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Research Article

STOCK STATUS OF THE GIRAFFE CATFISH: *AUCHENOGLANIS OCCIDENTALIS* (VALLENCIENNES 1840) FOR CONSERVATION AND MANAGEMENT STRATEGIES IN OGUTA LAKE, NIGERIA

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ABSTRACT
The stock status: Age, Growth rates, Recruitment, Total mortality, Fishing Mortality and Exploitation rate of *Auchenoglanis occidentalis*in Oguta Lake, Nigeria were investigated. Assorted fishing gears were used to catch fish fortnightly from September 2023 to April 2024, covering both dry and rainy seasons. Standard lengths (S.L.) of 26,778 specimens of *A. occidentalis* were taken to the nearest centimetre (cm). The length data were analyzed with Electronic Length Frequency Analysis (ELEFAN II) of FISAT II software fitted into the Von Bertalanffy Growth Model (VBGM). TheVBGM was $L_{(t)} = 55.75[1 - e^{-0.5(t - 0.202)}]$. The estimated Maximum length (L_∞) = 55.75cm. Total Mortality (Z) = 1.862 yr^{-1}, Natural Mortality (M) = 0.887yr^{-1}, Fishing Mortality (F) = 0.975yr^{-1} and Exploitation rate (E) = 0.527yr^{-1}. Length at first sexual maturity (L_m) = 37.166cm.*A. occidentalis* is experiencing over-exploitation due to over-fishing in Oguta Lake as F and E are > 0.5yr^{-1}. The fishery in Oguta Lakeis also not operating at its Maximum Sustainable Yield (MSY). For the management strategies: there should be restriction on the use of small mesh sizes in the catching of *A. occidentalis* and also length sizes of not more than 37.166cm should be restricted for catches. The identified recruitment period in the month of June every year should be closed for fishing to ensure conservation of *A. occidentalis* and to avoid the collapse its fishery in Oguta Lake.

Keywords: *A. occidentalis, Oguta Lake, Stock Status, Conservation, Management*

INTRODUCTION
Examining fish population dynamics is crucial as it enables the assessment of the average size of fish within specific length categories, helps to determine mortality and exploitation rates, and allows for the conversion of length equations into growth equivalents. Moreover, it connects with environmental factors, aiding in the evaluation of the overall health of fish populations (Bolger & Connoly, 2019). Additionally, as climate change and human activities pose threats to aquatic ecosystems globally, understanding how fish populations react to these stress factors is vital not only for the ecosystem but also for broader climate-resilient initiatives. Enhancing our comprehension of these dynamics will support wider biodiversity and conservation efforts (Ogueri *et al.,* 2025a).

Fish populations in newly created reservoirs and farm ponds that previously had no fish will experience a short phase of unrestricted, exponential growth (Edwards *et al.,* 2011). This phenomenon occurs because initial resources are abundant; however, as the fish population grows, both fish and spatial resources become constrained, leading to regulation of fish numbers through density-dependent factors affecting growth and/or survival. Nevertheless, the biomass of fish populations does not stay constant but rather fluctuates around an average level due to variations in environmental conditions, habitat quality and availability, fishing mortality, and interactions with other species like predators or competitors

(Brewer and Orth, 2014). Although fishing can keep the average fish biomass significantly below the system's carrying capacity, random biomass fluctuations still happen due to changes in fish recruitment (Cooke *et al.,* 2002). Recruitment pertains to the entry of young fish into the population, and from a management viewpoint, it typically signifies the addition of fish to the fishable stock, as noted by Edward et al. (2020); when new recruits fail to replace those lost to mortality, the population is likely to decrease. Walters and Martell (2024) argued that population models are primarily constructed for exploited species, positing that this trend arises because it is easier to justify the expense of conducting surveys and catch sampling programs for species that support significant fisheries. Furthermore, population models are essential in studying rare or endangered species.

Auchenoglanis occidentalis, commonly referred to as the "Giraffe catfish," belongs to the Claroteidae family (Nelson, 2006). This species is found in various freshwater environments across Africa and has drawn interest from researchers due to its ecological significance (Agboola *et al.,* 2018), economic potential, and role in aquaculture (Adeoye *et al.,* 2021), as well as its possible applications in biomedical research (Adesina *et al.,* 2020). Morphologically, *A. occidentalis* exhibits typical characteristics of catfish, including a Cylindrical body, three pairs of barbels and an adipose fin as described in FishBase (2025) seen in Fig1.

Fig 1. *Auchenoglanis occidentalis* (Source: FishBase 2025)

Teugels *et al.* (2007) said that *A. occidentalis* displays sexual dimorphism with males often exhibiting larger body size and more robust secondary sexual characteristics than the females.
Observation by Agbogidi and Emoghene (2019) on Osmoregulatory mechanisms of *A. occidentalis* highlights its ability to adapt to a wide range of salinity levels. Additionally, Okomoda *et. al.,* (2020) explored the respiratory adaptations of *A. occidentalis* to hypoxic condition, pointing out its tolerance to low level oxygen environments. Adebisi *et. al.,* (2018) noted that *A. Occidentalis* is omnivorous in nature and opportunistic feeder which makes it widespread in an aquatic environment. Reproductive biology and breeding patterns of *A. occidentalis* were investigated by Olaniyi and Ayanda (2021).

A. occidentalis holds significant importance in aquaculture due to its fast growth, high fecundity and tolerance to various debilitating environmental conditions (Ovie*et. al.,* (2022) while study by Onyema *et al.* (2022) addressed the management strategies for disease prevention in aquaculture settings.
Oguta Lake is the largest naturally occurring lacustrine ecosystem in south East Nigeria (Ogueri *et. al.,* 2025b). It occurs within 5°41' and 5°44'N and the 6° 50' and 6° 45' E with linear shape (Fig. 2). It receives flow from Rivers Njaba, Awbana and Utu then flows out slowly through its confluence with Orashi River given the Lake its Lacustrine status. Socio-economically, the lake is of immense value to the inhabitants of Oguta, Nkwesi and Awo as sources of navigation, domestic uses, tourism and 80% of fish protein.
Oguta Lake is imbued with abundant ichthyofauna (Ukagwu and Okeke, 2024), and *A. occidentalis* is one of the abundant fish species (Osijaye *et. al.,* 2024).
A. Occidentalis is currently classified as "Least Concern" on the International Union for Conservation of Nature (IUCN, 2025) Red list. This classification is due to its wide distribution across Africa in various Lakes and Rivers such as the Nile, Niger, Lake Chad and the Congo River System.
However, while *A. occidentalis* is not considered as endangered at present, Froese and Pauly (2025) suggested strongly that continued monitoring and management of its population are necessary to ensure its long-term conservation.
Obvious importance of the species and Oguta Lake notwithstanding, there is no published works on the Fisheries parameters such as Growth, Length-at-age, growth rate, recruitment, mortality, fishing rate and exploitation rate in the Lake.
Therefore, this study aims at investigating the stock status of *A. occidentalis* that will provide baseline information for the management of A. occidentalis fishery to ensure long-term conservation of this important fish species.

MATERIALS AND METHODS

Four sites within the Oguta Lake's basin were designated as sampling stations (Fig. 2) in order to avoid bias in sampling. The sites were selected based on easy accessibility and their proximity to fish landing area around the Lake. Assorted fishing nets (Mesh sizes > 2.55cm) traps and baskets were used by professional fisher folks fortnightly to catch fish from September 2023 to April 2024; covering both the dry and rainy seasons. Catches from the local fish mongers were also examined. The catch was sorted into their different species using identification keys of Adesulu and Sydenham (2007) and Olaaosebikin and Raji (2015) the standard length (S.L) of the specimen were taken to the nearest centimeter (cm). The length data obtained were grouped in 1-cm intervals and analyzed with Electronic Length Frequency Analysis II (ELEFAN II) in FISAT II (FAO – ICLARM) software as explained in details in Gayanilo*et. al*., (2005). The data were fitted into the Von Bertalanffy Growth Model (VBGM):

$$L_{(t)} = L_{\infty}[1 - e^{-k(t - to)}]$$

Where

$L_{(t)}$ = Length at time, t
L_{∞} = Length at infinity (maximum length the fish tends to grow to in the Lake)
K = Growth curvature/coefficient to which the first tends to grow to L_{∞}.
t_o= time zero when the fish length is zero.
e= mathematical exponential
The total mortality rate (Z) was estimated by the length-converted catch curve while the natural mortality (M) was computed using Pauly's empirical formula incorporated into the FISAT II software.
The Fishing Mortality (F) was derived from the difference, F = Z – M.
The exploitation rate (E) was calculated by the quotient; E = F/Z.
Relative Yield per Recruit (Y^1/R) was estimated using the model also incorporated in the FISAT II software. Length at first capture (L_c) was read from the ELEFAN II plot while the length at first sexual

maturity (L_m) was determined as $L_m = \frac{2*L\infty}{3}$ (Hoggarth *et al.,* 2006). The reproductive Load is a quotient L_c/L_∞(Morgan, 2009).

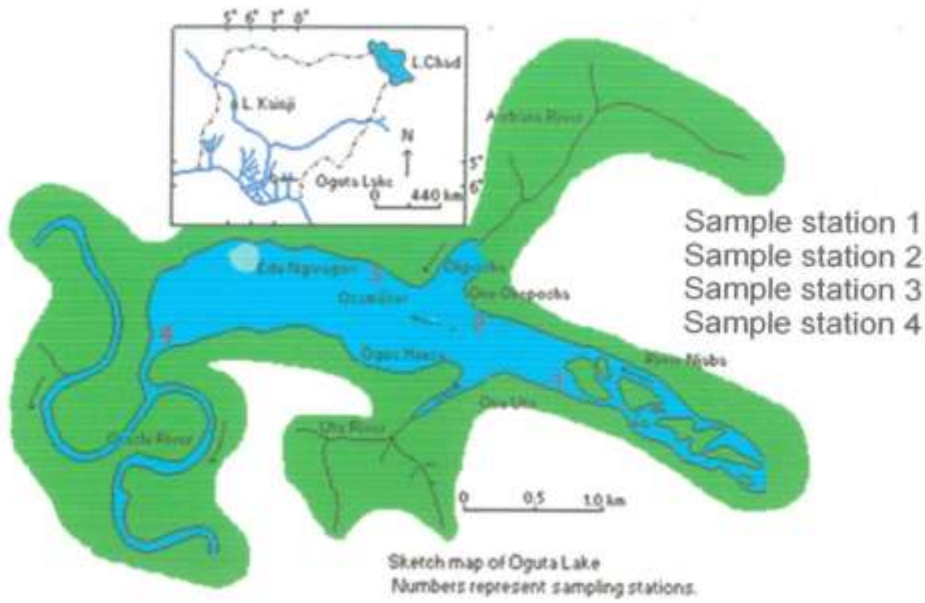

Fig 2. Map of Oguta Lake. The sampling stations are indicated with numbers.

RESULTS

A total number of 26,778 specimens of *A. occidentalis* were examined ranging in standard length from 10 to 55cm (mean ±s.d. = 21.5 ± 13.27). In Fig.3 is the ELEFAN II plot of the length data. The length – at – age and growth rate is shown in Table 1. The VBGM is

$L_t = 55.75\ [1 - e^{-0.5(t - 0.762)}]$

Table 1. Length – at – age and growth rate of *A. occidentalis* in Oguta Lake.

Age	Length (cm)	Growth rate (cm/yr)
1	7.68	
		18.33[a]
2	26.00	
		11.33[b]
3	37.34	
		7.02[c]
4	44.36	
		4.34[d]
5	48.70	
		2.68[e]
6	51.39	
		1.66[f]
7	53.05	
		1.03[f]
8	54.08	

Foot note: Values with different superscripts are significantly different (P < 0.05)

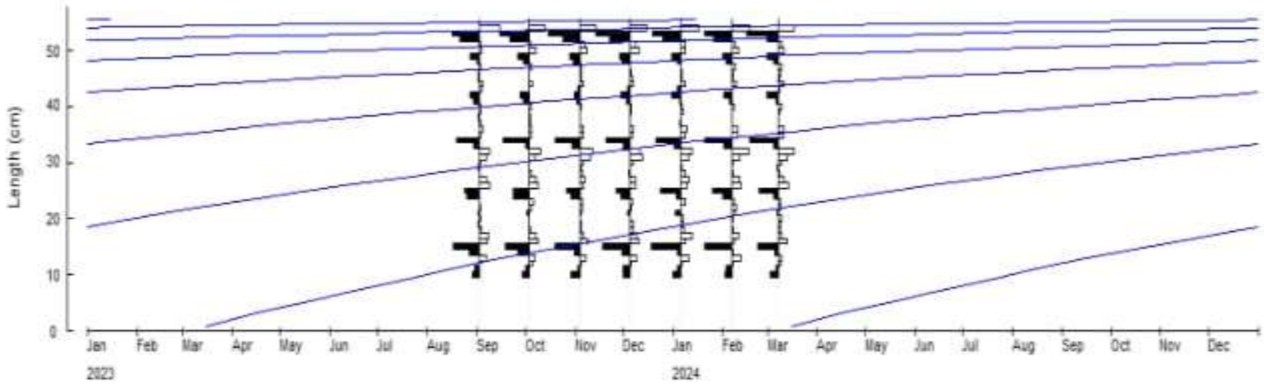

Fig 3. ELEFAN II plot of *A. occidentalis* in Oguta Lake

In the table, the fastest growth rate was between age 1 and age 2 (18.33 cm/yr) which was statistically different ($p < 0.05$). As the fish grows older the growth rate reduces and the least was between age 7 and age 8. The growth rate is not significantly different ($p > 0.05$) as the growth rate tends to zero. The chart in fig.4 shows the growth performance index (∅') of 0.57yr^{-1} indicating good growth per year.

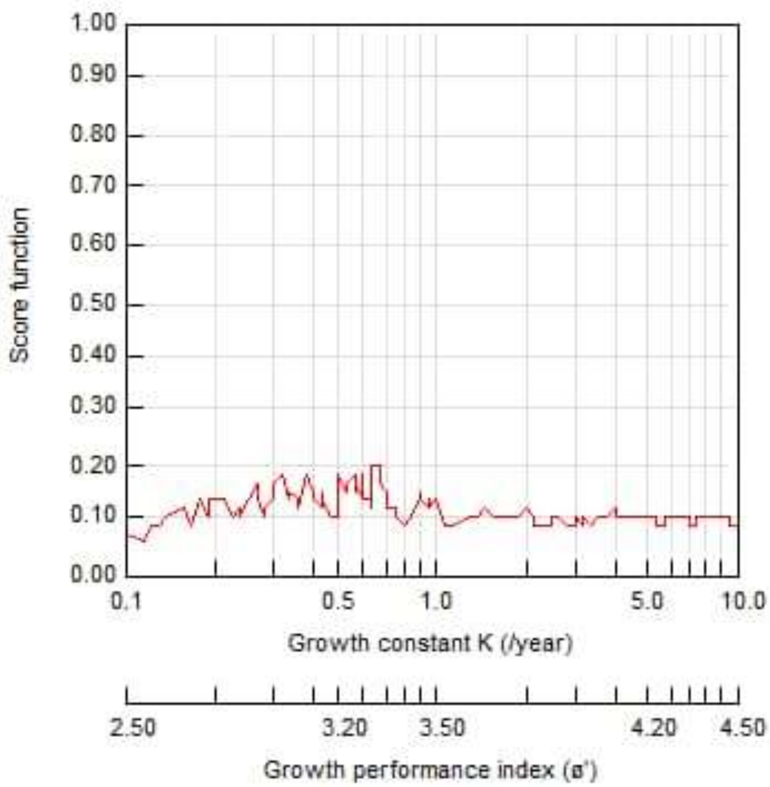

Fig. 4: Chart of Growth performance index of *A. Occidentalis*

In Fig. 5 is presented the length – converted catch curve of *A. occidentalis.*

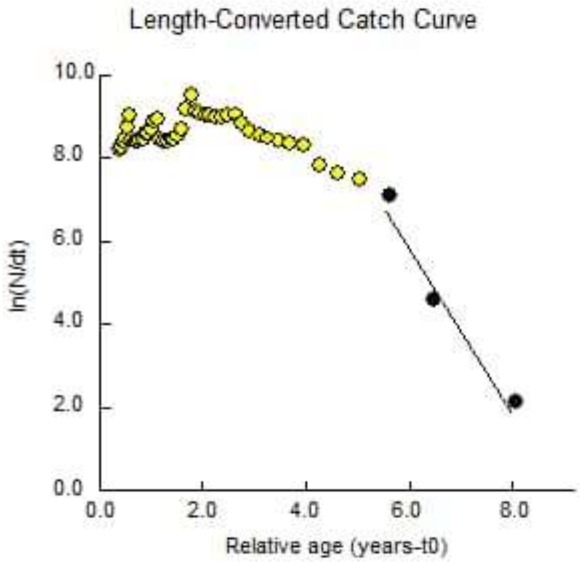

Fig. 5: the length – converted catch curve of *A. occidentalis.*

The catch curve displays two distinct segments represented by the yellow and black data points. The yellow data points from descending pattern, indicating a gradual decline in abundance with increasing age or length, which is typical of a fish population under natural mortality and fishing pressure. The black data points, indicating the older age group or larger fish sizes at from the expected pattern and show a steeper decline abundance.
The Total Mortality (Z) was 1.862yr$^{=1}$, the Natural Mortality (M) = 0.887yr^{-1}, and Fishing Mortality (F) = 0.975yr^{-1}. The Exploitation rate (E) was 0.527yr^{-1}. The length at first sexual maturity (L_m) was 37.166cm.
Fig. 6 depicts the stock status of *A. occidentalis* using the knife - edge method. The stock showed over – exploitation at E = 0.52 yr^{-1} and critical values L_c/L_∞= 0.179.

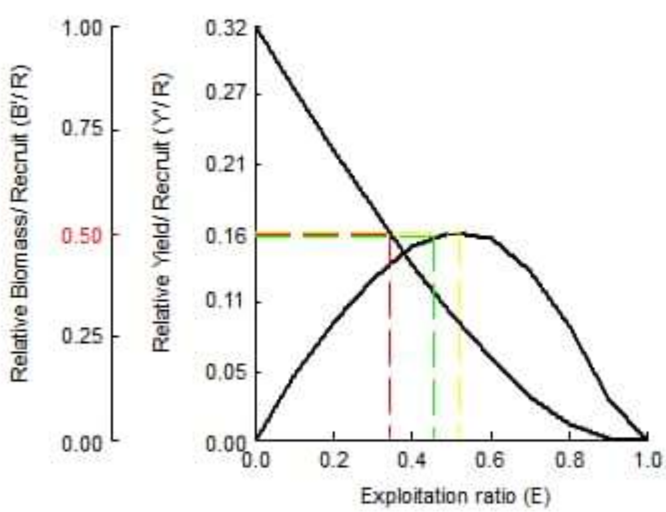

Fig. 6: Stock status of *A. occidentalis*

From Fig 6, the Relative yield per Recruit (Y'/R) show that the values are below 1.

In Fig. 7 is presented the Recruitment rate (yr^{-1}) of *A. occidentalis*. A major single recruitment peak is observed at the month of June with the lowest in February.

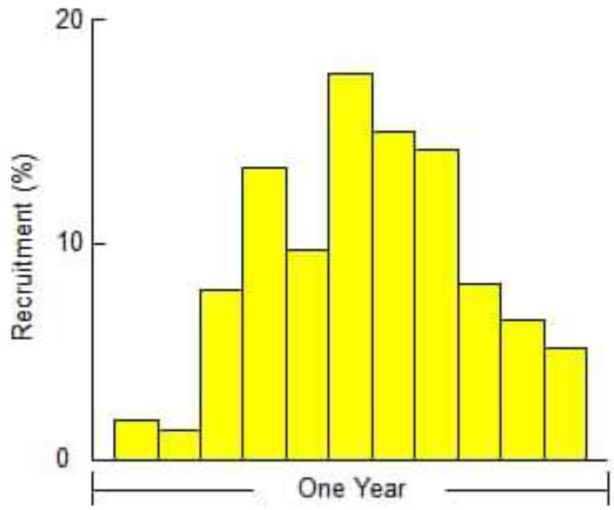

Fig. 7: Recruitment rate (yr^{-1}) of *A. occidentalis* in Oguta Lake

DISCUSSION

The comprehensive analysis of various parameters including growth rates, mortality rate, exploitation rate and maturity sizes offers a holistic understanding of *A. occidentalis* ecological dynamics within the Oguta Lake ecosystem. The study shows that *A. occidentalis* exhibit a moderate growth rate with maximum length of 55.75cm and growth performance index of 0.335yr^{-1} using ELEFAN II and VBGM. In Ikongbeh *et. al.*, (2024), the L_∞ was 46.73cm. The L_∞varies according to locality. In FishBase (2025), maximum length recorded was 70cm while the largest recorded is 90cm in Congo River System (Greernekk and Vreven, 2023).

The age recorded in this study is 7 – 8 years. Age classes of fish depends on the environmental conditions and the fish species. In *Ogueri et. al*., (2025a), *Brycinus nurse* lived up to 5 years, *CitharinusCitharus* 8 years (Ogueri *et. al*., 2025b). *Distichodus rostratus*, 5 years; *Clarias gariepinus* 7 years and *Gymnarchus niloticus*, 10 years (Ogueri *et al*., 2025c)

The importance of length – at – age in stock assessment is to determine the gradient of the fish species growth over time. The growth coefficient (K) is observed at 0.51yr^{-1} indicating the rate at which the species approaches its maximum length of L_∞= 55.75cm. Fishes naturally grow faster at younger ages than at older ages. As the fish approaches its maximum length, the growth rate tends to Zero (Miranda *et. al*., 2017)

The total mortality (Z) in this study observed was 1.862yr^{-1}, the natural mortality (M) = 0.887 yr^{-1} and fishing mortality (F) = 0.975yr^{-1}which means of all the mortality experienced by the fish in Oguta Lake, 47.63% is as a result of natural mortality (disease, old age, predation, etc) while 52.36% is due to fishing mortality. In optimal fishing condition, it should be F = M = 0.5yr^{-1} (Hilborn and Walters, 2013). This indicates that *A. occidentalis* is experiencing over fishing in Oguta Lake. Igongbeh *et. al.,* (2024) in Akata Lake, Benue state, Nigeria recorded F = 0.781yr^{-1} which is even higher than what was observed in this present study.

Fishing can hold average fish biomass well below the carrying capacity for the system, but in these cases random fluctuations in biomass still occur due to variations in fish recruitment (Cooke *et al,* 2002).

The estimated Exploitation rate in this study was E = 0.527yr^{-1}. The Exploitation maximum (E_{max}) should be 0.5yr^{-1} according to Hilborn et al (2001). Thus, it is deduced that *A. occidentalis* is over - exploited in Oguta Lake.

The current exploitation rate slightly exceeds the optimal level, hinting at potentially unsustainable fishing practices. Factors such as the species appealing taste and economic pressure may be driving increased exploitation (Ogbonna, 2023).

With reference to FAO (2011) where the Yield per Recruit (Y'/R) is less than 1, is indicating that the fishery is not operating at its maximum sustainable yield (MSY); In Fig. 6, the (Y'/R) values were less than 1, indicating that *A. occidentalis* is not operating at its MSY in Oguta Lake.

According to Tsikliras and Froese (2019), MSY represents the maximum catch that can be taken from a fish stock over an indefinite period without causing the stock to decline.

Reproductive Load is a critical component of fish population dynamics as it assists in ensuring long – term sustainability of the fish stock and the ecosystem they inhabit (Morgan, 2008). In this study, the Reproductive load recorded was 0.179 which was less than 0.5. Using Froeses's (2006) assessment, *A. occidentalis* was undergoing over exploitation during the period of observation and the fish were being caught before it reached their maximum size.

The length at first sexual maturity (L_m) in this present work was 37.166cm. Most specimens (60 – 70%) caught were below the L_m. This shows that the mature adult population (spawning biomass) is depleted to a level where they no longer have the reproductive capacity to replenish themselves (not enough adults to produce young ones).

The peak of recruitment observed was June. Ogbonna (2023) made similar observation. Recruitment in Fisheries is period of breeding where the young ones start appearing in the catches (Quist, 2007).

CONCLUSION AND RECOMMENDATIONS

The study investigated the stock status of *A. occidentalis* in view of providing baseline information for the conservation and management strategies of the species in Oguta Lake. The total mortality established was high (1.862yr^{-1}) arising from over – fishing. The species is experiencing over – exploitation and the fishery not operating at its Maximum Sustainable Yield (MSY).

Recommendations

1. To engage the relevant stake holders in enforcing the regulation on the use of small mesh sizes in the fishing.
2. Restriction on the catching of *A. occidentalis* below the size of 37.5cm so as to have the stock that would replenish the decline
3. Restriction on the catch during the identified peak period of recruitment in June every year
4. Further research through ecological modelling in the identification of the spawning sites so as to declare these sites closed for fishing during the recruitment in June annually, in Oguta Lake.

REFERENCES

Adebisi, A. A., Olaniyi, W. A andAyanda, O. I. (2018). Feeding ecology of the African catfish (*Auchenoglanis occidentalis*) in a Nigerian freshwater reservoir. *Revista de Biologia Tropical*, **66**(3), 1230 – 1240.

Adeoye, O. T., Agboola, D., and Olurin, K. B. (2021). Bioaccumulation and physiological responses of *Auchenoglanis occidentalis* exposed to sub lethal concentrations of glyphosate – based herbicide. *Environmental Science and Pollution Research*, **28**(1), 562 - 572

Adesina, G. U., Abodunrin, O. O. and Adebisi, A. A. (2020). Antioxidant antimicrobial and anti – inflammatory activities of the ethanolic extract of the skin and flesh of *Auchenoglanis occidentalis*. *Journal of Traditional and Complimentary Medicine*, **10**(5), 474 – 480.

Adesulu, E. A and Sydenham, D.H.J. (2007). The Freshwater and Fisheries of Nigeria. *Macmillan Nigeria Publishers, Lagos, Nigeria 397pp.*

Agbogidi, O. M. and Emoghene, A. O. (2019). Osmoregulatory and haematological responses of the African catfish, *Auchenoglanis occidentalis*(Valenciennes, 1840), fingerling to salinity stress. *International Journal of Fisheries and Aquatic Studies*, **7**(6), 32 – 37.
Agboola, J. I. and Anetekhai, M. A. (2008). Length – Weight relationships of some fresh and brackish water fishes in Badagry Creek, Nigeria. *Journal of Applied Ichthyology*, **24**(7) 623 - 625.
Bolger, I and Connoly, P. L. (2019). The selection of suitable indices for the measurement and analysis of fish condition. *J. Fish Biol,* 34: 171 – 182.
Brewer, S. K. amdOrth, D. J. (2014). Small mouth Bass, *Micropterusdolomieu* (Lacepede, 1802). *American Fisheries Society Symposium 82 000 – 000 2014 © by the American Fisheries Society.*
Cooke, S. J., J. F. Schreer, D. H. Wahl and D. P. Philipp (2002). Physiological impacts of catch and release angling practices on Largemouth Bass and small mouth Bass. Pages 480 – 512 in D. P. Philipp and M. S. Bidgway, Black Bass ecology conservation and management. American Fisheries Society Symposium 31, Bethseda, Maryland.
Edward, U. C., Robert N. M., Ahress, Angela B. Collins and K. Lorenzon (2020). Fish population recruitment: What recruitment means why it matters. Edis.itas.ufl.edu FA 222. Electronic Data information source of UF/IFAS. https//www.echocommunity.org.resources
FAO (2011). Food and Agriculture Organization. Review of the state of World Marine Fishery Resources. *FAO Fisheries and Aquaculture Technical paper No 569. 334p. ISBN: 978 – 92 – 5 – 107023 - 9*
Fishbase (2025). www.fishbase.org (Retrieved 19/July 2025).
Froese, R and D. Pauly Editors (2025). Fishbase. 2025
Gayanilo, F. C., Sparre, P and Pauly, D. (2005). FAO-ICLARM Stock Assessment Tools II (FISAT II) *User's guide FAO Computerized Information series (Fisheries). No 8, revised version, FAO, Rome, pp. 168.*
Greenrickk Tom and Emmanuel Vreven (2023). A re –valuation of the species level diversity within the catfish genus; *Auchenoglanis occidentalis* (Siluriformes: Clarotiedae). *Journal of Natural History,* **47** 47 – 48. 2979 – 3010. *www.atichthy.org/en*
Hilborn, R., Maguire, J. J., Parma, A. and Rosenberg A. (2001). The precautionary approach and Risk management: Can they increase the probability of success in Fisheries Management?*Canadian Journal of Aquatic Sciences,* **58***,* 99 – 107.
Hoggarth, D. D., Abeyasekera, S., Arthur, A., Beddington, J. R., Burn, R. W., Halls, A. S., Kirkwood, G. P., McAllister M., Medley P., Mees, C. C., Pilling G. M., Wakeford, R and Welcomme, R. L. (2006). Stock assessment and Fishery management. A framework guide to the FMSP stock assessment tools. *FAO Fisheries Technical Paper No. 487, Rome, Italy 261* pp. 17.
Ikongbeh, O. A., Ataguba, G. A. and Omuwa I. W (2024): Age growth and Mortality of *Auchenoglanis occidentalis* from Lake Akata, Benue state, Nigeria. *Nigerian Journal of Fisheries and Aquaculture.* **12(**1) 2024.
IUCN (2024). International Union for the Conservation of Nature. Red list of Threatened Species. Version **16** updated March, 2024. *Auchenoglanis occidentalis* (Retrieved 1/2025) Species ID Number: Ref. 130435. (IUCN 3.1).
Morgan, M. J. (2008). Integrating reproductive biology into Fisheries management. *Marine Ecology Progress Series*, 357, 291 – 302.
Miranda, L. E., Beltoli P. W. and Brown M. L. (2017). Mortality. In C. S. Craig and M. L. Brown editors. Analysis and interpretation of freshwater fisheries data *American Fisheries Society, Bethesida, Maryland, Lagos* 228 -277. 47 – 61.
Nelson, J. S. (2006). *Fishes of the World (4 ed.)* Hoboken, N. J: John Wiley and Sons pp 161 – 162.
Ogbonna, C. I. (2023). Reproductive Biology of *Auchenoglanis occidentalis* in Oguta Lake, Nigeria. *Journal of Aquatic Sciences,* **10**(1) 25 – 34.

Ogueri, C. Adaka G. S., Bunu, A. J., Nwaka, D. E., Utah, C., Wilfred, P. N., Ekeledo, C. B., Ogah, J., and Adebayo, E. J., (2025a) Stock status of *Brycinusnurse* (Ruppel 1832) in Oguta Lake, Nigeria for conservation and management strategies. *Research article. Glob. Science Res.Env. Sc.* **5**(1) 1 – 5 *DOI: 10. 53902/GSRES. 2025. 05. 000535.*

Ogueri, C. Adaka G. S.,Utah, C., Ekeledo, C. B., Chinnah, U. K., Cyril, U. E., Ezeafulukwe, C. F., Bunu, A. J., Njoku, D. C. and Madu, C. H. (2025b) Stock status of the moonfish (*Cithainus Citharus*) for management strategies and conservation in Oguta Lake, Nigeria.*Uttar Pradesh journal of Zoology.* **46**(10) pg 394 – 403. *Article no. UPJ02.4864 ISSN 0256 – 971 x (P). DOI: https//doi.org/10.56557/Upjo2/2025/V46/104998.*

Ogueri, C. Adaka G. S., Utah, C., Madu, H. C., Ekeledo, C. B., Ezeafulukwe, C. F., Bunu, A. J., Njoku, D. C., Chinnah, U. K.and Cyril, U. E. (2025c). Assessment of three fish species stock for conservation and management policy in River Imo, Nigeria. *Uttar Pradesh journey of Zoology. Vol 46(10) pg 282 – 296. Article no. UPJ02.4864 ISSN 0256 – 971 x (P). DOI: https//doi.org/10.56559/Upjo2/2025/V46/104999*

Okomoda, V. T., Ezemoyife, C. I. and Ukwungwu, M. V. (2020). Acute exposure or *Auchenoglanis occidentalis*fingerlings to hypoxic condition: haematological response. *Journal of Applied Life Sciences International,* **22**(6), 1 – 7.

Olaniyi, W. A and Ayanda O. I. (2021). Spawning ecology and breeding pattern of *Auchenoglanis occidentalis* in Asa Reservoir, Kwara state, Nigeria. *Life Sciences International,* **24**(4), 15 – 45.

Olaesebikan, B and Raji A. (2015). Field Guide to Nigerian Freshwater Fishes. P. 78, New Bussa, Nigeria.

Onyema, I., Obiakara, M. C. and Onyema, E. D. (2022). Probiotics as an ecofriendly approach to enhance growth performance and control diseases in Aquaculture: A review. *Aquaculture international*, 30(1) 1 – 20.

Osijaye, G. K., Bob. Manuel Fage, Ofon, G. and Igbani, F. (2024) Assessment of fish fauna in Oguta Lake, Imo State, Nigeria. *African Journal of Sciences and traditional medicine. Vol. Mt. 1. ISSN 7942. DOI.10.58578/AJSTM VIII 3502.*

Ovie, S. I., Adebisi, A. A and Olaniyi, W. A. (2019) Dietary protein requirement of *Auchenoglanis occidentalis* fingerlings. *Egyptian Journal of Aquatic Research.* **45**(4), 319 – 324.

Quist, M. C. (2007). An evaluation of techniques used to index recruitment variation and year – class strength. *North American Journal of Fisheries Management.* **27** 30 – 42.

Teugels, G. G., Adriano, D., Audenaerde, T. U., Decru. E., Dierckx, T., Gourene, G and Muller T. (2007). An overview of the catfish from the Lower Guinean ichthyofaunal province. *Ichthyological Exploration of Freshwaters,* **18**(3), *209 -221.*

Tsikliras, Athanassios and FroeseRaine (2019). Maximum sustainable yield. *Encyclopedia of Ecology (2nd Ed.) Elsevier. Pp 108 – 115. doi:10.1016/B978-0-12-409548-9.10601-3. ISBN 978044641304.52CID1500 25979*

Ukagwu, J & Okeke, P.A. (2024). Current assessment and clarification of fishing gear and crafts deployed by fisherfolks in Oguta Lake, Nigera. *Global Journal of Fisheries Science.* **2** *33 -41. ISSN 2782 – 750X. DOI.org/10.31248/GJF 2024.050*

***Walters,* C. and Martell, J. (2024).** Fisheries ecology and management. *Princeton, University Press Princeton, New Jersey.*