

Morphological variations of *Tilapia guineensis* (Bleeker 1862) and *Sarotherodon melanotheron* (Ruppell 1852) (Pisces: Cichlidae) from Badagry and Lagos lagoon, South-West, Nigeria

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Abstract

Sarotherodon melanotheron (Ruppell) and *Tilapia guineensis* (Bleeker) are two dominant cichlids in Badagry and Lagos Lagoon, South-western Nigeria. Comparative racial studies were investigated among these species using multivariate analysis of nine morphometric characters and nine meristic counts of 100 specimens each. The results showed that they were phenotypically separable populations of the same species with some level of divergence in morphometric characters. The data were analysed using independent sample t-test after allometric test revealed significant differences ($p < 0.05$) in body depth, caudal peduncle depth, and number of gill rakers in *Sarotherodon melanotheron* while vertebrae, caudal peduncle depth and right gill raker in *Tilapia guineensis* which were suggested to have occurred as a result of environmental fluctuations, genetic diversity and difference in salinity in the two water bodies.

Keywords: Morphometric; Meristic; *Sarotherodon melanotheron*; *Tilapia guineensis*

Introduction

Tilapia guineensis (Bleeker, 1862) and *Sarotherodon melanotheron* (Ruppell, 1852) are typical estuarine species which can be found in abundance in most of the lagoons and estuaries of West Africa, supports a major lagoon fishery. They can live and reproduce in a wide range of salinities. They have adapted to diverse habitats: permanent and temporary rivers, large equatorial lakes, tropical and subtropical rivers, open and closed estuaries, lagoons, swampy lakes, deep lakes and coastal brackish lakes [1]. For instance, the brackish *Sarotherodon melanotheron* and *Tilapia guineensis* were the last species recorded during droughts in the very saline waters of the Casamance River [2]. They are however not found at high elevations and generally require water warmer than 20°C [3].

Fagade [4] reported the relative abundance of *Tilapia guineensis* and *Tilapia mariae* in Lekki Lagoon. Kuton and Kusemiju, [5] studied their species diversity and richness of these species and others in the Badagry, Lagos and Lekki Lagoons. They are euryhaline species found along the West Coast of Africa [6]. These fishes have a great economic importance, ranking among the major species caught within the lagoon fisheries and there is an increasing interest in this fish for aquaculture purposes, particularly in areas of high or variable salinities, characteristic of the estuaries and extensive lagoon systems which constitute its natural range. In this habitat, other species more traditionally used in 'tilapia' culture are either not locally available (*Oreochromis mosambicus*) or do not tolerate the prevailing saline conditions (*O. niloticus*). *T. guineensis* shares much the same range and habitat as *Sarotherodon melanotheron*, but neither species is well known for aquaculture purposes.

Analysis of phenotypic variation in morphometric characters or meristic counts remains the most commonly used method to delineate stocks of fish despite the advent of techniques which directly examines biochemical or molecular genetic variation, these conventional methods continues to have an important role in stock identification even to date [7]. It remains the simplest and most direct method of species identification as confirmed in the previous studies [8,9].

Hence, the objective of this study is to Assessing the morphological variations that occur in *Tilapia guineensis* (Bleeker, 1862) and *Sarotherodon melanotheron* (Ruppell, 1852) in Badagry and Lagos lagoon in Lagos States, Southwest, Nigeria using morphometric and meristic features in view of possible ecological changes and to estimating the level of divergence in this species among the two lagoons.

Materials and Methods

Study areas

The study sites were Badagry and the Lagos lagoon, all along the coast of Nigeria. The Badagry Lagoon lies between longitudes 3°0' and 3°45' E and between latitudes 6°25' and 6°30' N. It is part of a continuous system of lagoons and creeks along the coast of Nigeria from the border with the Republic of Benin to the Niger delta.

Lagos lagoon, on the other hand, lies between longitude 3° 23' and 3° 43' E and between latitude 6° 22' and 6° 38' N. It also forms part of an intricate system of waterways made up of lagoons and creeks that are found along the coast of Nigeria from the Republic of Benin border to the Niger Delta. The substratum was fine sand and mixed mud. Some of the physico-chemical features have been described by some authors [10-13] provided information on its sediments and communities.

Collection of specimens

A total of 200 samples of *Sarotherodon melanotheron* and *Tilapia guineensis* ranging between 12 cm and 15 cm standard length were collected from both sites within intervals of 4 weeks for three months, to ensure that samples were obtained as close to same period of the year as possible. The size ranges of fish used were likely to be of approximately the same age. The specimens were transported in ice chest to the laboratory, where measurements started immediately to avoid shrinkage.

Identification of these species of cichlid was done using Daget [14]; the confirmation of the identified species was carried out based on their colour in life and meristic characters.

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Laboratory analysis

Each specimen were given a serial identification number after drained off using filter papers. The morphometric features analysed are Standard Length (SL), Head Length (HL), Head Depth (HD), Body Depth (BD), Snout Length (Snl), Eye Diameter (ED), Caudal Peduncle Length (CPL), Caudal Peduncle Depth (CPD) and Head To Dorsal Fin Origin (HDO). All measurements were taken with a dial calipers and determined to the nearest centimeter on a measuring board. Measurements of body parts were made with the head of fish pointing left.

The meristic characters are Dorsal Fin Rays (DR), Pectoral Fin Rays (PR), Ventral Fin Rays (VR), Anal Fin Rays (AR), Branchiostergal Rays (BrR), Right And Left Gill Rakers, and Vertebrae. All the fin rays were counted with head of fish pointing left.

Analysis of the morphometric features and meristic counts was based on independent sample T-test.

Results

A total of 200 specimens of *S. melanotheron*, and *T. guineensis* made up of 50 each from the two study sites, were examined and analyzed. The statistical analysis of the morphometric features, as shown in Table 1, indicates that there were significant differences ($p < 0.05$) in the Body Depth (BD), Caudal Peduncle Depth (CPD) and number of Gill Rakers in *Sarotherodon melanotheron* while in vertebrae, as shown in Table 3, Caudal Peduncle Depth and Right Gill Raker in *Tilapia guineensis*, other features – SL, HL, HD, Snl, ED, CPL and HDO – showed that the fish were, in all probability, obtained from two statistically indistinguishable races or stocks. The mean values of meristic characters from Badagry and Lagos lagoon of two populations were shown in Tables 2 and 4. The fin rays including brachiostergal rays were fairly constant which required no further statistical analysis but other characters such as Vertebrae and Gill Raker counts revealed significant differences ($p < 0.05$) between the two populations.

Morphometric measurements	Lagos Lagoon Range (cm)	Mean Value	Badagry Lagoon Range(cm)	Mean Value (cm)	T-Value
Standard length (SL)	12.3-13.5	12.98 ± 0.443	12.5-13.5	12.94 ± 0.422	0.653
Head Length (HL)	4.5-5.3	4.90 ± 0.031	4.5-5.0	4.96 ± 0.172	0.320
Head Depth (HD)	1.9-2.3	2.06 ± 0.018	1.9-2.3	2.09 ± 0.022	0.901
Body Depth (BD)	1.7-2.5	2.10 ± 0.027	1.9-3.0	2.16 ± 0.045	9.022*
Snout length (Snl)	0.9-1.2	1.02 ± 0.011	0.9-1.2	1.01 ± 0.012	0.621
Eye Diameter (ED)	1.0-1.4	1.26 ± 0.015	1.0-1.4	1.22 ± 0.016	1.652
Caudal Penduncle Length (CPL)	2.5-2.7	2.59 ± 0.011	2.4-2.7	2.57 ± 0.011	0.773
Caudal Penduncle Depth (CPD)	1.5-1.8	1.64 ± 0.016	1.6-2.2	1.95 ± 0.030	9.364*
Head-Dorsal fin Origin (HDO)	5.0-6.1	5.52 ± 0.055	4.9-6.0	5.40 ± 0.053	1.627

Standard error indicated with mean values.

*Effect was significant at 5% level of significance while tabulated value is 1.96 in t-test

Table 1: Mean values and T-value on morphometric measurements of *S. melanotheron* from Badagry and Lagos lagoon.

Meristic measurements	Lagos Lagoon Range (cm)	Mean Value	Badagry Lagoon Range (cm)	Mean Value (cm)	T-Value
Branchiostergal Rays (BrR)	4	4	4	4	
Dorsal soft fin Ray (DSfR)	10	10	10	10	
Vertebrae (Vtr)	26-27	26.20 ± 0.571	26-27	26.20 ± 0.571	
Ventral fin ray (VR)	6	6	6	6	
Anal fin Ray (AR)	12-13	12.14 ± 0.050	12	12.10 ± 0.043	0.610
Dorsal Spine fin Ray (DSR)	15-16	15.94 ±	16	16.0	1.77
Right gill raker(Rgr)	19-22	19.87 ± 0.134	18-19	18.10 ± 0.043	12.506*
Left Gill Raker (LGR)	19-22	19.86 ± 0.134	18-19	18.10 ± 0.043	12.506*
Pectoral fin ray (PR)	11-12	11.14 ± 0.050	11-12	11.16 ± 0.052	0.277

Standard error indicated with mean values.

*Effect was significant at 5% level of significance while tabulated value is 1.96 in t-test

Table 2: Meristic counts of *S. melanotheron* from Badagry and the Lagos lagoon.

Morphometric measurements	LagosLagoon Range(cm)	Mean Value	Badagry Lagoon Range(cm)	Mean Value	T-Value
Standard length (SL)	13-15	13.61 ± 0.080	13-15	13.68 ± 0.080	0.602
Head Length (HL)	4.2-4.5	4.28 ± 0.012	4.2-4.5	4.29 ± 0.012	0.823
Head Depth (HD)	1.9-2.2	2.07 ± 0.010	2.0-2.2	2.06 ± 0.011	0.277
Body Depth (BD)	2.6-3.0	2.79 ± 0.017	2.6-3.0	2.79 ± 0.033	0.106
Snout length (Snl)	1.2-1.5	1.31 ± 0.010	1.2-1.5	1.31 ± 0.010	0.143
Eye Diameter (ED)	1.2-1.3	1.24 ± 0.007	1.2-1.3	1.25 ± 0.007	0.995
Caudal Penduncle Length (CPL)	2.1-2.4	2.26 ± 0.010	2.1-2.4	2.27 ± 0.010	0.701
Caudal Penduncle Depth (CPD)	2.0-2.3	2.11 ± 0.013	1.7-2.1	1.86 ± 0.018	11.243*
Head-Dorsal fin Origin (HDO)	4.3-4.5	4.36 ± 0.010	4.3-4.5	4.37 ± 0.010	1.163

Standard error indicated with mean values.

*Effect was significant at 5% level of significance while tabulated value is 1.96 in t-test

Table 3: Mean values and T-value on morphometric measurements of *T. guineensis* from Badagry and Lagos lagoon.

Meristic measurements	Lagos Lagoon Range(cm)	Mean Value	Badagry Lagoon Range(cm)	Mean Value	T-Value
Branchiostergal Rays (BrR)	4	4	4	4	
Dorsal soft fin Ray (DSfR)	11	11	11	11	
Vertebrae (Vtr)	27-28	227.2 ± 0.057	27	27 ± 0.00	3.50*
Ventral fin ray (VR)	6	6	6	6	
Anal fin ray (AR)	11	11	11	11	
Dorsal Spine fin Ray (DSR)	16	16	16	16	
Right gill raker(Rgr)	12-13	12.40 ± 0.070	12-13	12.08 ± 0.040	4.00*
Left Gill Raker (LGR)	12	12	12	12	
Pectoral fin ray (PR)	12	12	12	12	

Standard error indicated with mean values.

*Effect was significant at 5% level of significance while tabulated value is 1.96 in t-test

Table 4: Meristic counts of *T. guineensis* from Badagry and the Lagos lagoon.

Discussion

In this study, meristics, morphometric, biochemical and molecular features were used as they still remain dependable tools to characterize fish species. The fairly constant values of fin rays observed in the two populations agree with the findings [15] that fin rays of the tribe *Tilapiini* does not vary much.

The significant variations in Body Depth (BD), Caudal Pundicle Depth (CPD), the number of Gill Rakers and Vertebrae (Vtr) might have occurred as a result of environmental fluctuations, especially water temperature and salinity. The water temperature of Lagos lagoon varied between 24.6 and 31.8°C while that of Badagry ranged from 28.0 to 31.5°C. Though, they are both brackish water bodies, salinity ranged between 0.5‰ and 15‰ as reported by Ajao and Fagade [13].

Also, Kusemiju [11] reported that the differences in Gill Raker counts of *Chrysichthys nigror5digitatus* might have occurred as a result of isolation caused by differences in salinity gradients between Lagos and Lekki lagoons in Nigeria. The natures of substratum, as well as variation in dietary items, have been observed to influence morphometric features of species populations [16]. Hence, the significant differences observed in the morphometrics may have occurred as a result of isolation caused by variation in these ecological factors in the two habitats just as genetic diversity cannot be rule out.

Conclusion

The potential shown by *Tilapia guineensis* and *Sarotherodon melanotheron* for aquaculture breeding programme, especially their ability to live and reproduce in a wide range of salinity, coupled with their abundance in these water bodies, should be exploited in the near future.

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