Genetic Diversity of *Tilapia guineensis* (Bleeker, 1862) in Some Nigerian Coastal Waters

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A thesis submitted for the award of Doctor of Philosophy (Ph.D.) in the

Department of Cell Biology and Genetics, University of Lagos.

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SCHOOL OF POSTGRADUATE STUDIES,

UNIVERSITY OF LAGOS,

CERTIFICATION

This is to certify that the thesis:

Genetic Diversity of *Tilapia guineensis* (Bleeker, 1862) in Some Nigerian Coastal Waters

Submitted to the School of Postgraduate Studies,
University of Lagos

for the award of the degree of

Doctor of Philosophy (Ph.D.) is a record of original research carried out

By:

UKENYE Esther Adaku

In the Department of Cell Biology & Genetics

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DECLARATION

I declare that the work in this thesis titled "Genetic diversity of *Tilapia guineensis* in some Nigerian coastal waters" was carried out by me **UKENYE ESTHER ADAKU,** under the supervision of Dr. I. A. Taiwo and Dr. P. E. Anyanwu of the Department of Cell Biology and Genetics, Faculty of Science, University of Lagos, Nigeria and Nigerian Institute for Oceanography and Marine Research, Victoria Island, Lagos. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at any other University.

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(Director of Research)	Signature	Date

DEDICATION

I dedicate this work to God Almighty, my parents, my lovely husband and all those who contributed to the accomplishment of my academic goal and professional career.

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Abstract

Tilapia guineensis, a typical estuarine cichlid species in the West Coast of Africa, is an important fish species in view of its immense contribution to the nutritional needs, economic growth, and development of many African nations including Nigeria. Knowledge of current level of diversity and genetic structure of *T. guineensis* populations in Nigeria is lacking. This knowledge will be useful for fishery management, aquaculture production, stock conservation, and fish improvement through selective breeding. In the present study, morphological and molecular techniques were used to characterize and investigate genetic diversity of this species for breeding and conservation purposes. Six hundred and twenty samples were collected from six coastal states namely Rivers, Delta, Lagos, Ondo, Akwa Ibom and Bayelsa in Nigeria. Two locations were selected per state to study intra and inter specific variations making a total of twelve locations. Three morphological methods (morphometric, meristic and truss network data) were used for determination of phenotypic variation while ten microsatellite markers were utilized for genetic diversity assessment. DNA was extracted and subjected to polymerase chain reaction (PCR) amplification and polyacrlamide gel electrophoresis (PAGE) for allelic separation and genetic differentiation. Physicochemical characteristics of sampling stations were determined to assess the environment of the organism. The physicochemical parameters investigated are water temperature, pH, conductivity, salinity, dissolved oxygen (DO) and biological oxygen demand (BOD). Physico-chemical samples were collected using standard procedures and samples analyzed using standard techniques. Physicochemical characteristics investigation reveals that all physicochemical parameters were within ranges of international permissible levels in water. This implies a satisfactory physicochemical regime during the study period, suggesting the water bodies still have a positive integrity to support aquatic life. Principal component analysis (PCA) revealed two principal components (PC-1 and PC-11) that accounted for 90.3% of observed variation in morphometric attributes; 58.1% and 58.8% in meristics and truss network system respectively. When compared to other locations, fish in Iwoama had the highest mean weight of 0.29±0.006 kg with a mean total length of 0.24±0.002 m. Truss network data showed that Brass location had the highest mean length of 0.149±0.001 m. Among the thirteen morphometric variables considered, pre-anal length (PAL) and standard length were the most correlated while dorsal fin count (DFC) and anal fin count (AFC) were the most correlated among the meristic variables. Cluster analysis revealed three clusters for meristic variables and two clusters for morphometric and truss network variables respectively while principal component loadings revealed that dorsal and caudal fin rays were the two most useful discriminating variables for differentiating *T. guineensis* populations in Nigeria. Molecular studies showed that all the loci were multi-allelic giving an average of 3.1 alleles per locus. The number of alleles (Na) ranged from 2 to 4 alleles per locus while the number of effective alleles (Ne) ranged from 1.087 to 2.612. Buguma, Badagry and Brass populations had the highest genetic diversity as was revealed by heterozygosity and shannon index. However, genetic diversity was low in some studied populations of *T. guineensis* in Nigerian coastal waters. The longest pairwise genetic distance of 0.30 was between Brass in Bayelsa State and River Ethiope in Delta State. Clustering using simple sequence repeat (SSR) data gave four major clusters which did not concur with clustering based on geographical location. The present study established that meristics revealed more

variability than morphometrics and truss network system in differentiating the morphological stocks of *T. guineensis* and should be recommended for differentiating *T. guineensis*, especially when combined with the other two morphological methods. The study established that Buguma in Rivers state, Badagry in Lagos state and Brass in Bayelsa state populations have higher genetic diversirty and are therefore identified as suitable areas for sourcing *T. guineensis* for fish improvement through appropriate breeding and conservation. However, Oron and Ibaka in Akwa Ibom state populations had the lowest biodiversity necessitating conservation efforts.

Key words: *Tilapia guineensis*, morphological, microsatellite, coastal rivers, Nigerian.