



Journal Homepage: -[www.journalijar.com](http://www.journalijar.com)

## INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/17281  
DOI URL: <http://dx.doi.org/10.21474/IJAR01/17281>



### RESEARCH ARTICLE

#### INVENTORY OF AQUATIC MOLLUSCS IN THE SOUBRE RIVER-LAKE DAM AREA TO ASSESS THE BIOLOGICAL STATUS OF THIS AQUATIC ECOSYSTEM (SASSANDRA RIVER, COTE D'IVOIRE, WEST AFRICA)

Gougloin Touamin Hugues Esmel<sup>1</sup>, Dietoa Yehe Mathieu<sup>1</sup> and Tah Leonard<sup>2</sup>

1. Laboratoire d'Environnement et de Biologie Aquatique (LEBA), UFR-Sciences et Gestion de l'Environnement (SGE), Université Nangui Abrogoua (UNA), 02 BP 801, Abidjan 02, (Côte d'Ivoire).
2. Centre de Recherches Océanologiques (CRO), BPV 18 Abidjan, Côte d'Ivoire.

#### Manuscript Info

##### Manuscript History

Received: 20 May 2023  
Final Accepted: 24 June 2023  
Published: July 2023

##### Key words:-

Molluscs, Biological State, Lake, Population, Abundance, Diversity, Soubre and Cote D'ivoire

#### Abstract

The aim was to study the population dynamics of aquatic molluscs in relation to abiotic variables in the fluvio-lacustrine zone of the Soubré hydroelectric dam, in order to determine its bioecological status. The Mollusc class and physico-chemical parameters were sampled monthly in two periods, the first from July 2019 to February 2020 and the second from March 2021 to June 2021 at six (06) sampling stations. The total abundance was 16,885 individuals divided into 16 taxa belonging to two (02) classes, five (05) orders and ten (10) families were identified. The stations located in the lake recorded the highest number of individuals, while the TIE station (Tiémé, 13 taxa) located in the fluvial environment was the most diverse of all the sampling sites. Taxa such as *Melanoïdes tuberculata*, *Indoplanorbis exustus* and *Viviparus* sp. appeared frequently in all the sampling stations. Focused Principal Correspondence Analysis (FPCA) revealed that turbidity, TDS and dissolved oxygen had a strong influence on the abundance of molluscs at the sites studied. Several species studied in our environment are important intermediate hosts of parasites, in particular Planorbidae (*Indoplanorbis exustus*), which represents a potential risk to public health. However, three invasive taxa, *Aplexa marmorata*, *Indoplanorbis exustus* and *Melanoïdes tuberculata* were collected. The biological condition of the sampling sites was generally good. Assuming that the ecological state of the sediments in the lake environment is not yet damaged.

Copy Right, IJAR, 2023., All rights reserved.

#### Introduction :-

Molluscs are one of the major groups of phyla in the animal kingdom. These animals have a soft body, but may have a shell. However, the body of a mollusc is subdivided into three parts: the head, the foot and the visceral mass. The head contains the sensory organs. Molluscs can be distinguished from other aquatic organisms by the presence of a calcareous shell made up of a single part in the case of gastropods and two articulated parts in the case of bivalves (Lévêque, 1972). Molluscs are triploblastic metazoans with primitively bilateral symmetry; they have a coelom (Curtis H., *et al.*, 2008). This phylum is made up of eight classes, seven of which are still extant and one extinct: Solenogastres, Caudofoveates, Polyplacophores, Monoplacophores, Cephalopods, Bivalves, Scaphopods and

Gastropods (Hickman C. *et al.*, 2000 ; Vielma H. 2013). However, only two classes are found in freshwater. They are generally classified into two categories, according to the nature of their shells: Gastropods and Bivalves (Lamellibranchs). As well as playing an essential ecological role (and providing ecosystem services), molluscs are also known to be intermediate hosts for a number of microbes and vectors of several diseases.

Since the early 20th century, biologists have relied on aquatic macroinvertebrates to assess environmental quality (Chapman *et al.*, 1982). However, molluscs occupy a prominent place among the aquatic organisms suitable for biological monitoring (Goldberg, 1986; Salanki, 1989) and are often used for passive and active biomonitoring. They are also used to determine the risks and hazards to which an aquatic ecosystem may be exposed (Borcherding & Volpers, 1994; Allan J. D. & Flecker, 1993 ; Kiblut, 2002). Human activities exert pressures that have multiple impacts on aquatic environments. However, molluscs are subject to both natural (currents, changes in salinity, flooding, etc.) and anthropogenic (contamination, habitat destruction, fishing pressure, etc.) pressures in the fluvio-lacustrine zone of the Soubré dam. Furthermore, it is generally thought that macroinvertebrates living in rivers are distributed according to environmental factors (Minshall & Robinson, 1998). They are therefore interesting organisms for characterising the biological state of the aquatic environment, in order to monitor contamination and assess its effects. In order to assess the biological state of the environment using molluscs, a study was carried out in the fluvio-lacustrine zone of the Soubré hydroelectric dam. The recently built Soubré hydroelectric dam is located on the Sassandra River in western Côte d'Ivoire.

Little information is available on the ecology of molluscs in the Ivorian lake environment. This study therefore aims to show the population dynamics of the aquatic mollusc community in relation to environmental variables in the fluvio-lacustrine zone of the Soubré hydroelectric dam in order to assess its biological status.

## **Materials and Methods**

### **Sampling site**

The fluvio-lacustrine zone of the hydroelectric dam that was the subject of our study is located in the Soubré department in western Côte d'Ivoire. The stations were chosen taking into account the criteria of accessibility, the occupation of the surrounding perimeter and the ecological particularity established according to the type of habitat of the site. These choices were defined following a survey carried out in the fluvio-lacustrine zone of the Soubré hydroelectric dam in June 2019. To do this, it was necessary to take into account the type of occupation of the nearby slope as well as the physiognomy of the banks at each sampling station. However, six sampling stations were selected (Figure 1) in the fluvio-lacustrine zone of the Soubré hydroelectric dam. It should be noted that at the various sampling stations, two points were defined for stations (TIE, PON and KAR) in the river environment, given its steep slope, and five (05) points were defined radially for stations (AMA, GNA and KPE) in the lake environment.

**-Tiémé (TIE)** is a station located in the fluvial zone upstream of the Sassandra River. The station's geographical coordinates are: 05°52'18.02" North and 06°43'19.8" West. The bank of this site is deep, with a substrate of clay and sand. It is a station covered with forest dance.

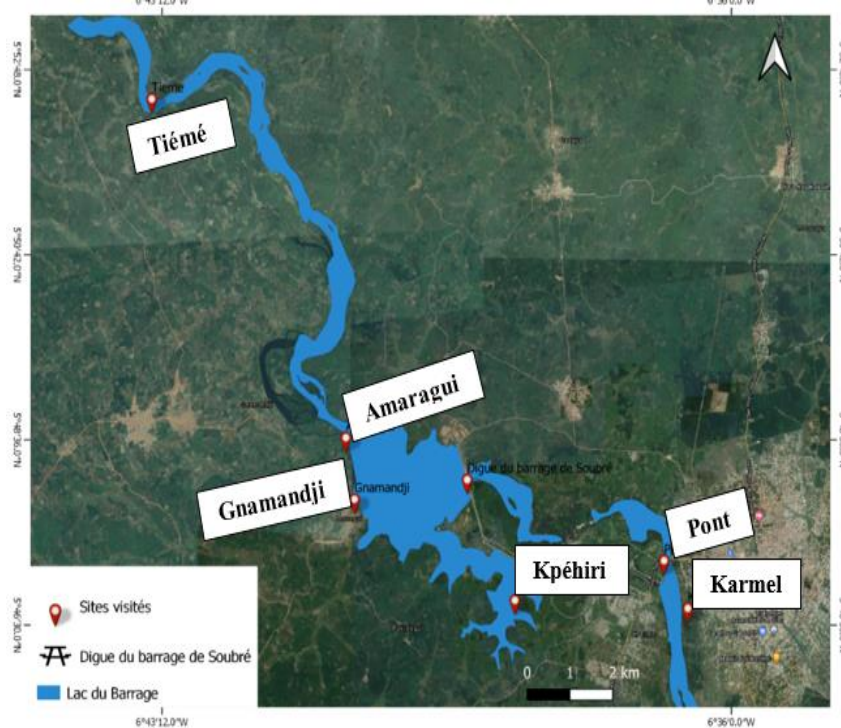
**-Amaragui (AMA)** is the station located in the upstream zone of the lake with geographical coordinates of 05°48'20" North and 06°43'09" West. It is an intermediate environment between the lake and the fluvial part of the Sassandra River. The substrate at this station is made up of sand and clay. This area is covered by rubber and cocoa plantations. This zone is largely covered by aquatic vegetation.

**-Gnamandji (GNA)** is located in the median zone of the lake, in geographical position 05°46'57"North and 06°36'08"West. The station's substrate is clay and sand. This station is located near a village that bears its name. There is a fish landing site that records the daily presence of humans. The body of water is covered by aquatic vegetation.

**-Kpéhiri (KPE)** is located in the lower reaches of the lake in a floodplain with a sandy bed at 05°46'82"North and 06°38'74"West. The banks are made up of sandy-clay materials with a very gentle to steep slope in places. The bed has a sandy bottom. The vegetation consists of very degraded forest, cocoa and rubber plantations and yam fields.

**-Pont (PON)** is a station located in the lower part of the river not far from the town of Soubré at the following geographical coordinates: 05°47'16.5 "North and 06°36'51 "West. This site is located near a PON. The substrate of this biotope is sand. The plant cover of the bank is mainly composed of Poaceae (*Echinochloa pyramidalis*). The water is clear during the study period and the bottom of the water is visible. Around the site, there are maize fields and domestic debris close to the bank. The bank has a very gentle slope.

-**Karmel (KAR)**, this station located near the town of Soubré, is one of the stations located in the river zone. The geographical coordinates of this site are: 05°46'44 "North and 06°36'33 "West. The substrate at this station is made up of sand and clay. Maize fields, dwellings and domestic debris are close to the bank of the station. The bank has a steep slope.



**Figure 1:-** Location map of the Soubré dam fluvio-lacustrine sampling zone (Ivory Coast): Tiémé = **TIE** ; Amaragui = **AMA** ; Gnamandji = **GNA** ; Kpéhiri = **KPE** ; Pont = **PON** ; Karmel = **KAR**

### Mollusc sampling

The collection of aquatic molluscs from the six stations was carried out monthly, but in two phases: from July 2019 to February 2020 and the second phase from March to June 2021. Given the extent of the plant cover in the sampling zones (littoral and sublittoral), the 12 shots of nets and Van Veen grab nets recommended by the European Union's Water Framework Directive (WFD), taking into account the potential habitats of the molluscs, were divided equally between the mud and the herbaceous zones. Stations located in the lake environment had five sampling points (at 1, 2, 3 and 4 m depth) in addition to bank sampling, while stations in the fluvial part of the study environment had two sampling zones (bank and at 1 m depth). Molluscs were collected at the sublittoral level of the various sites using a Van ven grab. Surface species (shoreline) were also caught using a haze net. At each site, four (04) sediment samples corresponding to a total surface area of 0.25 m<sup>2</sup> were taken at various depths (from 1 to 4 m). On leaving the water, the contents were washed on a 0.5 mm sieve. All samples were fixed in 70% alcohol. In the laboratory, all samples were sorted using a binocular microscope, counted and identified to the lowest taxonomic level using the appropriate key (Dejoux *et al.*, 1981; Mary, 2000).

During each sampling mission, the sites were characterised by measuring water temperature (°C), turbidity (NTU), pH, conductivity (µS/cm) and dissolved oxygen (mg/l) using a multiparameter.

### Data analysis

The aquatic mollusc data were analysed using methods with simple and multivariate variables.

-The percentage of occurrence provides information on the habitat preferences of a given species. According to Hyslop (1980), this is the number of the species that is counted each time the species appears in the samples. It is calculated as follows:  $F = F_i * 100 / F_t$ , where:  $F_i$  = number of samples containing species  $i$ ;  $F_t$  = total number of samples obtained. Depending on the value of  $F$ , three groups of species are distinguished: constant species ( $F \geq 50\%$ ); accessory species ( $25\% \leq F < 50\%$ ); accidental species ( $F < 25\%$ ).

-Shannon-Weaver diversity (H) is the degree of complexity of a stand. It is expressed by an index that integrates both the richness of the stand and the specific abundances. It is used to express the structure of the population and to characterise the equilibrium of the population in an ecosystem. The Shannon index is calculated as follows:  $H' = -\sum P_i \log_2 P_i$  or  $P_i = N_i / N$ .  $N_i$  = number of species  $i$ ,  $N$  = total number of species and  $\log_2$  = logarithm to the base of 2.

-Pielou's equitability index (J) expresses the distribution of Mollusc individuals between species in the same environment. For this study, Pielou equitability was calculated using Shannon-Weaver index data. The RStudio software was used to calculate the Pielou index (J) using the following formula:  $E = H' / H'_{\max}$  or  $H'_{\max} = \log_2 S$  ( $H'$  = Shannon-Weaver index.  $S$  = Specific richness).

-Sorensen's similarity index (S) was calculated to assess the similarity of taxonomic richness of aquatic molluscs between the different sampling stations. Sorensen's similarity index was calculated to assess the similarity of taxonomic richness of aquatic molluscs between the different sampling stations.

IS : Sorensen's coefficient of similarity

T1 : number of taxa in environment 1

T2 : number of taxa in environment 2

T : number of taxa common to environments 1 and 2

$$IS = \frac{2T}{T_1 + T_2} \times 100$$

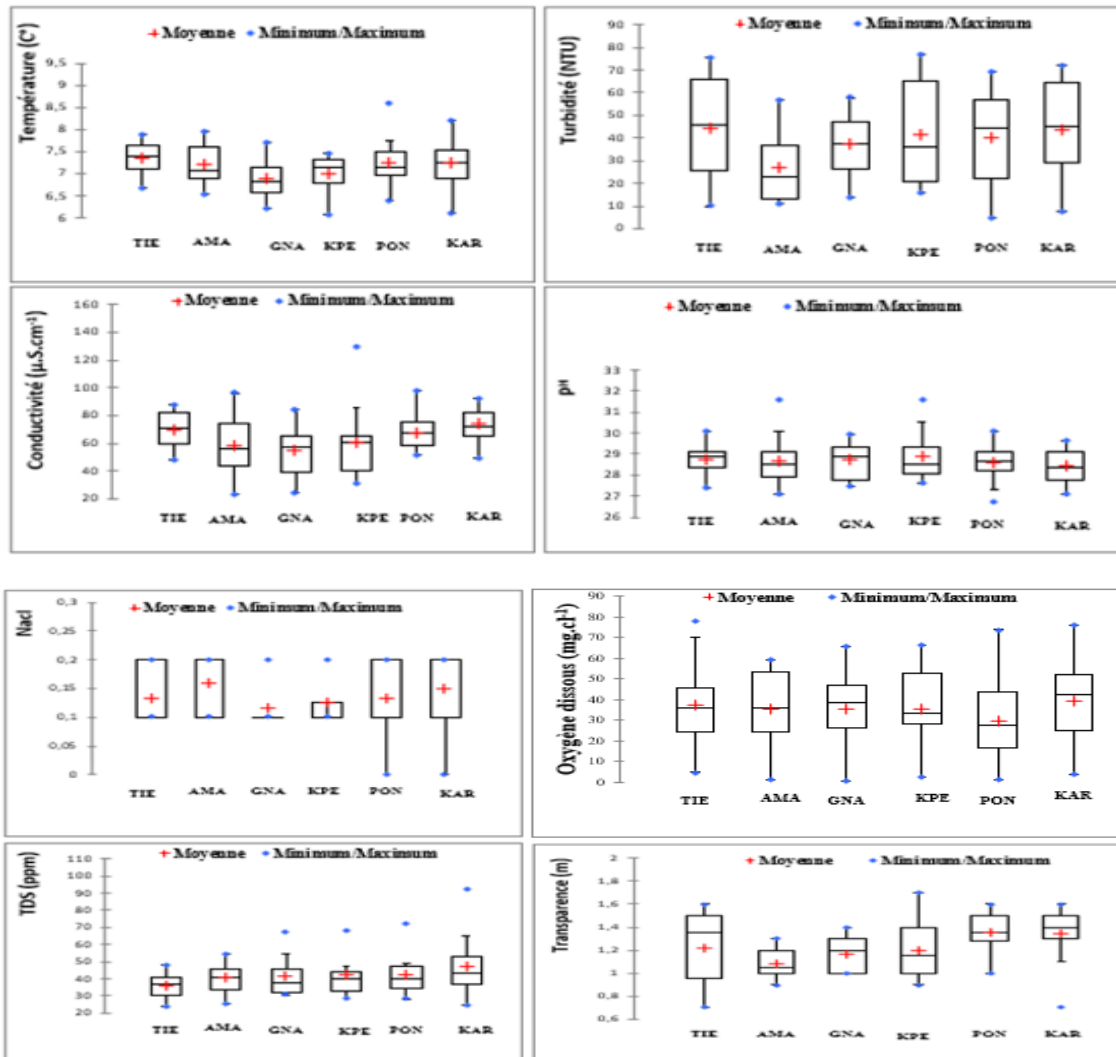
-In this study, a Focused Principal Correspondence Analysis (FPCA) was carried out on the basis of environmental parameters, focusing on the most abundant taxa of molluscs collected from river-lake stations, to determine the abiotic variables that significantly influence the abundance of the main taxa. This analysis was carried out using the "psy" package [13]. The normality of the various abiotic and biotic data was verified using the Shapiro-Wilk test [14]. The Kruskal-Wallis test was then used to test the variability of the parameters and indices between the different groups of stations when the distribution of variables did not meet one of the conditions for the use of a classic ANOVA.

-The Malacological Index of Overall Quality of Lake Systems (IMOL) was applied to the data from the stations studied. In this study, the IMOL was adapted to assess the biological status of the water based on sediment samples from all the stations. An adaptation of this index will be made in this study because of the maximum depth of the fluvio-lacustrine environment, which is 25 metres. The purpose of the IMOL is to assess the overall biological state of a natural body of water (lake, lagoon) with a maximum depth of between 10 and 30 metres. Once the IMOL value has been determined, the WFD (2011) proposes the biological status classes listed in Table VI to assess the biological status of the water. Each class is assigned a colour.  $IMOL \geq 8$  =Very good (Blue),  $7 \leq IMOL < 8$  =Good (Orange),  $4 \leq IMOL \leq 6$  =Average (Yellow),  $1 \leq IMOL < 4$  =Mediocre (Green) and  $0$  =Poor (Red).

## Results:-

### Environmental variables

The spatial variations in the environmental parameters of the water in the fluvio-lacustrine zone are illustrated in Figure 2. The lowest temperature (26.6°C) was recorded at the PON station, while the highest value (31.6°C) was observed at the AMA station located in open water. The lowest conductivity value (23.4  $\mu\text{S}/\text{cm}$ ) was recorded at the TIE station upstream of the river part of the study area in March, while the KPE station downstream of the lake environment had the highest value (129.5  $\mu\text{S}/\text{cm}$ ) in May. At all the stations studied, the pH ranged from 6.08 to 8.6. The lowest pH value was recorded at the KAR station (near the town of Soubré), while the highest was recorded at PON, also near a maize field downstream of the KAR station. The minimum dissolved oxygen content (0.9 mg/cl) was obtained at the GNA station near the village and the maximum (78 mg/cl) at the TIE station on the river. Turbidity was highest (71 NTU) at the KPE station and lowest (4.95 NTU) at the PON station. The TDS value of the water in the fluvio-lacustrine zone of the Soubré dam varies between 23.9 (TIE station) and 92.4 ppm (KAR station). Analysis of the transparency of the water at the six sampling points reveals that the PON and KAR stations had the lowest value (0.7 m), while the KPE station recorded the highest value (1.7 m). Variations in NaCl concentrations in the study area ranged from 0 to 0.2. There was no significant difference between variations in physico-chemical parameters from one station to another (Kruskal-Wallis test,  $p > 0.05$ ).



**Figure 2:-** Spatial variations in the physico-chemical parameters of the water in the fluvio-lacustrine environment of the Soubré hydroelectric dam lake.

### Composition and distribution of molluscs

In the fluvio-lacustrine zone of the Soubré dam, the total abundance: 16885 individuals of aquatic molluscs were caught during the sampling period. Spatially, 1526 at TIE, 4284 at AMA, 3961 at GNA, 3808 at KPE, 1314 at PON and 1992 at KAR were sampled. This population of Molluscs is largely dominated by the Gastropod class, which accounts for 99% of the organisms collected. The Bivalve class accounted for 01% of the individuals sampled. The Mollusca phylum was identified (Table I), divided into five (5) orders, 10 families and 16 taxa. The Bivalve class includes two orders, two families and three taxa. The Gastropoda class contains three (3) orders, eight (8) families and 13 taxa. In this last faunal group, the Thiaridae family is the most abundant with 6260 individuals, or 37.07% of the Molluscs, and is also abundant in all the sampling stations. It is followed by the Viviparidae family (22.3%) and then the Planorbidae family, which accounts for 14.10% of the samples. On the other hand, the Lymnaeidae, Hydrobiidae and Sphaeriidae are less represented, with 2.71%, 01.51% and 00.38% of the individuals collected respectively.

In terms of diversity, the order Basommatophres recorded more taxa (07) compared with six for the order Mesogasteropoda. Table II shows the numbers of different aquatic molluscs collected at each of the sampling sites. Figure 2 shows the composition and distribution of the 15 mollusc taxa sampled at the six macroinvertebrate sampling sites.

Table II presents the taxonomic richness and the Shannon-Weaver Index (H) and Pielou Equitability Index (J). In the lacustrine environment, i.e. at AMA, GNA and KPE, abundance was twice as high as at stations in the fluvial zone (TIE, PON and KAR). The TIE station recorded 15 taxa, making it the site with the highest number of taxa collected during the study. It is followed by the GNA station with 13 taxa, then AMA where 12 taxa were sampled in this biotope. Stations KAR and PON came next with 11 and 09 taxa respectively. TIE has (2.02) the highest Shannon\_H Index and the lowest was obtained at the PON site (1.62). The Pielou Equitability Index shows a net variation from 0.53 (KPE) to 0.50 (KAR).

Sorensen's Similarity Indices were calculated and recorded in Table III. The highest Sorensen's Index (96%) was obtained between TIE and AMA, while the lowest (45.54%) during this study was found between the PON and KPE sites. There was a significant variation in the Shannon-Weaver index (H') from one station to another (Kruskal-Wallis test,  $p < 0.05$ ).

A Principal Correspondence Analysis (PCA) was carried out to highlight the correlation between the stations and the abundance of the main families of Molluscs in the fluvio-lacustrine zone of the Soubré hydroelectric dam (Figure 3). The Monte Carlo permutation test indicates that the result of this analysis is significant ( $p < 0.05$ ). Axis I expresses 68.53% of the information, while axis II expresses 17.74%. The first two axes represent 86.27% of the total variability. Analysis of the graph shows that axis I is positively correlated with Planorbidae, Physidae, Corbulidae and Thiaridae. Axis II is positively correlated with the Sphaeridae family.

A Focused Principal Component Analysis (FPCA) was then carried out on the basis of the environmental parameters, focusing on the most abundant mollusc taxa. The FCA revealed that the species *Lanites varicus* was positively correlated with abiotic parameters such as TDS and NaCl, but negatively correlated with temperature, transparency, conductivity, pH, turbidity and dissolved oxygen. The distribution of this taxon was significantly influenced ( $P < 0.05$ ) by pH and dissolved oxygen. *Physa marmorata* was negatively correlated with all physico-chemical parameters. This taxon was significantly influenced by dissolved oxygen, pH, conductivity and transparency. The taxon *Indoplanorbis exustus* was negatively correlated with transparency, temperature, NaCl, pH, dissolved oxygen and conductivity and positively correlated with turbidity and TDS. The abundance of this taxon was significantly influenced by conductivity alone. *Melanoides tuberculata* was negatively correlated with transparency, conductivity, temperature, TDS, turbidity and NaCl, and positively correlated with dissolved oxygen and pH. This taxon was significantly influenced by conductivity, pH, transparency and dissolved oxygen. In contrast, the taxon *Viviparus sp.* is negatively correlated with transparency, conductivity, temperature, pH and NaCl and positively correlated with dissolved oxygen, TDS and turbidity. This taxon was significantly influenced by conductivity and transparency (Figure 5).

Table IV summarises the presence/absence of molluscs taken into account in calculating the Malacological Index of Overall Quality of Lake Systems (IMOL). A total of 11 taxa were collected in the sediment (benthos) of the various stations in the fluvio-lacustrine zone of the Soubré hydroelectric dam. Two of the taxa belonged to the Bivalve class and nine (09) to the Gastropod class. Stations AMA and GNA recorded the largest number (09 taxa) of Mollusca taxa, while station KPE recorded eight (08) taxa. Stations TIE and KAR recorded seven (07) taxa each, while station PON recorded five (5) taxa, the lowest taxon richness value.

Table V shows the spatial variations in IMOL and the biological state of the sediments (benthos) at the six (06) sampling stations in the fluvio-lacustrine environment of the Soubré dam. The AMA, GNA and KPE stations recorded IMOL values of 9 and 8 respectively. These values indicate a very good biological status for these sampling stations. However, the TIE and KAR stations each recorded an IMOL value of 7. The IMOL values for these stations indicate good biological status. While the PON station recorded a value of five (05), this site is in average biological condition. Consequently, of the six sampling stations, three (03) have very good biological status, two (02) have good biological status and one (01) has average biological status.

**Table I** :-Compositions and frequencies of occurrence of mollusc taxa in the different sampling stations in the fluvio-lacustrine zone of the Soubré dam.

Classes	Orders	Families	Taxa	Acro	Sampling stations					
					TIE	AMA	GNA	KPE	PON	KAR
Bivalves	Myids	Corbulidae	<i>Corbula gibba</i>	Corgi	*	-	*	**	-	-
			<i>Corbula trigona</i>	Cotri	**	***	*	**	-	*
	Venoroides	Sphaeriidae	<i>Pissidiuim punetifera</i>	Pipu	**	**	-	-	**	-
Gastropods		Lymnaeidae	<i>Lymnaea natalensis</i>	Lyna	*	**	**	**	*	*
		Physidae	<i>Aplexa marmorata</i>	Apma	-	-	-	-	*	-
			<i>Physa marmorata</i>	Phyma	**	***	**	***	-	**
	Basommatophres	Planorbidae	<i>Afrogonus sp.</i>	Afro	-	*	-	**	**	**
			<i>Biomphalaria pfeifferi</i>	Biop	*	**	**	**	-	**
			<i>Bilinus globosus</i>	Biglo	-	*	*	-	-	*
			<i>Indoplanorbis exustus</i>	Inex	***	***	***	***	***	**
	Littorinimorphs	Hydrobiidae	<i>Hydrobia gabonensis</i>	Hyga	*	-	**	*	*	-
		Ampullariidae	<i>Lanites varicus</i>	Lava	**	***	***	***	**	***
	Mesogasteropoda	Bithyniidae	<i>Gabbiella africana</i>	Gaaf	*	***	***	**	*	**
		Thiaridae	<i>Melanoides tuberculata</i>	Metu	***	***	***	***	***	***
			<i>Potadoma liricincta</i>	Poli	*	-	*	-	*	*
		Viviparidae	<i>Viviparus sp.</i>	Vivi	***	***	***	***	***	***

Tiémé = **TIE** ; Amaragui = **AMA** ; Gnamandji = **GNA** ; Kpéhiri = **KPE** ; Pont = **PON** ; Karmel = **KAR**

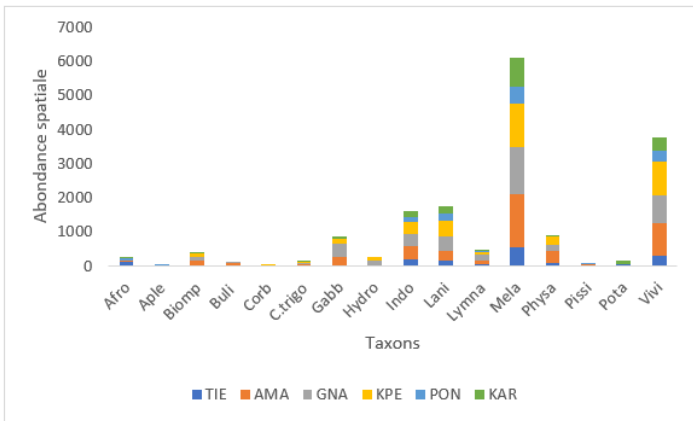


Figure 3 : Spatial abundance of mollusc taxa sampled

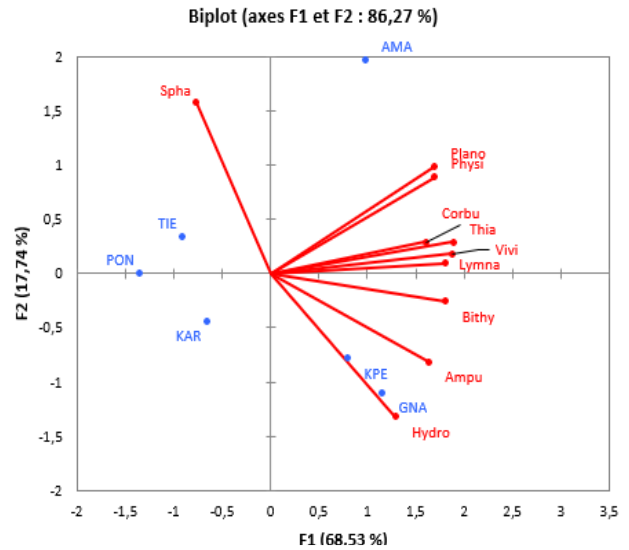


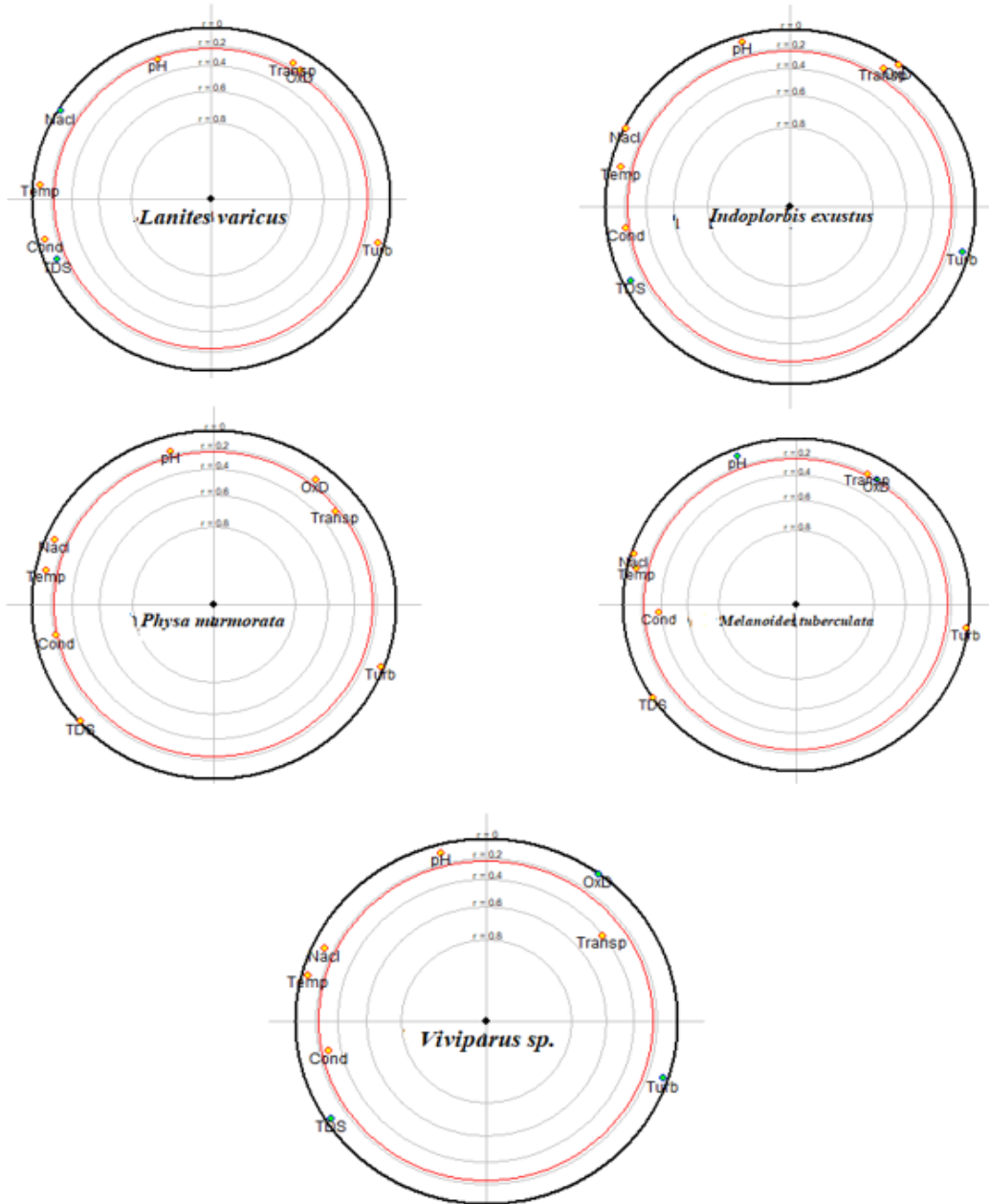
Figure 4 : Principal Correspondence Analysis (PCA) of taxa and sampling stations

Table II: Spatial variations in relative abundance, taxonomic richness, Shannon-Weaver Index\_H and Equitability\_J of taxa at sampling sites

	Sampling stations					
	TIE	AMA	GNA	KPE	PON	KAR
Individuals	1526	4284	3961	3808	1314	1992
Taxonomic richness_s	15 <sup>a</sup>	12 <sup>a</sup>	13 <sup>a</sup>	11 <sup>a</sup>	09 <sup>a</sup>	11 <sup>a</sup>
Shannon-Weaver_H	2,01 <sup>b</sup>	1,87 <sup>b</sup>	1,92 <sup>ab</sup>	1,82 <sup>b</sup>	1,65 <sup>a</sup>	1,74 <sup>ab</sup>
Equitability_J	0,51 <sup>a</sup>	0,52 <sup>a</sup>	0,52 <sup>a</sup>	0,53 <sup>a</sup>	0,52 <sup>a</sup>	0,50 <sup>a</sup>

Table III:- Sorensen index values for taxonomic similarity of molluscs between stations.

	TIE	AMA	GNA	KPE	PON	KAR
TIE						
AMA	96					
GNA	92,85	80				
KPE	84,61	78,26	91,66			
PON	66 ;66	66,66	45,54	50		
KAR	84,61	78,26	83,33	81,81	70	



**Figure 5:-** Focused Principal Component Analysis (FPCA) based on the four most abundant macroinvertebrate taxa as dependent variables and physico-chemical parameters as independent variables. Yellow dots indicate abiotic parameters that are negatively correlated with taxon abundance, while green dots indicate those that are positively correlated with taxon abundance. The points inside the red circle represent the parameters significantly correlated ( $P < 0.05$ ) with taxon abundance (*Melanoides tuberculata*, *Lanites varicus*, *Indoplorbis exustus*, *Viviparus sp.*, *Physa marmorata*, Transp = transparency, Temp = temperature, Cond = conductivity, OxD = dissolved oxygen, pH = hydrogen potential, Nacl, TDS = solid content, Turb = turbidity).

**Table IV:-** Sedimentary molluscs (benthos) at IMOL stations.

Stations	IMOL indices	Biological condition
TIE	7	Good
AMA	9	Very Good
GNA	9	Very Good
KPE	8	Very Good
PON	5	Average
KAR	7	Good

**Table V:-** Spatial variations in the IMOL index and biological states.

Tiéomé = **TIE** ; Amaragui = **AMA** ; Gnamandji = **GNA** ; Kpéhiri = **KPE** ; Pont = **PON** ; Karmel = **KAR**

Classes	Taxa	Sampling stations					
		TIE	AMA	GNA	KPE	PON	KAR
Bivalves	<i>Corbula trigona</i>		+		+		
Gastropods	<i>Pissidium punetifera</i>	+	+			+	
	<i>Melanoides tuberculata</i>	+	+	+	+	+	+
	<i>Lanites varicus</i>		+	+	+	+	+
	<i>Lymnaea natalensis</i>		+	+	+		+
	<i>Afrogonus sp.</i>	+		+			
	<i>Gabbiella africana</i>		+	+	+		+
	<i>Hydrobia gabonensis</i>	+		+			
	<i>Physa marmorata</i>	+	+	+	+		+
	<i>Indoplanorbis exustus</i>	+	+	+	+	+	+
	<i>Viviparus sp.</i>	+	+	+	+	+	+
<b>Total taxa</b>		7	9	9	8	5	7

### Discussion:-

In the fluvio-lacustrine zone of the Soubré dam, analysis of the physico-chemical parameters revealed that these variables : pH (hydrogen potential), temperature, dissolved oxygen, turbidity, sodium chloride content (NaCl), transparency, conductivity and dissolved solids content (TDS) did not vary significantly between the sampling sites. However, the high turbidity value recorded at the KPE station is thought to be the result of numerous human activities, namely the intensification of agriculture and fishing. Upstream of the lake, at the TIE station in particular, parameters such as hydrogen potential (pH), dissolved oxygen and transparency recorded higher values. Intensive human activity (illegal gold panning and cocoa fields) was regularly observed on this site and in the surrounding area. However, downstream of the river, at the PON station, low dissolved oxygen and temperature values were observed during our study. On the other hand, the conductivity value recorded at this site was higher than at the other sites, because minerals (ions) are abundant in this part of the river. This could be justified by the fact that aquatic vegetation has completely covered this part of the river. Conductivity is used to determine the presence of minerals, as well as all the other more or less harmful ions in the water column (Wetzel, 1993). As for KAR, the turbidity value was higher, as the dissolution of particles in the water could be due to a number of anthropogenic activities (leaching, cornfields and fishing) in the area. Detergents, which probably also come from wastewater from nearby settlements, contain phosphorus, the excess of which leads to eutrophication of the water (Valente *et al.*, 1997). At the GNA station, low conductivity and pH values were recorded. At this station, which is located next to a village that bears its name, a number of human activities are carried out on a daily basis. Whatever the station, the temperature recorded in the fluvio-lacustrine environment is always above 26°C. The waters in this study area are relatively warm. Our results corroborate those of Diétoa (2002) on Lake Ayamé and Ouattarra (2015) on Lake Kodjoboué (Côte d'Ivoire). The variation in temperature and dissolved oxygen could be linked to the absence of plant cover on the lake. Transparency varies between 0.6 and 1.70 m in the fluvio-lacustrine zone of the Soubré dam. These values are roughly equal to those observed (7.3 and 1.12 m) at Lake Ayamé on the Comoé River by Diétoa (2002).

In the course of this study 16 species of freshwater molluscs grouped into eight (8) families (Corbulidae, Sphaeriidae, Lymnaeidae, Planorbidae, Hydrobiidae, Ampullariidae, Bithyniidae, Thiaridae and Viviparidae) were recorded. Our results are very much in line with previous studies of aquatic molluscs by Allouko *et al* (2018) on the Aghien lagoon and Kabré *et al* (2000 and 2002) on the Bagré and Comoé dam lakes respectively, which report that Gastropods are the most dominant communities in terms of diversity and abundance in the freshwater mollusc phylum. This specific diversity of Molluscs is higher than that obtained in Lake Taabo (04) by Ouattara (2015). Spatial taxonomic diversity varied between 09 and 15 in the study area, and there was no significant difference in taxonomic richness between the stations where aquatic molluscs were collected (Kruskal-Wallis test,  $p < 0.05$ ). However, the TIE station recorded the highest taxonomic diversity, as this site is located in the natural environment of the study area. Table 3 shows the variation in the Pielou Equitability Index (J) for the six (6) sites. However, there is a slight difference between the river stations and the lake stations, although this difference is not statistically significant. On the other hand, the Shannon-Weaver index showed a significant difference between the harvesting sites. The Shannon-Weaver index (H) at the PON station was significantly different from the other sampling sites. Fisher *et al* (1982) put forward the principle that the higher the environmental conditions, the higher the diversity index. The taxonomic level reached in our study did not allow us to observe this significant difference at the Soubré dam lake.

Focused Principal Component Analysis (FPCA) indicates that dissolved oxygen, turbidity and dissolved solid content (DSC) significantly influence the abundance of aquatic mollusc taxa. Our results do not corroborate those of Soro (2021) who noted that only dissolved oxygen significantly influenced taxa in Lake Blondey (Côte d'Ivoire). The quantity of dissolved oxygen, TDS, turbidity and water temperature are therefore positively or negatively correlated with the abundance of mollusc taxa collected. Bond & Downes (2003) have shown that the composition and organisation of aquatic macroinvertebrate communities are influenced by the physico-chemical characteristics of the water.

Macroinvertebrates are an indicator of the biological state of an ecosystem, with the various species showing a wide variety of responses to organic pollution (of natural or anthropogenic origin), and this has been demonstrated many times in rivers and lakes (Rosenberg & Resh, 1993; Karr & Chu, 1999 ; Gnohossou, 2006). In this study, the assessment of water quality concerned the molluscs in the sediment of the stations sampled, with the aim of highlighting the disparities linked to the possible intermediate disturbances essential to the human activities in the fluvio-lacustrine zone of the Soubré hydroelectric dam. The ecological quality assessment based on the Malacological Index of Overall Quality of Lake Systems (IMOL) at the stations in the river-lake zone of the Soubré hydroelectric dam varies between 5 and 9. These values indicate average and very good condition respectively. The stations located in the fluvial environment have lower IMOL values indicating an average biological condition of the water. This could be explained, on the one hand, by the availability of conditions favourable to the development of pollutant-resistant indicator taxa such as the Thiaridae and, on the other hand, by the relative shallowness of certain sampling zones. The high IMOL values recorded at the stations located in the lake can be explained by the taxonomic composition of the benthic populations in the study environment, particularly the presence of Bivalve and Gastropod taxa in the sediment taken from these stations.

### **Conclusion:-**

The study enabled us to draw up an initial inventory of the mollusc community in the fluvio-lacustrine zone of the Soubré dam and to gain knowledge of the spatial dynamics of this community and the biological state of this ecosystem. The results relating to abiotic parameters do not reveal any significant variation. The taxonomic composition of the Molluscs shows the presence of 16 taxa, 13 of which belong to the Gastropod class, which is the most diverse, and three (03) to the Bivalve class. The degree of organisation of the molluscs in the study area was analysed using the Shannon-Weaver diversity index (H), the Pielou equitability index (E) and the Sorensen similarity index. The TIE station, with the maximum value of the diversity index ( $H : 2.01$  bits/individual) appears to be the most diverse station, while the maximum value of equitability ( $E : 0.53$ ) is noted at the KPE station, which is the most stable and best organised. The highest value (96%) of the taxonomic similarity index was estimated between stations TIE and AMA, while the lowest value (45.54%) was observed between stations PON and GNA. At the ecological level, the ACPF mentions that the abiotic parameters: dissolved oxygen, turbidity and dissolved solid content (TDS) significantly influence the abundance of the main taxa of aquatic molluscs in the study environment. The IMOL indicates that the sediment waters at the three sites located in the middle of the lake are of very good biological condition, while those in the natural river bed are of good ecological quality.

**Bibliographical References:-**

1. Allan J. D. & Flecker A. S. (1993). Biodiversity conservation in running waters : identifying the major factors that threaten destruction of riverine species and ecosystems, *Biosciences* 43(1), 32-43.
2. Bond N. R. & Downes B. J. (2003). The independent and interactive effects of fine sediment and flow on benthic invertebrate communities characteristic of small upland streams. *Freshwater Biology*, 48 : 455-465.
3. Borchering J. & Volpers M. (1994). The "Dreissena-Monitor". First results on the application of the biological early warning system in the continuous monitoring of water quality. *Water Science and Technology*, 29, 99-201.
4. Chapman, P. M., Farrell M. A. & Brinkhurst, R. O., (1982). Relative tolerances of selected oligochaetes to individual pollutants and environmental factors. *Aquatic Toxicology*, 2, 47-67.
5. Curtis H., Barnes N., Schnek A. & Massarini A. (2008). *Biología*. Editorial Médica Panamericana. Madrid.
6. Diétoa Y. M. (2002). Entomofaune et stratégies alimentaires des poissons du genre *Brycinus* (Characidae) en milieux fluviales et lacustre (Bassin Bia et Agnéby ; Côte d'Ivoire). Thèse de Doctorat, Université d'Abob-Adjamé, Côte d'Ivoire, 261 p.
7. Falissard B. (1999). Focused Principal Component Analysis: looking at a correlation matrix with a particular interest in a given variable. *Journal of Computational and Graphical Statistics*, 8: 906 - 912.
8. Fisher S. G., Gray L. J., Grimm N. B. & Bush D. E. (1982). Temporal succession in a desert stream ecosystem following fresh flooding. *Ecol. Monogr.*, 52 : 93-110.
9. Goldberg E. G. (1986). The mussel watch concept. *Environmental Monitoring and Assessment*, 7, 91-103.
10. Gnohossou P.M. (2006). La faune benthique d'une lagune ouest africaine (le lac Nokoue au Bénin), diversité, abondance, variations temporelles et spatiales, place dans la chaîne trophique. Thèse de Doctorat de l'Institut National Polytechnique de Toulouse, Toulouse, France, 188 p.
11. Hickman C., Roberts L., & Parson A. (2000). *Principios integrales de zoología*. McGraw Hill Interamericana : España.
12. Kabré T. A., Illé A. & Guenda W. (2000). Inventaire et étude de la densité de distribution des insectes du benthos des deux lacs de barrage de Bagré. *Science et Technique, série Sciences Naturelles et Agronomie*, 24(2) : 121-132.
13. Kabré T. A., Dinguiné D. & Bouda S. (2002). Effet du rétrécissement de la superficie d'eau sur les macroinvertébrés du lac de barrage de la Comoé, Sud-ouest du Burkina Faso. *Science et Technique, série Sciences Naturelles et Agronomie*, 26(1) : 37-49.
14. Karr J.R. & Chu E.W. (1999). Restoring life in running waters. Better biological monitoring. Island Press. Washington D. C., Island Press, 206 p.
15. Kiblut K. (2002). Les communautés ichtyologiques et mesures de l'intégrité biotique du bassin versant de la rivière Kamouraska. Diplôme d'Etudes Supérieures Spécialisées « Ingénierie des Hydrosystèmes Continentaux en Europe », 64p.
16. Lévêque C. (1972). Mollusques benthiques du lac Tchad : écologie, étude des peuplements et estimation des biomasses. *Cah. ORSTOM, sér. Hydrobiol.*, 6 (1), 3-45.
17. Minshall, G.W. & Robinson, C.T. (1998). Macroinvertebrate community structure in relation to measures of lotic heterogeneity. *Archiv für Hydrobiologie*, 141, 129-151.
18. Ouattarra D. S. (2015). Diversités taxonomique et fonctionnelle des macroinvertébrés du lac Kodjoboué (Côte d'Ivoire). Mémoire de master, Université Nangui Abrogoua d'Abob-Adjamé, Côte d'Ivoire, 74 p.
19. Rosenberg D.M. & Resh V.H. (1993). Freshwater biomonitoring and benthic macroinvertebrates. New York, Chapman & Hall. 488 pp.
20. Salanki J. (1989). New avenues in the biological indication of environmental pollution. *Acta Morphologica Academiae Scientiarum Hungaricae*, 40, 295-328.
21. Soro N. (2021). Effets des aliments exogènes du tilapia du Nil *Oreochromis niloticus* (Linné, 1758) sur la diversité et la structure des peuplements naturels des étangs piscicoles (ferme piscicole de Blondey, Côte d'Ivoire). Thèse de Doctorat, Université Nangui Abrogoua d'Abob-Adjamé, Côte d'Ivoire, 150 p.
22. Valente J. P., Podilha P. M., & Silva A. M. (1997). Contribution of *Botucatu*-sp with nutrients (phosphorus and nitrogen) to dam. *Eletica Quimica*, 22, 31-28
23. Vielma H. (2013). El mundo de la biología. Fundación Polar. Venezuela. Disponible en : [https://bibliofep.fundacionempresaspolarg.org/media/16994/libro\\_mundo\\_biologia\\_lw\\_14.pdf](https://bibliofep.fundacionempresaspolarg.org/media/16994/libro_mundo_biologia_lw_14.pdf)
24. Wetzel R. G. (1993). *Limnologia* Lisboa Fundacao Calouste Gulbenkian. 91.