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The Study of Macro Invertebrate Fauna in Wetland Areas of Lokoja, Nigeria

Abidina Abba*, Ukwedeh Ojoniko Mary, Kachi Jolly Babangida and Alhassan Abdulrahman
Department of Biological Sciences, Faculty of Science, Federal University Lokoja, Kogi state, Nigeria
P.O. Box: 1154
*Corresponding author email: abidina.abba@fulokoja.edu.ng

***Abstract*— The analysis of the macro invertebrate assemblage in the wetlands of Lokoja and physico-chemical parameters; based on anthropogenic events across catchments of the wetland, sampling stations were allocated. From January to June, ecological parameters such as air and water temperature dissolve oxygen concentration, depth and pH levels as well as the macro invertebrate fauna were assessed. The analysis found that the temperature of air and water was highest in the March (31.42±1.0◦C) and April (38.3±0.5C) respectively; Average Depth and dissolve oxygen concentration of the water were higher in June (0.55 ± 0.07 m) and (5.30±0.92 mg/l) each, while pH was higher in May (5.73±0.68). Similarly, the overall macro invertebrate was frequent during the dry season compared to the rainy season. Higher abundance was observed in the month of April with Coleopterans being highest followed by Orthoptera; followed by May and June. We observed changes in the growth dynamics of macro invertebrate fauna from April to subsequent May and June. Our findings revealed the state of macro invertebrate fauna in the wetland Areas of Lokoja, secondly we highlighted the condition of pollution in the wetland areas as such we recommend restoration of the wetland so as to increase ecological efficiency of the wetland as well as wastewater management framework aim at eradicating elicit environmental pollution by humans into the aquatic ecosystem.**

***Keywords*— Pollution; Ecological monitoring; Macro Invertebrate physicochemical parameters; Lokoja Nigeria**

I. INTRODUCTION

Wetlands are areas that are saturated with fresh water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem [1]. Wetlands have unique characteristics; they are generally distinguished from other water bodies based on their water level and on the types of fauna and flora that live within them. Macro invertebrates are a very diverse group of organisms with a wide range of environmental tolerances and preferences and are generally abundant in freshwater habitats [2]. In tropical African regions, research on the status and trends of freshwater macro invertebrates in wetland has not been given much attention compared to non-tropical regions [3]. As a result, some species may already have become extinct even before they were taxonomically classified leading to lack of taxonomical information. Therefore, this study tends to give an overview of the biodiversity of macro invertebrates fauna in wetland areas of Lokoja Metropolis.

Wetland Areas in Lokoja are characterized by having rich diversity coupled with a lot of challenges as a result of human anthropogenic activities ranging from farming, pollution from the municipal sewer, irrigation activities, and lack of Monitoring and restoration from the environmentalist. Macro invertebrates are one of the factors that determine the ecological integrity of an Ecosystem as such their diversity represents the quality of the wetland Areas in Lokoja and can therefore be altered by humans [4]. The study was designed to evaluate the macro invertebrate distribution as well as some environmental factors that influence their productivity and abundance. Determining the environmental factors is a key to lake restoration [5]. There are strong correlations between the water physical and chemical characteristics [6-8]; the nature of the riparian area of the wetland is of enormous important in determining the distribution of benthic macro invertebrate [9]. It's also very influential factors in the abundance and distribution [10]; physic-chemical factors generated by human pollutions also affect the density of Macro invertebrate [11]. Temperature, dissolved solutes and geomorphology are the physical properties that mainly change the macro invertebrate distributions [12-17]. Understanding the distribution and abundance of macro invertebrate in a shallow water is important because of their vulnerability to the surface atmosphere [18]. Apart from the surface tension and small gravels in the water, emergent plants and provide shelter to the macro invertebrate community distribution and diversity [19]. Over population of human race, completion for habitat lead to deforestation and increase in irrigation due to high food demand which immensely affect aquatic ecosystems [20]; Even though the organisms that live in aquatic habitat respond to most of the stresses [21]. It's also obvious in the tropical regions that most research give more emphasis on the freshwater macro invertebrate while neglecting the ones in the wetland areas [3].

II. MATERIALS AND METHODS

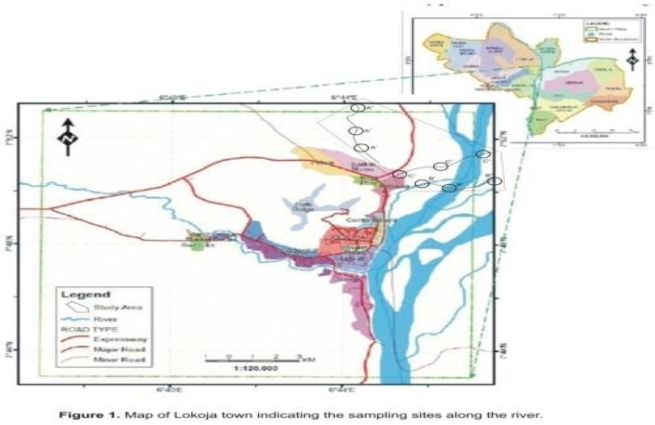

Figure 1. Map of Lokoja town indicating the sampling sites along the river.

Figure 1: Map of Lokoja town showing the sampling sites

DESCRIPTIONS OF THE STUDY AREA

SarkinNoma Wetland Is Located between Longitude 7° 50' And Latitude 6°45'north. Kabawa Is Located Immediately After The Old Market Of Lokoja, Kogi State. Kabawa Is geographically Located Between 7°49'14.8"N 6°44'59.5"E; Lokoja Metropolis, Kogi State Capital.

Station 1: This station was characterized by dark and brownish mud, debris and sand in some places. Washing of clothes, trading, fermenting and sieving of cassava and washing of fruit are among the common human activities that occurred in the station.

Station 2: This station was characterized by dark and brownish mud, debris and sand in some places. Washing of clothes, cars, fermenting and sieving of cassava were among the common human activities that occurred in the station.

Station 3: Station three is swampy. The substratum was characterized by both mud and sand. Water flow was generally slow. Farming and washing of cloth were among the common human activities that occurred in the station. However, sampling locations are adversely polluted by fecal matters and farming by local populace. Discharge of municipal sewers, large fermentation and sieving of cassava, washing of clothing, washing of slaughterhouses, washing of fruit, running of water from car wash and sand collection. It is also a center of subsistence fishing.

III. Sample Collection

Macro invertebrates in wetland were collected follow the procedure by [22]. Using a kick net within the space of six (6) month; sampling carried out once per month from January to June 2017 with mesh size 1mm which was swept back and forth for a distance of approximately 1 cm.

IV. Sample Preparation

Specimen was manually picked out from the sediment and preserved in 75% ethanol. Later in the laboratory, macro invertebrates were counted using a hand lens and identified up to species level using keys. Physiochemical parameter of the water sample was analyzed according to Standard Methods for Water and Wastewater Monitoring [23].

V. Results and Discussion

This section will highlight our major findings as well as the observations from the study such as the physic-chemical properties of the water, and the macro invertebrate assemblage observed during the study period.

The compositions and abundance of macro invertebrate during the study period (Table 1) indicate high abundance at station 3 followed by station 2 with least composition found at the station 1diversity of the taxa in the study were distributed in all the three stations with dominant taxa being Odonata and Diptera, while Spider and Mollusks were the least abundant taxa. The dominant population of the macro invertebrate observed at station 3 was due to the productivity of the wetland as well as the high decomposition of organic matter and topography of the location which support habitat of many Diptera species. The overall population shows insects are the highest population during the study Result is presented as mean ± standard deviation. P≥0.05.

TABLE 2: Average Monthly Physico-chemical Parameters in the Wetland Areas of Lokoja

Parameters	Jan	Feb	Mar	Apr	May	Jun
Air temp. ℃	30.1± 1.01	31.2± 1.05	31.4± 1.00	30.7± 1.00	30±0. 26	29.5± 0.50
Water Temp. ℃	27.9± 0.05	28.0± 0.15	28.3± 0.51	38.3± 0.50	27.9± 0.31	27.6± 0.40
Depth (m)	0.50± 0.06	0.46± 0.07	0.45± 0.07	0.50± 0.06	0.52± 0.07	0.55± 0.07
Do (mg/l)	4.7±0 .50	4.49± 0.75	4.21± 0.37	5.1±0 .51	5.16± 0.55	5.30± 0.92
pH	5.6±0 .36	5.37± 0.49	5.67± 0.76	5.07± 0.49	5.73± 0.68	5.73± 0.68

The study looked at water temperature, water depth, water acidity, dissolved oxygen and pH levels in the winter. Air temperature were highest in the month of March (31.4 ±1.0), followed by February (31.2±1.05) then April (30.7±1), January (30.1±1.01) May (30±0.26) and June (29.5±0.50). Water temperature was highest in the month of April (38.3±0.5) followed by February and March (28.3±0.51 each); then January and May (27.9±0.31 each) and month of June with least value (27.6±0.40). However, the Depth recorded was highest in June (0.55±0.07), May (0.52±0.06) and January and April (0.50±0.06 each). Dissolve Oxygen concentration was higher in the month June (5.30±0.92) then May (5.16±0.55) and April (5.1±0.51mg/L), January (4.7±0.50) and lowest concentrations was recorded in the month of February (4.21±0.37) and March (4.49±0.75); pH values were lower in the month of April (5.07±0.49), February (5.37±0.49) and January (5.6±0.36), while the higher values recorded were in the month of May and June each with 5.73±0.68 followed by 5.67±0.76 in March.

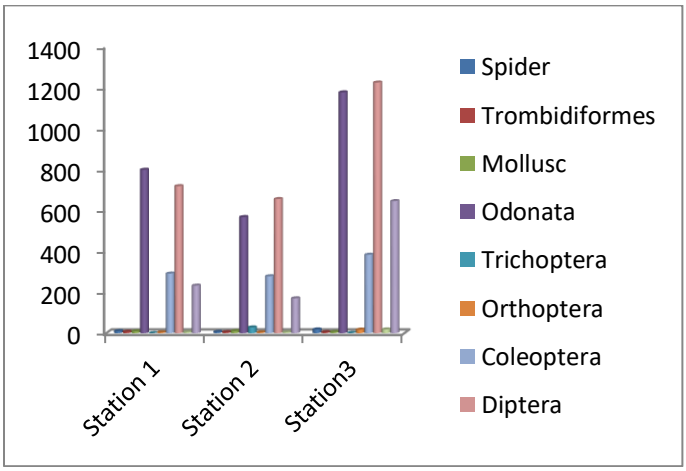

Figure 2: Diversity of Macro invertebrate Taxa in Wetland Areas of Lokoja

Table 1 Composition and distribution of macro invertebrate in the Lokoja wetland Areas

Species	Station 1	Station 2	Station 3	Species	Station 1	Station 2	Station 3
Spider	1	2	15	***Donacia Sp***	4	5	-
Lumbricussp	1	-	1	***Dytiscus Sp***	-	-	1
Dolomedes fimbriatus	8	4	2	***Hydrophilus Sp***	52	50	32
Argyroneta aquatica	-	3	1	***Gyrinus Sp***	150	146	125
Trombidiformes	7	5	5	***Platycerus***	-	7	2
Arrenurus Sp	-	3	-	**Diptera**	85	77	225
Mollusk	9	10	6	***Tabanus Sp***	1	1	-
Lymnaea Sp	-	3	-	***Culicoides Sp***	1	-	-
Odonata	10	4	42	***Stratiomys Sp***	4	4	2
Aeshna Sp.	7	7	-	***TipulaSp***	-	-	16
Macromia africana	25	10	15	***Megistocera longipennis***	-	-	11
Gomphus Sp	34	23	46	***Simulium Sp***	1	-	-
Haginus Sp	250	210	350	***Eristalis sp***	13	-	-
Libelluia Sp	98	87	130	***Chironomous sp***	523	510	354
Sympetrum Sp	15	11	30	***Polypedilum sp***	132	100	470
Tetragonula Sp	337	200	521	***Chironomus sp***	34	32	370
Coenagrion scitulum	22	15	42	***Tanytarsussp***	9	8	1
Ischnura Sp	3	-	5	***Hymenoptera***	-	3	5
Trichoptera	-	28	1	***Caraphractus sp***	3	3	-
Hydropsyche sp	1	2	1	***Apisnearctica***	3	2	18
Orthoptera	-	-	7	***Lepidoptera***	4	1	-
Nemobius sylvsetris	-	4	5	***Boloria euphrosyne***	59	50	210
Acrida chinensis	4	-	5	***Aphantopus hyperantus***	50	50	115
Acridacineraa	2	3	4	***Carterocephalus palaemon***	64	40	150
Coleoptera	5	5	12	***Helicoverpazea***	59	30	170
Total							**2,090**

The abundance of macro invertebrate during the study (Figure 2) shows Diptera (718-1224 sp) has been the highest in the study followed by Odonata (567-1176 sp), Coleoptera (278-383 sp), Lepidoptera (170-645 sp), while the lowest are the Mollusk and Spider (0-10 sp), Tormbidiforms (5-7 sp), and Orthoptera (0- 4 sp).

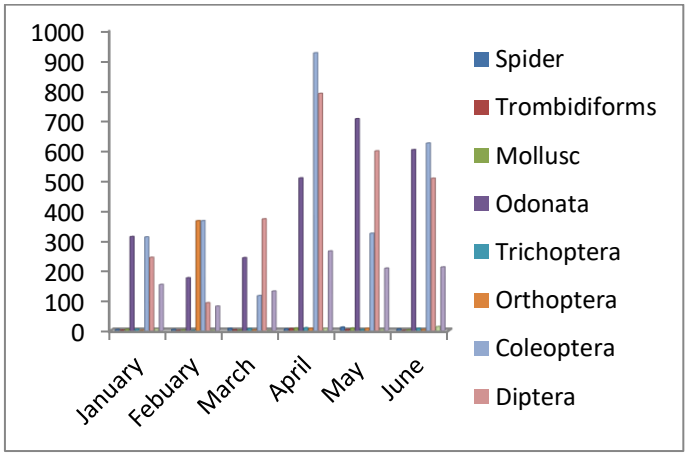

Figure 3: Abundance of Macro invertebrate taxa from January to June

The abundance of macro invertebrates based on the sampling time (Figure 3) showed higher concentration during the wet season from (April to June) while least abundance was seen during the dry season from January to March.

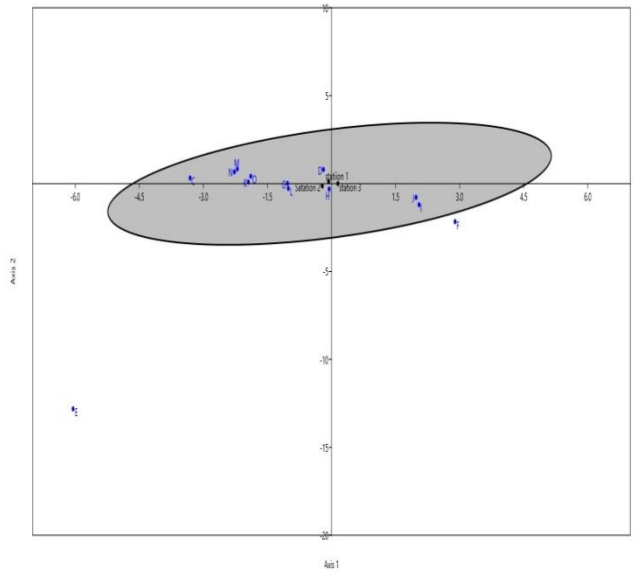

Figure 4: Correspondence analysis of Macro invertebrate Families and Environmental variables

Figure 4 shows the relationship between the Macro invertebrate and Environmental variables. The status of the macro invertebrate communities decreases with declining habitat quality. Using a diverse range of multivariate analysis, family and genus had shown many of the same correlations to physico-chemical parameters and macro invertebrate diversity (Fig. 4). Though this response to diversity indices was unique, species were clustered in the middle of the CCA map.

It is suspected that dirt and remains from the human anthropogenic activities may affect the lives of the organisms in the wetland. Wetlands are rich in humus compound and very low pH which means low level of Electrical conductivity [24]. According to Santos [25], Wetland conductivity is directly proportional to the animal community richness. In March, there is low abundance in the wetland areas in comparison to the month of April and May (Figure 3) at the same time high vegetation cover by the Macrophyte due to colonization caused by flood since November of the previous year as reported by Souilimi *et al.*, [26]. The high abundance of Odanata and Diptera in present study coincide with the findings of Souilimi et *al*., [26] and [27], also similar macro invertebrate compositions were seen at station 3 and station 1 while least composition of macro invertebrate was at station 2. There are different species observed in this study which are varied with the sampling locations such as Lepidoptera, Orthoptera, Coleoptera, Mollusks, Spider, Trombidiformes and Trichoptera among others; this difference can be attributed to the collection methods and physicochemical properties of the water as reported by Perera [28]. The predator and generalist predominance at station 1 and 2 are associated to food availability at the sampling location, due to tillage that causes upward colonization and food availability. Although, few months later, with flood irrigation it is possible to see many increases that were already present. These observations are similar for Stenert [29], when predators and generalists are the dominant tropic group at wetland fields, along with collectors.

Similarly, benthic macro invertebrate found at the sampling station 1 and 3 were shredders and some are scrapers with not much impact in the ecological dynamics of the wetland as a result of limited availability of organic matter during the sampling period. While the other groups with higher abundance aggregated during the irrigation period indicate similarities could be much higher if there is higher water retention in the soil as reported by Stenert [29].

The station 3 has more diverse and abundant of benthic macro invertebrate than station 1, and 2, even though the station 2 and 1 have benthic macro invertebrates that could help to sustain aquatic communities such as aquatic birds or fish, which feed on site, in the drainage canals or water bodies underlying. It is necessary to study different management practices that can help define the agricultural practices more favorable for the maintenance of functionality of these artificial wetlands.

However, Physico-chemical parameters observed in this study (Table 2) are similar to the previous study in the same location (Abba, 2019); Depth reported was higher in June (0.55±0.07), May (0.52±0.06) and January and April (0.50±0.06). The concentration of dissolved oxygen was higher in the months of June (5.30±0.92) than May (5.16±0.55) and April (5.1±0.51mg/L), January (4.7±0.50) and the lowest concentrations were recorded in the months of February (4.21±0.37) and March (4.49±0.75); pH values were lower in the months of April (5.07±0.49), February (5.37±0.49) and

January (5.6±0.36), while higher values were recorded in the months of May and June. The high temperature observed during the months of April, May and June was in accordance with the findings of [22, 30, and 27]. This relationship is identical to that presented in Barbour et al., [32].

VI. Conclusion

The Macro invertebrate abundance study was conducted in the wetland areas of Lokoja, Nigeria, in which physico-chemical parameters such as water temperature, pH, Depth, Do were recorded. The concentration of physico-chemical parameters from April to June is rising (Rainy season). Macro invertebrate abundance was also recorded in wetlands where Diptera, Odonata and Lepidoptera are the highest species recorded, while Orthoptera, spider and mollusk are the lowest species recorded. The Macro invertebrate in the wetland in station 3 has greater variety and high proportion than Station 1 and Station 2; even though the station 2 have a possibility of macro invertebrates that can help the survive, aquatic birds such as aquatic insects. More research on the effect of human activities and chemicals on macro invertebrate communities are needed.

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Conflict of Interest

Authors declare no conflict of interest on this article.

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