
**E-ISSN: 2347-5129**
**P-ISSN: 2394-0506**
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2017; 5(6): 331-336

www.fisheriesjournal.com
Received: 06-09-2017
Accepted: 07-10-2017

**ASSI Sonan Romuald**
Department of Environment, Jean Lorougnon Guédé University, Daloa city (Côte d'Ivoire)

**Konan Koffi Félix**
Department of Environment, Jean Lorougnon Guédé University, Daloa city (Côte d'Ivoire)

**Aliko N'guessan Gustave**
Department of Environment, Jean Lorougnon Guédé University, Daloa city (Côte d'Ivoire)

**Boussou Koffi Charles**
Department of Environment, Jean Lorougnon Guédé University, Daloa city (Côte d'Ivoire)

**Bony Kotchi Yves**
Department of Environment, Jean Lorougnon Guédé University, Daloa city (Côte d'Ivoire)

**Coulibaly Kalpy Julien**
Institut Pasteur de Côte d'Ivoire

**Correspondence**
**ASSI Sonan Romuald**
Department of Environment, Jean Lorougnon Guédé University, Daloa city (Côte d'Ivoire)

# Growth patterns of two freshwater fish belonging to the genus *Schilbe* Oken, 1817 (*Schilbe mandibularis* and *S. intermedius*) in the estuarine system of Aghien Lagoon, West Africa

**ASSI Sonan Romuald, Konan Koffi Félix, Aliko N'guessan Gustave, Boussou Koffi Charles, Bony Kotchi Yves and Coulibaly Kalpy Julien**

**Abstract**
Growth patterns of *Schilbe mandibularis* and *Schilbe intermedius* were assessed using the LWR and the Von Bertalanffy model. Fish samples were collected monthly between June 2014 and May 2015 from artisanal and experimental captures in the Aghien Lagoon. Growth type was determined using the length-weight relationship. Length frequency data were analysed with FiSAT software using the ELEFAN package in order to estimate growth parameters. For both species, the coefficient of allometry (*b*) was significantly high than 3 (t test, $p < 0.05$) showing a positive allometric growth. Concerning growth parameters, results indicated that the asymptotic length was higher in *S. mandibularis* ($L\infty = 213.28$ mm SL for *S. mandibularis* and $L\infty = 203.63$ mm SL for *S. intermedius*). However, growth coefficient and growth performance index were higher in *S. intermedius*. $K = 0.78$ year$^{-1}$ and $\Phi' = 2.50$ for *S. intermedius*; $K = 0.41$ year$^{-1}$ and $\Phi' = 2.27$ for *S. mandibularis*. Growth modelization revealed 4 and 2 cohorts respectively for *S. mandibularis* and *S. intermedius*.

**Keywords:** Growth type, Growth parameters, *Schilbe mandibularis* and *Schilbe intermedius*, Aghien Lagoon, West Africa

## 1. Introduction

Fish belonging to the Schilbeidae family are classified as catfish and they are characterized by a dorso-ventrally flattened head, a rather short abdomen, a laterally compressed caudal region, and an elongate anal fin. Dorsal fin short, sometimes absent; pectoral fins provided with a spine (as also the dorsal fin of most species). Three or four (depending on species) pairs of barbels around mouth. Five genera have so far been recognized in Africa: *Parailia*, Siluranodon, *Irvineia*, *Schilbe* and *Pareutropius* (De Vos, 2007) [1].

Each of these genera includes at least one West African representative, and there are eleven species of Schilbeidae occurring in this region. The genera *Parailia, Siluranodon* and *Pareutropius* have little economic value because of their small size, but some species of the genera *Irvineia* and *Schilbe* may attain rather large sizes (500 mm and more) and are highly appreciated food fishes (De Vos, 2007) [1].

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. Vanga (1994) [2] reported that these two fish species are highly consumed by populations in West Africa. *Schilbe intermedius* presents a very wide geographical distribution in comparison with *S. mandibularis*. It is distributed nearly throughout the continent, with the exception of North and South Africa (south of the River Pongola). *Schilbe mandibularis* is a Guinean form, known from the Eburneo-Ghanean region (De Vos, 2007) [1]. Given their economic importance and the high fishing pressure on these two species, it is necessary to have information on the dynamics of their populations.

Indeed, population parameters evaluate the effect of fishing on a fishery as a basis for fishery management decisions (Sissenwine *et al.* (1979) [3]. Age and growth are particularly important for describing the status of a fish population and for predicting the potential yield of the fishery.

It also facilitates the assessment of production, stock size, recruitment to adult stock and mortalities (Lowe-McConnel, 1987) [4]. Furthermore, studies on the population dynamics of tropical fish stock have been limited by the difficulty of ageing tropical fish species, which from the ecological perspective inhabit ‘steady state environment’. The length-weight relationship (LWR) of fish is an important fishery management tool. Its importance is pronounced in estimating the average weight at a given length group (Beyer, 1987) [5] and in assessing the relative well being of a fish population (Bolger and Connoly, 1989) [6].

Previous studies had focused on LWR and growth parameters of these two species in different environments. For example, Konan *et al.* (2017) [7] had determined the LWR of these two species in the South-eastern Rivers of Côte d'Ivoire. The growth parameters of *S. mandibularis* and *S. intermedius* had been assessed respectively in the Ayamé Lake of Côte d’Ivoire (Tah *et al.* (2010) [8] and in the Pendjari River of Benin (Ahouanssou, 2011) [9].

This study aimed to compare the length-weight relationships and growth parameters of these two fish species belonging to the same genus.

## 2. Materials and methods

### 2.1 Study site and samples collection

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 (Figure 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) [10]. The Aghien Lagoon could reach 11 m deep (Guiral and Ferhi, 1989) [11]. 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) [10]. 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 [12]; Traoré *et al.* 2014) [13].

Samples were collected monthly between June 2014 and May 2015 from artisanal and experimental captures in Aghien Lagoon. Fishes were collected using gill nets (10 to 40 mm stretch mesh). Fish specimens were identified following Paugy *et al*. (2003*a*) [14], Paugy *et al*. (2003 *b*) [15], Sonnenberg and Busch (2009) [16], Eschmeyer (2014) [17], Froese and Pauly (2014) [18].

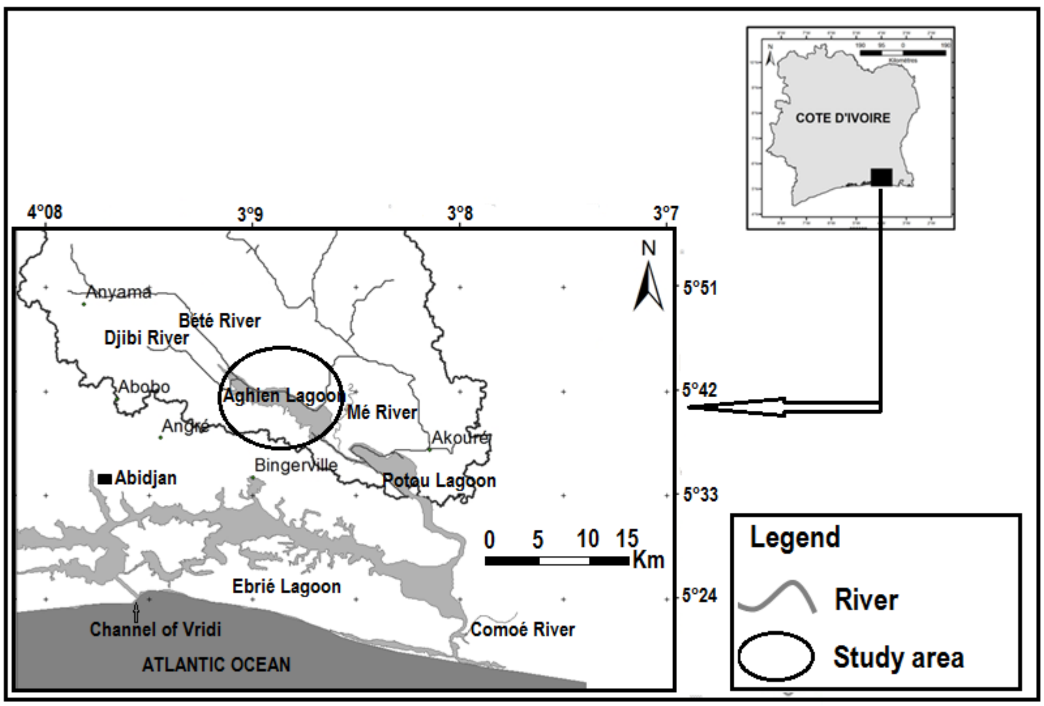


**Fig 1:** Map showing the Study Area

### 2.2 Determination of growth type using length-weight relationship (WLR)

The relationship between length and weight of fish was analyzed by measuring length and weight of fish specimens collected from study area. The length-weight relationships were estimated using the following equation (Froese, 2006) [19]:

$W = aL^b$

Where, W is the whole body weight (g), L is the length of fish (mm), a is the intercept of the regression and **b** is the regression coefficient.

The parameters *a* and *b* of the length-weight relationships were estimated by the least-squares method based on logarithms: $\text{Log } W = \text{Log } (a) + b \text{ Log } (L)$

The correlation between the length and weight is known as significant in this study, when the absolute value of r is higher or equal to 0.7 (Boussou, 2013) [20].

The value of *b* gives information on the kind of growth of fish: the growth is isometric if $b = 3$ (Naeem *et al.* (2010) [21] and the growth is allometric if $b \neq 3$ (negative allometric if $b < 3$ and positive allometric if $b > 3$) (Konan *et al.* (2007) [7].

A Student’s t-test was used for comparison *b* value obtained in the linear regression with isometric value (Konan *et al.* 2007 [7]; Boussou, 2013) [20].

### 2.3 Assessment of growth parameters following the Von Bertalanffy

From the length–frequency distribution of the samples, ELEFAN I (Electronic LEngth Frequency ANalysis) was used to obtain preliminary estimates of asymptotic length (L∞) and growth constant (K) of the Von Bertalanffy Growth Function (VBGF) following Gayanilo *et al*. (2002) [22]. The growth model used is as follow:

$L_t = L\infty\ (1\text{-}e^{-k(t-to)})$

Where Lt is the length at age t; L∞ is the asymptotic length; K is the growth coefficient and to is the theoretical age at which the length is zero.

Based on these preliminary estimates, a length-converted catch curve was constructed. Through the detailed analysis of the left (ascending) part of the length-converted catch curve, the mean selection curve of the fishing gear was estimated. This selection curve was used to correct the length–frequency data for gear selection toward small fish (Pauly, 1984) [23]. New estimates of L∞ and K were obtained using the FiSAT II (FAO ICLARM Stock Assessment Tools) software from the analysis of the corrected length–frequency data. The best combination of L∞ and K was selected, employing as indication of fitness the Rn index (Pauly, 1987) [24] defined as Rn = ESP/ASP where ESP is the explained sum of peaks and ASP is the available sum of peaks in the length frequencies.

Munro and Pauly (1983) [25] and Pauly and Munro (1984) [26] defined the relationship of growth performance index:

$\Phi' = \text{Log}_{10}K + 2\text{Log}_{10}L\infty$

The age of the fish at zero length was obtained by the equation of Pauly (1979) [27]:

$\text{Log}_{10}(-t_0) = -0.392 - 0.275\text{Log}_{10}L\infty - 1.038\text{Log}_{10}K$

Potential longevity, $t_{max}$, was worked out of the following formula (Pauly, 1980) [28]:

$t_{max} = 3/K$

## 3. Results

### 3.1 Length-frequency distribution

The smallest specimen of *Schilbe mandibularis* (N = 135 individuals) measured 68 mm SL and the largest measured 204 mm SL. One mode was observed at 85-102 mm SL (Figure 2). Concerning *Schilbe intermedius* (N = 440 individuals), the size of the smallest specimen was 50 mm SL and the largest specimen measured 174 mm SL. One mode was also recorded at 87-99 mm SL (Figure 2).

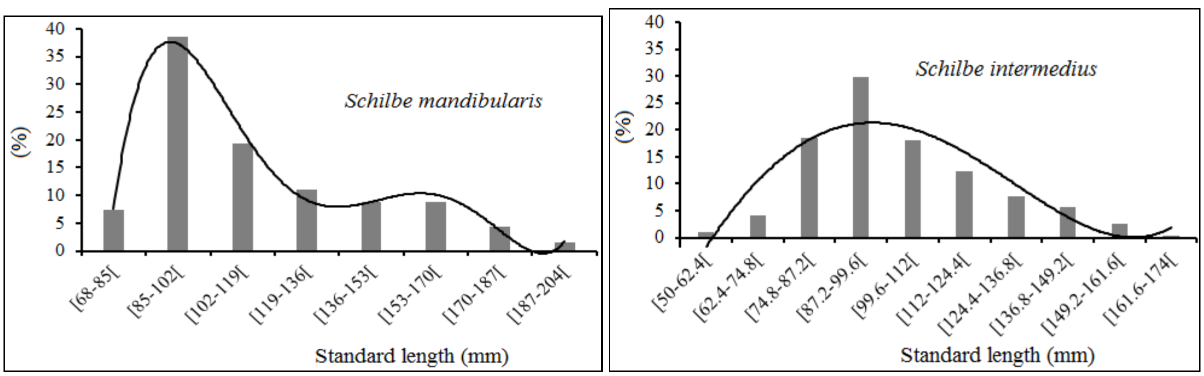


**Fig 2:** Length- frequency distribution of *Schilbe mandibularis* and *Schilbe intermedius* from the Aghien Lagoon.

### 3.2 Length-weight relationships

All regressions were highly significant ($p < 0.01$). For both species, the allometric coefficient (b) was significantly higher to 3 ($p < 0.05$). Therefore, growth was positive allometric for *Schilbe mandibularis* (*b* =3.39) and *Schilbe intermedius* (*b* =3.75) (Figure 3 and table 1).

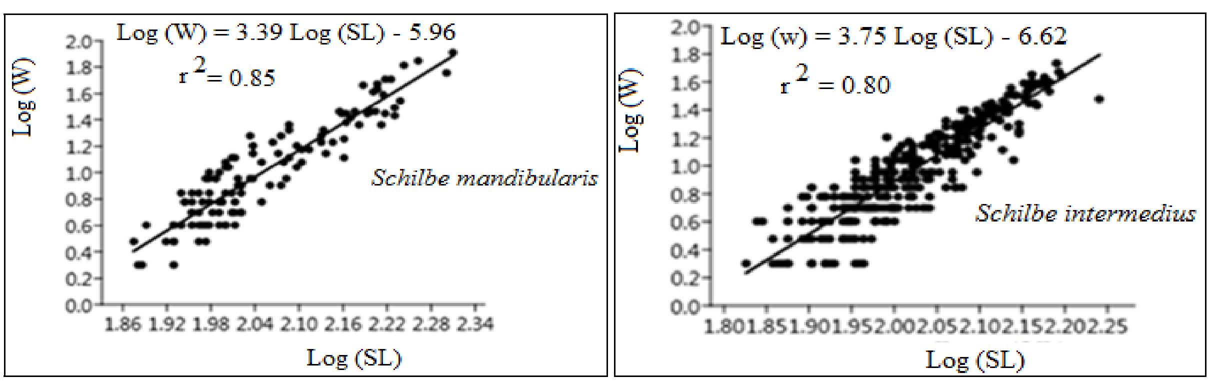


**Fig 3:** Regression between length and weight of *S. mandibularis* and *S. intermedius* from the Aghien Lagoon

**Table 1:** Standard length (SL in mm) and length-weight relationship (LWR), parameters for *S. mandibularis and S. intermedius* from the Aghien Lagoon.

| Species | N | Min | Max | Mean ± SD | *a* | *b* | SE (*b*) | $r^2$ | Growth type |
|---|---|---|---|---|---|---|---|---|---|
| *S. mandibularis* | 135 | 68 | 204 | 114.64 ± 2.63 | 0.002 | 3.39 | 0.127 | 0.85 | A+ |
| *S. intermedius* | 440 | 50 | 174 | 102.33 ± 0.99 | 0.001 | 3.75 | 0.098 | 0.80 | A+ |

### 3.3 Assessment of growth parameters following the Von Bertalanffy model

Growth parameters following the Von Bertalanffy are shown in table 2. The asymptotic length of *Schilbe mandibularis* ($L\infty$ = 213.28 mm SL) was greater than that of *Schilbe intermedius* ($L\infty$ = 203.63 mm SL). However, for the growth coefficient (K) and performance growth index (Φ'), values were higher in *S. intermedius* (K= 0.78 year$^{-1}$ and Φ'= 2.50). For *S. mandibularis*, K = 0.41 year$^{-1}$ and Φ' = 2.27. The estimated values of best fits (Rn value) were 0.51 and 0.63 respectively for *S. mandibularis* and *S. intermedius* (Figure 4). The theoretical age $t_0$ was estimated at -0.53 year for *S. mandibularis* and -0.40 year for *S. intermedius*. The potential longevity was higher in *S. mandibularis* ($t_{max}$ = 7.30 years) than in *S. intermedius* estimated at ($t_{max}$ = 3.84 years). Growth curves indicated that captured fish belonged to 4 cohorts for *S. mandibularis* and 2 cohorts for *S. intermedius* (Figure 5).

**Table 2:** Growth parameters following the Von Bertalanffy

| Species | $L\infty$ (mm) | K (year$^{-1}$) | Φ’ | Rn | $t_0$ | $t_{max}$ (year) |
|---|---|---|---|---|---|---|
| *S. mandibularis* | 213.28 | 0.41 | 2.27 | 0.51 | -0,53 | 7.30 |
| *S. intermedius* | 203.63 | 0.78 | 2.50 | 0.63 | -0.40 | 3.84 |

The Von Bertalanffy growth function (VBGF) in Aghien Lagoon takes the form:

*Schilbe mandibularis* : $L_t = 213.28\ [1 - e^{-0.41\ (t + 0.53)}]$

*Schilbe intermedius*: $L_t = 203.\ 63\ [1 - e^{-0.\ 78\ (t + 0.\ 40)}]$

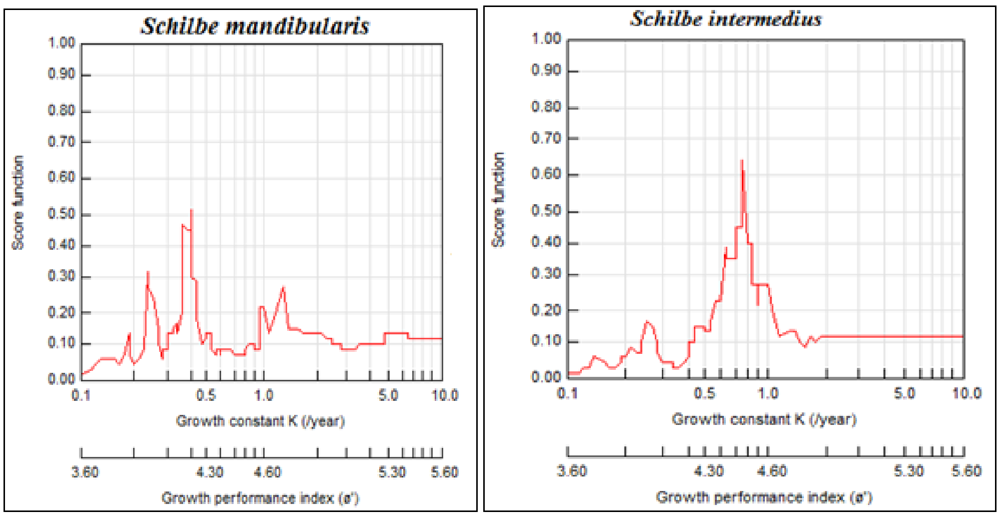


**Fig 4:** K- scan routine for determining best growth curvature giving best value of asymptotic length with growth performance indices

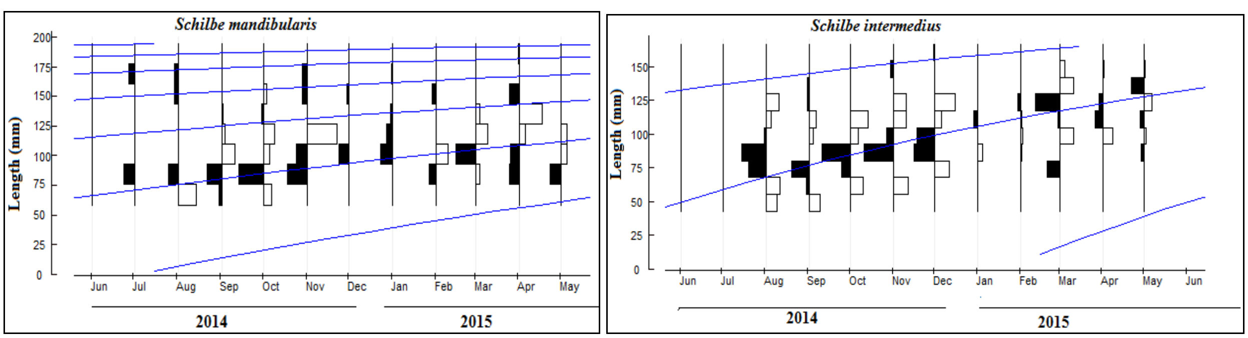


**Fig 5:** Von Bertalanffy growth curve for *Schilbe mandibularis* and *Schilbe intermedius*

## 4. Discussion

In this study, the maximum size recorded for *Schilbe mandibularis* (204 mm SL) is smaller than that recorded by Doumbia (2003) [29] in the Bia River (500 mm SL). Concerning, *Schilbe intermedius*, the maximum size (174 mm SL) is smaller than that obtained by Ahouanssou (2011) [9] in the Pendjari River (269 mm SL). According to Pervin and Mortuza (2008) [30], *b* values may range from 2.5 to 4.0, suggesting that the result of this study (*b* = 3.39 and 3.75) was valid. Konan *et al.* (2007) [7] also reported a positive allometric growth for *S. intermedius* and *S. mandibularis* from rivers of the South-eastern of Côte d’Ivoire.

Analysis of the growth coefficient (K = 0.41 year$^{-1}$ for *S. mandibularis*; K = 0.78 year$^{-1}$ for *S. intermedius*) indicated that both studied species are long-lived fish species. Indeed, the range of 0 - 1 year$^{-1}$ for the growth coefficient is the range of long-lived fish species (Jutagate and De Silva, 2003) [31]. In addition, this analysis showed also that these species were growing rapidly (Branstetter, 1987) [32]. However, the growth of *S. intermedius* was faster than that of *S. mandibularis*. Etim *et al.* (1999) [33] and Ahouanssou (2011) [9] observed also rapid growth for *S. intermedius* respectively in the Crow River (Nigeria) and the Penjari River (Benin). Concerning *S. mandibularis*, rapid growth was recorded by Tah *et al.* (2010) [8] in the Ayamé Lake.

Pauly and Munro (1984) [26]; Pérez-Bote and Roso (2012) [34] indicated that species within the same family are expected to have similar values of growth performance index. In this study, the growth performance index for *S. mandibularis* (Φ’ = 2.27) and *S. intermedius* (Φ’ = 2.50) were close, and thus almost conform to the pattern suggested by previous studies.

Similar values of growth performance index had been observed in previous studies: Φ' = 2.59 for *S. mandibularis* in the Ayamé Lake (Tah *et al*. (2010) [8], Φ' = 2.79 for *S. intermedius* in the Pendjari River (Ahouanssou, 2011) [9]. Furthermore, Ahouanssou (2011) [9] recorded values of asymptotic length and potential longevity ($L\infty$ = 295.7 mm SL and $t_{max}$ = 6 years) for *S. intermedius* greater than those obtained in this study. For *S. mandibularis*, Tah *et al.* (2010) [8] reported an asymptotic length of 29 cm TL. Data on the potential longevity of *S. mandibularis* were not available in previous studies. Therefore, comparisons could not be made with the value recorded in this study.

## 5. Conclusion
This study made it possible to compare the type of growth and the growth parameters of *Schilbe mandibularis* and *Schilbe intermedius* in the Aghien Lagoon. The Length-weight relationships revealed a positive allometric growth for both species. The Von Bertanlanffy model indicated that the asymptotic length of *S. mandibularis* was greater than that of *S. intermedius*. However, the growth coefficient and the growth performance index of *S. intermedius* were higher than those of *S. mandibularis*. Growth coefficient values indicated rapid growth for both species.

## 6. Acknowledgements
Data of this study were collected during the project “Study of the water quality of the Aghien Lagoon” and authors are grateful to the promoters of this project: “Agence Française pour le Développement” (AFD) and “Ministère des Eaux et Forêts de Côte d‟Ivoire”.

## 7. References
1. De Vos L. Schilbeidae. In: Stiassny MLJ, Teugels GG and Hopkins CD. (eds.) Poissons d'eaux douces et saumâtres de basse Guinée, ouest de l’Afrique. Muséum National d’ Histoire Naturelle 2007; 1(800):631-652.
2. Vanga AF. La pêche au barrage d'Ayamé. University of Abidjan, D.E.A., Abidjan, 1994, 50.
3. Sissenwine MP, Brown BE, Brenna H. Brief History and the State of the Arts of Fish Production Models and Some Applications to Fisheries of the North-Eastern United States. Climate and Fisheries Workshop Centre for Ocean Management Studies. University of Rhode Island. 1979, 25-28.
4. Lowe-McConnell RH. Ecological studies in tropical fish communities. Cambridge: University of Cambridge Press. 1987, 382.
5. Beyer JE. On length-weight relationships computing the mean weight of the fish of a given length class. Fishbyte. 1987; 5(1):11-13.
6. Bolger T, Connolly PL. The suitable of suitable indices for the measurement analysis of fish condition. Journal of Fish Biology. 1989; (34):171-182.
7. Konan KF, Ouattara A, Ouattara M, Gourène G. Weight-length relationship of 57 fish species. Ribarstvo. 2007; 65(2):49-60.
8. Tah L, Joanny TG, N'Douby V, Kouassi JN, Moreau J. Preliminary estimates of the population parameters of major fish species in Lake Ayamé I (Bia basin; Côte d'Ivoire). Journal of Applied Ichthyology. 2010; 26:57-63.
9. Ahouanssou MS. Diversité et Exploitation des poissons de la rivière Pendjari (Bénin, Afrique de l’Ouest). University of Abomey-Calavi, PhD Thesis, Abomey-Calavi, 2011, 234.
10. Koffi KJP, N’go YA, Yéo KM, Koné D, Savané I. 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. 2014; 19:19-35.
11. Guiral D, Ferhi A. Caractérisation ionique et isotopique d’un système hydrologique tropical: Lalagune Ebrié (Côte d‟Ivoire). Oeceanologica Acta. 1989; 12:47-55.
12. Bedia AT, N’zi KG, Yao SS, Kouamelan EP, N’douba V, Kouassi NJ. Typologie de la pêche en lagune Aghien-Potou (Côte d’Ivoire, Afrique de l’ouest) : acteurs et engins de pêche. Agronomie Africaine. 2009; 21(2):197-204.
13. Traoré A, Soro G, Kouadio KE, Bamba SB, Oga MS, Soro N *et al*. Evaluation des paramètres physiques, chimiques et bactériologiques des eaux d’une lagune tropicale en période d’étiage : la lagune Aghien (Côte d’Ivoire). International Journal Biological Chemical Sciences. 2014; 6(6):7048-7058.
14. Paugy D, Lévêque C, Teugels GG. Poissons d'eaux douces et saumâtres de l'Afrique de l'Ouest. 2003a; 1:457.
15. Paugy D, Lévêque C, Teugels GG. Poissons d'eaux douces et saumâtres de l'Afrique de l'Ouest. 2003b; 2:815.
16. Sonnenberg R, Busch E. 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. 2009; 2294:1-22.
17. Eschmeyer WN, Fricke R, van der Laan R. Catalog of fishes: genera species references. 2014. Available: http: //researcharchive. Calacademy.org/research/ichthyology/catalog/fishcatmain.asp (Accessed 6 th June, 2014).
18. Froese R, Pauly D. FishBase. World Wide Web electronic publication. 2014. [Cited 2014 January] Available: http// www.fishbase.org (Accessed 6th June, 2014).
19. Froese R. Cube law condition factor and weight-length relationships: history meta-analysis and recommendations. Journal of Applied Ichtyology. 2006; 22:241-253.
20. Boussou KC. Variations morphométriques biologie et écologie du Cichlidae *Chromidotilapia guntheri* (Sauvage, 1882) dans des hydrosystèmes de l’Est et du Sud de la Côte d’Ivoire. University of Nangui Abrogoua, PhD Thesis, Abidjan, 2013, 161.
21. Naeem M, Salam A, Ishtiaq A, Shafique S. Length-weight and condition factor relationship of farmed hybrid (*cat a catla* ♂ x *labeo rohita* ♀) from Multan, Pakistan. Sindh University Research Journal. Science Series. 2010; 42:35-38.
22. Gayanilo FC, Sparre JrP, Pauly D. The FAO-ICLARM Stock Assessment Tools II. 2002. (FiSAT II Ver. 1.0). Available: http://www.fao.org/fi/statist/fisoft/fisat/index.htm.
23. Pauly D. Length-converted catch curves and the seasonal growth of fishes. ICLARM. Fishbyte. 1984; 8:33-38.
24. Pauly D. Application of information on age and growth of fish to fishery management. In: Summerfelt RC and Hall GE. (eds.) The Age and Growth of Fish. USA: The Iowa State University Press. 1987, 495-506.
25. Munro JL, Pauly D. A simple method for comparing the

growth of fishes and invertebrates. ICLARM Fishbyte. 1983; 1:5-6.
26. Pauly D, Munro JL. Once more on the comparison of growth in fish and invertebrates. ICLARM Fishbyte. 1984; 2:21.
27. Pauly D. Theory and management of tropical multispecies stocks: a review with emphasis on the Southeast Asian demersal fisheries. ICLARM Sudies Review. 1979, 1.
28. Pauly D. On the interrelationships between natural mortality, growth parameters and mean environmental temperature in 175 fish stocks. Journal du Conseil Inernational pour l'Exploration de la Mer. 1980; 39:175-192.
29. Doumbia L. Stratégies spatio-temporelles des peuplements et stratégies alimentaires de deux poissons-chats africains : *Schilbe mandibularis* (Günther, 1867) et *Schilbe intermedius* (Rüppell, 1832) (Bassin Bia et Agnébi, Côte d'Ivoire). 2003; 3:52-139.
30. Pervin MR, Mortuza MG. Notes on length-weight relationship and condition factor of freshwater fish, *Labeo boga* (Hamilton) (Cypriniformes: Cyprinidae). University Journal of Zoology, Rajshahi. 2008; 27:97-98.
31. Jutagate T, De Silva SS. Yield, growth and mortality rate of the Thai river sprat, *Clupeichthys aesarnensis*, in Sirinthorn Reservoir, Thailand. Fisheries Management and Ecology. 2003; 10:221-231.
32. Branstetter S. Age and growth estimates for blacktip, *Carcharhinus limbatus*, and spinner, *C. brevipinna*, sharks from the Northwestern Gulf of Mexico. Copeia. 1987; 4:964-974.
33. Etim L, Lebo PE, King RP. The dynamics of an exploited population of a siluroid catfish (*Schilbe sintermidius*, Reupell, 1832) in the Cross River, Nigeria. Fisheries Research. 1999; 40:295-307.
34. Pérez-Bote JL, Roso R. Growth and length–weight relationships of *Sander lucioperca* (Linnaeus, 1758) in the Alcántara Reservoir, south-western Spain: comparison with other water bodies in Eurasia. Journal of Applied Ichthyology. 2012; 28:264-268.