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Growth Allometry and Condition Factor of Some Mormyrids in Lower River Niger at Idah, Kogi State, Central Nigeria

Onimisi, Meriyamoh Mero[1], Salaudeen Mutiat Motolani[2], Abubakar, Khadijat[3], Obaje, Caleb Ojochegbe[4]
[1-4] Department of Fisheries and Aquaculture, Prince Abubakar Audu University, PMB 1008, Anyigba, Kogi State, Central Nigeria

ABSTRACT

The study examined the growth allometry and condition factor of six Mormyrids of lower River Niger at Idah, Kogi State of central Nigeria. Three hundred and thirty two (332) mormyrids namely *Mormyrus rume, Mormyrus macrophthalmus, Mormyrops deliciosus, Hyperopisus bebe occidentalis, Gnathonemus petersii and Pollimyrus isidori* were obtained monthly from the local fishermen between June 2024 and November 2024.The fish were caught using 5.1 cm and 7.3 cm gill nets as well as traditional valved basket traps. The collected specimens were transported in ice-packed plastic containers to maintain freshness. Species identification was carried out in the laboratory using established taxonomic references. Standard length and body weight of the specimens were measured to the nearest 0.1cm and 0.1g respectively. The length-weight relationship (LWR) was determined using the equation $W = {}_aL^b$, while condition factor was evaluated using the equation $K = 100 \times W/L^{3.}$ Results revealed variations in LWR among species with *M rume* and *P. isidori* exhibiting positive allometric growth having b value of 3.1 and 3.2 respectively, *M. macrophthalmus* and *G. petersii* showed isometric growth (b = 3) while *M. deliciosus and H. bebe occidentalis* displayed negative allometry of 2.9 and 2.7 respectively. The condition factor analysis revealed significant differences ($P < 0.05$) among the species. *G. petersii* exhibited the highest condition factor (1.67) while *M. deliciosus* had the lowest (0.72). The findings highlighted the need for targeted conservation strategies to protect critical habitats and maintain resource availability, particularly for species with lower condition factors. Mitigating environmental stressors such as pollution and habitat degradation are essential for sustaining the health and growth potential of Mormyrid species in the lower River Niger. Long-term monitoring programs are recommended to assess population trends, growth dynamics, and environmental influences, ensuring adaptive management strategies that promote the sustainability of these ecologically significant fish species.

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Corresponding Author:
Onimisi, M. M.

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1. INTRODUCTION

Mormyrids or Family Mormyridae commonly known as elephant-snout fish due to their distinctive elongated snouts are widely distributed across various African water bodies. They are soft-rayed bony fishes with abdominal pelvic fins, forked tail fins, small mouths and eyes, restricted gill openings, and small scales (Olaosebikan and Raji, 2004). They have gained significant scientific interest due to their unique biological characteristics and ecological importance. Mormyrids are known for their electroreception and electro communication abilities, which play crucial roles in their behavior, feeding, and reproduction (Abowei *et al*, 2021).
The length-weight relationship can be used as a character to differentiate taxonomic units and the relationship changes with various developmental events in life of fish such as metamorphosis, growth and state of sexual maturity. Furthermore, the length-weight relationship can also be used in setting yield equations for estimating the number of fishes landed and comparing the population in space and time (Somyi, 2017). Moreover, the empirical relationship between the length and weight of fish species, improves the knowledge of the natural history of commercially important fish species, thus making conservation and utilization possible (Alhassan *et al*., 2014).

The condition factor is employed to evaluate and compare the overall well-being, fatness, "condition" of fish. This measurement is founded on the assumption that fish of the same length but with greater weight are in better physiological health (Seher and Suleyman, 2012; Andem *et al*., 2013; Shahnawaz *et al.*, 2014; Wally *et al*., 2015; and Balai *et al*., 2017). Additionally, the condition factor serves as a valuable indicator for monitoring factors such as feeding intensity, age, and growth rates in fish and also, the status of the aquatic ecosystem in which fish reside can be evaluated by using it as a gauge, as it is significantly affected by both the living (biotic) and non-living (abiotic) environmental factors (Seher and Suleyman 2012). These relationships are fundamental for fisheries management, as they allow for the estimation of biomass from length frequency data and help in assessing the well-being of fish populations (Froese, 2019).

Several research bodies have highlighted the importance of understanding the biology and ecology of fish species in order to develop effective conservation and management strategies. The Food and Agriculture Organization (FAO) of the United Nations has emphasized the need for sustainable management and conservation of fish populations in order to ensure food security and livelihoods for millions of people worldwide (FAO, 2018). The Inter-governmental Panel on Climate Change (IPCC) has also highlighted the impact of climate change on fish populations and the need for urgent action to mitigate these impacts (IPCC, 2019), In Nigeria, the Federal Department of Fisheries has identified the need for research on fish biology and ecology in order to develop effective management and conservation strategies (FDF, 2017), The Nigerian lnstitute for Oceanography and Marine Research has also emphasized the importance of research on fish populations in order to ensure sustainable management and conservation (NIOMR, 2018).

Researchers have reported abundance of Mormyrid species in inland waters of Nigeria (Ogbe and Fagade 2003; Adeosun *et al*., 2011; Ataguba *et al*., 2014; Bawaa *et al*. 2019 and Danba *et al*., 2020). Onimisi and Shittu, 2015 reported on aspects of the biology of *M. rume* with emphasis on its food and feeding, length weight relationship and condition factor in lower River Niger at Idah, Kogi State. Despite the ecological and economic importance of the mormyrids there is scanty knowledge on most of the species in the Lower River Niger at ldah. This knowledge gap hinders the development of effective conservation and management strategies, and threatens the long-term sustainability of the species (FAO, 2018). The aim of this research therefore is to study the growth allometry and condition factor of the mormyrids in the lower River Niger at Idah, Kogi State, Nigeria. This will add to the knowledge of the biology of the species in lower river Niger at Idah, give information on the environmental suitability for the species and also a baseline information in the management and sustainability of the species.

2. MATERIALS AND METHODS

Study Area

This study was carried out in Idah, Kogi State, Nigeria (Figure 1). Idah is a town in Kogi State, Nigeria (Figure 2) on the eastern bank of the River Niger in the middle belt region of Nigeria situated on Latitude: 7° 04' 60.00' N Longitude: 6° 44' 59.99' E. River Niger, at ldah, is an extension of the two major Nigerian rivers; River Niger after which the country Nigeria is named, and River Benue, after their confluence in Lokoja. The Idah River is located between latitude 7°61"N and longitude 6°42"E (Figure 2) and it serves as a boundary between Kogi and Edo states. The temperature of the water ranges between 22 and 31°C depending on the season. It is relatively turbid and has a slightly alkaline pH between 7.5 and 7.8 (depending on the sampling location). The highest water levels are usually recorded between August and September, while the lowest water level is usually recorded between March and April (Adeyemi, 2010). Local communities at the different axis of River Niger bank exploit the water for fishery, and domestic purposes. The water is exposed to both human and animal wastes, discharge of untreated industrial and domestic wastewaters, runoffs and dead organic plants and animals.

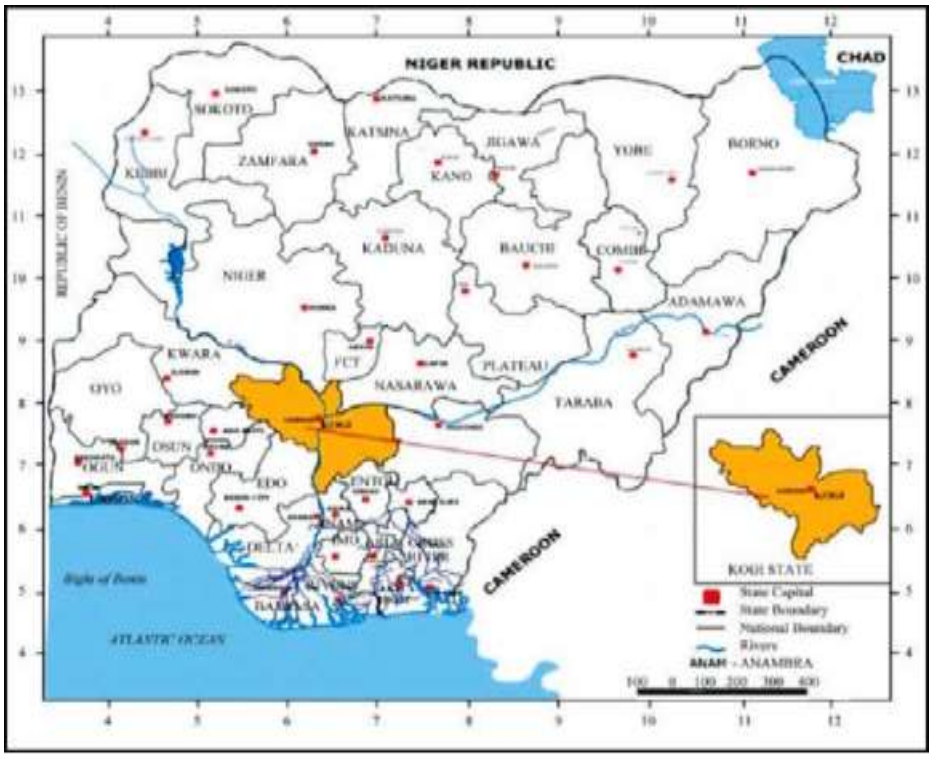

Figure 1: Map of Nigeria Showing Kogi State

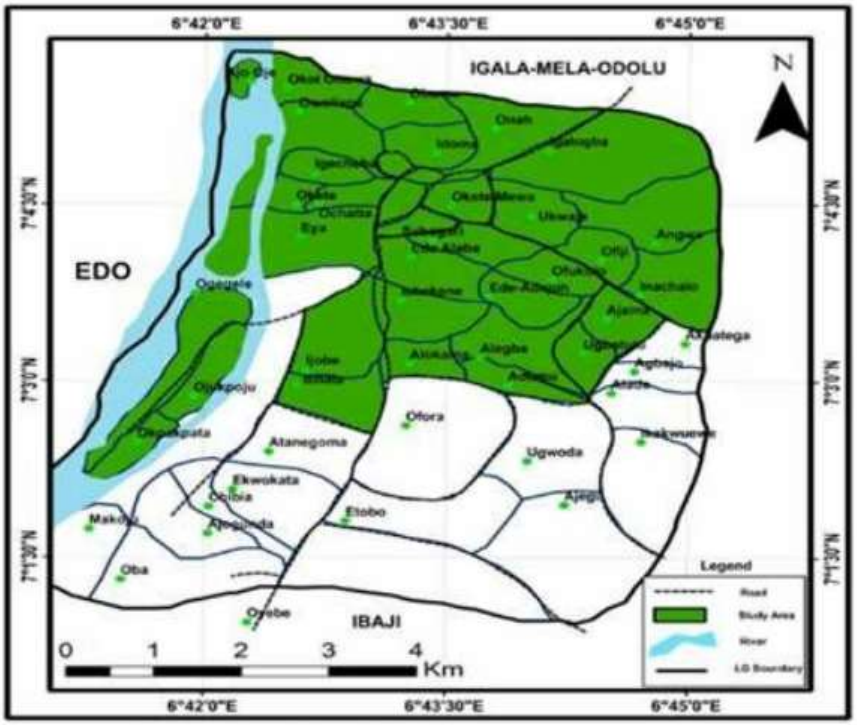

Figure 2: Map of Idah Showing the Study Area

Sample Collection

Fish samples were obtained from the local fishermen at Ega fishing landing site of lower River Niger at Idah, between June 2024 and November, 2024. *The fishermen used* gill nets of mesh sizes 5.1 cm and 7.3 cm and traditional valved basket traps. The fish samples collected for this study were transported in ice-packed containers to Prince Abubakar Audu University Anyigba Fish biology laboratory. Identification of the various species of mormyrids was done using guidelines provided by Olaosebikan and Raji (2004). Standard length (SL) and body weight (W) of the specimens were measured to the nearest 0.1 cm and 0.1 g respectively.

Length-Weight Relationships

The morphometric characters used in the LWR were standard length (SL) and body weight of the samples. SL was taken along the anterio-posterior body axis, from mouth tip to the mid-point of caudal fin origin using a meter rule. The body weight was measured using a digital top-loading electronic weighing balance (Acculab model). SL values were recorded in centimeter (cm) while the body weight values were recorded in grams (g). The association between length and weight was established using the equation:

$W = {}_a L^b$ (Le-Cren, 1951)

Where;
W = weight of the specimen in grams (g),
L = standard length of the specimen in centimeters (cm),
a = coefficient associated with body form and
b = exponential expressing the relationship between length and weight.

Data obtained were transformed to logarithm to obtain a linear equation as:
Log W = log a + b Log L (Kahraman *et al.*, 2014).
Also, the degree of association between them was estimated by computing the correlation coefficient (r^2) through the linear regression analysis:
$R = r^2$

Estimation of Condition Factor
The condition factor (K) of each individual specimen was estimated by applying the formulae described by Fulton (1911):
$K = W * 100/L^3$
Where
K = condition factor,
W = weight of the fish in (g),
L = standard length of fish in (cm)

Data Analysis
The relationship between length and weight was analyzed by linear regression after transforming the data into logarithm. Correlations among the morphometric parameters were computed using Spearman correlation coefficient. All of these analyses were performed at a significance level of 0.05 ($\alpha = 0.05$).

3. RESULTS AND DISCUSSION

Three hundred and thirty two (332) mormyrids belonging to 5 genera were used for the study. The species include *Mormyrus rume*, *Mormyrus macrophthalmus*, *Hyperopisus bebe occidentalis*, *Mormyrops deliciousus*, *Gnathonemus petersii* and *Pollimyrus isidori*. These species have been reported in Nigerian waters (Ogbe and Fagade, 2003 Olaosebikan and Raji, 2004; and Ipinmoroti, 2013). The length-weight relationship revealed variations in the growth allometry from positive, isometric to negative allometry among the mormyrids of lower river Niger at Idah (Table 1).

Table 1: Length-Weight Relationship of Mormyrid Species in the Lower River Niger at Idah

Species	N	SL (cm) Range	SL (cm) Mean	Wt (g) Range	Wt (g) Mean	a	b	r
M. rume	61	11.2 - 21.9	15.4 ± 1.9	11.5 - 76.0	39.8 ± 16.6	0.008	3.1	0.97
M. deliciousus	61	9.4 - 20.5	14.45 ± 3.2	8.5 - 48.4	21.78 ± 11.4	0.008	2.9	0.96
H. occidentalis	76	10.4 - 18.5	15.5 ± 1.9	14.3 - 74.5	34.5 ± 17.4	0.003	2.7	0.94
M. macrophthalmus	50	8.5 - 18.0	14.5 ± 2.0	8.9 - 55.4	36.3 ± 8.7	0.003	3.0	0.95
G. petersii	42	9.2 - 16.0	11.5 ± 2.1	10.5 - 64.5	25.5 ± 15.3	0.028	3.0	0.96
P. isidori	42	6.5 - 12.5	11.0 ± 3.1	6.0 - 33.5	18.50 ± 8.5	0.019	3.2	0.95

Key note: N - Number of samples, SL - Standard length, Wt - Weight, a - intercept, b - slope, r - correlation co-efficient

Mormyrus rume and *Pollimyrus isidori* exhibited positive allometric growth with b values of 3.1 and 3.2 respectively. The positive allometric growth exhibited by these species suggests that as they increase in length they gain weight at a faster rate, resulting in a bulkier body. This growth pattern can be advantageous, reflecting favorable environmental conditions such as abundant food resources or optimal habitat features that support rapid growth. This observation aligns with the findings of Onimisi and Shittu (2015) and Adeyemi *et al.* (2019) who reported similar growth pattern for *Mormyrus rume* in the same water body. This pattern is also consistent with findings of Adepo-Gourene *et al.,* 2019 and Abowei *et al.* 2019 from other West African freshwater studies. They attributed positive allometric growth to the fish's ability to effectively exploit available resources, making it a resilient species in its ecological niche. The positive allometric growth observed in *M. rume* and *P. isidori* in lower River Niger at Idah is indicative of adequate food supply and minimal predation pressures on them in the river.

Mormyrus macrophthalmus and *Gnathonemus petersii* exhibited an isometric growth of 3.0 indicating that the weight and length of this species increase proportionally. This growth type is typical of species that inhabit stable environments where growth conditions do not fluctuate significantly. Studies in similar aquatic environments, such as those by Omorinkoba *et al.* (2020) in Jebba Lake, Nigeria, have documented comparable growth dynamics, highlighting the importance of stable environmental conditions in supporting balanced growth patterns. Nwani *et al.* (2006) however reported isometric growth trend for *Gnathonemus petersii* in Anambra River, another Nigerian freshwater body. The isometric growth pattern of the species may indicate stable environmental conditions and a well-balanced food supply in the lower River Niger, allowing this species to grow uniformly without experiencing significant nutritional stress or competition. Given that *Gnathonemus petersii* is known for its reliance on electroreception to locate prey in turbid waters, its growth consistency may also be attributed to its ability to efficiently forage for food even under challenging environmental conditions.

The length-weight relationship for *Mormyrops deliciousus* and *H. bebe occidentalis* revealed a growth exponent of 2.9 and 2.7 respectively, indicative of negative allometric growth. This means that *these species* tend to grow longer without gaining weight as rapidly, resulting in a more elongated and less bulky body compared to species with positive allometric growth. This is consistent with findings in other West African rivers, where similar growth patterns have been linked to factors such as high competition for food or seasonal variations in resource availability (Adepo-Gourene *et al.,* 2019). This growth pattern may reflect adaptive responses to environmental pressures, allowing *Mormyrops deliciousus* and *H. bebe occidentalis* to optimize their energy use under varying ecological conditions.

The variations in growth patterns among the Mormyrid species studied reflect the complex ecological interactions and adaptive strategies that each species employs to survive in the lower River Niger. Positive allometric growth, as seen in *Mormyrus rume* and *Pollimyrus isidori*, suggests that these species benefit from conditions that promote rapid weight gain, possibly due to abundant food or optimal habitat structures that support their growth. In contrast, the isometric growth of *M. macrophthalmus* and *G. petersii* indicates a balanced environment with stable resources, while the slight negative allometric growth of *M. deliciousus* and *H. bebe occidentalis* points to adaptive strategies for dealing with fluctuating or competitive conditions. These findings are significant as they provide a deeper understanding of the ecological dynamics of mormyrid species in Nigeria's freshwater systems, emphasizing the need for species-specific management strategies. For instance, species with positive allometric growth may require continued efforts to preserve their habitats to maintain the favorable conditions that support their robust growth. Meanwhile, species exhibiting isometric or negative allometric growth may benefit from interventions aimed at improving resource availability or reducing competition.

The condition factor (*K*) of the mormyrids in River Niger at Idah as shown in Table 2 provides insight into their overall health and well-being.

Table 2: Condition Factor of Mormyrid Species in the Lower River Niger at Idah

Species	N	K	K Status
M. rume	61	1.10	Good condition
M. deliciousus	61	0.72	Poor condition
H. occidentalis	76	0.92	Poor condition
M. macrophthalmus	50	1.19	Very good condition
G. petersii	42	1.67	Very good condition
P. isidori	42	1.39	Very good condition

Note: N - Number of samples, SL - Standard length, Wt - Weight, K - Condition Factor,
K Status: = 1: Good condition; > 1: Very good condition and < 1: Poor condition

Among the species examined, *G. petersii* exhibited the highest condition factor (1.67), suggesting that it thrives well in its environment, likely due to abundant food availability and favorable habitat conditions. *P. isidori* also showed a relatively high condition factor (1.39), indicating that it is in good nutritional status and benefits from the ecosystem. *M. macrophthalmus* had a moderate condition factor (1.19), suggesting that while it is in fairly good health, it may not be as well-nourished as the species with higher values. *Mormyrus rume* displayed a similar trend (1.10), maintaining reasonable health but not reaching the optimal condition of the top species. The lowest condition factor of 0.72 and 0.92 observed in *M. deliciosus* and *H. bebe occidentalis* when compared to studies conducted on similar species in Nigerian freshwater bodies showed variations. For instance, in the study by Adeyemi *et al.* (2010), mormyrid species in River Benue showed a general trend of condition factors above one (1) suggesting good feeding conditions. The findings of the present study aligned with those of Fagade (1983) which indicated that species with condition factors below one may be facing ecological stress, while those above one are generally in good condition. The results indicate that some species in River Niger are thriving, while others may be experiencing environmental challenges. The differences in condition factors suggest species-specific adaptations to the habitat, competition, and food resources available in the river.

4. CONCLUSION

The study of growth allometry and condition factor among mormyrid species in the lower River Niger at Idah provides valuable insights into their adaptability and ecological status. The variations observed in length-weight relationships suggest species-specific growth patterns influenced by environmental conditions. The condition factor analysis further reveals differences in species health, indicating varying levels of adaptation to the habitat. Comparisons with other studies underscore the role of habitat quality and resource availability in shaping fish growth and condition. The findings emphasize the need for sustainable fisheries management to ensure the continued survival and productivity of these species in the River Niger ecosystem.

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