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Length-Weight Relationship and Condition Factor of *Parachanna obscura* (Günther, 1861) in Man-Made Lake Ayamé 2 and Agnéby River (Côte d'Ivoire)

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ABSTRACT

Length-weight relationships and condition factor (*K*) of *Parachanna obscura* (Günther, 1861) were studied in the man-made Lake Ayamé 2 and Agnéby River. Specimens were sampled monthly from September 2015 to August 2016. The standard length and body total weight of each specimen were measured to nearest 1 mm and to nearest 1 g respectively. The sex was determined. The following formula: $W = a\ SL^b$ was used for describing the length-weight relationships. The condition factor (*K*) was calculated from the formula: $K = 10^5 W/SL^3$. The *b*-values for combined sexes, 3.069 and 2.981 indicated that *P. obscura* exhibited an isometric growth in the man-made Lake Ayamé 2 and Agnéby River (Agboville) respectively whereas in the Agnéby River (Agnéby-village) ($b = 3.222$), its growth was positive allometric type. The results of the seasonality of length-weight relationships revealed that the specimens' weight increases from dry to rainy seasons. In the two streams, the *K*-value was higher in the both seasons for both sexes. It was greater than 1 showing a good physiological condition of *P. obscura* in the man-made Lake Ayamé 2 and in the Agnéby River. Thus, this work had provided basic information which could enhance production of *P. obscura* in the man-made Lake Ayamé 2 and in Agnéby River.
KEY WORDS: *Parachanna obscura*, growth, isometry, allometry, well-being, Côte d'Ivoire

1. INTRODUCTION

A rational management of fishery resource requires an in-depth knowledge of its biology and ecology in general and biometric relationships in particular [1, 2]. Among them, the length-weight relationships are widely presented as useful tools in domains of fisheries sciences [3]. Indeed, length-weight relationship provides information on population parameters [4]. This relationship can be used for deriving comparisons between fish populations from regions or habitat groups [5]. In addition, length and weight data can indicate environmental changes. So, this tool is essential for understanding the human pressure level between regions [4].

The condition factor is of paramount importance in fishery sciences, as it provides information on condition of fish species and the entire community [6]. It is also significant for management and conservation of natural populations [6]. This factor is strongly influenced by under-world biotic and abiotic environmental conditions and can be often used to compare two or more co-specific populations living in similar or different conditions [7]. Thus, it can be used as an index to assess the ecological status of the aquatic ecosystem in which fish live.

Parachanna obscura belongs to the family Channidae. This species has a wide range of distribution in inland water of Tropical Africa [8]. Thus, it occupies several varieties of habitats such as streams, rivers and lakes [9].

The length-weight relationship and condition factor of *P. obscura* have been mostly reported in Nigeria [10, 11, 12, 13]. In Côte d'Ivoire, few studies have been conducted on length-weight relationships and condition factor of *P. obscura* [14, 15]. However, no information is available on fish population biology such as, length-weight relationships and condition factor of *P. obscura* from man-made Lake Ayamé 2 and Agnéby River where it presented an economic interest for people. Therefore, the aim of the present study is to assess growth patterns and heath conditions according to sexes and seasons.

2. MATERIAL AND METHODS

2.1. Study areas

The present study was conducted in the man-made Lake Ayamé 2 and the Agnéby River, two coastal rivers situated in the South-East region of Côte d'Ivoire (Fig. 1). The impoundment of the Bia River comprises two dams. The man-made Lake Ayamé 2 is located between these dams (5°34′ - 5°37′ N and 3°09′ - 3°10′ W).

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This Lake has artificial outflow provoked by shutting and opening dams. It has an average surface of 7 km² [16] and its opening background is characterised by muddy substrate with a low transparency. Also, the substrate was composed of rock and dry wood. The pool is covered by aquatic plants. Five sampling stations are selected on the Lake.

The Agnéby River is a continuum River which rises in Affery in the East region and enters Ebrié lagoon in the South region of Côte d'Ivoire [17]. Three and two sampling stations are selected respectively in the upper (Agboville: 5°56′ N and 4°14′ W) and lower (Agnéby-village: 5°19′ N and 4°21′ W) of the Agnéby River (Fig. 1). Agboville sampling stations are subject to drying during the long dry season while Agnéby-village stations are characterized by the permanence of water.

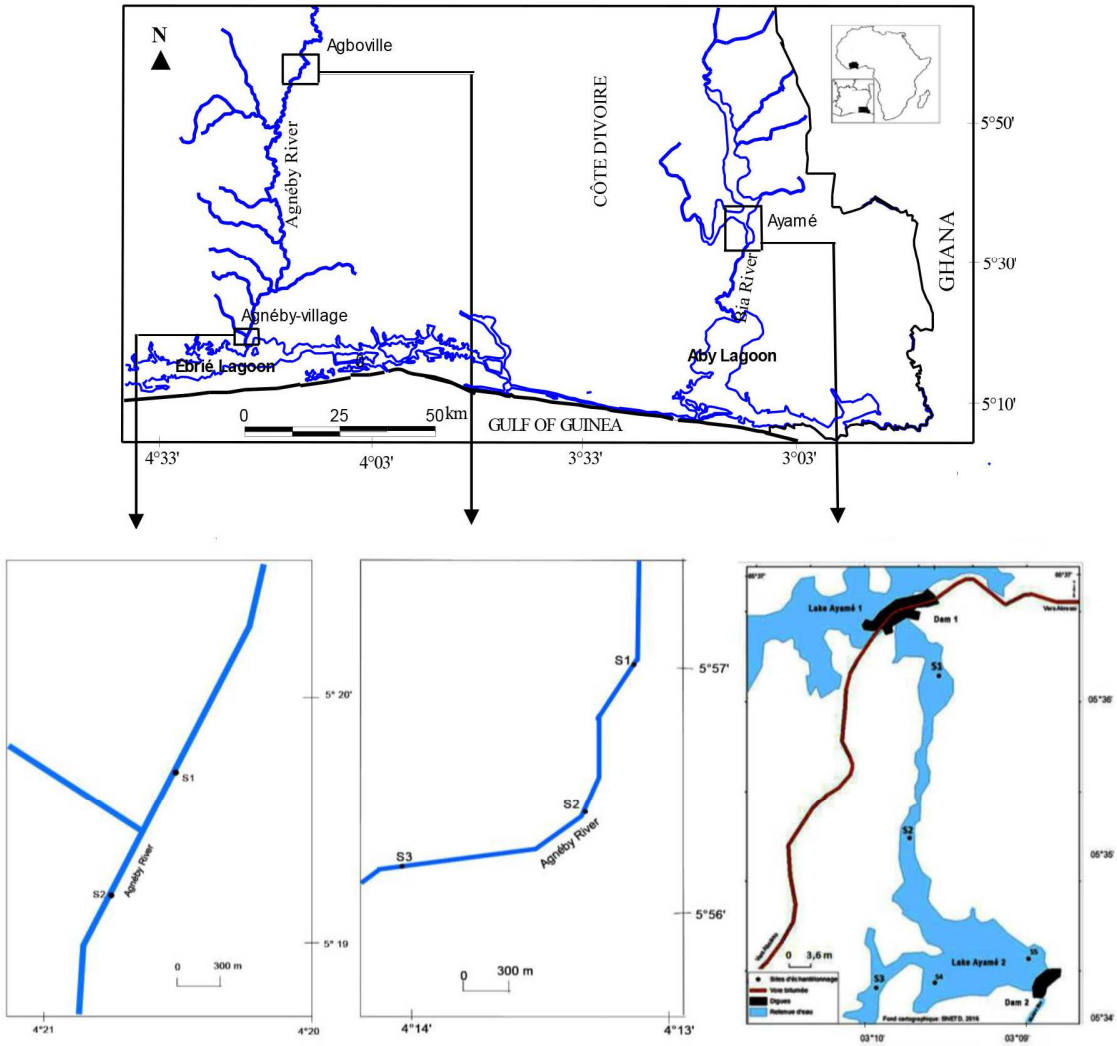

Fig.1: Map showing the localities (□) and sampling sites (•) of *Parachanna obscura* in Agnéby River and man-made Lake Ayamé 2

These aquatic ecosystems are localized in a region under the influence of equatorial transition climate characterized by two rainy seasons separated by a short dry period from August to September, and a more pronounced one from December to March [18].

2.2. Sampling and data analysis

The samples of *Parachanna obscura* were collected monthly from September 2015 to August 2016 on three localities: Ayamé (man-made Lake Ayamé 2), Agboville and Agnéby-village (Agnéby River). Experimental fishing was done with gill-nets, traps and the samples were completed by commercial fishing. The

standard length of each specimen was measured to the nearest 1 mm on a measuring board. The individual body weight was measured to nearest 1 g using electronic weighing balance. The sex was determined after the dissection of the fish. The length-weight relationships of fish are estimated from the formula: $W = a\ SL^b$, where W is the total body weight of fish in gram (g), *a* is a constant, SL is standard length of fish in millimetre (mm) and *b* is the allometry coefficient. The value of parameters (*a* and *b*) was determined by a linear transformation of previous equation [14]. This transformation is of type: Log (W) = Log (*a*) + *b* Log (SL). *b*-value gives the information on the growth of fish. In order to verify if calculated *b* was significantly different from 3, the Students *t*-test was used as expressed by the equation according to Sokal and Rohlf, [19]: $t_s = (b-3)/SE$ where t_s is *t*-test value and *SE* the standard error of the allometry coefficient *b*. The type of growth was determined using the t_s value: if $t_s \geq 1.96$ this implies that $b \neq 3$ so an allometric growth (negative allometry if $b < 3$ and positive allometry if $b > 3$) and if $t_s < 1.96$ the implication is $b = 3$ so an isometric growth.

The condition factor (*K*) was calculated according to Mouneiné [20], thus $K = 10^5 W/SL^3$; where *K* is condition factor, SL is standard length (mm) of fish and W the total body weight (g) of fish. If $K \geq 1$ this implies a good condition and well-being of fish whereas $K < 1$ indicates a bad physiological fish condition [21].
The degree of association between the variables was assessed by the determination coefficient (R^2). The Kruskal-Wallis and Mann-Whitney *U*-test have been used to compare the size and the condition factor by sites, sexes and seasons. All the statistical analyses were considered at significance level of 5 % ($p < 0.05$) using STATISTICA 7.1.

3. RESULTS

3.1. Size and weight distribution

The standard length and body weight of *Parachanna obscura* in man-made Lake Ayamé 2 and Agnéby River for sampling period are presented in table 1.

In the man-made Lake Ayamé 2, the female standard length ranged from 130 mm to 385 mm with a mean of 239 ± 49 mm in the dry season. It varied from 128 mm to 355 mm with a mean to 237 ± 46 mm in rainy season. The body weight ranged between 31 g and 574 g (mean: 216 ± 128 g) and from 25 g to 621 g (mean: 208 ± 123) respectively in the dry and the rainy seasons. For males, length ranged from 130 mm to 440 mm with a mean of 264 ± 60 mm, weight varied between 42 g and 688 g with a mean of 311 ± 175 g in dry season while length ranged from 160 mm to 350 mm with an average of 260 ± 51 mm and weight ranged between 48 g and 609 g with a mean of 270 ± 154 g in the rainy season.

Table 1: Standard length and body weight by sex and by season *Parachanna obscura* captured in the man-made Lake Ayamé 2 and Agnéby River

				Standard length (mm)			Weight (g)		
Sites	**Sexes**	**Seasons**	**n**	**Min**	**Max**	**Mean ± SD**	**Min**	**Max**	**Mean ± SD**
Man-made Lake Ayamé 2	Female	DS	66	130	385	239 ± 49	31	574	216 ± 128
		RS	39	128	355	237± 46	25	621	208 ± 123
	Male	DS	64	130	440	264 ± 60	42	688	311 ± 175
		RS	36	160	350	260 ± 51	48	609	270 ± 154
Agnéby River (Agboville)	Female	DS	46	120	230	167 ± 28	21	182	68 ± 36
		RS	37	128	230	162 ± 28	30	143	68 ± 34
	Male	DS	47	133	300	173 ± 32	34	347	78 ± 54
		RS	20	140	210	179 ± 22	30	143	86 ± 36
Agnéby River (Agnéby-village)	Female	DS	20	155	300	224 ± 58	55	418	200 ± 152
		RS	24	125	230	197 ± 40	24	201	137 ± 66
	Male	DS	44	145	425	273 ± 88	44	1273	444 ± 412
		RS	32	150	360	251 ± 63	55	1015	337 ± 323

n = specimen number, Min = minimum, Max = maximum, SD = standard deviation, DS = dry season and RS = rainy season

In the Agnéby River (Agboville stations), for female population, length varied from 120 mm to 230 mm with a mean of 167 ± 28 mm and from 128 mm to 230 mm with a mean of 162 ± 28 mm in the dry and rainy seasons respectively. Concerning the weight, it ranged between 21 g and 182 g with an average of 68 ± 36 g in the dry season and from 30 g to 143 g with an average of 68 ± 34 g in the rainy season. For males, the smallest measured standard lengths were 133 mm and 140 mm in the dry and rainy seasons respectively. The heaviest sizes (standard length) were 300 mm in the dry season and 210 mm in the rainy season. Average standard lengths were 173 ± 32 mm and 179 ± 22 mm for dry and rainy seasons respectively. The weight ranged between 34 g and 347 g with a mean of 78 ± 54 g and from 30 g to 143 g with a mean of 86 ± 36 g.

In the Agnéby River (Agnéby-village), the standard lengths of females ranged from 155 mm to 300 mm and the weight varied between 55 g and 418 g in the dry season. During the rainy season, length varied from 125 mm to 230 mm with an average of 197 ± 40 mm and the weight varied between 24 g and 201 g with an average of 137 ± 66 g. For males, the smallest lengths were 145 mm and 150 mm in the dry and the rainy seasons respectively while the heaviest lengths were 425 mm and 360 mm for the dry and rainy seasons respectively. The

weight varied from 44 g to 1273 g with a mean of 444 ± 412 g in the dry season. In the rainy season, it ranged from 55 g to 1015 g with a mean of 337 ± 323 g.

The Kruskal Wallis test indicated that the specimens captured in the Agnéby River (Agboville stations) were smaller and less heavy than those of man-made Lake Ayamé 2 and Agnéby River (Agnéby-village stations) ($p < 0.05$).

3.2. Length-weight relationships

Length-weight relationship parameters of *P. obscura* are displayed in table 2. For females, the relationship between fish standard length and weight of man-made Lake Ayamé 2, Agnéby River (Agboville stations) and Agnéby River (Agnéby-village stations) was derived respectively as $W = 0.007*SL^{3.017}$, $W = 0.008*SL^{2.973}$ and $W = 0.005*SL^{3.237}$. For male population, those equations are $W = 0.006*SL^{3.106}$, $W = 0.009*SL^{2.936}$ and $W = 0.005*SL^{3.212}$ respectively in man-made Lake Ayamé 2, Agnéby River (Agboville stations) and Agnéby River (Agnéby-village stations). The *b*-values (3.017 and 2.973) did not differ statistically (t-test, $ts < 1.96$) from isometric value ($b = 3$), indicating an isometric growth pattern for females in man-made Lake Ayamé 2 and in the Agnéby River (Agboville).

The corresponding exponent *b*-values were 3.106 and 2.936 for males respectively in man-made Lake Ayamé 2 and Agnéby River (Agboville). These *b*-values revealed a positive and negative allometric growth pattern respectively in man-made Lake Ayamé 2 and Agnéby River (Agboville) for male population. For both combined sexes, the growth was isometric type (Table 1). In the Agnéby River (Agnéby-village), the corresponding exponent *b*-values were 3.237, 3.212 and 3.222 respectively for females, males and both combined sexes. These *b*-values were greater than 3 and indicated positive allometric growth pattern ($t_s > 1.96$) for *P. obscura* in the Agnéby River (Agnéby-village).

Length-weight relationship parameters of *P. obscura* in man-made Lake Ayamé 2 and Agnéby River for both dry and rainy seasons were presented in table 3. In the dry season, for females, a *b*-value of 2.888 and 2.909 was found in the man-made Lake Ayamé 2 and Agnéby River (Agboville) respectively while in the rainy season, *b* was 3.116 and 3.227 respectively in the man-made Lake Ayamé 2 and Agnéby River (Agboville).

Table 2: Length-weight relationship parameters and growth type of *Parachanna obscura* in the man-made Lake Ayamé 2 and Agnéby River according to sex

Sites	Sex	n	R^2	a	b	t_s	SD	Type of growth
Man-made Lake Ayamé 2	Female	105	0.950	0.007	3.017	0.487	0.035	I
	Male	100	0.962	0.006	3.106	2.731	0.039	A^+
	Both sexes	205	0.957	0.007	3.069	1.685	0.041	I
Agnéby River (Agboville)	Female	83	0.905	0.008	2.973	0.906	0.030	I
	Male	67	0.957	0.009	2.936	2.300	0.028	A^-
	Both sexes	150	0.931	0.008	2.981	0.862	0.022	I
Agnéby River (Agnéby-village)	Female	44	0.989	0.005	3.237	2.745	0.086	A^+
	Male	76	0.985	0.005	3.212	2.847	0.075	A^+
	Both sexes	120	0.987	0.005	3.222	3.652	0.061	A^+

n = specimens number, R^2 = determination coefficient, a = intercept, b = allometry coefficient, t_s = calculated value of Student test, SD = standard deviation, I = isometric pattern, A^+ = positive allometric pattern and A^- = negative allometric pattern

Table 3: Length-weight relationship parameters and growth type of *Parachanna obscura* in the man-made Lake Ayamé 2 and Agnéby River by sex and by season

Sites	Sexes	Seasons	n	R^2	a	b	t_s	SD	Type of growth
Man-made Lake Ayamé 2	Females	DS	66	0.919	0.004	2.888	2.060	0.054	A^-
		RS	39	0.970	0.006	3.116	2.626	0.044	A^+
	Males	DS	64	0.845	0.022	2.591	4.127	0.099	A^-
		RS	36	0.969	0.006	3.089	1.801	0.049	I
Agnéby River (Agboville)	Females	DS	46	0.915	0.001	2.909	2.709	0.034	A^-
		RS	37	0.930	0.005	3.227	5.602	0.040	A^+
	Males	DS	47	0.966	0.011	2.848	5.731	0.026	A^-
		RS	20	0.959	0.001	3.927	12.912	0.072	A^+
Agnéby River (Agnéby-village)	Females	DS	20	0.995	0.007	3.065	0.650	0.099	I
		RS	24	0.997	0.003	3.475	12.929	0,037	A^+
	Males	DS	44	0.990	0.006	3.147	2.309	0.063	A^+
		RS	32	0.976	0.004	3.337	2.106	0.160	A^+

n = specimen number, R^2 = determination coefficient, a = intercept, *b* = allometry coefficient, ts = value of *t*-test, SD = standard deviation, I = isometric, A^+ = positive allometric pattern, A^- = negative allometric pattern, DS = dry season and RS = rainy season

For males, *b*-value was 2.591 and 2.848 respectively in the man-made Lake Ayamé 2 and Agnéby River (Agboville) during the dry season. In the rainy season, it was 3.089 and 3.927 in the man-made Lake Ayamé 2 and Agnéby River (Agboville) respectively. The Student test revealed that these *b*-values differed significantly from theoretical value 3 ($ts > 1.96$) except to 3.089. This implies that for captured females in the man-made Lake Ayamé 2 and Agnéby River (Agboville), the growth was negative and positive allometric pattern in the dry and the rainy seasons respectively. For males, these values indicated that the growth was negative pattern during the dry season while in the rainy season; it was isometric type in the man-made Lake Ayamé 2 and positive allometric pattern in the Agnéby River (Agboville).

In the Agnéby River (Agnéby-village), the growth was isometric pattern for females while for males, it was positive pattern during the dry season. In the rainy season, *P. obscura* growth was positive pattern for both sexes.

3.3. Condition factor (*K*)

The condition factor of *P. obscura* was studied by sex and by season, the results were indicated in table 4. In the man-made Lake Ayamé 2, *P. obscura* condition factor (*K*) ranged between 0.719 and 2.300 with a mean of 1.334 ± 0.210, from 0.756 to 1.722 with a mean of 1.295 ± 0.173 respectively in the dry and rainy seasons for females. For males, the smallest *K*-values were 0.341 and 1.092 while the heaviest values were 2.072 and 1.593 respectively in the dry and rainy seasons. The means were 1.384 ± 238 and 1.301 ± 301 respectively in the dry and rainy seasons.

In the Agnéby River (Agboville stations), *K*-value varied from 0.833 to 3.048 with an average of 1.517 ± 0.517 for females, between 0.966 and 2.370 with an average of 1.364 ± 0.317 for males in the dry season while in the rainy season, it ranged from 1.067 to 1.738 with an average of 1.300 ± 0.136 for females and from 1.037 to 1.540 with a mean of 1.313 ± 0.168 for males.

In the Agnéby River (Agnéby-village stations) *K*-value ranged between 1.296 and 1.474 with a mean of 1.385 ± 0.079 in the dry season while during the rainy season, it varied from 1.178 to 1.519 with a mean of 1.392 ± 0.157 for female. For male, it ranged from 1.244 to 1.912 with a mean of 1.461 ± 0.172 in the dry season and between 1.135 and 1.965 with a mean of 1.563 ± 0.309 in the rainy season.

Mann-Whitney's test indicated significant difference between *K*-value in dry and rainy seasons for female population in the Agnéby River ($p < 0.05$). For both sexes, the smallest value of the mean of *K* (1.397) was found in the Agnéby River (Agboville) while the heaviest value ($K = 1.562$) was noted in Agnéby River (Agnéby-village). Kruskal-Wallis's test revealed that the difference of condition factor of the specimens (combined sexes) were significant between the three localities ($p = 0.005$).

4. DISCUSSION

The specimens caught in the Agnéby River (Agboville stations) were smaller and less heavy than those of man-made Lake Ayamé 2 and Agnéby River (Agnéby-village). This observed difference of size might be due to the intensity and fishing methods that differ from on site to another. Indeed, the fishing was officially forbidden on man-made Lake Ayamé 2 whereas it's not in Agnéby River.

Table 4: Values of condition factor by season and by sex of *Parachanna obscura* caught in the man-made Lake Ayamé 2 and Agnéby River

Sites	Sexes	Seasons	n	Min	Max	Mean ± SD
Man-made Lake Ayamé 2	Female	DS	66	0.719	2.300	1.334 ± 0.210
		RS	39	0.756	1.722	1.295 ± 0.173
	Male	DS	64	0.341	2.072	1.384 ± 0.238
		RS	36	1.092	1.593	1.301 ± 301
Agnéby River (Agboville)	Female	DS	46	0.833	3.048	1.517 ± 0.517
		RS	37	1.037	1.738	1.300 ± 0.136
	Male	DS	47	0.966	2.370	1.364 ± 0.317
		RS	20	1.067	1.540	1.313 ± 0.168
Agnéby River (Agnéby-village)	Female	DS	20	1.296	1.474	1.385 ± 0.079
		RS	24	1.178	1.519	1.392 ± 0.157
	Male	DS	44	1.244	1.912	1.461 ± 0.172
		RS	32	1.135	1.965	1.563 ± 0.309

n = specimen number, DS = dry season, RS = rainy season, Min = minimum, Max = maximum and SD = standard deviation

However, although the fishing was not forbidden on the Agnéby River, the fishing gears (gill nets) usually used by the fishermen in the Agnéby River (Agneby village stations) were not appropriate and efficient for catching *P. obscura* that live in the bottom where they move little. Consequently, *P. obscura* was only caught

accidentally by fishermen explaining thus, the presence of large specimens in this environment. Unlike Agnéby-village stations, the sites of Agboville were characterized by a massive use of gill nets and traps (hoop nets). The latter gear is very efficient to catch *P. obscura* regularly. In addition, ichthyo toxins such as pesticides are used by riverside residents to maximize fish catches during the dry season. It is known that the ichtyo toxins using kills the fishes. Consequently, it will provoke the development of a population mainly composed of young individuals. The small size of *P. obscura* recorded at the Agboville station might be due to these reasons.

The relationship between standard length and total weight revealed that for both combined sexes, *P. obscura* exhibited isometric growth pattern in the man-made Lake Ayamé 2 and Agnéby River (Agboville) while it exhibited positive allometric growth pattern in the Agnéby River (Agnéby-village). This growth pattern showed that the specimens of *P. obscura* become more robust as they increase in length indicating a balance between the increases in length and in weight during the growth in the lake and River (Agnéby-village). But, the rate of increase in length was less than the rate of increase in weight in the Agnéby River (Agnéby-village). These results differ from those obtained by Tah et al. [22] in Lakes Ayamé 1 and Buyo (Côte d'Ivoire), by Obasohan et al. [12] in Ibiekuma stream (Nigeria) and by Bolaji [10] in the Igwu and Itu River's wetland (Nigeria) who had reported negative allometric growth pattern for *P. obscura*. According to Froese [23], difference of growth pattern might be due to several factors such as food availability, environmental conditions, maturity stages and sampling period. In the case of present study, in addition of food availability, the isometric growth pattern of *P. obscura* could be explained by environmental conditions of the different habitats. Indeed, the ideal living habitat of this fish species reported by Bonou and Teugels [9] is calm habitats where it is quiet. The Lake Ayamé 2 conditions respond to this requirement of *P. obscura* because its localization between two dams stops strongly the flooding and also because any human activities are forbidden. In the Agnéby River (Agboville), the positive allometry obtained revealed a growth retardation which would be due to the intensity of fishing in this environment.

In this study, *P. obscura* exhibited negative growth for both female and male sexes in dry season in Lake Ayamé 2 and Agnéby River (Agboville stations). In rainy season, the growth was positive allometric for these populations except for sampled males in man-made Lake Ayamé 2 which had isometric growth pattern. In the Agnéby River (Agnéby-village), the females were isometric growth pattern in dry season while the males were positive allometric growth for both dry and rainy seasons. Females were also, positive allometric growth in rainy season. These results imply that the fish weight increases from dry to rainy seasons. This may be attributed to the favourable conditions of these aquatic environments during the rainy season. Indeed, it was reported that the nutrient rate increases in the streams during the rainy season. [24]. Similar observation was made on *Synodontis schall* in man-made Lake Ayamé 2 [25]. In addition of food availability, the increase of the female weight from dry to rainy seasons could be attributed to gonad maturation. Indeed, *P. obscura* breeds mainly during the rainy season as reported by Olurin and Savage [11]. The increase of females' weight under the influence of gonads during the rainy season [26] should explain equally the positive allometry growth observed in the females during this period.

Condition factor is a morphometric index used to assess physiological status of fish. Besides environmental conditions, it was influenced by fattening, differences in size or age [27, 28]. In the present study, the *K*-value was greater than 1 showing a well-being of *P. obscura* in the two streams during the dry and the rainy seasons. The good physiological condition of *P. obscura* notably in the man-made Lake Ayamé 2 during the dry season where the water is not renewed and there is depletion in oxygen [25] could be attributed to its adaptation to life in hypoxic environments. Indeed, Channidae possess a cavity above the gill chamber, which functions as an accessory respiratory organ. This organ is in the form of two pharyngeal supra-branchial chambers allowing them to breathe directly atmospheric air [9]

5. CONCLUSION

The size distribution indicated that *Parachanna obscura* captured in the Agnéby River (Agboville stations) was smaller and less heavy than those of Lake Ayamé 2 and Agnéby River (Agnéby-village stations). The results of length-weight relationships revealed an isometric growth in the man-made Lake Ayamé 2 and Agnéby River (Agboville stations) and positive allometric growth pattern in the Agnéby River (Agnéby-village stations) for both combined sexes. The seasonal variation of length-weight relationship parameters showed that fishes tend to become thinner as they grow larger during dry season and become more robust as they increase in length during rainy season. The condition factor showed that this fish species was in good physiological state in the man-made Lake Ayamé 2 and in the Agnéby River in the both seasons.

6. REFERENCES

1. Greiner, R. and D. Gregg, 2010. Considering recreational catch and harvest in fisheries management at the bio-regional scale. Fish. Manag. Ecol., 17 (4): 336-345.

2. Naeem, M., N. T. Narejo, A. Salam, S. A. Rasool, M. Khalid and A. Ishtiaq, 2015. Length-weight relationships of juvenile *Pangasius* with special reference to body size and condition factor. Sindh Univ. Res. J. (Sci. Ser.), 47(3): 523-526.

3. Ecoutin, J. M. and J. J. Albaret, 2003. Relation longueur-poids pour 52 espèces de poissons des estuaires et lagunes de l'Afrique de l'Ouest. Cybium, 27: 3-9.

4. Niyonkuru, C. and P. Lalèyè, 2012. A comparative ecological approach of the Length-Weight relationships and Condition factor of *Sarotherodon melanotheron* Rüppell, 19852 and *Tilapia guineensis* (Bleeker 1862) in Lakes Nokoué and Ahémé (Benin, West Africa). Intl. J. Busin. Hum. Technol., 2 (3): 41-50.

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

6. Muchlisin, Z. A., M. Musman and M. N. S. Azizah, 2010. Length relationships and condition factor of tow threatened fishes, *Rasbora tawarensis* and *Poropuntius tawarensis,* endemic to Lake Laut Tawar, Aceh Province. Ind. J. Appl. Ichthyol., 26 (6): 949-953.

7. Edah, B. A., A. O. Akande, C. Ayo-Olalusi, and A. Olusola, 2010. Computed the wet weight-dry weight relationships of *Oreochromis niloticus* (Tilapia). Internet J. Food Saf., 12: 109-116.

8. Courtenay, W. R. Jr. and J. D. Williams, 2004. Snakeheads (Pisces, Channidae) – A biological synopsis and risk assessment. U.S. Geological survey Circular, pp: 125-126.

9. Bonou, C. A. and G. G. Teugels, 1985. Révision systématique du genre *Parachanna* Teugels et Daget 1984 (Pisces : Channidae). Rev. Hydrobiol. Trop., 18 (4): 267-280.

10. Bolaji, B. B., T. U. Mfon and D. I. Utibe, 2011. Preliminary study on the aspects of the biology of snakehead fish *Parachanna obscura* (Günther, 1861) in a Nigerian wetland. Afr. J. Food Agric. Nutr. Dev., 11 (2): 1-10.

11. Olurin, K. B. and O. D. Savage, 2011. Reproductive biology, length-weight relationship and condition factor of the African snake head, *Parachanna obscura*, from River Oshun, South-west Nigeria. Intl. J. Fish. Aquac., 3 (8): 146-150.

12. Obasohan, E. E., E. E. Obasohan, J. A. Imasuen and C. E. Isidahome, 2012. Preliminary studies of the length-weight relationships and condition factor of five fish species from Ibiekuma stream, Ekpoma, Edo state, Nigeria. J. Agric. Res. Dev., 2 (3): 061-069.

13. Oboh, I. P. and M. O. Omoigberale, 2014. Length-weight Relationship and Fecundity of *Parachanna obscura* (Ophiocephaliformes: Channidae) in Ovia River, Southern Nigeria. Centre point J., 20 (2): 53-66.

14. Konan, A. K. F., M. Ouattara, A. Ouattara and G. Gourène, 2007. Weight-length relationship of 57 fish species of the coastal rivers in south-eastern of Ivory Coast. Ribarstvo 65 (2): 49-60.

15. Tah, L., K. S. Da Costa, N. J. Kouassi and J. Morea, 2009. Effort de pêche et production piscicole au lac d'Ayamé I (bassin de la Bia ; Côte d'Ivoire) après le départ des pêcheurs « Bozos ». Agron. Afr., 21 (1): 103-115.

16. Da Costa, K. S., G. Gourène, L. Tito De Morais and D. F. E. Van Den Audenaerde, 2000. Caractérisation des peuplements ichtyologiques de deux fleuves côtiers ouest-africains soumis à des aménagements hydro-agricoles et hydroélectriques. Vie et milieu, 50 (2): 65-77.

17. Goula, B. T. A., Z. A. Kouadio, K. E. Kouakou, Y. A. N'Go, C. N'Doumé and I. Savané, 2009. Simulation du comportement hydrologique du bassin versant de l'Agnéby, en Côte d'Ivoire. Rev. Ivoir. Sci. Technol., 13: 91-113.

18. Savané, I. and M. Konaré, 2010. Climate. In: Biodiversity Atlas of West Africa, volume III: Côte d'Ivoire (eds A. Konaté. and D. Kampmann), pp: 124-125.

19. Sokal, R. R. and F. J. Rohlf, 1987. Introduction to Biostatistics 2nd Edn. Freeman publication, New York, pp: 93-131.

20. Mouneiné, N., 1981. Remarques sur la relation longueur/poids et le facteur de condition chez les poissons. Cybium, 5 (4): 77-85.

21. Tiogue, T. C., M. T. E. Tomedi, D. Nguenga and J. Tchoumboue, 2010. Caractéristiques de morphologie générale et de croissance du Cyprinidae africain *Labeobarbus batesii* dans la plaine inondable des Mbô, Cameroun*.* Intl. J. Biol. Chem. Sci*.,* 4 (6): 1988-2000.

22. Tah, L., G. Gooré Bi and K. S. Da Costa, 2012. Length-weight relationships for 36 freshwater fish species from two tropical reservoirs: Ayamé I and Buyo, Côte d'Ivoire. Intl. J. Trop. Biol. Conserv*.,* 60 (4): 1847-1856.

23. Froese, R., 2006. Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations. J. Appl. Ichthyol., 22: 241-253.

24. Castillo-Rivera, M., 2013. Influence of rainfall pattern in the seasonal variation of the fish abundance in a tropical estuary with restricted marine communication. J. Water Resour. Prot., 5: 311-319.

25. Blahoua, K. G., R. N. Etilé, T. A. Bedia, S. S. Yao and V. N'Douba, 2017. Seasonal variation in the length-weight relationships and condition factor of *Synodontis schall* (Bloch and Schneider, 1801) (Siluriformes: Mochokidae in man-made Lake Ayamé 2 (Côte d'Ivoire). Intl. J. Fish. Aquac. Stud., 5(1): 173-177.

26. Lalèyè, A. P., J. C. Philipart and J. C. Heymans, 1995. Cycle annuel de l'indice gonadosomatique et la condition chez deux espèces de *Chrysichthys* (Siluriformes, Bagridae) au lac Nokoué et à la lagune de Port-Novo au Bénin. Cybium, 19 (2): 131-142.

27. Quignard, J. P. and R. Man-Wai, 1983. Relation taille-poids et coefficient de condition de *Diplodus Sargus* o^{+} et o^{++} de deux étangs palavasiens : Prevost et Mauguio. Cybium*,* 7 (3): 31-41.

28. Anwa-Udondiah, E. P. and P. C. G. Pepple, 2011. Length-weight relationship and Condition factor of Blackchin Tilapia (*Sarotherodon melanotheron*) cultured in sheltered outer tanks. Proceedings of the 26th Annual Conference of the Fisheries Society of Nigeria, pp: 98-102.