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Research Article

LENGTH-WEIGHT RELATIONSHIP AND EXPLOITATION PARAMETERS OF *CHRYSICHTHYS NIGRODIGITATUS* (LACEPEDE) IN CAGE FISH FARMING AREA ON LAKE KOSSOU, BANDAMA BASIN

***[1]Akian D. D, [2]Aliko N. G, [1]Quenum C. L, [2]Traore G. and [3]Ouattara A**

[1]Unité Mixte de Recherche et d'Innovation Sciences Agronomiques et Procédés de Transformation, Institut National Polytechnique Félix HOUPHOUËT-BOIGNY (INP-HB), Yamoussoukro, Côte d'Ivoire
[2]Unité de Formation et de Recherche Environnement, Université Jean LOROUGNON GUÉDÉ, Daloa, Côte d'Ivoire
[3]Pôle Pêche et Aquaculture, Unité de Formation et de Recherche en Sciences et Gestion de l'Environnement, Université Nangui ABROGOUA, Abidjan, Côte d'Ivoire

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ABSTRACT

Chrysichthys nigrodigitatus is one of the species exhibiting opportunistic feeding behaviour around floating cages used for tilapia rearing. The aim of this study was to assess, for the first time, the impact of floating cage aquaculture on growth and exploitation parameters of *Chrysichthys nigrodigitatus* in Lake Kossou. A total of 864 specimens males and females were caught from April to September 2023 near sixty floating cages during tilapia feeding. The fish were weighed and then measured to determine growth and operating parameters using FISAT II software. The allometry coefficient greater than 3 for both sexes indicate a positive allometry growth in *C. nigrodigitatus*. No significant difference was observed between the condition factor in males and females. The growth coefficient shows that *C. nigrodigitatus* specimens grow faster than the asymptotic length. Exploitation parameters indicate a short lifespan (2.3 years), fishing mortality (0.40 yr^{-1}) lower than natural mortality (1.89 yr^{-1}) and a lower exploitation rate (0.17) of *C. nigrodigitatus* in the cage fish farming area. This study showed that *C. nigrodigitatus* is presumed to be under-exploited around the floating cages on Lake Kossou.

Keywords: *Chrysichthys nigrodigitatus*, Exploitation parameters, Floating cages, Lake Kossou, Length-weight.

INTRODUCTION

Cage aquaculture is developing in response to the growing demand for aquatic products (Tacon and Halwart, 2007). To optimize production, cages can be used to grow fish at high stocking densities per unit volume. Due to land scarcity and climate change, Nile tilapia (*Oreochromis niloticus*) farming in floating cages in lagoons and lakes alongside artisanal fishing, is becoming more prevalent in Côte d'Ivoire (Nobah *et al.,* 2008; Yoboué *et al.,* 2018). The production of fish in floating cages helps enrich the farming area with organic matter, usually consisting in feed residues and compounds that come from captive fish's metabolism (Gorlach-Lira *et al.,* 2013; Olapoju *et al.,* 2014). Indeed, pellet feed is manually distributed to fish during cage farming using devices designed to prevent pellets from exiting the cages. Despite taking precautions, pellet losses are still observed while feeding (Aas *et al.,* 2011; Dempster *et al.,* 2011). These feed residues and other organic matter from the cage nets contribute to the development of macroinvertebrates (Yoboué *et al.,* 2018). The presence of these residues as a food source attracts specific fish species (Sanchez-Jerez *et al.,* 2011; Uglem *et al.,* 2014), including *Pellonula leonensis*, *Coptodon zilli*, and the silver catfish *Chrysichthys nigrodigitatus* (Lacepède), to the cages, leading to an increase in the amount of fish resources in this floating cage fish farming area. The abundance of fish has prompted fishermen to heavily exploit the affected areas.

The silver catfish, commonly known as *Chrysichthys nigrodigitatus*, inhabits both freshwater (Ama-Abasi *et al.,* 2021) and brackish waters of Africa. This species is found in both freshwater and brackish waters in Côte d'Ivoire and is caught in inland fisheries (Aboua *et al.,* 2010). *Chrysichthys nigrodigitatus*, known for its insectivorous

*Corresponding Author: AKIAN D. D. Unité Mixte de Recherche et d'Innovation Sciences Agronomiques et Procédés de Transformation, Institut National Polytechnique Félix HOUPHOUËT-BOIGNY (INP-HB), Yamoussoukro, Côte d'Ivoire. akiandieudonne@yahoo.fr

diet in lake Kossou (Ouattara *et al.,* 2024), is one of the opportunistic feeding species found around floating cages (Ameworwor *et al.,* 2019). This species' growth can be influenced by the physicochemical composition of the water and the quality of natural food available in the environment, just like other species. Quantitative parameters such as the length-weight relationship, condition factor, recruitment, and fish mortality are important indicators for fish stock management (Lizama *et al.,* 2002 ; Lederoun *et al.,* 2018). The length-weight relationship can be used to predict a fish's weight when its length is known, or vice versa (Froese *et al.,* 2014). In fish, the condition factor reflects information about the fish's physiological state and its well-being (Ighwela *et al.,* 2011 ; Seher and Suleyman, 2012). This biological indicator can be affected by a number of factors, including stress, sex, spawning season, food availability, and water quality parameters (Khallaf *et al.,* 2003). Condition factors can be used to compare populations living in different environmental conditions (Wootton, 1990; Anyanwu *et al.,* 2007). It is therefore an important indicator for understanding the life cycle of fish species, and can be used for their proper management (Lizama *et al.,* 2002).

Despite its importance in inland fisheries, data on the biology of *Chrysichthys nigrodigitatus* are limited to specific bodies of water (Bedia *et al.,* 2017), with almost no information available for specimens caught in the Bandama River. In order to improve our understanding of this species' life cycle and optimise its management, it is important to have reliable data on its biological and ecological parameters. The present study was conducted to acquire data on the growth and exploitation parameters of *C. nigrodigitatus* around floating cages in the Kossou Dam Lake. The overall objective was to evaluate the impact of fish farming in floating cages on the growth and exploitation parameters of *C. nigrodigitatus* in Lake Kossou.

MATERIAL AND METHODS

Study area and data collection

The study was conducted on the Kossou hydroelectric dam Lake, located at an altitude of 203 m in central Côte d'Ivoire, between 6° 58’ and 8° 08’ North latitude and 5° 27’ and 5° 45’ West longitude (Koné *et al.,* 2022). The Kossou dam Lake was built on the Bandama River in 1971 and covers an area of 1700 km². Specimens of *C. nigrodigitatus* were caught from April to September 2023 near the floating cages (Figure 1) used for pre-growing and growing Nile tilapia (*Oreochromis niloticus*), which were fed a floating extruded feed. Catches were made daily at feeding time using a circular dip net with a diameter of 1 m and a mesh size of 14 mm. After being caught, the *C. nigrodigitatus* specimens were sexed by visual examination of the urogenital papilla to determine the sex ratio, which is the ratio of the number of females to that of males (Kareem *et al.,* 2019). The sex ratio will be expressed as the number of males per female (F:M). Standard length (Ls) and individual weight were then measured using a ichtyometer and a SARTORIUS scale (capacity 3100 g, accuracy 0.01 g), respectively.

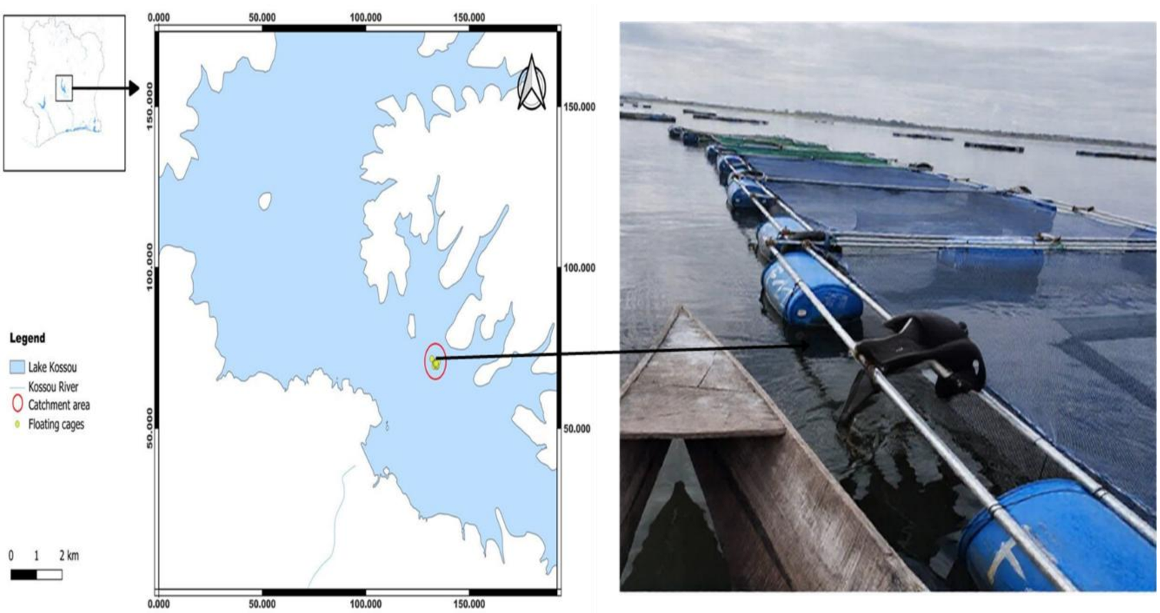

Figure 1. Map of *Chrysichthys nigrodigitatus* capture zone on the Kossou dam Lake.

Measurement of physico-chemical parameters of the water of the lake

The physicochemical characteristics of the water in the fish capture area were measured once per day prior to the initial feeding. Temperature and oxygen levels were measured using an oxythermomer (Extech DO700 model). pH, nitrate (NO_3^-), nitrite (NO_2^-), and ammonium (NH_4^+) concentrations were measured twice a week using specific colorimetric kits (JBL PROAQUATEST COMBISET POND).

Determination of the Size Classes of *Chrysichthys nigrodigitatus* Specimens

The number of size classes (k) per sex was determined according to Sturge (1926) using the following formula:

$k = 1 + (3.332 \times \log10(n))$, where n = the total number of individuals.

The size class interval (SC) was determined using the following formula:

SC = (Ls max - Ls min) / k, where Ls max is the maximum Ls and Ls min is the minimum Ls.

Determination of the length-weight relationship

The length-weight relationship was determined using the formula $P = a \times Ls^b$, where P and Ls represent, respectively, the weight in grams and the standard length in centimeters of the fish (Ricker, 1973; Froese, 2006). A logarithmic transformation of the relationship equation was performed in the form Log P = Log a + b × Log Ls to graphically determine a and b values. The constant a is the environmental factor describing the rate of change of weight with length, while b is the species-specific factor, the slope of the regression line (weight per unit length). When the value of b is equal to 3, growth is isometric. If b is greater than 3, fish become heavier, showing positive allometric growth reflecting optimal living conditions. Growth is described as negative allometric when fish become lighter as they increase in length; in this case, b is less than 3 (Moslen and Miebaka, 2017).

Determination of the condition factor

The Fulton condition factor was calculated using the following formula (Gomiero and Braga, 2005): $Fc = 100 \times P/Ls^b$

With P the weight of the fish in g grams, Ls the standard length in centimeters, and b the allometric coefficient derived from the length-weight relationship.

Determination of growth parameters

To estimate the growth parameters, the asymptotic length (L∞) and the growth coefficient (K), the Von Bertalanffy growth equation (Gayanilo *et al.,* 2002) was used:

$Lt = L\infty \times (1 - e^{-K(t-to)})$, where Lt = fish length at time t (cm), L∞ = asymptotic length (cm), the length the species could reach if it continues to live and grow indefinitely, K = growth coefficient or growth rate characterizing the rate at which the species grows towards L∞ (yr^{-1}), and t_o = theoretical age of the fish at zero size (yr).

The theoretical age t_0 was obtained from the Pauly equation (Pauly, 1980):

$Log10 (-t_0) = -0.392 - 0.275 \text{ Log10 } L\infty - 1.038 \log10 K$

The growth performance index (Ø') was evaluated using the values of L∞ and K from the formula proposed by Pauly and Munro (1984): Ø' = Log10 K + 2 Log10 L∞

The approximate maximum lifespan (Tmax) was calculated according to the Pauly and Munro equation (1984) : Tmax = 2.9957 / K

Determination of exploitation parameters

Exploitation parameters such as total mortality (Z), natural mortality (M), fishing mortality (F), and the exploitation rate (E) of *C. nigrodigitatus* around floating cages in Lake Kossou were determined. A stock is considered lightly exploited when E is less than 0.5, according to which stock exploitation is optimal when F = M (or E = 0.5) (Gulland, 1971). The exploitation rate is obtained using the formula: E = F / Z, where Z = F + M (Sparre and Venema, 1996).

Data analysis

The KHI-2 test was used to determine whether the proportion of males and females in *C. nigrodigitatus* specimens deviated significantly from the expected sex ratio (1:1). Levene's test and the Shapiro-Wilk test were used to verify the homogeneity of variances and the normality of the distribution of weight and condition factor values in males and females, respectively. A Student's t-test was used to compare the means of the weight and condition factors, and then to verify whether the allometry coefficient (b) differed from 3. All tests were performed using Statistica 12.0 software, with a significance level of 0.05 applied. The growth and exploitation parameters were determined using the FISAT II (FAO ICLARM Stock Assessment Tool II) software version 1.2.2.

RESULTS AND DISCUSSION

During the collection period, the average temperature was 29.32 ± 0.68°C, the oxygen concentration was 6.27 ± 0.93 mg/L, the average pH was 7.95 ± 0.35, and the average concentrations of NO_3^-, NO_2^-, and NH_4^+ were 0.36 ± 0.20 mg/L, 0.08 ± 0.04 mg/L, and 0.05 ± 0.01 mg/L, respectively (Table 1). A total of 864 specimens, including 359 females and 505 males, were captured, resulting in a sex ratio (F:M) of 1:1.4 in favor of males. This ratio differs significantly from the expected sex ratio (1:1) ($\chi^2 = 24.6$, d.f. = 1, $p < 0.05$). The weight of males ranged from 33 g to 1800 g, with a mean of 255.6 ± 232.9 g, and that of females ranged from 49 g to 1982 g, with a mean of 240.4 ± 203.5 g (Table 2). Overall, no significant difference was observed between the weights of males and females (Student's t-test, $t_{cal} = 0.99$, d.f. = 862, $p > 0.05$). The standard length ranged from 11.5 to 49 cm for males and from 11 to 47.5 cm for females. The average recorded sizes were 22.8 ± 5.5 cm and 22.3 ± 5.3 cm, respectively. The size distribution was unimodal in both sexes (Figure 2), with the modal classes of 18.3 - 21.7 cm and 16.9 - 20.3 cm for males and females, respectively. In males, sizes between 14.9 and 25 cm represented 73.3% of the catch, while in females the majority of catches (67.7%) were between 16.9 and 27 cm.

Table 1. Physico-chemical parameters of the waters at the study area.

Parameters	Min	Max	Mean ± SD
T (°C)	28	30.5	29.32 ± 0.68
O_2 (mg.L^{-1})	5	7.8	6.27 ± 0.93
pH	7.5	8.5	7.95 ± 0.35
NO_3^- (mg.L^{-1})	0.1	1	0.36 ± 0.20
NO_2^- (mg.L^{-1})	0.02	0.15	0.08 ± 0.04
NH_4^+ (mg.L^{-1})	0.02	0.1	0.05 ± 0.01

Table 2. Weights and standard lengths (min, max and mean ± SD) of males and females. *Chrysichthys nigrodigitatus* captured around floating cages.

Sexes	**Weight (g)**			**Standard lengths (cm)**		
	Min	Max	Mean ± SD	Min	Max	Mean ± SD
Males	33	1800	255.6 ± 232.9	11.5	49	22.8 ± 5.5
Females	49	1982	240.4 ± 203.5	13.5	47.5	22.3 ± 5.3

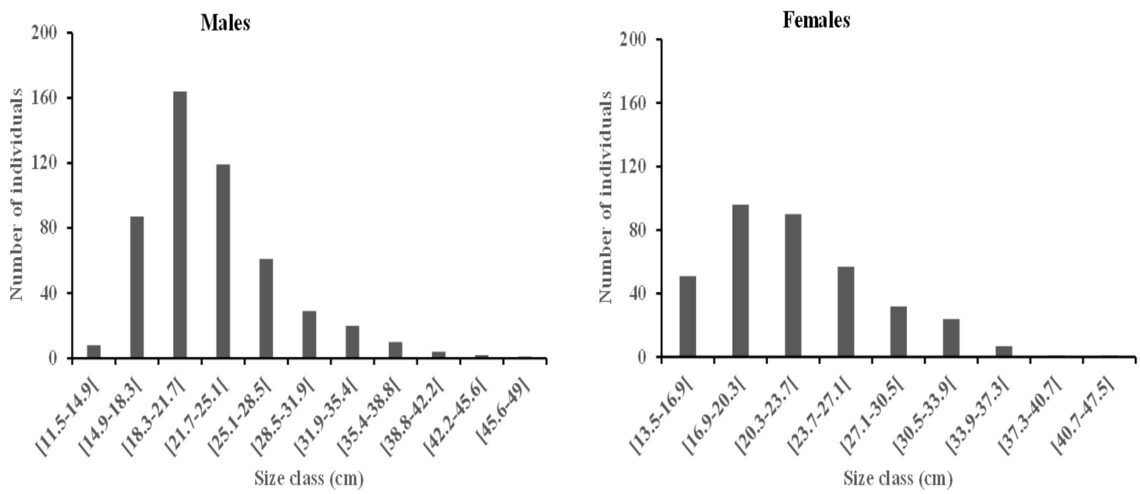

Figure 2. Length class distribution in specimens of *Chrysichthys nigrodigitatus* caught around floating cages on Kossou dam lake.

The values of *b* and the correlation coefficient (r) were respectively 3.04 and 0.96 for males, and 3.05 and 0.98 for females (Figure 3). The value of *b* obtained for both sexes was significantly greater than 3 (Student's t-test, t_{cal} = 34.53, d.f. = 504, $p < 0.05$ and tcal = 35.79, d.f. = 358, $p < 0.05$, respectively for males and females).

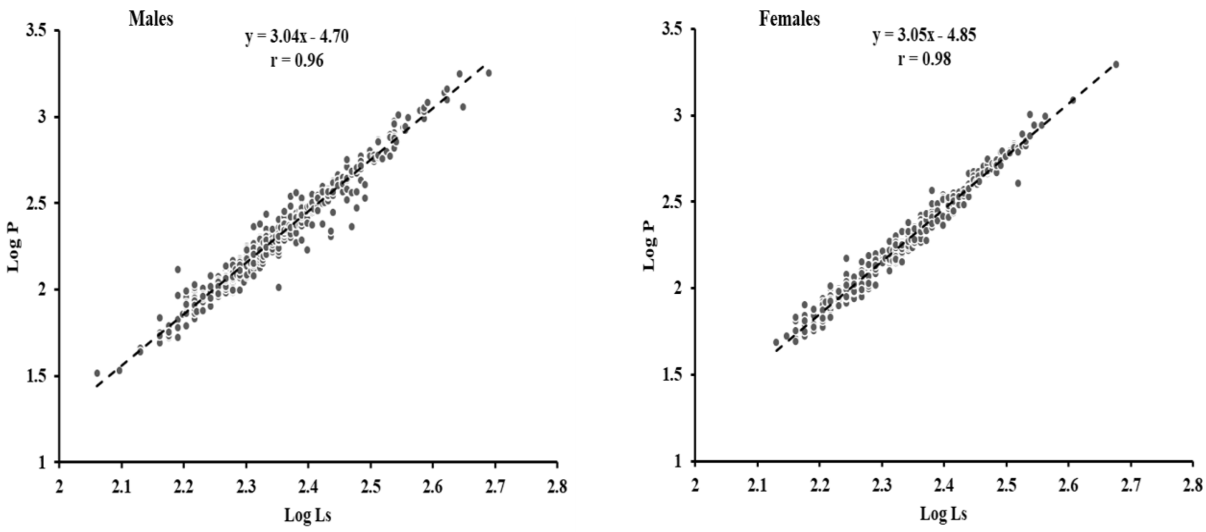

Figure 3. Weight-length relationship in specimens of *Chrysichthys nigrodigitatus* caught around floating cages on Kossou dam lake

The mean condition factor was 1.54 ± 0.10 in males and 1.55 ± 0.08 in females. No significant difference was observed for this parameter between the two sexes (Student's t-test, t_{cal} = 1.43, d.f. = 862, p > 0.05). The asymptotic length (L∞) and the growth coefficient (K) were 47.82 cm and 1.3 yr^{-1}, respectively, while the growth performance index (Ø') was 3.47 cm with a fitting index of 0.39 (Figures 4 and 5). The theoretical age of the fish at zero size (t_0) was estimated at -0.38, while the lifespan (maximum age, tmax) was estimated at 2.3 years.

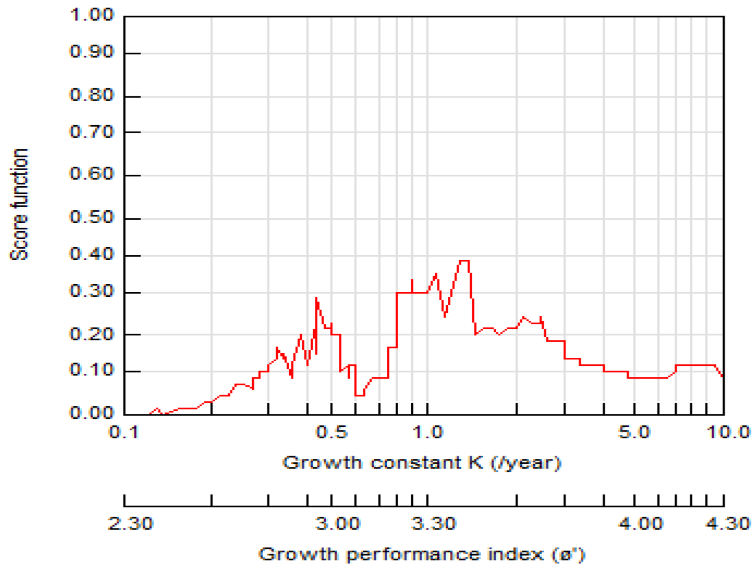

Figure 4. Variation curve of the adjustment index (Rn) as a function of the growth coefficient (K) and the performance index (Ø') in *Chrysichthys nigrodigitatus.*

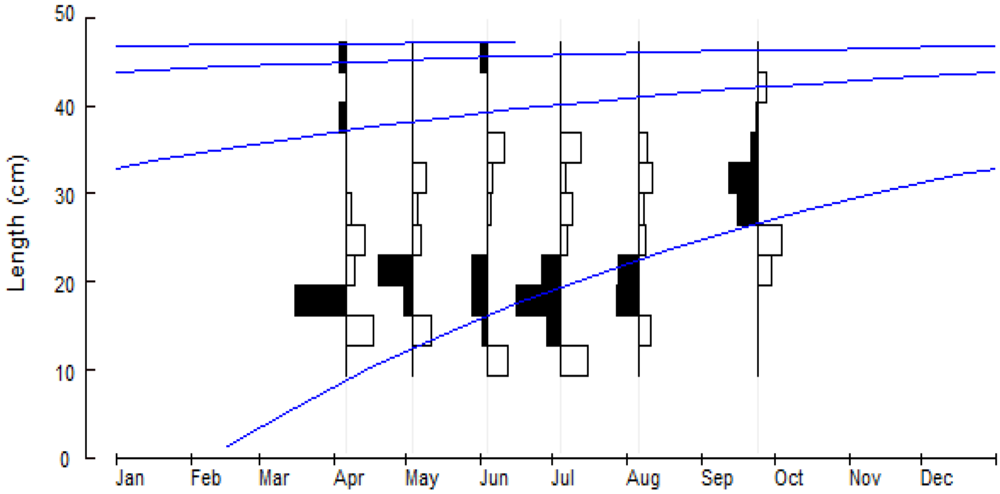

Figure 5. Growth curves according to the Von Bertalanffy model of *Chrysichthys nigrodigitatus.*

The values obtained for total mortality (Z), natural mortality (M), and fishing mortality (F) of *C. nigrodigitatus* were 2.29 yr^{-1}, 1.89 yr^{-1}, and 0.40 yr^{-1}, respectively (Figure 6). This result shows that fishing mortality is lower than natural mortality of *C. nigrodigitatus* in the study area. The exploitation rate was E = 0.17.

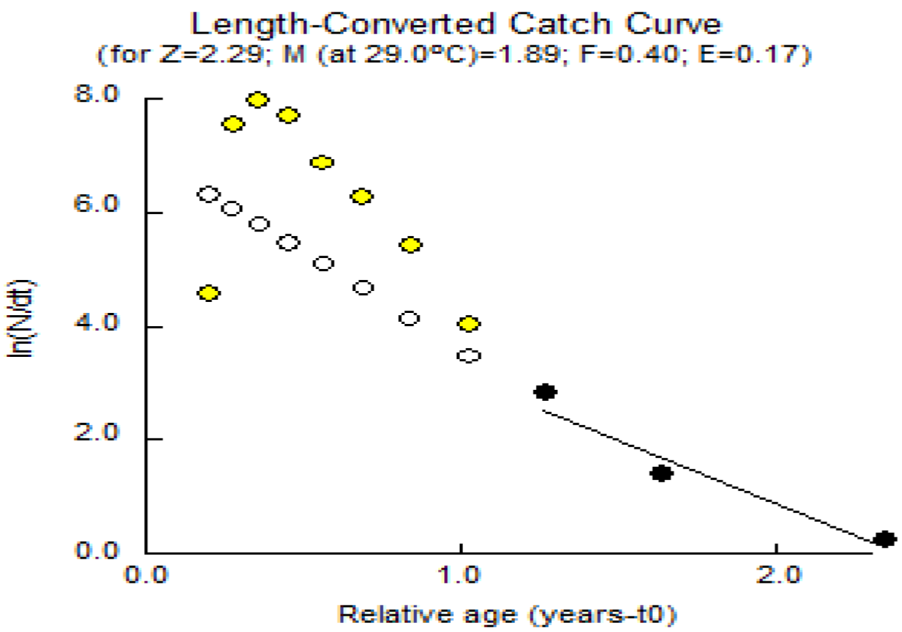

Figure 6. Capture curve according to standard lengths of *Chrysichthys nigrodigitatus*

This study assessed the impact of floating cage fish farming on the growth and exploitation parameters of *Chrysichthys nigrodigitatus* in Lake Kossou. The physicochemical parameters of the water in the Lake demonstrated that *Oreochromis niloticus* farming in floating cages did not exert a deleterious effect on the physicochemical quality of the Lake water. Indeed, the average pH, oxygen, and temperature values were similar to those recorded by Koné *et al.* (2022) in the southern part of Lake Kossou, where fish farming in cage was not practiced. Furthermore, the nitrogen compound concentrations measured by these authors (nitrate = 1.33 ± 0.95 mg/L, nitrite = 2.16 ± 1.11 mg/L, and ammonium = 0.54 ± 0.94 mg/L) were higher than those found in our study area. Species present around floating cages, including *C. nigrodigitatus*, play an important ecological role by consuming leftover feed from the cages, thus reducing the environmental impact of fish farming (Lupatsch *et al.,* 2003; Fernandez-Jover *et al.,* 2008). The recorded sex ratio was skewed towards males (1:1.4). This sex ratio differed from 1.15:1 and 1.5:1 obtained respectively by Olanrewaju and Kareem (2023) for populations of *C. nigrodigitatus* in Lake Asejire, Nigeria, and Tiogué *et al.* (2020) in the Nkam River, Cameroon. This male dominance could be explained by the migration of females to the spawning area during the study period. Indeed, this species generally reproduces during the rainy season, from April to October, according to the work of Dia (1975), Tiogué *et al.* (2020), and Olanrewaju and Kareem (2023). The size distribution ranged from 18.3 to 21.7 cm for males and from 16.9 to 20.3 cm for females. A strong correlation exists between weight and length in male (r = 0.96) and female (r = 0.98) *Chrysichthys nigrodigitatus*, indicating that the length of captured specimens increases with weight. Analysis of the length-weight relationships shows positive allometry of growth in *C. nigrodigitatus* specimens captured around the cages. The b values obtained (3.04 for males and 3.05 for females) fall within the observed range (2 - 4) for most fish (Bagenal and Tesch, 1978) and are higher than the value of 2.76 obtained by Kien *et al.* (2022) for specimens of the same species captured at Tiassalé in the Bandama River. These values also differ from 2.84 and 2.81 obtained by Sadio *et al.* (2021) and by Ouattara *et al.* (2023) in specimens of the same species caught respectively in Lake Selingue and Lake Buyo. Negative allometric growth was also observed in *C. nigrodigitatus*, which feeds primarily on insects in these environments (Ouattara *et al.,* 2024). The availability of natural food combined with commercial pellets in the capture area around the floating cages in Lake Kossou would be responsible for positive allometric growth of the species (Henderson *et al.,* 2005). The environmental conditions around the floating cages would be favorable to the best growth of catfish and also their abundance compared to areas without food resources. A similar abundance of several fish species including *Liza aurata*, *Chelon labrosus* and *Boops boops* feeding on leftover feed pellets has also been observed around fish farms in the Mediterranean and represented a significant part of the catches of artisanal fishing (Arechavala-Lopez *et al.,* 2010; Arechavala-Lopez *et al.,* 2011).

The maximum size of captured specimens was 1982 g and 47.5 cm Ls for females and 1800 g and 49 cm Ls for males. The condition factor values obtained (Fc = 1.54 ± 0.10 for males and Fc = 1.55 ± 0.08 for females) were greater than 1, indicating that environmental conditions, particularly the abundance of food resources, were favorable for fish growth. The condition factor obtained was higher than those obtained by several authors for *C. nigrodigitatus* specimens captured in environments where floating cage aquaculture is not practiced (Ekamen, 2000; Offem *et al.,* 2008; Tiogué *et al.,* 2020). The asymptotic length ($L\infty$) and the growth coefficient (K) are 47.82 cm and 1.3 yr^{-1}, respectively. The theoretical age of the fish at zero size (t_0) is estimated at -0.38, while the lifespan (maximum age, tmax) is estimated at 2.3 years. The growth coefficient results for *C. nigrodigitatus* show that the captured specimens grow faster than the asymptotic length. Indeed, fish species with a growth coefficient in the range of 0.20 to 0.50 yr^{-1} and above are characterized by rapid growth (Branstetter, 1987). The growth performance index (Ø'=3.47 cm) lies beyond the range of values (2.65 - 3.32) for African fish, as defined by Bajot and Moreau (1997). Growth parameters (K and Ø') are higher than those observed by Bédia et al. (2017) in *C. nigrodigitatus* specimens from the Ebrié Lagoon (growth coefficient of 0.33 yr^{-1}, growth performance index of 2.968 cm). Age at zero size and longevity are lower than those of these specimens (t_0 = -0.69 and Tmax = 9.09 yr). Our results indicate that *C. nigrodigitatus* growth is enhanced near floating cages due to the availability of commercial food. The short longevity suggests that specimens of this species are highly vulnerable to capture around the cages.

Fishing mortality of *C. nigrodigitatus* recorded in the study sarea (F = 0.59 yr^{-1}) is lower than natural mortality (M = 2.33 yr^{-1}). This reflects both the underexploitation of the species in the aquaculture area and its abundance. This trend in fishing mortality is confirmed by the exploitation rate (E = 0.2), which is lower than the optimum reference rate (E = 0.50) defined by Gulland (1971). The total mortality (Z = 2.92 yr^{-1}) and natural mortality (M = 2.33 yr^{-1}) values obtained are higher than those observed by Bédia *et al.* (2017) in *C. nigrodigitatus* in the Potou sector of the Ebrié Lagoon, total mortality (Z = 1.79 yr^{-1}), natural mortality (M=0.73 yr^{-1}). In terms of fishing mortality and exploitation rate, lower values than those obtained in the Potou sector of the Ebrié Lagoon (F = 1.73 yr^{-1} and E = 0.59; Bédia *et al.,* 2017) are shown by this study. These results confirm that the species is not under threat in Lake Kossou (Azeroual *et al.,* 2010).

CONCLUSION

The aim of this study was to assess the impact of floating cage aquaculture on the growth and exploitation parameters of *C. nigrodigitatus* in Lake Kossou. The results showed that *C. nigrodigitatus* growth is enhanced near floating cages with a positive allometric growth in both males and females' specimens, linked to favourable nutritional conditions around the floating cages compared to areas without food resources. *C. nigrodigitatus* specimens grow faster than their asymptotic length in the study area. Exploitation parameters indicate a short lifespan, with fishing mortality lower than natural mortality. This suggests that this species is highly vulnerable to capture but under-exploited around fish farming cages, hence its abundance. These findings show that fish farming in floating cages has a positive ecological impact on other fish in the natural environment, especially *C. nigrodigitatus*.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

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AI TOOL DECLARATION

The authors declare that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

REFERENCES

Aas, T. S., Oehmea, M., Sørensen, M., Hee, G., Lygren, I., & Åsgårda, T. (2011). Analysis of pellet degradation of extruded high energy fish feeds with different physical qualities in a pneumatic feeding system. *Aquacultural Engineering, 44*(1), 25–34. https://doi.org/10.1016/j.aquaeng.2010.11.002.

Aboua, R. D. B., Konan, N. G., Kouamelan, E. P., Berté, S., & Bamba, M. (2010). Organisation spatiale du peuplement de poissons dans le Bandama. *International Journal of Biological and Chemical Sciences, 4*(5), 1480–1493. https://doi.org/10.4314/IJBCS.V4I5.65547.

Ama-Abasi, D., Uwalaka, S., Oboh, D., & Uyoh, E. (2021). Domestication of *Chrysichthys nigrodigitatus* of the cross river, as an adaptation to climate change and a boost for aquaculture expansion in Nigeria. *ASRIC Journal on Agricultural Sciences, 1*, 21–29.

Ameworwor, M. Y., Asmah, R., Ofori-Danson, P. K., & Clottey, M. N. K. (2019). Enhancing local fish production through cage aquaculture on the Volta Lake : Impacts on capture fisheries. *Journal of Fisheries and Coastal Management, 1,* 1–7. https://doi.org/10.5455/jfcom.20190313031430.

Arechavala-Lopez, P., Sanchez-Jerez, P., Bayle-Sempere, J., Fernandez-Jover, D., Martinez-Rubio, L., Lopez-Jimenez, J. A., & Martinez-Lopez, F. J. (2011). Direct interaction between wild fish aggregations at fish farms and fisheries activity at fishing grounds : a case study with *Boops boops*. *Aquaculture Research, 42,* 996–1010. https://doi.org/10.1111/j.1365-2109.2010.02683.x.

Arechavala-Lopez, P., Uglem, I., Sanchez-Jerez, P., Fernandez-Jover, D., Bayle-Sempere, J. T., & Nilsen, R. (2010). Movements of grey mullet *Liza aurata* and *Chelon labrosus* associated with coastal fish farms in the western Mediterranean Sea. *Aquaculture Environment Interactions, 1,* 127–136. https://doi.org/10.3354/aei00012.

Azeroual, A., da Costa, L., Lalèyè, P., & Moelants, T. (2010). *Chrysichthys nigrodigitatus*. The IUCN Red List of Threatened Species 2010 : e.T182997A8019531. https://doi.org/10.2305/IUCN.UK.2010-3.RLTS.T182997A8019531.en.

Bagenal, T. B., & Tesch, F. W. (1978). Age and Growth, in ″Methods for Assessment of Fish Production in Freshwater″, Ed. IBP Handbook 3, Blackwell Scientific Publications, Oxford, UK, 101–136.

Bédia, A. T, N'doua, E. R., Goore, G. I., Essetchi, K. P., & N'douba, V. (2017). Paramètres de croissance et d'exploitation de *Chrysichthys nigrodigitatus* (Lacepède, 1803) (Siluriformes, Bagridae) dans une lagune tropicale : lagune Ebrié (Secteur I : lagune Potou, Côte d'Ivoire). *Tropicultura, 35*(4), 253–261. https://doi.org/10.25518/2295-8010.1053.

Branstetter, S. (1987). Age and growth estimates for blacktip, *Carcharhinus limbatus*, and spinner, *C. brevipinna*, sharks from the Northwestern Gulf of Mexico. *Copeia, 4*, 964 - 974. https://doi.org/10.2307/1445560.

Dempster, T., Sanchez-Jerez, P., Fernandez-Jover, D., Bayle, S. J, Nilsen, R., & Bjørn, P. A. (2011). Proxy measures of fitness suggest coastal fish farms can act as population sources and not ecological traps for wild gadoid fish. *PLoS ONE, 6,* e15646. https://doi.org/10.1371/journal.pone.0015646.

Dia, K. A. (1975). Détermination de l'âge des mâchoirons *Chrysichthys nigrodigitatus*: Premières Estimations de la Croissance. *Document Scientifique Centre de Recherches Océanologiques, 6*(2), 139–151.

Ekanem, B. S. (2000). Some reproductive aspects of *Chrysichthys nigrodigitatus* (Lacepede) from cross river, Nigeria. Naga. *The ICLARM Quarterly*, *23*, 24–28

Froese, R., Thorson, J. T., & Reyes, R. B. (2014). A Bayesian approach for estimating length-weight relationships in fishes. *Journal of Applied Ichthyology, 30*, 78–85. https://doi.org/10.1111/jai.12299.

Gorlach-Lira, K., Pacheco, C., Carvalho, L. C. T., Melo, J. H. N., & Crispim, M. C. (2013). The influence of fish culture in floating net cages on microbial indicators of water quality. *Brazilian Journal of Biology, 73,* 457–463. https://doi.org/10.1590/S1519 69842013000300001.

Gulland, J. A. (1971). The fish resources ofthe oceans. Fishing New (Books) Ltd., west by fleet, for FAO, England, 225p.

Henderson, P. A. (2005). The Growth of Tropical Fishes, In Val A, Val V and Randall D (eds.). The Physiology of Tropical Fishes. Academic, New York, USA. p. 85–101.

Kareem, O. K., Olanrewaju, A. N., & Orisasona, O. (2019). Aspect of reproductive biology of *Parachanna obscura*, Gunther 1861 in a Southwestern Nigerian Reservoir. *The International Journal of Environmental Impacts, 2*(3), 272–282. https://10.2495/EI-V2-N3-272-282.

Kien, K. B, N'Da, A. S., Aboua, B. R. D., & Kouamelan, E. P. (2022). Length-weight relationships and condition factor of the main species of fish caught on the Bandama River (Ivory Coast). *International Journal of Scientific*

Research Updates, 3(2), 037–042. https://10.53430/ijsru.2022.3.2.0038.

Koné, N., N'Da, A. S., Kien, K. B., Boguhé, G. F. dit H., & Berté, S. (2022). Caractérisation physico-chimique des eaux du lac du barrage hydroélectrique de kossou, fleuve bandama, Côte d'Ivoire. *Revue Ivoirienne des Sciences et Technologie, 39*, 55–69.

Lederoun, D., Lalèyè, K. R., Boni, A. R., Amousso, G., Vodougnon, H., Adjibogoun, H. & Lalèyè, P. A. (2018). Length-weight and length-length relationships of some of the most abundant species in the fish catches of Lake Nokoué and Porto-Novo Lagoon (Benin, West Africa). *Lakes & Reservoirs, 23*, 351–357. https://doi.org/10.1111/lre.12243.

Lupatsch, I., Katz, T., & Angel, D. L. (2003). Assessment of the removal efficiency of fish farm effluents by grey mullets: A nutritional approach. *Aquaculture Research, 34*(15), 1367–1377. https://doi.org/10.1111/j.1365-2109.2003.00954.x.

Fernandez-Jover, D., Sanchez-Jerez, P., Bayle-Sempere, J. T., Valle, C., & Dempster, T. (2008). Seasonal patterns and diets of wild fish assemblages associated to Mediterranean coastal fish farms. *ICES Journal of Marine Science, 65*(7), 1153–1160. https://doi.org/10.1093/icesjms/fsn091.

Moslen, M. & Miebaka, C. A. (2017). Length-weight relationship and condition factor of *Mugil cephalus* and *Oreochromis niloticus* from a Tidal creek in the Niger Delta, Nigeria. *Archives of Agriculture and Environmental Science, 2*(4), 287–292. https://doi.org/10.26832/24566632.2017.020406.

Offem, O. B., Akegbejo, Y. S., & Omoniyi, T. I. (2008). Diet, size and reproductive biology of the silver catfish, *Chrysichthys nigrodigitatus* (Siluriformes ; Bagridae) in the cross river, Nigeria, *Review Biology in Tropics, 56*(4), 1785–1799. https://doi.org/10.15517/rbt.v56i4.5759.

Olanrewaju, A. N., & Kareem, O. K. (2023). Aspect of Reproductive Biology of *Chrysichthys nigrodigitatus* (Lacepède 1803) in Asejire Reservoir, Nigeria. *Asian Journal of Biological Sciences, 16*(4), 541–549. https://doi.org/10.3923/ajbs.2023.541.549.

Olapoju, O. A. & Edokpayi, C. A. (2014). Ecological study on the impact of mariculture fish cage site on the physico-chemical characteristics of Lagos Lagoon, south western Nigeria. *Journal of Ecology and the Natural Environment, 6*(12), 398–405. https://doi.org/10.5897/JENE2014.0471.

Ouattara, M., Traore, A., Boussou, K. C., & Attoungbre, K. S. (2023). Growth parameters of *Chrysichthys nigrodigitatus* (Lacépède, 1803) and *Chrysichthys maurus* (Valenciennes, 1840) in Buyo Lake (Middlee - West : Côte d'Ivoire). *GSC Advanced Research and Reviews, 16*(01), 260–267. https://doi.org/10.30574/gscarr.2023.16.1.0285.

Ouattara, Z. T., Doumbia, L., Dosso, M., Ouattara, A., & Gourène, G. (2024). Trophic diversity and ecological balance of ichtyofauna in three lentic ecosystems of Côte d'Ivoire: Kossou, Taabo and Faé Lakes. *International Journal of Biosciences, 24*(2), 20–31. https://doi.org/10.12692/ijb/24.2.20-31.

Pauly, D. (1980). On the interrelationships between natural mortality, growth parameters, and mean environmental temperature in 175 fish stocks, *Journal du Conseil International pour l'Exploration de la Mer, 39,* 175–192. https://doi.org/10.1093/icesjms/39.2.175.

Pauly, D., & Munro, J. L. (1984). Once more on the comparison of growth in fishes and invertebrates. *Fishbyte, 2*, 21–22.

Sadio, O., Simier, M., Le Loc'h, F. & Tito, de M. L. (2021). Length-weight relationships of 19 fish species from two tropical artificial reservoirs (Manantali and Selingue) in Mali, West Africa. *Cybium, 45*(1), 59–62. https://doi.org/10.26028/cybium/2021-451-007.

Sanchez-Jerez, P., Fernandez-Jover, D., Uglem, I., Arechavala-Lopez, P., Dempster, T., BayleSempere, J. T., Pérez, C. V., Izquierdo, D., Bjørn, P.-A., & Nilsen, R. (2011). Coastal fish farms as fish aggregation devices (FADs). In: Bortone SA, Brandini FP, Fabi G, Otake S (eds) Artificial Reefs in Fishes Management, pp. 187–208. CRC Press, Boca Raton. https://doi.org/10.1201/b10910-13.

Sparre, P., & Venema, S. C. (1996). Introduction à l'évaluation des stocks de poissons tropicaux. Première partie. FAO. Document Technique sur les pêches. N° 306 / 1, Revue.1. FAO, Rome, 401 p.

Tacon, A. G. J., & Halwart, M. 2007. Cage aquaculture : a global overview. In Halwart M, Soto D and Arthur JR (Eds). Cage Aquaculture-Regional Reviews and Global Overview. pp. 1–16. *FAO Fisheries Technical Paper, 498*. 241 p.

Tiogué, T. C., Zebaze, T. B., Zango, P., & Tomedi-Tabi, E. M. (2020). Reproductive Strategy of *Chrysichthys nigrodigitatus* (Lacepède, 1803) in a Natural Environment in the Nkam River, Littoral Cameroon. *International Journal of Zoology*, *Vol. 2020*. https://doi.org/10.1155/2020/1378086.

Uglem, I., Karlsen, Ø., Sanchez-Jerez, P., & Sæther, B.-S. (2014). Impacts of wild fishes attracted to open-cage salmonid farms in Norway. *Aquaculture Environment Interactions, 6,* 91–103. https://doi.org/10.3354/aei00112.

Yoboue, K. P., Aboua, B. R. D., Berté, S., Coulibaly, J. K., Ouattara, N. I., & Kouamelan, E. P. (2018). Impacts des exploitations piscicoles en cages flottantes sur la structure des macroinvertébrés benthiques de la lagune Ebrié (Côte d'Ivoire). *International Journal of Biological and Chemical Sciences, 12*(2), 769–780. https://doi.org/10.4314/ijbcs.v12i2.12.