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Fishing and morphological characteristics of a Catfish, *Schilbe mandibularis* (Günther, 1867), in the Bandama River (Ivory Coast)

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Abstract

This study on the species *Schilbe mandibularis* fished in the Bandama river was carried out from July 2020 to June 2021. Its objective was to assess its quantity caught by fishing and its morphological characteristics. The specimens were caught using gillnets, weighed and then measured. The results obtained give a total fishing effort of 6675 trips for a total production of 43879.19 g. Individuals have negative allometric growth across the entire river. The condition factor varies from 0.27 to 4.6 for an average of 1.16 ± 0.51. Medium-sized specimens were the most numerous in the catches. Today, it is important to reorganize the fishing of *Scilbe mandibularis* so that it can be practiced in a responsible and sustainable way.

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Introduction

Côte d'Ivoire is a West African country located between 04°-11° north latitude and 03°-08° west longitude (Diaha *et al.,* 2009). It has 4 main rivers (Comoé, Cavaly, Sassandra and Bandama) on which are built the main hydroelectric dams ensuring all inland fishing activities (Da Costa and Dietoa, 2007). Fish, the main product of this fishery, is the main source of protein for african populations (Micha and Frank, 2004).

Furthermore, it contributes to the prosperity of local populations and remains the most accessible protein to the less economically well off people (Coulibaly, 2010). All these assets associated with the rapid increase in the ivorian population have led to increased pressure on the various fisheries, thus creating situations of overexploitation (Lévêque and Paugy, 1999; Koudou *et al.,* 2020). High fishing pressure leads to a reduction in the yield of fishing trips, a reduction in the size of individuals landed and a change in catches in favor of less prized species (Gracia and Demetropoulos, 1986).

This is the case of the species *Schilbe mandibularis*, encountered in the Bandama river, which is massively caught by artisanal fishermen in an anarchic manner insofar as there is no basis for management (Aliko *et al.,* 2010). The work carried out being fragmented, the present study was initiated to assess the level of production of this species by artisanal fishing and to determine the morphological characteristics of its population in the Bandama river.

Material and methods

Study area

This study was carried out on the Bandama river between 6°00'-6°20' north latitude and 4°90'-5°00' west longitude (Fig. 1). This area is characterized by a substrate made of large rocks, sands and gravels with a heterogeneous population exercising in several economic fields. Two sub-prefectures were selected for the surveys: the sub-prefecture of Taabo, with the stations of N'Dènou, Ahouaty and Kotiessou; the sub-prefecture of Pacobo with the stations of Pacobo, Singrobo and Aheremou 2.

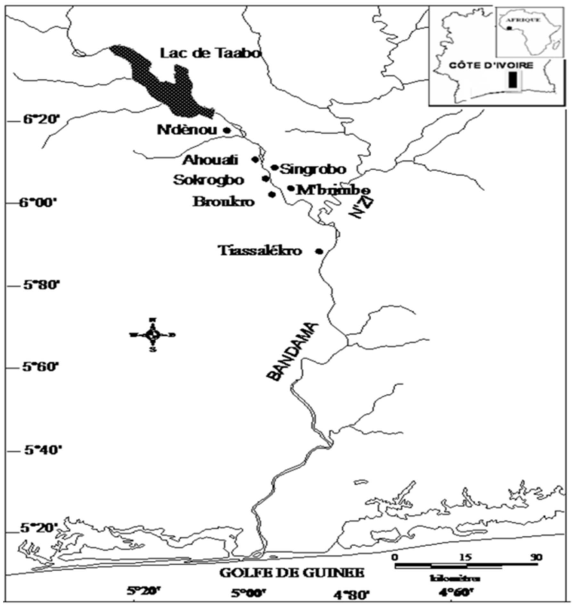

Fig. 1. Geographical location of the sampling stations (●) on the Bandama river.

Data collection

From July 2020 to June 2021, sampling of *Schilbe mandibularis* from artisanal fishing was carried out each month for two days per site. On landing, a questionnaire was administered to each crew for information regarding the name of the fisherman, the gear used, the dimensions of the gear and the fishing area. The fish were sorted first and the total mass assessed with a scale of 10kg range and an accuracy of 1g thereafter.

The specimens were then randomly selected from the different batches to be measured (standard length LS, to the nearest centimeter using an ichthyometer), and weighed (total weight PT, with a scale of 500g span and d an accuracy of 0.01g). To catch the fish, the gillnets were set in the evening and hauled in the next morning. The gillnets have a length varying between 100 and 800m, a depth of 150 m with a mesh of 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60mm between knots.

Data processing

Fishing effort

The fishing effort considered in this study is the set of daily fishing trips. In order to determine the actual fishing pressure in the fishing area, the number of fishing trips per month for each fishing unit per site was evaluated. These data made it possible to estimate the total fishing effort.

Catch Per Unit Effort (CPUE)

The Catch Per Unit of Effort is the mass of catches made by a fisherman during a fishing trip. It is expressed ing/trip. For each month, an average catch per unit effort (CPUEm) was determined from all the daily catches recorded during the month in question according to the following formula:

CPUEm = Mt / Nt

With Mt = total mass in g of daily catches landed by all the fishermen surveyed in the month; Nt = total number of fishing trips in the month.

Total catches or total productions

The monthly catches (Ci) (in g) were calculated by summing the daily catches made at each site during month i.

The summation of the monthly quantities made it possible to calculate the total annual quantity (Ca) of fish caught by the fishermen. The total amount was obtained by the following formula:

Ca = ∑Ci

Determination of population characteristics

Condition factor

The condition factor (Kc) is used to determine the overweight of fish in an environment. The formula is:

$Kc = (PT/LF^3) \times 105$ (Kraidy *et al.*, 2014)

PT = fish weight (g); LF = fork length (mm)

Allometric relationship

The height-weight relationships follow the model:

$P = aLF^b$ (Le Cren, 1951)

P = specimen weight (g); LF= fork length (mm).

Parameters a and b respectively represent the proportionality coefficient and the allometric coefficient and are determined after the logarithmic transformation of the type:

$Ln(P)=ln(a)+b \times ln(LF)$.

b provides information on the type of growth of the species considered:

- b= 3, growth is isometric (growth in weight is equal to growth in height),
- b< 3, the fish shows negative allometric growth (growth in weight is less than growth in size),
- b> 3, the fish exhibits positive allometric growth (growth in weight is greater than growth in size).

The histograms of the size frequency distribution were established by site. Size ranges, modal classes and average sizes of the different calculated populations.

Statistical analyzes

Student's t test was used to compare the calculated allometric coefficients to the threshold allometric coefficient 3.

Results

Fishing assessment

Fishing effort

The monthly evolution of the fishing effort deployed to catch *Schilbe mandibularis* is shown in Fig. 2. The total fishing effort obtained is 6675 trips. The number of fishing trips is higher in March (725 trips) and lower in October (494 trips) for a monthly average of 556.25±60 trips.

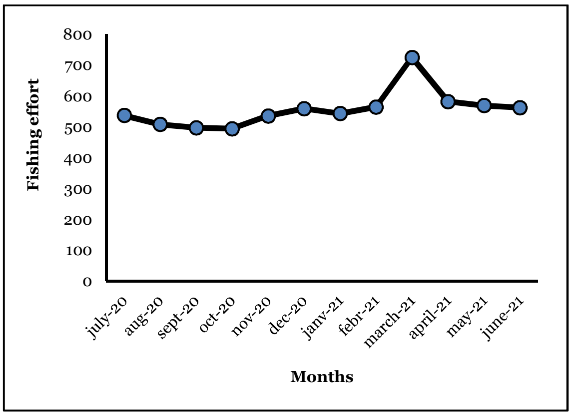

Fig. 2. Monthly evolution of fishing effort on the Bandama river from July 2020 to June 2021.

Total Capture

The total production of *Schilbe mandibularis* on the Bandama river was estimated at 43879.19g for a monthly average of 3656.60±2033.35g.

The variation of this total catch on the Bandama river (Fig. 3) shows a maximum value of 8323g in March against the lowest in October (1738.88g).

Catch per Unit Effort (CPUE)

The CPUE values calculated over the entire study area have a sawtooth pattern (Fig. 4). A first smaller peak is noted in August (5.67g/trip). The second, larger peak is observed in March (11.48g/trip). The lowest catch of 3.52g/trip is obtained in October. The average monthly catch per unit effort is 6.36±2.81g/trip.

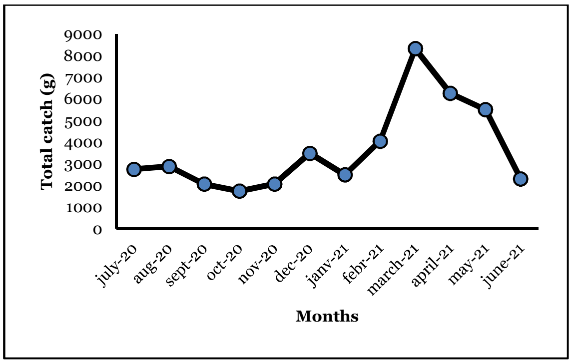

Fig. 3. Monthly evolution of *Schilbe mandibularis* catches on the Bandama river from July 2020 to June 2021.

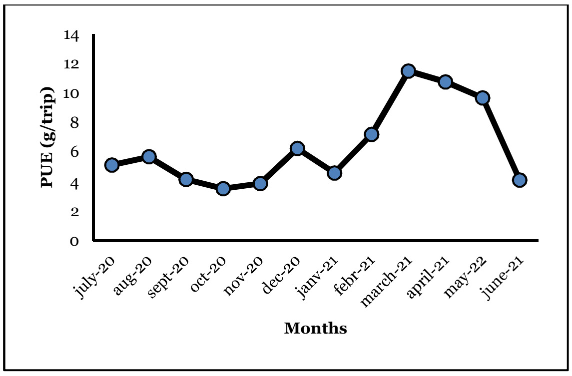

Fig. 4. Monthly evolution of catch per unit effort (CPUE) of *Schilbe mandibularis* on the Bandama river from July 2020 to June 2021.

Morphometric characteristics of populations

Condition factor (Kc)

The condition factor of the species *Schilbe mandibularis* of the Bandama river varied with a minimum of 0.27, a maximum of 4.6 and a mean of 1.16±0.51 (Table 1).

Table 1. Condition factor (Kc) of the population of *Schilbe mandibularis* of the Bandama river from July 2020 to June 2021. (n: number of individuals, min: minimum, max: maximum).

	Kc		
n	Min	max	Kc-mean
1000	0.27	4.6	1.16±0.51

Allometric relationship

The sizes of *Schilbe mandibularis* harvested on the Bandama river from July 2020 to June 2021 are between 8.5 cm and 31.5 cm for masses varying from 15 g to 172 g. The study of the length-mass relationship of this species gave the curve (Fig. 5) with the following regression equation: $M = 12.19.10^{-2} \times LS^{2.61}$ ($r = 0.83$).

The correlation coefficient (r) obtained for this species is close to unity. There is a strong correlation between length and mass of *Schilbe mandibularis*. The value of the allometric coefficient b obtained is 2.61. This value is significantly different from 3 (Student's t test, $p<0.05$) (Table 2). On the Bandama River, *Schilbe mandibularis* therefore has a negative allometry.

Size structures

The structuring of the population of *Schilbe mandibularis* (Table 3) showed that the landed specimens have sizes that oscillate between 8.5 and 31.5 cm with an average of 17.77±1.88 cm and a modal class of [17.5-20.5[(Fig. 6) .

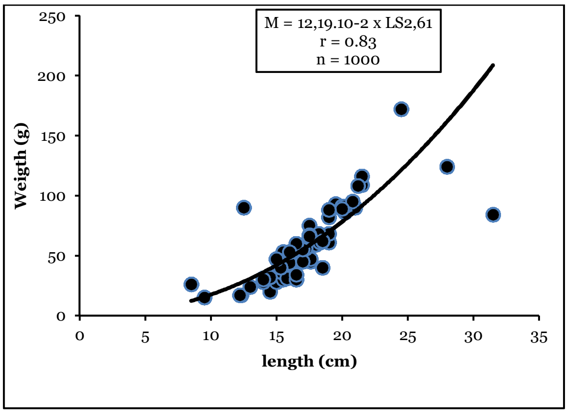

Fig. 5. Length-weight relationship of *Schilbe mandibularis* individuals on the Bandama river from July 2020 to June 2021. (r = correlation coefficient; LS = standard length, M = total weight and n = number).

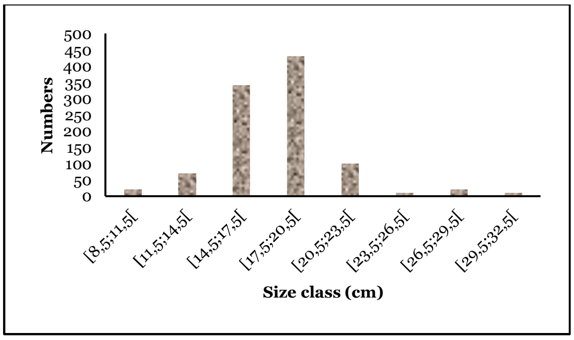

Fig. 6. Size frequency histograms of specimens of *Schilbe mandibularis* recorded on the Bandama river from July 2020 to June 2021.

Table 2. Descriptive statistics relating to the height and weight of specimens of *Schilbe mandibularis* and parameters of the length-weight relationships of different categories of individuals recorded from July 2020 to June 2021 on the Bandama river. (n: number of individuals, a: proportionality constant, b: allometric coefficient, r: correlation coefficient, A-: negative allometric growth)

N	length (cm)		weight (g)		Growth parameters			
	min	max	min	Max	A	b	R	Type of growth
1000	8.5	31.5	15	172	$12{,}19.10^{-2}$	2.61	0.83	A^{-}

Table 3. Population size structure of *Schilbe mandibularis* on the Bandama River from July 2020 to June 2021.

Size range	Average size (cm)	Modal class
[8.5-31.5]	17.77±1.88	[17.5-20.5[

Discussion

The study of fishing and the morphological characteristics of *Schilbe mandibularis* revealed a high fishing effort (6675 trips). This could be explained by the high number of foreign fishermen on the Bandama river. These "bozo" fishermen's only activity is fishing (Koudou, 2014). This means that they are found almost all year round on the river in very large numbers (Kien *et al.,* 2021).The total catch obtained in the present study () is higher than that noted on Lake Taabo, built on this river, by Aliko *et al.* (2010). The abundance of plants in the river could be the cause. Doumbia *et al.* (2008) observed a diet rich in plant debris and animal debris in *Schilbe mandibularis*. Specimens of this species would therefore be attracted to the river where the presence of plants is an important source of food. This idea is supported by Lévêque (1995) who states that the search for food is a determining factor in the choice of habitat for a given species. The value of the allometric coefficient b obtained (2.61) for the present study is less than 3, which suggests that *Schilbe mandibularis* has a negative allometric growth over the entire Bandama river. Similar results were noted by Ecoutin and Albaret (2003) in estuarine and lagoon environments in West Africa. The *Schilbe mandibularis* fish seem to grow faster than they get bigger. The value of the correlation coefficient (r) is high in the *Schilbe mandibularis* populations (r = 0.83). Similar results (r = 0.97) were observed by Ecoutin and Albaret (2003). These high values of r reflect a strong relationship between the weight and size of the fish caught. In addition, these show that the growth in length of the specimens of *Scilbe mandibularis* studied is proportional to the increase in weight. According to Angelescu *et al.* (1958), the condition factor is an index that reflects, on the one hand, the physiological condition of the fish and, on the other hand, the biotic and abiotic factors of the environment. Indeed, this index reflects the well-being of populations throughout their life cycle. The average condition factor of our study is 1.16±0.51. This value is higher than that noted by Ecoutin and Albaret (2003) (0.36.10-2) for this same species in the lagoons of West Africa. According to Angelescu *et al.* (1958), the range of condition factor for fish body condition is in the range of 1.0 to 2.5.

The value of the condition factor in our study indicates that the specimens of *Schilbe mandibularis* exploited are in good condition. Its very varied diet would be an advantage for its survival in this environment. Thus, the difference between the population condition factors may be linked to the quantity and/or quality of food available in the different capture environments (Kartas and Quignard, 1984; Koné, 2000).

The size structures in the present study highlighted a dominance of individuals whose size is between 17.5

and 20.5 cm. Kien *et al.* (2021) indicated that specimens of *Schilbe mandibularis* in this size range are considered adults. Furthermore, Aliko *et al.* (2010) showed that Lake Taabo was colonized by juveniles of this species. The present results could explain a phenomenon of migration of *Schilbe mandibularis*. Indeed, the juveniles encountered on Lake Taabo migrate to the river for their reproduction. These observations are in agreement with those obtained by (Hopson, 1982). which affirms that in the great African lakes, this species migrates in small tributaries to reproduce.

Conclusion

At the end of this study, we will retain that it allowed us to have the first data on the parameters of the length-weight relationship and the condition factor of the Schilbeidae *Schilbe mandibularis* on the Bandama river. The different growth patterns have shown that individuals of this species grow more than they get fatter. In addition, the study of the condition factor means revealed a value of 1.16±0.51. This value reflects a better well-being of the fish in this river. With a view to sustainable co-management of the *Schilbe mandibularis* fishery on the Bandama river, more in-depth studies will need to be conducted, which will take into account other aspects of the bioecology of this species.

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References

Aliko NG, Da Costa KS, Konan KF, Ouattara A, Gourène G. 2010. Fish diversity along the longitudinal gradient in a lake of West Africa, Taabo hydroelectric reservoir, Ivory Coast. Ribarstvo **68(2),** 47-60. https://hrcak.srce.hr/58001

Angelescu V, Gneri FS, Nani A. 1958. La merluza del Mar Argentino (*Biologia y taxonomia*). Servicio de Hidrografia Naval, Secretaria de Marina **1004, 1-244.** http://hdl.handle.net/1834/19661

Coulibaly R. 2010. Analyse de la contribution de la pêche à l'économie ivoirienne. DESS, hautes études en gestion de la politique économique. Université Félix Houphouët-Boigny, Abidjan, Côte d'Ivoire. 28p.

Da Costa KS, Dietoa YM. 2007. Typologie de la pêche sur le lac Faé (Côte d'Ivoire) et implications pour une gestion rationnelle des ressources halieutiques. Bulletin Français Pêche Pisciculture **384,** 1-14. http://dx.doi.org/10.1051/kmae:200700

Diaha NC, N'Da K, Kouassi KD. 2000. Etude comparée de la pêche des thonidés mineurs par les chaluts doubles et les pirogues dans la zone économique exclusive (ZEE) ivoirienne. Tropicultura **27(3),** 152-158. http://www.tropicultura.org/text

Doumbia L, Ouattara A, Gourène G. 2008. *Régime alimentaire* du poisson-chat Schilbe mandibularis (Gunther, 1867) dans deux bassins fluviaux de Côte d'Ivoire (Bia et Agneby). European Journal of Scientific Research **21(2),** 305-313. https://www.researchgate.net /292567778

Ecoutin JM, Albaret JJ. 2003. Relation longueur-poids pour 52 espèces de poissons des estuaires et lagunes de l'Afrique de l'Ouest. Cybium **27(1),** 3-9. https://www.documentation.ird.fr/hor/fdi:01003140

Garcia S, Demetropoulos A. 1986. L'aménagement de la pêche à Chypre. FAO Document Technique Pêches 43 p.

Hopson AJ. 1982. Lake Turkana. A report on the findings of the Lake Turkana. Project 1972-1975. London Overseas Development Administration **6,** 4-16. https://www.biodiversitylibrary.org/bibliography

Kartas F, Quignard JP. 1984. La fécondité des poissons téléostéens. Masson (Collection biologie des milieux marins), Paris 117 p.

Kien KB, Ndiaye A, Aboua BRD. 2021. Caractérisation De La Diversité, De La Structure Des Tailles Et Du Stress Écologique Au Niveau Du Peuplement Des Poissons Sur Le Fleuve Bandama (Côte d'Ivoire, Afrique De l'Ouest). European Scientific Journal, ESJ **17(43),** 1857-7881.

Kien KB, Ndiaye A, Boguhe GFDH. 2021. Migratory Dynamics of Bozo Fishermen on the Rivers of Ivory Coast: The Case of the Bandama River. International Journal of Applied Agricultural Sciences **7(5),** 232-236. DOI: 10.11648

Koné T. 2000. Régime alimentaire et reproduction d'un tilapia lagunaire (Sarotherodon melanotheron Rüppell, 1852) dans la rivière Bia et le lac de barrage d'Ayamé (Côte d'Ivoire). Thèse de Doctorat. Katholieke Universiteit Leuven (Belgique). 253P.

Koudou D, Kakou YSC, Sékongo LG. 2020. Pêche dans le lac de Korhogo (Côte d'Ivoire) : acteurs, exploitation incontrôlée et signes de dégradation de la ressource halieutique. DALAGEO **19(002),** 8-19. https://www.revuegeo-univdaloa.net/fr/publication

Koudou D. 2014. Eaux et conflits en Côte d'Ivoire: regard géographique sur des conflits halieutiques larvés au lac du barrage hydroélectrique de Taabo. Revue Canadienne de Géographie Tropicale **2(1),** 47-56. http://laurentienne.ca/rcgt

Kraidy LAB, Koné N, Berté S, N'zi GK, Yao SS, Kouamelan PE. 2014. Pêche et paramètres de reproduction de Pellonula leonensis Boulenger 1916, dans le lac de Taabo (Fleuve Bandama, Côte d'Ivoire) :Implications pour une exploitation durable du stock. International Journal Biological Cheminal Science **8(1),** 75-88.

Le Cren ED. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). Journal Animal Ecological **20,** 201-219. https://doi.org/ 10.2307

Lévêque C, Paugy D. 1999. Impacts des activités humaines. In : IRD (Ed.), Les poissons des eaux continentales africaines : diversité, biologie, écologie, utilisation par l'homme, Paris pp 365-383.

Lévêque C. 1995. L'habitat : être au bon endroit au bon moment ? Bulletin français Pêche Pisciculture **9 (20),** 337-339. https://doi.org/10.1051/kmae:1995

Micha JC, Franck V. 2004. Etude prospective pour la relance du secteur pêche et aquaculture en côte d'Ivoire. Ministère de la Production Animale et des Ressources Halieutiques, Abidjan 60 p.