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Studies on the Ocular Lens Asymetry in Populations of *Synodontis Nigrita* (Pisces: Mochokidae) in Ona Lake, Southern Nigeria

Ekelemu Jerimoth Kesena

Department of Fisheries,
Delta State University, Asaba Campus, Asaba-Nigeria
jerimothekelemu@yahoo.com

Abstract: *The ocular lens asymmetry and condition factors variations were studied in Synodontis nigrita (Mochokidae) in Ona Lake (Southern Nigeria), from January 2007 to December 2008. Six hundreds specimens of adult size of this species were collected, and for each samples weight and relevant morphometric characters were measured for conditions factors determination. Then their ocular lens were extracted and dried, and horizontal diameter were measured using a micrometer screw gauge. The ANOVA mean comparisons method and Duncan multiple range test, were used for data analysis. Result showed mean condition index to be 1.6, implying that the fish were in good condition. Out of the 600 individuals of S.* nigrita *collected, 524 (87.33%) had the left ocular lens diameter significantly bigger than the right, while the remaining 76 (12.67%) had their right lens significantly greater than the left (t-test: P<0.01). The observed asymmetry between the left and right ocular lens diameter in S.* nigrita *is probably a consequence of fluctuating asymmetry which resulted from developmental instability and which in turn must have been eventuated by incipient environmental pollution and status of the lake. The asymmetry between the left and right ocular lens diameter displayed by S. nigrita in the lake, is most likely a consequence of fluctuating asymmetry resulting from developmental instability.*

Keywords: *Ona Lake, Synodontis nigrita, individuals, ocular lens diameter, condition factor.*

1. INTRODUCTION

Racial studies have been conducted to determine the degree of variation among widely distributed species. In conducting such studies, meristic and morphometric characters, tagging experiments as well as electrophoresis have been used either separately or in combination. Some of the meristic characters that have been used are number of spines and rays in the pectoral, pelvic, dorsal and anal fins. Other features such as left and right gill filaments and rakers, standard and total lengths, head and gape lengths, body weight and depth are examples of morphometric characters that can be used. However, some measure of constraint should be exercised in the use of meristic and morphometric characters for racial studies, especially when there is discrepancy in left - right asymmetry of a particular trait. Such asymmetrical features may be the result of environmental stress, which ultimately affect growth or development. [1], described homeostasis as a feature in living organisms responsible for regulation of the physiological processes of growth, reproduction and life itself. In ecosystems, stress (changes in the environmental conditions which adversely affect organisms) may disrupt this regulatory process during development of the organisms, thereby compromising development. Such compromise may cause alterations in the way parts of the body grow or function. Developmental stability according to [2] and [3], "is the ability of a given genotype to consistently reproduce a given phenotype in a particular environment. Under stress conditions, which may be environmental or genetic, a phenotype may not be accurately reproduced, resulting in developmental instability". Thus variability in a trait repeated within the individual is most likely developmental in origin and may be the result of environmental heterogeneity or generic variation [4].

Fluctuating asymmetry (FA) is a population parameter that measures random deviation from perfect symmetry in bilaterally symmetric traits. Fluctuating symmetry is often used as a measure of developmental stability, that is, the ability to regulate development and produce the genetically targeted phenotype despite environmental perturbations [5].

These authors suggest that bilateral symmetry in fish is set by a pool of genes and observed phenotypic deviations are often related to environmental perturbations.

S. nigrita is a widely distributed species in tropical Africa [6] and [7]... [8], while conducting age studies on *Citharinus citharus* and *Synodontis nigrita* using the ocular lens diameters of the fish samples, observed that the ocular lens of S. *nigrita* displayed an unusual pattern. Some of the S. *nigrita* have the left ocular lens bigger than those of the right ocular lens, while others had the right lens bigger than left. This study aims at reanalyzing these data statistically and to proffer possible explanation for such asymmetry between left - right ocular lens in this species.

2. METHODS

2.1. Study Area

Ona Lake (study area) is a fresh water ecosystem lying west of River Niger. It has it's source from Utto spring and is located eight kilometres (8 Km) from Asaba, Nigeria. It lies on longitude 6° 41'E and latitude 6° 15'N on the equator. It's morphometric and physico-chemical characteristics as well as the ichthyofaunal community have been described by [9]. In the wet season, the lake appears as one body of water, but in the dry season it is compartmentalised into three distinct channels of Ono-ododo, Ogbu and Obabala which are designated stations I, II and III for the purpose of this study.

2.2. Fish Sampling

Sampling for *Synodontis nigrita* was conducted fortnightly from January 2007 to December 2008 in the three channels of the lake (Stations I, II and III), using a complement of bottom and sub-surface fish gears made up of gill-nets, set-nets, non-return valve traps and fish pots. Fish samples collected were identified to species level, using the keys according to [10], [6] and [7]. In the laboratory, ocular lens of S. *nigrita* samples were extracted dried at room temperature for twelve hours. The length and weight of the fish samples were measured to the nearest centimeter and gram, while the diameter of each lens was measured to the nearest 0.5 mm, using a micrometer screw gauge [11]. The state of health or fitness of fish samples collected were determined using the condition factor 'K' = $W100/L^3$, for the three stations where W = weight and L = length.

2.3. Statistical Analysis

Data collected on the left and right ocular lens were subjected to t-test. Furthermore data collected for the three stations were subjected to analysis of variance and means separated using Duncan's multiple range test.[12].

3. RESULTS

3.1. Frequency Distribution of *S. Nigrita* Ocular Lens Diameter

A total of six hundred (600) individuals of S. *nigrita* sampled from the three stations (I, II and III) were examined. Frequency distribution of ocular lens diameter of fish is presented in Table 1.

Table1. *Ocular tens diameter (mm) frequency distribution of S.* nigrita

Class Interval (mm)	Frequency
0.00- 0.50	2
0.51 - 1.00	16
1.01 - 1.50	56
1.51 - 2.00	126
2.01 - 2.50	312
2.51 - 3.00	70
3.01 - 3.50	6
3.51 - 4.00	12

Left and right ocular lens diameter of *S. nigrita* by sex in the three stations

There was significant difference between the left and right ocular lens diameters of the specimens examined (t-test: $P<0.01$) irrespective of station or sex. The results are presented in tables 2-4 below.

Table2. *Ocular lens diameters of* Synodontis nigrita *samples observed in Station I,*

Sex	Right > Left	Left > Right No(%)	Total
Male	-	14(63.64)	14(63.64)
Female	-	8(36.36)	8(36.36)
Total	-	22	22

(Figures in parenthesis represent percentage occurrence)

Table3.*Ocular lens diameters by sex of* S. nigrita *samples observed in station II.*

Sex	Right > Left No/%	Left>Right No/%	Total No/%
Male	22 (12.22)	104 (47.71)	126 (57.80)
Female	18 (8.26)	74 (33.94)	92 (42.20)
Total	40 (18.35)	178 (81.65)	218

(Figures in parenthesis represent percentage occurrence)

Table4.*Ocular lens diameters of* Synodontisnigrita *samples observed in station III.*

Sex	Right > Left No (%)	Left >Right No (%)	Total No (%)
Male	22 (5.56)	200 (55.56)	220 (61.11)
Female	16 (4.44)	124 (34.44)	140 (38.89)
Total	36 (10.00)	324 (90.00)	360(100)

Figures in parenthesis represent percentage occurrence.

Mean condition factor (K) for *S. nigrita* in the three stations

The condition factor for the population offish sampled, is presented station by station in Table 5.

Table5. *Summary of Analysis of variance of the Condition Factors (K) for* Synodontis nigrita *in the three stations of Lake Ona.*

	Station I	Station II	Station III	Average
Mean ± (SEM)	$2.54^{a} \pm 0.21$	$1.57^{b} \pm 0.25$	$1.32^{b} \pm 0.28$	1.60
Range	(2.07 – 3.12)	(0.62 – 3.44)	(0.65 – 2.23)	

Means with different alphabets as superscripts are significantly different from each other (P< 0.05).

Results of analysis of variance showed fish samples in station I with K value 2.54 to be in better condition, and significantly different from those of stations II and III ($P<0.05$). Stations II and III which had K values of 1.57 and 1.32 respectively were not significantly different from each other ($P>0.05$).

4. DISCUSSION

Left - right ocular lens diameters of S. *nigrita* in the study area displayed an asymmetrical pattern different from the normally expected bilateral symmetry displayed by fishes. Station I, which is the smallest of the three stations sampled in the lake has a depth of 5.73 m. There is reduced human activity here. Only 22 individuals were collected here and they all had their left ocular lens bigger than the right. More males were encountered than females. Station II with a depth of 6.32 m, is the largest of the three stations sampled [13]. Here two hundred and eighteen (218) individuals were sampled during the study period. As was observed in Station I, more males than females were encountered. One hundred and twenty – six (126) males or 57.8 % compared to ninety – two (92) females' or 42.2 % were collected. Unlike in Station I, 178 (81.65 %) of the individuals collected had their left ocular lens bigger than the right lens. On the other hand, 40 or 18.35 % of the individuals sampled, had the right ocular lens bigger than the left lens. This same pattern was observed in Station III, as presented in Table 4 below. This Station is second largest portion of the lake with a depth of 5.98 m [13]. Here, three hundred and sixty (360) individuals were sampled. Out of this figure, three hundred and twenty–four (324) or 90 % of the individuals had the left ocular lens bigger than the right lens. The remaining thirty-six (36) or 10 % of the individuals sampled had the right ocular lens bigger than the left ocular lens.

Bilaterally symmetrical organisms usually have their two halves being mirror images of one another. However in this study, the right and left ocular lens diameters of S. *nigrita* were significantly different from each other (t-test: $P<0.01$). This deviation from bilateral symmetry as displayed by S. *nigrita* in Ona Lake may be indicative of an ecosystem which is under stress. [1], stated that such asymmetrical features may be the result of environmental stress, which ultimately affect growth or development of the organism. Ona Lake can be considered a stressed ecosystem because of the heavy human activities (laundry and bathing), which may be a veritable source of heavy input of detergents into the water body. The lake is cropped yearly. The harvesting process is through the use of the bark of Indian bamboo, which are woven into a mat and used to drag the whole lake, from top to the bottom. In the

process the bottom sediments are stirred up and the whole lake becomes very turbid. Some of the fishes which escape being caught, get trapped in the muddy water and die due to stress and asphyxiation. This process is repeated season after season, giving individuals that survived the previous season, little time to establish a new population. The constant changes experienced in the environmental conditions of the lake, may have put the lake and its biota under stress. Under this stressed condition, the homeostatic features responsible for the regulation of physiological processes of growth, reproduction and life in the fish may have been altered, resulting in the left - right eye lens of S. *nigrita* in Ona Lake, being asymmetrical. This finding is supported by the work of [5] on the relationship between fluctuating asymmetry and reproductive investment in Perch, where they stated that any non-directional differences between the two sides of a normally bilaterally symmetrical organism, must be environmental in origin. They reported that under stress conditions, which may be environmental, a phenotype may not be accurately produced resulting in developmental instability which further supports the result of this study.

The average condition factor 'K' for *S. nigrita* sampled in the Lake was 1.80 and this was without respect to sex. [9], had earlier reported similar 'K' values in their study of the 'Growth patterns and condition factors of four dominant fish species' in the lake This result reveals that *S. nigrita* in Ona Lake are generally healthy, in having 'K' values of above 1. Apart from Station I, where only 22 individuals were sampled and all the individuals had the left ocular lens bigger than the right, a proportion of the right lens were also found to be bigger than those of the left in the other stations. The size and symmetry of the ocular lens had no relationship with the sex of the fish. Both sexes displayed asymmetry in their ocular lens In all, individuals which had the left ocular lens bigger than right lens in the population of *S. nigrita sampled* were 524 or 87.33 %, while those with right ocular lens bigger than the left numbered 76 or 12 67 %,

5. CONCLUSION

The asymmetry between the left and right ocular lens diameter displayed by *S. nigrita* in the lake, is probably a consequence of fluctuating asymmetry resulting from developmental instability occasioned by the stressed status of the lake. It is recommended for further studies, that this study be replicated in the neighboring aquatic ecosystems, to validate the result obtained.

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AUTHOR'S BIOGRAPHY

Ekelemu, Jerimoth Kesena (Ph.D), Lectures in the Department of Fisheries, Delta State University, Asaba Campus, Asaba, Nigeria.