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THE EFFECT OF WATER AND LIGHT GRADIENTS ON THE DISTRIBUTION OF COMMELINA ERECTA AND BENGHALENSIS SPECIES IN NAGONGERA CAMPUS TORORO DISTRICT, UGANDA

BY

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ABSTRACT:

Commelina species are plant resources full of promise as future food and feed
that thrive in diverse ecosystems(Runyambo et al., 2022). They are medicinal plants, leafy vegetables,forage for ruminants, feed for cricket insects, crop protection, and fuel.(Wilson, 1981). Both species are commonly found in tropical and subtropical regions, exhibiting a wide distribution range. However, their distribution patterns are influenced by different environmental factors, particularly light and water availability(Duke, Ball, & Ellison, 1998).
Light plays a crucial role in the growth and development of plants. Commelina erecta is a shade-tolerant species that thrives in partially shaded areas, such as the understory of forests(Thompson, 1985). It exhibits a preference for lower light intensities, as excessive sunlight can lead to leaf damage and reduced growth(Roberts & Paul, 2006). In contrast, Commelina benghalensis is a sun-loving species that requires high light intensities for optimal growth(Greene, 1980). It is commonly found in open areas, such as grasslands and disturbed habitats.

Water availability also plays a significant role in determining the distribution of these two species. Commelina erecta is more tolerant of drought conditions and can survive in areas with lower water availability(HAROON et al., 2023). It has adapted mechanisms to conserve water, such as rolling its leaves to reduce transpiration. On the other hand, Commelina benghalensis requires higher water availability and is commonly found in areas with higher rainfall or near water bodies(Sabila, 2008).

DECLARATION

I **KAMATI EVANS** hereby declare that this is my original work and has never been submitted by any other student for degree or any other award in any University or other institution of higher learning. The information derived from the literature has been duly acknowledged in the text and a list of references provided.

Signature…………………… Date…22/10/2024……

APPROVAL

The report has been submitted for examination to the Faculty of Science and Education Busitema University with the approval of my supervisor.

Sign………………………… Date…15/10/2024…

Mr. WAMBOGA EMMA

SUPERVISOR

DEDICATION

I dedicate this report to my beloved mother Yapcheboi Esther, sibling Sabila John Rawlings, Chekwemboi Brina, my friends; Bwambale Lawrence, Mpango Ashiraf, Isabirye Derrick and beloved Biology lecturers for their selfless encouragement and support they rendered to me throughout the course.

ACKNOWLEDGEMENT

I express my sincere gratitude and appreciation for assistance and encouragement I got from the lecturers and the laboratory technicians in the Biology department of Busitema University, Government of Uganda and friends who made it possible for me to complete my research project.

Above all I thank the Almighty GOD who rendered me life and enabled me to carry on with this work, all my friends and Biology class who helped me have a good stay at Busitema University, Nagongera campus.

May the good Lord bless them all.

LIST OF ABREVIATIONS

CE	COMMELINA ERECTA
CB	COMMELINA BENGHALENSIS
RA	RELATIVE ABUNDANCE
CS	COMMELINA SPECIES
OA	OPEN AREA
SA	SHADE AREA

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1 INTRODUCTION

1.1 BACKGROUND

Commelina species are plant resources full of promise as future food and feed that thrive in diverse ecosystems.(Runyambo *et al*., 2022) They are medicinal plants, leafy vegetables, forage for ruminants, and feed for cricket insects, crop protection, and fuel. Understanding the factors that influence the distribution of plant species will be crucial for ecological research and conservation efforts(Byers *et al*., 2002). Among these factors, water availability and light gradients play significant roles in shaping plant communities. This research study aims to investigate the effect of water and light gradients on the distribution patterns of two closely related species, Commelina erecta and Commelina benghalensis in nagongera campus.

Commelina erecta and Commelina benghalensis, commonly known as dayflowers, are herbaceous plants belonging to the family Commelinaceae(Webster, Burton, Culpepper, York, & Prostko, 2005).. These species are known for their rapid growth and ability to colonize a wide range of environments.

Water availability is a critical factor influencing plant distribution, as it directly affects plant growth, survival, and reproduction(Baker, 1974). Plants have evolved various adaptations to cope with water stress, such as deep root systems, succulent leaves, and reduced stomata openings(Griffiths & Males, 2017). In water-limited environments, plant species with efficient water-use strategies are more likely to thrive compared to those with higher water requirements.

Light intensity is another crucial factor that influences plant distribution. Light availability affects photosynthesis, which is essential for plant growth and development(Kami, Lorrain, Hornitschek, & Fankhauser, 2010). Different plant species exhibit varying degrees of shade tolerance, with some species thriving in full sunlight, while others prefer shaded environments(Middelton, 1998). Light gradients can be created by the presence of taller vegetation, topographic features, or human-made structures, leading to variations in plant community composition.

Previous studies have shown that Commelina erecta and Commelina benghalensis exhibit contrasting preferences for water and light conditions. Commelina erecta is often found in moist habitats particularly under shade. In contrast, Commelina benghalensis is more adaptable to drier conditions and can tolerate periods of water scarcity(Swarbrick & Mercado, 1987). This difference in water requirements suggests that water availability may be a significant factor influencing the distribution patterns of these species.

Similarly, light availability may also play a role in the distribution of Commelina erecta and Commelina benghalensis. Commelina erecta is typically found in open areas with ample sunlight, while Commelina benghalensis can tolerate shaded environments, often growing under the canopy of taller vegetation(Riar, 2012). These observations suggest that light intensity may influence the spatial distribution of these species.

To investigate the effect of water and light gradients on the distribution patterns of Commelina erecta and Commelina benghalensis, this study will be conducted in nagongera campus. The study will involve collecting data on plant abundance, water availability, and light intensity across nagongera campus. Statistical analyses will be performed to determine the relationship between plant distribution and environmental variables, such as water availability and light intensity.

Understanding the factors that influence the distribution of Commelina erecta and Commelina benghalensis is essential for effective conservation and management strategies(Olubode, 2023). By identifying the key environmental factors that shape their distribution patterns, this research study will contribute to our understanding of plant ecology and provide valuable insights for habitat restoration and invasive species management.

1.2 Problem Statement

In most cases Commelina erecta and Benghalensis has always been thought as weeds in agricultural practices as they result into great loses in agricultural yields. Their positive contribution must also be looked at especially as leafy vegetables, medicinal plants, forage crops, and environmental modifiers(Sarkar et al., 2023) .Therefore insights must be drawn into the effect of light and water gradient on their distribution. A more recent report by Lim (Lim et al., 2023) on the distribution, effect and control of exotic plants.

This is crucial for maximizing the benefits derived from these plants while mitigating any negative impacts they may have on agricultural productivity or native (Isaac, Gao, & Li, 2013)biodiversity(Ezejiofor, Enebaku, & Ogueke, 2014)

Recognizing the multifaceted roles that Commelina erecta and Benghalensis can play(Maiti & Mallick, 2023). This provides natural remedies to enhancing soil fertility or controlling erosion - underscores the need to reevaluate their status in order to harness their full potential (Sadida *et al.*, 2024)

Conservation has only been carried out in protected areas of Tororo and other parts of the world and yet it should be ranging from local, to regional, and internationally.

In Nagongera, no research has been carried out to understand the effect of light and water gradient on the distribution of commelina erecta and commelina benghalensis in order to develop strategies for conservation.

My focus is to disentangle effect of light and water gradient governing Commelina erecta and benghalensis species in Nagongera. Unraveling these factors will contribute to prioritization of ecological aspects leading to the growth conditions of Commelina erecta and benghalensis species. This is a pioneer study investigating the light and water gradients affecting Commelina erecta and benghalensis species in Nagongera campus, Tororo District, Uganda.

The objectives of this study are; to compare the responses of Commelina erecta and species benghalensis to varying light and water conditions. To assess the distribution patterns of Commelina erecta and species benghalensis along light gradients. To evaluate the distribution patterns of Commelina erecta and species benghalensis along water gradients.

By investigating how these plants interact with their environment, we can enhance our understanding of plant ecology, potentially identify factors that limit their distribution and contribute to conservation strategies aimed at preserving biodiversity in various ecosystems.

1.3 RESEARCH QUESTIONS

1. How does the availability of light affect the distribution of Commelina erecta and Benghalensis species?

2. What is the relationship between water gradient and the distribution of Commelina erecta and Benghalensis species?

3. How do variations in light intensity impact the growth and distribution of Commelina erecta and Benghalensis species?

1.4 Objectives

1.4.1 General objective

To compare the responses of Commelina species erecta and species benghalensis to varying light and water conditions.

1.4.2 Specific objective

1. To assess the distribution patterns of Commelina species erecta and species benghalensis along light gradients.

2. To evaluate the distribution patterns of Commelina species recta and species benghalensis along water gradients.

1.5 Hypotheses

1.5.1 Null hypotheses

There is no significant difference in the effect of light and water gradients on the distribution of commelina erecta and benghalensis species.

1.6 Significance

The study of the effects of light and water on the distribution of Commelina erecta and Commelina benghalensis is significant in ecological studies and conservation of biodiversity for several reasons: Understanding Habitat Requirements: Investigating how light and water influence the distribution of these species helps researchers understand their habitat requirements, which is crucial for conservation efforts.

Species Coexistence: Studying the distribution patterns of both species sheds light on their coexistence mechanisms, providing insights into community dynamics and species interactions.

Ecological Niche Partitioning: Analyzing the responses of both species to light and water gradients reveals their ecological niche partitioning, essential for maintaining biodiversity.

Climate Change Implications: As climate change alters light and water regimes, understanding how these species respond will help predict future distribution shifts and inform conservation strategies.

Invasive Species Management: Commelina benghalensis is considered invasive in some regions. This study's findings can inform management strategies to prevent its spread and mitigate impacts on native ecosystems.

Conservation of Native Species: Understanding the ecological requirements of native species like Commelina erecta informs conservation efforts, ensuring the protection of vulnerable species and maintaining ecosystem balance.

Ecosystem Services: By understanding how these species contribute to ecosystem functioning, researchers can better appreciate the importance of preserving biodiversity and ecosystem services.

Baseline Data: This study provides valuable baseline data for future research, monitoring, and conservation initiatives, enabling tracking of changes in species distribution and ecosystem health.

By exploring the effects of light and water on Commelina erecta and Commelina benghalensis, researchers can advance ecological understanding, inform conservation strategies, and ultimately contribute to preserving biodiversity.

1.7 Limitations of the study

Geographical scope: The study may be limited to a specific region or ecosystem, making it difficult to generalize findings to other areas.

Species-specific focus: The study only examines two species, which may not represent the entire plant community or ecosystem.

Environmental factors: The study only considers light and water gradients, neglecting other environmental factors like temperature, soil type, or biotic interactions.

Spatial and temporal scales: The study may be limited to a specific spatial scale (e.g., local) or temporal scale (e.g., short-term), which may not capture long-term or large-scale patterns.

Methodological constraints: Field experiments or observations may be subject to methodological limitations, such as sampling biases or measurement errors.

Intrinsic species traits: The study may not account for intrinsic species traits, like physiological or morphological characteristics, that influence distribution patterns.

Anthropogenic influences: Human activities (e.g., land use changes, pollution) may impact species distribution, but are not considered in the study.

Interactions with other species: The study may not examine interactions between Commelina species and other plant or animal species, which can influence distribution patterns.

Evolutionary adaptations: The study may not consider evolutionary adaptations of the species to changing environmental conditions.

Scalability: Findings may not be scalable to other ecosystems or regions with different environmental conditions.

Lack of baseline data: Insufficient historical data may limit the ability to compare current distribution patterns with past patterns.

Confounding variables: Unaccounted-for variables may influence the distribution patterns, leading to incomplete or inaccurate conclusions.

By acknowledging these limitations, researchers can refine their methods, consider additional factors, and consider future research directions to build upon the existing study.

CHAPTER TWO

2 LITRATURE REVIEW

2.1 Introduction

To study the effect of water gradient on the distribution of these species, I shall conduct surveys within Nagongera campus. By comparing the abundance and distribution patterns of Commelina erecta and Benghalensis in different plots to be marked, I can gain insights into their water requirements and their ability to adapt to varying water availability. This knowledge can be valuable for conservation efforts, especially in assessing the distribution patterns of Commelina species erecta and species benghalensis along light gradients and evaluating the distribution patterns of Commelina species recta and species benghalensis along water gradients.

2.1.1 Light Availability:

Light availability plays a significant role in determining the distribution of plant species. In a study by (Riis *et al*., 2012)**,** it was found that Commelina erecta exhibited a preference for open habitats with high light availability. The species showed higher growth rates and reproductive success in areas with direct sunlight, suggesting its adaptation to open environments. Similarly, Benghalensis was also found to thrive in areas with high light intensity, as reported by(Webster & Grey, 2008)**.** These findings highlight the importance of light availability in shaping the distribution of these two species.

2.1.2 Shade Tolerance:

While both Commelina erecta and Benghalensis prefer high light conditions, they also exhibit varying degrees of shade tolerance. In a study by(Isaac et al., 2013)**,** it was observed that Commelina erecta showed reduced growth and reproductive success under shaded conditions. This suggests that the species may struggle to compete with other shade-tolerant plants in densely vegetated areas. On the other hand, Benghalensis was found to possess moderate shade tolerance, as reported by(Shahrukh *et al*., 2023)**.** This ability to tolerate shaded environments may explain its wider distribution range compared to Commelina erecta.

2.1.3 Water Availability:

Water availability is another crucial factor influencing the distribution of plant species. According to a study by Kreuzwieser & Gessler (Kreuzwieser & Gessler, 2010)**,** it was found that Commelina erecta exhibited a preference for moist habitats, such as riverbanks and wetlands. The species showed higher growth rates and reproductive success in areas with adequate water supply. Similarly, Benghalensis was also found to thrive in moist environments. These findings suggest that water availability plays a significant role in determining the distribution patterns of both species.

2.1.4 Drought Tolerance:

While both Commelina erecta and Benghalensis prefer moist habitats, they also possess varying degrees of drought tolerance. According to a report by Rodenburg, Meinke, & Johnson (Rodenburg, Meinke, & Johnson, 2011) **,** it was observed that Commelina erecta showed reduced growth and reproductive success under drought conditions. This indicates its vulnerability to water scarcity, limiting its distribution in arid regions. Conversely, Benghalensis was found to possess moderate drought tolerance, as reported by(Archibold, 2012) **.** This ability to withstand water stress may explain its wider distribution range compared to Commelina erecta.

2.1.5 Competitive Interactions:

The distribution patterns of Commelina erecta and Benghalensis are also influenced by competitive interactions with other plant species. According to a report by Oba, Vetaas, & Stenseth, 2001) (Oba, Vetaas, & Stenseth, 2001) , it was found that Commelina erecta exhibited a competitive advantage over other plants in open habitats with high light availability. This suggests its ability to outcompete other species in such environments, leading to its dominance.

Similarly, Benghalensis was also found to exhibit competitive traits, as reported by(Nanjani, Soni, Paul, & Keharia, 2022) . These competitive interactions may further shape the distribution patterns of both species.

CHAPTER THREE

3 METHODS AND MATERIALS

3.1 Study Area

The sampling was done within the period of March to May 2024.

The study area was conducted within nagongera campus and was divided into plots basing on the light availability i.e. shade, partial and open areas of the campus. The coordinates where taken from each plot sampled and they include; under shade area: plot 1(0.755811, 34.044902), plot 2 (0.756432, 34.045731), plot 3 (0.756408, 34.045246), plot 4 (0.756449, 34.046149), plot 5 (0.758780, 34.045163), latitudes and longitudes respectively. In open area: plot 1 (0.756734, 34.045225), plot 2 (0.756469, 34.045707), plot 3 (0.756009, 34.045837), plot 4 (0.756600, 34.045896), (0.756644, 34.045949), latitudes and longitudes respectively.

3.2 Materials for data collection.

The researcher employed the following material during data collection in order to obtain the results of the set objectives. The material may include a quadrat, ruler, pen, a notebook and a phone with an app of GPS. (Kaffoor, Venkatachalapathi, Jamuna, Karthika, & Paulsamy, 2017)

3.3 Data collection methods

3.3.1 Quadrat method

The sampling method to be used was quadrat method. Quadrat sampling is a classic tool for the study of ecology, especially biodiversity(Oertli et al., 2005). It is an important method by which organisms in a certain proportion (sample) of the habitat are counted directly. It is used to estimate population abundance (number), density, frequency and distributions(Henderson, 2003). The quadrat method has been widely used in plant studies. A quadrat is a four-sided figure which delimits the boundaries of a sample plot(Maqboul, Aoujdad, Fadli, & Fekhaoui, 2014).

The area of study was identified and data collected on the distribution of commelina erecta and benghalensis species within Nagongera campus. I used the square quadrat of 1m x 1m to sample the distribution of commelina erecta and benghalensis within the identified area.

I randomly placed the quadrats within the study area, ensuring that they were spaced at least 10m apart to minimize overlap. I also used a bottle filled with soil and faced away from the selected area and threw it randomly to avoid biasness in data collection.

Within each quadrat, I identified and recorded the number of commelina erecta and commelina benghalensis within each quadrat thrown as per plot under study. I did the sampling in areas under shade and open areas, the shade areas where moist compared with the open areas. I repeated this process in each plot that was under study.

The figure below shows how data was collected

Figure 1 image 1

Figure 2 image 2

Figure 3 image 3.

Figure 4 image 4.

3.4 DATA ANALYSIS METHODS

3.4.1 SHANNON WEINER INDEX

The Shannon Weiner index (H') is a quantitative measure that reflects how many different types (such as species) there are in a dataset, and simultaneously takes into account how evenly the basic entities (such as individuals) are distributed among those types(Tomy, Chesneau, & Madhav, 2021). It's a widely used metric in ecology, conservation biology, and environmental science(Tucker et al., 2017). It works as follows;

Species proportion: Calculate the proportion of individuals belonging to each species (pi) in the community. This is done by dividing the number of individuals of each species by the total number of individuals.

Natural logarithm: Calculate the natural logarithm (ln) of each species proportion (pi).

Multiply and sum: Multiply each species proportion (pi) by its natural logarithm (ln pi), then sum these values for all species.

Negative sign: Apply a negative sign to the sum, which gives the SWI a positive value.

The SWI formula: SWI = $-\Sigma$ (pi ln pi)

Interpretation:

Higher values: indicate greater diversity, meaning more species are present, and each species has a relatively equal abundance.

Lower values: indicate lower diversity, meaning fewer species are present, or one species dominates the community.

4 CHAPTER FOUR

4.1 DATA PRESENTATION

The commelina species; erecta and benghalensis were each identified whenever a quadrat was thrown and were counted in open and shade areas. (table 1 and table 2).

There was a total of 443 commelina species (erecta and benghalensis); 56 commelina recta and 120 commelina benghalensis species from open area and 165 commelina erecta commelina benghalensis from shade area.

In terms of relative abundances, it was calculated basing on that particular species in a given quadrat then relative abundances within quadrats were summed up and divided by total number of quadrats to get an overall abundance of grass species in both open and shade area (Table 3).

Relative abundance of commelina erecta was 49.9 and that of commelina benghalensis was 50.1

A slightly low Shannon diversity index value was obtained from commelina benghalensis in both open and shade area while slightly high value was obtained in commelina erecta in both open and shade area. (Table 4). The evenness index was calculated for commelina species from both open and shade areas and the values obtained where for commelina erecta and benghalensis (table 4). The value of equitability ranged from 0 to 1. It's equal to 1 when all species have the same abundance and tends towards 0 when the near total of flora is concentrated on only one species.

The table below shows the distribution of commelina benghalensis and commelina erecta under the shade.

PLOT NUMBER	COMMELINA ERECTA	COMMELINA BENGHALENSIS
1	30	16
2	45	20
3	32	28
4	36	26
5	22	12

Figure 5

The table below shows the distribution of commelina erecta and benghalensis in open area

PLOT NUMBER	COMMELINA ERECTA	COMMELINA BENGHALENSIS
1	6	14
2	10	25
3	9	19
4	15	27
5	16	35

Figure 6

Table 3. Comparison of relative abundance of commelina species (erecta and benghalensis) in open and shade areas.

PLOT NO	OPEN AREA		TOTAL	SHADE AREA		TOTAL	G.TOTAL	RELATIVE ABUNDANCE	
	CE	CB		CE	CB			CE	CB
1	6	14	20	30	16	46	66	8.13	6.77
2	10	25	35	45	20	65	100	12.42	10.16
3	9	19	28	32	28	60	88	9.26	10.61
4	15	27	42	36	26	62	104	11.51	11.96
5	16	35	51	22	12	34	85	8.58	10.60
TOTAL	56	120	176	165	102	267	443	49.9	50.1

Figure 7

Table 4. Comparison of relative abundance of commelina species (erecta and benghalensis) in both open and shade areas.

CS	AREA		TOTAL	pi	pi^2	-ln pi	pi* ln pi	ln S	D	H^i	E
	OA	SA									
CE	56	165	221	0.499	0.249	0.695	0.347	5.398	4.016	0.347	0.057
CB	120	102	222	0.501	0.251	0.691	0.346	5.403	3.984	0.346	0.057
∑(values)	176	267	443	1	0.5	1.386	0.693	6.094	2	0.693	0.114

Figure 8

A graph showing relative distribution of commelina erecta and commelina benghalensis under shade

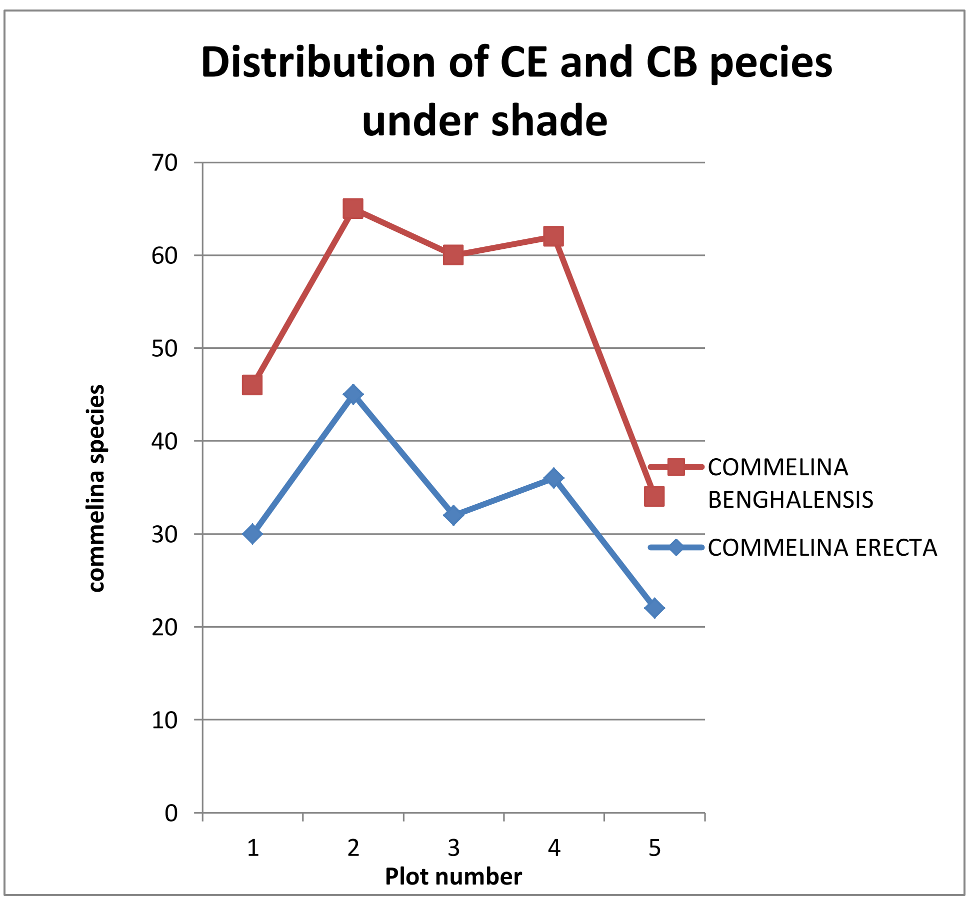

Figure 9

A graph showing relative distribution of commelina erecta and commelina benghalensis under shade

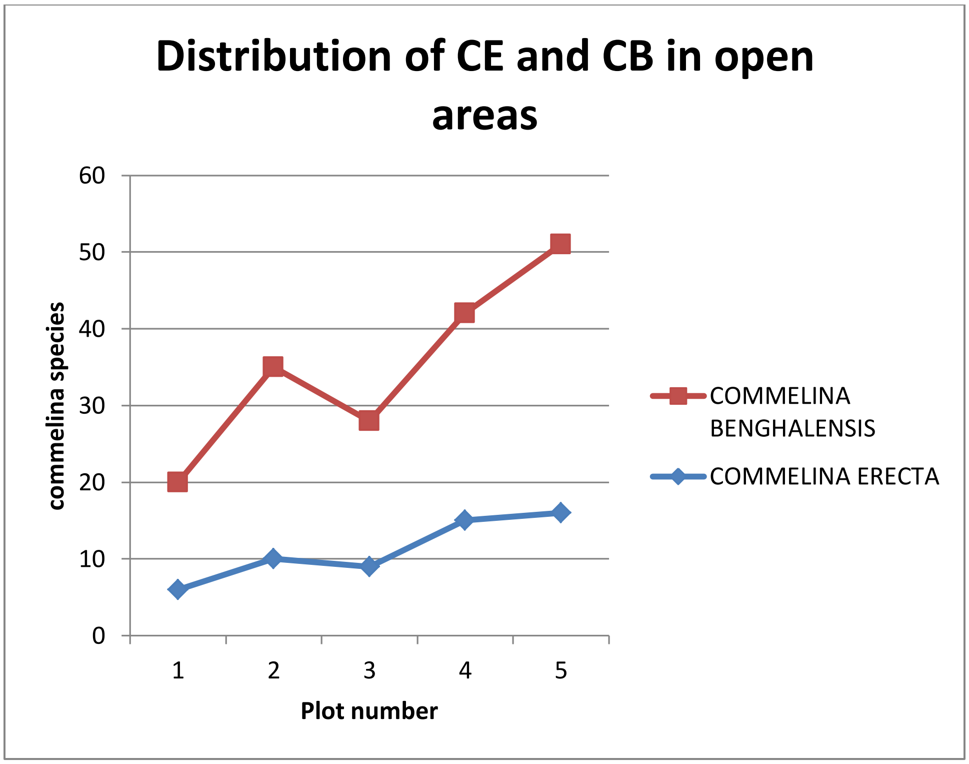

Figure 10

A pie chart showing the relative abundance of commelina erecta from the five plots sampled (open area)

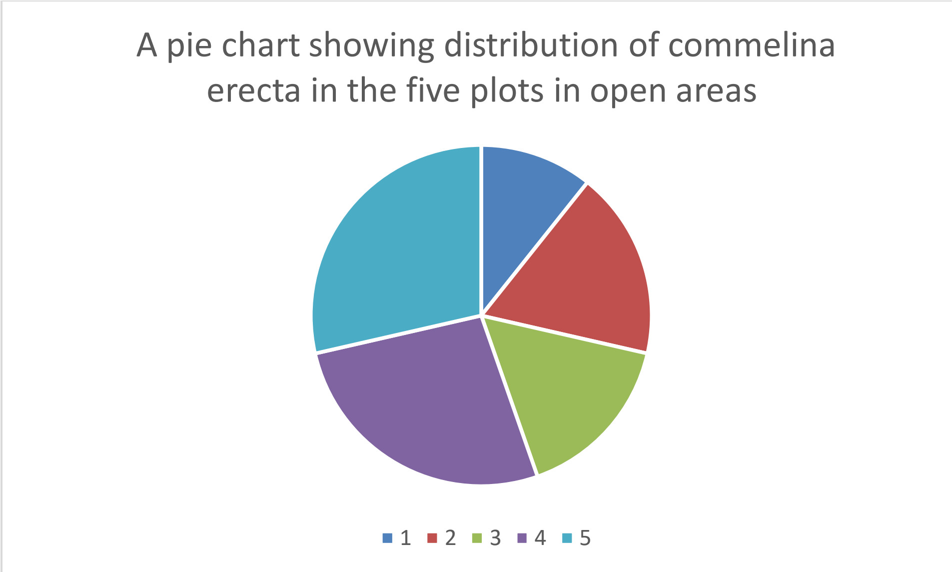

Figure 11
A pie chart showing the relative abundance of commelina benghalensis from the five plots sampled (open area)

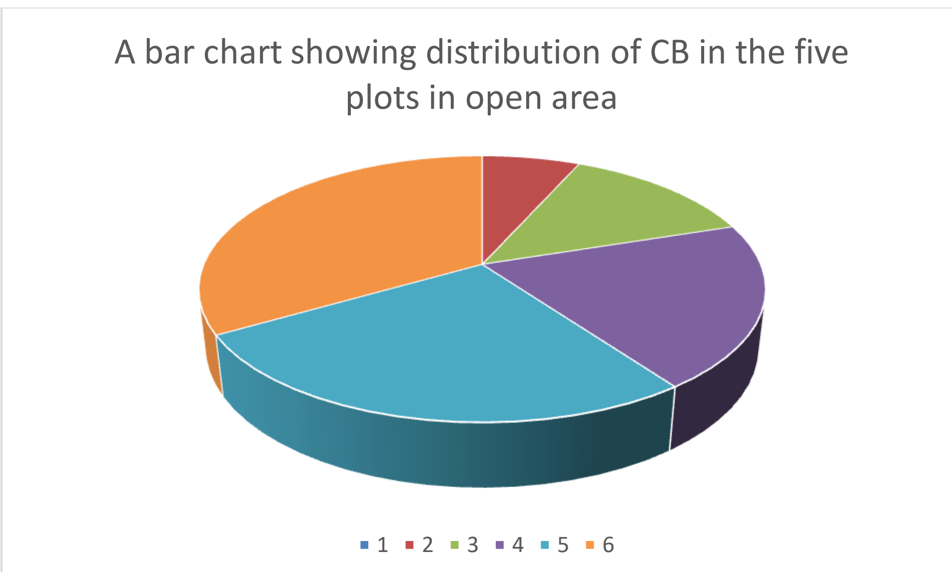

Figure 12
A pie chart showing the relative abundance of commelina erecta from the five plots sampled (shade area)

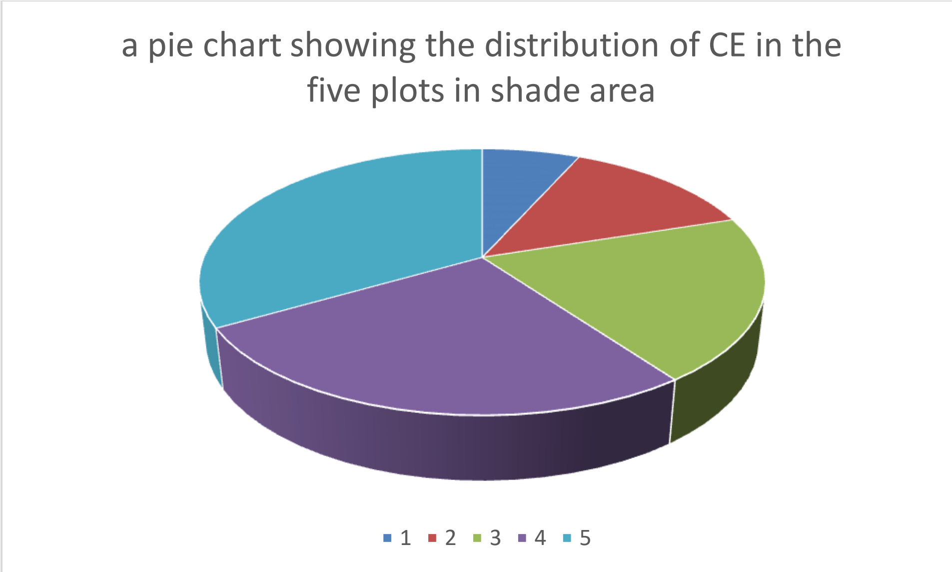

Figure 13
A pie chart showing the relative abundance of commelina erecta from the five plots sampled (shade area)

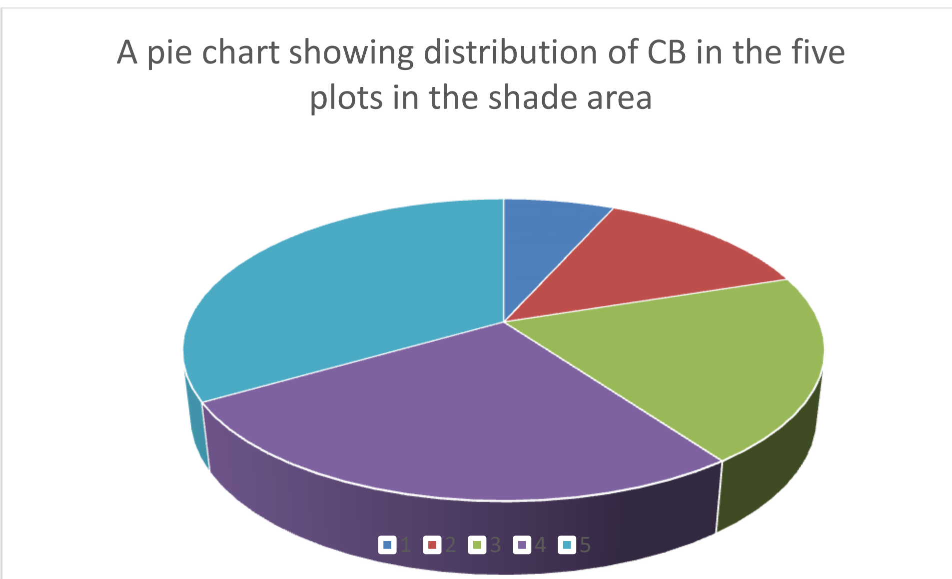

Figure 14
A pie chart showing the relative abundance of commelina erecta from the five plots sampled

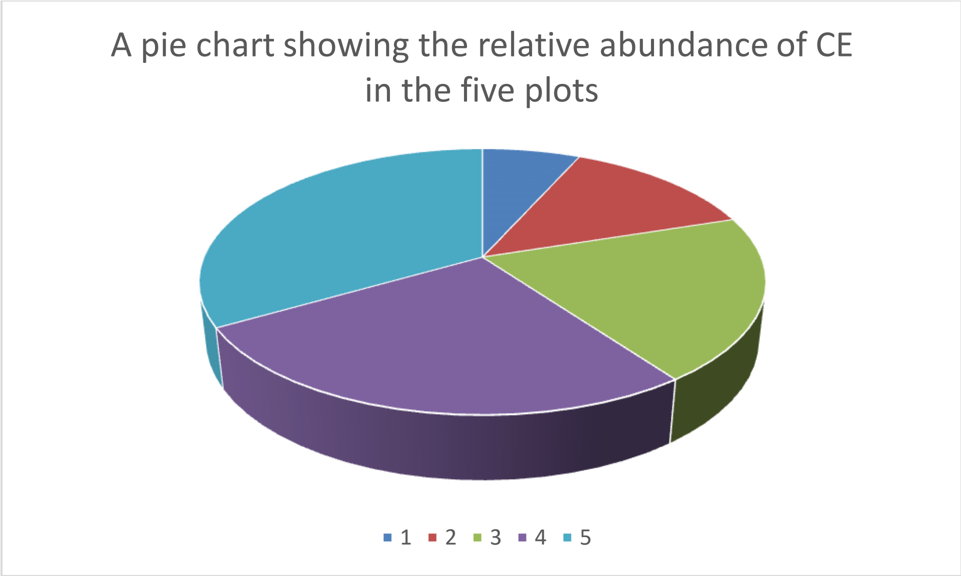

Figure 15

A pie chart showing the relative abundance of commelina benghalensis from the five plots sampled

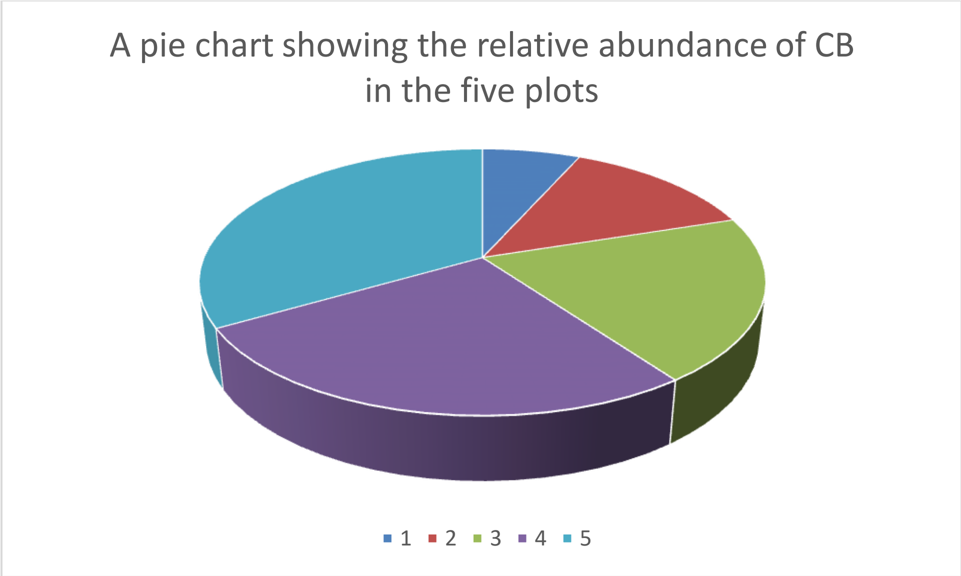

Figure 16

4.2 DATA ANALYSIS

All data were collected from the month of March to May and was subject two ways Analysis of Variance (ANOVA). Other analyses used were diversity indices which were calculated using *Shannon diversity index (H')*

The Shannon-Weiner value is high when it's above 3.0, medium when it's between 2.0 and 3.0, low when it's between 1.0 and 2.0 and very low when it's is smaller than 1.0.

Generally the Shannon diversity was smaller than 1.0 for both species from open and shade areas (Figure 8 and 9)

The diversity and evenness of grass species was higher in open areas compared to shade areas of Nagongera Town Council. (Table 4)

Simpson's value index D ranged between 0 and 1, where 0 means no diversity while 1 means infinite diversity. The value of D indicates the probability that two randomly selected individuals in a community belong to different species. The higher the value of D, the higher the diversity, while the lower the value of D the less the diversity the community is.

The lowest Simpson index in shade area was 0.63and 0.27 in open area (table 4). The values indicate 63% and 27% probability of diversity in shade and open areas respectively. This implies that shade areas was highly diverse in relation to open areas

5 CHAPTER FIVE

5.1 DISCUSSION OF RESULTS

The distribution of Commelina erecta and Commelina benghalensis in Nagongera campus, Tororo, Uganda is influenced by light and water gradients. Both species are adapted to thrive in environments with varying light and water conditions.

Commelina erecta is more tolerant of shade and can grow in areas with low light intensity, while Commelina benghalensis requires more light and is found in areas with high light intensity. The difference in light requirements leads to a segregation of the two species, with C. erecta found in more shaded areas and C. benghalensis in more open areas.

Commelina erecta is more drought-tolerant and can survive in areas with low water availability, while Commelina benghalensis requires more water and is found in areas with high water availability. The difference in water requirements leads to a segregation of the two species, with C. erecta found in drier areas and C. benghalensis in wetter areas.

5.2 CONCLUSION

In conclusion, the distribution of Commelina erecta and Commelina benghalensis in Nagongera campus, Tororo, Uganda is significantly influenced by light and water gradients. The two species have adapted to thrive in different environments, with C. erecta tolerating shade and drought, while C. benghalensis requires more light and water. The results support the idea that light and water gradients play a crucial role in shaping the distribution patterns of these species. However the results may be influenced by other environmental factors not considered in the study, such as soil type or biotic interactions. Also the study's findings may not be generalizable to other regions or ecosystems with different environmental conditions. Understanding these differences is essential for managing and conserving these species in their natural habitats. Additionally, this knowledge can be applied in agricultural practices, such as selecting suitable species for specific environmental conditions, to optimize crop growth and productivity.

5.3 RECOMMENDATION

Based on the research findings, I recommend the following:

Conservation efforts. Prioritize the protection of areas with suitable light and water gradients that support the coexistence of both Commelina species.

Habitat management. Maintain a balance between open and shaded areas to ensure a mosaic of habitats that cater to the different requirements of both species.

Water management. Implement sustainable water management practices to maintain optimal water gradients, preventing excessive waterlogging or drought that may favour one species over the other.

Monitoring and research. Continuously monitor the populations of both species and conduct research to better understand their ecological requirements and interactions.

Sustainable land use. Encourage sustainable land-use practices like agroforestry and permaculture that maintain ecological balance and reduce habitat destruction.

Community engagement. Educate local communities on the importance of conservation and sustainable land use to ensure their participation and support.

Ecotourism. Develop ecotourism initiatives that promote the appreciation and conservation of these species and their habitats.

Collaboration and policy. Foster collaboration among stakeholders, researchers, and policymakers to develop and implement effective conservation policies and strategies.

By implementing these recommendations, the distribution and coexistence of Commelina erecta and Commelina benghalensis in Nagongera campus, Tororo, Uganda, can be effectively managed and conserved for future generations.

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