

MORPHOMETRIC, MERISTICS AND COMPARATIVE STUDIES OF *CHRYSICTHYS NIGRODIGITATUS* (LACEPEDE) FROM LAGOS, LEKKI AND BADAGRY LAGOONS, LAGOS STATE, SOUTH-WEST NIGERIA.

*AJADO, Edward Oluwarotimi ; **EDOKPAYI, Clement Aghatise & *WILLIAMS, Bamikole
*Marine Biology Section, Nigerian Institute for Oceanography & Marine Research, Lagos, Nigeria.

**Department of Zoology, Marine Biology & Fisheries, University of Lagos, Nigeria.

Abstract

Morphometric measurements, meristic counts and comparative studies of *Chrysiichthys nigrodigitatus* samples from Lagos, Lekki, and Badagry Lagoons was carried out to determine the amount of variation among the species from the different locations using seven meristic and two morphometric characters. Significant differences were observed only between the headlength ($F=14.02$; $P < 0.05$), Number of anal rays ($F=19.9$; $P < 0.05$) and of gill raker counts ($F = 142.0$, 160.94 ; $P < 0.05$). The differences observed in the meristic characters could be attributed to environmental and climatic differences of the three isolated sites and therefore phenotypic rather than genetic. This study is valuable for the selection of quality strains of fish species for aquaculture production.

Key words: Lagos lagoon, Lekki lagoon, Badagry lagoon. *Chrysiichthys nigrodigitatus*, Nigeria.

Introduction.

Investigation of morphometric variation, particularly of meristic series, in wide-ranging species of fishes has in many cases disclosed a lack of homogeneity with respect to certain characters (Hubbs, 1934; Lissner, 1934; Tester, 1937). The existence of racial stocks within a large river system has been extensively used as a basis of conservation measures for sockeye salmon (*Oncorhynchus nerka*) of the Fraser River, British Columbia (Royal, 1953). Multivariate statistical analysis of morphometric characters has been utilized for studying fish stock diversity (Copeman, 1977; Winans, 1984). Pante et al (1988) studied the use of canonical discriminant analysis of morphometric and meristic characters to identify cultured tilapias and suggested that the above method commonly used in fish taxonomy offered little promise in differentiating tilapia strains and introgressed hybrids.

Goodman (1973), in his racial studies of channel catfish (*Ictalurus punctatus*), from different geographical locations in the United States of America noticed highly significant difference between strains for all measurements except caudal peduncle width. Two of the wild strains, those with little or no-inbreeding, exhibited a large degree of variability with respect to those characteristics that could be of potential use in selective breeding. Lindsey (1961) pointed out that the demonstration of significant meristic differences between samples of fish from two areas may usually be taken as evidence for some degree of racial segregation, even though hereditary and environmental factors cannot be dissociated.

In tropical countries, literature on the racial studies of individual fish species are scarce. This is in sharp contrast to temperate species where detailed information is available.

Ikusemiju, (1973,1975) in one of the earliest report on racial studies in tropical Africa, observed that *Chrysiichthys nigrodigitatus* from Lagos and Lekki Lagoon were not genetically isolated. There was however significant differences on basis of left and right gill raker counts. This differences he attributed to isolation caused by differences in salinity gradients in the two

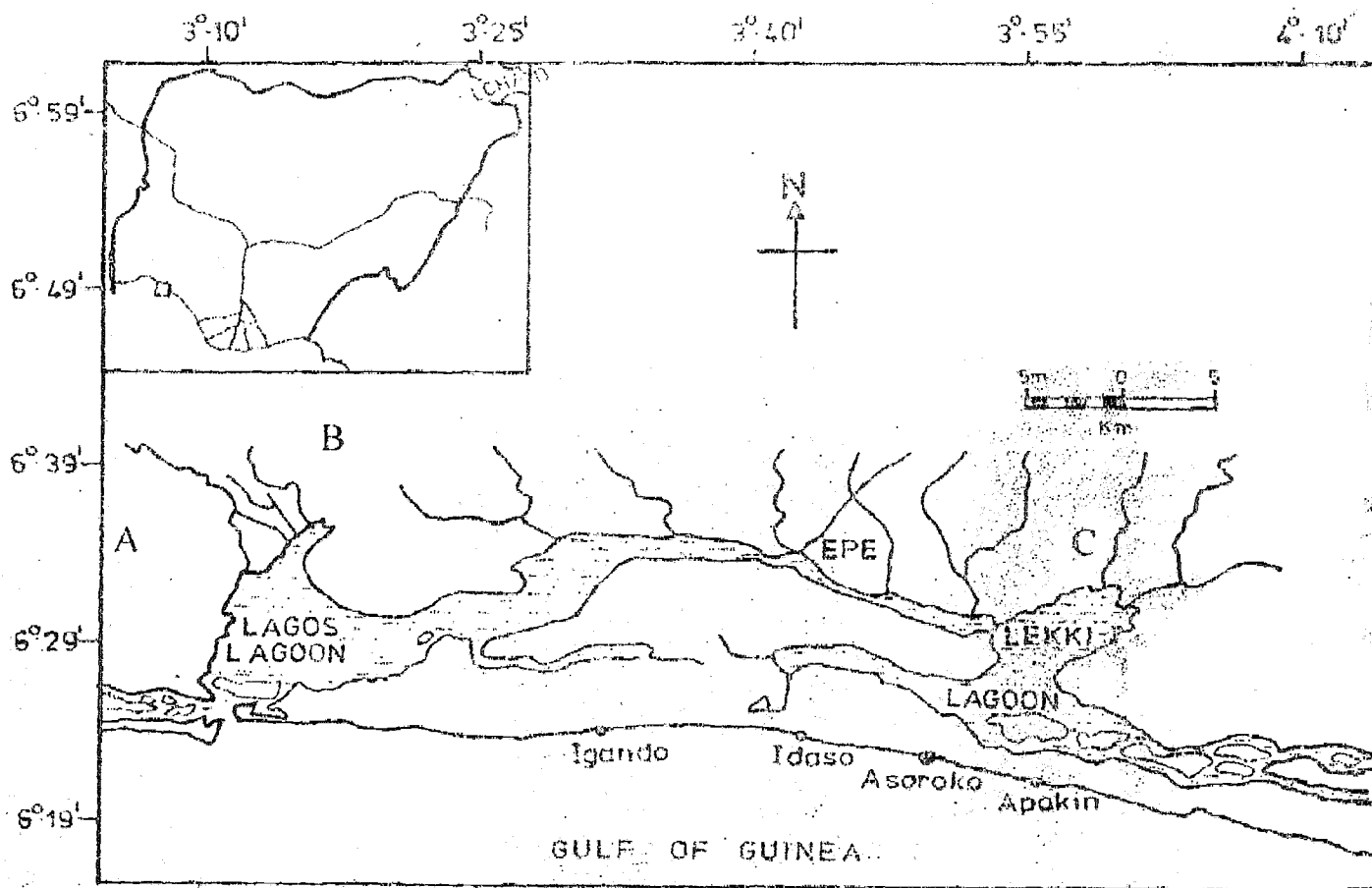
lagoons. Ezenwa (1978) conducted survey on the distribution of *Ch. nigrodigitatus* from seven widely separated geographical locations, Lagos Lagoon, Warri River, R. Niger, (Onitsha), Port Harcourt Creeks, Imo River (Okigwe), Crossriver (Calabar) and Benue River (Makurdi) in Nigeria. His result revealed variations in body depth, head length, anal rays and gill rakers.

This present work could be seen as a follow up of the first work carried out since 1975 by Ikusemiju on the same specie Meristic and Morphometric characters are used in this study to determine variations in the different populations.

Study Area

Lagos and Lekki lagoons lies between longitude 2 40 and 40 30 and between latitude 6 25 and 6 37 N. It is connected to the Gulf of Guinea via the Lagos harbor.(fig. 1). Brackish and fresh water conditions occur in various parts of the lagoon at different times of the year.(Ikusemiju,1975).

Badagry lagoon lies between longitude 30 45 and latitude 6 30 N (Fig. 1). It is part of a continuous system of lagoons and creeks lying along the coast of Nigeria from the border with the Republic of Benin to the Niger Delta with depth of the water ranging from 1-3 meters. It is characterized by freshwater most of the year (Ezenwa, 1981).



Samples of *Chrysichthys nigrodigitatus* were collected from three (3) locations in Lagos State namely Lagos Lagoon, and Lekki/Epe Lagoon, Badagry Lagoon (Figure 1). Live specimens were

obtained directly from local fishermen on landing and taken to the laboratory. Samples were collected between July to September 1995. The size range of fish samples was 21cm - 27cm standard length as these were likely to be of approximately the same age.

One hundred specimens of *Ch. nigrodigitatus* were collected each from Lagos, Lekki and Badagry lagoons. Specimens were collected as close to the same period of the year as possible. Seven meristic and two morphometric characters were studied. The meristic characters include counts of Dorsal, Pectoral, Pelvic, Anal rays, vertebrae and the right and left gill rakers. The Morphometric characters measured are the Standard length and Head length, as described by Ikusemiju (1975).

Laboratory Procedure

Measurements and counts were made on the left side of the fish except for the gill rakers which were counted on both the left and right sides. The complete gill rakers on the lower and upper parts of the anterior gill arch were counted under magnification using hand lens after removing the anterior gill arch from the fish. All the fin rays were counted. Where the last two branched fin rays had a common root, they were counted as one and when they had distinct roots, they were counted as two. For vertebrae counts, the flesh around the skeleton was teased off after slight boiling and the skeleton was then thoroughly rinsed and dried before counts were made. The counts included the atlas and urostyle. For the Morphometric measurements, the Head Length (HL) cm was measured from the tip of the snout to the most posterior projection of the opercula membrane. Standard length (SL) cm was measured from the tip of the snout to the caudal base.

Statistical procedure

Routine statistical analysis using the One-way analysis of variance was employed to analyze the Morphometric and Meristic Data. Where differences occurred, the Turkey's Test of "honestly significance difference" (hsd) test was used to detect where these differences occurred.

Results:

Meristic Characters:

Summary of Meristic and Morphometric characters of *C. nigrodigitatus* from the three stations - Lagos, Lekki and Badagry Lagoons is presented in Table 1. The mean, maximum and minimum with the result of ANOVA are shown.

The dorsal rays, excluding the single dorsal spine had a constant value of six in all the three stations. The pelvic rays had a constant value of six while the soft pectoral rays also had a constant value of nine. The vertebrae count had constant value of forty-two in all the three stations (Table 1).

The Anal ray count of *Ch. nigrodigitatus* from Lagos lagoon ranged from 10 to 12 with a mean of 10.23; those of Lekki lagoon ranged from 10 to 12 with a mean of 10.85, while Anal ray count of specimen from Badagry ranged from 10 to 13 with a mean of 10.64 (Table 1). Analysis of variance was used to check for statistical differences. Anal ray count from Lagos, Lekki and Badagry lagoons were statistically different ($F = 19.9; P < 0.05$) (Table 1).

Test indicated that *C. nigrodigitatus* from Lekki and Badagry lagoons were statistically similar and different from *Ch. nigrodigitatus* populations from Lagos lagoon ($q = 6.2, 2.1, 4.1$) respectively.

The right gill raker counts ranged from 26 to 28 with a mean of 27.01 in Lagos lagoon. Lekki lagoon specimens had counts ranging from 25 to 28 with a mean of 26.15 while specimen from Badagry lagoon had counts ranging from 26 to 28 with a mean of 27.59 (Table 1). The right gill raker counts of *Ch. nigrodigitatus* from the three stations were significantly different ($F = 142.0$; $P < 0.05$; Table 3). Turkey's test indicates independent populations at the study sites ($q = 24.0, 9.6, 14.3$). Variations also existed in the left gill raker counts within the three stations. Specimens from Lagos lagoon had counts ranging from 26 to 28 with a mean of 27.02. Lekki lagoon counts ranged from 25 to 28 with a mean of 26.14 while Badagry lagoon had 26 to 28 with a mean of 27.61 (Table 1). There were statistical differences in the left gill raker counts of *Ch. nigrodigitatus* from the three stations ($F = 190.94$; $P < 0.05$; Table 3). Turkey's test showed that the stock means were different ($q = 24.5, 9.8, 14.6$).

Morphometric Characters

The variation of Head length and standard length are shown in Table 3. The relationships of the HL and SL for *Ch. nigrodigitatus* from Lagos, Lekki and Badagry lagoons are presented in scatter plots (Figs. 2,3,4)

The standard length of *Ch. nigrodigitatus* from Lagos Lagoon had a mean of 23.75cm ranging from 21.20cm to 27.0cm. Specimens from Lekki Lagoon ranged from 21.0cm to 27.0cm with a mean of 23.91cm; while Badagry Lagoon specimens ranged from 21.0cm to 27.0cm with a mean of 23.55cm (Table 1). There were no statistically significant differences in the standard length of *Ch. nigrodigitatus* from Lagos, Lekki and Badagry lagoons ($F = 0.31$; $P > 0.05$). The head lengths ranged from 5.50cm to 7.40cm Lagos Lagoon with a mean of 6.42cm. Specimen from Lekki Lagoon ranged from 6.0 to 7.90cm with a mean of 6.32cm, while head length of Badagry lagoon specimen ranged from 5.60cm to 7.2cm having a mean of 14.02cm (Table 1)

There were statistical differences in the headlength of *Ch. nigrodigitatus* from the three stations ($F = 14.02$; $P < 0.05$). Turkey's test applied showed that Badagry and Lagos lagoon specimens were similar and different from Lekki lagoon specimens ($q = 7.75, 5, 2.75$) respectively. The regression of headlengths to standard lengths of *Ch. nigrodigitatus* from Lagos lagoon and Lekki lagoon is presented together in a scatter plot (Fig. 2). A positive relationship between HL and SL for *Ch. nigrodigitatus* from Lagos and Lekki was observed. The formula expressing HL as a function of SL for *C. nigrodigitatus* from Lagos lagoon was $HL = 0.71 + 0.24 (SL)$ and for Lekki lagoon specimens is, $HL = 0.57 + 0.25 (SL)$. There was no significant difference between the slope of the relationship of specimens from Lagos lagoon and Lekki lagoon ($t = 0.5$; $P > 0.05$). The regression lines was therefore parallel. The variance of the stock was not statistically different ($F = 1.5$; $P > 0.05$).

The regression of Headlengths to standard lengths of *Ch. nigrodigitatus* from Lagos lagoon and Badagry lagoon is presented together in a scatter plot (Fig. 3). A positive relationship between HL and SL for *Ch. nigrodigitatus* from Lagos and Badagry was observed. The formular expressing HL as a function of SL for *Ch. nigrodigitatus* from Lagos lagoon was $HL = 0.71 + 0.24 (SL)$ and from Badagry lagoon specimen, $HL = 1.44 + 0.21 (SL)$. There was no significant difference between the slope of the relationship of specimens from Lagos lagoon and Badagry lagoon ($t = 1.5$; $P > 0.05$). The regression lines are therefore equal. The variance of the populations were not statistically different ($F = 1.5$; $P > 0.05$).

The regression of headlengths to standard length of *Ch. nigrodigitatus* from Lekki lagoon and Badagry lagoon is presented together in a scatter plot (Fig. 4). A positive co-relationship between HL and SL for *Ch. nigrodigitatus* from Lekki lagoon and Badagry was observed. The

formula expressing HL as a function of SL for *Ch. nigrodigitatus* from Lekki lagoon is $HL = 0.57 + 0.25 (SL)$ and for Badagry lagoon specimen, $HL = 1.44 + 0.21 (SL)$. There was no significant difference between the slope of the relationship of specimens from Lekki and Badagry lagoons ($t = 2$; $P > 0.05$). The regression lines were therefore parallel, the variance of the populations was not statistically different.

Discussion

In this study, Meristic and Morphometric measurements were used to evaluate racial relationship in *Chrysiichthys nigrodigitatus*. Much of the observed variation between groups of *Ch. nigrodigitatus* in Lagos, Lekki and Badagry lagoons probably reflects environmental differences. Precise data on local environmental variation were not available, but the location of the lagoons suggest that environmental conditions may differ greatly among them. The salinity gradients differ; Lagos lagoon is Brackish, Lekki lagoon is freshwater, while Badagry lagoon is slightly Brackish (Ikusemiju, per. comm). Meristic and Morphometric characters were used to determine the amount of variation, if any, in *Ch. nigrodigitatus* from Lagos, Lekki and Badagry lagoons. The number of dorsal rays, pectoral and pelvic rays and vertebrae from the three locations were constant indicating identity in the parental stock. This probably indicates the non-effect of genotypic and phenotypic factors on the above characters.

Similar observations were made by several authors on *Ch. nigrodigitatus* from different locations in Nigeria, (Ikusemiju, 1975; Ezenwa, 1978; Marcus, 1982). However, differences have been observed in the vertebral count of the other fish species, (Lissner, 1934; Vermour, 1957). There were significant differences in the head length, anal fin rays and left and right gill raker counts. A similar observation was reported for racial studies on fishes from different parts of Nigeria (Ikusemiju, 1975; Ezenwa, 1978). Ezenwa (1978) suggested that occurrence of racial strains of *Ch. nigrodigitatus* in different parts of Nigeria was probably responsible for the statistical differences in head length, anal ray fins, and the upper and lower gill rakers of specimens observed from seven isolated locations. From the result of this investigation, it was observed that *Ch. nigrodigitatus* from Lagos and Badagry had relatively shorter head lengths. This similarity may be related to the similarity in salinity of the two locations.

A regression analysis of the head length upon the standard length of *C. nigrodigitatus* as a result of pairing (2-groups) from the locations showed that there was no statistically significant difference in the observed Morphometric characters.

Summary

Ch. nigrodigitatus samples were collected from Lagos, Lekki and Badagry lagoons, Lagos State.

The variations observed on the meristic characters of *C. nigrodigitatus* from Lagos, Lekki and Badagry lagoons showed that Anal ray counts and gill raker counts were statistically significant. This difference could be due to environmental factors in the lagoons. The Dorsal, Pectoral and Pelvic rays and vertebrae counts had constant values of 6, 9, 6 and 42 respectively. This probably indicates identity in their parental stock.

Morphometric measurements indicated significant statistical difference in the Head length, while Standard length showed no statistical difference in the three lagoons. This could be due to the uniform length range used in this study.

The hypothesis underlying Morphometric and Meristic studies of sub-population of fish is that under conditions of partial or complete isolation of groups of fish, slight differences in body

proportions or Meristic characters will be preserved in each group (Alhstrom, 1957). These small differences will not necessarily be apparent in individual specimens but often only in an average of a large number of specimens. The significance of the difference is appraised by means of statistical procedures based on the theory of probability. The differences might be due to either environmental or hereditary factors. It is usually extremely difficult to determine whether differences are phenotypic or genotypic, yet knowledge of the causes of the differences is essential to an understanding of the significance. It could therefore be concluded that the differences observed in *Chrysiichthys nigrodigitatus* may be due to environmental factors in the different locations. They may not be genetically separable populations but statistically separable populations.

Further detailed analysis involving the study of environmental factors that may influence Meristic and Morphometric characters is needed to make proper predictions on the racial relationships of the studied populations and the use of a more appropriate method Electrophoresis (Anyanwu 1993).

References

- Ahlstrom, E. H. (1957): A review of recent studies of sub-populations of pacific fishes. In contributions to the study of sub-populations of fishes. Special scientific report - fisheries No. 208 U.S. Dept. of Interior, Fish and Wildlife service.
- Anyanwu, A. O. (1993): Protein electrophoresis, Meristic and Morphometric parameters in the Racial studies of commercial fish species off the Nigerian Coast. Ph.D. Thesis, University of Ibadan, Nigeria pp.
- Copeman, D. G. (1977): Population differences in rainbow smelt, *Osmerus mordax*: multivariate analysis of Mensual and Meristic data. J. fish Res. Board of can., 34, 1220 - 1229.
- Ezenwa, B. I. O. (1978): Studies on the distribution, Age and Growth of the catfish, *Chrysiichthys nigrodigitatus* (L) M. Sc. Thesis, University of Lagos, Nigeria pp. 39 - 67..
- Goodman, R. K. (1973): A comparison of Morphometric characteristics of channel catfish, *T. punctatus* (R) from seven different geographical locations. M.Sc. Dissertation, Auburn University, Alabama, U.S.A. pp. 27.
- Hubbs, C. L. (1934): Racial and Individual variations in animals, especially fishes. Amer. Nat 68 (715): 115 - 128.
- Ikusemiju, K. (1973): A study of the catfishes of Lekki Lagoon with particular reference to the species, *Chrysiichthys walkeri* (Bagridae) Ph.D. Thesis. University of Lagos, Nigeria. pp. 188
- Ikusemiju, K. (1975): A comparative racial study of the catfish *C. nigrodigitatus* from Lagos and Lekki Lagoons. Nigeria. Bulletin de IFAN T. 37 Ser. A. No. 4, 1975 pp. 887 - 898.
- Marcus, O. (1982): The Biology of the clupeid, *Ilisha africana* (Bloch) off the Nigerian coast. Ph.D. Thesis. University of Lagos, Nigeria.
- Pante, K. J. R. Lester and R. S. V. Pullin (1988): A preliminary study in the use of canonical discriminant analysis of morphometric and meristic character to identify cultured tilapias, P. 251 - 257, in R. S.V. pullin, T.

- Bhukaswan, K. Tingutai and J. L. Maclean (eds). The second international symposium on Tilapia in Aquaculture ICLARM Conference proceedings 15, 635p. Department of Fisheries, Bangkok, Thailand, and International centre for living Aquatic Resources Management, Manila, Philipines.
- Royal, L. A. (1953): The effects of regulatory selectivity on the productivity of Fraser River Sockeye. Canadian Fish culturist, No. 14:1-12
- Tester, A. L. (1937): Populations of herring (clupea pallasii) in the Coastal waters of British Columbia. Journal of the Biological Board of Canada, vol. 3, No. 2, 108 - 144.
- Vermour, E. H. (1957): Morphometric comparison of three races of Kokanee (Oncorhynchus nerka) within a large British Columbia Lake. Journal fish res. Bd. can. 14 (4) : 573 - 598.
- Winans, C. A. (1984): Multivariate morphometric variability in pacific salmon technical demonstration, can. J. fish. Aqua. sci., 41: 1150.
- Zar, (1978): Biostatistical analysis. New Jersey: Prentice-Hall.