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The Morphometric and Meristic Features of the Oreochromis Niloticus and Hepsetus Odoe Fish Species in Owanla Reservoir, Ore, Osun State, Nigeria

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ABSTRACT

Morphometric and meristic analyses are crucial tools for distinguishing fish populations and assessing ecological adaptations within aquatic environments. This study investigated the morphometric and meristic characteristics of *Oreochromis niloticus* and *Hepsetus odoe* inhabiting the Owalla Reservoir, Osun State, Nigeria, to determine their population structure, growth patterns, and environmental responses. Ninety-eight specimens (53 *O. niloticus* and 45 *H. odoe*) were collected between July and October 2024 using gill and cast nets. Standard morphometric measurements and meristic counts were obtained and analyzed using SPSS version 22.0. Length–weight relationships (LWR) were established through regression models, while the physicochemical properties of the reservoir water were assessed to evaluate environmental suitability. Results revealed positive allometric growth in both species ($b > 3$), indicating improved weight gain relative to body length, with *O. niloticus* showing a stronger correlation ($r^2 = 0.96$) than *H. odoe* ($r^2 = 0.91$). The water's physicochemical parameters, including dissolved oxygen (5.10–7.32 mg/L), temperature (24–27.6 °C), and pH (6.57–7.10), were within optimal limits for tropical fish sustainability. Statistical visualizations showed distinct linear growth trends between total length and body weight across species and age groups. The findings underscore the ecological adaptability of both species and their potential for aquaculture development.

Keywords: Morphometric analysis, Oreochromis niloticus, Hepsetus odoe, Owalla Reservoir, Physicochemical analysis.

INTRODUCTION

Fish constitute one of the most significant renewable aquatic resources and play vital ecological, nutritional, and economic roles worldwide. In Nigeria, fish contribute about 40% of total animal protein intake, reflecting their importance to national food security and livelihoods (Ogunbajo et al., 2021). However, overexploitation and environmental degradation have reduced wild fish stocks, necessitating scientific studies on population structure and adaptation (Akinwande et al., 2022).

The majority of people in this region of the world rely on fish as an inexpensive source of protein to balance their daily diets. *Hepsetus odoe* is one of the inland water resources that provide the majority of the food supply in the tropics. The growing demand for fish protein in Nigeria is necessitated by the gradual decline in the traditional source of protein in the country. As a result, overfishing put the nation's fisheries potential under excessive stress.

Among the most ecologically significant freshwater species are *Oreochromis niloticus* (Nile tilapia) and *Hepsetus odoe* (African pike characin). *O. niloticus* is widely recognized for its adaptability, rapid

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growth, and aquaculture potential (Kefi et al., 2023). Conversely, *H. odoe* is a piscivorous species that serves as an apex predator in African inland waters, contributing to ecosystem stability (Agboola et al., 2024). Understanding their morphometric and meristic variations enhances management and conservation strategies.

The availability of open access regulations caused many of the world's fisheries to fail due to overfishing. The United Nations Food and Agricultural Organization (FAO,2022) reports that fish catches increased steadily until the mid-1990s, at which point they started to level off.

Fish are an essential component of aquatic ecosystems, which are systems where changes made in one area may have an impact on other areas. As a result, it is becoming more and more important to regulate human interference in the aquatic ecosystem after first monitoring its condition. Only in such a framework will capture fisheries be able to sustain themselves as a source of food and revenue for decades to come (Safi, 2014).

Fish makes over 40% of the animal protein consumed in Nigeria. This suggests that people's consumption of animal protein will be impacted by any decrease in fish availability. Because it includes omega-3 fatty acids, which lower the risk of cardiovascular disease, hypertension, arteriosclerosis, etc., fish greatly improves national health. For the sake of their health and mental development, pregnant women and young children should eat fish. According to Eyo (2001), children with high IQs also benefit from eating fish. It also contributes to the healthy growth of the fetus's brain cells. As a result, fish is recommended by doctors as the preferred animal protein, particularly for kids and adults over 50.

A significant fish in the tropical and subtropical regions is *Oreochromis niloticus*. It is the most common bony species in Africa, and it grows quickly and can survive in a variety of water types. This is ascribed to a number of advantageous traits, such as the capacity to effectively transform organic and household wastes into high-quality protein, a broad variety of food, plasticity in growth, firm flesh, and good flavor. It has red coloring on the head and lower body, a dorsal fin with a dark border, and a caudal fin with regular vertical stripes.

One of the few members of the *Hepsetidae* family of characiforms, *H. odoe* is found in large numbers in the inland waters of western and central Africa. With a prominent snout and an elongated body shape, the ventral surface is silvery and the dorsal surface is dark brown or green. It is piscivorous in nature and has a torpedo shape, *H. odoe's* color varies, which is related to its wide range of distribution and developmental stage (young to adults). Its dentition is one of its most notable features; both the upper and lower jaws are full of sharp, pointed teeth, but the upper jaw has only one row and the lower has two; each jaw has two pairs of dermal flaps can be found on the upper and lower jaws and its colouration varies with sizes.

The differences in its features are likely related to the habitat among the variants in different species (Turan *et al*., 2004; Randall and Pyle, 2008). Morphometric characters (referring to measurable structures like fin length, head length, eye diameter, or ratios between such measurements) and meristic counts (including almost any countable structure, such as fin rays, scales, and gill rakers) are also crucial for understanding the taxonomy (González *et al*., 2016).

Morphometric and meristic analyses are key to taxonomy, stock assessment, and growth modeling (Bing *et al*., 2022; Sreekanth *et al*., 2021). Morphometrics quantify body structure measurements, while meristics involve counting features such as scales and fin rays (González *et al*., 2016). These parameters often vary with ecological pressures, providing insights into population adaptation and environmental responses (Hussain *et* ., 2023).The current study aimed at comparison the morphometric and meristic features of *O. niloticus* and *H. odoe* in the Owalla Reservoir, determining their growth patterns and condition factors; and assessing the physicochemical properties of the reservoir to evaluate habitat suitability.

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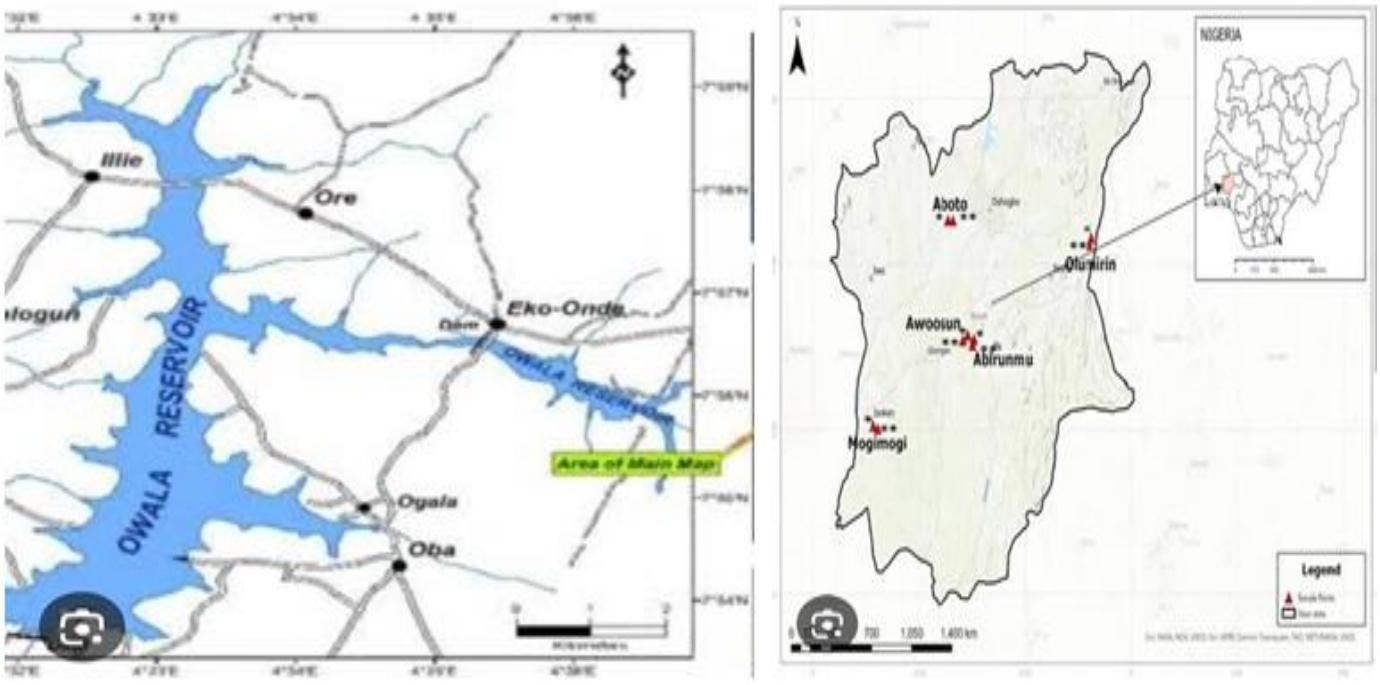
MATERIALS AND METHODS

Study Area

Samples of *O.niloticus* and *H. odoe* were collected from Owalla reservoir, Ore, Osun State every two weeks for four months. Samples were collected in the month of July, August, September and October 2024. The man-made reservoir supports domestic use, irrigation, and fisheries, surrounded by Guinea savanna vegetation with annual rainfall of 1,200–1,500 mm and temperature between 25–29 °C (Akinwande et al., 2022). The reservoir lies between Lat7 ^{0} 44'30.44'' and 7 ^{0} 57' 00.79''N and Long 4 ^{0} 45'21.71'' and 4 ^{0} 51'23.48''.



Sample Collection

Gill nets and cast nets were used to collect the samples, which were then placed in plastic buckets and then taken to the Pure and Applied Biology Department's laboratory for the necessary analysis. The samples were processed that same day without any chemical treatment, with the exception of the gonalds, which were preserved in Gilsons' fluid. Varieties exhibiting both size and sex groups were collected.

Laboratory Procedure

Each fish sample in the laboratory was identified by its serial number, and the date of collection was noted as follows:

Length Measurement

On the same day that they were collected, the weights of the fishes were measured using a weighing scale, and the lengths of the *O. niloticus* and *H. odoe* fish samples were measured using a calibrated measuring board. The standard length (SL) for each sample was determined by measuring the distance between the caudal peduncle, or the point where the tail and tail fin meet, and the tip of the snout. Additionally, the distance between the longest fin ray and the tip of the snout was used to calculate the total length (TL).

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Morphometric and Meristic Analysis

The relationship between length and weight was modeled using W=aLb$W=aLb$, linearized as log⁡10W=log⁡10a+blog⁡10L$\log_{10}W=\log_{10}a+b\log_{10}L$. Condition factor (K) was computed as K=100W/L3$K=100W/L3$.

Physicochemical Analysis of Owalla Reservoir

The water samples collected were transported immediately to the laboratory for evaluation of their physicochemical properties for temperature, pH, dissolved oxygen, conductivity, colour, biochemical oxygen demand, chemical oxygen demand, total suspended solids, sulphates and nitrates.

RESULTS

Table 1: Hepsetus odoe fish samples in Owalla River

Fish Samples	Date collected	Total length	Weight	Ovary length
H_1	3/7/24	14.0	100	20.17
H_2	1707/24	18.2	118	22.15
H_3	31/07/24	17.5	200	32.10
H_4	14/08/24	41.3	250	36.11
H_5	28/08.24	40.0	350	37.40
H_6	11/09/24	39.3	365	35.00
H_7	25/09/24	43.2	475	45.77
H_8	09/10/24	45.0	500	60.32
H_9	23/10/24	45.5	480	55.17

Table 2: *Oreochromis niloticus* fish samples in Owalla River

Fish Samples	Date collected	Total length	Weight	Ovary length
O_1	3/7/24	2.5	17.9	10.12
O_2	1707/24	3.2	18.6	14.10
O_3	31/07/24	10.7	13.5	22.11
O_4	14/08/24	15.6	17.8	24.01
O_5	28/08.24	12.9	15.3	28.20
O_6	11/09/24	35.7	29.8	29.41
O_7	25/09/24	38.0	35.1	31.14
O_8	09/10/24	41.0	41.0	35.12
O_9	23/10/24	40.3	38.0	41.03

Table 3: Growth and Condition Analysis of *Hepsetus odoe* in Owalla River

Age group (years)	Length class (cm)	Frequency	Mean weight	Sex (M/F)

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		(n)	(g)	
0+	6.0- 7.9	12	7.87	Mostly juvenile
1+	8.5-12.23	19	14.55	Rapid growth stage
2+	11.0-13.93	17	29.60	Near maturity
3+	15.2-16.82	10	52.54	Mature adults
4+	17.0-19.73	6	89.4	Spawning stock
5+	21.2-25.40	4	103	Mostly female Old stock

Table 4: Growth and Condition Analysis of *Oreochromis niloticus* in Owalla River

Age group(years)	Length class(cm)	Frequency (n)	Mean weight (g)	Sex (M/F)
0+	4.0-5.7	18	5.20	Early juveniles
1+	7.0-8.0	25	15.55	Fast growth stage
2+	11.0-11.03	27	39.60	Near maturity
3+	12.2-15.82	18	77.54	Mostly male (mature adults)
4+	16.0-19.73	12	95.7	Mostly female (mature adults/ breeders)
5+	18.5-20.00	6	103	Mostly female Old stock

Table 5: Mean variation of the physicochemical parameters in Owalla river.

Temp(^{o}C)	24.00±0.20a	27.67±0.11a
Ph	6.57±0.18b	7.10±0.08b
EC (Scm^{-1})	I10±1.25a	180±1.60a
DO(mg/l)	5.10±1.26a	7.32±0.21b
Hardness(mg/l)	191.00±4.53a	236.33±21.85a
Alkalinity(mg/l)	40.00±3.02a	67±2.53b
Turbidity Biochemical oxygen Demand	11.05±0.20b 2.0±0.10b	24.51±0.10a 3.1±0.11a

Both species exhibited positive allometric growth ($b > 3$). Correlation coefficients were $r^2 = 0.96$ for *O. niloticus* and $r^2 = 0.91$ for *H. odoe*. Condition factors increased with age, peaking in mature adults ($K \approx 2.1$). Significant differences were observed ($p < 0.05$) in meristic features. *O. niloticus*: 31–33 lateral line scales, 12–14 dorsal fin rays, 10–11 anal fin rays and *H. odoe*: 48–50 lateral line scales, 9–11 dorsal fin rays, 8–10 anal fin rays.

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The present study describes the length-weight relationships (LWRs), length-length relationships (LLRs), size at first sexual maturity, spawning season, sex ratio and fecundity of the fish samples (Hamilton, 1822). Sampling was done using traditional fishing gear (cast net). Total length (TL) and standard length (SL) were measured with digital slide calipers. Individual body weight (BW) and gonad weight (GW) were determined to an accuracy of 0.01 g for all specimens. The gonadosomatic index (GSI) was calculated and size at first maturity for males and females estimated using GSI and TL as indicators. Female ≥ size at first maturity was used to determine fecundity.

Physicochemical parameters were within optimal limits: temperature (24–27.6 °C), pH (6.6–7.1), and DO (5.1–7.3 mg/L), indicating a suitable habitat for both species.

DISCUSSION

Fish species exhibited strong morphometric correlations and positive allometry, suggesting adequate food and stable environmental conditions (Sreekanth et al., 2021). Higher *b* values in *O. niloticus* reflect efficient energy conversion typical of tilapia species under favorable growth conditions (Kefi et al., 2023).

The increasing condition factor across age classes indicates healthy growth and reproductive fitness (Fagbuaro et al., 2021). Meristic divergence confirms taxonomic distinctness and ecological niche differentiation, consistent with González et al. (2016) and Hussain et al. (2023).

Stable water quality parameters reinforce the ecological balance and aquaculture potential of the Owalla Reservoir (Adesina et al., 2021; FAO, 2022).

CONCLUSION AND RECOMMENDATIONS

Both *O. niloticus* and *H. odoe* exhibited positive allometric growth, stable condition factors, and favorable adaptation to Owalla Reservoir conditions. Their coexistence indicates ecological complementarity *O. niloticus* thriving in shallow zones and *H. odoe* dominating open waters.

Recommendations

1. Implement routine morphometric and water quality monitoring.
2. Promote *O. niloticus–H. odoe* co-culture systems to optimize ecosystem productivity.
3. Train local fishers on sustainable harvesting and conservation.
4. Control agricultural runoff and domestic effluents to maintain water quality.
5. Support further research using molecular and isotopic tools for stock differentiation.

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