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Research Article
Length-Weight Relationships and Condition Factor of Twenty-Four Freshwater Fish Species from Lake Buyo, Côte D'Ivoire

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Abstract
Background and Objective: The growth of freshwater fish is influenced by several ecological and environmental factors. So the present study was aimed to provide baseline data on the length-weight relationship and condition factor of fish after changes in the hydrological regime of Lake Buyo. **Materials and Methods:** A total of 4696 individuals belonging to 13 families and 24 species were collected by using gill nets and traps, measured and weighed between June 2018 and May 2019. Length-weight relationship (LWR), Fulton's condition (K) and relative condition (Kn) factors were analyzed from Standard Length (SL) and body weight (W). **Results:** Specimens exhibited length and weights varying between 2.4 and 53.6 cm (mean = 14.88±11.85) and 0.5-1278.0 g (mean = 177.18±311.70), respectively and the slope b value ranged between 2.149 and 3.341. Among all species, sixteen species showed negative allometric growth (Student's t test, b<3), four species, isometric growth (b = 3) and four species, positive allometric growth (b>3). Condition factor K varied between 0.79±0.06 and 4.44±0.65 while Kn, between 0.49±0.08 and 3.47±0.43 and the majority of fish species (83%) had K>1.4, reflecting good condition in the study area. **Conclusion:** There was a significant relationship between length with weight and both condition factor for all species. Analysis of size structure indicated a reduction in the length of populations tested and among them, the growth type of seven species was changed compared to previous studies. It was concluded that changes in the hydrological regime would have an impact on the length and growth parameters of most fish.

Key words: Length-weight relationship, allometric, isometric, Buyo, condition factor, hydrological regime

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Fish growth is the result of energy transformations in the aquatic ecosystem and its knowledge is essential to conduct a study of fish stocks and their evolution, as well as the biological production of the area. There are several factors that influence the variation of growth parameters such as environmental conditions, availability of prey, population density, individual variations and spatiotemporal distribution[1,2].

Lake Buyo, built on the Sassandra River, supports a diversity of wildlife with 45 fish species and has been the site of significant fishing activity in recent decades due to high population density[3,4]. Several studies showed that the zone of Lake Buyo that is located in Taï National Park represents a spawning area for many species of fish[5]. For example, *Coptodon zillii* built several nests near the shore to protect larvae and juveniles in this area[6]. However, this area is experiencing a significant drop in water level, the destruction of fish habitats due to the construction of a second dam (Soubré dam) downstream of Lake Buyo[7,8]. According to Kabré and Illé[9], the modification of the hydrological regime can effect sizes, growth and physiological conditions of fish.

Indeed, several ichthyological studies have focused on trophic and reproductive parameters[10,11], but few have been interested in growth. The studies were carried out by Tah *et al.*[12] on fish growth before the construction of Soubré dam, almost a decade ago. However, there are few data on the size-frequency and condition factor for fish of Lake Buyo. Indeed, the condition factor allows to follow the evolution of the overweight state of fish and is a good parameter for comparing the overall physiological state of fish population during a seasonal cycle or between basins with different ecological conditions[13]. Therefore, the present study aimed to provide baseline data on the length-weight relationship and condition factor and up-to-date information for some freshwater fish species.

MATERIALS AND METHODS

Study area: Lake Buyo is an artificial lake located on the Sassandra River in South-Western of Côte d'Ivoire (1°14'-7°03'N, 6°54'-7°31'W) (Fig. 1). It covers an area of 920 km^2 with a catchment area of 75 000 km^2. The vegetation of the region is primarily tropical rainforest[14]. Lake Buyo is located in a region under the influence of a subequatorial climate characterized by two seasons (rainy: February-November; dry: December-January). The hydrological regime of the lake depends on Sassandra River, tributaries of N'zo and rainfall of the region. Eleven sampling sites were chosen in the part of Lake Buyo located in Taï National Park which is an important nursery areas[5].

Sampling and statistical analysis: Specimens of fish were monthly collected from June 2018 to May 2019 in Lake Buyo, using experimental gill nets with eight different stretch mesh sizes (8, 10, 15, 20, 30, 40, 50 and 60 mm) and traps. Specimens were identified using Paugy *et al.*[15] and the scientific names of each species were checked with Fishbase[16]. The fish samples were preserved in 10% formalin and transported to the

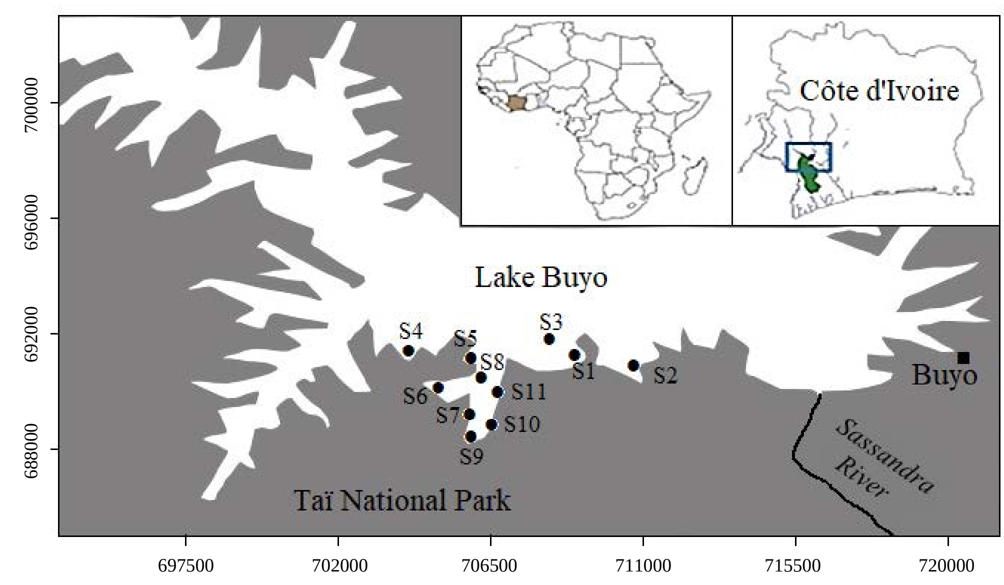

Fig. 1: Map showing the localization of sampling sites (S1 to S11) in Lake Buyo (Côte d’Ivoire)

laboratory. In the laboratory, Standard Length (SL) was measured to the nearest 0.1 cm by using a caliper and Weight was measured using a digital balance with an accuracy of 0.1 g. Only fish species presenting a sample size higher than 10 individuals were taken into account[17].

Coefficient of variation: The coefficient of variation (CV) of each species size was calculated using the following formula:

$$CV = 100 \times (SD/SL\ mean)$$

where, SD is standard deviation.

According to N'Da *et al.*[18], CV<2%, the size structure is very homogeneous; 2%≤CV≤30%, it is homogeneous; CV>30%, it is heterogeneous.

Length-weight relationship: Length-weight relationship was performed by establishing the logarithm-transformed linear model expressed as the following equation:

$$LogW = Loga + bLogSL$$

where, "a" representing the intercept of the regression line and "b" the slope of the relationship.

The student's t-tests (ts) were used to verify whether the slope "b" was significantly different from the theoretical value of 3 (p<0.05). Thus, according to Zar[19], ts value of each specie was calculated by expression:

$$ts = \frac{b-3}{sb}$$

where b is slope, sb is standard error of the slope.

$$s = \sqrt{\frac{\left(\frac{SW}{SFL}\right) - b^2}{n-2}}$$

where, SW is variance of body weight, SFL is variance of Standard Length, n is sample size.

In addition, ts to be compared with the table value of t for n-2 degrees of freedom for making inferences about the null hypothesis[20]. If t>ts (p>0.05), accept the null hypothesis that b = 3, the growth is isometric; if t<ts (p>0.05), b ≠ 3, the growth is allometric (negative allometric if b<3 and positive allometric if b>3).

The determination of correlation coefficient r^2 was used as an indicator of the quality of the linear regressions and a value close to 1 means a better model.

Condition factor: Fulton's condition factor[21] (K) was estimated from the relationship $K = 100W/SL^3$ to assess the fish condition in Lake Buyo. Furthermore, the relative condition factor[22] (K_n) was calculated by the equation:

$$K_n = W/W_C$$

where, W is the measured weight and Wc is the calculated weight[22]; $Wc = aSL^b$ and "a" and "b" values were obtained from the length-weight relationships.

Based on Morton and Routledge[23] the K value is divided into five categories as follows: Very bad (0.8-1.0), Bad (1.0-1.2), Balance (1.2-1.4), Good (1.4-1.6) and Very good (>1.6).

Statistical analysis: Statistical analysis was conducted by combining the data from the wet and dry seasons due to the limited number of sample sizes in certain months. Mean values of length-weight relationship and condition factor were thus considered to be representative of the study area regardless the sampling locations. For these reasons, the estimated length-weight relationship and the values of "b" should be considered as mean annual values, as proposed by several authors[24,25]. Correlation of Standard Length (SL), body weight (W), Fulton's condition factor (K) and relative condition factor (Kn) were tested using the Spearman rank correlation test. The Statistica 7.1 software was used and all statistical analyses were considered significant at 5% (p<0.05).

RESULTS

Descriptive statistics of length and weight measurements: A total of 4696 individuals belonging to 24 species and 13 families were sampled in this survey (Table 1). The examined specimens exhibited Standard length and weights varying between 2.4 and 53.6 cm (Mean±SD = 14.88±11.85) and 0.5-1278.0 g (Mean±SD = 177.18±311.70), respectively, over the whole year. The most abundant species (n≥100) sampled were *Enteromius macrops* (618), *Chrysichthys nigrodigitatus* (339), *Schilbe mandibularis* (348), *Clarias anguillaris* (121), *Synodontis punctifer* (437), *S. koensis* (203), *Oreochromis niloticus* (350), *Hemichromis fasciatus* (263), *Hemichromis bimaculatus* (158), *Sarotherodon melanotheron* (100) and *Coptodon zillii* (1058) belong to Cyprinidae, Schilbeidae, Clariidae, Mochokidae and Cichlidae. Among fish families, Cichlidae are represented by the largest number of species. Coefficients of variation (CV) of 8 species were greater than 30% indicating that the size structure is heterogeneous (Table 1). This group globally includes the large species of SL ranging between 14-53.6 cm. Of 16 species with a

Table 1: Statistical description of length and weight obtained for twenty-four fish species sampled between June 2018 to May 2019 in Lake Buyo, Côte d'Ivoire

			Standard Length			Weight	
Family	Species	n	Min-Max	Mean±SD	CV	Min-Max	Mean±SD
Clupeidae	*Pellonula leonensis* Boulenger, 1916	82	2.4-6.3	4.44±0.82	18.49	0.5-3.94	1.57±0.69
Arapaimidae	*Heterotis niloticus* (Cuvier, 1829)	11	13.7-40.2	25.38±8.53	33.64	35-838	282.73±261.04
Mormyridae	*Mormyrus rume* Valenciennes, 1847	49	15.5-53.6	31.84±10.31	32.39	30-1278	344.53±355.59
	Marcusenius ussheri (Günther, 1867)	11	13.0-19.5	15.47±2.04	13.20	31-98	56.27±21.13
Alestidae	*Brycinus longipinnis* (Günther, 1864)	51	5.8-8.3	7.16±0.55	7.74	5-15	10.60±2.10
	Brycinus imberi (Peters, 1852)	44	8.3-13.0	10.26±1.53	14.92	12-52	31.70±12.67
Distichodontidae	*Distichodus rostratus* Günther, 1864	20	10.8-27.5	14.03±4.76	33.93	28-398	80.85±104.47
Cyprinidae	*Enteromius macrops* (Boulenger, 1911)	618	4.9-8.0	6.80±0.72	10.66	2.8-14	8.18±2.75
	Enteromius ablabes (Bleeker, 1863)	13	4.4-5.9	5.26±0.59	11.39	2.5-6.8	4.74±1.34
Claroteidae	*Chrysichthys nigrodigitatus* (Lacepède, 1803)	339	7.5-35.0	14.39±5,03	35.00	8-886	97.03±127.5
	Chrysichthys maurus (Valenciennes, 1840)	62	7.5-21.8	16.02±2.88	17.99	14-280	107.53±63.27
Schilbeidae	*Schilbe mandibularis* (Günther, 1867)	348	10.0-25.0	15.32±3.06	19.98	11-159	50.03±33.25
Clariidae	*Clarias anguillaris* (Linnaeus, 1758)	121	18.5-48.0	31.10±6.51	20.94	62-970	340.73±222.03
Malapteruridae	*Malapterurus electricus* (Gmelin, 1789)	89	10.9-23.5	16.95±2.83	16.72	32-357	133.43±65.954
Mochokidae	*Synodontis punctifer* Daget, 1965	437	8.5-22.5	14.27±2.89	20.30	15-277	71.54±50.80
	Synodontis koensis Pellegrin, 1933	203	7.8-13.5	9.77±1.19	12.18	9-63	25.60±8.83
Latidae	*Lates niloticus* (Linnaeus, 1758)	220	7.5-37.4	15.33±5.32	34.74	8-941	104.93±131.14
Cichlidae	*Oreochromis niloticus* (Linnaeus, 1758)	350	3.0-25.0	12.31±5.09	41.41	3-646	112.83±142.28
	Hemichromis fasciatus Peters, 1857	263	5.2-14.4	9.21±1.72	18.68	7-83	26.87±16.28
	Hemichromis bimaculatus Gill, 1862	158	5.2-8.0	6.99±0.60	8.70	5-18	12.18±3.09
	Sarotherodon melanotheron Rüppell, 1852	100	4.5-19.0	9.86±3.27	33.23	6-202	53.35±49.33
	Sarotherodon galilaeus (Linnaeus, 1758)	27	5.5-14	9.58±3.48	36.38	8-102	48.88±37.57
	Coptodon zillii (Gervais, 1848)	1058	4.8-21.5	9.45±2.27	24.06	5-389	38.70±31.29
	Coptodon guineensis (Günther, 1862)	22	7.9-11.5	10.15±1.13	11.19	13-75	45.63±15.04
All species		4696	2.4-53.6	14.88±11.85	-	0.5-1278	177.18±311.7

n: sample size, CV: Coefficient of variation of length, Min: Minimum, Max: Maximum, SD: Standard deviation

Table 2: Summary of Condition factors, Length-weight relationships parameters and growth type for twenty-four fish species sampled between June 2018 to May 2019 in Lake Buyo, Côte d'Ivoire

			Parameters of LWR					
Species	K (Mean±SD)	Kn (Mean±SD)	r^2	a	b	sb	ts	Growth type
Pellonula leonensis	1.71±0.25	1.40±0.17	0.946	0.022	2.602	0.071	-5,665	A-
Heterotis niloticus	1.35±0.12	1.12±0.08	0.995	0.019	2.861	0.075	-1,867	A-
Mormyrus rume	0.79±0.06	0.66±0.05	0.993	0.012	2.995	0.045	-0,221	I
Marcusenius ussheri	1.45±0.08	1.19±0.07	0.979	0.020	2.829	0.135	-1,260	I
Brycinus longipinnis	2.87±0.42	3.47±0.43	0.643	0.044	2.149	0.229	-3,719	A-
Brycinus imberi	2.79±0.29	1.66±0.17	0.944	0.025	2.825	0.103	-1,653	I
Distichodus rostratus	2.22±0.26	1.44±0.17	0.978	0.023	2.856	0.097	-1,451	I
Enteromius macrops	2.49±0.34	0.89±0.12	0.880	0.016	3.308	0.049	6,335	A+
Enteromius ablabes	3.19±0.32	2.19±0.18	0.924	0.031	2.541	0.221	-2,082	A-
Chrysichthys nigrodigitatus	2.51±1.74	1.64±1.10	0.878	0.024	2.836	0.065	-2,020	A-
Chrysichthys maurus	2.40±0.42	1.70±0.29	0.894	0.025	2.786	0.122	-1,714	A-
Schilbe mandibularis	1.19±0.23	0.49±0.08	0.942	0.010	3.341	0.045	7,598	A+
Clarias anguillaris	1.02±0.14	1.10±0.15	0.945	0.018	2.803	0.063	-3,162	A-
Malapterurus electricus	2.56±0.38	1.77±0.26	0.921	0.026	2.788	0.087	-2,421	A-
Synodontis punctifer	2.15±0.37	1.03±0.18	0.934	0.017	3.071	0.039	1,789	A+
Synodontis koensis	2.69±0.55	2.92±0.53	0.732	0.038	2.371	0.101	-6,220	A-
Lates niloticus	2.15±0.28	1.38±0.18	0.980	0.022	2.878	0.027	-4,471	A-
Oreochromis niloticus	3.82±0.51	1.59±0.21	0.987	0.024	2.997	0.021	-2,475	A-
Hemichromis fasciatus	3.12±0.43	1.58±0.22	0.937	0.024	2.909	0.047	-1,932	A-
Hemichromis bimaculatus	3.51±0.55	2.54±0.38	0.715	0.035	2.528	0.132	-3,417	A-
Sarotherodon melanotheron	4.28±0.68	1.87±0.29	0.975	0.027	2.920	0.047	-1,695	A-
Sarotherodon galilaeus	4.44±0.65	2.53±0.21	0.994	0.035	2.684	0.051	-6,270	A-
Coptodon zillii	3.89±0.51	1.75±0.23	0.963	0.026	2.929	0.018	-3,965	A-
Coptodon guineensis	4.16±0.41	1.12±0.11	0.946	0.018	3.317	0.174	1,837	A+

SD: Standard deviation, K: Fulton's condition factor, Kn: Relative condition factor, I: Isometric, A-: Negative allometric, A+: Positive allometric, ts = Student's t test ($p<0.05$), sb: Standard error of the slope, b: Slope, r^2: Coefficient of correlation, LWR: Length-weight relationship

Table 3: Spearman rank correlation for Standard Length (SL), body weight (W), Fulton's condition factor (K) and Relative condition factor (K) of twenty-four fish species sampled between June 2018 to May 2019 in Lake Buyo, Côte d'Ivoire

Species	SL-W	SL-K	SL-Kn	W-K	W-Kn	K-Kn
Pellonula leonensis	0.967*	-0.608*	-0.157	-0.419*	0.049	0.859*
Heterotis niloticus	0.994*	-0.543	-0.178	-0.543	-0.178	0.872*
Mormyrus rume	0.986*	0.006	0.013	0.094	0.102	0.999*
Marcusenius ussheri	0.995*	-0.087	0.196	-0.055	0.227	0.936*
Brycinus longipinnis	0.790*	-0.439*	-0.062	0.126	0.503*	0.889*
Brycinus imberi	0.978*	-0.231	-0.091	-0.124	0.017	0.983*
Distichodus rostratus	0.960*	0.087	0.250	0.248	0.408	0.976*
Enteromius macrops	0.901*	0.183*	-0.055	0.537*	0.326*	0.963*
Enteromius ablabes	0.968*	-0.448	0.036	-0.355	0.138	0.857*
Chrysichthys nigrodigitatus	0.890*	-0.145*	0.085	0.146*	0.373*	0.960*
Chrysichthys maurus	0.944*	-0.176	0.043	0.082	0.265	0.956*
Schilbe mandibularis	0.970*	0.444*	0.020	0.616*	0.223*	0.881*
Clarias anguillaris	0.949*	-0.322*	0.015	-0.070	0.273*	0.911*
Malapterurus electricus	0.962*	-0.205	0.021	0.029	0.253	0.962*
Synodontis punctifer	0.964*	0.125*	0.038	0.347*	0.264*	0.995*
Synodontis koensis	0.824*	-0.347*	0.037	0.169	0.531*	0.872*
Lates niloticus	0.978*	-0.301*	-0.004	-0.149	0.151	0.939*
Oreochromis niloticus	0.992*	-0.027	-0.018	0.069	0.079	1.000*
Hemichromis fasciatus	0.961*	-0.154	-0.047	0.088	0.195*	0.991*
Hemichromis bimaculatus	0.815*	-0.237*	0.065	0.306*	0.585*	0.938*
Sarotherodon melanotheron	0.990*	0.009	0.152	0.101	0.243	0.980*
Sarotherodon galilaeus	0.971*	-0.791*	-0.054	-0.655*	0.148	0.570*
Coptodon zillii	0.982*	-0.101*	0.030	0.063	0.193*	0.989*
Coptodon guineensis	0.964*	0.698*	0.443	0.774*	0.530	0.934*

*: Correlation is significant at the 0.01 level

homogeneous size structure, *Pellonula leonensis*, *Brycinus longipinnis*, *Enteromius macrops*, *E. ablabes* and *Hemichromis bimaculatus* are small species whose maximum length is less than 10 cm. On the contrary, other large species such as *Schilbe mandibularis* (SLmax = 25 cm) and *Clarias anguillaris* (SLmax = 48 cm) belong to homogeneous species.

Length-weight relationship and condition factor: The parameters of length-weight relationships (LWR) are presented in Table 2. Correlation coefficient (r^2) are ranged from 0.643 (*Brycinus longipinnis*) to 0.995 (*Heterotis niloticus*) and all regressions were highly significant. Only 6 species, *B. longipinnis*, *E. macrops*, *Chrysichthys nigrodigitatus*, *C. maurus*, *Synodontis koensis* and *H. bimaculatus* had a coefficient $r^2<0.90$ while coefficients of 18 other species were higher than 0.90. The coefficient b ranged from 2.149 for *B. longipinnis* to 3.341 for *S. mandibularis* (Table 2). For 6 species (25%), the value of b is equal to 3 (Student t-test, p = 0.05) and these species showed isometric growth (I). For other species (75%), b was significantly different from 3 (Student t-test: p<0.05). Sixteen species (70.83%) of this last category showed a negative allometric growth (b<3) and four species *Enteromius macrops, Schilbe mandibularis, Synodontis puntifer* and *Coptodon guineensis* showed positive allometric growth (b>3).

Mean values of condition factors, K and Kn for twenty-four fish species from Lake Buyo is presented in Table 2. K ranged between 0.79±0.06 (*Mormyrus rume*) and 4.44±0.65 (*Sarotherodon galileaus*) whereas Kn varied between 0.49±0.08 (*S. mandibularis*) and 3.47±0.43 (*B. longipinnis*). All Cichlidae species showed a high condition factor (K>3) in the lake. Spearman rank correlation showed a significant correlation (p<0.01) between SL with W and K with Kn in all species but no significant correlation (p>0.01) was observed between SL and Kn (Table 3). Moreover, the test revealed that there was a strong correlation among W vs. K, W vs. Kn and SL vs. K in 8, 10 and 13 species, respectively.

DISCUSSION

The results showed a wide range of sizes, between 2.4 cm (*Pellonula leonensis*) to 53.6 cm (*Mormyrus rume*) indicated a non-selectivity of gillnets and traps used in data collection. The abundance of certain species such as *C. zillii, E. macrops, S. punctifer, C. nigrodigitatus and O. niloticus* may be evidence of shoaling behavior in the lake. Several authors have indicated the sizes of first maturity of *Malapterurus electricus* (15.27 cm♀ and 15.90 cm♂) and *Synodontis koensis* (5.82 cm♀ and 9.31 cm♂) in Lake Buyo[11,26]. In this study, specimens of *M. electricus* of LS≥16 cm and those of S. koensis of LS≥9 cm, represented more than 50% of the population tested, respectively. This suggests that juveniles, sub-adults and adults were considered in data analysis.

A significant correlation coefficient was observed for all tested species. These high values of correlation coefficients obtained in the annual assessment of LWRs mean a good quality of the prediction of linear regression for the analyzed fish species and suggested that extrapolation in future catches can be done for this size range in lake Buyo. The values of b varied between 2.149 and 3.341 and are the range of values (2-4) usually encountered in fishes[27]. Of the 36 species whose growth parameters were obtained in Lake Buyo before the change of hydrological regime linked to the construction of the Soubré dam[12], only 15 species appear in the present study. The LWRs for 8 species *Heterotis niloticus, Hemichromis fasciatus, Oreochromis niloticus, Distichodontus rostratus, Malapetrurus electicus, Synodontis koensis, Lates niloticus* and *Sarotherodon galilaeus* reported by previous study corroborate the negative allometric growth reported in our study (Student's t test, b<3). The negative allometric growth suggested that these species have a relatively slow growth rate and tend to be thinner. However, the isometric growth (Student's t-test, b = 3) observed for *Mormyrus rume* and *Marcusenius ussheri* in the current study was not in conformity with the negative allometry reported by Tah *et al.*[12]. Our results indicated that *C. nigrodigitatus*, *H. bimaculatus* and *C. zillii* showed negative allometric growth whereas the growth type was isometric for the first specie and positive allometric (Student's test, b>3) for the last two species[12]. *Schilbe mandibularis* and *Synodontis punctifer* displayed positive allometric growth in our study whereas it exhibited a negative allometric growth. Indeed, fish having a positive allometric growth, became heavier reflecting the optimal conditions of growth. These changes in growth patterns can be justified by environmental parameters linked to change in the hydrological regime. According to several authors, hydrological variability and seasonal changes have important consequences on the functioning of tropical hydro systems, biology and dynamics of fish populations[28,29]. Furthermore, the homogeneity of the size structure of most species and the reduction of maximum length was observed in this study when the same characteristics of capture gear were used[12]. For example, maximum length observed for *H. niloticus*, *M. rume*, *C. nigrodigitatus*, *H. fasciatus*, *O. niloticus* are 40.2 cm, 53.6 cm, 35.0 cm, 14.4 cm, 25.0 cm, respectively while sizes were 89 cm, 78 cm, 44.5 cm, 21 cm, 33 cm, respectively[12]. Indeed, the modification of growth type for many species may be a response to a decrease in sizes and may also reflect overfishing practices by local fishermen[30].

For nine other species, this work presented the first results of LWR in Lake Buyo. Among them, *B. imberi* which has isometric growth in this study presented negative allometric growth in Lake Ayame and *C. anguillaris* showed differences in growth type in both lakes[12]. For *P. leonensis* and *B. longipinnis*, the present study has shown that both species displayed a negative allometric growth while it was isometric in coastal rivers in Côte d'Ivoire[31]. Indeed, Da *et al.*[32] indicated that *S. galilaeus* showed negative allometric growth in Lake Bam while the growth was positively allometric in Kompienga reservoir. While it cannot conclusively explain the agreements and disagreements with published literature, it might be due to the condition of the species and the living environment. As widely known, Length-weight parameters are influenced by many factors such as the season and effects of different areas, gonad maturity, food availability, stomach fullness and differences in the number of specimens examined and the observed length ranges of the species caught[33-37]. However, these factors were not taken into consideration in this study. Condition factors have generally been used to assist in assessing the state of health and productivity of fish[13,36]. Two types of condition factors were used in the present study and calculations of relative condition factor (Kn) looked slightly the same as K. Fulton's condition factor (K) for 20 species (83%) is greater than 1.4, indicating a state of wellbeing for these fish species in Lake Buyo[23]. However, the high condition factor values for Cichlid species such as *Sarotherodon melanotheron* (4.28), *Oreochromis niloticus* (3.82), *Hemichromis fasciatus* (3.12), *Coptodon guineensis* (4.16) and *C. zillii* (3.89) confirmed the good adaptation of these species in lake environments, which is linked to their ability to support a wide range of environmental conditions unlike Mormyridae[38], as the case of *M. rume* with a K<1. Indeed, Cichlidae has a very varied diet and present ecological and behavioral adaptations, which justifies their abundance in lake environments[39-41]. Although the species *Clarias anguillaris* and *Schilbe mandibularis* are generally present in lake environments[42,43], the present study indicated a bad condition in Lake Buyo. Their condition seems justified by the homogeneous character of their population and may be due to intense exploitation in the lake environment because they are large species.

CONCLUSION

The present study reported the length-weight parameters of 9 species for the first time and updated the parameters for 15 species in Lake Buyo and their condition factors. Sixteen species had negative allometric growth and represented more than 66% of all the species examined, while only 4 species (about 17%) had positive allometric growth. Despite the good condition of most species, the present study seemed to indicate that Lake Buyo might be a relatively less favorable environment for the survival and development of *Mormyrus rume*, *Shilbe mandibularis* et *Clarias anguillaris*. These parameters could be used as a useful tool for more effective management of fisheries in Lake Buyo which is important nursery area.

SIGNIFICANCE STATEMENT

This study discovered the modification of fish growth parameters following the hydrological regime change of Sassandra river, which shows the need for conservation measures. The findings will be an effective tool for fishery biologists, managers and environmentalists to initiate better regulation options for the sustainable conservation of the remaining stocks of fish species in Lake Buyo.

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