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ORIGINAL RESEARCH

INTRA-SPECIFIC VARIATION IN SILVER CATFISH (*Chrysichthys nigrodigitatus*) ACROSS DIFFERENT LOCATIONS IN SOUTH-WESTERN NIGERIA

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Abstract:

Introduction: Fish have recently proved their ability to quickly adapt to newly invaded habitats. The *Chrysichthys nigrodigitatus,* Silver Catfish is a highly valued commercial fish in Nigeria and other West African countries due to its high nutritional content and market demand. Intra specific variations in the silver catfish are critical for understanding the population dynamics. The study was designed to evaluate phenotypic differences and growth patterns in the Silver Catfish, across Southwestern Nigeria.

Aims: To correlate meristic and morphometric measurement, determine homogeneity and heterogeneity of the specie, and evaluate phenotypic differences amongst the groups.

Materials and Methods: One hundred and forty-five samples of *C. nigrodigitatus* were collected from artisanal fishermen at four locations namely the Epe and Ojo Lagoon, Badagry Creek, and the Abeokuta River. Morphological attributes were evaluated using sixteen morphometric measurements, and statistical analyses such as descriptive statistics, one-way ANOVA, and correlation analysis were performed

Results: Morphometric variations were observed in body length, head width and other variables with mean value of parameters ranging from 0.67±0.26 in Head Depth at Epe to 23.164±3.57 in Total Length at Abeokuta. Samples from Abeokuta, Ojo, and Epe exhibited negative allometric growth (b <3), while Badagry showed positive allometric growth(b>3).

Conclusion: This study highlights the importance of understanding intraspecific variations in *C. nigrodigitatus* and their ability to adapt to different environments. Highlighting the benefits of phenotypic study in order to assess species population and conserve genetic trait. Variations between populations observed could be as a result of exposure to environmental constraints.

To Keywords: Silver Catfish, *Chrysicthys nigrodigitatus,* IntraSpecific variations, South Western Nigeria

All co-authors agreed to have their names listed as authors.

1. INTRODUCTION

In phylogenetics, it is critical to analyse differences in stock variability and morphometrics, with one of the most prevalent methods being morphometric and meristic characterization of particular parts of their body form [1]. These differences are either as a result of genetic differences or environmental factors that include but are not limited to temperature, salinity, radiation, dissolved oxygen, water depth and current flow [2].

Poor understanding of fish and fishery management can lead to dramatic changes in the biological attributes and productivity of a species [3]. Studies of morphologic variation between populations continue to have an important role to play in stock identification while stable differences in shape between groups of fish may reveal different growth, mortality or reproductive rates that are relevant for the definition of stocks [4].

The silver catfish, *Chrysichthys nigrodigitatus*, also known as Obokun in Yoruba, is a major African commercial fish with a high economic value, highly prized, and common in Nigeria's inland waters, it is widely consumed as food in Nigeria and other West African countries such as Senegal, Gambia, Ivory Coast, Liberia, Zaria, and Gabon due to its high market demand and value, as well as its high nutritional content [5, 6, 7].
The Silver Catfish is a benthic omnivorous feeder because of its ability to use just any food material present in its environment, with significant ontogenetic shifts in diet composition subsisting and feeding on a variety of benthic food items (seeds, insects, bivalves and detritus), and specializes on its feeding habits with age and size [8].
In their study on populations of the Silver Catfish in Badagry Creek (Nigeria) [9] demonstrated that they had the highest relative abundance with 15.7%, [10, 12] study found that *C. nigrodigitatus* was the most abundant fish species in Cross River wetlands and asserted for 12.8% and 4.3% of the overall catch in the wet and dry seasons, respectively [12, 13].
With strong correlation between the Silver Catfish and their abundance in the wet seasons, it is therefore, necessary to understand their adaptive strategy and differences in growth patterns. Hence, the objective of this study is to identify phenotypic differences and growth patterns in *C. nigrodigitatus* across SouthWestern Nigeria, by comparing morphometric characters present.

2. MATERIAL AND METHODS

2.1 SAMPLE LOCATION

The samples were collected from Epe and Ojo Lagoon, Badagry creek, and the Abeokuta River with latitudes 8°41'0'N and longitudes 3°28'0'E, latitude 6°55'60"N and longitude 3°24'0"E, latitude 6.411566°N and longitude 2.882037°E, and, latitude 7.145244, longitutde 3.327695 respectively. The prevailing climate is usually the rainfall thus favouring a thriving fishery and aqua cultural activities. Fishing activities are mainly carried out by local artisanal fishermen who lived around the riverine environment. These water bodies contain several species of fish which are of economic value to the people as source of income and food.

2.2 SAMPLE COLLECTION PROCEDURE

One hundred and forty-five specimens of *C. nigrodigitatus* were collected from artisanal fishermen from landing sites at the brink of the river from November 2022 to April 2023. Forty (40) each were collected from Epe, Badagry, and Ojo populations, while 25 were gotten from the Abeokuta River. Fish samples were collected with caution to prevent damage to body parts, stored and iced for preservation at the Postgraduate laboratory of the Department of Zoology and Environmental Biology, Lagos State University.

2.3 DATA COLLECTION FOR DETERMINATION OF MORPHOLOGICAL VALUES

Fishes were defrosted first before measurement at room temperature (25 °C). Sixteen morphometric characters were identified from 145 fish samples across study locations with measurements taken using a vernier caliper, and with the aid of an electronic balance of 0.1g precision for weight values. The measured morphometric characters were Total length (TL), Standard length (SL), Body depth (BD), Head depth (HD), Head length (HL), Eye diameter (ED), Pre-dorsal distance (PDD), Dorsal fin length (DFL), Pre-pectoral distance (PPD), Pectoral fin length (PFL), Pre-anal distance (PAD), Anal fin length (AFL), Caudal peduncle distance (CPD), Head width (HW), Inter-orbital distance (IOD), and Snout length (SNL).

2.4 STATISTICAL ANALYSIS

Univariate statistics such as minimum, maximum, mean, mode and standard deviation was used to describe morphological trait. Pearson correlation was used to reveal strength of association between phenotype using MS Excel version 2021.

3. RESULTS AND DISCUSSION

3.1 MORPHOMETRIC STUDIES

Descriptive statistics on phenotypic values and coefficient of variation in morphometric characteristics of the studied *C. nigrodigitatus* populations are presented in Table 1. The mean value of morphometric parameters ranged from 0.67±0.26 in HD at Epe to 23.164±3.57 in TL at Abeokuta. The Total Length had a mean value of 17.59±4.26533 at Badagry, for Ojo the mean was 22.43±3.19048, Epe had a Total length mean of 14.65±4.234849 while Abeokuta had a Total length mean of 23.16±3.5701. Coefficient of variability of the population varied from 9.032% in IOD to 77.6801% in HL. A total of 81.3% of morphometric attributes were heterogeneous (CV >10%).

Table 1 Morphological parameters and its values using univariate analysis of the studied population (N=145)

Variable(cm)	*Statistics*	*BADAGRY*		*OJO*		*ABEOKUTA*		*EPE*	
	Mean± SD	*17.593*	*4.265*	*22.429*	*3.191*	*23.164*	*3.570*	*14.65*	*4.235*
TL	*CV %*	*24.245*		*14.225*		*15.412*		*28.907*	
	Min-Max	*9.8*	*23.4*	*17.5*	*29.5*	*17*	*31.5*	*8*	*22*
	Mean± SD	*13.408*	*3.529*	*16.893*	*2.310*	*17.792*	*2.724*	*11.008*	*3.405*
SL	*CV%*	*26.32*		*13.672*		*15.308*		*30.930*	
	Min-Max	*6.6*	*19.4*	*12.5*	*22.5*	*12.5*	*24.2*	*5.5*	*16*
	Mean± SD	*2.903*	*0.652*	*2.755*	*0.637909*	*3.672*	*0.676*	*1.543*	*0.519*
BD	*CV%*	*22.457*		*23.157*		*18.396*		*33.635*	
	Min-Max	*2*	*4*	*1.5*	*4*	*2.3*	*5.5*	*0.4*	*2.7*

	Mean± SD	*2.01*	*0.434*	*4.517*	*0.929179*	*2.7*	*0.561*	*0.67*	*0.260*
HD	*CV%*	*21.607*		*20.572*		*20.760*		*38.862*	
	Min-Max	*1.2*	*3.4*	*2*	*6.3*	*2*	*4*	*0.3*	*1.4*
	Mean± SD	*4.033*	*0.949*	*1.055*	*0.820*	*5.172*	*0.982*	*2.153*	*0.531*
HL	*CV%*	*23.529*		*77.680*		*18.981*		*24.673*	
	Min-Max	*1.5*	*5.3*	*0.4*	*4.3*	*3.5*	*7.5*	*0.3*	*1.4*
	Mean± SD	*1.015*	*0.238*	*3.086*	*0.847*	*0.936*	*0.293*	*2.153*	*0.532*
ED	*CV%*	*23.458*		*27.439*		*31.282*		*24.673*	
	Min-Max	*0.5*	*1.4*	*1*	*4.5*	*0.5*	*1.5*	*1.5*	*3.5*
	Mean± SD	*5.96*	*0.580*	*6.445*	*0.986*	*7.048*	*1.269*	*4.763*	*0.555*
PDD	*CV%*	*9.730*		*15.291*		*18.008*		*11.644*	
	Min-Max	*4.6*	*7.3*	*4*	*8.5*	*4.7*	*10.4*	*3.6*	*6*
	Mean± SD	*5.065*	*0.679*	*5.802*	*1.019*	*5.48*	*0.924*	*2.823*	*1.033*
DFL	*CV%*	*13.41*		*17.565*		*16.865*		*36.587*	
	Min-Max	*3.7*	*6.5*	*3.1*	*8*	*4.2*	*7.7*	*1.1*	*5*
	Mean± SD	*3.795*	*0.344*	*3.788*	*0.718*	*4.168*	*0.981*	*3.04*	*0.418*
PPD	*CV%*	*9.068*		*18.958*		*23.535*		*13.732*	
	Min-Max	*3*	*4.3*	*2*	*5*	*2.5*	*6.5*	*2*	*4.1*
	Mean± SD	*3.045*	*0.398*	*3.152*	*0.637*	*3.28*	*0.891*	*1.793*	*0.518*
PFL	*CV%*	*13.072*		*20.212*		*27.155*		*28.875*	
	Min-Max	*2.1*	*3.9*	*1.8*	*4.7*	*2*	*5.3*	*1*	*3*
	Mean± SD	*9.043*	*1.083*	*9.4*	*1.931*	*12.112*	*1.831*	*9.43*	*1.245*
PAD	*CV%*	*11.974*		*20.542*		*15.114*		*13.197*	
	Min-Max	*7*	*11.2*	*7.5*	*15*	*9*	*16*	*5.5*	*12*
	Mean± SD	*2.798*	*0.343*	*3.217*	*0.606*	*3.32*	*0.58*	*1.64*	*0.508*
AFL	*CV%*	*12.263*		*18.845*		*17.477*		*30.993*	
	Min-Max	*2*	*3.4*	*1.8*	*4.3*	*2.5*	*4.7*	*0.8*	*2.6*

	Mean± SD	*3.288*	*0.597*	*2.61*	*0.722*	*3.804*	*1.181*	*1.47*	*0.43*
CPD	*CV%*	*18.162*		*27.657*		*31.035*		*29.278*	
	Min-Max	*2*	*5*	*1*	*3.7*	*2.5*	*7*	*0.5*	*2.5*
	Mean± SD	*2.395*	*0.344*	*2.648*	*0.527*	*2.672*	*0.662*	*2.473*	*0.822*
HW	*CV%*	*14.369*		*19.92*		*24.79*		*33.238*	
	Min-Max	*1.8*	*3*	*1.5*	*4.5*	*1.5*	*4.5*	*1.2*	*4.4*
	Mean± SD	*4.058*	*0.367*	*4.083*	*0.47*	*3.96*	*0.481*	*3.345*	*0.38*
IOD	*CV%*	*9.032*		*11.498*		*12.133*		*11.348*	
	Min-Max	*3.5*	*5.2*	*3.3*	*5.7*	*3*	*5*	*2.8*	*4.1*
	Mean± SD	*2.965*	*0.510*	*3.321*	*1.239*	*2.352*	*0.695*	*2.348*	*0.752*
SNL	*CV%*	*17.19*		*37.301*		*29.536*		*32.038*	
	Min-Max	*1.9*	*4*	*1.8*	*6.4*	*1.8*	*5*	*1.1*	*4.5*

** Total length=TL, Standard length=SL, Body depth=BD, Head depth=HD, Head length=HL, Eye diameter=ED, Pre-dorsal distance=PDD, Dorsal fin length=DFL, Pre-pectoral distance=PPD, Pectoralfin length=PFL, Pre-anal distance=PAD, Anal fin length=AFL, Caudal peduncle distance=CPD, Head width=HW, Inter-orbital distance=IOD, and Snout length=SNL.*

3.2 Length-Weight Relationship of *Chrysichthys nigrodigitatus* from Abeokuta, Badagry, Epe, and Ojo Lagoons

The length-weight relationships of *Chrysichthys nigrodigitatus* from the studied locations revealed that Abeokuta, Ojo, and Epe exhibited negative allometric growth (b <3), while Badagry showed positive allometric growth as shown in **Figures 1, 2, 3, and 4.**

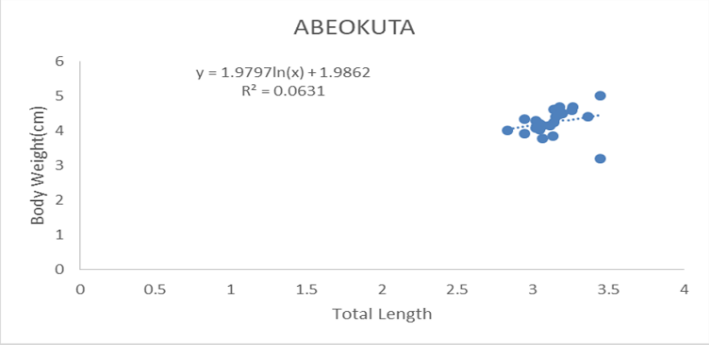

Fig 1: Natural Log of Length-Weight Relationship in *Chrysichthys nigrodigitatus* from Abeokuta

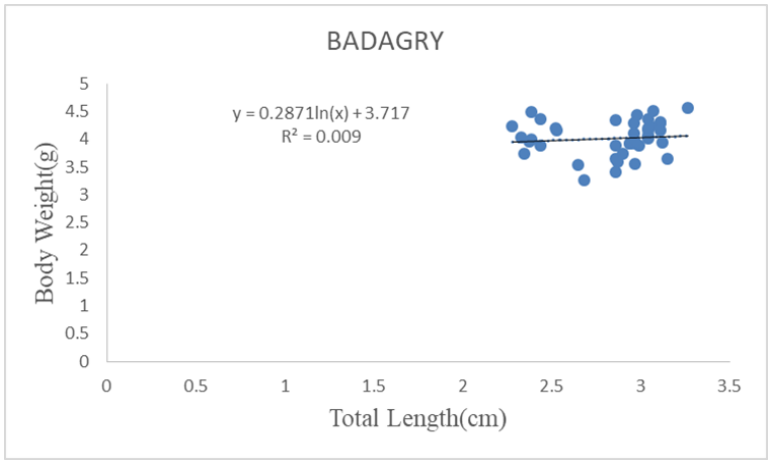

Fig 2: Natural Log of Length-Weight Relationship in *Chrysichthys nigrodigitatus* from Badagry Lagoon

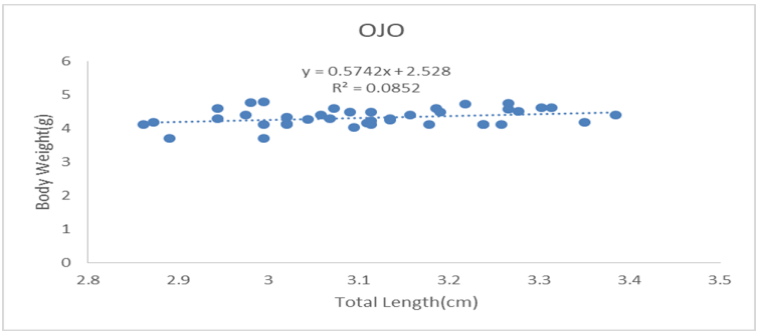

Fig 3: Natural Log of Length-Weight Relationship in *Chrysichthys nigrodigitatus* from Ojo River

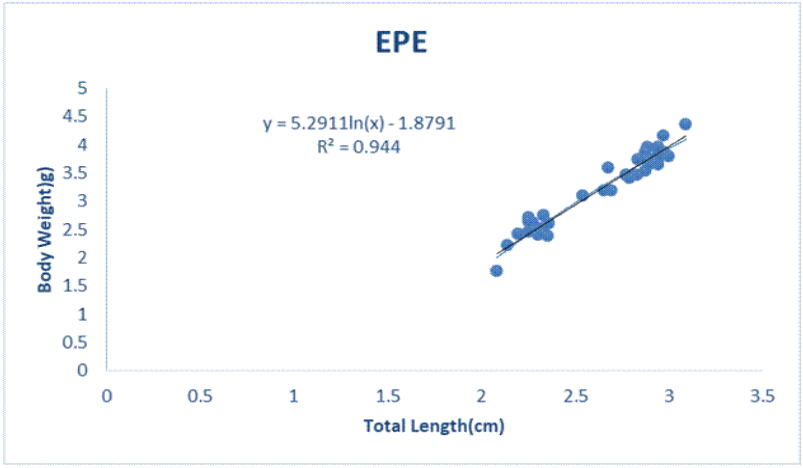

Fig 4: Natural Log of Length-Weight Relationship in *Chrysichthys nigrodigitatus* from Abeokuta

The correlation coefficient of morphological variables of *C. nigrodigitatus* from Epe, and Ojo lagoons are revealed in fig 5&6. All correlated characters in Ojo revealed a positive association except in BD to HD,

while correlations within the Epe sampled fish showed negative associations in few of its variables such as DFL to HD and DFL to PDD.

	TL	SL	HD	HL	ED	BD	PDD	DFL
TL	1							
SL	0.983464	1						
HD	0.048373	0.070799	1					
HL	0.618267	0.650487	0.510711	1				
ED	0.512289	0.530159	0.52217	0.537719	1			
BD	0.812942	0.828798	0.143381	0.557185	0.419626	1		
PDD	0.086746	0.07634	0.323839	0.529315	-0.01332	0.188817	1	
DFL	0.274722	0.217136	-0.27127	-0.2643	-0.34168	0.27317	-0.12207	1

Fig 5: Correlation plot of phenotypic variables measured for Epe sampled fish

	TL	SL	HD	HL	ED	BD	PDD	DFL
TL	1							
SL	0.309495	1						
HD	0.577238	0.414055	1					
HL	0.43385	0.356595	0.330145	1				
ED	0.363341	0.411501	0.521275	0.299877	1			
BD	0.256632	0.043289	-0.03407	0.584758	-0.31288	1		
PDD	0.640881	0.411798	0.366558	0.752117	0.235661	0.681523	1	
DFL	0.406283	0.293548	0.320639	0.586479	0.152556	0.503872	0.711926	1

Fig 5: Correlation plot of phenotypic variables measured for Ojo sampled fish

DISCUSSION

Morphometric characters present in the silver catfish were evaluated to identify phenotypic differences present. The total length had a mean value of 17.59±4.26533 at Badagry, for Ojo the mean was 22.43±3.19048, Epe had a total length mean of 14.65±4.234849 while Abeokuta had a total length mean of 23.16±3.5701. Whenu et al. [15] also reported a similar mean value of (TL) of *C. nigrodigitatus* at Epe Lagoon. The length-weight relationships of *C. nigrodigitatus* from Epe, Ojo, and Abeokuta Lagoon reveal a negative allometric growth while Badagry populations showed a positive allometric growth. This implies that the fishes become fatter as they increase in weight (riedel *et al.,* 2007).

This result agrees with the study of Emmanuel and Momodu [14] also reported that *C. nigrodigitatus* exhibited a negative allometric growth pattern. Whenu et al. [15] reported that *C. nigrodigitatus* in Epe Lagoon exhibited a negative allometric growth. Ouattara et al. [16] study on *C. nigrodigitatus* showed a good level of intra-population variation, but added that genetic assessment was required to corroborate the results. M'bari *et al.* [17] study on *C. nigrodigitatus* population in cote d' ivoire revealed intra-

populational phenotypic plasticity as the result of an interaction between environmental and genetic factors.

Pearson correlation matrix revealed significant association between morphological characters with total length and standard length having strong positive correlation (>/=1). This implies that they are directly proportional in terms of growth and changes in either of these characters could imply a significant impact on the other.

4. CONCLUSION

This study showed connections between morphological variables, including trends in length and weight, and emphasized the relevance of phenotypic research in assessing species populations and maintaining genetic traits.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

AUTHORS' CONTRIBUTIONS

Mautin Hunkanrin, Abdulazeez Giwa and Sobola Sokefun designed the study, Abiodun Adams performed the statistical analysis, Oluwatosin Adebola wrote the protocol, and Peter Ojo wrote the first draft of the manuscript. Mautin Hunkanrin and Abiodun Adams managed the analyses of the study. Oluwatosin Adebola managed the literature searches and performed most of the experiment. All authors read and approved the final manuscript.

ETHICAL APPROVAL

All authors hereby declare that "Principles of laboratory animal care" (NIH publication No. 85-23, revised 1985) were followed, as well as specific national laws where applicable. All experiments have been examined and approved by the appropriate ethics committee

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