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RESEARCH ARTICLE

SEASONAL VARIATIONS IN CONDITION FACTOR OF TWO FRESHWATER FISH SPECIES BELONGING TO THE GENUS *SCHILBE* OKEN, 1817 (*SCHILBE MANDIBULARIS* AND *S. INTERMEDIUS*) IN AN ESTUARINE ECOSYSTEM, AGHIEN LAGOON (CÔTE D'IVOIRE, WEST AFRICA).

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Abstract

We studied changes in condition factor (CF) of two fish species belonging to the genus *Schilbe*: *Schilbe mandibularis* and *S. intermedius* in the estuarine system of Aghien Lagoon. Fish populations were sampled monthly during one year from July 2014 to June 2015. Samplings were performed by experimental fishing using gillnets. Means of condition factor were determined for the four climatic seasons that characterize the study site. Results indicated that the global condition factor including both climatic seasons was significantly higher in *S. mandibularis* than that obtained in *S. intermedius* ($p < 0.05$). Condition factor showed high variations ($p < 0.05$) between climatic seasons in *S. mandibularis*. The highest average (CF = 2.83) was recorded in the long dry season while the lowest (CF = 0.09) was obtained in the short dry season. Concerning *S. intermedius*, condition factor showed relatively low variations but differed significantly ($p < 0.05$) between climatic seasons. The highest average (CF = 0.80) occurred in the long wet season while the lowest (CF = 0.16) occurred in the long dry season. We concluded that the condition factor of these two species exhibited very different seasonal trends in the Aghien Lagoon.

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Introduction:-

Schilbe is a genus of Schilbid Catfishes native to Africa. Some are colloquially called "butter catfishes", though this may also refer to the Asian genus *Ompok* of the family Siluridae. Twenty-two valid species belong to this genus, six of which are found in West Africa: *S. intermedius*, *S. uranoscopus*, *S. mystus*, *S. micropogon*, *S. brevianalis* and *S. mandibularis* (Froese and Pauly, 2017).

In the Aghien Lagoon, the Schilbeidae family was represented by four species (*Parailia pellucida*, *Parailia spiniserrata*, *Schilbe mandibularis* and *Schilbe intermedius*) among which *S. mandibularis* and *S. intermedius* were the most abundant. In addition, these two species were among the fish most targeted by the artisanal fishing in this freshwater lagoon.

The condition factor which show the degree of well-being of the fish in their habitat is expressed by 'coefficient of condition' also known as length-weight factor. This factor is a measure of various ecological and biological factors

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such as degree of fitness, gonad development and the suitability of the environment with regard to the feeding condition (Anene, 2005; Ndimele et al., 2010).

In fisheries sciences, the condition factor is used in order to compare the “condition”, “fatness” or wellbeing of fish. It is based on the hypothesis that heavier fish of a particular length are in a better physiological condition (Bagenal et al., 1978). Condition factor is also a useful index for monitoring of feeding intensity, age, and growth rates in fish (Ndimele et al., 2010). The condition factor of fish can be affected by a number of factors such as stress, sex, season, availability of feeds, and other water quality parameters (Khallaf et al., 2003). It is strongly influenced by both biotic and abiotic environmental conditions and can be used as an index to assess the status of the aquatic ecosystem in which fish live (Anene, 2005). Condition factors of different tropical fish species were investigated and reported by several studies (Abowei and Davies, 2009; Alfred-Ockiya and Njoku, 1995). Indeed, condition factor has been used as an indicator of health in fishing biology studies since the beginning of the 20th century, such as growth and feeding intensity (Froese, 2006).

This study aimed to describe the changes that occurred in the condition factor of *Schilbe mandibularis* and *S. intermedius* during the four climatic seasons that characterize the Aghien Lagoon.

Materials and methods:-

Study site:-

The Aghien Lagoon is located in the Southeastern of Côte d'Ivoire between latitudes 5°22'N and 5°26'N and longitudes 3°49'W and 3°55'W (Fig. 1). This lagoon is located to the north of the Ebrié Lagoon from which it is separated by the Potou Lagoon. The Aghien and Potou Lagoons communicate through a natural channel (Koffi et al., 2014). The Aghien Lagoon could reach 11 m deep (Guiral and Ferhi, 1989). This lagoon covers an area of 20 km² for a perimeter of 40.72 Km. It is supplied by two main tributaries, Djibi and Bété Rivers, and is almost exclusively continental all year long. This gives to the hydrosystem a fluvial character (Koffi et al., 2014). Located in an estuarine zone, the ichthyological diversity of this lagoon is strongly influenced by species of marine and continental origin. The result is a very diverse fish community with intense fishing activity (Bédia et al., 2009; Traoré et al., 2014). The Aghien Lagoon is subject to an equatorial climate characterized by four seasons (Durand and Chantraine, 1982). The monthly distribution of these seasons is shown in Table 1.

Data Sampling:-

Fish populations were sampled monthly during one year from July 2014 to June 2015. Three sampling areas were chosen along the longitudinal axis of the lagoon (From the mainland at the mouth of the Djibi and Bété Rivers, to the Potou Lagoon). Thus, we had: the upstream sector (05°24.91'N - 03°53.74'W and 05°25.66'N - 03°54.23'W), the median sector (05°25.36'N - 03°53.75'W and 05°24.95'N - 03°52.50'W) and the downstream sector (05°24.18'N - 03°50.91'W and 05°23.21'N - 03°50.49'W). This choice of sampling sites was selected to cover a fair degree of habitat heterogeneity in Aghien Lagoon.

Data were collected through experimental fishing using gillnets of various mesh sizes (from 10 to 40 mm). The 3 sectors were sampled during each survey. Fishing was done overnight (17.00 to 7.00) and during the day (7.00 to 13.00).

Fish species were identified according to Paugy et al. (2003a, b), Sonnenberg and Busch (2009), Eschmeyer (2013) and Froese and Pauly (2014). For all individuals caught, the standard length (SL) was measured to the nearest millimeter and the total weight (W) was recorded to the nearest gram.

Data analysis :-

Global length-weight relationships (LWR) including both seasons and seasonal LWR (at different seasons) were established for each species according to the following formula (Pauly, 1983):

$$W = a \cdot SL^b$$

Parameters “a” and “b” were obtained by linearization of the previous equation through logarithmic transformation as following:

$$\text{Log}W = \text{Log}a + b \cdot \text{Log}SL$$

Where: W = the weight of fish in gram (g), SL = the standard length of fish in centimeter (cm), a = exponent describing the rate of change of weight with length (= the intercept of the regression line on the Y axis), b = the slope of the regression line also designed as allometric coefficient.

The condition factor (CF) was determined by using the following equation (Gomiero and Braga, 2005):
 $CF = 100W/SL^b$

b = the value obtained from the length-weight equation. The exponent 'b' value, that is equal to 3, was not used to calculate the 'CF' value. Bolger and Connolly (1989) claim that it is not a real representation of the length-weight relationship for greater majority of fish species. Therefore the 'b' value used was obtained from the estimated length-weight relationship equation ($W = a*SL^b$) as suggested by Lima-Junior et al. (2002).

Seasonal variations of condition factor in *Schilbe mandibularis* and *S. intermedius* were compared among climatic seasons using all of data from samples obtained in both study stations. A mean value of the condition factor was calculated for each species at different season. And Seasons were compared using the parametric Anova test (One-way analysis of variance) once the variances were shown to be homogeneous (Levene's test). For two-by-two comparisons, the Tukey's pair wise test was used. The minimum significant level for the relevant test was set at $p < 0.05$. The statistical analyzes were carried out using the PAST 3.14 software.

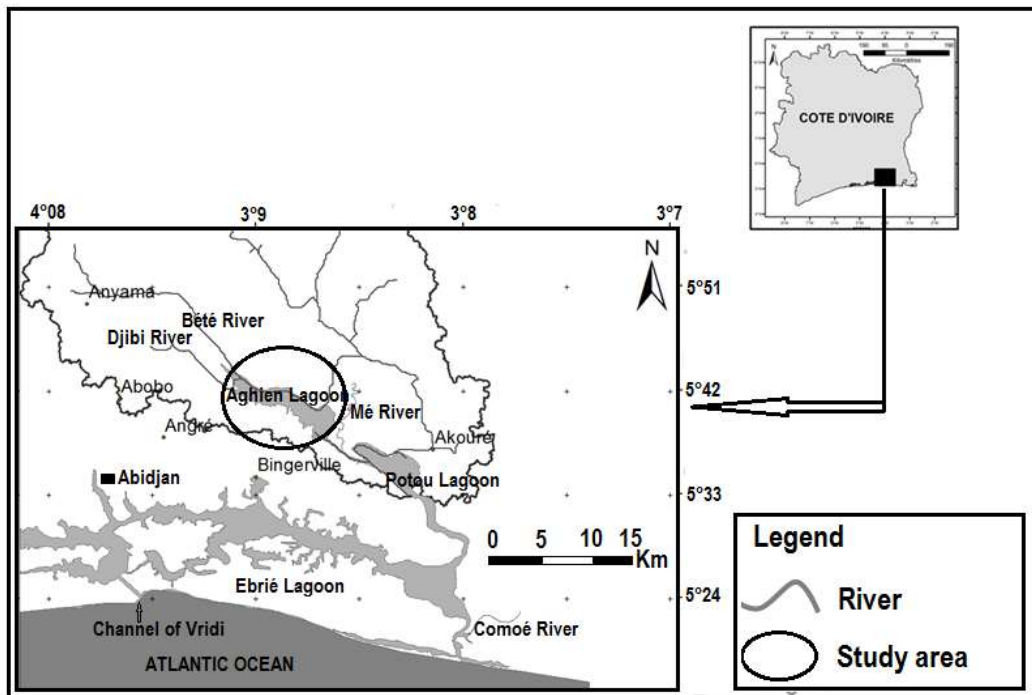


Fig. 1:- Location of the Aghien Lagoon in the South-Eastern of Côte d'Ivoire.

Table 1:- The four climatic seasons of the Aghien Lagoon according to Durand and Chantraine (1982).

Climatic seasons	Corresponding months
Long dry season (LDS)	December, January, February, March
Long wet season (LWS)	April, May, June, July
Short dry Season (SDS)	August, September
Short wet season (SWS)	October, November

Table 2:- Samples size (number of individuals) at different seasons in Aghien Lagoon.

Species	LDS	LWS	SDS	SWS
<i>Schilbe mandibularis</i>	38	42	60	85
<i>Schilbe intermedius</i>	90	68	156	124

Results:-**Fish size and Length-weight relationships:-**

Fish size ranged respectively from 68 to 204 mm and from 50 to 174 mm for *S. mandibularis* and *S. intermedius*. Fish size showed significant differences ($p < 0.05$) between climatic seasons for both species (Tab. 3).

The global length-weight relationships performed for both seasons indicated that the regression equation varied significantly ($p < 0.05$) between the two species (Tab. 4).

The seasonal length-weight relationships obtained for each species are presented in tables 5 and 6. Concerning *S. mandibularis*, the slope of the regression (b) ranged from 2.554 (LDS) to 3.865 (SDS). For *S. intermedius*, b ranged from 3.138 (LWS) to 3.672 (LDS).

Variations in condition factor:-

The annual average of the condition factor was higher ($p < 0.05$) in *S. mandibularis* (CF = 0.84) than that recorded in *S. intermedius* (CF = 0.29). Overall comparison of seasonal condition factor between the two species is illustrated in figure 2.

In *S. mandibularis* population, condition factor showed a high decrease from LDS to SDS with mean values of 2.83 and 0.09 respectively. A low increase was recorded from SDS to SWS. For *S. intermedius*, seasonal variations of condition factor were relatively low. Condition factor increased from LDS to LWS and decreased in SDS. For this species, the averages of condition factor were less than 1 at both seasons. Condition factor values are presented in table 7. The Anova test indicates significant differences ($p < 0.05$) between seasonal condition factors for both species (Tab. 7).

Tab. 3:- Fish size (SL in mm) at different seasons in Aghien Lagoon.

Species	LDS		LWS		SDS		SWS		Anova test	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	F	p
<i>S. mandibularis</i>	95 - 173	125,4 _a	95 - 204	124,8 _a	68 - 183	107,5 _b	76 - 200	111,3 _b	2.58	0.044
<i>S. intermedius</i>	79 - 174	111,7 _a	99 - 163	130,9 _b	50 - 140	91,4 ^c	64 - 155	93,6 ^c	120.50	1.216E-44

Means with different letter are significantly different.

Tab. 4:- Length-weight relationships of *Schilbe mandibularis* and *S. intermedius* for both seasons in Aghien Lagoon.

Species	Regression equation between W and SL	Coefficient of determination	Ancova test	
<i>S. mandibularis</i>	$\text{LogW} = 3.342 * \text{Log SL} - 2.515$	$R^2 = 0.753$	F=18.47	P=0.00002
<i>S. intermedius</i>	$\text{LogW} = 3.570 * \text{Log SL} - 2.727$	$R^2 = 0.751$		

Tab. 5:- Length-weight relationships of *Schilbe mandibularis* at different seasons in Aghien Lagoon.

Climatic seasons	Regression equation between W and SL	Coefficient of determination
LDS	$\text{LogW} = 2.544 * \text{LogSL} - 1.567$	$R^2 = 0.714$
LWS	$\text{LogW} = 2.788 * \text{Log SL} - 1.737$	$R^2 = 0.969$
SDS	$\text{LogW} = 3.865 * \text{Log SL} - 3.061$	$R^2 = 0.901$
SWS	$\text{LogW} = 3.230 * \text{Log SL} - 2.482$	$R^2 = 0.834$

Tab. 6:- Length-weight relationships of *Schilbe intermedius* at different seasons in Aghien Lagoon.

Climatic seasons	Regression equation between W and SL	Coefficient of determination
LDS	$\text{LogW} = 3.672 * \text{Log SL} - 2.834$	$R^2 = 0.712$
LWS	$\text{LogW} = 3.138 * \text{Log SL} - 2.100$	$R^2 = 0.920$
SDS	$\text{LogW} = 3.570 * \text{Log SL} - 2.727$	$R^2 = 0.751$
SWS	$\text{LogW} = 3.477 * \text{Log SL} - 2.665$	$R^2 = 0.657$

Tab. 7:- Fish condition factor at different seasons in Aghien Lagoon.

Species	LDS		LWS		SDS		SWS		Anova test	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean	F	p
<i>S. mandibularis</i>	1.36 - 4.46	2.83 ^a	1.45 - 2.15	1.84 ^b	0.04 - 0.16	0.09 ^c	0.12 - 0.80	0.35 ^d	639.4	5.13E-34
<i>S. intermedius</i>	0.07 - 0.30	0.16 ^a	0.57 - 1.00	0.80 ^b	0.06 - 0.43	0.20 ^c	0.06 - 0.57	0.23 ^d	949.9	1.00E-118

Means with different letter are significantly different.

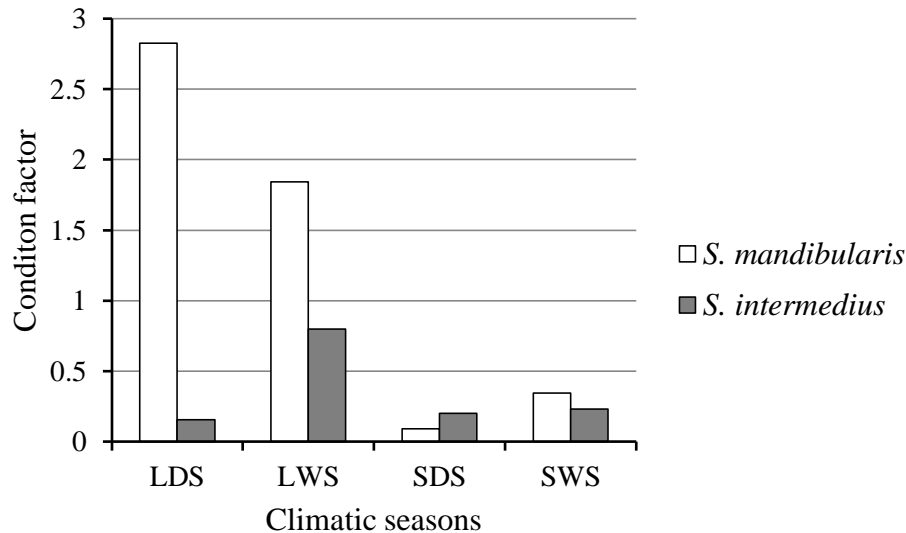


Fig. 2:- Seasonal variations in average of condition factor of *Schilbe mandibularis* and *S. intermedius* in Aghien Lagoon.

Discussions:-

For both species, fish sizes varied significantly from one climatic season to another. This implies great variability in the proportions of the different stages of fish development during the year. The mean sizes were higher in LDS and lower in SDS for *Schilbe mandibularis*. Concerning *S. intermedius*, mean sizes were higher in LWS and lower in SDS. Moreover, the maximum sizes recorded in the Aghien Lagoon for the two species (204 and 174 mm SL respectively for *Schilbe mandibularis* and *S. intermedius*) were lower than those observed by De Vos (2003) in the continental African waters (300 and 500 mm SL respectively for *Schilbe mandibularis* and *S. intermedius*).

Overall, LWR differed significantly between the two species. Consequently, these two species belonging to the same genus showed a very different growth. Knowledge on length-weight relationships of fish helps in predicting potential yield and determination of size at capture for obtaining optimum yield, as these parameters are directly related to weight of the fish (Le Cren, 1951; Chonder, 1972). According to Martin (1949) the values of the exponent 'b' usually remain between 2.5 and 4.0 and in majority of the cases the value was not equal to '3'. Our results coincide with the interval of 2.5 - 4.0 ('b' ranged from 2.554 to 3.865 for *S. mandibularis* and ranged from 3.138 to 3.672 for *S. intermedius*).

The condition factor varied significantly between climatic seasons for both species. This result would probably be a consequence of the large variation in fish sizes between climatic seasons. Indeed, condition factor is influenced by the stage of sexual maturity and this maturity depends on the stage of development of the fish. According to Bagenal and Tesch (1978), the range 2.9 - 4.8 is the recommended condition factor as suitable for matured fresh water fish. Our results showed that fish condition factor ranged from 0.04 to 4.46 for *S. mandibularis*. For *S. intermedius* condition factor varied from 0.06 to 1.00. In the Taabo Lake (Bandama Basin, Côte d'Ivoire), Aliko et al. (2015) reported that condition factor in *S. mandibularis* ranged from 1.17 to 4.02 with an average of 1.93 ± 0.36 . Uneke and

Alionye (2015) recorded an overall condition factor of 0.46 for *S. intermedius* in the Mid Cross River Flood System (Southeastern of Nigeria).

Seasonal condition factor was highest in LDS while it was lowest in SDS for *S. mandibularis*. According to Ouattara et al. (2008), *S. mandibularis* in the Bia River reproduced in the rainy season from April to June and from August to October. These authors added that maximum breeding activity of *S. mandibularis* occurred from April to June, corresponding to the peak of rainfall. The high condition factor values of LDS could be explained by a high proportion of gonad-maturing individuals for breeding in the following season, which corresponds to the long rainy season. Concerning *S. intermedius*, the highest seasonal condition factor was recorded in LWS while the lowest occurred in LDS. In the Pendjari River (Benin, West Africa), Montcho et al. (2011) indicated that spawning of *S. intermedius* lasted from June to November, coinciding with peaks in rainfall and flooding. The LWS period, which had high condition factor values, coincided partially with the spawning period of *S. intermedius* as reported by Montcho et al. (2011). We could conclude that the condition factor for these two species belonging to the same genus exhibited very different seasonal trends in the same lagoon.

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References:-

1. Abowei, J.F.N. and Davies, O.A. (2009): Some Population Parameters of *Clarotes laticeps* (Rüppell, 1829) from the Fresh Water Reaches of Lower Nun River, Niger Delta, Nigeria. *American Journal of Scientific Research*; 2:10-19.
2. Alfred-Ockiya, J.F. and Njoku, D.C. (1995): A Comparative Analysis of the Length Weight Relationship and Condition Factor of Four Species of Grey Mullet (*Pisces / Mugilidae*) from the New Calabar River, Rivers State, Nigeria. *J. Tech. Edu.*, 2:5-10.
3. Aliko, N.G., Assémian, N.E., Boussou, K.C. and Konan, K.F. (2015): Some Biological Characteristics of Ten Fish Species in a Tropical Man-made Lake, Taabo Reservoir, West Africa. *American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)*, 14 (3): 27-34.
4. Anene, A. (2005): Condition Factor of Four Cichlid Species of a Man-made Lake in Imo State, Southeastern Nigeria. *Turkish Journal of Fisheries and Aquatic Sciences*, 5: 43-47.
5. Bagenal, T.B. and Tesch, F.W. (1978): *Methods of Assessment of Fish Production in Fresh Waters*. IBP Handbook N° 3, 3rd ed. Oxford Blackwell Scientific Publication, London: 101-136.
6. Bédia, A.T., N’zi, K.G., Yao, S.S., Kouamélan, E.P., N’douba, V. and Kouassi, N.J. (2009): Typologie de la pêche en lagune Aghien-Potou (Côte d’Ivoire, Afrique de l’ouest) : acteurs et engins de pêche. *Agronomie Africaine*, 21 (2): 197-204.
7. Bolger, T., P.L. and Connolly, P.L. (1989): The suitability of suitable indices for the measurement analysis of fish condition. *Journal of Fish Biology*, (34):171-182.
8. Chonder, S.L. (1972): “Length-weight relationship of mature female *Labeo gonius* (Hamilton) from the Keetham Reservoir.” *Journal of the Inland Fisheries Society of India*, (4): 216-217.
9. De Vos, L. (2003): *Schilbeidae*. p. 97-116 In C. Lévêque, D. Paugy and G.G. Teugels (eds.) *Faune des poissons d’eaux douce et saumâtres de l’Afrique de l’Ouest*, Tome 2. Coll. Faune et Flore tropicales 40. Musée Royal de l’Afrique Centrale, Tervuren, Belgique, Museum National d’Histoire Naturelle, Paris, France and Institut de Recherche pour le Développement, Paris, France, 815p.
10. Durand, J.R. and Chantraine, J.M. (1982): L’environnement climatique des lagunes ivoiriennes. *Revue Hydrobiologie Tropicale*, 15 (2): 85-113.
11. Froese, R. (2006): Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations. *J. Appl. Ichthyol.*, 22: 241-253.
12. Froese, R. and Pauly D. (2017): *FishBase*. World Wide Web electronic publication. (www.fishbase.org). Electronic version (05/2017).
13. Gomiero, L.M. and Braga, F.M. S. (2005): The condition factor of fishes from two river basins in Sao Paulo state, Southeast of Brazil. *Acta Scientiarum*, (27): 73-78.
14. Guiral, D. and Ferhi, A. (1989): Caractérisation ioni que et isotopique d’un système hydrologique tropical: Lalagune Ebrié (Côte d’Ivoire). *Oceanologica Acta*, 12: 47 - 55.

15. Khallaf, E., Galal, M. and Athuman, M. (2003): The biology of *Oreochromis niloticus* in a polluted canal. *Ecotoxicology*, 12: 405-416.
16. Koffi, K.J.P, N'go, YA., Yéo, K.M., Koné, D. and Savané, I. (2014): Détermination des périmètres de protection de la lagune Aghien par le calcul du temps de transfert de l'eau jusqu'a la lagune. *Larhyss Journal*, 19: 19-35.
17. Le Cren, E. D. (1951): "Length-weight relationships and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*)." *Journal of Animal Ecology*, 20: 201-219.
18. Lima-Junior, S.E., Cardone, I.B. and Goite, R. (2002): Determination of a method for calculation of Allometric Condition Factor of fish. *Acta scientiarum*, 24: 397-400.
19. Martin, W.R. (1949): The mechanism of environmental control of body form in fishes. University of Toronto: Ontario Fisheries Research Laboratory, 70: 1-172.
20. Montcho, S.A., A. Chikou, P.A. Lalèyè, and K.E. Linsenmair, (2011): Population structure and reproductive biology of *Schilbe intermedius* (Teleostei: Schilbeidae) in the Pendjari River, Benin. *African Journal of Aquatic Science*, 36 (2): 139-145.
21. Ndimele, P.E., Kumolu-Johnson, C.A., Aladetohun, N.F. and Ayorinde, O.A. (2010): Length-weight relationship, condition factor and dietary composition of *Sarotherodon melanotheron*, Ruppell, 1852 (Pisces: Cichlidae) in Ologe Lagoon, Lagos, Nigeria. *Agric. Biol. J. North Am.*, 1: 584-590.
22. Ouattara, M., Doumbia, L., Yao, K. and Gourène, G. (2008): Reproduction du poisson-chat africain *Schilbe mandibularis* (Günther 1867) (Siluroidei; Schilbeidae) en milieux lacustre et fluviatile (Côte d'Ivoire). *Live Stock Res. Rural Dev.*, 20, 1, Article 12.
23. Paugy, D., Lévêque, C. and Teugels, G.G. (2003a): Poissons d'eaux douces et saumâtres de l'Afrique de l'Ouest, édition complète. Tome I. Edition IRD-MNHN-MRAC, Paris-Turvuren, 457p.
24. Paugy, D., Lévêque, C. and Teugels, G.G. (2003b): Poissons d'eaux douces et saumâtres de l'Afrique de l'Ouest, édition complète. Tome II. Edition IRD-MNHN-MRAC, Paris-Turvuren, 815p.
25. Pauly, D. (1983): Some simple methods for the assessment of tropical fish stocks. *FAO Fisheries Technical paper*, (234), FAO, Rome, Italy, 52p.
26. Sonnenberg, R. and Busch, E. (2009): Description of a new genus and two new species of killifish (Cyprinodontiformes: Nothobranchiidae) from West Africa, with a discussion of the taxonomic status of *Aphyosemion maeseni* Poll, 1941. *Zootaxa*, 2294: 1-22.
27. Traoré, A., Soro, G., Ahoussi, K.E., Bamba, S.B., Soro, N. and Biémi, J. (2014): Niveau de contamination en métaux lourds des sédiments d'une lagune tropicale : la lagune Aghien (Sud-est de la Côte d'Ivoire). *Afrique Science*, 10 (3): 73-88.
28. Uneke, B.I. and Alionye, G. (2015): Sex Ratio, Gonad Maturation and Condition Factor of *Parailia pellucida* and *Schilbe intermedius* in the Mid Cross River Flood System, Southeastern, Nigeria. *American Journal of Science and Technology*, 2 (4): 183-187.