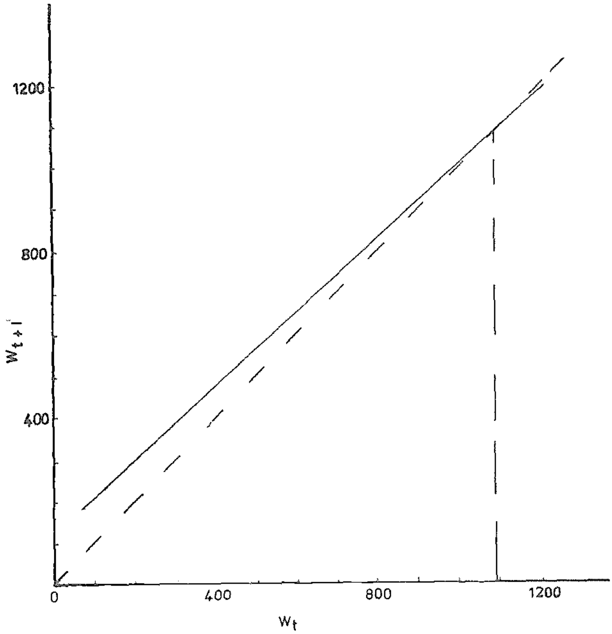

Figure 5 The Ford-Walfoıd plot of W_t on W_t for male and female <u>C. canariensis</u>

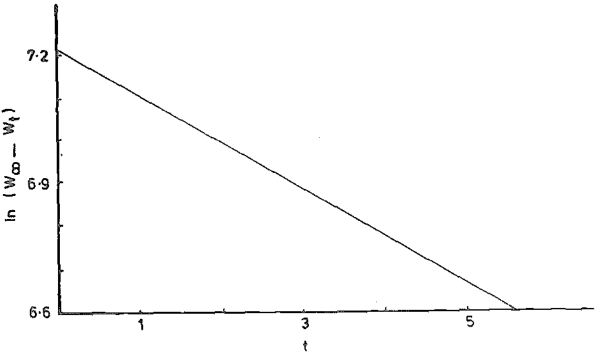

Figure 6 The plot of In (W∞ - W_t) on t. for male and female <u>C. canariensis</u>