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Growth Coefficient of Fish Species Within the Andoni River, Niger Delta, Nigeria and Their Aquaculture Implications

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Abstract: Total length measurements of 11 scientifically and commercially important fish species from the Andoni River artisanal fishery were analyzed after conversion into constant class length frequency data of 1 cm interval. Sampling was carried out between January and December, 1999 and pooled into one year data. Results revealed that in 64%, (i.e., seven of the fishes) approached asymptotic length L_8 (length at affinity) at a relatively rapid rate of K (growth coefficient) of 0.69-1.7 year^{-1}. The fishes with the high K value were Ethmalosa fimbriata, Eucinostomus melanopterus, Ilisha africana, Galeoides decadactylus, Pseudotolithus elongatus, Sarotherodon melanotheron and Tilapia guinensis. Liza grandisquamis, Lutjanus goreensis and Pomadasys jubelini making up the remaining 36% with K range of 0.3-0.39 year^{-1} took a relatively longer time frame to get to big sizes which is not a favourable criterion in fish selection for aquacultural practices.

Key words: Fish growth coefficient, andoni artisanal fisheriy, Niger Delta

INTRODUCTION

The curvature parameter of the Von Bertalanffy growth function or fish growth coefficient (K) is an important growth parameter in fishery Statistics. It depicts the rate of dimension per time (year, months, weeks or days) at which the asymptotic length (i.e., length of very old fish) is approached (Pauly, 1983; Gayanilo and Pauly, 1997). Few studies have been conducted that evaluated the growth coefficient of fish stocks within and outside Nigeria. A few of these studies have been reported in (Table 1).

As one of the fundamental parameters that have to be determined and used as input into fish stock prediction models, its significance in fishery statistics cannot be over emphasized.

Consequently, this study provides information on the growth coefficient of most of the scientifically and commercially important fish species often harvested by the Andoni River artisanal fishers. Fish species belonging to the Mugilidae and Cichlidae are targets of brackish water aquacultural practices in Rivers State and other coastal States in Nigeria; this study will reveal their suitability in brackish water aquaculture practice.

Table 1:Growth coefficient of fish species from literature

Fish species	Growth coefficient K (year^{-1})	Author	Region
Pseudotolithus. elongatus	0.280	Nawa (1987)	Cross rivers estuary
Chrysichthys. nigrodigitatus	2.390	Nawa (1987)	Cross rivers estuary
Cynoglossus goreensis	0.097	Nawa (1987)	Cross rivers estuary
Galeoides decadactylus	0.200	Abohweyere (1989)	Nigerian inshore waters
Mugil cephalus	0.5547	Hart (1997)	Bonny river
Periophthalmus barbarus	0.360	King (1996)	Estuarine swamps of cross rivers
Periophthalmus barbarus	0.360	King (1997)	Nigerian inshore waters
Limnothrissa miodon	0.145	Cochraine (1984)	Kariba lake
Limnothrissa miodon	0.254	Marshall (1987)	Kariba lake
Limnothrissa miodon	0.079	Chifamba (1992)	Kariba lake
Limnothrissa miodon	0.104	Moreau *et al.* (1991)	Tangayika lake
Limnothrissa miodon	0.100	Spliethoff *et al.* (1983)	Kivu lake

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MATERIALS AND METHODS

The Andoni River lies between latitudes 4°o 28[1] to 4°0 45[1] North and longitudes 7°0 45[1] East in the Niger Delta of Nigeria and its water is brackish in nature (Francis, 2003).

Oyorokoto and Kaa (Ika) watersides are two main landing sites for the Andoni artisanal fishers. Figure 1 About 21 unmotorized dug out canoes are landed daily at the Kaa waterfront.

Biweekly fish samples from five randomly selected landed artisanal catches from January to December 1999

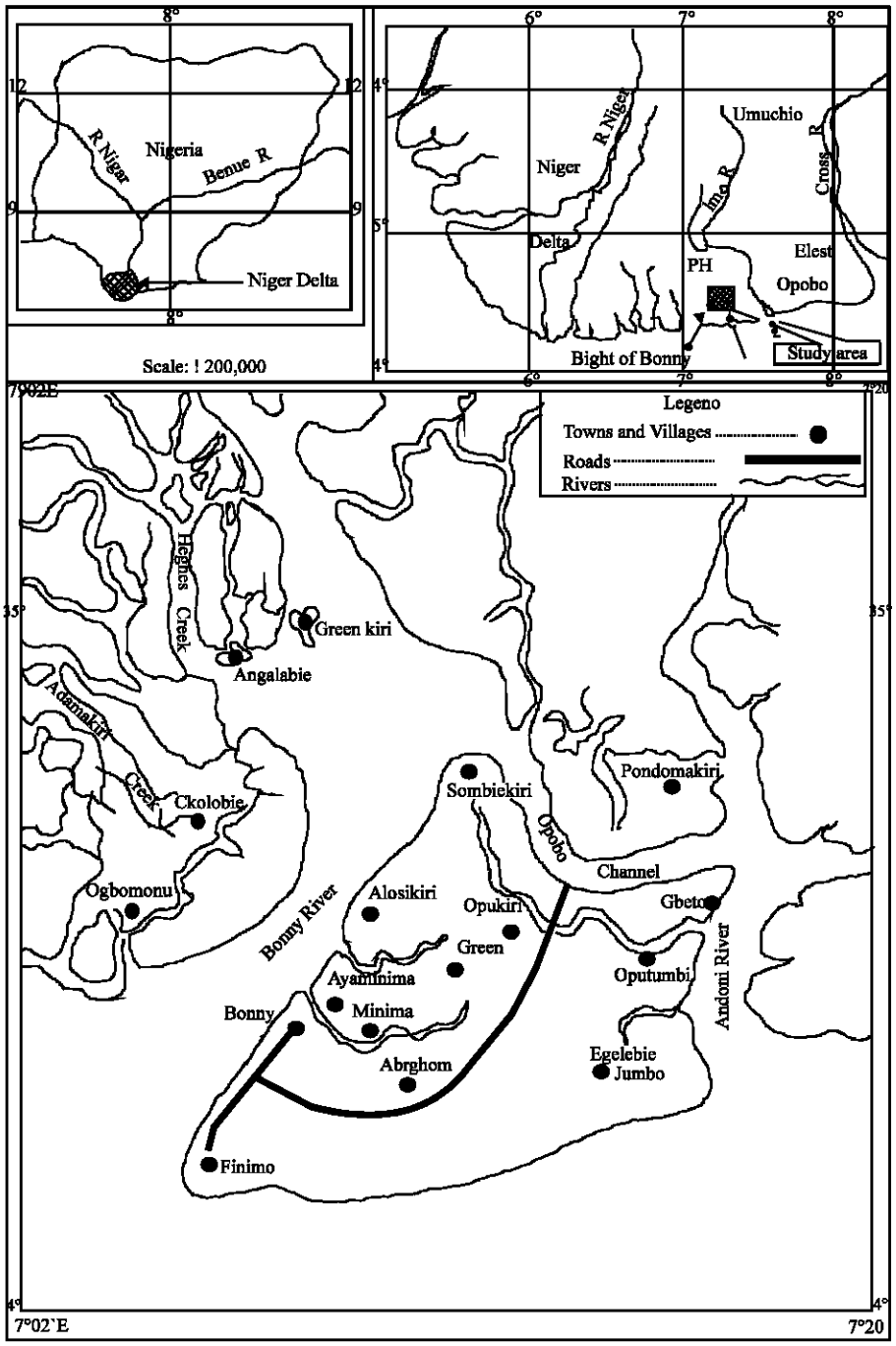

Fig. 1: Part of Niger Delta showing bonny and andoni rivers

Table 2: Comparative growth coefficients of fish species from the Andoni River System, Niger Delta, Nigeria (1999 Data)

	SCAN of K- value ($year^{-1}$)			Length-at-age K_3 ($year^{-1}$)		
Fish species	K_1	Rn	Elefan 1 K_2 ($year^{-1}$)	K_3 ($year^{-1}$)	S.e of K	CV of K
Chrysichthys nigrodigitatus	0.30	0.16	0.30	0.32	0.05	0.15
Ethmalosa fimbriata	0.47	0.31	0.47	0.22	0.06	0.26
Eucinostomus melanopterus	0.71	0.20	0.81	0.23	0.06	0.18
Ilisha africana	0.48	0.31	0.68	*	*	*
Galeodes decadactylus	0.93	0.34	0.93	*	*	*
Liza grandisquamis	0.39	0.16	0.39	0.28	0.48	0.17
Lutjanus goreensis	0.39	0.15	0.39	0.34	0.13	0.44
Pseudotolithus elongatus	0.69	0.17	0.69	0.27	0.03	0.12
Pomadasys jubelini	0.32	0.16	0.32	0.42	0.03	0.06
Sarotherodon melanotheron	1.30	0.20	1.30	0.34	0.01	0.03
Tilapia guinensis	0.74	0.19	0.74	0.41	0.10	0.25

Key: * Catch population was low for this analysis, $year^{-1}$ = per year,K = growth coefficient

were obtained for length frequency data collection. The fishes were identified to species level using (Reed *et al*., 1967; Tobor, 1968; Blache, 1970; Schneider, 1990). Following the procedure outlined by Pauly (1983) total length measurements of fish from all the sampled catches were taken. The length from the tip of the snout to the end of the caudal fin formed the Total Length (TL), in centimeters using transparent plastic ruler. All the length measurements were put in 1cm class interval, pooled for the year and analyzed using FiSAT (FAO-ICLARM Fish Stock Assessment Tool) soft ware package.

Powell-Wetherall plot routine was employed for determination of L_8 which served as input into scan of K-value routine for estimates of K_1. From the ELEFAN 1 Automatic Search routine, K_2 values were calculated and through the Pauly integrated length-frequency method (not in FiSAT), the length-at-age data were evaluated Francis (2003) culminating in the evaluation K_3 values.

RESULTS

Results of the growth coefficients for the 11 commercially important fish species obtained from the Andoni artisanal fishery is reported in (Table 2).

The coefficients K_1 and K_2 ranged between 0.30-1.30 $year^{-1}$ under the scan of K-value and ELEFAN 1 routines respectively but fell between 0.22 and 0.42±Standard Error (S.E) for K_3 using length-at-age routine.

The values of K_1 and K_2 were the same, (Table 2), except in 18% cases (i.e., Eucinostomus melanopterus and Ilisha africana) where the rates were higher with ELEFAN 1 routine (K_2) to the degree of 0.10 and 0.20 for the above two fishes, respectively.

The K_3 values were equal or slightly higher than those of K_1 and K_2 in 22% of the fishes (i.e.,*Chrysichthys nigrodigitatus* and *Pomadasys jubelini*).

Based on a mathematical average of 0.50, the results showed, in the cases of K_1 and K_2 that 64% of the fishes (*E. fimbriata*, *E. melanopterus*, *I. africana*, *G. decadactylus*, *P. elongatus*, *S. melanotheron* and *T. guinensis*) approached L_8 rapidly with only four species 36% (*C. nigrodigitatus*, *L. grandisquamis*, *L. goreensis* and *jubelini* approaching at a slow rate. The K_3 values indicated that all the 11 fish species approached L_8 slowly.

DISCUSSION

The growth coefficient values reported in this study compare favourably with reports of other fish stock assessment studies. In a few cases, rates higher or lower than values reported in this study were seen in literature and have been provided in (Table 3). The differences in the K values obtained from this study and those from Lagos area by Ezenwa and Ikusemiju (1981), Udoh (1994) for the Cross River System and Nawa (1987) for the Cross River estuary all around the Niger Delta in Nigeria can be accounted for by differences in stock population emanating from genetic factors, Physico-chemistry of their aquatic habitat Odo and Inyang (2001), nutrient availability, population dependent factors of the particular geographical location Francis (2003) and other abiotic factors. The aforementioned factors may also be responsible for the little variation observed in the K values for *I. africana*, *P. elongatus* and *T. guinensis* for the various regions indicated in (Table 3). The numerically close K values obtained in this present study and those of Moses (1988) and Essen (1995), all in the Niger Delta for *E. fimbriata* indicate that the *E. fimbriata* assemblage from these water bodies may be of the same stock while that from the Sierra Leonian Shelf may be of a different stock.

Tabash and Sierra (1996), considering their results and those of other workers agreed that the Lutjanidae generally, approached the L_8 slowly which tallies with the results of this study (Table 3).

The low K_3 values in comparison to K_1 and K_2 may be due to the elimination of longer lengths of fishes from the

Table 3: Comparison of growth coefficients of fishes of the andoni river system with those of other regions

Fish species	K (year^{-1})	Author	Region
C. nigrodigitatus	0.300	Present study	Andoni river system
	0.165	Ezenwa and Ikusemiju (1981)	Lagos area
	0.191	Udoh (1994)	Cross river system
	2.390	Nawa (1987)	Cross river estuary
E. fimbriata	0.470	Present study	Andoni river system
	0.250	Showers (1996)	Sierra leonian shelf
	0.430	Moses (1988)	Nigerian inshore waters
	0.360	Essen (1995)	East of Niger delta
I. africana	0.480	Present Study	Andoni river system
	2.330	Stokholm (1992)	Coastal waters: Republic of benin and lagos state
	1.370	Showers (1996)	Sierra leonian shelf
P. elongatus	0.690	Present Study	Andoni river system
	0.280	Nawa (1987)	Cross river estuary
	0.380	Etim *et al.* (1994)	Cross river estuary
Sciaenid species	0.50-1.94	Chekraborty (2001)	Mumbai waters
Lutjanus vivanus	0.32	Tabash and Sierra (1996)	Costa rica
L. buccanella	0.35		
L. goreensis	0.39	Present Study	Andoni river system
T. guinensis	0.740	Present Study	Andoni river system
	0.475	Fagade (1979)	Lagos areas

pooled length-frequency data, which is a necessity before estimating the lengths at various ages of fish cohorts. Such elimination ensures removal of gaps in the length-frequency histogram when using the Pauly's integrated length frequency method to estimate relative age of fish species.

The fact that the growth coefficient values k_1 and k_2 obtained through the scan of K-value and ELEFAN 1 routines respectively had the same figures in 82% cases and differed to the degree of 0.10 and 0.20 in only two fish species indicate that scan of K-value routine in FiSAT can be safely used for growth coefficient calculations without fear of producing invalid results. This finding is vital because scan of K-value routine is simpler to use in the calculation of K values.

AQUACULTURAL IMPLICATIONS

The division of the eleven fish species into two groups; of one rapidly approaching L_8 and the other approaching slowly has implications for brackishwater aquacultural practices in the Niger Delta of Nigeria.

The need to conserve biodiversity and reduce pressure on capture fisheries in order to ensure sustainability, provide alternate means of employment, income, food and nutritional security brings to light the important role brackishwater aquacultural practices will play for the achievement of the aforementioned objectives and the eventual realization of the millennium development goals by the year 2015.

The results of this study have shown that *E. fimbriata*, *E. melanopterus*, *I. africana*, *G. decadactylus*, *P. elongatus*, *S. melanotheron* and *T. guinensis* approach L_8 at a fast rate and thus can be suitably used in brackish water aquaculture. Besides *S. melanotheron* and *T. guinensis* that do reproduce in confinement, the fingerlings of the remainder of the above mentioned group can be collected from the wild and reared in enclosures such as ponds, pens and cages to table size.

The mullets, especially *Mugil cephalus*, are widely cultured in Asia, Israel IBP (1981) and many parts of the world including Nigeria. Some of the species in this family are favourably disposed to aquacultural practices because of their delicious flesh and abundance of seed all year round in the coastal states of Nigeria. However *L. grandisquamis* in this study falls into the group that approaches $L_{8\ slowly}$. This result does not disqualify the mullets from brackishwater aquaculture practices in Nigeria since K_1 and K_2 value of *L. grandisquamis* which is approximated to 0.40 is close to 0.50. Besides, good aquaculture management principles enhance growth rate of fish fingerlings to table size, genetic make up not withstanding.

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