Bulletin de l'Institut Scientifique, Rabat, Section Sciences de la Vie, 2024, n° 46, 29–35 **e-ISSN : 2458-7184**

Exploitation of fish assemblage in Dassoungboho dam lake in Northern Ivory Coast

Exploitation du peuplement de poissons du lac de barrage de Dassoungboho au nord de la Côte d'Ivoire

Kouassi Brahiman Kien[1*], Awa Ndiaye[1], Benié Rose Danielle Aboua[2] & Essetchi Paul Kouamelan[2]

1. *Peleforo Gon Coulibaly University, Biological Sciences Training and Research Unit, BP 1328 Korhogo, Ivory Coast*
**(kienkouassibrahima@upgc.edu.ci)*
2. *Félix-Houphouët-Boigny University, Biosciences Training and Research Unit, 22 BP 582 Abidjan 22, Ivory Coast.*

Abstract. This study, carried out in the Dassoungboho dam lake, made it possible to evaluate the exploitation of the fish assemblage in this water reservoir. Sampling lasted 4 days per month for 12 months. The fish come from experimental fishing and landings from local fishermen. The ichthyofauna inventory revealed the existence of 21 species of fish divided into 3 orders and 8 families. Four types of fishing gear are used for fishing activities in Dassoungboho lake. These are the gillnet, traps, longlines and cast net. The results of this study showed free access to the resource and that traps are the most used gear (85%) by fishermen with reduced mesh sizes (between 8 and 23 mm). The analysis of the structure of the assemblage revealed a relatively diverse environment (H'=1.93±0.15 and E=0.76±0.04), dominated by the Cichlidae family (33.33%) and the species *Synodontis bastiani* (20.78%). This fish assemblage is mainly composed of juvenile specimens (65.44%). The analysis of ecological stress showed a stressed environment synonymous with overexploitation of fish.

Keywords. Fish assemblage, Species diversity, Ecological stress, Fishing gears, Dassoungboho dam lake (Nothern Ivory Coast)

Résumé. La présente étude, menée sur le lac de barrage de Dassoungboho, a permis d'évaluer l'exploitation du peuplement de poisson dans cette retenue d'eau. L'échantillonnage a duré 4 jours par mois pendant 12 mois. Les poissons sont issus de la pêche expérimentale et des débarquements des pêcheurs locaux. L'inventaire de l'ichtyofaune a révélé l'existence de 21 espèces de poissons reparties en 3 ordres et 8 familles. Trois types d'engins de pêche sont utilisés pour l'exploitation des poissons à Dassoungboho. Ce sont le filet maillant, les nasses, les palangres et l'épervier. Les résultats de cette étude ont montré un libre accès à la ressource et que les nasses sont les engins les plus utilisés, à 85% par les pêcheurs avec des mailles réduites (entre 8 et 23 mm). L'analyse de la structure du peuplement a révélé un milieu relativement diversifié (H'=1,93±0,15 et E= 0,76±0,04), dominé par la famille des Cichlidae (33,33%) et l'espèce *Synodontis bastiani* (20,78%). Ce peuplement est composé majoritairement de spécimens juvéniles (65,44%). L'analyse du stress écologique a montré un milieu stressé synonyme d'une surexploitation des poissons.

Mots-clés : Peuplement de poissons, Diversité spécifique, Stress écologique, Engins de pêche, Lac de barrage de Dassoungboho (Nord Côte d'Ivoire).

INTRODUCTION

The fresh waters of Africa are very rich in fish, which explains why fishing has always been practiced as a subsistence activity in the same way as hunting and gathering (Koudou 2012). Fish in all its forms provides an appreciable supply of protein (Halain 1950). Thus, fishing has been a major source of protein and income for humanity. But very early on, the activity experienced declines in several countries due to galloping demographics with too many fishermen, chasing resources that had become increasingly rare (Kiossa 2011). And this is all the more accentuated in continental artisanal fisheries where we witness the use of gear and fishing practices that are destructive of resources (COMHAFAT 2014). The management of fisheries resources has become a crucial issue both biologically and economically (Kien *et al.,* 2018).

In Ivory Coast, inland fishing is based on a set of lake fisheries, the main ones of which are the lakes of Kossou, Buyo, Ayamé, Taabo and Faé. On these reservoirs, the typology of fishermen and the characterization of fishing practices were carried out by various researchers including Vanga (2004), DA Costa & Konan (2005) and Koudou (2012). Unlike these reservoirs, few researchers have dealt with small reservoirs of the northern Ivory Coast (Koudou *et al*. 2020). The northern dam lakes, built since the 1970s (Le Guen 2002), were initially used for agricultural and pastoral purposes, but today they represent real fishing potential (Cecchi *et al.* 2007).

The risk of a reduction in catches observed on these lakes (Koudou *et al.* 2020) imposes, today, the need to evaluate the various pressures influencing the productivity of these lake systems. Indeed, one of the factors that leads to the degradation of fish stocks is the mode of exploitation of these resources (Montchowui *et al.* 2008). It is in this sense that in Ivory Coast, the state has implemented a fishing and aquaculture development strategy whose main objective is responsible fishing with a view to ensuring conservation, sustainable management and development of fishery resources while respecting ecosystems and biodiversity, in order to combat food insecurity and poverty (PSDPA 2014).

This study is a contribution to strengthening this strategy in the north zone where no study has yet been carried out to scientifically assess the impact of fishing on fish assemblage in fisheries on lakes. The general objective of this study is to assess the fishing pressure on the fish population of Dassoungboho lake (Korhogo) in northern Ivory Coast with a view to better planning for the conservation of fishery resources.

METHODS

Description of study area

Located between 9°26 N and 5°48 W, Dassoungboho lake (Figure 1) was created in 1973 by the Ivory Coast Water Distribution Company (SODECI). Initially with an agropastoral vocation, this dam has a strong fishing potential and fishing is practiced there by various communities with distinct socio-demographic characteristics (Silué 2012).

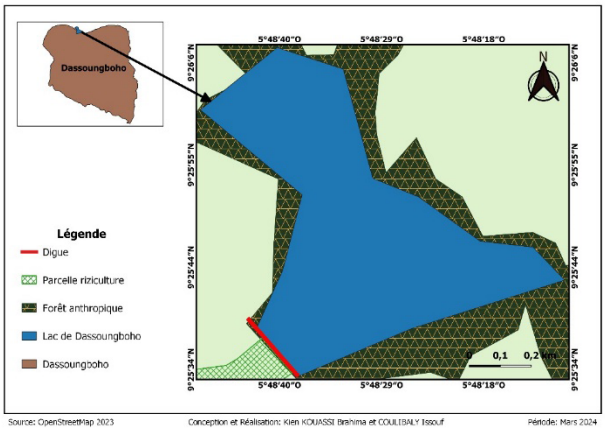

Figure 1 : Location of the Dassoungboho lake

Sampling collection

Fish were collected between April 2022 and March 2023 using fish landing from local fishermen. Fish landings surveys lasted 4 days per month for 12 months. During these missions we first discussed with fishermen the conditions of access to the resource before proceeding to examine the recorded daily catches. Thus for each landing, the characteristics of the fishing gear (name, number, mesh), the total mass and specific composition of the catch, the mass and the number of specimens per species are noted. Fish identification was done using the dichotomous key of Paugy *et al.* (2003a and b). Each specimen was measured using an ichthyometer before being weighed using a TEFAL EASY brand 1g precision balance.

Expression of biological indicators

Specific Richness (RS)

The number of species captured was determined for the entire sampling period from April 2022 to March 2023.

Numerical (N) or weight (P) percentage

The numerical (N) or weight (P) percentage for the present study was calculated by taking the ratio of the number of individuals (n) or the mass of individuals (p) of a species or family to the total number of individuals (Nt) or the total mass of individuals (Pt) multiplied by one hundred. It was calculated according to the following formulas:

$N = (n/Nt) \times 100$

$P = (p/Pt) \times 100$

Determination of ecological stress

In this work, the hypothesis to be verified is that of a stressed environment. Indeed, the diversity of fishing gear deployed should lead to a stressed environment (Tah 2012). Thus, the ABC curve (Abundance/Biomass Comparison Curves) was drawn. The cumulative percentages of abundance and biomass according to the ranks of species in the same benchmark give the ABC curves. According to Kantoussan (2007):

−If the cumulative biomass curve is above the abundance curve then the environment is in a state of non-stress.

−If the biomass and cumulative abundance curves merge or almost merge then the environment is in a phase of light stress.

−If the cumulative biomass curve is below the abundance **curve** then the environment is in a state of significant stress. Furthermore, the degree of stress of an ecosystem disturbed by anthropogenic factors can be effectively assessed using the Clarke (1990) and Grall (2006) index, noted W.

It was calculated in this study by the following formula:

$$W = \sum_{i\ 1}^{s} \frac{(B_i - A_i)}{(50)(S-1)}$$

W: stress index
Ai and Bi: rank of species i (i varying from 1 to S) for biomass and abundance
S: number of species considered.
The W index varies from -1, when biomass totally dominates abundance, to +1 otherwise.

Rate of adults and juveniles in catches

To study the fishing pressure on the fish population of Dassoungboho lake, the sizes of the specimens were analyzed.

The sizes of the specimens for the most abundant populations in the captures were grouped as follows for each species: sizes smaller than the size of the smallest mature individual; sizes between the size of the smallest mature individual and that of first maturity and finally those greater than the size of first maturity of the species considered. Individuals in the first category are considered juveniles, those in the second category are called sub-adults, while those belonging to the third category are called adults.

RESULTS

Conditions of access to fishery resources

Fishing activities in Dassoungboho lake are regulated by agents of the fishing offices of the Regional Directorate of Animal and Fishery Resources in the Poro region, where this study takes place. Access to the fishing zone is by acquiring a permit and a fishing license issued by the authority in charge of fisheries management. The cost of this license is set at 15000 FCFA/year. In addition, the fisherman must pay a tax of 3000 FCFA/month. However, the investigations carried out during this study showed that these rules are not respected by the actors who enjoy free access to the lake and its resources.

Fishing gears

The fishing gears used in Dassoungboho lake are of 4 types: traps (85%), gillnets (11%), longlines (3%) and cast nets (1%). 88% of gillnet meshes are between 10 and 35 mm. Concerning the traps, they have meshes ranging from 8 to 23 mm. The mesh sizes of gillnets and traps are well below those required by fishing regulations in Ivory Coast. The mesh of the cast nets used on the lake is between 30 and 80 millimeters.

Taxonomic richness

A total of 21 fish species have been recorded (Tab. 1) in Dassoungboho lake. **These species belong to** 8 families and 3 orders. The order of Siluriformes is the most diverse with 5 families and 8 species inventoried in Dassoungboho lake. It is followed by the order of Cichliformes with 2 families and 8

species and that of Osteoglossiformes which is represented by a single family and 5 species.

Proportion of different fish families in the lake

The present study showed that in Dassoungboho lake (Tab. 2), the families best represented numerically are the Cichlidae (33.33%) and the Mormyridae (23.83%). Then come the Mochokidae, the Clariidae and the Claroteidae (9.52% each). Schilbeidae, Malapterurudae and Anabantidae are the families least represented in the catches with 4.76% each. The distribution of fish families in terms of weight indicates that the Cichlidae (52.17%) and the Claroteidae (27.46%) are the most present. The other families (Mochokidae, Mormyridae, Clariidae, Anabantidae, Malapterurudae and Schilbeidae) are less represented in the catches with an overall proportion of 20.37%.

Table 1: List of fish species recorded in Dassoungboho lake

Taxons	Order	Family	Species
	Osteoglossiformes	Mormyridae	*Mormyrus rume*
			Marcusenius furcidens
			Marcusenius senegalensis
			Marcusenius ussheri
			Pollimyrus isidori
	Siluriformes	Claroteidae	*Chrysichthys maurus*
			Chrysichthys nigrodigitatus
		Schilbeidae	*Schilbe intermedius*
		Clariidae	*Clarias anguillaris*
			Clarias buettikoferi
		Malapterurudae	*Malapterurus electricus*
		Mochokidae	*Synodontis bastiani*
			Synodontis punctifer
	Cichliformes	Cichlidae	*Hemichromis bimaculatus*
			Hemichromis fasciatus
			Oreochromis niloticus
			Sarotherodon galilaeus
			Sarotherodon melanotheron
			Coptodon guineensis
			Coptodon zillii
		Anabantidae	*Ctenopoma petherici*
Total	3	8	21

Table 2: Numerical and weight proportion of the different families of fish recorded in Dassoungboho lake

Taxons and %	Family	Number of species	%	Weight (g)	%
	Mormyridae	5	23.83	9490	4.54
	Claroteidae	2	9.52	57370	27.46
	Schilbeidae	1	4.76	1600	0.77
	Clariidae	2	9.52	8600	4.12
	Malapterurudae	1	4.76	2850	1.36
	Mochokidae	2	9.52	16010	7.66
	Cichlidae	7	33.33	108970	52.17
	Anabantidae	1	4.76	4000	1.92
Total	8	21	100%	208,890	100%

Proportion of different fish species in the lake

At the species level (Tab. 3), those with the largest numbers of catches are respectively *Synodontis bastiani* (20.78%), *Coptodon guineensis* (19.56%), *Chrysichthys nigrodigitatus* (13.22%) and *Oreochromis niloticus* (11.89%).

The other species captured on the lake are *Sarothenodon melanotheron, Synodontys punctivating, Hemichromis bimaculatus, Pollimyrus isidori, Schilbe Intermedius, Hemichromis fasciatus, Ctenopoma petherici, Clarias anguillaris, Chrysichthys maurus, Sarkerodon galilaeus, Don zillii, Mormyrus rume, Marcusenius furcidens, Marcusenius senegalensis, Marcusenius ussheri* and *Clarias buettikoferi*. All these species only represent 34.55% of catches.

The species best represented by weight in the total catch landed in Dassoungboho Lake are *Coptodon guineensis* (27.14%) and *Chrysichthys nigrodigitatus* (24.76%) (Tab. 3). The species *Oreochromis niloticus, Sarotherodon melanotheron, Synodontys bastiani, Clarias anguillaris, Hemichromis fasciatus, Synodontys punctifer, Pollimyrus isidori, Chrysichthys maurus, Ctenopoma petherici, Sarotherodon galilaeus, Malapterurus electricus, Marcusenius furcidens, Hemichromis bimaculatus, Schilbe intermedius, Mormyrus rume, Marcusenius senegalensis, Clarias buettikoferi, Coptodon zillii* and *Marcusenius ussheri* complete this list at 48.01%.

Assessment of ecological stress

Figure 2 illustrates the distribution of abundances and cumulative biomasses in catches in Dassoungboho lake. This figure shows that the distribution of abundances is above that of biomasses. The stress index W obtained has a value equal to -0.033.

Table 3: Numerical and weight proportion of the different fish species recorded in Dassoungboho lake

Species	Number	%	Weight (g)	%
Mormyrus rume	20	0.22	680	0.33
Marcusenius furcidens	20	0.22	2660	1.27
Marcusenius senegalensis	10	0.11	210	0.1
Marcusenius ussheri	10	0.11	140	0.07
Pollimyrus isidori	280	3.11	5800	2.78
Chrysichthys maurus	140	1.56	5650	2.7
Chrysichthys nigrodigitatus	1190	13.22	51720	24.76
Schilbe intermedius	240	2.67	1600	0.77
Clarias anguillaris	150	1.67	8400	4.02
Clarias buettikoferi	10	0.11	200	0.1
Malapterurus electricus	90	1	2850	1.36
Synodontis bastiani	1870	20.78	9480	4.54
Hemichromis bimaculatus	400	4.44	2270	1.0
Hemichromis fasciatus	200	2.22	7610	3.64
Oreochromis niloticus	1070	11.89	23490	11.25
Sarotherodon galilaeus	110	1.22	2950	1.41
Sarotherodon melanotheron	630	7	15760	7.54
Coptodon guineensis	1760	19.56	56700	27.14
Coptodon zillii	30	0.33	190	0.09
Ctenopoma petherici	170	1.89	4000	1.91
Total	9000	100%	208890	100%

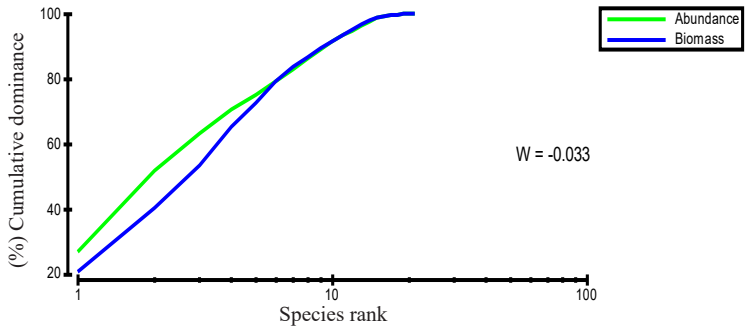

Figure 2: Comparison of the distributions of abundance and biomass in fish catches in Dassoungboho lake

Rates of adults and juveniles

Analysis of the rate of adults and juveniles in the catches (Tab. 4) in Dassoungboho lake shows that the species *Chrysichthys nigrodigitatus, Oreochromis niloticus, Sarotherodon melanotheron, Synodontys bastiani, Clarias anguillaris, Hemichromis fasciatus, Synodontys punctifer, Pollimyrus isidori, Chrysichthys maurus, Ctenopoma petherici, Sarotherodon galilaeus, Malapterurus electricus, Marcusenius furcidens, Mormyrus rume, Marcusenius senegalensis, Clarias buettikoferi, Coptodon zillii* and *Marcusenius ussheri* making 85.71% of the species considered, were mainly captured at the juvenile stage. This first group includes 65.44% of all specimens sampled in Dassoungboho lake.

The group consisting of *Coptodon guineensis, Hemichromis bimaculatus* and *Schilbe intermedius* (14.29% of the species considered) mainly presents sub-adult individuals in the catches. These individuals represent 32.22% of all individuals fished over the sampling period.

No species was captured with a majority of specimens in the adult stage during the present study. Furthermore, only the species *Synodontys bastiani* (5.35%), *Chrysichthys nigrodigitatus* (3.36%) and *Chrysichthys maurus* (28.57%) presented mature individuals during the different sampling missions. These mature individuals make up 2.33% of the total population.

Proposal for sustainable management of fish resources

A concerted approach to the management of Dassoungboho lake in particular and that of the continental area in general and its resources must be considered for the protection of fish and the sustainability of fishing activities in these ecosystems. This type of approach offers a framework for permanent exchange on the activities to be carried out, which guarantees an effective and sustainable management process.

Table 4: Distribution of fish species according to their maturity

Species	Number	Juvenile (%)	Sub-adult (%)	Adult (%)
Mormyrus rume	20	100		
Marcusenius furcidens	20	66.67	33.33	
Marcusenius senegalensis	10	100		
Marcusenius ussheri	10	100		
Pollimyrus isidori	280	96.43	3.57	
Chrysichthys maurus	140	50	21.43	28.57
Chrysichthys nigrodigitatus	1190	91.6	5.04	3.36
Schilbe intermedius	240	25	75	
Clarias anguillaris	150	100		
Clarias buettikoferi	10	100		
Malapterurus electricus	90	66.67	33.33	
Synodontis bastiani	1870	85.56	9.09	5.35
Synodontis punctifer	600	91.67	8.33	
Hemichromis bimaculatus	400	7.5	92.5	
Hemichromis fasciatus	200	25	75	
Oreochromis niloticus	1070	93.46	6.54	
Sarotherodon galilaeus	110	100		
Sarotherodon melanotheron	630	98.41	1.59	
Coptodon guineensis	1760	2.84	97.16	
Coptodon zillii	30	100		
Ctenopoma petherici	170	100		
Total	9000	65.44%	32.22%	2.33%

DISCUSSION

The results of this work showed free access to fishery resources in Dassoungboho lake. This free access gives rise to uncontrolled fishing practices (Koudou *et al.* 2020) responsible for the certain degradation of fish and their habitat (Kien *et al.* 2018). This situation generally results in the use of prohibited devices (Vanga 2013).

Indeed, for catching fish in Dassoungboho lake, fishermen prefer 85% traps because they are durable, lower cost, easy to handle and efficient (Kien 2016). Unfortunately, the mesh size of these traps, between 8 and 23 mm, is well below the minimum 45 mm recommended by Ivorian law. This practice is not only devastating for the resource (N'dri *et al.* 2020) but also reflects the absence of fishing service agents in the control field (Koudou *et al.* 2020).

The catches analyzed during this study made it possible to observe 21 species belonging to 8 families and 3 orders. The Cichlidae family (33.33%) and the *Synodontis bastiani* species (20.78%) appeared dominant in these captures. The predominance of Cichlidae and the species *Synodontis bastiani* observed in the present work could be explained by the successful progressive adaptation of these fish over time to the unfavorable conditions in this lake; notably the entry by runoff of inputs used by rice and market garden crops unlike other species. This same observation observed by Alhousseini (2002) led these authors to affirm that the specific composition of the catches of a given ecosystem reflects a good adaptation of the species that appeared dominant.

For this study, it is worth noting that specific richness is not the best indicator for assessing fishing pressure. In fact, no study of this type has previously been carried out on this lake to allow a comparison of specific richness.

According to Blanchard *et al.* (2004), the ABC method seems to effectively reflect changes in the structure of exploited populations. This method, applied to the fish assemblage of Dassoungboho lake, gives abundance and biomass curves which indicate a phase of stress in this lake. These observations show that this environment can be considered as a stressed ecosystem, according to the theoretical model of Warwick (1986).

According to Jennings *et al.* (1998), in aquatic environments, fishing exploitation is primarily carried out on k-strategy species. In this case, the proportion of large species logically decreases. In contrast, small species that are poorly exploited and freed from predation are developing (Daan *et al.* 2005). The population is then dominated by small species. In the locality of Dassoungboho, the impacts of fishing exploitation seem to have reached this level of modification of the population.

The results of the present study show that more than half of the species caught by fishermen in Dassoungboho lake (65.44%) are juveniles. This result indicates high fishing pressure on the fish assemblage of Dassoungboho lake.

This situation is linked to the low mesh size of the fishing gear (≤23 mm) most used in the lake. This observation should guide fisheries managers in their decision-making for sustainable management of the resource. Such an observation made on Ayamé lake by Ouattara *et al.* (2006) led these authors to propose the closure of fishing during the fish reproduction season. This measure, if applied in Dassoungboho lake, combined with strict control of gear mesh could limit the recruitment of juveniles in the northern reservoirs in general. This strategy will be more effective if it takes into account the political, administrative authorities, industry managers and fishermen. This participatory approach to managing the lake and its resources will allow better water monitoring.

Such an experience in the Bandama River made it possible, for example, to put an end to the conflict between fishermen and the manager of the fishing industry in the context of the daily weighing of fishermen's catches (Boguhé 2015).

CONCLUSION

The study of the state of exploitation of Dassoungboho lake shows that the majority of its ichthyological population is made up of Cichlidae and Mormyridae at the family level and *Synodontis bastiani* and *Coptodon guineensis* at the species level. The ABC method applied to this population showed that Korhogo lake is in a state of stress and these risks getting worse if no sustainable management measures are considered. This measure is all the more important as more than half of the fish caught on this lake are juveniles, thus confirming intensive exploitation of the resource. Given the economic interest in this fishing activity in this part of Ivory Coast, concerted management of this sector is proposed for sustainable exploitation of the resource with a view to limit the risks of a collapse of the settlement.

ACKNOWLEDGEMENTS

We would like to thank professional fishers operating on Korhogo (north of Ivory Coast) area for their help and cooperation. We are also grateful to the Fishery Office of Korhogo for providing useful data and assistance.

REFERENCES

Alhousseini S. 2002. *Le poisson, une nouvelle ressource au barrage de Manantali*. *In* : Gestion intégrée des ressources naturelles en zones inondables tropicales, Colloques et Séminaires (Orange D., Arfi R., Kuper M., Morand P. et Poncet Y., éds). Édition IRD, Paris, 501-513p.

Blanchard F., Leloc'h F., Hily C. *et al.* 2004. Fishing effects on diversity, size and community structure of the benthic invertebrate and fish mega fauna on the Bay of Biscay coast of France. *Marine Ecology Progress Series*, 280, 249-260p.

Boguhé G.F.D.H. 2015. *Biologie de la reproduction et exploitation de deux espèces de crevette du genre Macrobrachium : M. macrobrachion (Herklots, 1851) et M. vollenhovenii (Herklots, 1857) du fleuve Bandama (Côte d'Ivoire).* Thèse de Doctorat, Université Félix Houphouët-Boigny, Abidjan, Côte d'Ivoire, 206p.

Cecchi P., Lévèque C. & Aubertin C. 2007. *L'Eau en Partage : les Petits Barrages de Côte d'Ivoire*. Édition IRD: Paris; 295p.

Clarke K.R. 1990. Comparisons of dominance curves. *Journal of Experimental Marine Biology and Ecology*, 138, 143-157p.

COMHAFAT. 2014. *Industrie des pêches et de l'aquaculture en Côte d'Ivoire*, rapport n°7 de la revue de l'industrie des pêches et de l'aquaculture dans la zone de la COMHAFAT, 95p.

Da costa K.S. & Konan K.F. 2005. *Lac Kossou : Potentiel halieutique et Modalités d'un développement durable de la pêche*. FAO/ PMEDP, Projet Pilote Pêche Kossou GCP/INT/735/UK, Rapp. Expertise, 200 p.

Daan N., Gislason H., Pope J.G. *et al.* 2005. Changes in the North Sea fish community: evidence of indirect effects of fishing? *ICES Journal of Marine Science,* 62 : 177-188.

Grall J. 2006. *Synthèse des méthodes d'évaluation de la qualité du benthos en milieu côtier*. Ifremer DYNECO/VIGIES/06-13/ REBENT.

Halain C.F. 1950. *Réalisations de la Mission piscicole au Congo belge*. In C. R. Conférence piscicole anglo-belge. Elisabethville (Congo belge), 13-18 juin 1949, 337-342p.

Jennings S., Reynolds J.D. & Mills' S.C. 1998. Life history correlates of responses to fisheries exploitation, Proceedings of Royal Society. *Biology Sciences*, 265, 333-339p.

Kantoussan J. 2007. *Impact de la pression de pêche sur l'organisation des peuplements de poissons : Applications aux retenues artificielles de Sélingué et de Manantali, Mali Afrique de l'Ouest*. Thèse de Doctorat, Mention halieutique Agrocampus de Renne, France, 195p.

Kien K.B. 2016. *Activités de pêche sur le fleuve Bandama (Côte d'Ivoire) : impact sur l'organisation du peuplement de poisson du cours inférieur et conséquences socioéconomiques.* Thèse de Doctorat, Université Félix HOUPHOUËT-BOIGNY, Abidjan, Côte d'Ivoire 2016, 206.

Kien K.B., Kouamé K.A., N'Da A. S. *et al.* 2018. Exploitation durable du poisson sur le cours inferieur du fleuve Bandama (Côte d'Ivoire): contraintes et recommandations. *Journal of Applied Biosciences*, 125 : 12542-12550.

Kiossa C.C. 2011. *Diversité et exploitation de quelques espèces de poisson de la rivière sô au Bénin.* Mémoire de master Université Polytechnique de Bobo Dioulasso, Institut du Développement Rural.113p.

Koudou D., Kakou Y.S.C. & Sékongo L.G. 2020. Pêche dans le lac de Korhogo (Côte d'Ivoire) : acteurs, exploitation incontrôlée et signes de dégradation de la ressource halieutique. *DALAGEO*, 19 (002) : 8-19.

Koudou D.A. 2012. *La pêche sur le lac de Taabo*. Thèse de Doctorat, Université Félix HOUPHOUËT-BOIGNY, Abidjan, Côte d'Ivoire, 389p.

Le Guen T. 2002. *Les barrages du Nord de la Côte-d'Ivoire: développement socioéconomique et état sanitaire des populations.* Doctorat nouveau régime en Géographie, Université de Bretagne Occidentale, 467p.

Montchowui E., Tobada P., Chikou A. *et al*. 2008. *Caractéristiques et impact de la pêche artisanale sur l'exploitation de Labeo senegalensis (Valenciennes, 1842) dans la basse vallée du fleuve Ouémé au Bénin*. Rapport 45p.

N'dri K.M., Diaby M., Yao K. *et al.* 2020. La peche continentale au lac de Songori (region du Gontougo; Nord-Est de la C**ô**te D›Ivoire) Facteurs de production et niveau d›exploitation halieutique. *Agronomie Africaine*, 32 (3) : 353 - 363.

Ouattara M., Gourène G. & Vanga A.F. 2006. Propositions de fermeture saisonnière de la pêche en vue d'une exploitation durable du poisson au lac d'Ayamé (Côte d'Ivoire). *Tropicultura*, 24 (1) : 7-13.

Paugy D., Lévêque C. & Teugels G.G. 2003a. *Faune des poissons d'eaux douces et saumâtres de l'Afrique de l'Ouest.* Tome 1. IRD (Paris), MNHN (Paris), France, MRAC (Tervuren), 457 p.

Paugy D., Lévêque C. & Teugels G.G. 2003b. *Faune des poissons d'eaux douces et saumâtres de l'Afrique de l'Ouest*. Tome 2. IRD (Paris), MNHN (Paris), France, MRAC (Tervuren), 815 p.

PSDPA. 2014. *Diagnostic, stratégie de développement et orientations*. Plan Stratégique de Developpement de la Pêche et de l'Aquaculture en Côte d'Ivoire, Tome 1, 102 p.

Silué P. D. 2012. *Impact socio-spatial des retenues d'eau dans le Nord de la Côte d'Ivoire : cas de la région des Savanes.* Thèse de Doctorat Unique Université Félix Houphouët-Boigny, 330 p.

Tah L. 2012. *Exploitation du lac d'Ayamé I (Côte d'Ivoire) après le départ des pêcheurs « bozo » en 1998 et impact sur les structures démographiques des populations ichtyologiques.* Thèse de Doctorat, Université Félix HOUPHOUËT-BOIGNY, Abidjan, Côte d'Ivoire, 177 p.

Vanga A.F. 2004. Conséquences socio-économiques de l'expulsion des pêcheurs étrangers en Côte d'Ivoire : lacs d'Ayamé et de Buyo. *Revue Europeenne Des Migrations Internationales.*, 20 (1), 197-205p.

Vanga A.F. 2013. Acteurs locaux et peche lagunaire aux produits toxiques dans la sous-prefecture de grand-bassam (Côte d'Ivoire). Agronomie Africaine, 25 (3), 299 - 308p.

Warwick R.M. 1986. A new method for detecting pollution effects on marine macrobenthic communities. *Marine Biology*, 92, 557-562p.

Manuscrit reçu le 15/06/2023
Version révisée acceptée le 03/01/2024
Version finale reçue le 09/01/2024
Mise en ligne le 10/01/2024