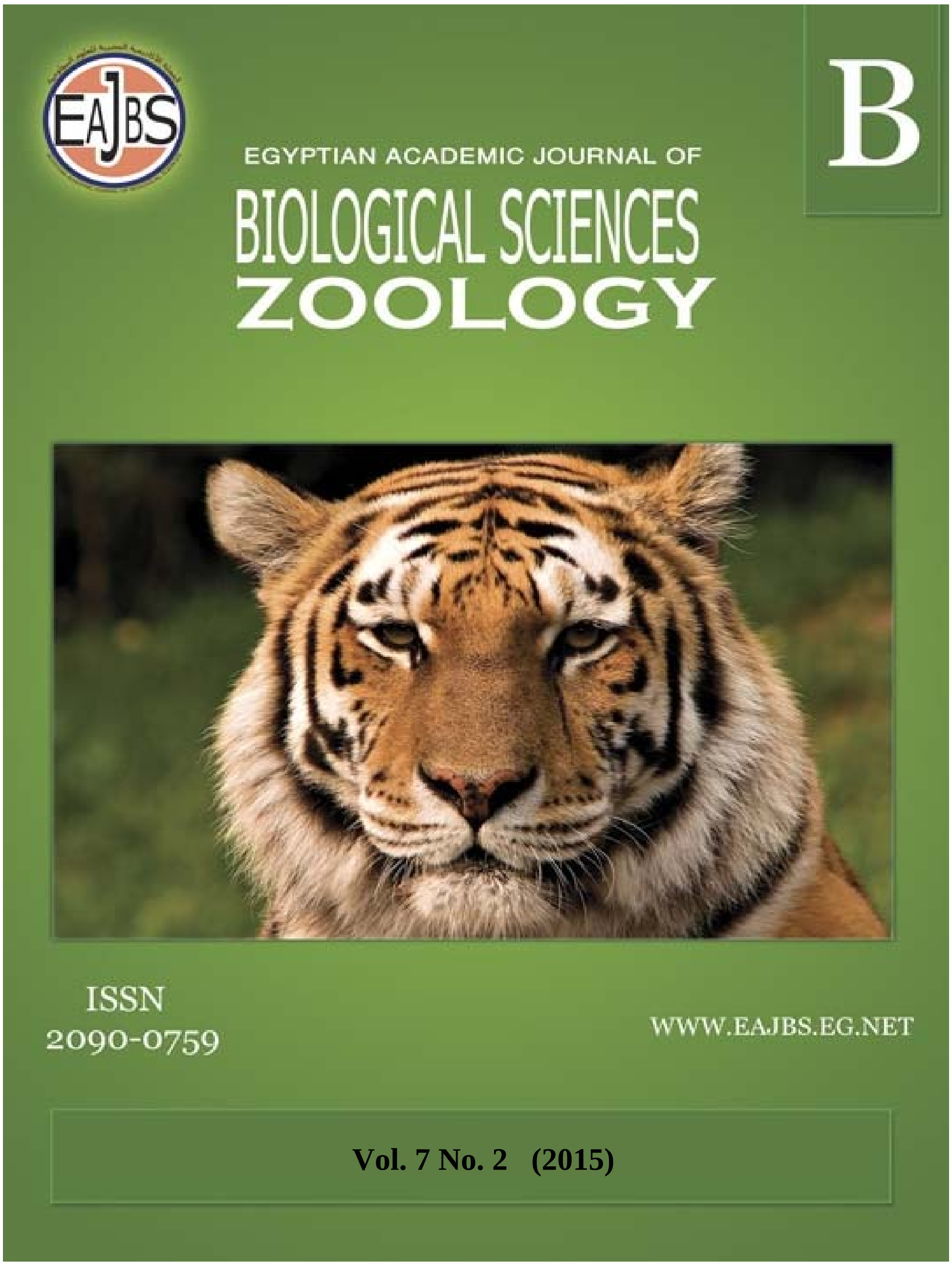

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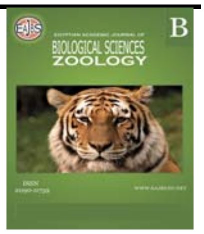

Growth, Mortality, and Longevity of *Tilapia guineensis* (Bleeker, 1852) in Tropical Man-Made Lake, Southwestern Nigeria

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ABSTRACT

Background: Fisheries resources are being depleted due to over-exploitation and inadequate information for planning and management; therefore, data on growth pattern, mortality, and exploitation rates of fisheries resources are essential for effective management and sustainable exploitation.

Method: Growth parameters, mortality rates, and longevity of the Guinean tilapia, *Tilapia guineensis*, (Bleeker, 1852) in Asejire Lake were obtained from length composition data from January, 2013 to December, 2013.

Results: The von Bertalanfy growth function estimates were: $L\infty$ = 30.98 cm Total length, K = 0.37 $year^{-1}$ and t_0 = -0.441. Total mortality rate (Z)was 1.19 $year^{-1}$, natural mortality rate (M) was calculated as 0.92 $year^{-1}$, fishing mortality rate (F) obtained was 0.27 $year^{-1}$, and the exploitation rate (E) was 0.23. Growth performance index (ø) computed as 2.55.

Conclusion: This result indicates low growth rate. The stock was not overexploited since exploitation rate was less than the optimal exploitation rate(0.5).

INTRODUCTION

Tilapine fishes endemic to Africa are widely distributed in tropical areas and have colonized a wide range of inland waters as natural or introduced species (Panfili *et al*., 2004). They are economically important as food fishes both in their native regions and elsewhere where they have been introduced or are grown in fish farms. Capture fisheries worldwide is undergoing stock depletion and led to inability to meet the fish demand, thus, sustainable exploitation of fisheries resources is required. For sustainable exploitation and proper management of fisheries resources, the data on fish biology and population dynamics are needed (Karimzadeh, 2011). Mortality is a very important aspect of population biology since it provides information about changes in the population (Abowei and Hart, 2009). The decrease in numbers of a year class (cohort) of fish by death through time is usually expressed by means of exponential rates (Pauly, 1983); natural mortality rate (M) includes all deaths due to natural causes, fishing mortality (F) is death caused by fishing, and total mortality (Z) is the combination of natural mortality and fishing mortality. Exploitation rate allows for determining whether a stock is overfished or not on the assumption that the optimal value of E = 0.5.

Previous works on population biology of fish in Nigeria water bodies include King and Etim (1989) on *Tilapia mariae* in Iba Oku wetland ; Ayoade (2007) on *Schilbemystus* in Oyanand Asejire Lakes; Abowei and Hart (2007) on *Chrysichthys nigrodigitatus* from Nun River; Abowei and Davies (2009) on *Gnathonemus tamandua* from Nun River; and Lebo *et al*. (2009) and Amiye and Erondu (2010) on fish species of the Andoni River. This study reports on the mortality, exploitation rate, and longevity of *Tilapia guineensis* in Asejire Lake on which there is dearth of information.

MATERIAL AND METHODS

Monthly fish samples (January 2013-December 2013) were caught from Asejire Lake by a 2–4 hour experimental fishing using a cast net of 35 mm mesh size handled by a local fisherman. *Tilapia guineensis* were identified according to Holden and Reed (1978) and Idodo-Umeh (2003). Specimens were measured to the nearest 0.1 cm with a measuring board and weighed to the nearest 0.1 g on a metler balance.

Length Composition of the Catch

The monthly length frequency distributions were computed from sample length measurements at 1.0 cm length intervals.

Growth Parameters

The growth of fish was described by the von Bertalanfy growth function:

$L_t = L\infty[1\text{-}\exp(-K(t - t_0)]$.

Estimates of the von Bertalanfy growth parameters, the asymptotic length ($L\infty$), and growth coefficient (K) were derived using the ELEFAN routine in the FiSAT suite of programs (Gayanilo *et al*., 1995). The theoretical age at length zero (t_0) was obtained from Pauly's (1979) equation: $\log_{10}(-t_0) = -0\ .392 - 0.275 \log_{10} L\infty - 1.038 \log_{10}K$.

Longevity (t_{max}) and Growth Performance Index (Ø)

Longevityand growth performance index were calculated.

Longevity (t_{max}) $= 3/K$ (Pauly, 1984).

Growth performance index (ø) $= \log_{10}K + 2 \log_{10} L\infty$ (Pauly and Munro, 1984).

Total annual instantaneous mortality rate (Z) was obtained by linearised length-converted catch curves (Sparre and Venema, 1992). Instantaneous natural mortality rate (M) was derived from the empirical equation of Pauly (1980):

$\log M = 0.1228 - 0.1912 \log L\infty + 0.7484 \log K + 0.2391 \log T$.

Taking mean monthly surface temperature of the water (T) as 27.98^0C.

The instantaneous fishing mortality rate (F) was calculated as Z – M and exploitation ratio was found as E = F/Z.

RESULTS

Length Composition of the Catch

The total length of*Tilapia guineensis* in Asejire Lake ranged between 11.4 cm and 29.7 cm (17.41 ± 3.2 cm) and the standard length ranged between 8.3 cm and 24 cm (13.42 ± 2.62 cm). *T. guineensis*with size range 10.0 – 13.9 cm formed 14.4% of the total catch; 14.0 – 17.9 cm constituted 45.3%; 18.0 – 21.9 cm formed 32.4 %; 22.0 – 25.9 cm formed 6.06%; and 26.0 – 29.9 cm made up 1.89 % of the total catch.

Growth and Mortality Parameters

The length frequency distribution for *T. guineensis* from FiSAT analyses is shown in Figure 1.

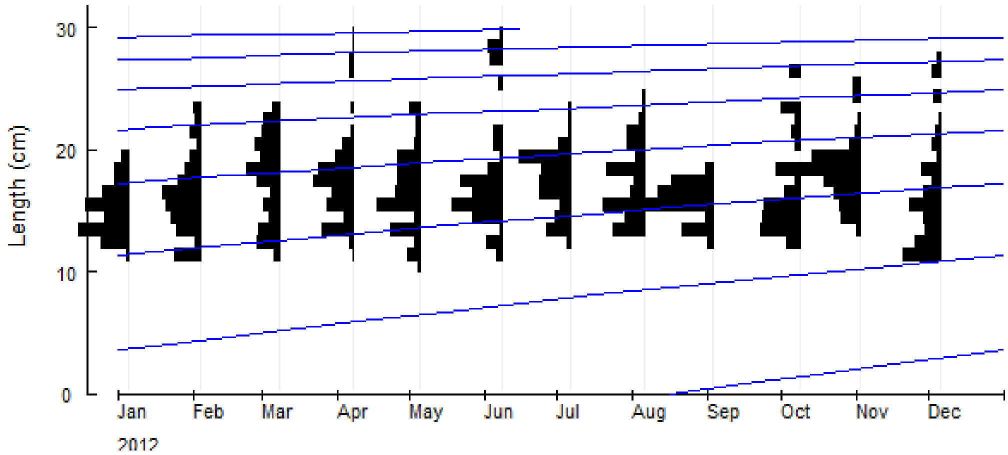

Fig.1. Length – Frequency for *Tilapia guineensis* with growth curve super imposed showing normal length – frequency histograms**.**

Table1. Some population parameters of *Tilapia guineensis* from Asejire Lake.

Parameter	Estimate
L∞ (TL,cm)	30.98
K (year^{-1})	0.37
t_0	-0.441
t_{max}(years)	8.11
Ø	2.55
M (year)	0.92
M/K	2.49
F (year^{-1})	0.27
Z (year^{-1})	1.19
E = F/Z	0.23

The parameters that describe growth in length (L∞, K, and t_0) and growth performance index(ø) is summarised as shown in Table 1. Using the estimated value of the average growth coefficient (K= 0.37 year^{-1}), the longevity (t_{max}) was calculated as 8.11 years, and the von Bertalanfy model for *T. guineensis* is described as:

The instantaneous total mortality rate (Z) was estimated as 1.19 year^{-1} (Figure 2) and the instantaneous natural mortality rates (M) was calculated as 0.92. The instantaneous fishing mortality coefficient (F) was 0.27year $^{-1}$ and the exploitation ratio (E) as 0.23.

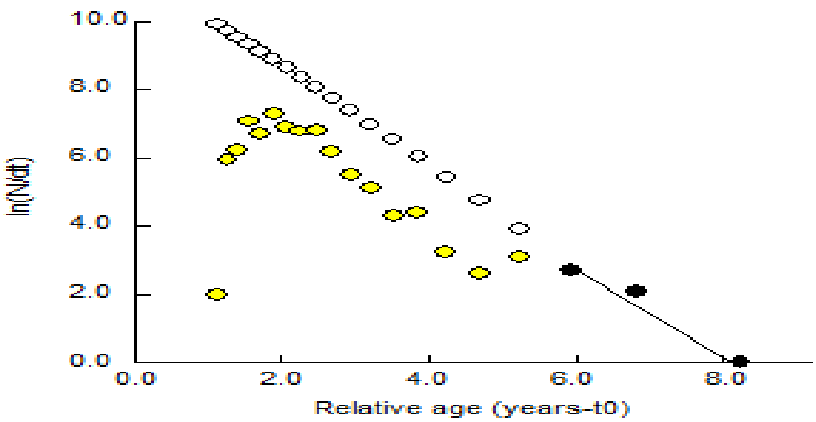

Fig. 2: Length- converted catch curve for *Tilapia guineensis*from Asejire Lake Z = 1.19; M (at 27.98ºC) = 0.92; F= 0.27; and E= 0.22.

DISCUSSION

Tilapia guineensis exhibited a slow growth rate in the Asejire Lake, since the value obtained for ø (2.55) is below the range of ø mean values 2.65-3.32 for some important fishes in Africa and these are low growth rates (Baijot and Moreau, 1997). They suggeted this slow growth may be caused by adverse environmental condition.The ø obtained for *T. guineensis* is lower than 3.09 for *Hemisynodontis membranaceus*in Lake Volta(Ofori-Danson *et al*., 2001); higher than 2.03 for *Sarotherodon melanotheron* in Sakumo Lagoon and Muni Lagoon (Koranteng *et al*., 1997; Koranteng *et al*., 2000); 2.14 for *S. melanotheron* of the Benya Lagoon population, and 2.05 for the Kakum River Estuary (Blay,1998).

The estimated values of the von Bertalanfy growth function $L\infty$ (TL, cm) = 30.98, K ($year^{-1}$) = 0.37 are similar to estimates for *T.mariae*, $L\infty$ (TL, cm) = 30.4, K ($year^{-1}$) = 0.4 (King and Etim,1989) but could not be compared to other cichlids (Blay,1998; Koranteng *et al*., 1997; Koranteng *et al*., 2000) probably due to introduction of bias by length used for data analyses.

According to Beverton and Holt (1966) the values of M/K (natural mortality to growth coefficient K) ratio usually fall between 1.12 and 2.5 for any result to be valid for scientific interpretations and deductions. The result obtained for M/K in this study fell within their results and therefore renders the mortality values suitable for scientific inferences such as management purposes. The higher natural mortality observed for the species compared to the fishing mortality may be as a result of the fish being a mid-trophic level species, thus the predation level is high.

Similar mortality values Z = 1.75$year^{-1}$, F= 0.76 $year^{-1}$,and M = 0.99 $year^{-1}$ were obtained for *T. mariae* by King and Etim (1989). The mortality values in this study were low compared to Z = 2.78 $year^{-1}$, M = 1.44 $year^{-1}$, and F = 1.34 $year^{-1}$ obtained by Amiye and Erondu (2010) for *T. guineensis* in Andoni River, Niger Delta; Z= 5.85 $year^{-1}$; F=3.55 $year^{-1}$, and M= 1.835 for *S. melanotheron* in Muni Lagoon (Koranteng *et al*., 2000); Z = 4.74 $year^{-1}$,F= 2.92 $year^{-1}$; and M= 1.82 $year^{-1}$ for *S. melanotheron* in Sakumo Lagoon (Koranteng *et al*., 1997). The estimated mortality values were higher than Z= 0.87, M= 0.663, and F= 0.23 $year^{-1}$ obtained for *Tilapia mariae* from Ibaoku stream (King, 1991). The differences in the mortality values could be due to selectivity of fishing gear, introduction of bias, and ecosystem differences of the fish stocks suggested by Amiye and Erondu (2010).

The exploitation ratio of the cast net for *T. guineensis* ranging from between 11.4 cm and 29.7 cm TL was below the expected optimal exploitation level, E = 0.5, thus there was under exploitation by the cast net. The exploitation ratio was lower than 0.65 and 0.66 obtained for *S. melanotheron* by Koranteng *et al*.(1997) andKoranteng *et al*.(2000). Amiye and Erondu (2010) estimated the exploitation ratio of *T. guineensis* in Andoni River to be 0.4820. The under exploitation of *T. guineensis* recorded in this study may be due to low efficiency of the gear used for fishing, low number of fishing craft/ fisherman, and limited time of fishing. This is contrary to the observation of Ayoade (2007) on the fishery of *Schilbe mystus* in Asejire Lake with exploitation rate of 0.78. The difference could be due to *S. mystus*being collected from gill net fishery by artisanal fiserhmen at the landing sites, thus increasing the number of hours of fishing and number of fishermen.

CONCLUSION

Tilapia guineensis exhibited a slow growth rate in the Asejire Lake. The exploitation ratio of the cast net for *T. guineensis* being lower than the expected optimal exploitation level, E = 0.5, indicated there was under exploitation by the cast net.

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