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RESEARCH ARTICLE

FIRST DATA ON THE ICHTYOLOGICAL POPULATION OF A NEW HYDROELECTRIC LAKE: CASE OF THE DAM OF SOUBRE, CÔTE D'IVOIRE

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Abstract

The new dam of Soubré in Côte d'Ivoire resulted in the creation of a 17.3 km^2 lake in April 2017. After an 18-month ban, the exploitation of fishery resources started and is mainly carried out by foreign "Bozo" fishermen. The present study, whose main objective was to conduct the ichthyological inventory of this lake, was executed between August 2019 and July 2021. The artisanal catches of fishermen were examined monthly in the three main landing sites of the lake. The species richness of the lake was estimated at 42 species. The specific weight composition of the catches indicates the predominance of the catfish *Chrysichthys nigrodigitatus* with 16% of catches. For numerical abundance, the Mormyridae *Marcusenius senegalensis* leads the catches with a 17% rate. It should be noted that this study allowed the observation of specimens of the freshwater shrimp of the genus *Macrobrachium* upstream of the lake, in the river-lake transition zone, while no individual of this species was captured in the lake.

Introduction:-

The fish populations of tropical rivers in Africa constitute the main fishery resources exploited by inland artisanal fisheries (FAO, 2020). However, this fish fauna is subject to various threats, including, infrastructure construction (bridges, roads and dams), overexploitation by fishing, deforestation, pollution (Lalèyè *et al.*, 2007), to which have been added, in recent decades, the effects of climate change and illegal gold panning (MINEDD, 2020). In Côte d'Ivoire, since 1959, the main rivers, particulary the Bia, Bandaman and Sassandra have been dammed for the production of hydroelectric power. This led to the creation of the Ayamé I and II hydroelectric dams on the Bia (1959), Kossou (1972) and Taabo (1979) on the Bandaman, Buyo (1980) on the Sassandra and Faé (1983) on the San Pedro. Subsequently, the resulting dam lakes gradually became real centers of continental fishery production (Da Costa *et al.*, 2002; Golé *et al.*, 2005; Da Costa and Dietoa, 2007; Tah *et al.*, 2009) with total landings approaching 8000 tons / year (DAP, 2014). However, although the species richness of the fish fauna in these lake reservoirs is estimated between 36 and 47 (Gourène *et al.*, 1999; Da Costa *et al.*, 2000; Tah *et al*., 2009), the catches landed in these river-lake fisheries remain dominated by 4 species. These are Tilapias *Oreochromis niloticus* and *Sarotherodon melanotheron*, catfish *Chrysichthys spp* and the "Cameroon" fish or *Heterotis niloticus*, which represent more than 88% of the total tonnages (FAO, 2008). According to Anoh (1994), the reservoirs story is recent in Côte d'Ivoire and very few studies on the initial state of ichthyological populations in these river-lake have been carried out (Traoré, 1996). The new dam of Soubré impounded in April 2017, led to the creation of a 17.3 km^2

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reservoir (CI ENERGIES, 2021). The present study, carried out two years after the creation of this dam, aims to characterize the aquatic fauna landed by artisanal fishing on this lake.

Material and Methods:-

Study site

The lake of Soubré is located in the Department of Soubré, in the Administrative Region of Nawa, in the Republic of Côte d'Ivoire, between 5 ° 48'16 " North latitude and 6 ° 39'22 " West longitude. It results from the construction of a hydroelectric dam on the Sassandra River and is currently the newest lake in Côte d'Ivoire (Anonymous 1, 2019). With an average area of 17.3 km^2, it can retain nearly 83,000,000 m^3 of water (CI ENERGIES, 2021). The climate of the Department of Soubré is hot and humid and is characterized by four (4) seasons: two rainy seasons and two dry seasons. There are two rainfall maxima: June for the long rainy season and September for the short season (ENVIPUR, 2014). Fishing activities on this lake are practiced by foreign professional fishermen commonly known as "Bozo", to those group are added some indigenous fishermen "Bakoué" and "Bété", who live along the lake (Anonymous 2, 2020). These different fishermen unload their products in three weighing main stations, which have been fitted out by the Aquaculture and Fisheries Office (BAP) of city of Soubré.

Sampling stations

During the prospecting phase, three stations have been identified from upstream to downstream on the lake for the commercial catches data collection (Figure 1),

1. Amaragui Station (S1): It is located at the northern end of the lake (05 ° 48'46.2 " N and 06 ° 41'39.3 " W), in the transition zone between the river and the lake. This station has a simple hangar which serves as a landing point, and further characterized by low attendance of fishermen (Figure 1).
2. Gnamandji Station (S2): Located in the axial part of the lake (05 ° 48'00.0 'N and 06 ° 40'49.2' W), this station represents the most active landing stage on the lake of Soubré. There is a market, animated by many fishmongers, composed with native women and Bozo fishermen wives. In addition, this station is characterized by the existence of several dead tree trunks, due to the absence of deforestation before the impoundment of the dam (Figure 1).
3. Kpéhiri Station (S3): The station located in the downstream part of the lake (05 ° 46'49.5 " N and 06 ° 38'44.1 " W), has a landing stage near the dike. This area, characterized by the presence of many rubber and cocoa plantations, receives fewer fishermen and fishmongers than station 2. Moreover, the entire lake is characterized by the massive presence of invasive aquatic plants, in particular the species *Eichhornia crassipes* or freshwater salads (more abundant at station 2).

Sampling of aquatic fauna

Data collection was carried out in two phases in the three stations identified during the prospecting phase on the lake (Figure 1): from August 2019 to February 2020 and from March 2021 to July 2021. This periodic breakdown of the sampling is explained by the COVID-19 pandemic occurrence, which caused a confinement on Ivorian territory, thus preventing access to the lake. For each station, two days were devoted to data collection per monthly outing. The activities consisted in gathering information from fishermen with the appropriate forms and on the other hand in analyzing the catches landed at the survey sites.

Survey of landings

For each fisherman surveyed at the landing, the type and characteristics of the fishing gear used (number, size, mesh size, drop, baited or not) were recorded. In addition, the total catch weight and the catch weight per gear were also noted.

Inspection of catches

At the landing, when the number of fishermen was less or equal to 10, all their catches were analyzed. However, when this number was greater than 10, a batch of 10 fishers was randomly selected for catch examination. The review consisted of the identification of the species according to the identification keys of Paugy *et al.* (2003a, b), enumeration and individual measurements. The identified specimens were individually measured to the nearest millimeter (standard [LS] and total [LT] lengths) and weighed to the nearest gram. The measurements were made using an ichthyometer and an electronic scale with a precision of 1 g.

Data analysis

Specific numerical and weight abundances

Numerical and weight abundances (biomass) were calculated respectively by the following formulas:

$$\mathbf{N = \frac{n}{Nt} * 100}$$

With: n = Number of individuals of a taxonomic group (species)
Nt = Total number of individuals

$$\mathbf{P = \frac{p}{Pt} * 100}$$

With: p = Weight of individuals of a taxonomic group (species)
Pt = Total weight of individuals

Diversity Index

Shannon and Weaver's (1963) diversity H' index and Piélou (1984) Equitability E were also calculated from the following formulas:

$$\boldsymbol{H' = -\sum \left(\frac{Ns}{Nt}\right) \log_2 \left(\frac{Ns}{Nt}\right)} \qquad \mathbf{E = \frac{H'}{\log_2 S}}$$

Where: H'= the Shannon and Weaver index; S = species richness; E = the equitability index.
The Shannon and Weaver specific diversity index (H') expresses the degree of organization of the settlement, its value H' is between 0.5 (very low diversity) and 5 (most diverse and fairly distributed communities). Equitability is a measure of the quality of this organization. E fluctuates between 0 and 1 (when it is close to 0, one species largely dominates the settlement, when it is equal to 1, all the species tend to have the same abundance in a natural and undisturbed environment) (Barbault, 2000 and Dajoz, 2000). These indices were calculated monthly to assess their variation overtime.

Occurrences

Percentage of occurrence was also calculated, it provides information on the preference of a species for a habitat type.

$$\mathbf{F = \frac{Fi}{Ft} * 100}$$

Where: F = total number of species; Fi = total number of species i
According to the classification proposed by Dajoz (2000), the value of the frequency makes it possible to determine three (3) taxonomic categories:
-Constant taxa: F> 50%
-Accessory taxa: 25% ≤F ≤ 50%
-Accidental taxa: F <25%

Statistical processing

The monthly variations in species richness, density, biomass and Shannon (H') and Piélou (E) indexes were compared using the one-way ANOVA test. These analyses were preceded by the Shapiro-Wilk test to check the normality of the populations. All these analyzes were carried out using R 3.6.2 software.

Results:-

Catch gear in use on the lake of Soubré

6 types of gear were identified on the lake of Soubré. These include hawknets, gillnets, traps, lines, longlines and harpoons. There are 2 categories of hawknets, monofilament "or nylon" hawknets with mesh sizes ranging from 20 to 40mm and multifilament hawknets with meshes greater than 40mm. On the lake of Soubré, the gillnets observed are dormant gillnets, with meshes varying from 20 to 60mm per side, for an average length of 46m and a drop of 3m. Four categories of traps were used by Soubré fishermen: conical liana traps or "papolo", generally baited; cylindrical liana traps or "tamani" used during high water; bamboo traps or "tymba" usually without bait and the wire mesh trap. The other gears observed are lines, among which we can distinguish simple lines and lines with multiple fish hooks or longlines and finally the harpoon which is a fishing gun consisting of a spear with hooks at the tip. All these gears are used at all times of the year and in all areas of the lake. In addition, the fisherman can combine several gears during a fishing trip.

Numerical and weight abundance of landed catches

Biomass and number of the catches examined

A total of 20,464 specimens, representing a biomass of 3.52 tons, were analyzed over the entire lake of Soubré during the study period. These catches were landed by a workforce of 393 fishermen on the whole lake. Table 1 shows the variation in the numerical and weight abundances of the catches landed according to the stations. The analysis of this table shows that the highest biomass (2.1 tons) or 60% of the landings was recorded at Gnamandji, the middle station. This biomass corresponded to a number of 8,978 specimens i.e. 44% of all catches. On the other hand, Kpéhiri, the downstream station, located near the dike had the lowest landed biomass (0.6 tons), i.e. 18% of the total biomass for 3,673 individuals (25% of the total number).

Monthly variations in biomass and numbers caught

Figure 2 shows the fluctuation of the biomass and the numerical abundance of the catches on the lake of Soubré. The biomass and numerical abundance curves show a similar general appearance. Peaks in biomass (0.55 tonnes) and headcount (2,995) were observed in August. In contrast, the lowest values of these parameters (0.17 tons and 767), were recorded respectively during the months of January and July (Figure 2). The Anova test showed that the monthly differences between biomass and numbers are significant ($p < 0.05$).

Weight and numerical composition of overall catches

Figures 3 and 4 present the weight and numerical abundances of the cumulative catches over the entire lake during the entire study period. The main species which dominates the population in terms of biomass is *Chrysichtys nigrodigitatus* with 0.57 tons or 16%, it is followed by *Marcusenius senegalensis*, *Lates niloticus* and *Heterotis niloticus* with each 8% or a value of 0.2 tons of the total biomass (Figure 3). In terms of numerical abundance, the preponderance is ensured by *Marcusenius senegalensis* (3,589; 17%), followed by the species *Chrysichtys nigrodigitatus* (3,214; 16%) and *Synodontis schall* (2,180; 11%) (Figure 4).

Diversity and species richness of landed catches

The ichthyological fauna exploited between August 2019 and July 2021 on the lake of Soubré is made up of 42 species, divided into 27 genus and belonging to 15 families. The richest families in terms of species are Mormyridae and Cichlidae (7 species), Alestidae (5 species), Clariidae, Mochokidae, Cyprinidae (4 species) and Claroteidae (3 species). The other families are each represented by a single species (Figure 5). Table 2 shows the distribution of species recorded according to the sampling stations. At the spatial level, the variation in species richness shows that the Gnamandji station with 40 taxa (95.23%) has the lowest specific diversity, just after the Kpéhiri and Amaragui stations with each 41 species (97.61%). In addition, at the Amaragui station, upstream of the lake, specimens of a species of shrimp, *Macrobrachium vollenhovii* of the Palemonidae family, were found in the catches.

Specific occurrence

Analysis of the occurrences on all stations during the entire study period allowed us to identify 3 groups of species. Two (2) accidental or rare species (4.7%) with a percentage of occurrence (F) less than 25% (*Polypterus endlicherii* and *Coptodon guineensis*), 8 accessory species (19%) with F between 25% and 50% (*Sarotherodon galileaus*, *Chromidotilapia guntheri*, *Hemichromis bimaculatus*, *Heterobranchus longifilis*, *Labeobarbus wurtzi*, *Labeobarbus bynni*, *Brycinus nurse*, *Pollimyrus isidori*) and 32 constant species (76%) which have an F value greater than 50% and among these 18 (42% of the total population) have a percentage of occurrence F of 100%. These species were therefore observed in all seasons in the catches during the 12 months of sampling (Table 2).

Monthly variations in specific wealth

The highest number of species (n = 39) was observed during the month of August on all the sampling stations (Figure 6), while the month of October recorded the lowest value (n = 30). The monthly variation in species richness according to the stations is significant (ANOVA 1: $p<0.05$) (Table 3). The values of the species richness fluctuate between 17 (Amaragui) and 34 (Kpéhiri), with respective averages 22.17 ± 3.3 in Amaragui, 26.34 ± 2.95 in Gnamandji and 23 ± 3.84 in Kpéhiri (Table 3).

Shannon Index (H') and Pielou Equitability (E)

The monthly variations in the Shannon Diversity (H') and Pielou Equitability (E) indices show the same pattern, in all the stations and for the entire sampling period (Figure 7). The lowest values of the Shannon indices (2.32) and the Piélou Equitability (0.46) were observed in September. While the highest values (H' = 2.82 and E = 0.56) were recorded in March. Regarding the spatial variation of the diversity indices (Table 3), the values of the Shannon

index (H') oscillate between 1.60 (Amaragui) and 2.72 (Kpéhiri). In addition, the Equitability indices increase from 0.38 to 0.58, respectively, from Amaragui station to Kpéhiri station. The mean values of H' and E in the stations were respectively 2.15 ± 0.19 and 0.48 ± 0.047 in Amaragui, 2.37 ± 0.18 and 0.50 ± 0.03 in Gnamandji and finally 2.34 ± 0.14 and 0.52 ± 0.041 in Kpéhiri (Table 3). No significant difference was observed in the monthly variation of the H' and E indices, depending on the station (ANOVA test 1: p> 0.05) (Table 3).

Discussion:-

The ichthyological fauna identified during this study comes from the catches of 6 types of gears, which are: hawknets, gillnets, traps (bamboo, lianas and wire), lines, longlines and harpoons. These fishing gears used by fishermen of the lake of Soubré are similar to those found in other lakes in Côte d'Ivoire (Vanga, 2004; Da Costa and Dietoa, 2007; Tah *et al.,* 2009) except beach seines and bamboo snare. According to Vanga (2004), beach seines are devastating gear for fish stocks (Diarra, 2020). A total of 42 fish species divided into 27 genus and 15 families have been identified between August 2019 and July 2021 on the lake of Soubré. This species richness (42) is lower than those reported by Teugels *et al.* (1988) (72 species) and Kouamé *et al.* (2008) (68 species). These observed differences could be explained by the size of the sampling areas. Indeed, Teugels *et al.* (1988) study covered the entire Sassandra river basin, while those of Kouamé *et al*. (2008) were carried out in the lower part of the Sassandra basin (from the lake of Buyo to the river estuary). In fact, the present study was only limited to the new Lake of Soubré, which impounded in April 2017. In contrast, our results are close to those of Goli Bi *et al.* (2019) who identified 45 species in the Buyo dam lake upstream of the Soubré dam. The most important families in terms of numbers are the Mormyridae, followed by the Claroteidae, the Mochokidae, and finally the Cichlidae, unlike most reservoirs where we observe the preponderance of Cichlidae. Indeed, the work of Gourène *et al.* (1999) and Tah *et al.* (2009) in the lake of Ayamé 1 (Ivory Coast); Montchowui *et al.* (2008) in Hlan (Benin); Ouédraogo *et al*. (2015) in the Sahelian lake of Higa (Burkina Faso); Adou *et al.* 2017 in the lake of Ayamé 2 (Ivory Coast) revealed the predominance of Cichlidae in the catches. The high proportion of Mormyridae could be explained by the creation of dam lakes generally resulting in the submersion of the surrounding vegetation. This then leads to the provision of a large amount of nutrients for the fish. Thus, the species that will be more successful in exploiting these resources and reproducing will be more abundant (Koné *et al.,* 2003). The Mormyridae could therefore be considered as pioneer and opportunistic species which take advantage of the new food sources available in the lake environment just after its impoundment. In addition, the specific dominance is ensured by the species of the *Marcusenius* genus, which could reflect a good quality of the water lake. According to Byanikiro *et al.* (2017), species of the Mormyridae family are quickly affected by unfavorable environmental conditions and would therefore be good indicators for characterizing the present state of a habitat and also the evolution of the state of an ecosystem (Niamien-Ebrottié *et al*., 2008). The strong presence of Mochokidae led by the species *Synodontis schall, Synodontis bastiani* and *Synodontis koensis* could be explained by their essentially omnivorous diet, composed of benthic invertebrates and macrophytes, with as main food the larvae of Chironomidae, fruits and plant debris (Diomandé *et al*., 2001). In addition, *S. koensis*, which is classified as a near-threatened species by the International Union for the Conservation of Nature (IUCN) (Awaïs *et al.,* 2010) is endemic to the Sassandra river (Kouamé, 2010). The presence of freshwater shrimp specimens of the *Macrobrachuim* genus in the catch of fishermen at the upstream station of the lake, in the river-lake transition zone could be explained by the break in ecological continuity created by the dam. Indeed, these remains of populations of *Machrobrachium* isolated by the dam will irreversibly decline (N'Zi *et al.,* 2008). In any season combined, the H' and E indices are respectively 2.06 and 0.48 in Amaragui, 2.29 and 0.71 in Gnamandji and 2.29 and 0.51 in Kpéhiri. According to Barbault (2000) and Dajoz (2000), a good organization of the population results in an equitability close to 1. A low equitability results from the predominance of a few species over all the taxa. However, when there is not an overabundance of a few organisms, the specific diversity is greater because spaces are freed, thus promoting the proliferation of several other species. The indexes values recorded are characteristic of diversify communities, and reflect a fairly good organization of the settlement of the Soubré dam lake. In addition, values of E less than 1 suggest that the settlement is dominated by some species to the detriment of others.

Conclusion:-

This study, which is the first, to describe the initial situation of the ichthyological fauna of a newly impounded reservoir in Côte d'Ivoire, allowed to inventory 42 species of fish in the new hydroelectric lake of Soubré. It shows, unlike the majority of the lakes of the dam of the country dominated by Cichlidae, the preponderance of *Chrysichthys nigrodigitatus* and *Marcusenius senegalensis* respectively, in terms of biomass and numerical abundance. The presence of shrimp of the *Macrobrachium* genus, an amphidromic species usually isolated

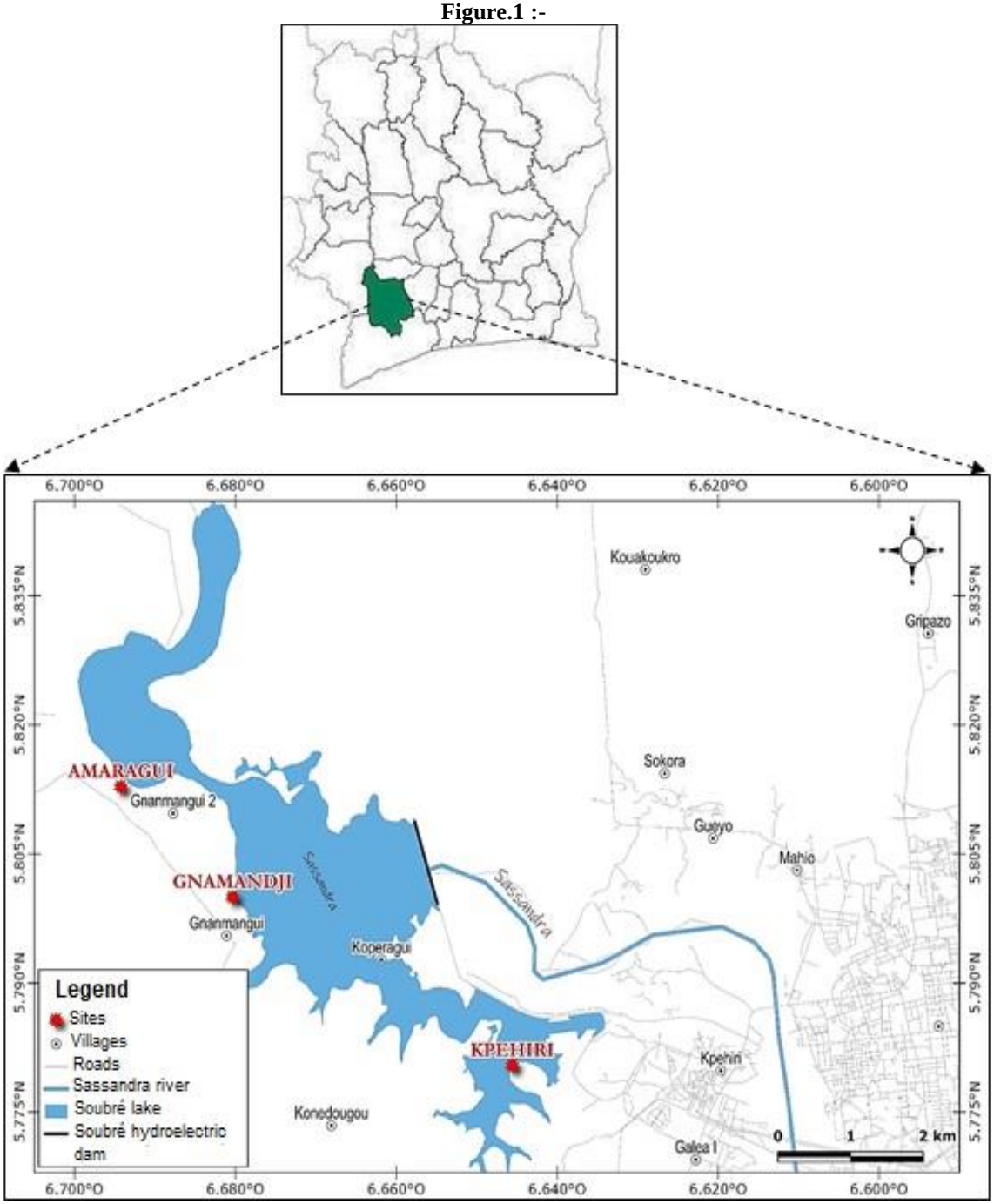
downstream of dams, was reported in the present study upstream of the river in the river-lake transition zone. The results of these investigations will serve as reference data for the ichthyofauna of Soubré lake and will enrich the national repertoire of ichthyological fauna of Côte d'Ivoire.

Conflict of interest

The authors declare no conflict of interest.

Figures:-

Figure.1 :-



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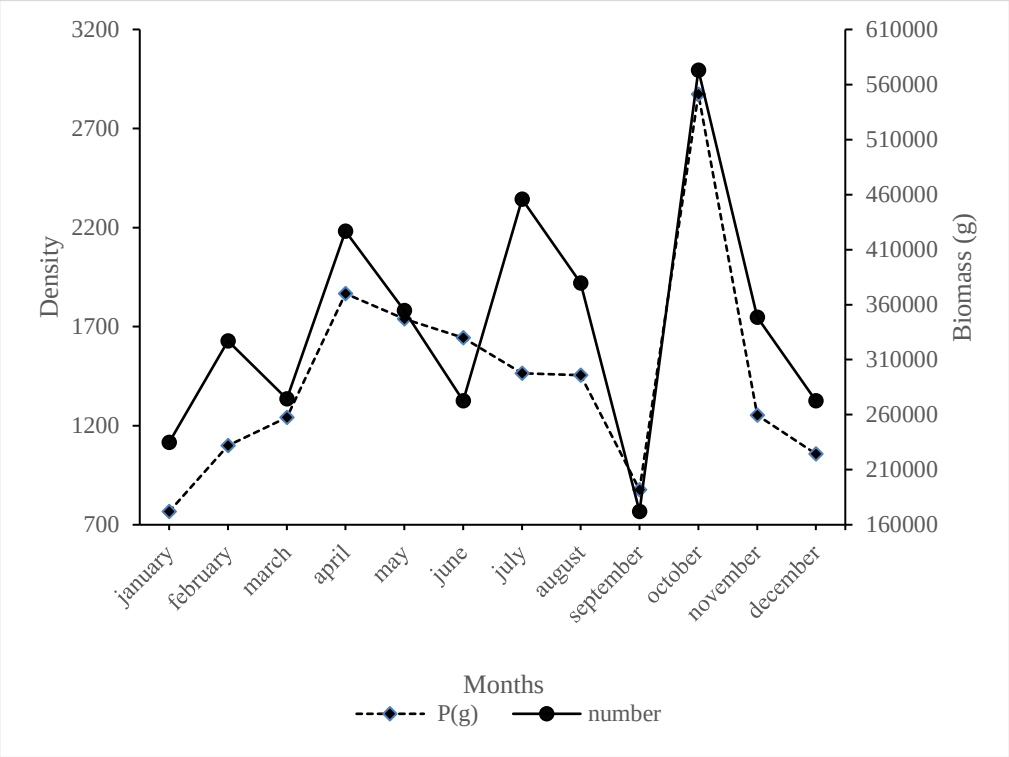

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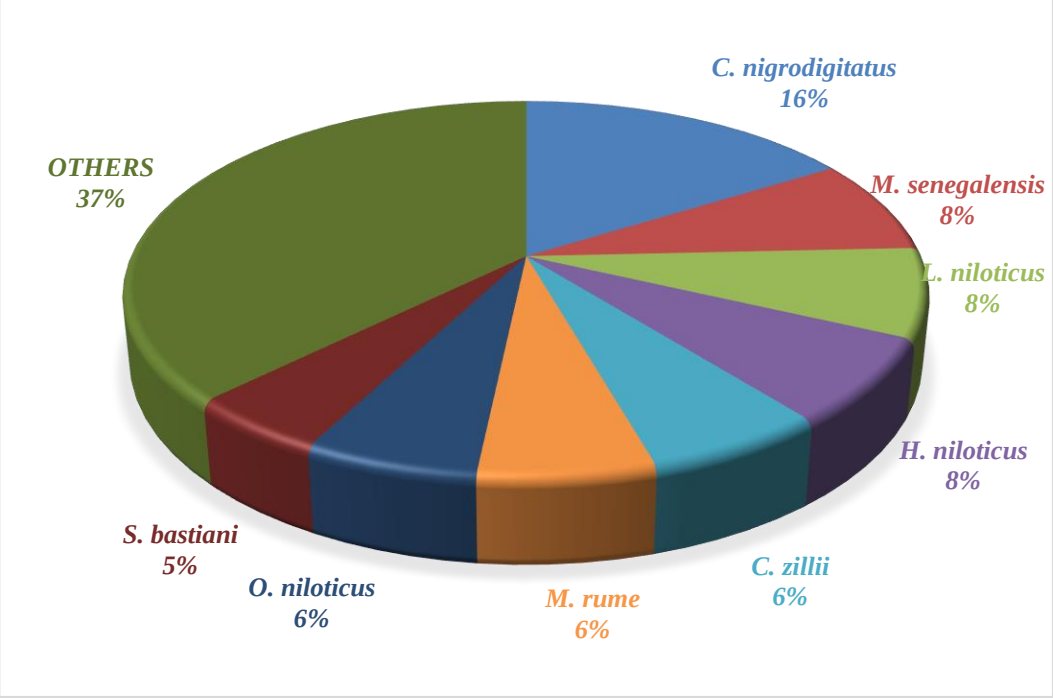

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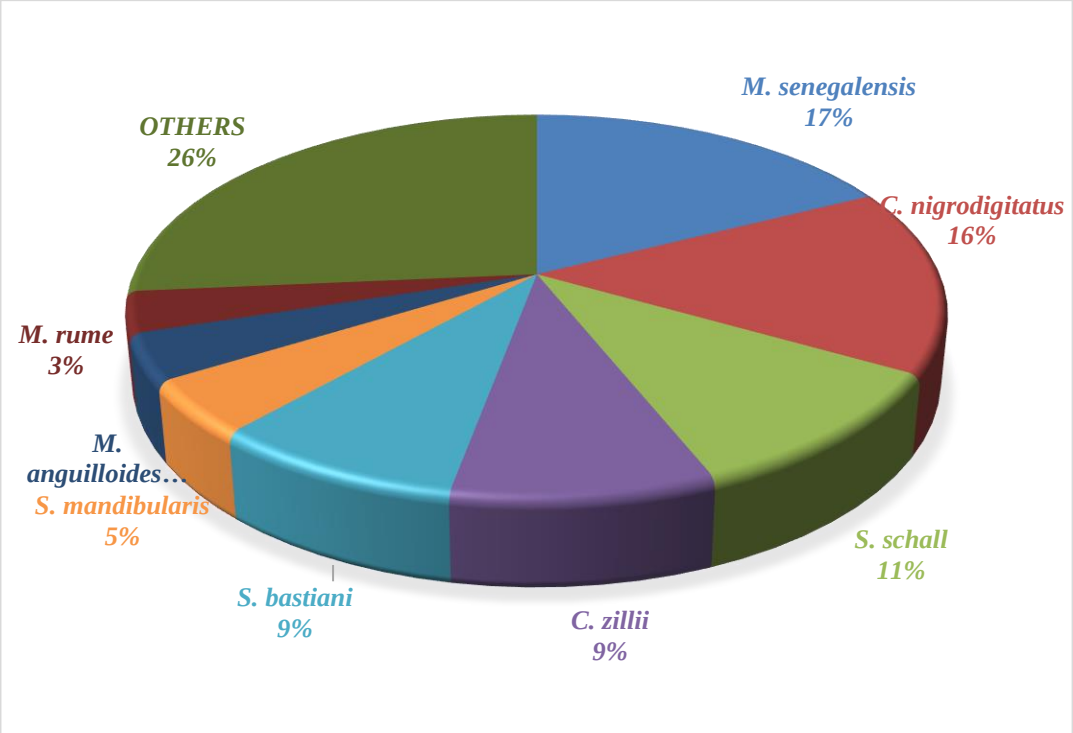

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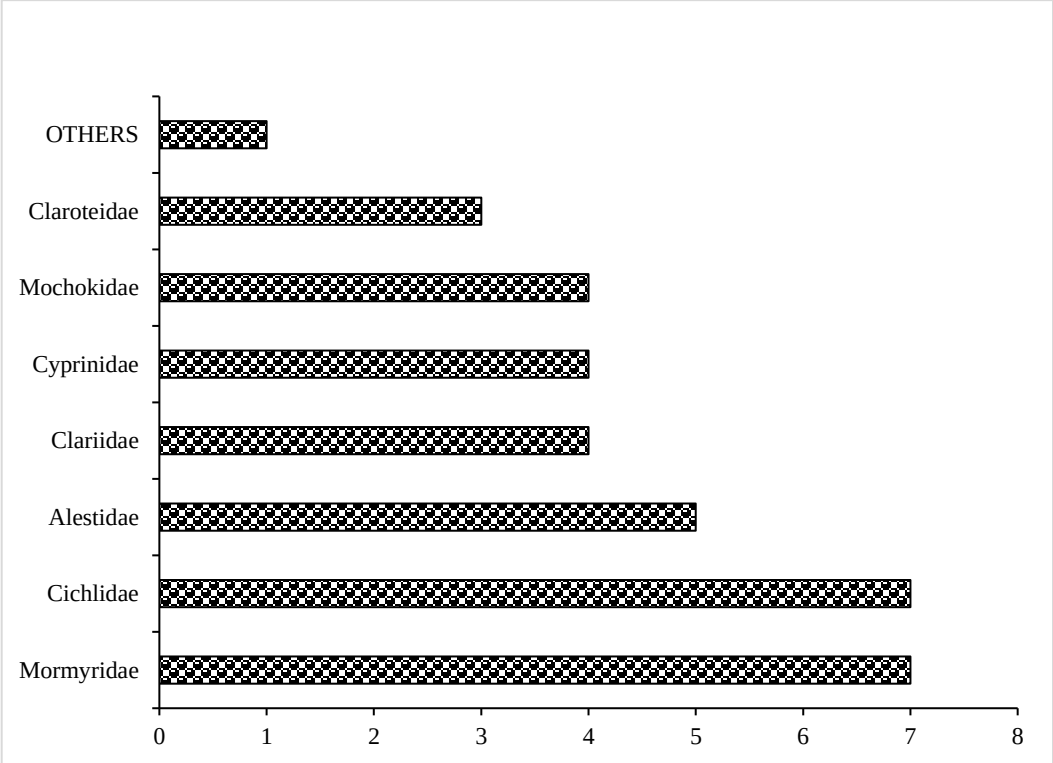

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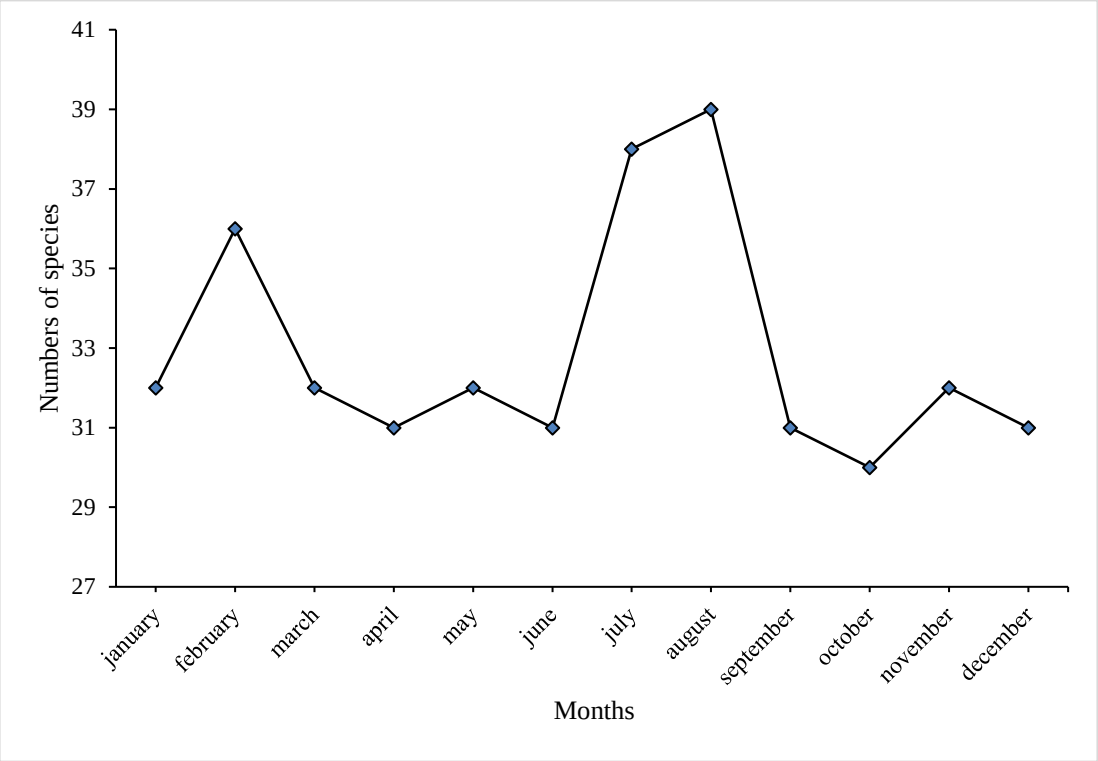

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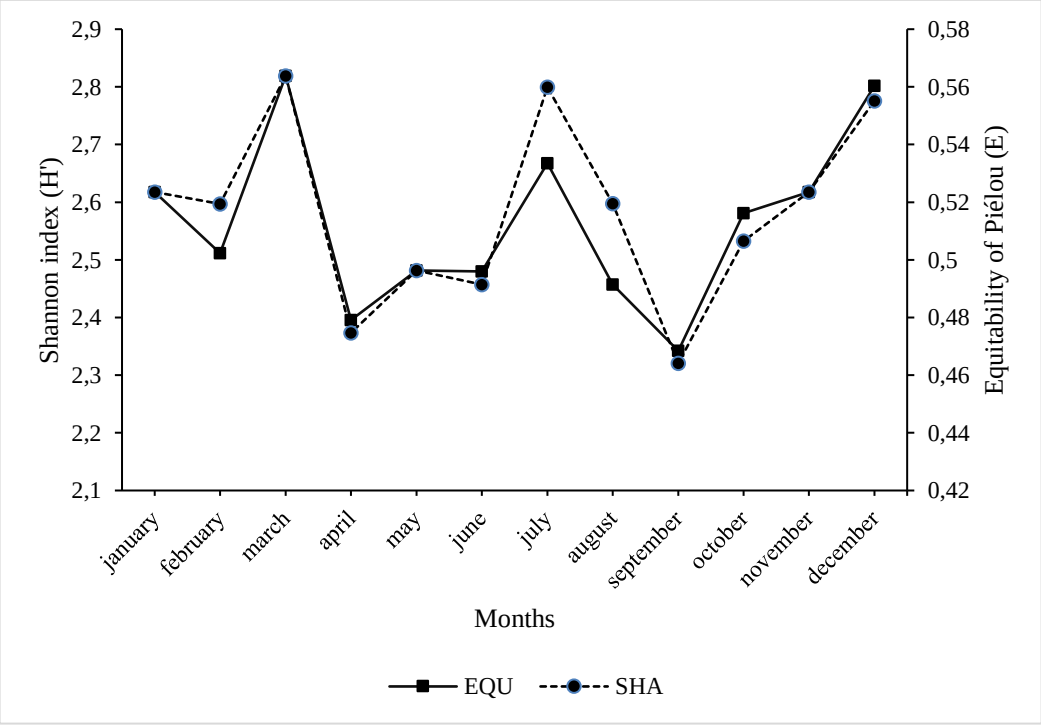

Fig.1: Location of sampling stations on Lake of Soubré during the period from August 2019 to July 2021
Fig.2: Monthly evolution of the Biomass and the number of fish caught on the lake of Soubré during the study
Fig.3: Specific weight composition of catches landed on the lake of Soubré during the study

Fig.4: Specific numerical composition of the catches landed on the lake of Soubré during the study
Fig.5: Classification of families according to the number of species observed in the catches between August 2019 and July 2021. The category "OTHER" represents 7 monospecific families (Arapaimidae, Channidae, Malapteruridae, Hepsetidae, Distichodontidae, Latidae, Polypteridae and Schilbeidae).
Fig.6: Monthly evolution of the species richness of the lake of Soubré
Fig.7: Monthly evolution of the Shannon index and the Equitability of the lake of Soubré

Tab. 1:- Biomass and numerical abundance of catches landed on the lake of Soubré.

	Amaragui	*%*	*Gnamandji*	*%*	*Kpéhiri*	*%*	*TOTAL*
NUMBER OF FISHERMEN CHECKED	**56**	**15**	**236**	**60**	**99**	**25**	**391**
NUMBER OF FISH	**7,813**	**38**	**8,978**	**44**	**3,673**	**18**	**20,464**
Biomass (tons)	**0.82**	**23**	**2.1**	**60**	**0.61**	**17**	**3.5**

Tab. 2:- List and occurrence of species recorded on the lake of Soubré between August 2019 and July 2021.

FAMILY	SPECIES	Amaragui	Gnamandji	Kpéhiri	OCCURRENCE
Polypteridae	*Polypterus endlicherii (Heckel, 1847)*	*			**8%**
Arapaimidae	*Heterotis niloticus (Cuvier, 1829)*	*	*	*	**92%**
Mormyridae	*Mormyrops anguilloides (Linnaeus, 1758)*	*	*	*	**100%**
	Marcusenius furcidens (Pellegrin, 1920)	*	*	*	**67%**
	Mormyrus rume (Valenciennes, 1846)	*	*	*	**100%**
	Marcusenius senegalensis (Stneindachner, 1870)	*	*	*	**100%**
	Marcusenius ussheri (Günther, 1867)	*	*	*	**75%**
	Petrocephalus bovei (Valenciennes, 1847)	*	*	*	**67%**
	Pollimyrus isidori (Valenciennes, 1847)	*	*	*	**33%**
Hepsetidae	*Hepsetus odoe (Bloch,1794)*	*	*	*	**75%**
Distichodontidae	*Distichodus rostratus (Günther, 1864)*	*	*	*	**100%**
Alestidae	*Alestes baremoze (Joannis, 1835)*	*	*	*	**100%**
	Brycinus imberi (Peters, 1852)	*	*	*	**75%**
	Brycinus macrolepidotus (Valenciennes, 1850)	*	*	*	**100%**
	Brycinus nurse (Rüppell, 1832)	*	*	*	**42%**
	Hydrocynus forskalii (Cuvier, 1819)	*	*	*	**83%**
Cyprinidae	*Labeobarbus bynni (Fabricius, 1775)*		*	*	**33%**
	Labeo coubie (Rüppell, 1832)	*	*	*	**100%**
	Labeo parvus (Boulenger, 1902)	*	*	*	**75%**
	Labeobarbus wurtzi (Pellegrin, 1908)	*	*	*	**42%**
Claroteidae	*Chrysichthys auratus (Geofroy St. Hilaire, 1809)*	*	*	*	**92%**
	Chrysichthys maurus (Valenciennes, 1840)	*	*	*	**100%**
	Chrysichthys nigrodigitatus (Lacépède, 1803)	*	*	*	**100%**
Schilbeidae	*Schilbe mandibularis (Günther, 1867)*	*	*	*	**100%**
Clariidae	*Clarias anguillaris (Linnaeus, 1758)*	*	*	*	**100%**
	Clarias sp.	*	*	*	**92%**
	Heterobranchus isopterus (Bleeker, 1863)	*	*	*	**75%**
	Heterobranchus longifilis (Valenciennes, 1840)	*	*	*	**42%**
Malapteruridae	*Malapterurus electricus (Gmelin, 1789)*	*	*	*	**100%**
Mochokidae	*Synodontis bastiani (Daget, 1948)*	*	*	*	**100%**
	Synodontis koensis (Pellegrin, 1933)	*	*	*	**100%**
	Synodontis punctifer (Daget, 1965)	*	*	*	**83%**
	Synodontis schall (Bloch et Schneider, 1801)	*	*	*	**100%**
Channidae	*Parachanna obscura (Günther, 1961)*	*	*	*	**83%**
Latidae	*Lates niloticus (Linnaeus, 1758)*	*	*	*	**100%**
Cichlidae	*Chromidotilapia guntheri (Sauvage, 1882)*	*	*	*	**33%**
	Hemichromis bimaculatus (Gill, 1862)	*		*	**42%**
	Hemichromis fasciatus (Peters, 1852)	*	*	*	**83%**

	Oreochromis niloticus (Linnaeus, 1758)	*	*	*	**100%**
	Sarotherodon galileaus (Linnaeus, 1758)	*	*	*	**33%**
	Coptodon guineensis (Bleeker, 1862)	*	*	*	**25%**
	Coptodon zillii (Gervais, 1848)	*	*	*	**100%**
	TOTAL	**41**	**40**	**41**	

Tab. 3:- Spatial variation of the species richness, the Shannon index (H') and the Equitability index (E) of the stations of the lake of Soubré

Station	Species richness		Shannon diversity index (H')		Equitability (E)	
	Mean±SE	**Min-Max**	**Mean±SE**	**Min-Max**	**Mean±SE**	**Min-Max**
Amaragui	22,17±3,3	17-26	2,15±0,19	1,60-2,45	0,48±0,047	0,38-0,58
Gnamandji	26,34±2,95	17-30	2,37±0,18	1,67-2,65	0,50±0,03	0,41-0,54
Kpéhiri	23±3,84	15-34	2,34±0,14	2,13-2,72	0,52±0,041	0,45-0,58
ANOVA: F	3,3517		3,1078		1,9594	
ANOVA:*p*	0,0473*		0,058		0,157	

References:-

1. Adou Y. E., Blahoua K. G., Bamba M., Yao S. S., Kouamélan E. P. & N'Douba V., 2017. Premières données sur l'inventaire du peuplement ichtyologique d'un lac ouest Africain situé entre deux barrages hydroélectriques : lac d'Ayamé 2 (Côte d'Ivoire). *Journal of Applied Biosciences, 110 : 10808-10818 ISSN 1997-5902.*
2. Anoh K. P. 1994. Contribution à l'étude du réseau de distribution des ressources halieutiques marines en Côte d'Ivoire. Thèse de Doctorat 3ème Cycle. Centre Universitaire de Cocody-Abidjan, Côte d'Ivoire. 324p.
3. Anonymous 1, 2019. Fiche technique du barrage de Soubré. Lancement officiel des travaux de construction du barrage hydroélectrique de Soubré dans la région de la NAWA. https://www.gouv.ci/doc/Fiche%20technique%20%20Barrage%20SoubreLancement250213.pdf, Consulted on 20/07/2021.
4. Anonymous 2, 2020. Rapport d'activités du Bureau aquaculture et Pêche de Soubré, 24p.
5. Awaïs A. & Lalèyè P., 2010. *Brycinus derhami In:* IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2, www.iucnredlist.org.
6. Barbault R., 2000. Ecologie générale : Structure et fonction de la biosphère. 5ème édition, Dunod, Paris. 326 p.
7. Byanikiro R. M., Nsila J. N., Busanga A. K., Ulyelali-Patho J. & Micha J-C. 2017. Caractérisation et écologie des peuplements des Mormyridae dans la réserve de Yoko (Kisangani, RD Congo). *Int. J. Biol. Chem. Sci.*, 11(3) : 967-999. DOI : http://dx.doi.org/10.4314/ijbcs.v11i3.4
8. CI ENERGIES 2021. *Côte d'Ivoire ENERGIES | Barrage de SOUBRE – Côte d'Ivoire ENERGIES*. https://www.cinergies.ci/barrage-de-soubre/. Consulted on 20/07/2021
9. Da Costa K. S., Gourène G., Tito De Morais L. & Thys van den Audenaerde D. F. E. 2000. Caractérisation des peuplements ichtyologiques de deux fleuves côtiers ouest-africains soumis à des aménagements hydroagricoles et hydroélectriques. *Vie et milieu*, 50 : 65-77.
10. Da Costa K. S., Traore K., Daha A. & Koffi K. J. 2002. Observations sur le peuplement ichtyologique et les activités de pêche dans le lac Fé. *In* : Yte W. Sankare Y., Kouassi N. C. et K. S. Da Costa (Eds.). Etude bioécologique des peuplements ichtyologiques et planctoniques du lac Fé, dans la région du Sud-ouest de la Côte d'Ivoire (San Pedro). Projet d'étude Participative (PEP) IDESSA /AISA/CRO, Rapport scientifique : pp 37 - 69.
11. Da Costa K. S. & Y. M. Dietoa. 2007. Typologie de la pêche sur le lac Fé et implications pour une gestion rationnelle des ressources halieutiques. *Bull. Fr. Pêche Piscic.* 384 : 1 - 14.
12. Dajoz R., 2000. Précis d'écologie (7ème édition) Dunod. Paris 615 p.
13. DAP, 2014. *In* Failler P., El Ayoubi H. & Konan A. 2014. Industrie des pêches et de l'aquaculture en Côte d'Ivoire. 10.13140/RG.2.1.2919.1843.
14. Diarra A., 2020. Kossou : un pôle de production halieutique en décadence. *Revue Espace, Territoires, Sociétés et Santé*, 3 (5), 79-91. https://www.retssa-ci.com/index.php?page=detail&k=85
15. Diomandé D., Gourène G., Tito de Morais. 2001. Stratégies alimentaires de *Synondontis bastiani* (Siluriformes : Mochokidae) dans le complexe de la Bia, Côte d'Ivoire. *Cybium* : Revue Internationale d'Ichtyologie, Paris : Muséum national d'histoire naturelle, 25, pp.7-21.

16. ENVIPUR, 2014. Rapport d'étude d'impact environnemental et social voirie de Soubré. AGENCE DE GESTION DES ROUTES. 143p
17. FAO. 2020. La situation mondiale des pêches et de l'aquaculture 2020. La durabilité en action. Rome. https://doi.org/10.4060/ca9229fr
18. FAO. 2008. Profil pêche par pays. La République de Côte d'ivoire. FID/CP/CIV. Rome, Italia.
19. Golé Bi G., Koffi J. & Dadi S., 2005. Contribution socio-économique de la pêche artisanale en Côte d'Ivoire, PMEDP, Rapport national, Abidjan, 49 p.
20. Goli Bi B. E. P., Kamelan T. M., Kien K. B., Berté S. & Kouamélan E. P., 2019. The spatio-temporal dynamics of the fish assemblage of the man-made Lake Buyo (Côte d'Ivoire, West Africa). *International Journal of Fisheries and Aquaculture* 11 (3): 72-85.
21. Gourène G., Teugels G. G., Hugueny B. & Thys van den Audenaerde D. F. E. 1999. Evaluation de la diversité ichtyologique d'un bassin ouest-africain après la construction d'un barrage. *Cybium*, 23 (2) : 147-160.
22. Koné T., Teugels G. G., N'Douba V., Kouamélan E. P. & Gooré Bi G. 2003. Fish assemblages in relation to environmental gradients along a small west African coastal basin, the San Pedro River, Ivory Coast. *African Journal of Aquatic Science*, 28 (2): 163-168.
23. Kouamé K. A., Yao S. S., Bi G. G., Kouamelan E. P. & N'Douba V., 2008. Influential environmental gradients and patterns of fish assemblages in a west African basin. *Hydrologica*, 603 (1) :159-169.
24. Kouamé K. A., 2010. Diversité biologique et habitudes alimentaires de quelques espèces de poissons dans le cours inférieur du bassin du fleuve Sassandra (Côte d'Ivoire). Thèse de Doctorat. Université de Cocody-Abidjan, Côte d'Ivoire, 178 p.
25. Lalèyè P., Villanueva M. C., Entsua-Mensah M. & Moreau J., 2007. A review of the aquatic living resources in Gulf of Guinea lagoons with particular emphasis on fisheries management. *Journal of Afrotropical Zoology*, *Proceedings of the Third International Conference on Africa Fish and Fisheries*, Cotonou, Benin, 10–14 November 2003, Special issue, 123–136.
26. MINEDD 2020. Un projet de lutte contre les changements climatiques expliqué aux populations du Bélier du 22/07/2020. Ministère de l'Environnement et du Développement Durable, environnement.gouv.ci/actualite.php ?rd=822 Consulted on 20/07/2021
27. Montchowui, E., Chikou, A., Kogbeto, M.-J. & Laleye, P. 2008. Biodiversité et structure des communautés de poissons du lac Hlan au Bénin. *International Journal of Biological and Chemical Sciences, 2 (2).* doi:10.4314/ijbcs. v2i2.39733
28. Niamien-Ebrottié E. J., Konan K. F., Gnagne T., Ouattara A., Ouattara M. & Gourène G. 2008. Étude diagnostique de l'état de pollution du système fluvio-lagunaire Aby-Bia-Tanoé (Sus-Est, Côte d'Ivoire) Sud *Sciences et Technologies*, 16 (1) : 513. DOI : http://documents.irevues.inist.fr/bitstream/handle/2042/30379/sst16_2.
29. N'Zi G.K., Gooré B.G., Kouamélan E.P., Koné T., N'Douba V. & Ollevier F. 2008. Influence des facteurs environnementaux sur la répartition spatiale des crevettes dans un petit bassin ouest africain – rivière Boubo – Côte d'Ivoire. *TROPICULTURA*, 26 (1) : 17-23
30. Ouédraogo R., Soara A. E. & Oueda A., 2015. Description du peuplement piscicole du lac Sahélien de Higa, un site Ramsar du Burkina Faso, Afrique de l'Ouest. *Journal of Applied Biosciences* 95: 8958-8965.
31. Paugy D, Lévêque C, Teugels GG (eds), 2003a. Faune des poissons d'eaux douces et saumâtres de l'Afrique de l'Ouest. Tome 1. IRD (Paris), MNHN (Paris), MRAC (Tervuren). 457 p.
32. Paugy D., Lévêque C, Teugels GG (eds), 2003b. Faune des poissons d'eaux douces et saumâtres de l'Afrique de l'Ouest. Tome 2. IRD (Paris), MNHN (Paris), MRAC (Tervuren), 815 p.
33. Piélou E. C., 1984. The interpretation of ecological data. *Wiley & Sons*, New York, 7 p.
34. Shannon E. C. and Weaver W., 1963. The mathematical theory of communication. *University of Illinois press*, 117 p.
35. Tah L., DA Costa K. S., Kouassi N. J. & Moreau J., 2009. Effort de pêche et production exploitée au lac d'Ayamé 1 (Bassin de la Bia ; Côte d'Ivoire) après le départ des pêcheurs « Bozos ». *Agronomie Africaine*, 21 (1) : 103-115.
36. Teugels G.G., Lévêque C., Paugy D. & Traoré K. 1988. État des connaissances sur la faune ichtyologique des bassins côtiers de Côte d'Ivoire et de l'Ouest du Ghana. *Revue d'Hydrobiologie Tropicale*, 21 (3) : 221-237.
37. TRAORE K. 1996. Etat des connaissances sur les pêcheries continentales ivoiriennes. PROJET FAO TCP/ IVC / 4553.
38. Vanga A. F., 2004. Conséquences socio-économiques de l'expulsion des pêcheurs étrangers en Côte d'ivoire : lacs d'Ayamé et de Buyo. *Revue européenne des migrations internationales*, 20 (1): 197-205.