Growth of *Sardinella maderensis* in the Lobe Estuary, Cameroon

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Introduction

The Madeiran sardine, *Sardinella maderensis,* is one of the main target species of the artisanal fishery of Cameroon. Locally called "strong kanda", "elolo" or "belolo", it is eaten fresh or smoked by Cameroonians and is one of the main sources of animal protein in the country. This paper highlights one aspect of its biology, namely, its growth, the knowledge of which is an essential prerequisite for rational exploitation.

Materials and Methods

The numerous estuaries in the Kribi zone are traditional fishing grounds for artisanal fishermen. The Lobe fishery - located 8 km south of Kribi - was chosen as sampling site for this study (Fig. 1). Random samples of fish caught with gillnets of 4 to 5 cm (stretched mesh size) were bought twice a month from fishermen between April 1987 and March 1988. The total length of 1,553 fish was measured during the period. Analyses were done using data lumped on a quarterly basis (First quarter = Jan.-Mar., etc.), a procedure recommended when recruitment fluctuates (Pauly 1983).

The approach used here to separate the length-frequency samples into their component normal distributions was the Bhattacharya (1967) method. This is based on a plot of the difference between successive logarithms of numbers against the lower limit of the size classes. This leads to series of straight lines with descending slopes, the X-intercepts of which estimate the mean length of each cohort (see Sparre 1985).

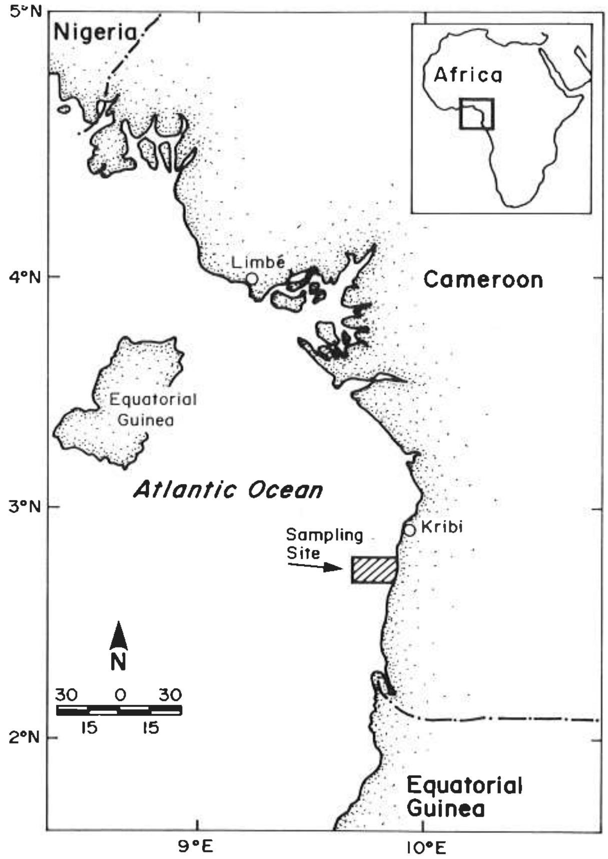

Fig. 1. Location of sampling site on Cameroon's coast.

Modal Progression Analysis (MPA)

After the mean lengths of all components of the available length-frequency samples were estimated, they were linked in a fashion thought to represent growth. The resulting growth increments were then used to estimate the parameters L and K of the von Bertalanffy Growth Function (VBGF) using a Gulland and Holt plot (1959).

Results and Discussion

The data used for the Bhattacharya analysis are given in Fig. 2A. Results for this method are summarized in Table 1. The growth increments and related Gulland and Holt plots (Fig. 2B) lead to estimates of L_∞ = 32.5 cm and K = 0.59 ($year^{-1}$).

For the regression which led to these results, one outlying data point was dropped. This point might be due to the fact that the second component distribution of the third quarter might not have been identified properly (low year-class strength); indeed, the standard deviation of Cohort II in Table 1 is relatively high compared to the others.

The reliability of these results will be strongly affected by the selectivity of the gear used. In fact, gillnets have a strong selection for only one narrow size range, fail to retain the bigger fish and allow the smaller ones to pass through (see Gulland 1983). It is therefore, expected that smaller or bigger mesh size would have selected different fish sizes, and led to different estimates of L_∞ and K. However, data obtained by Marcus (1984) for *S. maderensis* caught by gillnets of 4-7 cm (stretched mesh size) in Nigeria led to L_∞ = 37.5 cm and K = 0.34. These values do not differ much from our findings, corresponding to a growth performance index, ϕ' (see Pauly and Munro 1984), of 2.68 as compared to a ϕ'= 2.79 for the L_∞ and K values presented herein.

The presence of two modes in each quarter apparently indicate two yearly cohorts. Boely (1979), using the gonadosomatic index of fish collected from 1968 to 1972 in Sénégal, found *S. maderensis* to breed

Table 1. Mean lengths (and s.d.) of *Sardinella maderensis* quarterly samples collected near Kribi, Cameroon, April 1987-March 1988. Arrows indicate growth increments used for Gulland and Holt plot; their numbers are shown in Fig. 2A and 2B.

Quarter	Cohort I	Cohort II
1	17.2 (0.73)	19.3 (0.42)
2	15.9 (2.35)	19.6 (1.06)
3	15.3 (1.00)	20.0 (6.54)a
4	17.5 (0.68)	21.6 (2.16)

a not used, see text

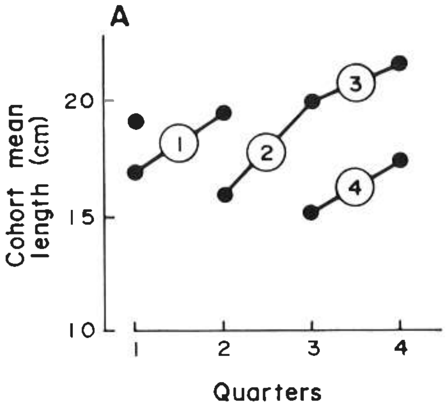

Fig. 2A. Linking of means following decomposition of quarterly samples using Bhattacharya's method (see also Table 1).

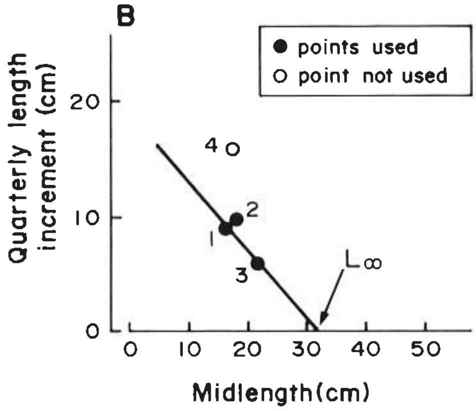

Fig. 2B. Gulland and Holt plot; x-intercept = L_∞, and slope (-) K.

Table 2. Input data for Gulland and Holt plot, with the regression equation and r value (data derived from Fig. 5 and Table 1).

Link No.	L(t1) (cm)	L(t2) (cm)	ΔL (cm)	Δt (year)	ΔL/Δt cm/year	(L(ti)+L(t2))/2 (cm)
1	15.3	17.5	2.22	0.25	8.88	16.43
2	15.9	20.0	4.09	0.25	16.36*	17.99*
3	20.0	21.6	1.60	0.25	6.4	20.84
4	17.2	19.6	2.39	0.25	9.56	18.36

Y = 19.322 - 0.595x; r = -0.791, n = 3
*Values not used in the regression analysis (see text for details).

continuously with two peaks of activity around April and October. In addition, we note that the mean lengths of the cohorts given in Table 1 correspond to relative ages of between 1 and 2 years. This indicates that the fishery depends mainly on 1-year old fish.

Currently, there is concern about the fishing pressure being exerted on juvenile sardines. The gillnets utilized by most fishermen appear to help avoid growth overfishing and to allow sufficient escapement of spawners (Boely 1979). However, the beach seines currently in use in nursery grounds, as well as the purse seines in use further offshore, do not allow young fish to escape from the nets. These practices, combined with strong fishing effort, may lead to overfishing of the stock.

Acknowledgments

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Management of Catfish (*Bagrus meridionalis* Günther) in Southern Lake Malaŵi

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Introduction

The catfish *Bagrus meridionalis* Günther, locally known as *kampango*, is a predator endemic to Lake Malaŵi where it lives in deeper water and feeds mainly on small bottom-living cichlid species. Some notes on its biology were given by Jackson et al. (1963). Substantial quantities of *kampango* are caught in gillnets and longlines by artisanal fishermen. The fish also occur as bycatch in the demersal commercial trawlers in southern Lake Malaŵi.

FAO (1976) reported declining catfish catch rates from gillnet and longline fisheries in southern Lake Malaŵi from the early 1950s to the early 1970s. Since *kampango* is one of the valued food and commercial fish species in Malaŵi, measures to control its exploitation should be taken. This paper assessess the yield of the fish using a dynamic pool model with the aim of giving advice on the rational exploitation of the fish.

Materials and Methods

The dynamic pool model of Beverton and Holt (1957) was used to calculate values of yield per recruit. Data concering the growth of *kampango* which were required in fitting the model were taken from the study carried out by Tweddle (1975). The natural mortality (M) was estimated from the equation of Pauly (1980).

During January to March 1987, bottom trawling was carried out in the north of fishing area B (Fig. 1) using the 88 hp research vessel "Ethelwyn