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Full Length Research

Growth and some morphometric dynamism of *Schilbe mystus* (Linnaeus, 1758) in Asejire Reservoir, Oyo State, Nigeria

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ABSTRACT: This study examined important population parameters for *S. mystus* in the Asejire reservoir, Nigeria, which included asymptotic length, growth coefficient, length at maturity, optimum length, growth performance, and mortality rate. This study was necessitated due to the decline in captured fisheries and the need to understand the population structure of the species. For eight months, 306 samples of *Schilbe mystus* were collected using gillnet from fishermen every two weeks (December–July 2019) and morphometric parameters were taken, after which the samples were preserved in the deep freezer for further analysis. The Von Bertalanffy growth function was used in estimating population parameters obtained from length-frequency data. The length at maturity (L_m) was 14.0 cm, the asymptotic length (L_∞) was 23.2 cm, the growth coefficient (K) was 0.66/year, the reproductive load (L_m/L) was 0.6, and the optimal length (L_{opt}) was 14.1 cm. The total mortality (Z) was 2.22, the exploitation rate (E) was equal to 0.35, and the 1.44/year for natural mortality (M) and fishing mortality was 0.78/year. A slow rate of growth caused by unfavourable environmental conditions is indicated by the overall growth performance(Ø) of 2.6, which was in order to improve the conservation and sustainability of *Schilbe mystus* and was attributed to adverse environmental factors. The result shows the need to modify the mesh size used for fishing on the water body for optimum exploitation.

Keywords: Asymptotic, growth, length, overexploitation, *Schilbe mystus*.

INTRODUCTION

One of the prevalent fish in Nigeria's inland waters is the *Schilbe mystus* (African Butter Catfish), which is essential in defining the dynamics and structure of the freshwater ecosystem and is also one of the most sorted after fish species in Nigeria's inland waters (Adeosun, 2019). In most fishing communities, this fish is an important food source that is rich in protein being consumed by many populaces, especially for those on a limited income (FAO, 2001; Kareem *et al.,* 2021). Also, they significantly play a functional role in the ecosystem and add economical value, playing notable roles in determining the changes and structure of the aquatic ecosystem (Van der Bank *et al.,* 2012). However, due to overfishing and environmental decline, there are indications that the catch of commercially important fishes is declining both qualitatively and quantitatively in both coastal and inland water systems (Jamu and Ayinla, 2003). Now, understanding varying patterns in fisheries and the status of the stock serves as a key factor in fisheries science, which is used to evaluate recruitment, growth, and mortality, that serves as guides for management decisions regarding harvest and conservation strategies (Maceina *et al*., 2007; Sindt *et al*., 2012). To establish the level of exploitation of a stock and whether it is overexploited or not, it is most useful to compare the current and expected fish abundance at a given time. This comparison also reveals whether the level of catch effort is sufficient to sustain or change the stock's abundance. Therefore, stock assessment is frequently done using statistical and mathematical models to quantify and predict the impact of fish populations on different management methods (Bonfil, 2005; Cadrin and Dickey-Collas, 2014). With reliable

management, capture fisheries can provide an important source of livelihood for many poor people and contribute a significant portion of their protein intake (Alam, 2001; Thilsted, 2010). Consequently, the demand for animal protein by this increasing population according to Kareem *et al*. (2019) is very high and also with the decline in fish production in Nigeria calls for effective management and conservation of fisheries resources (Oladimeji, 2016). Therefore, providing information on the recent population size and some growth parameters of *Schilbe mystus* in Asejire reservoir, Nigeria is much needed (Karimzadeh, 2011). This would be useful in evaluating the population structure, in an effort to develop management techniques for this species' sustainable utilization.

MATERIALS AND METHODS

Study area

The research was carried out at an altitude of 137 meters above sea level in the Asejire reservoir in southwest Nigeria, which is situated at latitudes 07°21-07°26N and 04°06-04°10E. The reservoir was built in the late 1960s and opened on November 17, 1972. It has a daily capacity of roughly 80 million litres of water, the bulk of which is used for household uses, as stated by Utete and Fregene (2020). River Oshun is the source of the Asejire Reservoir, which is located 30 kilometres east of Ibadan. The reservoir has an irregular Y-shape with two arms. According to Kareem *et al*. (2021), it is 19.5 km long, has a catchment area of 7,800 km^2, and is impounded on 2,342 hectares of land (Figure 1). The average pool altitude (water level) is 150 m, while the maximum flood elevation is 152.4 m. The gross storage is 7,403 million litres

Fish sampling

Between November 2018 and June 2019, 306 samples of *Schilbe mystus* were obtained from fishermen at the Asejire reservoir's landing spots every two weeks. Gill nets with mesh sizes of 50 –55 mm according to Kareem *et al*. (2021) were used to collect fish samples, which were then transported in an ice box to the Department of Aquaculture and Fisheries Research Laboratory at the University of Ibadan for deep freezing before further examination. Fish samples were identified using guides for identifying freshwater fish species published by Olaosebikan and Raji (2013) and Idodo-Umeh (2003). A digital weighing scale (OHAUS Model CT 6000) was used to measure weight, and a meter rule was used to measure total and standard length to the nearest 0.1 cm.

Assessment of growth and mortality data

The FiSAT II computer software package (version 1.2.2) for fish stock assessment was used to analyze the computed data of the average monthly length-frequency distribution of *S. mystus*. Growth parameters (L, K, and t_0) were calculated in accordance with Zhang *et al*. (2020) and Mustafa *et al*. (2019).

Maturity parameters

This is the typical length (Lm) at which a population of fish reaches sexual maturity. By an empirical relationship between length at initial maturity and asymptotic length L, the value and its standard error are determined (Froese and Binohlan 2000) using empirical growth parameters. The *S. mystus* optimal length (L_{opt}) and overall growth performances index (Ø) were calculated in accordance with Roy *et al*. (2020) and Ayo-Olalusi and Ayoade (2018) using von Bertalanffy growth function (VBGF) of Pauly and Munro (1984).

Natural, fishing, and total mortality analysis

The Von Bertalanffy growth function's parameters and the mean annual water temperature (T), as defined by Pauly, were used to compute natural mortality (Mustafa *et al*., 2019). A mercury-in-glass thermometer was used to measure the surface water temperature on a monthly basis. Likewise, overall mortality, Z, was determined by applying the technique outlined by Zhang *et al*. (2020). Consequently, the mortality attributed to fishing, or exploitation rate (E), can be calculated as E = F/F+M

Statistics analysis

The Statistical Package for Social Sciences (SPSS, version 21), FiSAT, and Microsoft Office Excel tools were used for all statistical analysis, including descriptive statistics of the data.

RESULTS

S. mystus at the Asejire Reservoir ranged in size from 11.0 to 22 cm according to Table 1, with a mean total length of 16.6 cm. The asymptotic length (L_∞) of 23.2 cm is one of the estimated growth parameters, as shown by the Von Bertalanffy growth curves in Figure 2. According to Table 2 and Figure 4, a fish species' growth performance (Ø) was 2.6 and its growth coefficient, or the rate at which it reached its maximum length, was 0.66/year. The longevity was 5.69 years, and the length at first capture (L25, L50, L75) was 13.02, 13.31, and 13.61 cm, respectively, for the stock's 25, 50, and 75% sensitive percentages to fishing gear in Figure 3. The *S. mystus'* first maturity length (Lm)

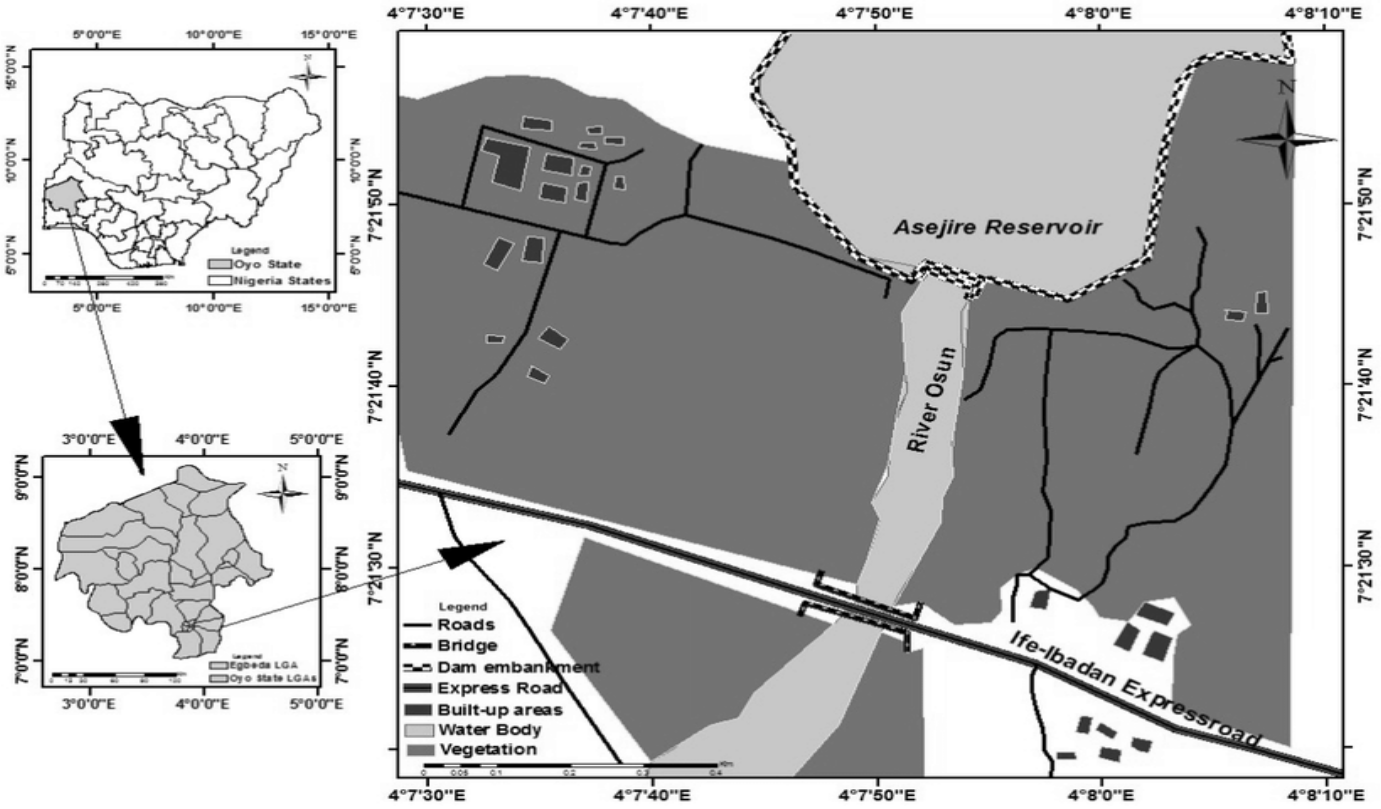

Figure 1. A map of Asejire Lake in Nigeria's Oyo State (Adapted from Kareem *et al*., 2021).

Table 1. Length frequency distribution data.

S/n	Size range (cm)	Frequency	Mean (cm)
1	11.5-12.8	6	12.3
2	13.0-13.7	6	13.3
3	14.0-14.6	8	14.7
4	15.0-15.8	42	15.6
5	16.0-17.0	143	16.6
6	17.1-17.8	54	17.6
7	18.0-18.8	35	18.5
8	19.0-19.6	10	19.7
9	20.3-22.0	2	21.1
Total		306	16.6

was 14.0 cm, whereas the ideal length (L_{opt}), at which a year class's total biomass reaches its maximum value, was 14.1 cm. The ratio of maximum length to asymptotic length (L_{opt} / L_{∞}) was 0.62 cm, and the reproductive load (Lm/L) was 0.60. Two recruitment cycles are seen annually in the *S. mystus* recruitment patterns in the Asejire reservoir (Figure 5). With a peak in March, the first recruitment took place between February and June. The second recruitment cycle runs from June through October, with June being its peak month. At a local water temperature of 29.6°C in the Asejire Reservoir, the estimated annual total mortality rate (Z) for *S.mystus* was 2.22/year, 1.44/ ear for natural mortality (M), 0.78/year for fishing mortality, and 0.35/year for exploitation (E) (Figure 6). Natural mortality ratios (M/K), VBGF growth coefficient (M/K), and Z/K ratios (respectively) were 2.18, 0.64 and 3.36.

The virtual population analysis in Figure 7 shows that natural mortality occurred within the 11 to 19 cm size range with the highest between 11 to 13 cm. Sixteen (16 cm) size range had the highest fishing mortality and catches.

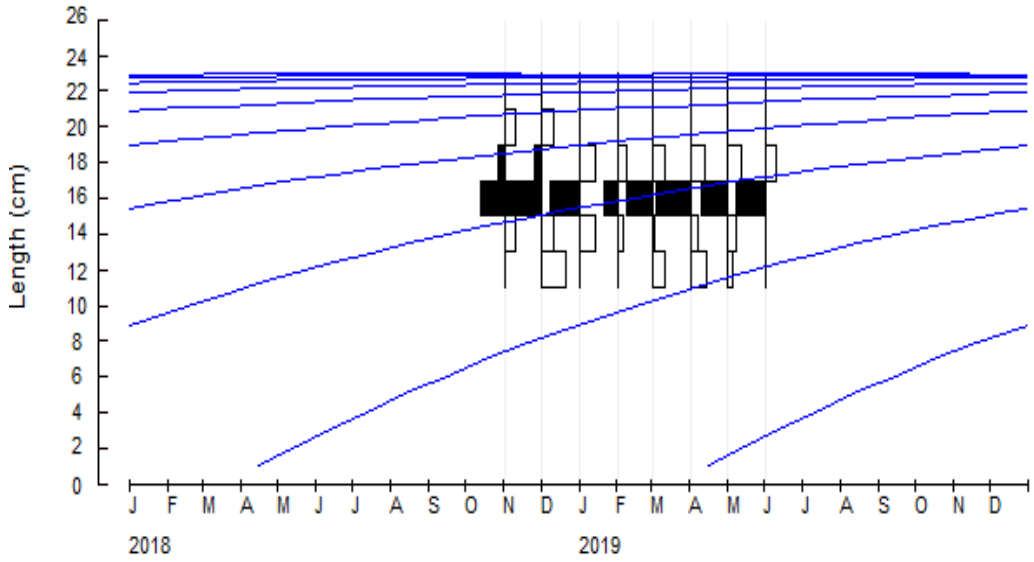

Figure 2. The *Schilbe mystus* Von Bertalanffy growth function curves at Asejire Reservoir in Oyo State, Nigeria.

Table 2. Some growth parameters of *S. mystus* in Asejire Reservoir.

Parameters	Values
Mean total length	16.6 cm
Asymptotic length(L_∞)	23.2 cm
Maximum length (L_{max})	22.0 cm
Length at optimum yield (L_{opt})	14.1 cm
Length at first maturity (L_m)	14.0 cm
Growth performance index (Ø)	2.30
Temperature (T)	29.6°C
Total mortality rate (Z)	2.22/year
Natural Mortality(M)	1.44/year
Fishing Mortality (F)	0.78/year
Exploration (E)	0.35/year
Reproductive load (L_m/L)	0.60
L_{25}, L_{50}, L_{75}	13.02 cm, 13.31cm, 13.61 cm

DISCUSSION

The values of asymptotic length (L_∞) for *S. mystus* were discovered to be 23.2 cm in Asejire reservoir, Oyo State. The estimates for L_∞ (23.2 cm) and K (0.66) were comparable to the findings of Mustafa *et al.* (2019) for *Mystus quilo* in the Bangladeshi Sundarbans habitat. The asymptotic length of *S. mystus* in the current study is also a little less than the maximum length found in another region. The value of the asymptotic length (L) and growth rate (K) obtained in the study by Ayo-Olalusi and Ayoade (2018) in *Sphyraena afra* in coastal waters of Lagos State, Nigeria, were 192.8 cm and 3.57 respectively. This variation could be attributed to overexploitation and other environmental factors encountered during the study. Additionally, the overall growth performance index for *Schilbe mystus* in Asejire (2.6) is comparable to those of Ayoade and Ikulala (2007), who found the same species in Asejire reservoir, Oyo State, and obtained a growth performance index of 2.62. It also falls within the range discovered by Mustafa *et al*. (2019) for *Mystus gulio*, *Acanthopagrus latus*, and *Chelon parsia*. In a similar vein, Abdul *et al.* (2020) found that Saddle Grunt Fish in Pakistani water had a 2.727 value. However, Mustafa *et al*. (2019) found that the Sitakunda coast of the Bay of Bengal had a superior growth performance index.

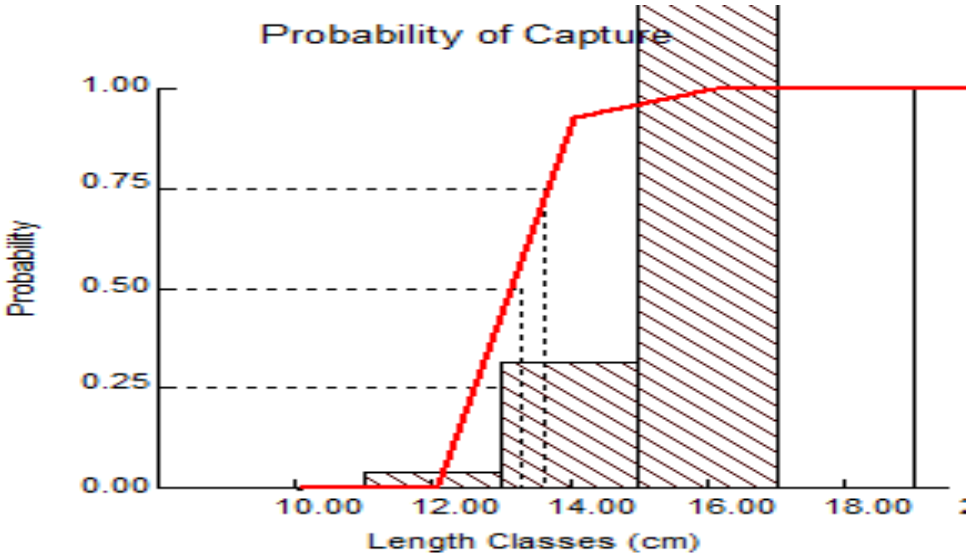

Figure 3. The likelihood of capturing *Schilbe mystus* in Oyo State, Nigeria's Asejire reservoir.

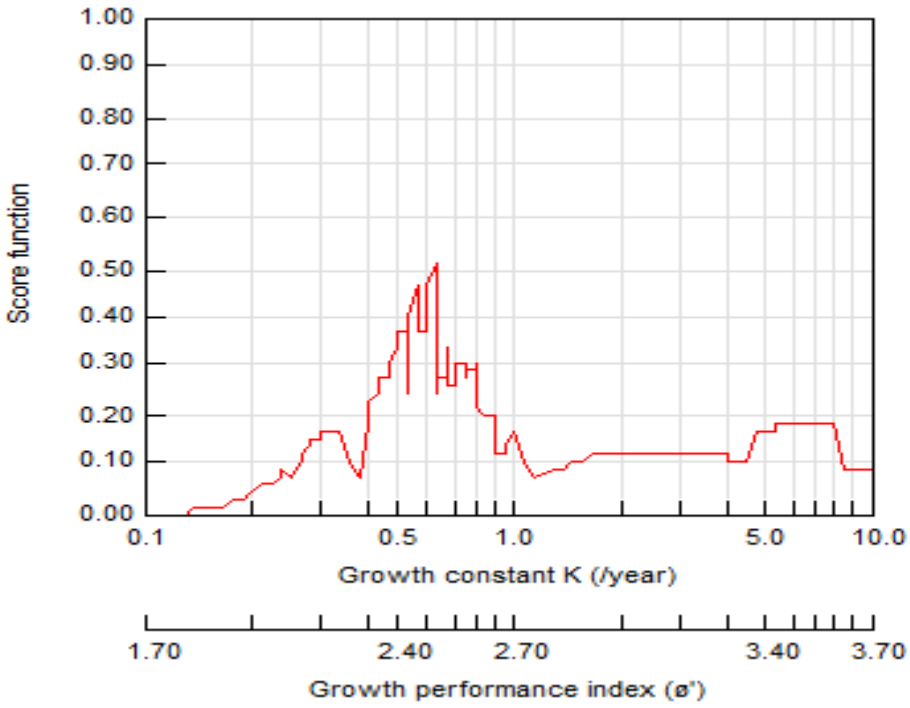

Figure 4. The *Schilbe mystus* growth performance index in Asejire reservoir in Oyo State, Nigeria.

According to Udoh *et al*. (2015), the varied ecological characteristics of a particular population stock are also responsible for the disparities in growth performance index. The standard length recorded for *S. mystus* from Asejire reservoir (10–18 cm) and the total length recorded (11.5–22 cm) are comparable to those reported by Olagbemide (2010) for *S. mystus* from Lekki lagoon, Lagos, Nigeria, who reported standard length 10.1–20.7 cm and total length range of 12–21.9 cm. In Erelu Lake, Oyo State, Nigeria, Kareem *et al*. (2016) measured the length of *S. mystus* samples, which ranged from 8.50 to 31.50 cm. The fluctuation in the *S. mystus* species' length

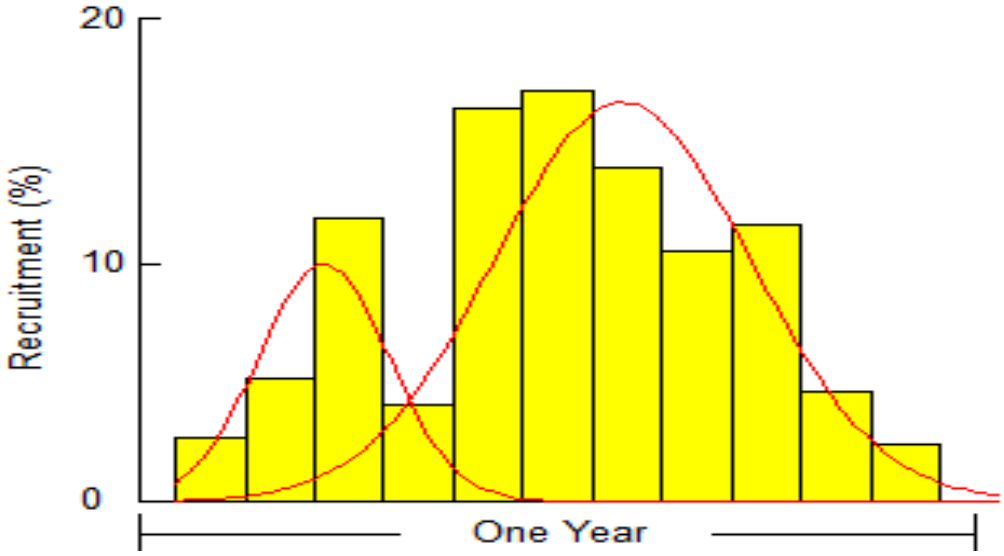

Figure 5. *Schilbe mystus* recruits in Oyo State, Nigeria's Asejire reservoir.

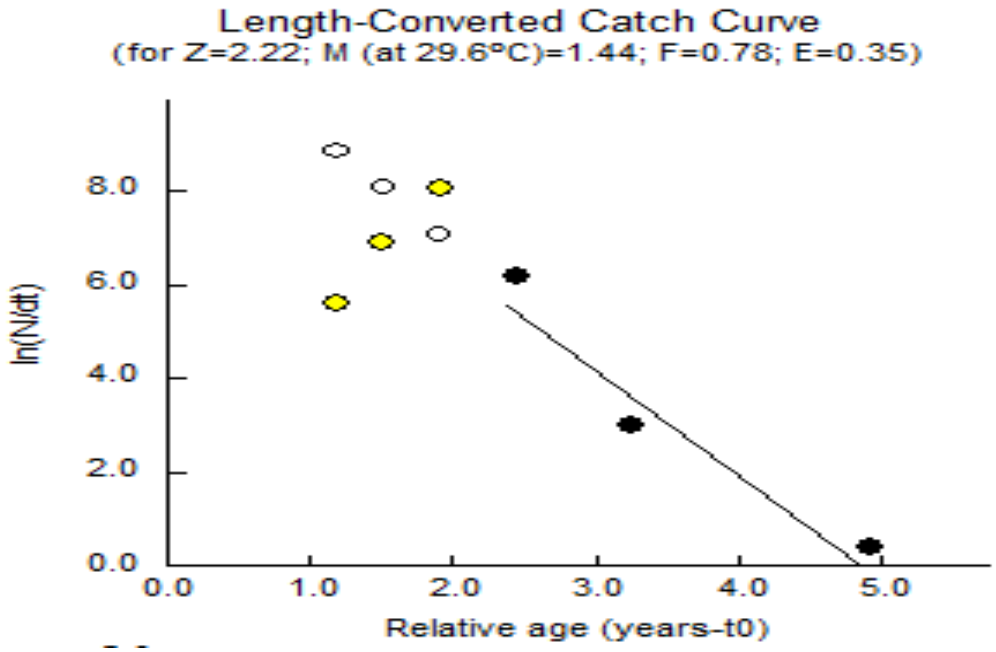

Figure 6. The *Schilbe mystus* length-converted catch curve in the Asejire resevoir.

range may be related to the growing amount of the species' exploitation. The K-value for *S. mystus* recorded in this study was 0.66, which is comparable to the K-value of 0.53 years for *S. mystus* reported by Ayoade and Ikulala (2007) in South Western Nigeria's Asejire reservoir. According to Pauly *et al*. (1984), K-values for tropical fish stocks range between 0.39 and 1.6 per year. This conclusion is consistent with their findings. The K-values are used to calculate an individual fish's expected lifespan. According to Binohlan (1998), who obtained fish with a maximum size of 200 cm, and mature at a length of about 100 cm had a reproductive load (L_m/L) of 0.5. Also, reproductive load(L_m/L) of 0.62 was calculated for *S. mystus* of Asejire in the reservoir using maturity length of 14.0 cm with maximum length of 22 cm. M/K ratio for *S. mystus* in Asejire reservoir was 2.18, which is comparable to the value obtained by Ayoade (2011) from the Asejire reservoir and Oyan Lakes with 2.19 and 2.33, respectively

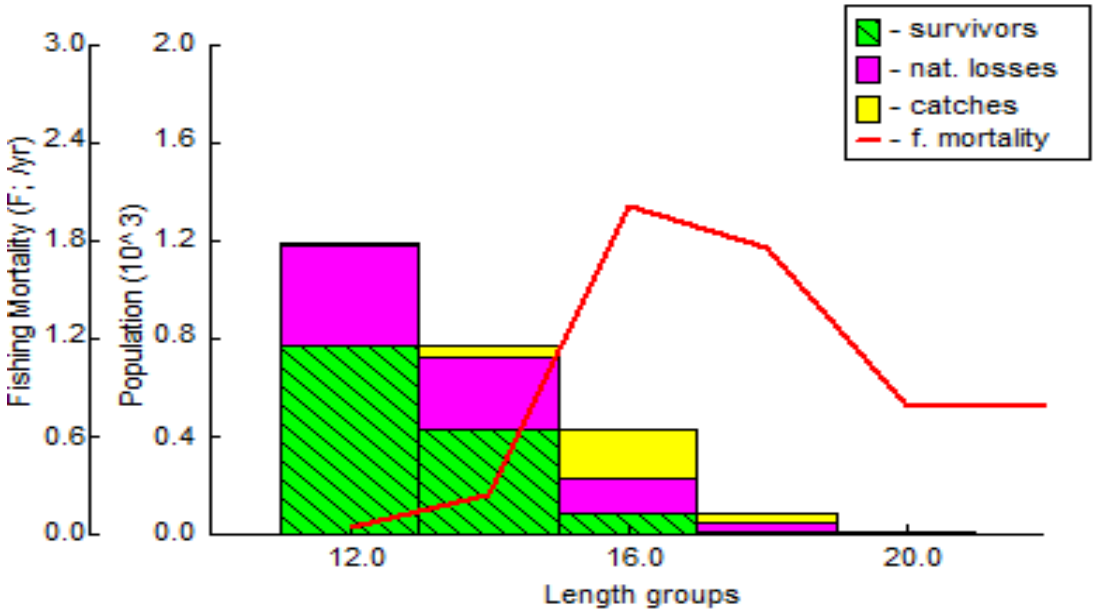

Figure 7. Virtual population analysis of *Schilbe mystus* in Asejire reservoir, Oyo State, Nigeria.

for the *S. mystus*. M/K has been observed to be in the range of 1.12–2.5 for the majority of fish, this range, according to Beverton and Holt (1957), demonstrates the reliance on estimated natural mortality (M). The exploitation rate (E) of 0.35 obtained for *S. mystus* in Asejire reservoir indicates the species is being under exploited to its maximum potential which is similar to that obtained by Panahibazaz *et al.,* (2012) for *Acanthopagrus latus* in the coastal waters of Hormozgan Province, Iran, and by Baset *et al.* (2020) for Saddle Grunt Fish from Pakistan but contrary to Ayoade and Ikulala (2007)who obtained 0.78 for *S. mystus* from Asejire reservoir. Consequently, the value obtained for instantaneous fishing may be due to the limited number of efforts, gear restrictions, and effective stakeholder management (Ayoade and Ikulala, 2007). The virtual population analysis of the species showed that the small sizes experienced the highest natural mortality whereas fishing mortality was highest within the middle to large sizes. This is consistent with Amponsah *et al.* (2016) who stated that small sized fish experience low fishing mortality and high natural mortality.

Conclusion

According to the study, *S. mystus* in the Asejire reservoir still has a low overall growth performance index, which indicates slow growth that may have been brought on by unfavorable environmental conditions. Additionally, the exploitation of the fishing gear indicates that the species is underexploited which could be attributed to restrictions on the quantity of entries and mesh widths.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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