Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
Impact Factor (RJIF): 5.83
www.entomoljournal.com
JEZS 2025; 13(4): 183-189
© 2025 JEZS
Received: 15-05-2025
Accepted: 18-06-2025

KOUAKOU Fokouo Kessia Irène
Biological Sciences Training and Research Unit, Department of Animal Biology, Peleforo GON COULIBALY University of Korhogo, BP 1328 Korhogo, Côte d'Ivoire

KOUATO Fulgence
Biological Sciences Training and Research Unit, Department of Animal Biology, Peleforo GON COULIBALY University of Korhogo, BP 1328 Korhogo, Côte d'Ivoire

KRA Kobenan Mathieu
Biological Sciences Training and Research Unit, Department of Animal Biology, Peleforo GON COULIBALY University of Korhogo, BP 1328 Korhogo, Côte d'Ivoire

BEBO Innocent
Biological Sciences Training and Research Unit, Department of Animal Biology, Peleforo GON COULIBALY University of Korhogo, BP 1328 Korhogo, Côte d'Ivoire

KOUASSI Koffi Dongo
Biological Sciences Training and Research Unit, Department of Animal Biology, Peleforo GON COULIBALY University of Korhogo, BP 1328 Korhogo, Côte d'Ivoire

N'DA Konan
Natural Sciences Training and Research Unit, NANGUI ABROGOUA University, Animals Biology and Cytology Laboratory, 02 BP 801 Abidjan 02, Côte d'Ivoire

Corresponding Author:
KOUAKOU Fokouo Kessia Irène
Biological Sciences Training and Research Unit, Department of Animal Biology, Peleforo GON COULIBALY University of Korhogo, BP 1328 Korhogo, Côte d'Ivoire

Growth patterns and condition factor of *Heterotis niloticus* (Cuvier, 1829) from Lôkpôhô dam lake (Côte d'Ivoire)

KOUAKOU Fokouo Kessia Irène, KOUATO Fulgence, KRA Kobenan Mathieu, BEBO Innocent, KOUASSI Koffi Dongo and N'DA Konan

DOI: https://www.doi.org/10.22271/j.ento.2025.v13.i4c.9553

Abstract
Growth is a key factor in assessing fish habitat quality in fisheries ecology. This work was carried out with the aim of analyzing the growth parameters of *Heterotis niloticus* (Cuvier, 1829) fished in the Lôkpôhô reservoir. The objective of this work is to contribute to the conservation and rational management of the stock of this fish. A total of 178 fish, from commercial artisanal fishing, were sampled from July to December 2023. On each specimen, the total weight and total length were recorded to the nearest gram and millimeter respectively. The length-weight relationship and condition factor were calculated. The data collected was processed using Excel and Statistica 7.1 software. The size of this fish varies between 14 and 74 cm. The most captured size ranges are between 14 and 22 cm and between 30 and 38 cm. In general, growth is negative allometry, without distinction of sex. It appears that the species grows faster than it gets bigger. In males and females, the average values of the condition factor K are 0.813 ± 0.071 and 0.832 ± 0.126, respectively. These individuals are not overweight in their biotope. On the other hand, individuals of indeterminate sex are overweight and live in an environment where conditions are favorable for them. However, no significant differences were observed in small and large specimens.

Keywords: *Heterotis niloticus*, growth, lake, Lôkpôhô, ivory coast

1. Introduction
Since the 1960s, Côte d'Ivoire has implemented a policy aimed at introducing new fish species into its waters in order to increase fishing productivity and promote the development of fish farming [1]. This group of species includes *Heterotis niloticus* (Cuvier, 1829). Currently, it occupies almost all freshwater bodies on the national territory [2]. The Lôpkôhô dam lake, located in the Northern region, is subject to exploitation of this species by artisanal fishing. Agro-pastoral activities negatively affect the physicochemical quality of the waters of this lake [3]. This situation constitutes a real problem for the fish's physical condition. Faced with this threat, it appears important to study the growth of *H. niloticus*.
Growth plays a crucial role in assessing fish habitat quality in fisheries ecology [4]. Length-weight relationship and condition factor are important growth indicators in fish. They are frequently used in fisheries management to obtain information on the status of fish stocks in an aquatic ecosystem (Hossain *et al*., 2006) [5]. Conservation and sustainable stock management strategies largely rely on knowledge of these growth indicators. Thus, the aim of this work is to contribute to a rational management of *Heterotis niloticus* at the Lôkpôhô dam lake.

2. Materials and Methods
2. 1 Study environment
The Lôkpôhô dam built on the secondary tributary of the Bandama (Lôkpôhô river) is located 10 km from Ferkessédougou and 40 km from Korhogo (Figure 1). It has an area of 620 ha [6]. In this area, the climate isdry savannah type. Temperatures fluctuate around 27.4 °C on average. Daily and annual temperature ranges are relatively significant, around 20 °C. The humidity rate varies between 40% and 50%, lower than in the south. There is the intermittent presence of a cool, dry wind (harmattan) between December and February. There are two seasons.

The dry season appears from November to June, with a few showers in April.As for the rainy season, it extends from July to October [7]. Annual rainfall reaches 1200 mm, with a unimodal regime centered in August-September, where between 600 and 700 mm of rain are received [8].

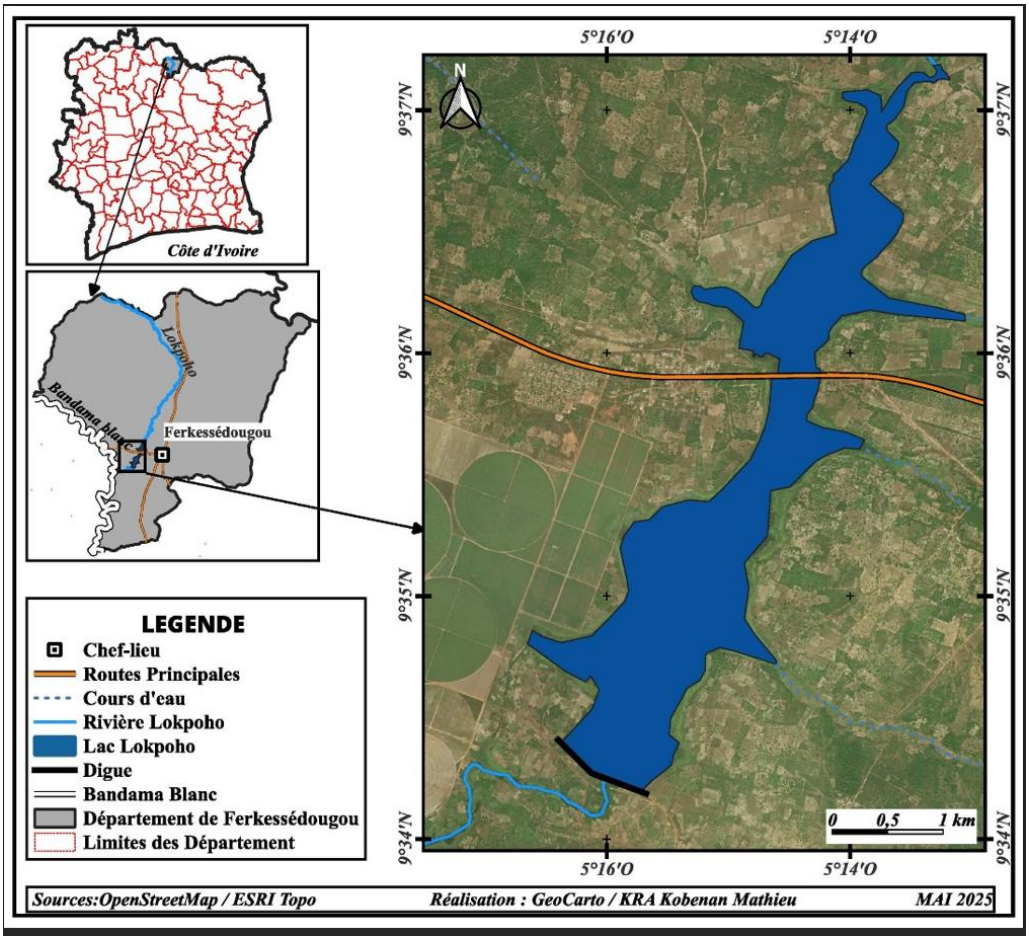


Fig 1: Presentation of the study environment

2.2 Fish sampling

Monthly sampling from commercial artisanal fishery landings was carried out from July 2023 to December 2024. Each month, 4 days were devoted to sampling. It was carried out every morning and was done in a simple random manner. The fish were transported to the laboratory in a cooler for analysis. On each specimen, the standard length and total length were recorded to the nearest millimeter. The total weight was recorded to the nearest gram. Each individual was then dissected and the sex was determined. The fish were caught using gillnets with mesh sizes between 25 and 80 mm and cast nets with mesh sizes between 30 and 80 mm.

2.3 Data analysis

2.3.1 Size frequency distribution

Sturge's rule [9] allowed the determination of the size classes used in the size frequency distribution. This rule varies the integer number k of classes or intervals to be constituted according to the number n of data (total number of individuals) using the following logarithmic operation: $K = 1 + (3.3 \times \log10(n))$

The lower bound of the classes is the smallest value and the upper bound is the largest value. The interval of each class is determined according to the formula:

Class range = (maximum value – minimum value) / (Number of classes)

A premise for constructing Sturge's rule is that the number of classes to be used must be large enough when the data are small in order to identify a possible concentration of data in a class. This rule is implemented in Excel.

2.3.2 Determination of the length-weight relationship

It was established for the sampled specimens according to the following formula:

$Pt = aLt\ b$ [10]

Where Pt and Lt represent the weight of the fish in grams and the total length in centimeters, respectively. a is a constant and b represents the allometric coefficient.

The parameters a and b are estimated after transforming the previous linear function into a logarithmic function with the formula: $\log Pt = \log a + b \log Lt$

To determine the nature of allometry, the observed value of the slope (b) was compared to the theoretical value 3. Typical values of the slope b, ranging from 2.5 to 3.5, from the logarithmic regression line of the length-weight relationship are determined in fish [11]. The value of b provides information on the type of growth of the fish. When the value of b is equal to 3, the growth is said to be isometric. When it is different from 3, the growth of the fish is allometric. If the value of b is less than 3, the allometry is negative or minor, the fish grows faster than it gets bigger. If the value of b is greater than 3, the allometry is positive or major, the fish grows faster than it gets bigger [12].

The coefficient of determination (R^2) was used in this work to

measure the degree of correlation between fish length and weight.

2.3.3 Determination of the condition factor

The condition factor was determined based on month, gender and size. It was calculated using the following formula:

K= 100 x Pt/ Lt3 [13],

With Pt and Lt respectively the total weight in grams and total length in centimeters.

The fish were classified into two groups according to the size at first sexual maturity [2]:

- Group 1 consists of immature individuals, that's to say juveniles measuring between 12 cm and 48 cm;
- Group 2 includes mature individuals (adults) between 48 cm and 74 cm in size.

2.4 Statistical analyses

The statistical significance of the coefficient of determination (R^2) was estimated and Student's t-test was used to check whether the b values were significantly different from the isometric b value equal to 3 at the 5% threshold.

The values of the condition coefficient K were subjected to the 1-way analysis of variance (ANOVA I) to see if this parameter varies significantly depending on the sex of the fish.

The Chi-square (X^2) test was used to compare the means of the condition factor of the two size class groups.

All these analyses were carried out using Statistica 7.1 software version 2006. The figures were obtained using Microsoft Office Excel 2021.

3. Results

3.1 Size frequency distribution of *H. niloticus*

Figure 2 shows how the size frequencies of the sampled *H. niloticus* specimens are distributed in the overall sample. The value of k is equal to 8. This means that the captured individuals were divided into 8 size classes.

H. niloticus individuals exhibit a bimodal size distribution that varies between 14 and 22 cm for the former and between 30 and 38 cm for the latter. This distribution shows that the largest individuals are those whose size varies within these intervals.

Size frequencies are moderately represented in individuals of the size class [38; 46 [cm. They are weakly represented in individuals of the class [62; 70 [cm and [70; 78 [cm.

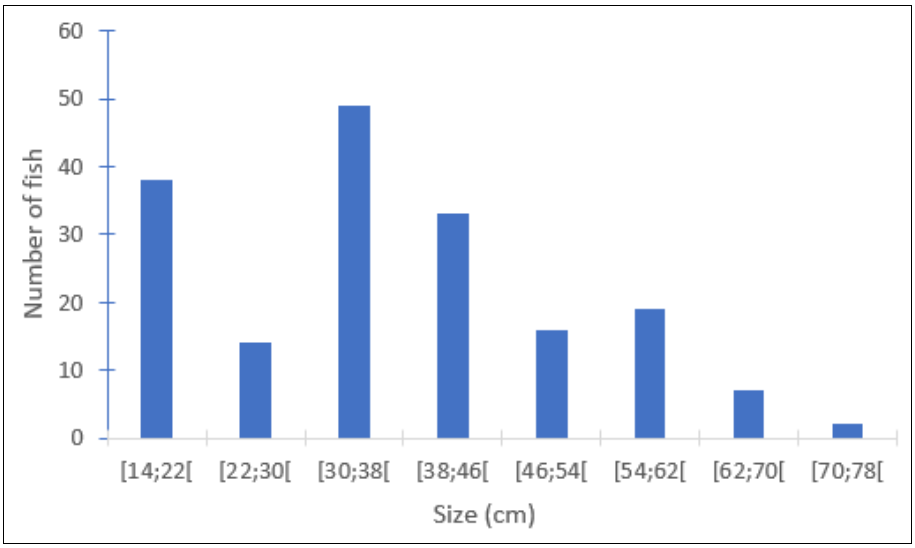


Fig 2: Size frequency distribution of *Heterotis niloticus* specimens from Lôkpôhô Dam Lake

3.2 Length-weight relationship of *H. niloticus*

The study of the length-weight relationship was carried out on a sample composed of 178 specimens whose individual total lengths were between 14 and 74 cm and the weight between 27 and 3103 g.

The relationship between total length and weight of *H. niloticus* individuals sampled at the Lôpkôhô dam lake is shown in Figure 3.

The general equation is Pt = 0.0418 L 2.5647. The value of the coefficient of determination R^2 is equal to 0.9344. A significant difference is highlighted by the applied Student t-test. The value of the allometry coefficient b determined is lower than the theoretical value b = 3 (Student t-test: t = 2.874; p = 0.012; p < 0.05).

In individuals of indeterminate sex, the relationship between total length and weight is as follows: Pt = 0.0238 L 2.75. The value of the coefficient of determination R^2 is 0.8295. The value of the allometry coefficient b of this relationship is 2.75. This value is significantly different from 3 (Student t-test: t = 2.3246; p = 0.048 < 0.05) (Figure 4).

In males, the equation for the length-weight relationship is Pt = 0.052 L 2.495. The coefficient of determination R^2 is equal to 0.9075.

In females, the equation for the length-weight relationship is as follows:

Pt = 0.046L2, 5414. The value of the coefficient of determination R^2 is equal to 0.9155.

The Student t-test applied according to sex shows a significant difference. The value of the allometry coefficient b determined is lower than the theoretical value (b = 3) for males (Student t-test, t = 5.244, p = 0.003; p < 0.05), for females (Student t-test, t = 14.186, p = 0.000; p < 0.05) (Figure 14).

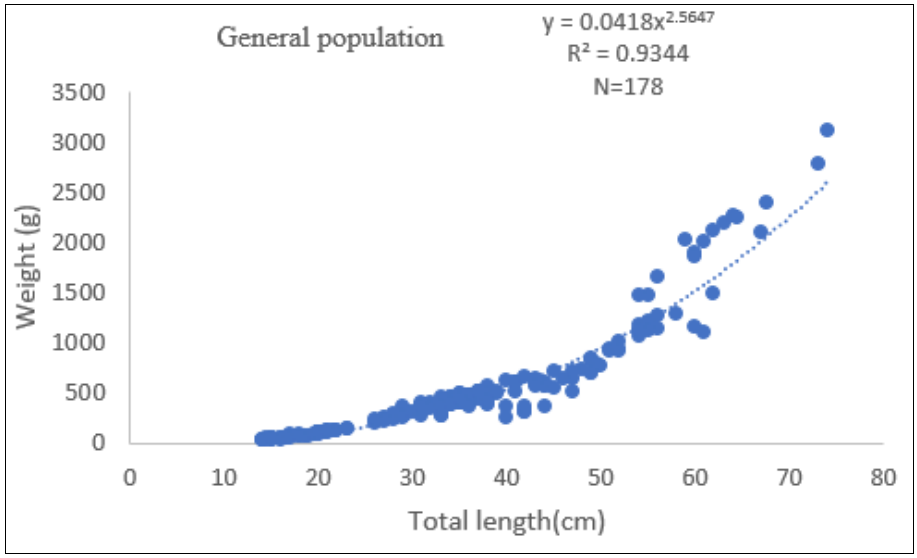
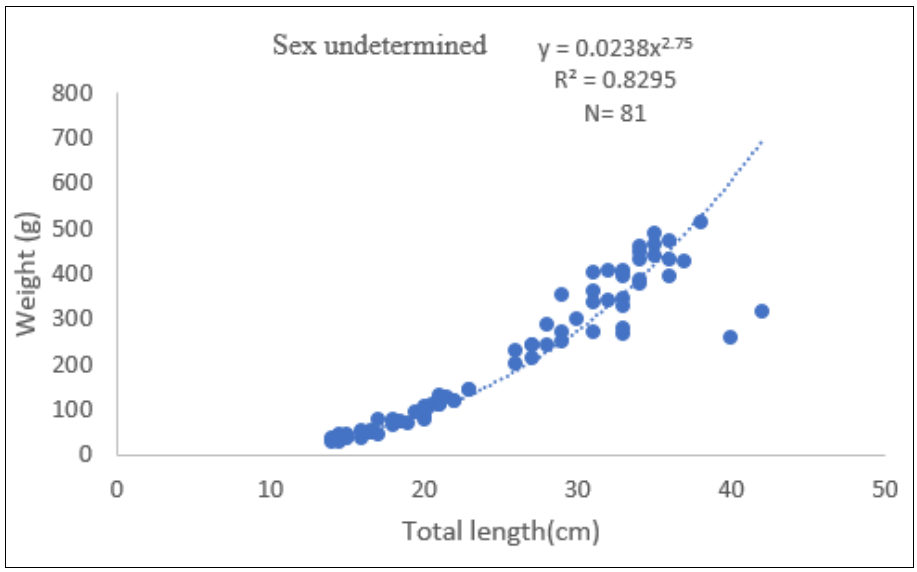
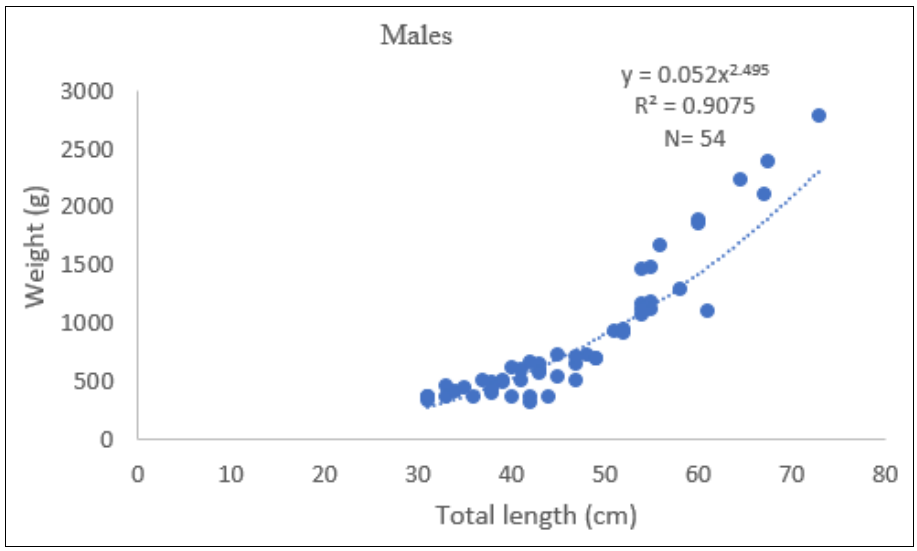


Fig 3: Length-weight relationship of *Heterotis niloticus* from Lôkpôhô Dam Lake





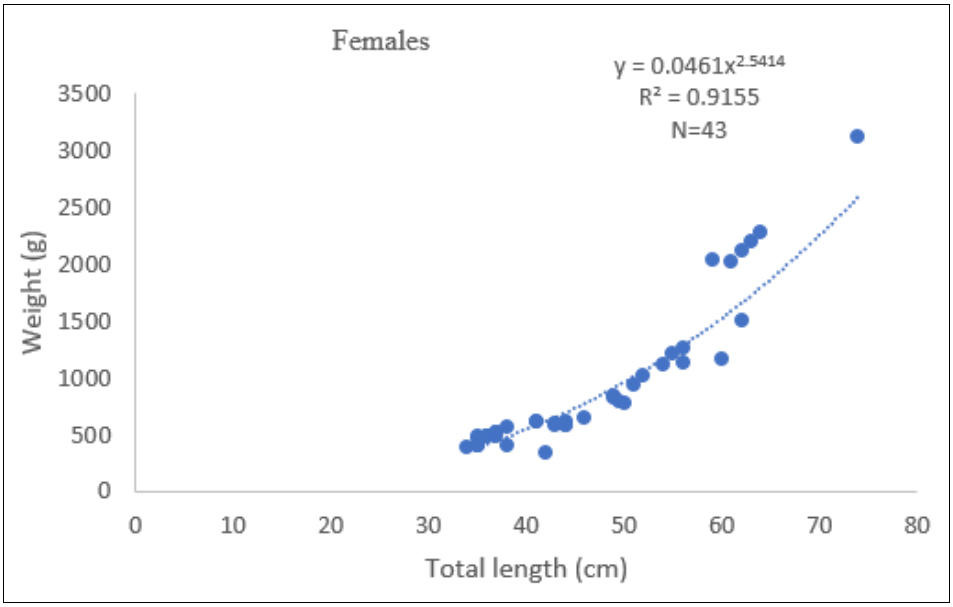


Fig 4: Length-weight relationship of *Heterotis niloticus* according to sex from Lôkpôhô Dam Lake

3.3 Monthly average condition factor

The mean condition factor varied from month to month and within the same month from one sex to another (Table 1). In females, the condition factor ranged from 0.668 ± 0.063 to 0.967 ± 0.12 with a mean value of 0.832 ± 0.126. The lowest value was observed during the month of September and the highest value in the month of October. For males, the condition factor ranged from 0.718 ± 0.134 to 0.902 ± 0.109 with a mean of 0.813 ± 0.071. The lowest value was observed during the month of July and the highest value during the month of December. However, there is no significant difference between the two sexes ($p = 0.776$; $p > 0.05$). In individuals with undetermined sex, the value of K varies from 0.978 ± 0.186 to 1.395 ± 0.01 with a mean of 1.146 ± 0.122. The lowest value is observed during the month of July and the highest value in the month of September.

Table 1: Monthly average condition factor of *H. niloticus* of Lôkpôhô dam lake

Month	Number of males	K average males	Number of females	K average females	Undetermined number	K average sex undetermined
July	21	0.718 ± 0.134	13	0.757 ± 0.109	20	0.978 ± 0.186
August	9	0.741 ± 0.13	8	0.693 ± 0.026	12	1.203 ± 0.129
September	7	0.896 ± 0.246	5	0.668 ± 0.063	9	1.395 ± 0.1
October	5	0.857 ± 0.216	6	0.967 ± 0.12	17	1.209 ± 0.083
November	6	0.766 ± 0.09	4	0.962 ± 0.053	11	1.096 ± 0.007
December	6	0.902 ± 0.109	6	0.95 ± 0.037	12	1 ± 0.112

3.4 Condition factor according to gender

The evolution of the condition factor according to sex is illustrated in Figure 5. The curves of evolution of the monthly condition factor have the same trends in males and individuals of indeterminate sex. On the other hand, the curve of evolution of the monthly condition factor of females does not evolve in the same direction as that of males. The mean value of K in females and males is respectively 0.832 ± 0.126 and 0.813 ± 0.071. However, there is no significant difference between the two sexes ($p = 0.776$; $p > 0.05$). In individuals of indeterminate sex, the mean value of K is 1.146 ± 0.122.

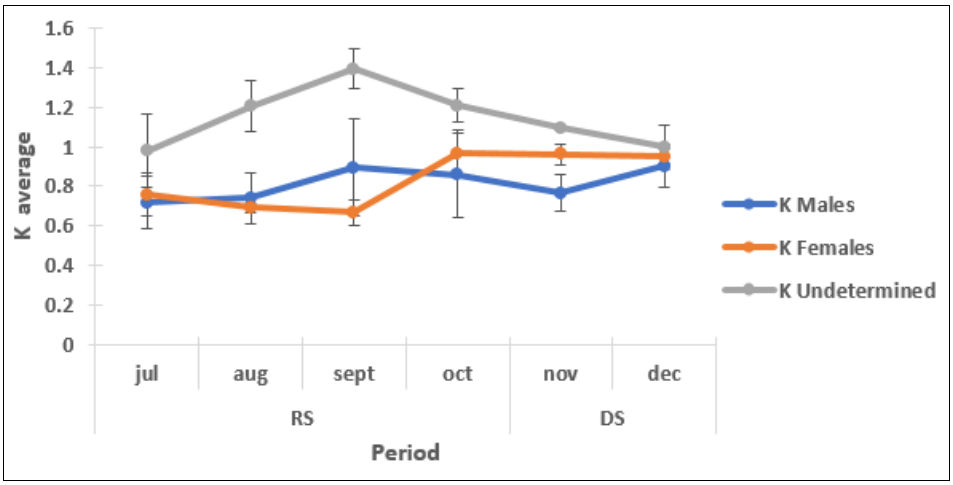


Fig 5: Sex-dependent condition factor in *H. niloticus* from Lôpkôhô Dam Lake from July to December 2023

3.5 Condition factor depending on size

The mean value of the condition factor K of group 1 constituent is 1 ± 0.14 and that of group 2 is 0.73 ± 0.09 (Table 2). The difference between these two groups is not significant with p = 0.837; p>0.05.

Table 2: Condition factor as a function of the size of *H. niloticus* from the Lôkpôhô dam lake

Size (cm)	Number of fish	K average
Group 1 (12 ≤ Lt < 48 cm)	138	1 ± 0.14
Group 2 (48 ≤ Lt < 78 cm)	40	0.73 ± 0.09

4. Discussion

The specimens of *Heterotis niloticus* sampled in this study have sizes that vary between 14 and 74 cm. The maximum size observed during our study is lower than that reported by [2] at the Agnéby River in Côte d'Ivoire (78 cm standard length). The duration of sampling could explain this difference in size range. Indeed, this study was carried out over a period of six months, while that of [2] was conducted over two years. This difference in size range could also be linked to the fishing gear used. Indeed in the work of [2], the gear used consisted of cast nets while in this work the gear used for fishing consisted of gillnets and cast nets. The majority of individuals caught belong to the size class [14; 22 [cm and [30; 38 [cm. These fish are considered juveniles (immature). Indeed, according to the work of [2], the size of first sexual maturity of *H. niloticus* is 54 cm in females and 48 cm in males. This suggests that all fish with a size below 48 cm are immature. The premature capture of fish that have not yet reached sexual maturity could lead to overexploitation. This situation would be linked to the use of nets with reduced meshes. Indeed, nets with meshes equal to 25 mm have been observed among some fishermen.

The study of the relationship between length and weight of *H. niloticus* shows that total length is strongly correlated (R2 = 0.9344) with body weight in this species. This fish has a minor allometric growth (b < 3, p < 0.05) regardless of sex. This result reveals that the fish grows faster in size than in weight. This rapid growth would be due to the availability of food and favorable environmental conditions of the living environment. This result is similar to that of [14] who obtained a negative allometry (b = 2.42) in this species in the Solomougou dam lake in northern Côte d'Ivoire. Our results are in agreement with those of [15] at the level of the Agnéby River (b = 2.73) and [16] in the lakes of Ayamé I (b = 2.55) and Buyo (b = 2.67) in Côte d'Ivoire. This minor allometry was also observed in this same species by [17] in the Sourou River in Burkina Faso (b=2.70) and [18] in the Ananbra River in Nigeria (b=2.79). Our results are however different from thosefrom [19] in Lake Ona in Nigeria. These authors obtained isometric growth in H. niloticus (b=3.03). Several reasons have been suggested to explain the differences between growth parameters in the same species in different aquatic environments, for example, food availability, habitat, size of specimens sampled and environmental conditions [20, 21].

Considering the sexes, the coefficient b of females is higher than that of males. This suggests that females have better growth in size than males. Our results are contrary to those of [22] which states that males grow faster than females.

Furthermore, the condition factor varies from month to month. The condition factor values of males and females are low and do not exceed the threshold value which is equal to 1. The difference is not significant between the two sexes (p = 0.776; p > 0.05). According to [23], K≥1 expresses the "well-being" of a population during its life cycle; while K<1 means that the fish is not overweight in its biotope. This suggests that individuals of both sexes are not in better physiological conditions. This situation could be explained by reproduction. Indeed, the monthly analysis of the condition factor revealed that the lowest mean K values in H. niloticus are obtained during the months of July and August in males while in females, they are observed during the months of July, August and September. These months correspond to the rainy season. The reproduction of this species takes place in the rainy season according to [2]. This period would probably correspond to the spawning period. These low K values observed in both sexes in this period could be explained by the fact that during the reproduction period the reserves are invested in the elaboration of sexual products. The development of the gonads increasingly compresses the digestive tract of the fish and can lower the condition factor [24]. The fish feed less and less and begin to draw on their reserves to meet their energy needs [25]. These periods of lower condition factor would therefore correspond to periods of weight loss. According to Dembélé *et al.* [26], the periods when the plumpness is better would correspond to periods of accumulation of nutrient reserves and optimal maturation of the gonads. On the other hand, concerning individuals of indeterminate sex, the average K is equal to 1.146±1.122. This indicates that these fish are plump and live in an environment where the conditions are favorable to them. Our results are in line with those of [14] who worked on juveniles of this fish at the Solomougou dam lake (K = 8.96). The K value observed by these authors is much higher than ours. This situation can be explained by the fact that the condition factor varies not only depending on feed availability, but also depending on the season and fish sizes, as well as the sample [27].

5. Conclusion

At the end of this study, it appears that fish are generally caught before they reach sexual maturity. The most caught size ranges are between 14 and 22 cm and between 30 and 38 cm. *H. niloticus* grows faster than it gets bigger. Males and females are not overweight in their biotope. On the other hand, individuals of indeterminate sex are overweight and live in an environment where conditions are favorable to them. However, there is no significant difference between small and large specimens.

The results obtained during this study can serve as a basis for better planning of the rational management of *Heterotis niloticus*.

6. References

1. Lazard J, Levêque C. Introductions et transferts d'espèces de poissons d'eau douce. Cah Agric. 2009;18(2-3):157-163.
2. Kouakou FKI. Biologie et pêche de *Heterotis niloticus* (Cuvier, 1829) (poisson cameroun) de la rivière Agnéby (Côte d'Ivoire) [Doctoral Thesis]. Abidjan: Université Nanguy Abrogoua; 2018. 148 p.
3. Soro TA, Etilé NR, Silué KD, Coulibaly L. Effets des activités agropastorales sur les paramètres physico-chimiques et le peuplement zooplanctonique des eaux du bassin du haut-bandama (Côte d'Ivoire). Rev Agrobiologia. 2021;11(2):2591-2599.
4. Searcy SP, Eggleston DB, Hare JA. Is growth a reliable

indicator of habitat quality and essential fish habitat for a juvenile estuarine fish. Can J Fish Aquat Sci. 2007;64:681-691.
5. Hossain MY, Ahmed ZF, Leunda PM, Jasmine S, Oscoz J, Miranda R, *et al*. Condition, length-weight and length-length relationships of the Asian striped catfish *Mystus vittatus* (Bloch, 1794) (Siluriformes: Bagridae) in the Mathabhanga River, Southwestern Bangladesh. J Appl Ichthyol. 2006;22:304-307.
6. Traoré K. Etat des connaissances sur les pêcheries continentales ivoiriennes (Rapport de consultation, avril 1996). Projet FAO TCP / IVC/ 4553. 1996. Accessed January 21, 2024. Available from: www.fao.org/docrep/fiel/009/ag188f/AG188F07.htm
7. Coulibaly L, Kouassi KH, Soro GE, Savané I. Analyse du processus de savanisation du Nord de la Côte d'Ivoire par télédétection: Cas du département de Ferkessédougou. Int J Innov Appl Stud. 2016;17(1):136-138.
8. Péné CB, Kehé M. Performances de trois variétés de canne à sucre et rationnement hydrique en prématuration au nord de la Côte d'Ivoire. Agron Africaine. 2005;17(1):7-18.
9. Scolt DW. Sturge's rules. Wiley Interdiscip Rev Comput Stat. 2009;1:303-306.
10. Le Cren ED. The length weight relationship and seasonal cycle in gonad weigth and condition in the Perch (*P. fluvitilis*). J Anim Ecol. 1951;20(2):201-219.
11. Froese R. Cube law, condition factor and weight-length relationship: history, meta-analysis and recommendations. J Appl Ichthyol. 2006;22:241-253.
12. Lévêque C. L'habitat des poissons. In: Lévêque C, Paugy D, editors. Les poissons des eaux continentales africaines: diversité, écologie, utilisation par l'homme. Paris: IRD; 1999. p. 251-270.
13. Ricker WE. Computation and interpretation of fish populations. Bull Fish Res Board Can. 1975;191:1-382.
14. Kouassi KD, Diaby M, Amon YN, N'da K. Length-Weight relationship and condition factor for 22 freshwater fish species from Solomougou Dam Lake (Korhogo, Côte d'Ivoire). Int J Fish Aquat Stud. 2020;8(1):172-175.
15. Kouakou FKI, Diaby M, Koné T, Kouato F, N'Da K. Length-weight relationship and population parameters of *Heterotis niloticus* from the Agnéby River (Côte d'Ivoire). J Chem Biol Phys Sci. 2024;14(3):221-232.
16. Tah L, Goore Bi G, Da Costa KS. Length-weight relationships for 36 freshwater fish species from two tropical reservoirs: Ayamé I and Buyo, Côte d'Ivoire. Rev Biol Trop. 2012;60(4):1847-1856.
17. Coulibaly ND. Relation longueur-poids chez quatre espèces de poissons de la rivière Sourou au Burkina Faso. Int J Biol Chem Sci. 2008;2(3):331-338.
18. Odo GE, Nwamba HO, Eyo JE. Aspects of the biology of *Heterotis niloticus* Cuvier 1829 (Osteoglossiformes: Osteoglossidae) in the Anambra flood river system, Nigeria. Anim Res Int. 2009;6(2):994-1002.
19. Ekelemu KJ, Zelibe SAA. Growth patterns and condition factors of four dominant fish species in lake Ona, Southern Nigeria. J Agric Vet Sci. 2012;4:44-52.
20. Tchouante TC, Efole ET, Tchoumboue J. Caractéristiques de la croissance et facteur de condition k de *Clarias jaensis* (Boulenger, 1909) pêchée dans les rivières de la plaine inondable des Mbô (Cameroun). Int J Innov Sci Res. 2019;43(1):1-9.
21. Hoto G, Sossoukpe E, Imorou RS, Fiogbe ED. Caractérisation morphologique, croissance staturo-pondérale et facteur de condition de la Sardinelle plate (*Sardinella maderensis* Lowe, 1838) des eaux côtières du Bénin (Afrique de l'Ouest). Int J Biol Chem Sci. 2022;16(3):1149-1166.
22. Moreau J. Exposé synoptique des données biologiques sur *Heterotis niloticus* (Cuvier, 1829). Synopsis FAO Pêches. 1982;(131):45.
23. Fulton T. Rate of growth of seas fishes. 20th Annual Report of the Fishery Board for Scotland, London. Fish Sci Div Scotl Rep. 1902;20:1035–1039.
24. Niare T, Tienou KC, Kodio A, Rurale E. Structure d'âge et croissance de *Clarias anguillaris* (Pisces, Clariidae) dans le Delta Central du Niger au Mali (Afrique de l'Ouest). Int J Biol Chem Sci. 2012;6(1):150-165.
25. Djadji ELG, Atsé BC, Sylla S, Konan KJ, Kouassi NJ. Reproduction du Mugilidae *Mugil cephalus* (Linné, 1758) dans deux complexes lagunaires (lagunes Ébrié et de Grand-Lahou) de la Côte d'Ivoire. Int J Biol Chem Sci. 2013;7(4):1701-1716.
26. Dembélé N, Sanogo Y, Konaté A, Sy A, Diop R, Traoré K, *et al*. Structure par taille et facteur de condition chez *Coptodon zillii* pêché dans le lac de Sélingué au Mali. Glob Sci J. 2022;10(8):2320-9186.
27. Tekounegning Tiogue C, Eyango Tomedi MT, Nguenga D, Tchoumboue J. Caractéristiques de morphologie générale et de croissance du Cyprinidae africain *Labeobarbus batesii* dans la plaine inondable des Mbô, Cameroun. Int J Biol Chem Sci. 2010;4(6):1988-2000.