Morphometric and Meristic Variations in *Tilapia guineensis* (Bleeker 1862) and *Sarotherodon melanotheron* (Ruppell 1852) from Badagry and Lagos Lagoons in Nigeria

Minasu Pentho Kuton[1]* and Bashir T. Adeniyi[2]
[1]Department of Marine Sciences, University of Lagos, Akoka-Yaba, Lagos, Nigeria
[2]Institute of Food Security, Environmental Resources and Agricultural Research (IFSERAR)
Federal University of Agriculture, Abeokuta, Nigeria
**mpkuton@unilag.edu.ng*

Abstract
Sarotherodon melanotheron and *Tilapia guineensis* are two dominant cichlids in the Badagry and Lagos lagoons in South-western Nigeria. Comparative racial studies were carried out among these species using multivariate analysis of 9 morphometric characters and 9 meristic counts of 100 specimens for each species from each lagoon. The results showed that the 2 species from the 2 lagoons were phenotypically separable populations with some levels 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 counts in *Tilapia guineensis*, which could have occurred as a result of environmental fluctuations, genetic diversity and differences in salinity in the 2 water bodies.

Keywords: meristic, morphometric, *Saretherodon 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 and support a major lagoon fishery (Trewavas, 1983). 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. For instance, the brackish *S. melanotheron* and *T. guinensis* were the last species recorded during droughts in the very saline waters of the Casamance River (Leveque, 1997). They are, however, not found at high elevations and generally require water warmer than 20 ^{o}C (Fitzsimmons, 2000).

Fagade (1978) reported the relative abundance of *Tilapia guineensis* and *Tilapia mariae* in the Lekki lagoon whereas Kuton and Kusemiju (2010) studied their species diversity and the richness of these species and others in the Badagry, Lagos and Lekki lagoons. They are euryhaline species found along the West Coast of Africa (Philippart and Ruwet, 1982).

T. guineensis and *S. melanotheron* have great economic importance. They rank among the major species caught within the lagoon fisheries and there is an increasing interest in these fishes 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 (*Oreochromis niloticus*). *T. guineensis* is mostly found in the same range and habitat as *S. melanotheron* but they are yet to be fully exploited for aquaculture purposes.

The 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 examine biochemical or molecular genetic variation. These conventional methods continue to play an important role in stock identification (Swain and Foote, 1999). It remains the simplest and most direct method of species identification as confirmed by the previous studies of Mamuris *et al*. (1998) and Hockaday *et al*. (2000).

Hence, the objective of this study is to assess the morphological variations that occur in *T. guineensis* (Bleeker, 1862) and *S. melanotheron* (Ruppell, 1852) in the Badagry and Lagos lagoons in Lagos State, South-western Nigeria, using morphometric and meristic features; in view of possible ecological changes and to estimating the level of divergence in these species between the two lagoons.

Materials and Methods

Study Areas

The study sites were the Badagry and Lagos lagoons, both along the coast of Nigeria. The Badagry lagoon lies between longitudes 3° 0′–3° 45′ E and latitudes 6° 25′–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.

The Lagos lagoon, on the other hand, lies between longitude 3º 23´–3º 43´ E and latitude 6º 22´–6º 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 (Oyekanmi, 2000). Ajao and Fagade (1990) provided information on its sediments and communities.

Collection of Specimens

100 samples each of *S. melanotheron* and *T. guineensis* ranging between 12 cm and 15 cm were collected from both sites monthly for 3 months. The size ranges of fishes used were likely to be of approximately the same age. The specimens were transported in ice chests to the laboratory, where measurements of morphometric characters and other laboratory procedures commenced immediately to avoid shrinkage. The identification of these was based on mophormetric and their colour in life as described by Daget (1991)

Laboratory Analysis

Each specimen was given a serial identification number after water was drained off using filter papers.

The morphometric features analysed were 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 dial calipers and determined to the nearest 1.0 cm on a measuring board. The measurements were taken to the left side of the fish.

The meristic characters analysed included the count of 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. Analysis of the morphometric features and meristic counts were based on independent sample T-test.

Results

A total of 200 specimens of *S. melanotheron* and *T. guineensis*, made up of 100 samples from the two study sites, were examined and analysed. The statistical analysis of the morphometric features, as shown in Tables 1 and 2, indicated that there were significant differences ($P < 0.05$) in the body depth (BD), caudal peduncle depth (CPD) and number of gill rakers in *S. melanotheron* while vertebrae, caudal peduncle depth and right gill raker revealed significant differences ($P < 0.05$) in *T. guineensis.*

Other features (SL, HL, HD, Snl, ED, CPL and HDO) showed that the fishes were, in all probability, obtained from two statistically indistinguishable races or stocks. The mean values of meristic characters of the species from Badagry and Lagos lagoons are shown in Tables 2 and 4, respectively. 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.

Discussion

The fairly constant values of fin rays observed in the two populations agreed with the findings of Holden and Reed (1991) that fin rays of the tribe *Tilapiini* do not vary much. Swain and Foote (1999) also stated that the morphology of a fish is usually determined by the interaction between genetic and environmental factors.

The significant variations in body depth (BD), caudal peduncle depth (CPD), the number of gill rakers and vertebrae (Vtr) might have occurred as a result of environmental fluctuations, especially water salinity and temperature though they are both brackish water bodies, whose salinity ranged between 0.5% and 15% as reported by Ajao and Fagade (1990).

The water temperature of the Lagos lagoon varied between 24.6–31.8 ºC while that of Badagry ranged from 28.0–31.5 ºC. The morphometric and meristic characters that were identified to distinguish these populations could be as result of local adaptations of these species, which have long been recognised to create morphological variations (Turan, 1999). Pollar *et al*. (2007) observed phenotypic plasticity of fish, which allows them to respond adaptively to environmental changes by the modification of physiology and behaviour which led to changes in their morphology, reproduction and survival that mitigate the effect of environmental variations.

Table 1: Morphometric Measurements of *S. melanotheron* from Badagry and Lagos Lagoons

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 2: Morphometric Measurements of *T. guineensis* from Badagry and Lagos Lagoons

Morphometric Measurements	Lagos Lagoon 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 ± .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: Meristic Counts of *S. melanotheron* from the Badagry and Lagos Lagoons

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 ± 0.134	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 4: Meristic Counts of *T. guineensis* from Badagry and Lagos Lagoons

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

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