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Age and Growth of the African Butter Catfish, *Schilbe mystus* (Linnaeus, 1758) in Asejire and Oyan Lakes, South-Western Nigeria

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Abstract: The length composition data of 18 consecutive months was used to estimate age and growth parameters of the butter catfish, *Schilbe mystus* (Chordata: Siluriformes: Schilbeidae) in Asejire and Oyan Lakes. The Von Bertalanffy growth constants for *S. mystus* in Asejire lake were $L_{\infty} = 28.5$ cm TL, $K = 0.53$ year⁻¹ and $t_0 = -0.31$ year with derived growth performance index $\phi = 2.62$. For this species in Oyan lake, $L_{\infty} = 28.7$ cm TL, $K = 0.39$ year⁻¹, $t_0 = -0.43$, $\phi = 2.51$. The rate of growth of this species was higher in Asejire than Oyan Lake. *S. mystus* live for about 6 years in both water bodies and attained more than 50% of the asymptotic length at the first age class. Total mortality rate Z , for the fish ranging from 9.6-25.5 cm TL and 9.5-26.5 cm TL were estimated as 5.14 and 1.83 year⁻¹ for Asejire and Oyan lakes, respectively and the natural mortality rate M , estimated as 1.16 and 0.91 year⁻¹, respectively with average fishing mortality rate F , calculated as 3.98 and 0.92 year⁻¹, respectively. The exploitation ratio ($E = F/Z$) for this species was 0.78 and 0.50, for Asejire and Oyan lakes, respectively. E for Asejire Lake (0.78) indicated that the species is over exploited.

Key words: *Schilbe mystus*, Oyan, Asejire, growth, mortality

INTRODUCTION

Schilbe mystus belongs to family Schilbeidae and is a siluroid catfish of commercial importance. The schilbeid catfish are salient components of the ichthyofauna of many freshwater bodies (Etim *et al.*, 1999) and like other catfishes are heavily exploited. Past work on biology of members of family Schilbeidae in Nigeria aquatic ecosystems were mainly on their food and feeding habits and reproduction (Adebisi, 1981; Elliot, 1986; Bankole, 1989; Olurin, 1994). Olatunde (1979a) and Etim *et al.* (1999) determined the age of *Eutropius niloticus* and *S. mystus* in Kainji Lake and *S. intermedius* in Cross River, respectively. Elliot (1986) and Olurin (1994) studied aspects of biology of fishes of Asejire and Oyan lakes respectively and included *S. mystus* but did little on age and growth pattern of this species. Thus there is paucity of information on growth, maturity and exploitation of this species in these lakes.

Age determination in fish species is essential for good fisheries management. Age and growth studies are of practical importance for describing the status of fish population and for predicting the potential of fisheries. This study reveals the age and growth pattern of *S. mystus* in Oyan and Asejire lakes and this will enhance effective management of this species in these lakes. It also provides for the first time, comparative study on age and growth patterns of two populations of a fish species simultaneously and this would reveal the similarities and differences in age and growth pattern of the two stocks brought about by ecological peculiarities of the two study sites.

Table 1: Features of Oyan and Asejire Lakes

	Oyan lake	Asejire lake
Location	20 km Northwest of Abeokuta	30 km East of Ibadan
Latitude	07°15' and 07°26'N	07°21'N
Longitude	03°6' and 3°16'E	04°07'E
Elevation	0 and 150 m above sea level	137 m
Geology	Precambrian metamorphic and plutonic rocks	Precambrian metamorphic rocks
Vegetation	Forest savanna mosaic	
Climate	Dry season: November to April Rainy season: May to October	Dry season: November to April Rainy season: May to October
Maximum length	27 km	-
Maximum width	6 km	-
Maximum depth	63 km	-
* Mean temperature	24.3°C	27.3°C
* Mean rainfall	102.6 mm	14.7 mm
* Mean humidity	77.4%	79%

Source: Elliot (1986) and Olurin (1994), * From present investigation

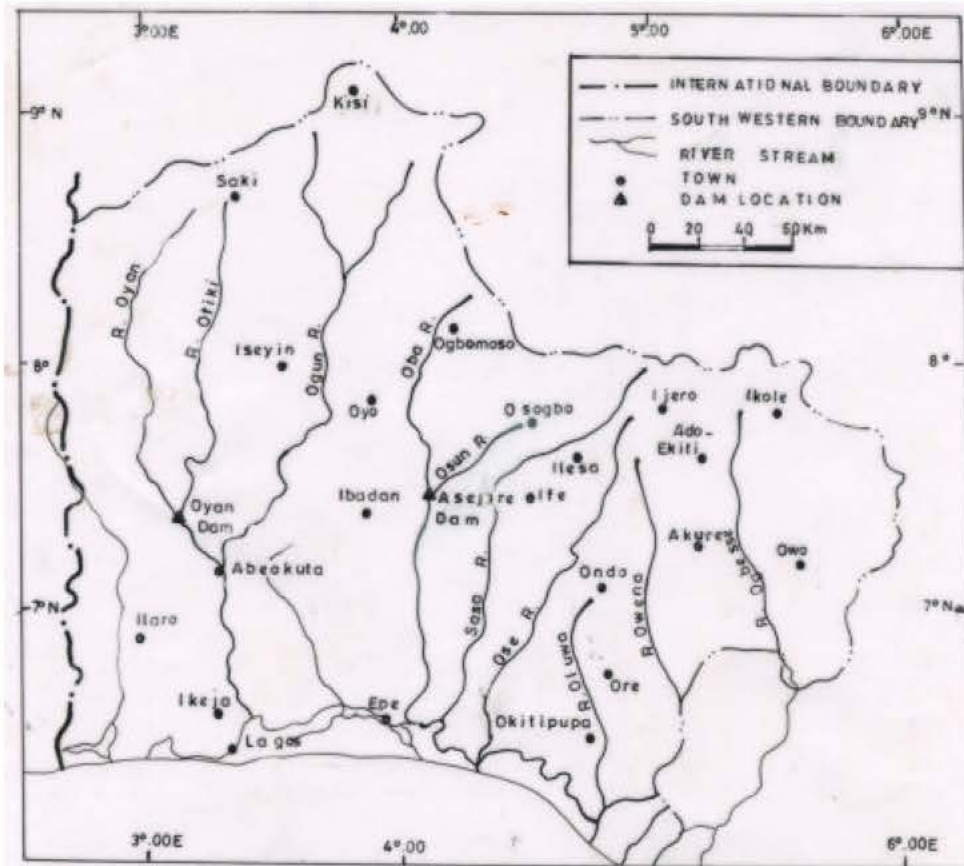


Fig. 1: Southwestern Map of Nigeria showing Oyan and Asejire Lakes

Study Areas

Oyan and Asejire lakes are manmade lake located in Southwestern Nigeria (Fig. 1) and there is a horizontal distance of about 100 km between them. Lake Asejire is constructed on River Oshun at about 30 km east of Ibadan, Oyo State. Oyan Lake started to fill with the closing of the gates of the dam sited 20 km northwest of Abeokuta on Oyan River on the 30th of October 1981. Table 1 illustrates various features of the two lakes.

MATERIALS AND METHODS

Specimens of *Schilbe mystus* were obtained from gill nets fisheries of Oyan and Asejire lakes from July 2000 to December 2001. Specimens were measured to the nearest 0.1 cm and weighed in the laboratory. The length frequency distribution of the species was made. The same length frequency plots were arranged sequentially with annual interval, with the aid of a curved ruler, a growth curve was drawn upon the length at different ages. This is the integrated length frequency method as suggested by Pauly (1983).

The Ford Walford plot was used to estimate the growth parameters that is, asymptotic length (L_{∞}) and growth coefficient (K) from the formula:

$$L_{t+1} = a + b \log L_t$$

where

$$L_{\infty} = \frac{a}{1-b} \text{ and } k = -\log e^b$$

and where L_{t+1} pertain to lengths separated by a constant time interval of one year. Pauly's (1979) empirical equation for the theoretical age at length zero (t_0) was used to obtain this parameter as $\log_{10}(-t_0) = -0.392 - 0.275 \log_{10} L_{\infty} - 1.038 \log_{10} k$.

The formula of Pauly and Munro (1984) was used to compute the index of overall growth performance ϕ' : $\phi' = 2 \log L_{\infty} + \log k$.

Total annual instantaneous mortality rate, Z was estimated by constructing linearized length-converted catch curves (Sparre and Venema, 1992). Instantaneous natural mortality rates, M were computed by the empirical equation of Pauly (1980) using a mean annual surface temperature of 27.6 and 25°C for Asejire and Oyan lake, respectively. The instantaneous fishing mortality rate, F was calculated as Z-M and exploitation ratio was found as $E = F/Z$.

RESULTS

The total length of *S. mystus* in Oyan Lake ranged from 9.5-26.0 cm with corresponding standard length of 8.0 to 21 cm. *S. mystus* with size range 9.4-14.9 cm formed 12.3% of the total catch, those of 15-20.7 cm constituted 76.9% of total catch, while those within 20.8-26.1 cm formed only 10.9% of total catch. For Asejire Lake, the total length of this species ranged from 9.6-25.5 cm with corresponding standard length of 7.8-21.5 cm. Specimens of *S. mystus* with size range 9.6-14.9 cm formed 14.9% of the total catch, 15-20.5 cm constituted 79.3% of total catch; while 20.6-25.5 cm formed 5.1% of total catch.

The body lengths obtained from the integrated length frequency data of *S. mystus* in Oyan and Asejire lakes are shown in Fig. 2 and 3, respectively. A comparison of the body lengths with percentage growth for each age of *S. mystus* in both study sites is shown in Table 2. The species attained similar length at the same age in both water bodies. Growth of *S. mystus* was fast in the early years and later slowed down in both water bodies.

The Ford Walford plot of body lengths at age data from integrated method on *S. mystus* in Oyan and Asejire lakes are shown in Fig. 4 and 5. The ultimate lengths (L_{∞}) of 28.5 and 28.7 cm were obtained for *S. mystus* in Asejire and Oyan lakes, respectively. The rates at which the ultimate lengths were approached were 0.53 and 0.39 year⁻¹ for this species in Asejire and Oyan lakes, respectively.

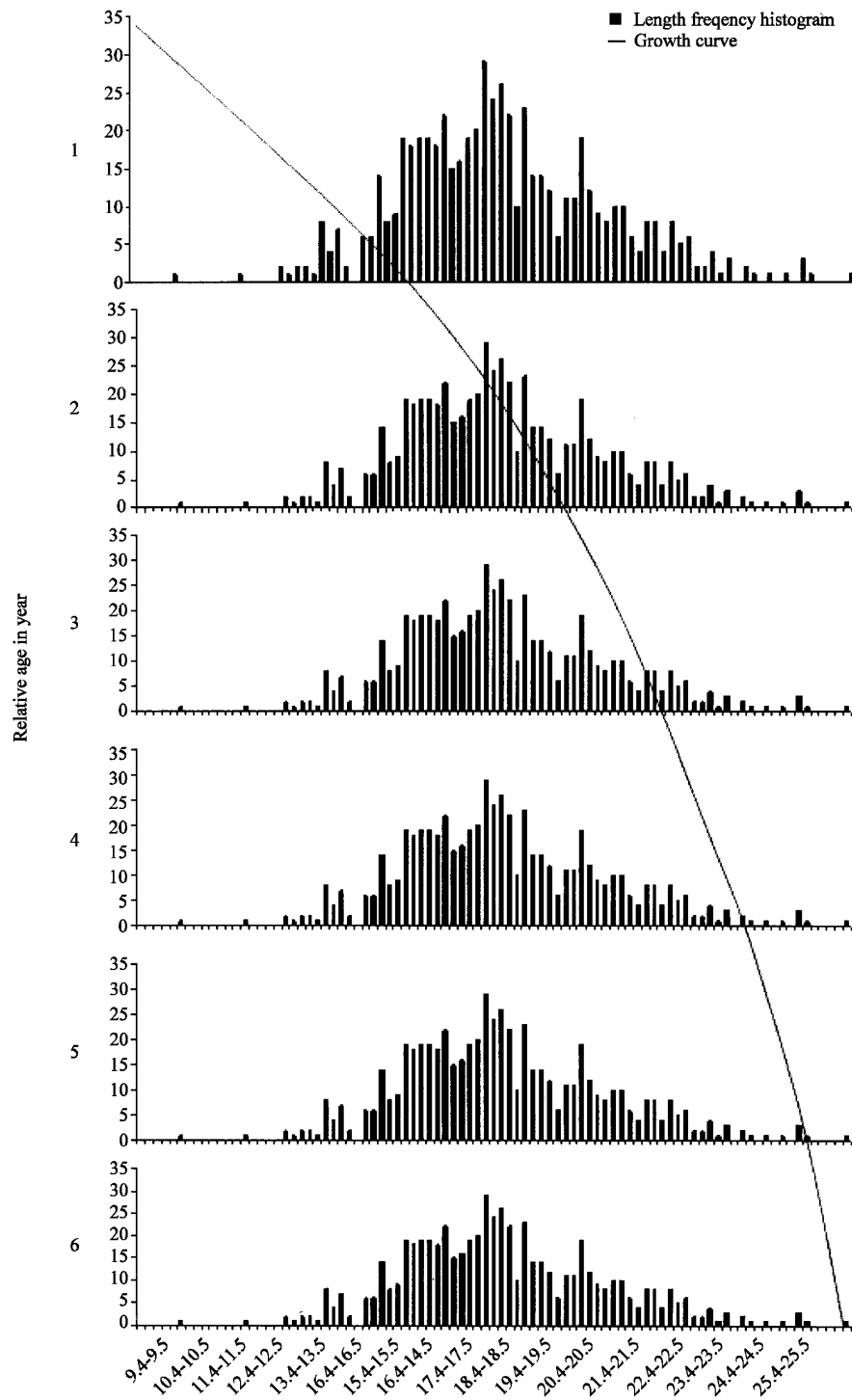


Fig. 2: Length frequency data of *Schilbe mystus* in Oyan Lake with the continuous and smooth growth curve

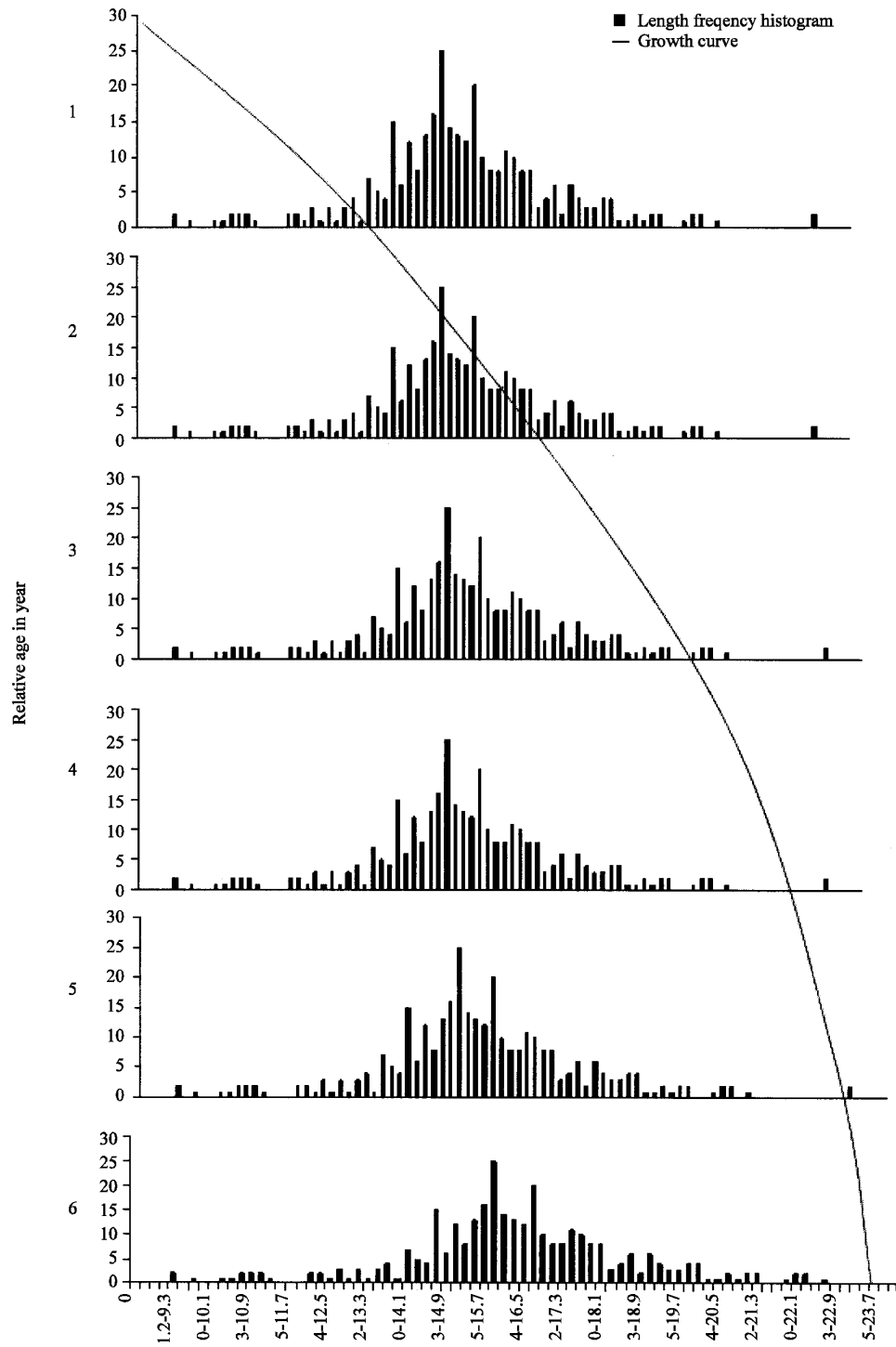


Fig. 3: Length frequency data of *Schilbe mystus* in Asejire Lake with the continuous and smooth growth curve

Table 2: Percentage growth for age groups of *Schilbe mystus* in Oyan and Asejire Lakes, Southwestern Nigeria

Age	Oyan lake		Asejire lake	
	TL (cm)	Growth (%)	TL (cm)	Growth (%)
1	14.7	56.5	14.3	57.2
2	19.1	16.9	149.1	19.2
3	21.7	10.0	21.7	10.0
4	23.5	6.9	23.7	8.0
5	25.1	3.5	24.7	4.0
6	26.0	—	25.0	1.2

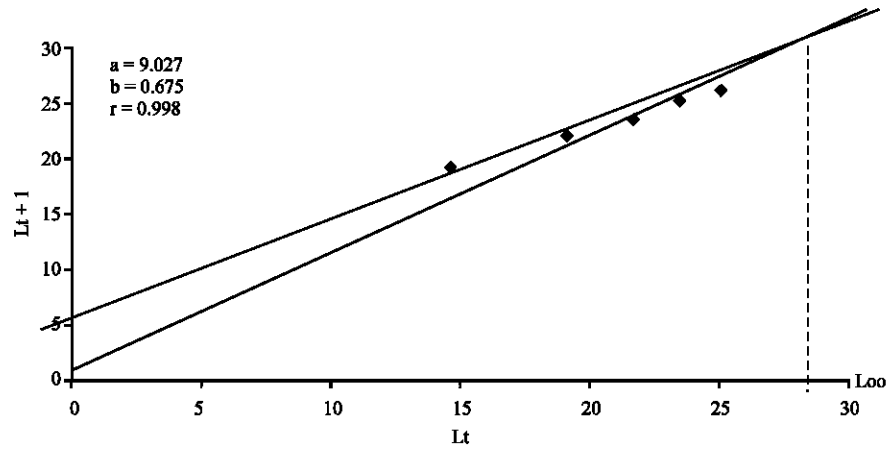


Fig. 4: A Ford Walford plot of body lengths at age data from integrated method data on *Schilbe mystus* in Oyan Lake

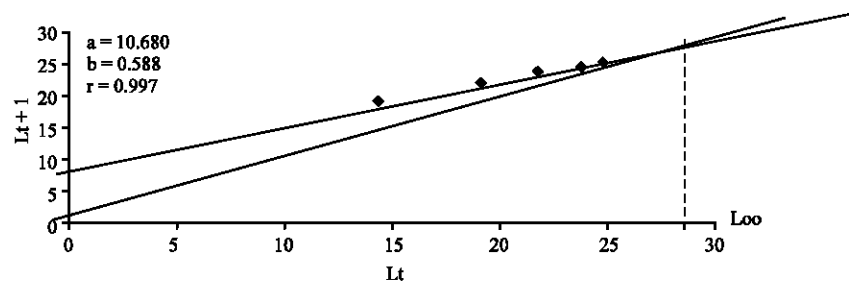


Fig. 5: A Ford Walford plot of body lengths at age data from integrated method data on *Schilbe mystus* in Asejire Lake

The Phi Prime value Φ' for *S. mystus* in Asejire Lake was 2.62 and in Oyan lake was 2.51. Table 3 shows the estimated growth parameters obtained for *S. mystus* in Oyan and Asejire lakes. The Von Berterlanffy growth model for the species is described as

$$L_t = 28.5 [1 - \exp(-0.53(t + 0.31))] \text{ for Asejire lake}$$

$$L_t = 28.7 [1 - \exp(-0.39(t + 0.43))] \text{ for Oyan lake}$$

The length converted catch curve gave a value of $Z = 5.14 \text{ year}^{-1}$ (Fig. 6) and $Z = 1.83$ (Fig. 7) for Asejire and Oyan lakes respectively. The exploitation ratio ($E = F/Z$) was 0.78 for *S. mystus* in Asejire lake and 0.50 for this species in Oyan lake. Using the $E_{opt} = 0.5$ criterion (Pauly and Munro, 1984) implies that the species is overexploited in Asejire lake.

Table 3: Estimated growth parameters of *Schilbe mystus* in Oyan and Asejire Lakes, Southwestern Nigeria

Parameters	Asejire lake	Oyan lake
L_{∞} (TL cm)	28.50	28.70
K (year^{-1})	0.53	0.39
t_0 (year^{-1})	-0.31	-0.43
ϕ'	2.62	2.51
M (year^{-1})	1.16	0.91
M/K	2.19	2.33
Z (year^{-1})	5.14	1.83
F (year^{-1})	3.98	0.92
$E = F/Z$	0.78	0.50

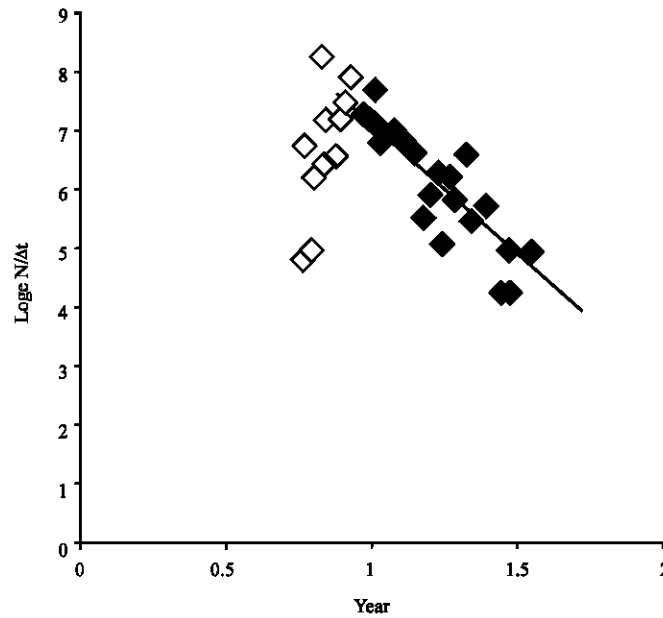


Fig. 6: Linearized length-converted catch curve for *Schilbe mystus* in Asejire Lake

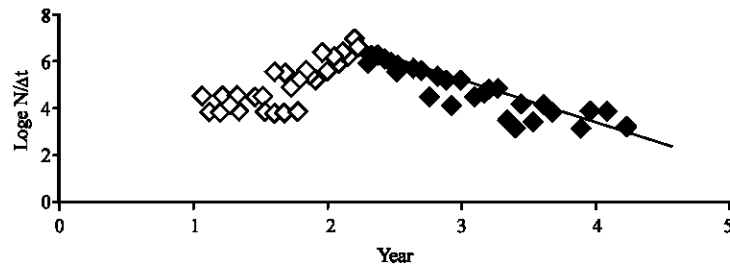


Fig. 7: Linearized length-converted catch curve for *Schilbe mystus* in Oyan Lake

DISCUSSION

The biological data that can be used to obtain information from which growth parameters can be estimated are of three types and these are tagging-recapture data, periodic markings on skeletal parts and length frequency data. According to Pauly (1983) the methods for analysis of length frequency data have found in the tropics, wider applications than the study of skeletal parts, while tagging studies

have generally been underutilized due to the fact that it is earlier to analyze and less equipment is needed. Length frequency data offer an important record from which invaluable information concerning the recent life history of the fish could be extracted (Etim *et al.*, 1999). To test reliability of length frequency data used, a total sample size of 1500 or more collected in a period of six or more months is adequate and the sequentially arranged length frequency data should display distinct peaks with apparent shift in modal length overtime (Pauly, 1987). The length frequency data used in this analysis meet these criteria due to large sample size collected for 18 months. Pauly (1983) demonstrated that the application of integrated length frequency distribution method on data of some tropical fishes resulted in better description of age and growth of *Pleiotropomus leopardus* (Lacepede, 1802) *Sardinella sirum* and *Leiognathus bindus* (Valenciennes, 1835).

The computed value of L_{∞} for *S. mystus* in Oyan lake is 28.7 and is 28.5 cm in Asejire lake. This indicates that the species attains similar final size in both environments. Etim *et al.* (1999) also obtained $L_{\infty} = 27.5$ cm for *S. intermedius* (Ruppell, 1832) in Cross River. However, larger sizes (L_{∞}) were obtained for this species in Kainji lake with $L_{\infty} = 33$ cm (Olatunde, 1979a) and $L_{\infty} = 52.63$ cm for the species in Lake Kariba (Frank, 1974).

The results indicated that there was very fast growth before 12 months in *S. mystus* from both study sites. This was followed by a gradual decrease in growth rate with increase in age. This observation is in line with Pannella (1974), Fagade (1980a), Oben and Ugwumba (1999). According to Ugwumba (1989), this further confirms fast growth in tropical fishes especially before onset of sexual maturity. After the attainment of maturity, the main part of the food consumed by the fish is not used for linear growth alone but for ripening of the gonads and other metabolic processes.

For growth comparison, Pauly and Munro (1984) overall growth performance index Φ' was used. According to Etim *et al.* (1999) growth comparison is a multivariate problem that must take into consideration both growth rate (k) and the asymptotic size (L_{∞}) and Φ' meets these criteria, is easy to compute and exhibits least variance when compared with other alternative indices. The overall growth performance indices for *S. mystus* in Asejire (2.62) and Oyan (2.51) agreed with Phi Prime values for schilbeid fishes in different tropical areas. Heckt (1980) obtained $\Phi' = 2.6$ for *Eutropius depressirostris* (Peters, 1852) in Luphephe Nwadezi impoundment, South Africa. Olatunde (1979a) got $\Phi' = 2.32$ for *S. mystus* in Kainji lake Nigeria and Etim *et al.* (1999) obtained $\Phi = 2.34$ for *S. Intermedius* in cross River, Nigeria. Generally, Φ' are species specific parameters and gross dissimilarity of Φ values for a number of stocks of the same species or related species is an indicator of the unreliability in the accuracy of estimated growth parameters. Thus, the similarity of Φ related species in different tropical areas points to the reliability of the computed growth parameters. However, the species show slow growth in both lakes according to Baijot and Moreau (1991), the Φ mean values of some important fishes in Africa range between 2.32-2.65 and considered these as low, the estimated Φ values (2.62 and 2.51) in this study fall within this range. This slow growth rates may be caused by adverse environmental condition.

From the result, more than 85% of the species were caught at smaller sizes or less than 3 years of age in both water bodies studied, although the species is estimated to have life span of about 6 years. This implies that they are normally caught before they grow large enough to contribute substantially to the stock biomass which indicates growth over fishing. The fish were caught with gill nets of mesh sizes ranging from 1-1.5 inches stretched mesh at Asejire and Oyan lakes, thus for proper management, the mesh sizes of nets allowed to be used for fishing on these water bodies will have to be increased or adjusted.

The estimated M/K ratios obtained for *S. mystus* in Asejire and Oyan lakes, 2.19 and 2.33, respectively show the reliability of the estimated natural mortality rate (M) because the M/K ratio has been reported to be within the range 1.12-2.5 for most of the fish (Beverton and Holt, 1957).

The estimated instantaneous fishing mortality rate, $F = 0.92 \text{ year}^{-1}$ for the *S. mystus* in Oyan lake is close to the natural mortality estimate of 0.91 year^{-1} and could be an appropriate life history strategy in the lake because this was reflected in its optimal level of exploitation. The optimal level of exploitation of fish in Oyan lake could also have been enhanced by good management of the lake and fisheries by Ogun Oshun river basin development where there are closed seasons when fishermen are prevented from fishing and also the number of entry/efforts are controlled. However, from the result for Asejire lake, the estimated exploitation level for the species is beyond the expected optimal level indicating over-exploitation. The higher growth performance (ϕ) of *S. mystus* in this water body could be an adaptation for survival of the species due to uncontrolled and increasing fishing effort due to lack of adequate management, so there is unlimited entry into the fishery.

This study revealed what some level of management could do to sustainability of fisheries. Open access fisheries in Asejire lake was overcapitalized/overexploited, there is need to limit the number of entry into fishing or increasing the mesh sizes and also closed seasons could be considered.

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REFERENCES

- Adebisi, A.A., 1981. Analyses of the stomach contents of the piscivorous fishes of the upper Ogun River in Nigeria. *Hydrobiologia*, 79: 167-177.
- Baijot, E. and J. Moreau, 1997. Biology and Demographic Status of the Main Fish Species in the Reservoirs of Burkina Faso. In: *Hydrobiological Aspects of Fisheries in Small Reservoir in the Sahel Region*. Technical Centre for Agricultural and Rural Cooperation. Baijot, E., J. Moreau and S. Bonda, (Eds.). Commission of the European Communities, Wageningen, Netherlands, pp: 79-109.
- Bankole, N.O., 1989. Feeding habits of selected fish species from Tiga Lake, Kano State, Nigeria. *Ann. Rep. Nat. Inst. Freshwater Fish*, pp: 23-27.
- Beverton, R.J.H. and S.J. Holt, 1957. On the dynamics of exploited fish populations. *Fish Invest. Minist. Agric. Fish. Food. Ser. II, Vol. 19*. HSMO, London, pp: 533.
- Elliot, O.O., 1986. Some aspects of the biology of the fishes at Asejire lake. Ph.D Thesis, University of Ibadan, pp: 301.
- Etim, L., P.E. Lebo and R.P. King, 1999. The dynamics of an exploited population of a siluroid catfish (*Schilbe intermedius* Ruppell, 1832) in the Cross River, Nigeria. *Fisheries Res.*, 40: 295-307.
- Fagade, S.O., 1980a. The structure of the otolith of *Tilapia guineensis* (Dumeril) and their use in age determination. *Hydrobiologia*, 69: 169-173.
- Frank, S., 1974. The Spotted Squeaker, *Synodontis nebulosus*, the Butter Catfish *Schilbe mystus*, The Vundu *Heterobranchus longifilis* and Electric Catfish *Malapterurus electricus*. Lake Kariba: A Man-made Tropical Ecosystem in Central Africa. Hodon, E.K. and A.G. Coche, (Eds.). W. Junk, The Hague, pp: 325-332.
- Heckt, T., 1980. Age, growth and mortality of the butter catfish, *Eutropius depressirostris* (Schilbeidae: Pisces) in the Luphephe Nwadedzi impoundment, Venda (South Africa). *J. Limnol. Soc. S. Afr.*, 6: 39-45.
- Oben, P.M. and O.A., Ugwumba, 1999. Age and growth of *Heterotis niloticus* (CUVIER) from an inland tropical lake. *Nig. J. Sci.*, 33: 85-99.

- Olatunde, A.A., 1979a. Age determination, length weight relationship and growth of *Eutropius niloticus* and *Schilbe mystus* in Lake Kainji, Nigeria. *Hydrobiologia*, 87: 49-83.
- Olurin, K.B., 1994. The ecology of feeding, reproduction and growth of the fishes in Oyan lake. Ph.D Thesis, University of Ibadan, pp: 209.
- Pannella, A., 1974. Otolith Growth Pattern and Aid in Age Determination of Temperate and Tropical Fish Species. *Proc. Intl. Symp. Ageing of Fish* Bagenal, T.B. (Ed.), pp: 28-39.
- Pauly, D., 1979. Theory and management of tropical multispecies stocks: A review with emphasis on the South East Asian. *Demersal Fisheries Stud. Rev.*, 1: 35.
- Pauly, D., 1980. A selection of simple methods for the assessment of tropical fish stocks. *FAO Fisheries Circular*, 729, FAO, Rome, pp: 54.
- Pauly, D., 1983. Some simple method for the assessment of tropical fish stocks. *FAO Fish Tech Paper*, 234: 8-16.
- Pauly, D., 1987. A review of the ELEFAN system for analysis of length-frequency data in fish and aquatic invertebrates. *ICLARM Conf. Proc.*, 13: 7-34.
- Pauly, D. and J.L. Munro, 1984. Once more on the comparison of growth in fish and invertebrates. *ICLARM Fishbyte*, 2: 21.
- Sparre, P. and S.C. Venema, 1992. Introduction to tropical fish stock assessment. Part I Manual. *FAO Fisheries Technical paper* 306, No. 1, Review 1, FAO, Rome, pp: 376.
- Ugwumba, O.A., 1989. Distribution and growth pattern of the ten pounder *Elops lacerta* in the freshwater, estuarine and marine environment in Lagos, Nigeria. *Arch. Hydrobiologia*, 115: 431-462.