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**ASSESS ABUNDANCE AND DIVERSITY OF AQUATIC INSECTS IN  
ODOPONYI SEASONAL STREAM, NAGONGERA SUBCOUNTY, TORORO  
DISTRICT**

**BY**

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**BU/UP/2021/3265**

**RESEARCH REPORT SUBMITTED TO THE DEPARTMENT OF BIOLOGY  
IN THE PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE  
AWARD OF THE DEGREE OF BACHELOR OF SCIENCE AND  
EDUCATION OF BUSITEMA UNIVERSITY**

**SEPTEMBER, 2024**

**DECLARATION**

I Nyongesa Philex hereby declare that the research report entitled, "Assess the abundance and diversity of aquatic insects in Odoponyi seasonal stream, Nagongera sub county, Tororo district" is my real and genuine work.

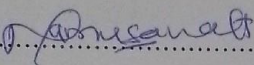
Signature;.....*Philex*.....

Date;.....*19/09/2024*.....

## APPROVAL

This research “Assessing the abundance and diversity of aquatic insects in Odoponyi seasonal stream in Nagongera sub county, Tororo district” has been submitted for examination with the approval of my supervisor;

Ms Namusana Hellen;

Signature:  .....

Date: 19/09/2024 .....

## **DEDICATION**

This research is dedicated to my beloved parents Mayende Stephen and Florence who offered financial support and spiritual support at every step of the study. This study is also dedicated to Rob and Karen Petkau for their tireless financial and social support towards the completion of the research.

## **ACKNOWLEDGEMENTS**

It is my great honour and privilege to honour and give all the glory to the Almighty God for his grace and favour upon my life and the entire course of my academics.

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## **ABSTRACT**

Aquatic insects play a fundamental irreplaceable ecological role in the intricate web of biodiversity and ecosystems. Despite the importance of aquatic insects in streams, many human activities such as rice growing, sand mining and cattle grazing affect the aquatic ecosystems changing the water quality which in turn affects the abundance and diversity of organisms. This study investigates the abundance and diversity of aquatic insects in the Odoponyi seasonal stream located in Nagongera sub-county, Tororo district, Uganda. A total of 38 insects from 11 families across five orders were collected using the kicknet method, revealing a stark contrast in insect communities between disturbed and undisturbed sites. The undisturbed site, characterized by intact riparian vegetation, hosted a significantly higher abundance of insects (27 individuals) compared to the disturbed site (11 individuals), although the latter exhibited greater species diversity (Shannon index: 1.594 vs. 0.7545). The Gomphidae family was the most abundant, highlighting its ecological importance in maintaining stream health. Results indicate that anthropogenic activities, including cattle grazing and sand mining, negatively affect aquatic insect populations, emphasizing the need for effective management and conservation strategies. This baseline data is crucial for future studies aimed at preserving aquatic ecosystems in the region and inform local stakeholders about sustainable land use practices.

## CHAPTER ONE: INTRODUCTION

### 1.1 Background

Globally, studies show that human activities such as agriculture affect the abundance and diversity of aquatic insects: studying the plain river network in the Lake Chaohu Basin in China (Zhang et al., 2021) observed decrease in the abundance and diversity of aquatic insects. According to (Davison, Rahbek, & Morueta-Holme, 2021) land use change is the main cause of habitat and biodiversity loss worldwide, having caused declines in abundance, diversity and health of both species and ecosystems.

Aquatic insects play a fundamental irreplaceable ecological role in the intricate web of biodiversity and ecosystems (Kalita & Das, 2023). As many aquatic insects have both aquatic (larval and adult) and terrestrial (adult) life stages, their impact is not limited to the aquatic environment alone and stretches into the terrestrial riparian environment.(Starr & Wallace, 2021) Aquatic insects are essential indicators of freshwater ecosystem health basing on the fact that they play crucial roles in nutrient cycling, food webs and overall ecosystem functioning(Kalita & Das, 2023).

Studies in Sub Saharan Africa show that diversity of macroinvertebrates is dominated by insects (Henri, 2021). However the abundance and diversity of aquatic insects has been drastically affected by anthropogenic activities resulting in loss of species and alteration of ecosystems(Tamiru, 2018)

Africa is known to have a diversity of aquatic insects yet entirely to be investigated, and that there is an urgent need to do so (Tchakonté et al., 2015). African streams have been reported to be rich in biodiversity, but because of increasing human influence, the abundance and diversity of aquatic insects has greatly reduced (Edegbene, Arimoro, Odoh, & Ogiadiaka, 2015).

Additionally, studies in East Africa show that Land use changes influence the natural functions of streams by impacting on water quality and altering water flow and as a result adversely affect aquatic organisms by exerting pressure on individual species (Gichana, 2013). According to (Fekadu, 2021) ,stream flow, complexity of the habitat and land use influence in the community greatly impact the abundance and diversity of insects in streams.

Uganda is not exceptional as the diversity and abundance of aquatic insects has been threatened by unregulated human activities (Denis, 2019)

Along Odoponyi seasonal stream, a study examined the effect of selected agricultural land uses on spatio-temporal variations in water quality and fish assemblage crossing agricultural landscapes (Turyahabwe, Turyabanawe, Andama, Othieno, & Wamono, 2023).

## **1.2 Statement of the problem**

Freshwater ecosystems are one of the most diverse ecosystems in the world (Gutiérrez-Rial et al., 2023). High diversity of insect fauna in streams is an indication of larger microhabitat diversity and better water quality conditions prevailing in the streams. (Maneechan & Prommi, 2015)

Despite the importance of aquatic insects in streams, many human activities such as rice growing, sand mining and cattle grazing affect the aquatic ecosystems changing the water quality which in turn affects the abundance and diversity of organisms (Ogidi & Akpan, 2022). Insects are not exceptional as they are also equally affected. Aquatic insects in stream ecosystems are sensitive to the impact of human activities (Resh & Jackson, 1993) and they are good biological indicators of stream disturbances (Das & Maity, 2021)

Studies on Odoponyi seasonal stream focused on spatio-temporal variations in water quality and fish assemblage (Turyahabwe et al., 2023) however, there are insects in this stream whose abundance and diversity has not been studied. This therefore compelled the researcher to assess the abundance and diversity of aquatic insects in the stream.

## **1.3 Objectives of the study**

### **1.3.1 General objective**

To assess the abundance and diversity of aquatic insects in Odoponyi seasonal stream in Nagongera sub county, Tororo district

### **1.3.2 Specific objectives**

1. To identify aquatic insects in Odoponyi seasonal stream in Nagongera Sub County.
2. To determine the diversity of aquatic insects in Odoponyi seasonal stream Nagongera Sub County.

3. To determine the abundance of aquatic insects in Odoponyi seasonal stream Nagongera Sub County.

#### **1.4.0 Hypotheses**

##### **1.4.1 Null hypothesis**

There is no significant difference in the diversity and abundance of aquatic insects in Odoponyi seasonal stream.

##### **1.4.2 Alternative hypothesis.**

There is a significant difference in the diversity and abundance of aquatic insects in Odoponyi seasonal stream.

#### **1.5 Significance of the study**

This study will provide information on the abundance and diversity of aquatic insects in Odoponyi seasonal stream, which will be a basis for other studies on this stream and other streams in Tororo district.

This study will contribute knowledge in the field of land use influence on the abundance and diversity of aquatic insects in Odoponyi seasonal stream and therefore be basis for studies on safe land use activities so as to maintain the stream's ecosystem.

#### **1.6 Justification of the study**

This study will serve as baseline information on the biomonitoring of Odoponyi stream that can be used by stream managers who are the local leaders and the neighboring communities for planning sustainable development around the course of the stream so as to conserve the ecosystems in and around the stream.

## **2.0 CHAPTER TWO: LITERATURE REVIEW.**

### **2.1 Introduction**

Worldwide, insects among other macro-invertebrates have been used as essential indicators of freshwater ecosystem health basing on the fact that they play crucial roles in nutrient cycling, food webs and overall ecosystem functioning (Kalita & Das, 2023). Catchment and riparian degradation has continued to cause declining ecosystem integrity of streams in many African countries (Dallas & Rivers-Moore, 2014)

Streams and rivers are particularly sensitive to anthropogenic activities, which can significantly impact the diversity and abundance of aquatic insect communities(Gimenez, Lansac-Tôha, & Higuti, 2015).

Insects constitute more than half of the known species on Earth, with millions possibly yet to be discovered. This vast insect diversity underscores their ecological importance and highlights their ubiquitous presence in almost every terrestrial and freshwater habitat(Kalita & Das, 2023).

Aquatic insects are comprised of more than 88500 described species from approximately 13 orders (Starr & Wallace, 2021)

### **2.2. Abundance of aquatic insects**

Abundance of aquatic insects in seasonal streams varies significantly across seasons (Wesner, 2010), it is also influenced by the stream flow (Walters & Post, 2011), nutrient availability and land use activities within and along the stream (Gimenez et al., 2015). During dry seasons, the abundance of aquatic insects greatly reduces and reaches peaks in the wet seasons (Janzen & Schoener, 1968).

### **2.3. Diversity of aquatic insects**

Studies show that streams support diverse ecosystems (Allan, 2004; Leigh, 2013). Seasonal streams support unique aquatic insects differing from permanent streams and they support aquatic insect communities adapted to variable flow regimes (Yamamuro, 2010). According to (Viza. & Muñoz, 2024), seasonal streams exhibit diverse temporal patterns in their hydrological regimes, which influence the diversity of aquatic insects. During periods of low flow, benthic insects such as Chironomidae, Baetidae, and Elmidae dominate due to their ability to tolerate dry conditions

(Rodríguez et al., 2022). Family Baetidae and Chironomidae possess pollution tolerance capabilities; additionally, these species can survive at a wide range of temperatures (Akyildiz & Duran, 2021). Notonectidae, Hydrophilidae Gomphidae, Coenagrionidae, Libellulidae, and Aeshnidae are referred to as species of low waterflow according to (Thakur, Grover, & Sinha, 2023).

According to (Starr & Wallace, 2021) aquatic insect community diversity and integrity are important due to the functional ecosystem roles they perform; therefore, landscape, and anthropogenic factors can all influence the community composition. The diversity of aquatic insects is influenced by various environmental factors such as temperature, pH, dissolved oxygen levels, nutrient availability, and substrate type (Finlay, 2011).

#### **2.4. Factors that affect insect abundance and diversity in streams**

Anthropogenic activities along river banks can exert various pressures on aquatic insect communities (Duan, Zhao-Yin, & Xu, 2011). These activities may include road construction, agriculture, deforestation, pollution, sand mining and water extraction. Urbanization and agricultural runoff introduce pollutants such as pesticides, fertilizers, and heavy metals into the water, which can degrade habitat quality and directly harm aquatic insects (Tiwari & Pal, 2022). Deforestation increases sedimentation rates and alters stream morphology, affecting insect habitats and disrupting life cycles (Yoshimura, 2012). Along Odoponyi seasonal stream, human activities such as rice growing, sand mining and cattle grazing take place and they influence the distribution aquatic insects; for example, where there is sand mining the floor of the stream is disturbed (Kumari, Pandey, & Kumar, 2024) thus disorganizing the habitat for these insects by disturbing the floor of the stream.

Several studies have investigated the effects of anthropogenic activities on aquatic insect communities in streams and rivers worldwide. A study by (Zhang et al., 2021) showed the effects of agricultural activities on stream insects in China and observed decreased abundance and diversity in streams affected by agricultural runoff compared to pristine sites.

For Odoponyi seasonal stream, a study by (Turyahabwe, 2023) showed that various agricultural activities in the landscapes of the Odoponyi stream watershed led to changes in spatio-temporal variations in water quality which in turn negatively affected ecosystems in the catchment which consists of these aquatic insects. Human activities such as cattle grazing and sand mining are likely to affect the life of insects in Odoponyi seasonal stream.

### **2.3.1 Effect of cattle grazing on diversity and abundance of aquatic insects**

According to (Bond, Sear, & Edwards, 2012) cattle preferentially defecate in streams. Feecal matter washed from the hooves of cattle (Davies-Colley, Nagels, Smith, Young, & Phillips, 2004) in addition to that washed from trampled and exposed banks around access points with damaged or absent riparian buffers contaminate the stream water. Cattle grazing in riparian areas can affect the structure of aquatic insect assemblages by adding nutrients (manure) to the stream, or by physically altering the habitat through trampling or foraging (del Rosario, Betts, & Resh, 2002).

A study by (Munn, 2018) showed that invertebrate community conditions decreased by about 30 percent as stream nutrient concentration increased. However, stream habitat exerted a stronger influence on invertebrate community condition than nutrient concentration (Munn, 2018). Cattle grazing and other activities like sand mining disturb the floor of the stream and thus altering the habitat for the aquatic insects. Disturbances in riparian areas also increase fine sediment loads into streams, damaging habitat and altering the aquatic insect assemblage (Yoshimura, 2012).

### **3.0 CHAPTER THREE; METHODOLOGY**

#### **3.1 Study Area**

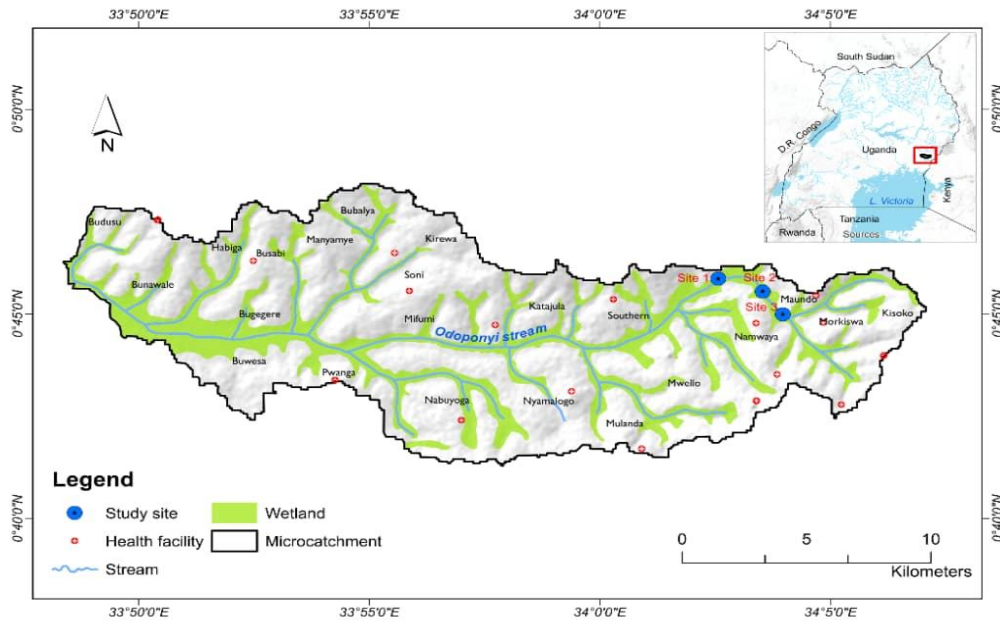
Odoponyi seasonal stream drains the lowland areas of eastern Tororo district and is located between Latitude: 0° 46' 7.19" N and Longitude: 34° 01' 20.40" E. It flows into River Manafwa in Butaleja district which is part of the larger R. Mpologoma catchment draining into L.Kyoga basin. The stream flows over a distance of 39km with its head waters originating from the high elevated areas with channels such as Rukuli, Morikiswa\_Rutengo channel, Pajagoti channel, Abongiti\_Kisoko channel which all connect to the stream. The biggest part of the relief is dominated by plateau intercepted by gentle slopes and dombo lowlands. Odoponyi stream traverses arable farms with a few grazing farms and planted eucalyptus woodlots in the upper through the middle section while the lower reaches cross papyrus swamp vegetation before draining into R. Manafwa. The catchment area experiences pronounced alternating wet and dry seasons between January to February (dry season) March-May (wet season), June-July (dry season) and August – December wet season. Although these pattern may change due to the current prevailing climate change effects.

#### **3.2 Study sites**

Odoponyi seasonal stream flows over a distance of 39Kms. Sample Sites were chosen along the upstream part of the river that stretches 2km

Three study sites were selected for this study based on the activities and features. Site 1 has riparian vegetation along the sides of the stream, site 2 and 3 had activities cattle grazing and sand mining respectively.

The first site was chosen where there was riparian vegetation so as to be used as the undisturbed site. Site one is 1.5 km away from site two. At site two there was cattle grazing taking place besides the stream and cattle crossing the stream. Site three was selected 0.5 km away from site two and 2km away from site one. At site three sand mining was taking place. The study was therefore done within 2km of the stream's flow within Nagongera sub county.



*Fig 1: Map showing study sites along Odoponyi seasonal stream*

### 3.3 Insect sampling

Insect sampling was carried out at three selected sites using kicknet method. The kick net was made of a metal square and screen net mesh, metallic poles with two handles measuring 1m from the top of the net frame. One person held the net downstream against the water flow direction, while another person kicked the substrates in water upstream from the kick net, to dislodge the aquatic insects, which were carried by the stream flowing water into the kick net. Samples from the kick net were then put in a sampling bottle with 70% ethanol, sealed, labeled and taken to the laboratory for classification using the field guide described by (Gerber & Gabriel, 2002).



*Fig 2: Researcher capturing insects in Odoponyi seasonal stream using kick net method*

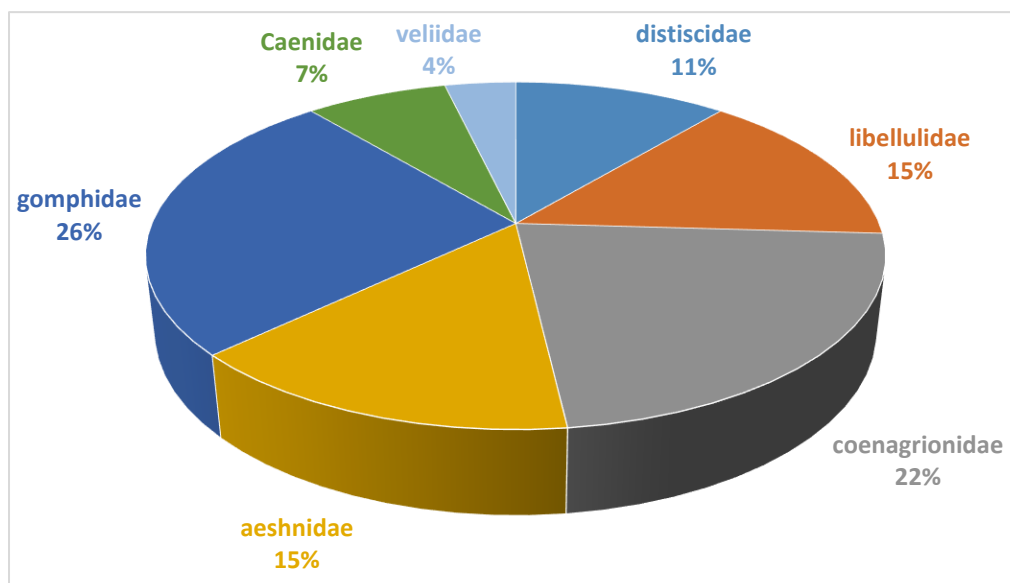
### 3.4 Data Analysis

In this study, data was analyzed using Shannon-Weiner index to determine the diversity of insect pollinators. Assessment of diversity was calculated by species richness, evenness and dominance. The formula below was used to determine Shannon index ( $H'$ ); ( $H' = - \sum p_i \ln p_i$ ) where  $p$  is the proportion  $n/N$  of individuals of one particular species ( $n$ ) and  $N$  is the total number of species. The abundance of insect pollinators will be calculated using the Simpson index ( $D = \sum (n_i/N)^2$ ) where  $N$  is number of individuals of all species and  $n_i$  is number of individuals of species  $i$ . T-test and Analysis of Variance (ANOVA) was used to compare the diversity and relative abundance of insect pollinators along forest edges with the forest interior at various sampling points.

## 4.0 CHAPTER FOUR: RESULTS

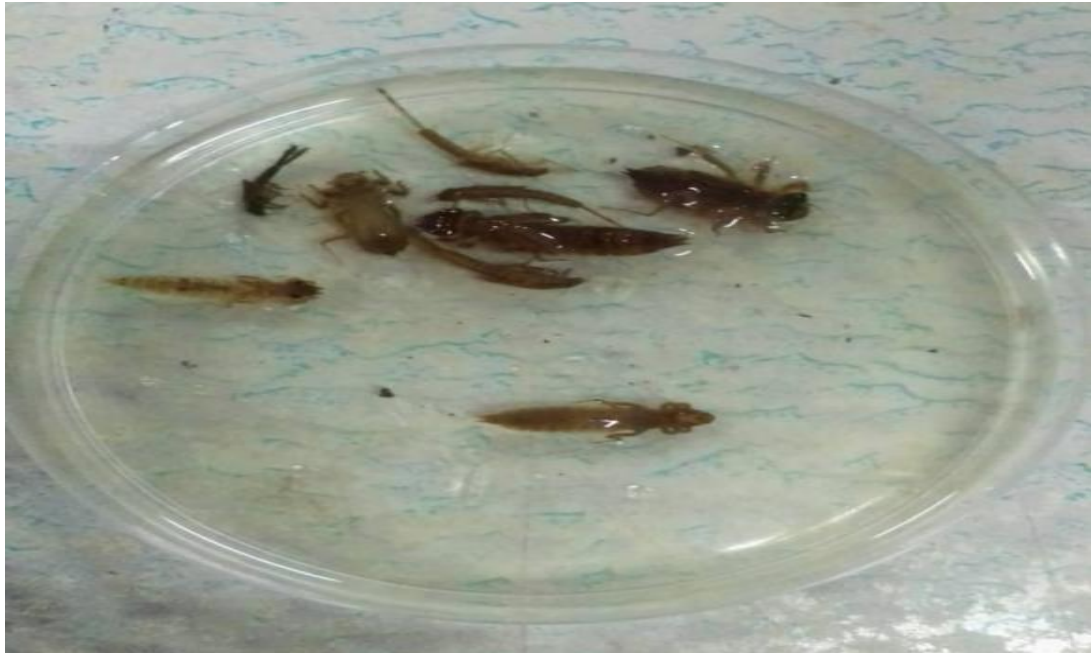
### 4.1 Diversity of Insects

A total of 38 insects from 11 families belonging to five orders were recorded. The largest family from the undisturbed site was Gomphidae (7) and the least was Veliidae (1). At the disturbed sites, families Chironomidae, Caenidae, Libellulidae and Nepidae had 2 insects recorded for each while for Hydrophilidae, Dysticidae and Notonectidae, one insect was recorded in each family. Insects collected from site 1 (undisturbed site) are showed in Fig 3 below.



*Fig. 3: The families of insects collected at site one*

The largest family in site 1 which was undisturbed was Gomphidae (26%) followed by Coenagrionidae (22%), Libellulidae(15%) and Aeshnidae(15%), Distiscidae(11%), Caenidae(7%). The smallest family was Veliidae(4%) as shown in Fig 3 above

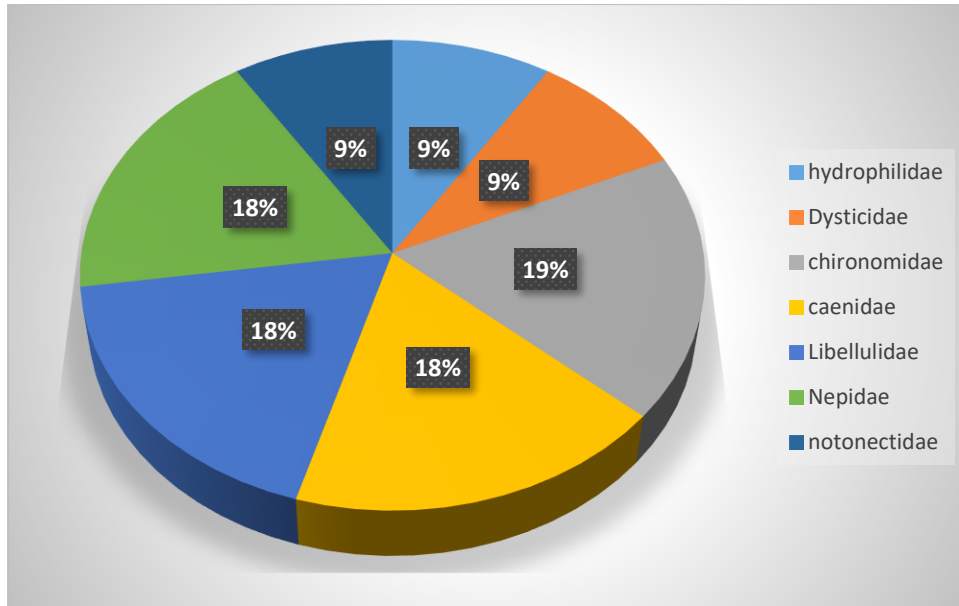


*Plate 1: sample from site 1 (undisturbed site)*



*Plate 2: Sample from site 1 (undisturbed site)*

At the disturbed sites, families Chironomidae, Caenidae, Libellulidae and Nepidae had 2 insects recorded for each while for Hydrophilidae, Dysticidae and Notonectidae, one insect was recorded in each family. Fig 4 below shows the abundance of insects in their families at site 2



*Fig 4: The families of insects at site two*

The largest family at the disturbed site was Chironomidae(19%) followed by Caenidae(18%), Libellulidae(18%) and Nepidae(18%). Families Dysticidae, Hydrophilidae and Notonecidae were the smallest at 9% as shown in Fig 4 above.



*Plate 3: sample from site 2*

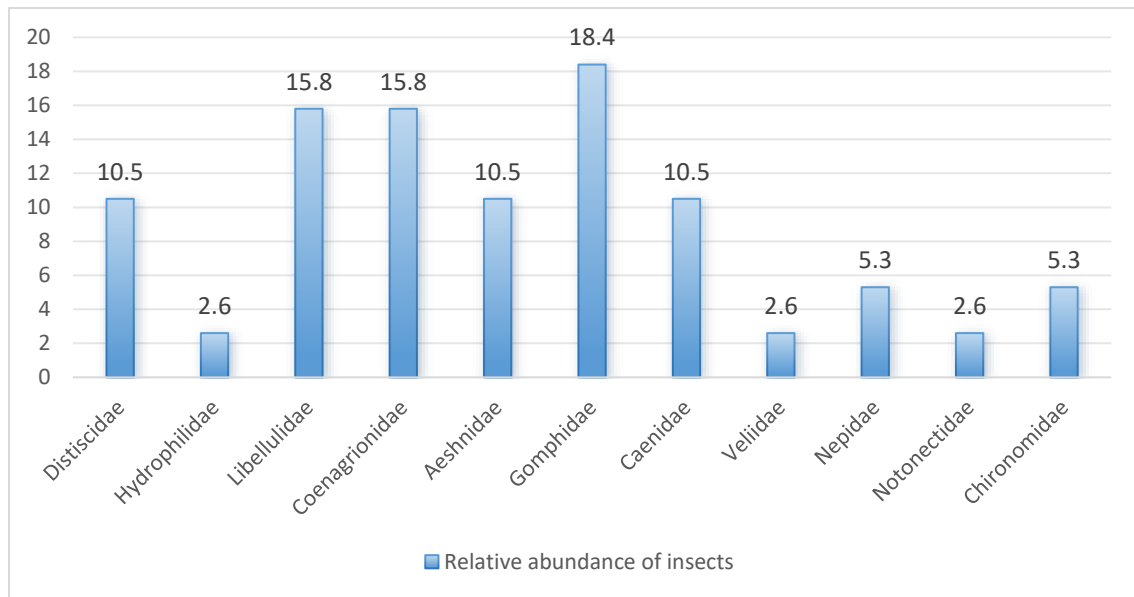
## 4.2 Relative abundance of insects

The total number of insects collected was 38, these were all collected from site 1 and site 2 because no insects were captured at site 3 in all collections. The insects recorded were from 11 families and 5 orders as shown in Table 4.1 below.

*Table 4.1. Relative abundance of insects in Odoponyi seasonal stream*

Order	Family	Number of insects	Relative abundance of insects
Coleoptera	Distiscidae	4	10.5
	Hydrophilidae	1	2.6
Odonata	Libellulidae	6	15.8
	Coenagrionidae	6	15.8
	Aeshnidae	4	10.5
	Gomphidae	7	18.4
Emphemeroptera	Caenidae	4	10.5
Hemiptera	Veliidae	1	2.6
	Nepidae	2	5.3
	Notonectidae	1	2.6
Diptera	Chironomidae	2	5.3
Total		38	

Gomphidae had the highest relative abundance (18.4%) followed by Coenagrionidae and Libellulidae (15.8%). Families Distiscidae, Aeshnidae, and Caenidae had the same relative abundance (10.5%). Nepidae and Chironomidae had a relative abundance of 5.3% while families Hydrophilidae, Veliidae and Notonectidae had the least relative abundance (2.6%)



**Fig 5: Relative abundance of insects collected from undisturbed site and the disturbed site**

Family Gomphidae had the highest relative abundance (18.4), followed by Coenagrionidae and Libellulidae (15.8%). Families Distiscidae, Aeshnidae, and Caenidae had the same relative abundance (10.5%). Nepidae and Chironomidae had a relative abundance of 5.3%. Families Hydrophilidae, Veliidae and Notonectidae had the lowest relative abundance (2.6) as showed in Fig 5 above

**Table 4.2 Results showing Shannon-Weiner and Simpson diversity indices.**

	Site 1	Site 2
Taxa_S	4	5
Individuals	27	11
Dominance_D	0.6241	0.2066
Simpson_1-D	0.3759	0.7934
Shannon_H	0.7545	1.594
Evenness_e <sup>H/S</sup>	0.5316	0.9848

The diversity indices showed that site 1 has more abundant insects (27) as compared to site 2 (11), however site 2 has more diversity of insects (1.594) and evenness (0.9848) as compared to site 1's diversity (0.7545) and evenness (0.5316). Site 2 recorded five orders and site 1 recorded four orders.

*Table 4.3: Relative abundance of insects at different sites*

Site	Number of insects	Evenness	Relative Abundance
Site 1	27	0.5316	71.1
Site 2	11	0.9848	28.9

The number of insects at site 1 was higher(27) thus a higher relative abundance (71.1%) and at site 2 the number of insects was lower (11) and thus giving it a lower relative abundance (28.9%). However, the value of Evenness was higher at site 2 (0.9848) than at site 1 (0.5316).

*Table 4.4: The two-way ANOVA showing results for significant difference between site 1 and site 2 at 5% confidence interval*

Tests for equal means					
site 1	site 2				
N:	5	N:	5		
Mean:	5.4	Mean:	2.2		
95% conf.:	(-5.516)	95% conf.:	- 1.6447		
Variance:	77.3	Variance:	0.2		
Difference between means:	3.2				
95% conf. interval (parametric):	(-5.8787 )				
95% conf. interval (bootstrap):	(-4.8 7.8)				
t :	0.8128	p (same mean):	0.4398	Critical t value (p=0.05):	2.306
Uneq. var. t :	0.8128	p (same mean):	0.4617		
Monte Carlo permutation:	p (same mean):	0.9206			
Exact permutation:	p (same mean):	0.92063			

From the table above, there is no significant difference in species diversity and abundance of insects between site 1 and site 2 since the calculated t-value (0.8128) is less than the critical t-value (2.306) and the p-value was greater than the significant level (0.05), this fails to reject the null hypothesis (H<sub>0</sub>)

## CHAPTER FIVE: DISCUSSION, CONCLUSION AND RECOMMENDATION

### 5.1. Discussion

A total of five orders, 11 families of insects were collected at the selected sites in Odoponyi seasonal stream in Nagongera subcounty. Altogether 38 insects were collected using the kicknet method.

The insects abundance varied according to the different land uses along and within the stream which agrees with (Gichana, 2013). Most insects were captured in the fairly undisturbed site of the stream which had riparian vegetation along the stream and hard to reach for people and cattle. At the other sites, very few insects were captured; specifically site 2 where cattle grazing takes place had a few insects collected which are 28.9% of those collected in site one. No insect was captured in site 3 where sand mining is done because sand mining alters the floor of the stream thus destroying the niche for the insects.

The most abundant family was Gomphidae followed by coenagrionidae and libellulidae.

Gomphidae had the highest relative abundance (18.4%) followed by coenagrionidae and libellulidae (15.8%). Families Distiscidae, aeshnidae, and caenidae had the same relative abundance (10.5%). Nepidae and chironomidae had a relative abundance of 5.3% while families hydrophilidae, veliidae and notonectidae had the least relative abundance (2.6%). The abundance of family Gomphidae was high due low water flow at the site and this agrees with (Thakur et al., 2023).

The diversity indices showed that site 1 had more abundant insects (27) as compared to site 2 (11), however site 2 had more diversity of insects (1.594) and evenness (0.9848) as compared to site 1's diversity (0.7545) and evenness (0.5316). Site 2 recorded five orders and site 1 recorded four orders.

However, according to the Two-way ANOVA, there is no significant difference in species diversity and abundance of insects between site 1 and site 2 since the calculated t-value (0.8128) is less than the critical t-value (2.306) and the p-value was greater than the significant level (0.05), this fails to reject the null hypothesis (H<sub>0</sub>).

## **5.2. Conclusion**

The overall objective of this study was to assess the diversity and abundance of insects in Odoponyi seasonal stream in Nagongera sub county Tororo district.

It was observed that the fairly undisturbed part of the stream were more diversely rich and isects were more abundant, there is therefore great need to preserve these areas by restricting access to cattle and the neighbouring community.

## **5.3. Recommendation**

This study presents the current status of part of Odoponyi seasonal stream diversity and abundance of aquatic insects. The study does not cover the entire river, but it is a basis for studies along other parts of the stream's flow area.

The kick net method was the single method used in this study, further studies can therefore be done using other methods for example the d-net method to collect insects.

## Appendix

### Appendix 1. Relative abundance of insects in Odoponyi seasonal stream

Order	Family	Number	Relative abundance
Coleoptera	Distiscidae	3	11.1
Odonata	Libellulidae	4	14.8
	Coenagrionidae	6	22.2
	Aeshnidae	4	14.8
	Gomphidae	7	25.9
Emphemeroptera	Caenidae	2	7.4
Hemiptera	Veliidae	1	3.7
Total		27	

### Appendix 2. Abundance of insects in undisturbed site

Order	Family	Number	Relative abundance
Coleoptera	Distiscidae	3	11.1
Odonata	Libellulidae	4	14.8
	Coenagrionidae	6	22.2
	Aeshnidae	4	14.8
	Gomphidae	7	25.9
Emphemeroptera	Caenidae	2	7.4
Hemiptera	Veliidae	1	3.7
Total		27	

Appendix 3. Abundance of insects in disturbed sites

Order	Family	Number	Relative abundance
Coleoptera	Hydrophilidae	1	9.09
	Dysticidae	1	9.09
Diptera	Chironomidae	2	18.18
Emphemeroptera	Caenidae	2	18.18
Odonata	Libellulidae	2	18.18
Hemiptera	Nepidae	2	18.18
	Notonectidae	1	9.09
Total		11	

Appendix 4. Insects collected on 10th May 2024 (1<sup>st</sup> collection)

Order	Family	Undisturbed site (site 1)	Disturbed sites		Total
			Site 2	Site 3	
Coleoptera	Distiscidae	1	0	0	1
	Hydrophilidae	0	1	0	1
Diptera	Chironomidae	0	2	0	2
Ephemeroptera	Caenidae	0	2	0	2
Odonata	Gomphidae	5	0	0	5
	Coenagrionidae	2	0	0	2

Appendix 5. Insects collected on 19th August 2024 (2<sup>nd</sup> collection)

Order	Family	Undisturbed site (site 1)	Disturbed sites		Total
			Site 2	Site 3	
Odonata	Libellulidae	2	1	0	3
	Coenagrionidae	3	0	0	3
	Aeshnidae	4	0	0	4
Hemiptera	Nepidae	0	2	0	2
	Notonectidae	0	1	0	1

Appendix 6. Insects collected on 23rd August 2024 (3<sup>rd</sup> collection)

Order	Family	Undisturbed site (site 1)	Disturbed sites		Total
			Site 2	Site 3	
Odonata	Libellulidae	2	1	0	3
	Coenagrionidae	3	0	0	3
	Aeshnidae	4	0	0	4
Hemiptera	Nepidae	0	2	0	2
	Notonectidae	0	1	0	1

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