Journal of Agriculture and Veterinary Sciences **Volume 4, September 2012**

www.cenresinpub.org
ISSN 2277-0062

GROWTH PATTERNS AND CONDITION FACTORS OF FOUR DOMINANT FISH SPECIES IN LAKE ONA, SOUTHERN NIGERIA

Ekelemu, K. Jerimoth and Samuel, A. A. Zelibe
Department of Fisheries Science
Delta State University, Asaba, Nigeria
Email: jerimothekelemu@yahoo.com

ABSTRACT

Growth patterns involving evaluation of Length-Weight Relationships (LWR) of four dominant fish species in Lake Ona, Southern Nigeria, were studied. The fish species, *Heterotis niloticus* (Osteoglossidae), *Syndontis nigrita* (Mochokidae), *Citharinus citharus* (Citharinidae) and *Heterobranchus bidorsalis* (Clariidae) were caught from 2001 to 2003, using varied fishing gears. The gears were-three bottom set and three surface set gill nets of mesh sizes 1.0, 3.0 and 5.0 cm, with each having a length of 25.0m and a depth of 3.0m; cast net with stretched mesh size of 6.4cm; fish baskets, locally called manly; non-return value traps and a set of long-lines of length 35.0m while Fish Aggregating Devices (FAD) and fences were equally used to aggregate fishes. The LWR was determined from the formula, w= aL^b with the parameters a and b in that formula estimated through logarithmic transformation in the form of Log W = Log a + bLog L. The condition factor (k) was estimated from the relationship, k = W100/L^3. The results obtained from LWR are presented for the four species and the values of the growth exponent "b"ranged from 1.92 to 3.04 for *H. bidorsalis*; 2.47 t0 3.03 for *H. nitoticus*; 1.39 to 2.11 for *C. citharus* and 1.01 to 1.97 for *S. nigrita*. Fish species in the lake were generally healthy and in good condition. Overall mean condition factor (k) were 1.21 for *H. bidorsalis*; 1.57 for *H. miloticus*; 2.40 for *C. citharus* and 1.60 for *S.nigrita*.

Keywords: *Length-weight relationship, Condition factor, Growth exponent, Isometric-allometric growth patterns, Lake Ona.*

INTRODUCTION

Length and weight are two basic components in the biology of fish species at individual and population levels. Length-Weight Relationship (LWR) is an important factor in fish ecology and indeed the biological study of fishes (Bagenal, 1978). LWR is of prime importance in parameterizing fish yield equations and stock assessments. LWR enables the estimation of biomass from commercial processing data. LWR as an empirical relationship is helpful in studying thenatural history of fishes. For example, it allows prediction of the weight of a fish from a given length in yield assessment (Le Cren, 1951 and Petrakis and Stergiou, 1995). LWR is employed also in studies of gonad development, rate of feeding, metamorphosis, maturity and condition (Le Cren, 1951). LWR provides information on growth patterns and it is known that during development, fish typically pass through several stanzas (Vanestov *et al.,*1957) and each may have its own LWR. Huxley (1932), Allen (1938), Le Cren (1951), Beverton and Holt (1957); dissected biomathematical implication of growth patterns. The mathematicalparameter of LWR of fish furnishes further information on the weight variation of individuals in relation to their length (condition factor, k). Thisfactor estimates the general well-being or relative fatness (plumpness) of the individual and it is frequently used in three cases:

Braga (1986) states that Fulton's condition factor is only adequate for the comparison of fish of the same size, while the allometric condition factor, which occurs when b≠3, is valid for the study of any range of length although at the same stage of development. Vazzoler (1996) states that it is inadvisable to use Fulton's condition factor and affirms that the determination of the value of 'b'is necessary in the use of the allometric condition factor so that results may be reliable. Length-weight relationship (LWR) and population dynamics are studied with the major objective of rational management and conservation of the resources. Effective management of any fishery requires considerable knowledge regarding population parameters such as length-weight, age and growth, mortality and recruitment of the exploited stock.King (1996a)noted that only a few estimates of species-specific LWR parameters are available for Nigerian fishes. King (1996a and 1996b) studied LWR of 149 species of fish population in Nigeria's inland and coastal waters. Ona is a natural freshwater lake in Oshimili South Local Government Area of Delta State in Southern Nigeria. Like other inland water bodies in Nigeria, Lake Ona has been undergoing steady exploitation over the years by artisanal fishermen, whose only objective is to catch fish for commercial purposes, no scientific study has been carried out on this lake until very recently, when the present authors commenced a series of investigation on varried aspects of the water body. The present study aims at providing ascientific background on the LWR offour dominant species in Lake Ona. The species, *Heterotis niloticus, Synodontis nigrita, Citharinus citharus and Heterobranchus bidorsalis* wereselected from an earlier work (Ekelemu and Zelibe, 2006). These species were omitted in studies of King (1996a and 1996b) and Anibeze (2000).

MATERIALS AND METHODS

Study area: Lake Ona lies West of River Niger and has its source from Utto spring. It is located eight kilometres from Asaba, Nigeria, lying on latitude $6^{0}4^{1}$1E and longitude $6^{0}15^{1}$N of the equator Fig. 1. The lake has a length of 2,250.01m, an area of 516,197.2m^2 and a volume of 4,413,804.12m^3.

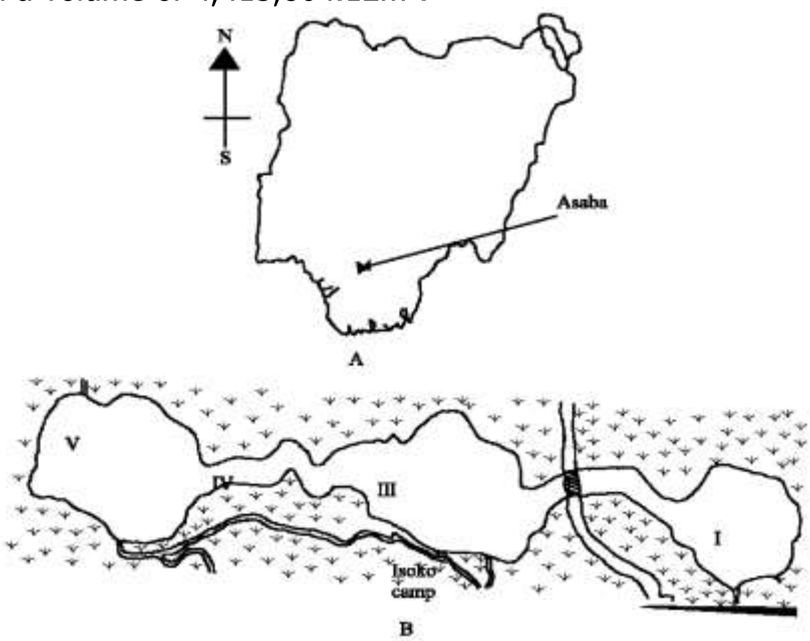

Fig 1: (a) Is Map of Nigeria, (B) shows details of study stations- I, II, III, IV and V on Lake Ona.

Topography and vegetation: Lake Ona lies in the Asaba-Ogwashi rock formation and has a gentle slope from its banks that permits inflow of surface run-off and organic matter derived from the surrounding vegetation. This load contributes to the allochthonous in-put of the lake. The substratum is made up of a deep layer of clay and an ad-mixture of silt and decomposing organic matter. The lake is devoid of thick tree canopy but it is dominated by floating aquatic macrophytes viz *Salvinia nymphellula Desv*. *Nymphaea lotus*Linn., present mostly in the back waters. Found floating on the water surface are *Azolla pinneta*, R. Br. Var. Africana (Desv) and *Pistia stratiotes*. Fringing the shoreline is a dense population of *Panicum subalbidium, Kunth. Paspahm scrobiculatum,* Linn*. and Diplazioum sammati*, Kahn.

Study Stations: in the wet season, Lake Ona appears as a common sheet of water but it is compartmentalized into three distinct sections of Ona-ododo, Ogbu and Obabala, with Ogbu and Ona-ododo being the largest and smallest respectively. Five sites were established in the course of the study and were designated stations I, II, III, IV and V Fig. 1. Stations I, III and V were Ona-ododo, Ogbu and Obabala, respectively. Station II is the link between stations I and III, while the link between stations III and V is station IV.

Sampling for Fish: Fish samples used for the study were collected at fortnightly intervals between August 2001 and 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 5.0cm were used for sampling. Each net had a length of 25.0m and a depth of 3.0m. In addition to these nets, one segmented cast net with pockets of stretched mesh size 6.4cm 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 35.0m 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 and 17.00-18.30h.

All fish samples caught were washed, packaged in Coleman ice-chests and transported to the laboratory, where they were sorted, counted and all measurements (total length, standard length and weight) were taken and recorded to the nearest 0.1cm and 0.1g, respectively. Fish samples were identified up to the species level according to Reed*et al.* (1967) and Idodo-Umeh (2003).

Data analysis: Total length, body weight and number of fish species caught at the three stations (I, III and V) were used for the following analysis:-The LWR was determined from the formula, $W = aL^b$. The parameters a and b in that formula were estimated through logarithmic transformation in the form, Log W = Log a + b Log L

Where,

W	=	Total body weight of fish
L	=	Total length of fish (cm)
b	=	Growth exponent or regression coefficient
Log a	=	Intercept on the Y-axis

The condition factor (k) was estimated from the relationship, k = W100.L^b after Le Cren (1951). Analysis of variance LSD and the new Duncan Multiple Range Test (NDMRT) were equally executed.

RESULTS

Catch data: A total of 1,394 fishes were caught during the sampling period. However attention in the present study focused on the four 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:- *Heterobranchus bidorsalis* (17 by number), *Heterotis niloticus*, (75 by number), *Synodontis nigrita* (288 by number) and *Citharinus citharus* (308 by number). *C. citharus* was therefore the most abundant while *H. bidorsalis* was least abundant as only 17 specimens were caught. 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 II and V, $P<0.05$.

Table 1: Catch data on four dominant species of fish in Lake Ona

Family	Species	Stations I	III	V	Total Per species
Clariidae	*Heterobranchus bidorsalis*	-	13	4	17
Osteoglossidae	*Heterotis niloticus*	26	44	5	75
Mochokidae	*Synodontis nigrita*	8	103	77	288
Citharinidae	*Citharinus citharinus*	9	187	112	308
Total per Station		43	347	298	

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

Total length of *H. bidorsalis* ranged from 15.9cm to 83.9cm in Lake Ona while the body weight ranged from 23.2 to 5,003.08g (Table 2). Total length of *H. niloticus* ranged from 17.6 to 59.3cm in Lake Ona while the body weight ranged from 46.6 to 1,621.0g Table 2. For *S. nigrita*, TL ranged from 04.5 to 18.0cm while it BW ranged from 05.8 to 56.3g in Lake Ona (Table 2). Across Lake Ona, TL for *C. citharus* ranged from 06.0 to 27.0cm while the BW ranged from 05.8 to 581.2g.

Table 2: Range of total length and body weight of four dominant species in Lake Ona

Range of Species	parameters	Station I	Station III	Station V
Heterobranchus	TL (cm)	-	30.6-83.9	15.9-1.1
bidorsalis	BW (g)	-	225.1-5,003.0	23.2-51.3

Heterotis niloticus	TL (cm)	17.648.7	17.2-59.3	22.7-56.5
	BW (g)	46.6-1,034.4	52.0-1,621.0	126.1-1,421.5
Synodontis nigrita	TL (cm)	05.8-10.9	04.5-18.0	05.2-16.5
	BW (g)	09.1-16.3	05.8-45.0	05.5-56.3
Citharinus citharus	TL (cm)	08.15.2	08.5-27.0	06.0-21.5
	BW (g)	33.0-132.0	15.2581.2	05.8-125.1

TL = Total Length, BW = Body Weight

Length-Weight Relationship: Presented in Table 3, are the parameters of LWR obtained in this study. From Table 3, *H. bidorsalis* – The b-values for this species for all the stations ranged from 1.92 to 3.04. Theb-values for *H. niloticus* for all the stations ranged from 2.47 to 3.03 (Table 3). As Table 3 shows, the b-values for *C. citharus* for all the stations ranged from 1.39 to 2.11 while a range of 1.01 to 1.97 was obtained for *S. nigrita*.

Table 3: Length-Weight Relationships and related statistics of four dominant species in Lake Ona

Family	Species	n	a	b	r	Station	Mean TL (cm)	Mean BW (g)
Clariidae	*H. bidorsalis*	00	---	---	---	I	---	---
		13	-1.78	2.93	0981	III	51.18	2,419.68
		04	-0.66	1.92	0.688	V	15.68	37.48
Osteoglossidae	*H. niloticus*	26	-1.94	3.03	0.991	I	22.18	214.35
		44	-1.24	2.62	0.941	III	29.56	497.03
		05	-1.11	2.47	0.940	V	35.33	649.20
Mochokidae	*S. nigrita*	08	0.18	1.01	0.852	I	8.06	12.44
		103	0.06	1.29	0.867	III	11.14	20.50
		77	0.77	1.97	0.764	V	12.91	21.13
Citharinidae	*C. citharus*	09	0.30	1.39	0.831	I	12.23	68.04
		187	0.05	1.62	0.804	III	14.03	77.29
		112	0.57	2.11	0.920	V	14.77	77.96

Condition factors of four dominant species in Lake Ona

Results ofanalysis for Condition Factors (k-values) of fish caught are presented in Table 4.From Table 4, condition factor for *H. bidorsalis*, ranged from 0.90 at Station V to 1.29 at Station III with a mean of 1.1.For *H. niloticus*, k-value ranged from 1.07 (Station V) to 1,70 (Station III) with a mean of 1.57. Condition factor for *S. nigrita* ranged from 1.3 (Station V) to 2.54 (Station I) with a mean of 1.60, while the range obtained for *C. citharus* was .01 (Station V) to 3.31 (Station I) with a mean of 2.40. An interesting trend is that for virtually all species, k-value was highest at Station I and least at Station V.

Table 4: Mean condition factor (k) for the dominant fish species in lake one

Species	Station I Number	Station III k	Station V k	Overall k	mean k
Heterobranchus bidorsalis	17	---	1.29	0.90	1.21
Heterotisniloticus	75	1.29	1.70	1.07	1.57
Synodontisnigrita	288	2.54	1.57	1.32	1.60
Citharinuscitharus	308	3.31	2.70	2.01	2.40

Seasonal variation in mean monthly condition factor (k):
Illustrated in Fig. 2, is the seasonal variation in mean monthly condition factor (k) of the dominant fish species in Lake Ona. *H. niloticus* and *H. bidorsalis*exhibited k-values that were high in the dry season and relatively lower in the wet season.

H. niloticus had a high k-value of .10 in March 2002, which was one of the dry months. The k-value equally droppedin the wet season to a minimum of 1.10 in October 2002, which was the outset of the dry season. *H. bidorsalis* had its highest k-value of 1.86 in January 2002, which was the peak of the dry season. It however, exhibited a minor peak of 1.49 in the wet season in May 2003.

For *S. nigrita* and *C. citharus*, wet season k-values were generally higher than those of the dry season. The maximum values were obtained in the wet season, 3.64 in August 2002 for *S. nigrita* and4.13 for *C. citharus* in June 2003. Least values were obtained in the dry season as 1.04 in October for *S. nigrita* and 0.66 in November 2001 for *C. citharus*.

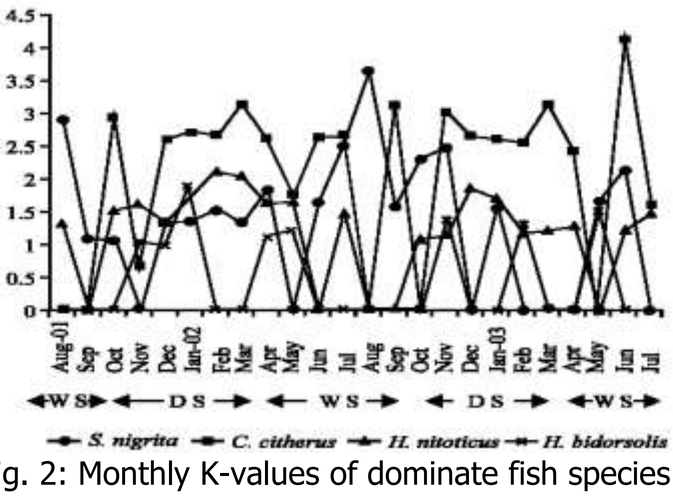

Fig. 2: Monthly K-values of dominate fish species from Lake Ona, Nigeria.

Table 5: Summary of Analysis of Variance forobserved variation in monthly means of condition factor

	S. nigrita	*C. citharus*	*H. niloticus*	*H. bidorsalis*	*p-value*
Samples	$\bar{X}\pm$ SE	$\bar{X}\pm$ SE	$\bar{X}\pm$ SE	$\bar{X}\pm$ SE	p<0.001
	$1.323^b\pm0.21$	$2.07^b\pm0.26$	$1.19^b\pm0.14$	$1.21^b\pm0.13$	p<0.001

Presented in Table 5 is the summary of analysis of variance for the observed variations in the condition factor of the dominant species. Mean monthly k-values for *H. niloticus* and *S. nigrita*were not significantly different (p>0.001) from each other but were significantly different from *H. bidorsalis* and *C. citharus* (p<0.001).

DISCUSSION

The highest values of meristic features obtained indicate that under natural conditions, fish attain commercial sizes in this little known natural tropical body of fresh water, Lake Ona.The overall growth exponent b obtained in this study ranged from 1.01 to 3.03. Growth model in fish generally follows the cube law hence the use of Fulton's Condition Factor or the isometric factor ($k = W/L^b$), attributing to the length-weight exponent, a b-value equal to 3 (Gullard, 1987). In "isometric growth pattern" the growth exponent, 'b'= 3, the body form maintains a constant proportion to length (Weatherly and Gill, 1987). When 'b' ≠ 3, Allometric growth pattern which could be negative or positive, is indicated. When 'b'< 3, negative allometry in growth pattern is indicated. When 'b' > is described as positive allometry. With respect to *H. bidorsalis* at Stations III and V where b-values obtained were less than the isometric value of 3, this species exhibited a negative allometric growth pattern. This implies that they tend to become thinner as they grow larger. However, at Station I, a different growth pattern, positive allometry was observed as a b-value of 3.04 was obtained. The growth pattern of *H. niloticus*, was observed to have followed a similar pattern, positive allometry was observed as a b-value of 3.04 was obtained. The growth pattern of *H. niloticus* was observed to have followed a similar pattern to that of *H. bidorsalis* with the b-values less than the isometric value of 3 at stations III and V. Thus, thesespecies exhibited a negative allometric growth pattern. This implies they tend to become thinner as they grow larger. However, at Station I, a different growth pattern, positive allometry was observed for a b-value of 3.03 was obtained. It was equally observed that at all stations, *S. nigrita* and*C. citharus* exhibited negative allometric growth patterns with the tendency to become thinner as they grow larger. It would appear that all species exhibited negative allometric growth pattern at stations III and V. Negative allometry in growth pattern was reported for juvenile cichlids, *Chromidoptilapia guntheri* and *Hemichromis fasciatus* in Lake Eleiyele, Ibadan Southern Nigeria (Zelibe, 1982), *Clarias gariepimus*(King, 1996a), Illesha Africana and *Heterobranchus longifilis* from River Idodo, Nigeria (Anibeze, 2000). Only *H. bidorsalis* and*H. niloticus*exhibited positive allometry at Station I. Positive allometry in growth pattern had been observed for yet some other juvenile cichlids, *Sarotherodon galileaus* and *Tilapia zilli*, in Lake Eleiyele, Ibadan Southern Nigeria (Zelibe, 1982). In their study on LWR of five species in Epe Lagoon Nigeria, Fafioye and Oluajo (2005), obtained range of b-values, 2.799 and 3.218 and concluded indication of nearly isometric relationship with 60% of the variation in body weight being accounted for by changes in length. The species in their study were*Clarias gariepinus, Illesha africana, Chrysichthys nigrodigitatus, C. walker* and *Ethmalosa fimbriata*

Condition factor: It was observed in the present study, that condition factor for all species were of values of I and above which indicate that fish species are doing well in the lake. When k is greater than unity, the fish species is heavy. Bagenal (1978), documented that for mature fresh water fish, condition factor aught be in the range of 2.9 to 4.8. While highest monthly value of k obtained for *H. dorsalis* of 1.86 in January, a dry month and exhibited a minor peak of 1.49 in the wet season, Anibeze (2000), recorded a monthly index of relative condition factor of 1.29+0.19 for males of a relative*. H. longifilis* in Idodo River. Contrary to the trend obtained for *Heterobranchus* species in this study, Anibeze (2000), yet observed increased k-values during the rains. Anibeze (2000) attributed increased values of mean monthly conditionfactor of*H. longifilis*, to availability of food and gonadal development. Factors known to influence a prevailing condition factor include conditions or decrease in feeding activity; density or population changes, or climate, the period and duration of gonadal maturation among others.

REFERENCES

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.

Bagenal, T., 1978. Method for assessment of fish production in Fresh Water. IBP Handbook No. 3. Blackwell Scientific Publications. Oxford London.

Beverton, R.J.H. and S.J. Holt, 1957. On the dynamics of exploited fish populations. Fish Invest. Minist. Agric Fish Food G.B. 19, 533p.

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

Ekelemu and Zelibe, 2006. Aspects of Hydrobiology of Lake Ona in Southern Nigeria. 1: Fish Fauna. J. Environl Hydrology14(*20*) :1 - 9

Holden, M. and W. Reed, 1978. West African freshwater fish. West African Nature Hanbooks. Longman Group Ltd. London.

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

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

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.

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.

Pauly, D., 1993. Fish Byte Editorial. Naga ICLARMQ. 16(23): 26.

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

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

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. de M., 1996. Biologia da reproducao de pixes telecosteos: 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.