Age Determination in *Citharinus citharus* (Pisces: Citharinidae) and *Synodontis nigrita* (Pisces: Mochokidae) in Lake Ona, Southern Nigeria

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Abstract: Age determination of *Citharinus citharus* (Pisces: Citharinidae) and *Synodontis nigrita* (Pisces: Mochokidae) in Lake Ona, Southern Nigeria were made in a study that spanned 2001 to 2003. The fish species were caught, using varied fishing gears that included:- bottom set and surface set gill nets of mesh sizes 1.0, 3.0 and 5.0 cm , with each having a length of 25.0 m and a depth of 3.0 m; cast net with stretched mesh size of 6.4 cm; fish baskets, non-return valve traps which along with fences formed fish pots and a set of long-lines of length 35.0 m. Fish Aggregating Devices (FAD) were deployed to aggregate fishes and invariably increased fishing success. Sampling was at three Stations (I, III and V) established on the Lake. In the Laboratory, specimens collected were identified and sexed, their total and standard lengths were measured in centimeters while their and body weights were taken in grams. The age of fish species were determined by analysis of Frequency distribution of Ocular Lens Diameters (OLD) Measured in Millimeters (mm) and validated by means of Length-Weight frequency distribution. Catch statistics were, 288 specimens of *S. nigrita* with a sex ratio of 1.6:1,TL range of 04.5-18.0 cm and BW range of 05.5-56.3 g ; 308 specimens of *C. citharus* with sex ratio of 1.4: 1, TL range of 06.0-21.5 cm and BW range of 05.8-581.2 g. Results of the Frequency distributions of OLD in *S. nigrita* studied indicate the population was made up of one age group with modal Class interval of 10.0-12.5 cm. In *C. citharus*, a single age group was clearly evident with modal Class interval of 15.0-17.5 cm. A lone Class interval of 25.0-27.5 cm, distal from the bulk may suggest another age group of *C. citharus* not fully represented in the sample. Length and Weight Frequency distributions of both species equally followed the same pattern as the OLD frequency distribution confirming mainly single age groups in the studied populations. Results obtained equally indicate there was a significant difference ($p<0.05$) between the left and right OLD in both species irrespective of sex. In *C. .citharus,* all the left lenses were bigger than the right ones. In *S. nigrita* however, 253 (88.77%) of the population had bigger left OLD while the remaining 32 (11.23%) had the right OLD bigger than the left ones. Since all other features used in identifying the specimens were the same, except for the observed differences in the eye lens of *S. nigrita*, it is suggestive that we may have seen the outset of speciation.

Key words: Length, weight, ocular lens diameter, frequency distribution, sex ratio, lake ona, Southern Nigeria

INTRODUCTION

Age determination and growth, are important aspects of fisheries and management. Age studies can furnish other basic data such as stock age structure, age at first maturity, spawning frequency, individual and stock responses to changes in the habitat, recruitment success etc. Age and growth data can in actual fact enhance determination of population changes due to fishing rates.

A number of methods have been used to age varied species of fish. Such methods involved the counting of annual or daily marks or growth checks on hard structures of fish. Such hard structures include:- Scale (Lagler, 1947; Ottawa and Simkiss, 1979; Ottaway, 1978),

otolith (Poinsard and Troadec, 1966, Pannella, 1971, 1974, 1980), opercular bones Fagade 1974 on *Tilapia melanotheron*), spines (Brennan, 1988; Brennan and Cailiet, 1989, 1991, Rossitar *et al.*, 1995; Steveson and Secor, 1999; Sun *et al.*, 2000). In addition, is the popular Petersen Method first described by Petersen (1891) (Sparre *et al.*, 1989; Pauly, 1982; Morgan and Pauly, 1987).

All these methods have numerous but specific drawbacks which include the requirement of a large number of specimens to be reasonably valid (Fletcher,1991). In addition are, the drudgery in preparation of slides for instance, and reading of growth marks that culminate in systematic and random errors (Beamish, 1969). Numerous readings are therefore adopted

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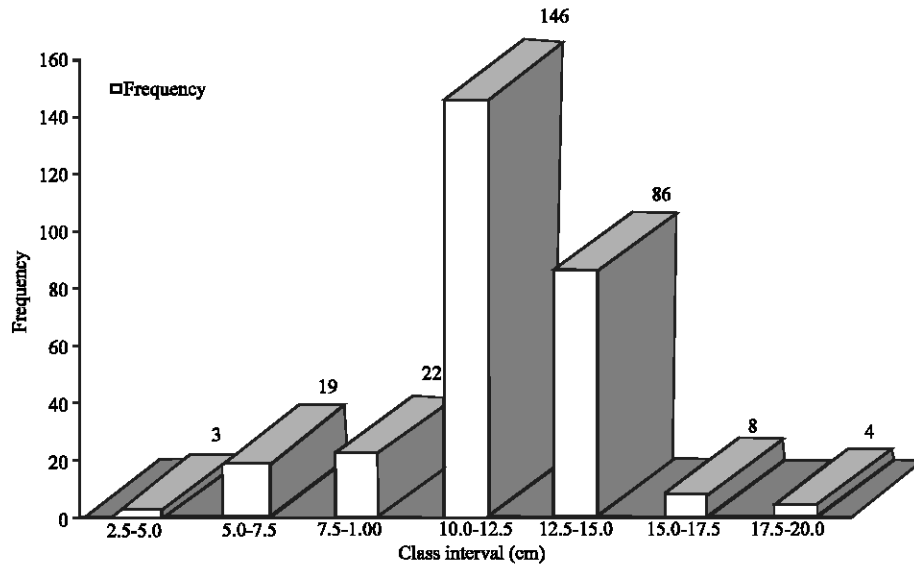
Fig. 1: Length (cm) frequency distribution for *Synodontis nigrita*

in order to validate whatever age is assigned to the specimen (Sandeman, 1969).

In order terrestrial animals, measurement of ocular lens is employed for their age determination. Typical examples being mammals and birds (Lord, 1959; Friend, 1967).

Following confirmation of such methods as reliable, the technique has been applied to estimate the age of fishes (Al-Hassan and Al-Sayab, 1974, Al-Hassen *et al*, 1991, 1992)

The present study focuses on two dominant species, *Citharinus citharus* and *Synodontis nigrita,* in Lake Ona, a natural freshwater lake in Oshimili South Local Government Area of Delta State in Southern Nigeria. Among earlier studies on *Citharinus citharus* were Bakare (1970), Imevbore and Bakare (1970), and Aramowo (1976) who looked at the food and feeding habits of this fish in River Niger at Kainji. Idodo-Umeh and Victor (1990) studied some aspects of ecology of *Synodontis nigrita* in River Ase, Southern Nigeria while Olojo *et.al..* (2003) considered the food and feeding habits of the same species in River Ogun, Southern Nigeria. From available literature, there is dearth of knowledge with respect to ageing of these species. The presen study aims at determination of age of two dominant species to bridge the gap.

MATERIALS AND METHODS

Study area: The location, topography and vegetation of the study area, have been described elsewhere by the present authors. For clarity however, the map of the study area showing the specially established experimental stations is shown in Fig. 1.

Sampling for fish: Fish samples used for the study were collected at fortnightly intervals between August 2001and July 2003 from the three stations designated I, III and V, which are the main channels of the lake. For the purpose of sampling one fisherman and a boatman were engaged for each station. At each station, three bottom set and three surface set gill nets of mesh sizes 1.0, 3.0 and 5.0 cm were used for sampling. Each net had a length of 25.0 m and a depth of 3.0 m. In study to these nets, one segmented cast net with pockets of stretched mesh size 6.4 cm was used at each of the stations.

To take care of the bottom dwellers, five sets each of fish baskets, locally called manly and the non-return value traps were similarly used at each station. There was also a set of long-lines of length 35.0 m which ran along the edges of the fringing vegetation of the three stations. In the dry season months, Fish Aggregating Devices (FAD) and fences were used to aggregate and catch fish. The gears used were tended twice on sampling days between 06.00-7.30 h and 17.00-18.30 h.

All fish samples caught were washed, packaged in iced plastic buckets and transported to the laboratory, where they were sorted and identified up to the species level according to Reed, (1967), Holden *et al.* (1978) and Idodo-Umeh (2003). They were then counted and all measurements (total length, standard length and weight) were taken and recorded to the nearest 0.1cm and 0.1g respectively. The ocular lens diameters of both eyes of the two most dominant species - *Citharinus citharus* and *Synodontis nigrita,* were measured. in mm.

Table 1: Catch data on experimental species of fish in lake Ona

Family	Genus	Sp	Station I	Station II	Station III	Total per sp.
Mochokidae	*Synodontis*	*Synodontis nigrita*	8	103	77	288
Citharinidae	*Citharinus*	*Citharinus citharus*	9	187	112	308
Total number of fish per station			43	347	298	

Table 2: Range of values of meristic features of experimental fish species in lake Ona

Species	Range of Parameters	Station I	Station III	Station V
Synodontis nigrita	TL in cm	05.8-10.9	04.5-18.0	05.2-16.5
	BW in g	09.1-16.3	05.8-45.0	05.5-56.3
Citharinus citharus	TL in cm	08.1-15.2	08.5-27.0	06.0-21.5
	BW in g	33.0-132.0	15.2-581.2	05.8-125.1

TL = Total Length, BW = Body Weight

Data analysis: Analysis of variance LSD and the New Duncan Multiple Range Test (NDMRT) were equally executed .

RESULT

Catch data: A total of 1,394 fishes were caught during the sampling period. However attention in the present study focused on two dominant species whose data are summarized in Table 1.

The catch data presented in Table 1 shows that the species and their occurrence by number were:- *Synodontis nigrita* (288 by number) and *Citharinus citharus* (308 by number).

Analysis of variance showed a significant difference among the monthly number of fish at the three stations of the lake $p < 0.01$. DMRT showed that the monthly number of fish at Station I was significantly different from those of stations III and V, $p < 0.05$.

Meristic data: Presented in Table 2, are range of values for Total Length (TL) in centimeters (cm) and Body Weight (BW) in grams (g) which were the two basic meristic features considered.

Total length of *S. nigrita,* ranged from 04.5 cm to 18.0 cm while its Body weight ranged from 05.8 g to 56.3 g in Lake Ona (Table 2). Across Lake Ona, TL for *C. citharus* ranged from 06.0 to 27.0 cm while the BW ranged from 05.8 g to 581.2 g.

Ocular Lens Diameter (OLD) of the two dominant species in Lake Ona
C. citharus: A total of three hundred (300) observations were made on OLD of *C. citharus* from the three Stations (I, III and V), where active fishing took place. This number was made up of 173 males and 127 females. The Sex Ratio was therefore 1.4: 1 while the results are presented in Table 3.

In all fish samples, it was consistently observed that the left ocular lenses are bigger than those of the right irrespective of sex (Table 3).

T-test conducted on data to determine the difference between the left and right ocular lens diameters in the three stations were significantly different. At Station I $p < 0.001$, while at Stations III and V $p < 0.01$. Pearson's correlation for Stations I, III and V were respectively 0.998599, 0950459 and 0.996558.

Regression of mean ocular lens diameter on weight for stations I, III and V. Result showed positive correlation in all three stations. Regression coefficient at Station I was $r = 0.4313.$ $p > 0.05$. At Stations III and V 'r' values were respectively $r = 0.7278, p < 0.001$ and $r = 0.9171$ $p < 0.001$.

Regression of mean ocular lens diameter on standard length for Stations I, III and V. There was a positive correlation in all three stations. The regression coefficient at Station I was $r = 0.2996$ $p > 0.05$. Results for Stations III and V were respectively $r = 0.7278$ and $r = 0.9532$, $p < 0.001$.

S. nigrita: Results of observations made on OLD of *S. nigrita* are presented in Table 4.

Total number of observations made from the three stations was 285 broken-down as 173 males and 112 females implying a Sex Ratio of 1.6:1. Of these, 253 (88.77 % of all observations) had their left ocular lens bigger than the right, while the remaining 32 (11.23 %) had their right ocular lens bigger than the left (Table 4).

T-tests conducted on the left and right ocular lens diameters showed they were significantly different from each other in all the Stations, $(p < 0.01)$. Pearson's correlation coefficient were 0.999408, 0.892539 and 0.907294 at Stations I, III and V, respectively.

Regression of mean ocular lens diameter on weight for stations I, III and V. Results showed a positive correlation in all the stations with a correlation coefficient of $r = 0.6659$ at Station I $p > 0.05$, 0.6308 at Station III and 0.7017 at Station V $p < 0.001$, respectively.

Regression of mean ocular lens diameter on standard length for Stations I, III and V. There was a positive correlation in all three Stations. The regression coefficient r at Station I was 0.7656 $p < 0.05$, while at Station III, $r = 0.7144, p < 0.01$ and Station V r = 0.9629, $p < 0.001$, respectively.

Length and weight frequencies as indices for age determination in fish species: The length-frequency distribution of *S. nigrita* in Lake Ona is presented in Fig. 1.

Table 3: Observations of ocular lens diameter for *C. citharus* at different stations

Sex	Comparative dimension of ocular lens Right>Left			Comparative dimension of ocular lens Left>Right		
	Station I	Station III	Station V	Station I	Station III	Station V
Male	-	-	-	6	98	69
Female	-	-	-	3	77	45
Total	-	-	-	9	177	114

Table 4: Observations of ocular lens diameter for *S. nigrita* at different stations

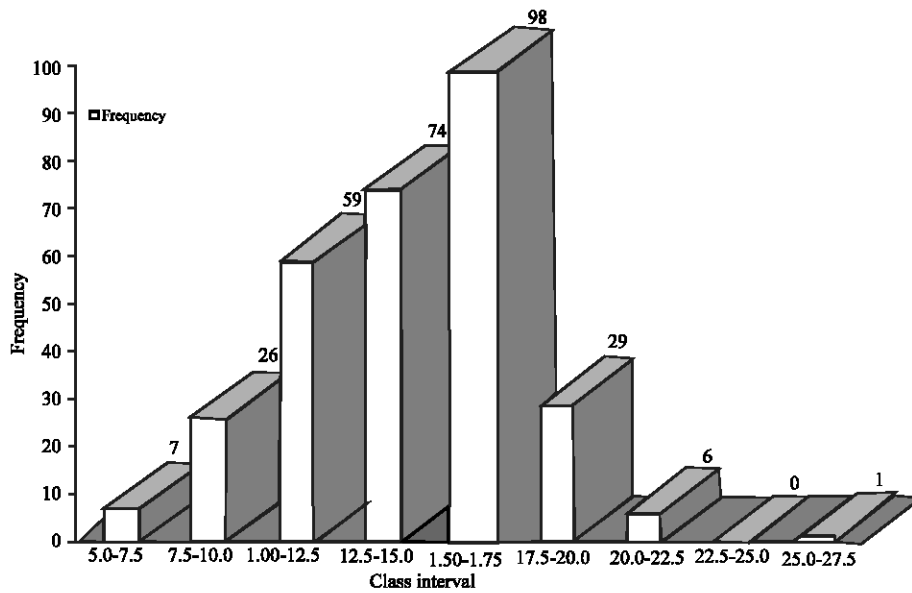| Sex	Comparative dimension of ocular lensRight>Left			Comparative dimension of ocular lensLeft>Right		
	Station I	Station III	Station V	Station I	Station III	Station V
Male	-	9	9	5	51	99
Female		8	6	3	35	60
Total		17(16.50%)	15 (8.62 %)	8 (100 %)	86(83.50%)	159 (91.38 %)

Fig. 2: Length (cm) frequency distribution for *Synodontis nigrita*

Results of length-frequency distribution for *S. nigrita* revealed one mode in the population with the modal class interval 10.0-12.5. cm.

Length- Frequency Distribution of *C. citharus* in Lake Ona is presented in Fig. 2.

Weight-frequency distribution for *Synodontis nigrita*: The Weight-Frequency Distribution for *S. nigrita* obtained is presented in Fig. 3.

A unimodal weight-frequency is illustrated in Fig. 4 with a modal class interval of 20.0-25.0 cm.

Weight-frequency distribution for *C.itharinus citharus*: The result of weight-frequency distribution obtained is presented in Fig. 4.

Like what was obtained for *S.nigrita*, a unimodal weight-frequency is illustrated in Fig. 5 with a modal class-interval of 50-100. The distribution tapers to 1 with a class-interval of 200-250. Another class-interval of 550-600 cm had a frequency of 1.

Ocular lens diameter frequency distribution for *Synodontis nigrita*: Presented in Fig. 5, is the Ocular lens diameter-frequency distribution for *S. nigrita*.

A unimodal distribution is clearly evident in Fig. 5. with a modal class interval of 2.00-2.50 mm.

Ocular lens diameter frequency distribution for *Citharinus citharus*: Presented in Fig. 6 is the Ocular lens diameter-frequency distribution for *C. citharus*.

Like for *S. nigrita*, a unimodal distribution with class-interval of 2.00-2.50 mm and modal frequency of 124 were obtained for *C. citharus* (Fig. 6).

Thus regression and scattergrams were plotted for ocular: Lens diameter and standard length as well as eye lens diameter and weight for both *S.nigrita* and *C. citharus*. The regression coefficient 'r' of eye lens diameter and weight for *S. nigrita* was positive and highly
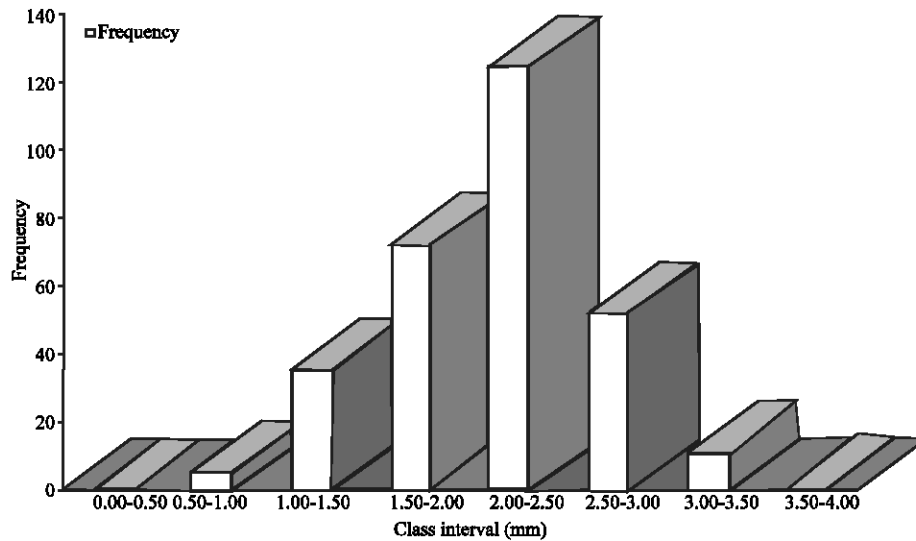
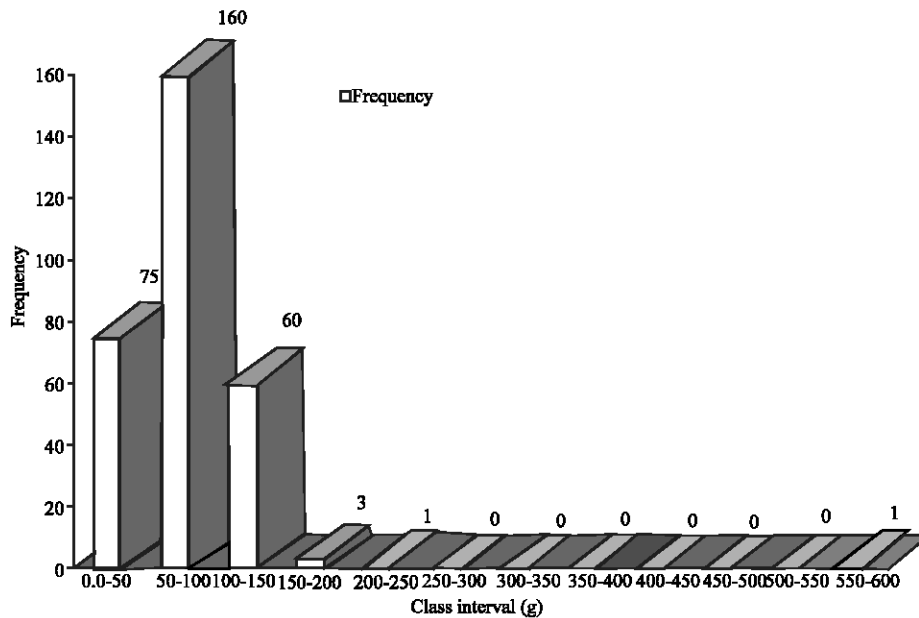Fig. 3: Weight (g) frequency distribution for *Synodontis nigrita*

Fig. 4: Weight (g) frequency distribution for *Citharinus citharus*

significant p<0.001 at Stations III and V. At Station I, 'r' was positive but not significant p>0.05.

DISCUSSION

The unimodal frequency distributions of OLD the two most dominant fish species viz *S. nigrita* and *C. citharus* obtained in this study, indicate that single age groups comprised the populations considered. In the case of *C. citharus* , an additional single class interval obtained distally to the right extremity of the prominent modal class points to existence of another age group that was excluded by the fishing gears from the catch.

The highly significant (p<0.001) positive regression coefficient 'r' obtained from regression analysis on OLD-standard length as well as OLD-body weight for both *S. nigrita* and *C.citharus* indicate that OLD can indeed be employed in age determination of fish species studied and other species in general. The findings obtained from the present study are in agreement with those of Conides and that eye lens diameter increases with the age.

In their study, Conides used the average ocular lens diameter of *Lithognathus mormyrus* and *Diplodus vulgaris,* to estimate the age of a population of the two fish species. They reported that the average ocular lens diameter of the fish species increased with age.
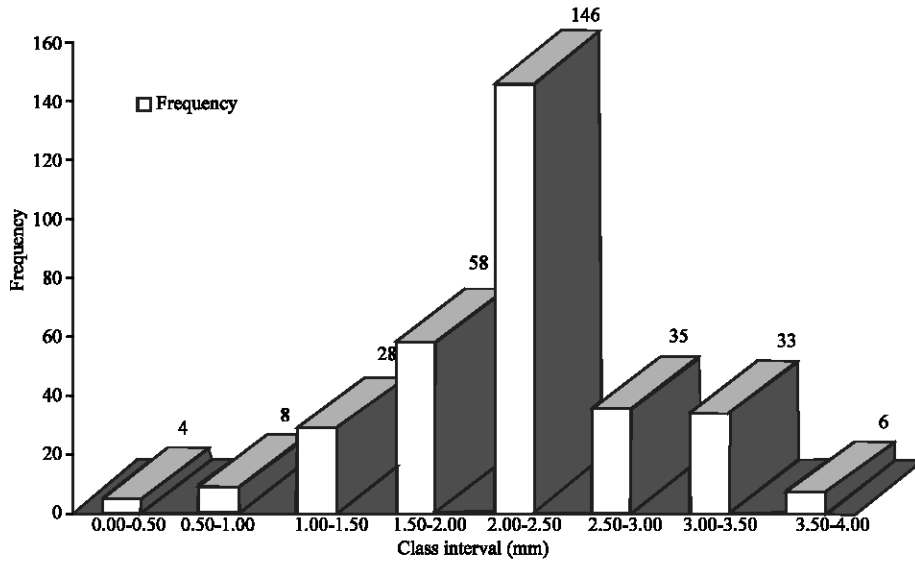
Fig. 5: Ocular (mm) diameter frequency distribution for *Citharinus citharus.*
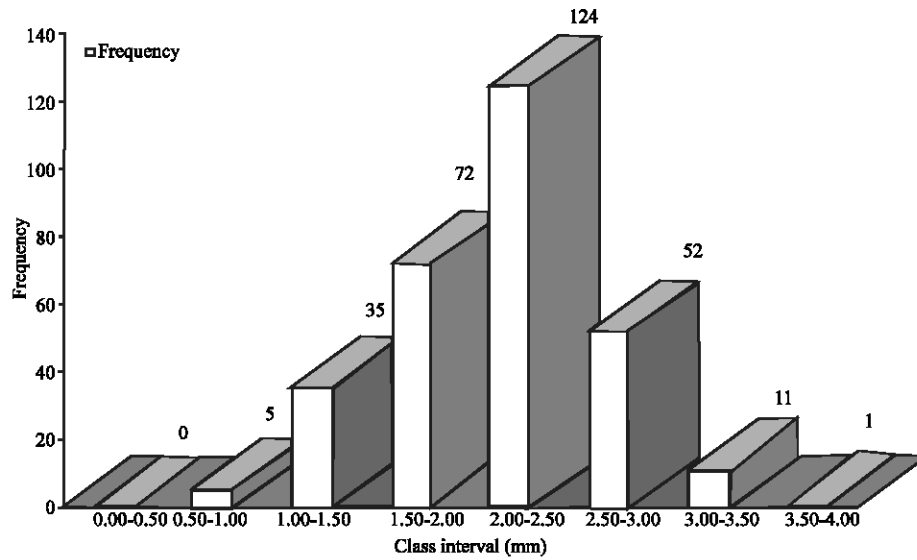

Fig. 6: Ocular (mm) diameter frequency distribution for *Citharinus citharus*

As per Bagenal (1978), length is an indicator of the likely age of a fish.

The results obtained were validated by the Petersen method as reported by Bagenal (1978), in which age of fish can be determined from the length frequency distribution. By this method the length composition of a fish population will most often exhibit modes among the small fish which correspond to the youngest age group. Close to the modes, all, or nearly all of the fish may be expected to be of one age group.

In the present study, results of length and weight frequency distributions for *S. nigrita* and *C. citharus* in this study, revealed an age group in the population of both species. In *C. citharus* however, at the far end of the frequency polygon, a frequency of 1 obtained for the Class-interval of 550-600 g, indicate may indicate the lower limits of another age group much older than the abundant group. The results of the length and weight frequency distributions obtained for both species there confirm the validity of those obtained from OLD frequency distribution.

In this study, with the exception of the observed differences in OLD in *S. nigrita,* there were no observed differences in the morphological and meristic features

among the individuals of the two species. Applying the ponderal index to the population of *S.nigrita,* individuals with the left ocular lens diameter bigger than the right ocular lens diameter as well as those with the right ocular lens diameter bigger left ocular lens diameter were both dominant in the population. It is therefore concluded that two strains of *S.nigrita* are present in Lake Ona and this may be the beginning of speciation.

REFERENCES

Al-Hassan, L.A.J., N.K. Al-Dahm and S.S. Hassan, 1991. Eye lens diameter as an age indicator in *Mystus pelosius* (Bagridae) Cybium, 15: 171-172p.

Al-Hassan, L.A.J., A.Y. Al-Dubaikel and N.K. Wahab, 1992. Ocular lens diameter as an age indicator in Heleost fishes collected from Basrah waters (Iraq). Acta Hydrobiol., 34: 275-279

Al-Hassan, L.A.J. and A.A. Al-Sayab., 1994. Eye lens as an age indicator in the catfish, *Silurus triotregus.* Pakistan J. Zool., 26: 81-82.

Allen, K.R., 1938. Some observations on the biology of trout in Windermere. J. Anim. Ecol., 7: 333-349.

Anibeze, C.I.P., 2000. Length-Weight Relationship and Relative Condition of *Heterobranchus longifilis* (Valencienness) from Idodo River, Nigeria. Naga, The ICLARM Q., 23: 34-35.

Arawomo, G.A.O., 1976. Food and feeding of three *Citharinus* species in Lake Kainji, Nigeria. J. Fish Biology, 9: 3-10.

Bakare, O., 1970. Bottom Deposits as Food of Inland Freshwater Fish. In: Visser. S.A.(Ed) *Kainji Lake Studies* Ecology Ibadan: Ibadan University press, 1: 65-85.

Bagenal, T.B., 1978. Method for Assessment of Fish production in fresh water. IBP Handbook No.3. Blackwell Scientific Publications. Oxford London.

Beamish, R.J., 1979. Differences in age of Pacific hake, Merluccius product using whole otoliths and sections of otoliths J. Fish. Res. Board Can., 36: 141-151.

Beyer, J.E., 1987. On length-weight relationships. Part I: Computing the mean weight of fish of a given length class. Fishbyte, 5: 11-13.

Beverton, R.J.H. and S.J. Holt., 1957. On the dynamics of exploited fish populations. Fish Invest. Minist. Agric. Fish Food G.B. (2 Sea Fish), pp: 19-533.

Bolger, T. and P.L. Connolly., 1989. The selection of suitable indices for the measurement and analysis of fish condition. J. Fish Biol., 34: 171-182.

Braga, F.M. de S. 1986. Estudo. Estudo entre fator de condicao e peso/comprimento para alguns peixes marinhos. Rev. Brasil. Biol., 46: 339-346.

Brennan, J. S., 1988. Age determination and verification of California white sturgeon (*Acipenser transmontanus*): A comparative analysis. M.S. Thesis, San Jose State Univ., CA, pp: 70.

Brennan, J.S. and G.M. Cailliet, 1989. Comparative age-determination techniques for white sturgeon in California. Trans. Am. Fish. Soc., 118: 296-310.

Brennan, J.S. and G.M. Cailliet., 1991. Age Determination and Validation Studies of White Sturgeon in California. In P. Williot (Ed.), Acipenser: sects du premier colloque international sur l'esturgeon, French, pp: 209-234.

Conides, A.J. and L.A.J. Al-Hassan, 2000. Using eye lens diameter as age indicator of young *Lithognathus mormyrus* and *Diplodus vulgaris.* Naga. The ICLARM Quarterly, 23: 21-22.

Egborge, A.B.M., 1976. The effect of impoundment on the water Chemistry of Lake Asejire. Nigeria Freshwater Biol., 9: 403-412.

Ekelemu and Zelibe, 2006. Aspects of hydrobiology of lake Ona in Southern Nigeria.1: Fish Fauna. (*Inpress*)

Fagade, S.O., 1974. Age determination in *Tilapia melanotherodon* (Ruppel) in the Lagos lagoon, Lagos Nigeria. Intl. Symp. Agiy of Fish, Ed T.B. Bagenal., pp: 71-77.

Fletcher W.J., 1991. A test of the relationship between otolith weight and age for the Pilchard, *Sardinops neopilchardus.* Can .J. Fish Aquatic Sci., 48: 35-38.

Friend, M., 1961a. Some observations regarding eye lens weight as a criterion of age in animals. N.Y. Fish Game .J., 14: 91-121.

Friend, M., 1967b. A review of research concerning eye lens weight as a criterion of age in animals. N.Y. Fish Game. J., 14: 152-165.

Friend, M., 1967c. Relationship between eye lens weight and variation in diet. N.Y. Fish Game. J., 14: 122-151.

Gullard, J.A., 1983. Fish stock assessment: a manual of basic methods. (Seies on Food and Agriculture). FAO/Wiley and Sons, New York, 1: 223.

Holden, M. and W. Reed., 1978. West African Freshwater Fish. West African Nature Handbooks. Longman Group Ltd. London.

Huxley, J.S., 1932. Problems of relative growth. Methuen, London.

Idodo-Umeh and Victor, 1990. Some aspects of the ecology of *Citharinus citharus* (Geoffery st. Hilaire 1809) In River Ase, Southern Nigeria.

Idodo-Umeh, G., 2003. Freshwater Fishes of Nigeria (Taxonomy, Ecological Notes, Diets and Utilization). Idodo-Umeh Publishers Nig. pp: 232.

Imevbore, A.M.A. and O. Bakare., 1970. The Food and Feeding Habits of Noncichlid Fishes of the River Niger in the Kainji Reservoir Areas. In: Imevbore, A.M.A. and O.S. Adegoke (Eds). *Kainji lake kainji studies* Ecology. Ife: Ife University Press.

Institute of Agriculture and Environmental Engineering Research CEMAGREF), Gazinet, France.

King, R.P., 1996a. Length-weight relationships of nigerian freshwater fishes. Naga, ICLARM Q., 19: 49-52.

King, R.P., 1996b. Length-weight Relationships of Nigerian coastal water fishes. Naga, ICLARM Q., 19: 53-58.

Lagler, K.F., 1947. Lepidological studies 1: Scale characters of the families of Great Lakes Fishes. Trans.Am. Microscop. Soc. 66: 257-312.

Le Cren, E.D., 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in Perch (Perch fluviatilis). J.Anim.Ecol., 20: 201-219.

Lord, R.D.Jr., 1959. The lens as an indicator of age in Cottontail rabbits. J. Wildlife Mgt., 23: 358-360.

Morgan, G.R. and D. Pauly, 1987. Analysis of Length-Frequency Data: Some Available Programs and User's Instructions. In: D. Pauly and G.R.Morgan (Eds.), *Length-based methods in fisheries research*. ICLARM Conference Proceedings,13: 373-462.

Olojo, E.A.A., K.B. Olorin and O.J. Osikoya, 2003. Food and feeding habits of *Synodontis nigrita* from the Osun River, South West Nigeria. NAGA World fish Center Quaterly, 26: 21-24.

Ottawa E.M. and K. Sickish, 1979. A comparison of traditional and novel ways of estimating growth rates from scales of natural population of young sea bass (*Dicentrachus labrax*) . J. Marine Biol. Association of the United Kingdom, 59: 49-59.

Ottaway, E.M., 1978. Rhythmic growth activity in fish Scales. J. Fish Biol., 12: 615-623.

Pannella, G., 1971. Fish Otoliths: Daily growth layers and periodical patterns. Science. New York. 173: 1124-1127.

Pannella, G., 1974. Otolith Growth Patterns: An Aid in Age Determination in Temperate and Tropical Fishes: In T.B Bagenal (Ed). *The aging of fish*. Unwin Brothers ltd., England: 23-39.

Pannella, G., 1980. Growth Patterns of Fish Sagittae. In: D.C. Rhoads and R.A. Lutz, (Eds). Skeletal Growth of aquatic Plenum. Press, New York, U.S.A., pp: 519-560.

Pauly, D., 1982 Studying Species Dynamics in Tropical Multi-Species Context. In: Pauly, D and G.I. Murphy (Eds). *Theory and management of tropical fisheries*. ICLARM, Conference Proceeding, a, Manila Philippines, pp: 33-70.

Pauly, D., 1983. Some simple methods for the assessment of tropical fish stocks. FAO. Fisheries Technical, FAO Rome, pp: 234.

Pauly, D., 1993. FishByte Editorial. Naga ICLARM Q., 16: 26.

Petersen, G.G., 1891. Eine methode zur bestimmug des altars und wuchses des fishe. Mitteilungen. Dentscher Seefisherei-Verein, 11: 226-236.

Petrakis, G. and K.I. Stergiou, 1995. Weight-length relationships for 33 fish species in Greek waters. Fish. Res., 21: 465-469.

Poinsard F. and J.I. Troadec, 1966. Determination de l'age per la lecture des Otolithes Chez deux especes de sciaenides ouest-african's (Pseudotolithes senegalensis C.V. et. *Pseudotolithus typus* Bl Kr). J Cons Perm. Intl. Explor Mer., 30: 291-301.

Reed, W., J. Burchard, A. J. Hopson, J. Joness and I. Yaro, 1967. Fish and fisheries of Northern Nigeria. Ministry of Agriculture, Kaduna, pp: 226.

Rossiter, A., D.L.G. Noakes and F.W.H. Beamish, 1995. Validation of age estimation for the lake sturgeon. Trans. Am. Fish. Soc., 124: 777-781.

Sandeman, E.J., 1969. Age determination and growth rate in redfish, *Sebastes* sp. from selected areas around Newfoundland. North West Atl. Fish Res. Bull., 6: 79-106.

Sparre, P.E. Ursin and S. Venema, 1989. Introduction to tropical fish stock assessment Port .F. Manual. FAO Fisheries Technical Paper 306/1: 337.

Stevenson, J.T. and D.H. Secor, 1999. Age determination and growth of Hudson River. Atlantic sturgeon, *Acipenser oxyrinchus*. Fish. Bull., 97: 153-166.

Stergiou, K.I. and C.Y. Politou, 1995. Biological parameters, body length-weight and length-height relationships for various species in Greek waters. Naga, ICLARM Q., 18: 42-45.

Sun, C.L., Huarg C.L. and S.Z. Yeh, 2001. Age and growth of the big eye tuna, *Thunnus obsesus*, in the Western Pacific Ocean.Fish Bull., 99: 502-509.

Vanestov,V., F.E. Eremeeva, N.O. Longe, M.E. Dmitrieva and R.Y.Braginskaya, 1957. Developmental stages in commercial anadromous fishes of Volga and Don Rivers. Tiody Inst. Morf. Zhivot., 16: 8-76.

Vazzoler, A.E.A. and M. de, 1996. Biologia da reproducao de peixes teleosteos: Teoria e pratica. Maringa: EDUEM. Sao Paulo: SBI., pp: 169.

Weatherley, A.H. and H.S. Gill, 1987. The biology of fish growth. London: Academic Press, pp: 443.

Zelibe, S.A.A., 1982. Ecology of Juvenile fishes at Eleiyele Lake in Ibadan. M.Sc. Thesis, University of Ibadan, Ibadan Nigeria.