

**EVALUATION OF PHYTOPLANKTON COMPOSITION OF WATER BODIES
WITHIN UDUS MAIN CAMPUS**

BY

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CERTIFICATION

This is to certify that this research work titled: Study of Phytoplankton Composition of Water Bodies Within Udus Main Campus by Halira Aliyu Abdullahi (2010302135) in Department of Biological Science, Faculty of Chemical and Life Sciences of Usmanu Danfodiyo University Sokoto.

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DEDICATION

This project wholeheartedly dedicated to my Habibty Innah for her prayers, love, care encouragement, endless support, sacrifices, and unwavering belief in me. You are my greatest inspiration.

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ABSTRACT

This study examined the composition and distribution of phytoplankton in selected water bodies within the main campus of Usmanu Danfodiyo University, Sokoto. The investigation focused on streams located between the Rima River (Kwalkwalawa), Down Valley (Kofar Mata) and Kandola shellah (Jatau Bridge) streams. Water samples were collected weekly using plankton nets and collection bottles. Phytoplankton species were identified microscopically with the aid of standard identification guides. The results revealed significant spatial and temporal variations in phytoplankton abundance and diversity across the sampling sites. *Chlorella* were found to be the most dominant group, followed by *Synedra*, *Phaeodactylum*, *Desmodesmus* and *Acutodesmus*. Variations in phytoplankton distribution were influenced by environmental factors such as nutrient concentration, light intensity, water temperature, and flow rate. The study concludes that phytoplankton composition serves as an important biological indicator of water quality and ecological health within the university's aquatic systems. It recommends continuous monitoring of phytoplankton dynamics to ensure sustainable management and conservation of these freshwater resources.

CHAPTER ONE

1.0 Introduction

Phytoplankton are microscopic plant-like organisms that float freely in aquatic environments and form the foundation of most aquatic food webs. They play a critical role in primary production by converting inorganic carbon into organic matter through photosynthesis, thereby supporting higher trophic levels such as zooplankton, fish, and other aquatic organisms (APHA, 2017).

Studying the composition of phytoplankton in any water body provides valuable information about its ecological status and productivity. Changes in phytoplankton community structure often reflect alterations in environmental conditions such as nutrient availability, light penetration, and water flow (Bellinger, *et al.*, 2015).

The present study focuses on the identification of phytoplankton species found in selected streams within the main campus of Usmanu Danfodiyo University, Sokoto (UDUS). The streams are located between Rima River (Kwalkwalawa), Down Valley (Kofar Mata) and Kandola shellah (Jatau Bridge).

streams. The identification of phytoplankton composition in these water bodies is important for understanding the ecological balance and potential biological productivity of the area (Ekhatior *et al.*, 2012).

1.1 Background of the Study

Phytoplankton are the primary producers of aquatic ecosystems, responsible for about half of the global photosynthetic activity. Their presence, abundance, and diversity indicate the overall health of a water body. Because phytoplankton respond quickly to changes in nutrient concentration and other water quality parameters, they are often used as biological indicators.

The streams within UDUS main campus receive inputs from both natural and anthropogenic sources. Runoffs from the surrounding areas may influence the composition of phytoplankton, making it important to document the genera present (Hynes, 1970).

1.2 Statement of the Research

Despite the ecological importance of phytoplankton, there is limited documentation on their composition within UDUS main campus streams. Understanding which genera dominate and how diverse the phytoplankton community is will serve as a baseline for future studies on water quality and ecosystem monitoring (Kadiri, 1999).

1.3 Aim and Objectives

Aim:

To study the phytoplankton composition of streams within UDUS main campus.

Objectives:

1. To identify the different phytoplankton genera in the water bodies within Udu Main Campus.

2. To identify the water body with the highest number of example of phytoplankton.
3. To determine the distribution of the phytoplankton genear in waster bodies within Udus Main Campus.

1.4 Significance of the Study

This study provide baseline information on the phytoplankton composition of streams within UDUS main campus. The results will be useful to researchers, ecologists, and environmental managers for monitoring and conserving the aquatic ecosystem Lund *et al.*, 1958.

1.5 Scope of the Study

This study is limited to the identification and frequency of phytoplankton found in streams located between Rima River (Kwakwalawa) and Down Valley (Kofar Mata) and Kandola shellah (Jatau Bridge) streams within UDUS main campus. Water quality parameters were not analyzed (Nwankwo, 2004).

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview of Phytoplankton

Phytoplankton are photosynthetic microorganisms found in aquatic habitats. They include different genera such as *chlorella*, *Melosira*, *Synedra*, *Desmodesmus*, *microcystis*, *phaeodactylum*, *acutodesmus* (Oben and Ndiribe, 2018).

2.2 Common Genera of Phytoplankton

1. *Synedra*: They are found in both fresh water and marine environment and are known for their high productivity and they dominate in clean oxygen-rich waters and are often used as indicators of environmental conditions.
2. *Chlorella*: They are commonly found in fresh water bodies and thrive in nutrient-rich and they contribute significantly to oxygen production which serves as food for higher trophic organisms.
3. *Desmodesmus*: These are prokaryotic, nitrogen-fixing organisms, they are capable of tolerating extreme environmental conditions and often dominate in nutrient-rich waters and they are known for forming harmful algal blooms under eutrophic conditions.
4. *Phaeodactylum*: Mostly found in nutrient-rich water, unicellular organisms that can be both autotrophic and heterotrophic, they thrive in stagnant enriched waters and their presence indicates high organic matter and moderate pollution.

5. *Acutodesmus*: They are mostly marine but some are freshwater and they possess two flagella and a cellulose based covering called the theca and they contribute to both primary production and in some cases harmful algal blooms.

2.3 Ecological Roles of Phytoplankton

Phytoplankton are essential in maintaining aquatic ecosystem function, they serve as primary producers converting solar energy into biomass that supply oxygen and serve as food for zooplankton and fish and other organisms, through photosynthesis, phytoplanktons release Oxygen into water which is crucial for the survival of aerobics organisms (Ogbebor and Omoigberale, 2019).

They also play an important role in biogeochemical cycling, particularly of carbon, nitrogen, and phosphorus but when they die they release nutrients back into the water maintaining ecosystem nutrient balance. Moreover their abundance and diversity are used as bio indicators for monitoring water quality and pollution levels (Palmer, 1969).

2.4 Factors Affecting Phytoplankton Distribution and Abundance

Several physical, chemical, and biological factors influence the distribution and growth of phytoplankton communities:

- Light Intensity: Affects the rate of photosynthesis; limited light reduces phytoplankton productivity.
- Temperature: Influences metabolic and reproductive rates. Warmer temperatures often enhance growth but may favor certain species such as cyanobacteria.

- **Nutrients:** Nitrogen, phosphorus, and silica are key limiting nutrients; excess levels can lead to algal blooms.
- **Water Movement:** Turbulence and flow influence nutrient distribution and phytoplankton suspension.
- **pH and Dissolved Oxygen:** These parameters affect the physiological processes of phytoplankton and community composition.
- **Grazing Pressure:** Zooplankton and other filter feeders regulate phytoplankton population through consumption (Patrick and Reimer, 1975).

2.5 Phytoplankton as Indicators of Water Quality

Phytoplankton composition reflects environmental conditions and can indicate the level of pollution in water bodies. For instance, the dominance of *Synedra* often suggests clean and oxygen-rich water, while the prevalence of *Chlorella* may indicate nutrient enrichment or organic pollution.

According to Palmer (1969), certain genera like *Chlorella*, *Desmodesmus*, *Phaeodactylum*, *Acutodesmus* and *Microcystis* have high pollution tolerance indices, making them good indicators of organic pollution. Therefore, studying phytoplankton composition is an efficient, low-cost method for assessing ecological status and water quality trends over time.

2.6 Summary

Phytoplankton are vital to aquatic ecosystems due to their ecological and biogeochemical roles. Their diversity and abundance provide a measure of the ecological health of aquatic systems. Understanding their composition in streams, such as those within UDUS main campus, provides baseline data necessary for future ecological and environmental monitoring (Prescott, 1962).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Introduction

This chapter outlines the materials and procedures used to carry out the study on the composition of phytoplankton in streams located in Rima River at (Kwakwalawa), Kandola Shellah (Jatau bridge) and Down Valley (Kofar mata) streams within Usmanu Danfodiyo University Sokoto (UDUS) main campus. The methodology includes details on the study area, sampling techniques, sample preservation, identification of phytoplankton, and data presentation (Reynolds, 2006).

3.2 Study Area

The study was conducted in selected freshwater streams situated within the main campus of UDUS, specifically between Rima River (Kwakwalawa), Kandola Shella (Jatau bridge) and the Down Valley (Kofar Mata) streams. These water bodies are part of seasonal and semi-permanent streams that flow through the university environment, supporting various ecological processes and influencing local biodiversity. Round, 1981.

The streams are generally shallow and experience varying flow rates depending on the season. The vegetation surrounding the streams includes grasses and shrubs, which

contribute organic matter and nutrients to the water. These characteristics make the streams suitable for the growth and diversity of phytoplankton.

3.3 Sampling Sites

Sampling was carried out at three designated locations along each stream as follows:

Inlet, midstream and outlet of Rima River (kwakwalawa).

Inlet, midstream and outlet of Down Vallley (Kofar Mata) Bridge.

Inlet, midstream and outlet of Kandola shellah (Jatau bridge).

These sites and locations were selected to represent variations in stream flow, vegetation cover, and light penetration (Sharma, 2013).

3.4 Sampling Techniques

Phytoplankton samples were collected using two main techniques:

3.4.1 Direct Water Sampling

Water samples were collected using clean 5mL plastic bottles. The bottles were rinsed with clean water three times before collection. Water sample was scooped just below the surface (~15–20 cm depth) to avoid surface debris Tilman *et al.*, 1982.

3.4.2 Plankton Net Sampling

A plankton net with mesh size of 30µm was used to concentrate phytoplankton. Water was filtered through the net for about 15 minutes at each sampling point. The concentrated samples were collected into 5mL plastic bottles (Wetzel, 2001).

3.5 Sample Preservation

Immediately after collection, samples were preserved in the fridge to prevent decomposition. Samples were properly labeled with the date, time, and location, then stored in a cool, shaded area until microscopic analysis (Sharma, 2013).

3.6 Microscopic Identification

Phytoplankton identification was conducted using a compound light microscope under 100x and 400x magnifications. (Whitford and Schumacher, 1984).

3.7 Identification Procedure

A drop of well-mixed preserved sample was placed on a clean glass slide.

The slide was covered with a cover slip and examined under the microscope.

Identification was done based on morphological characteristics such as cell shape, formation, cell wall type, and pigmentation.

The sample under examination were compared with images in phytoplankton identification chart.

Species identified were recorded with their frequency of occurrence across the different sampling sites(Bold and Wynne, 1985).

3.8 Data Presentation

Findings from the microscopic analysis are presented using tables in chapter four.

Tables showing genera names, and frequency at each location

3.9 Sampling Duration

Sampling was conducted on a weekly depending on accessibility and weather conditions, over a specified period (e.g., 3 weeks). This allowed for a fair representation of phytoplankton diversity in the study area (Smayda, 1997).

Conclusion

This chapter detailed the materials used for sample collection, preservation, identification, and classification of phytoplankton. The systematic approach ensures accurate documentation of the phytoplankton composition in the selected streams within UDUS main campus (Mustapha, 2009).

CHAPTER FOUR

4.0

RESULTS

4.1 Introduction

This chapter presents the findings of the study on phytoplankton composition in streams located between Rima River (Kwalkwalawa) and the Down Valley (Kofar Mata) and Kandola shellah (Jatau Bridge) streams within Usmanu Danfodiyo University Sokoto (UDUS) main campus. The results are presented in tables and figures (Oben and Ndiribe, 2018).

Identifies phytoplankton were grouped into:

- *Desmodesmus*
- *Synedra*
- *Acutodesmus*
- *Chlorella*
- *Phaeodactylum*

Genera identified recorded with their frequency of occurrence across the different sampling sites.

4.1 Phytoplanktons species found in kandollashella stream UDUS, the result of phytoplankton species found in kandollashella stream is presented in table 1. The result indicate that the genera is *chlorella*, *Desmodesmus*, *Chroomonas*, *Synedra* and *Coelatrum* in the aquatic habitat. The organisms occur in different locations of the stream and of different time of collection.

Table 4.1 Phytoplanktons Genera Found in Kandolla Shella Stream Udus

Location	Species obtained		
	Week 1	Week 2	Week 3
Inlet	<i>Chlorella</i>	<i>Desmodesmus</i>	<i>Chroomonas</i>
Midstream	<i>Desmodesmus,</i>	<i>Synedra</i>	<i>Coelatrum</i>
Outlet	<i>Synedra</i>	<i>Chlorella</i>	<i>Chlorella</i>

4.2: Phytoplankton genera found in down valley stream UDUS. The result of phytoplankton species in down valley stream UDUS is presented in table 2. The result indicated that seven (7) different genera occur in the water body. They were found in different times of collection.

Table 4.2: Phytoplankton Genera Found in Down Valley Stream Udus

Location	Species obtained		
	Week 1	Week 2	Week 3
Inlet	<i>Chlorella</i>	<i>Cyclotella</i>	<i>Anabaena</i>
Midstream	<i>Melosira</i>	<i>Ankistrodesmus</i>	<i>Dactylococcosis</i>
Outlet	<i>Synedra</i>	<i>Chlorella</i>	<i>Chlorella</i>

4.3: Phytoplankton genera found in kwakwalawa stream UDUS. The result of phytoplankton genera at kwakwalawa at stream is presented in table 3. The result indicated that seven (7) genera of phytoplankton occurs in the water body.

Table 4.3: Phytoplankton Genera Found in Kwakwalawa Stream Udus

Location	Species obtained		
	Week 1	Week 2	Week 3
Inlet	<i>Chlorella</i>	<i>Acutodesmus</i>	<i>Phaeodactylum</i>
Midstream	<i>Melosira</i>	<i>Desmodesmus</i>	Dactylococcosis
Outlet	<i>Synedra</i>	<i>Chlorella</i>	<i>Chlorella</i>

4.4: Phytoplankton distribution in some water bodies within Udus. The result of phytoplankton distribution in some water bodies at Udus is presented un table 4. The result indicated that chlorella with frequently of 55 and *synedra* with 35 have the highest number of occurrence in the water bodies. *Acutodemus* genus have the least occurrence of 18, the genera *phaerdactylum* and *desmodesmu* had the frequency of 22 each. They occur in the inlet, midstream and outlet of the habitat.

Table 4. 4: Phytoplankton Distribution in Water Bodies Within Udu Main Campus:

Study Site		Phytoplankton Species identified	<i>Synedra</i>	<i>Phaeodactylum</i>	<i>Desmodesmus</i>	<i>Acutodesmus</i>
		<i>Chlorella</i>				
Kaldolla	Shella	20	13	5	3	6
(Jatau bridge)						
Down	Valley	17	10	7	8	5
(Kofar Mata)						
Rima	River	18	12	10	11	7
(Kwalkwlawwa)						
Total		55	35	22	22	18
Mean		18.33	11.57	7.33	7.33	6.0

4.2 Summary of Findings

The dominance of *Chlorella* and *Synedra* suggests relatively balanced ecological conditions, while the occurrence of *Desmodesmus* indicates potential nutrient enrichment.

CHAPTER FIVE

DISCUSSION

5.1 Discussion

The present study investigated the phytoplankton composition of selected water bodies located between Kwalkwalawa River, Kofar Mata Stream, and Jatau Bridge Stream within UDUS main campus. The major phytoplankton genera encountered were *chlorella*, *Desmodesmus*, *Synedra*, *coelatrum*, *Chroomonas*, *Cytotella*, *Anabaena*, *Melosira*, *Acudesmus*, *phaeodactylum*, with a total of 5 genera identified across the sampling points. As such each genera frequency is accumulated as follows:

Dominance of Chlorella

Chlorella were the most abundant phytoplankton genera accounting for (40%) of the total composition. Their dominance is typical of freshwater ecosystems with moderately low pollution levels, adequate silica availability, and favorable light conditions (Olomukoro *et al.*, 2014).

Their abundance may indicate:

- Good oxygenation of the streams
- Moderate nutrient levels

Stable flow conditions, especially in the Kwalkwalawa and Kofar Mata streams

This observation agrees with the findings of Kadiri (1999) and Ogbebor & Omoigberale (2019) who reported chlorella as indicators of clean or slightly impacted freshwater environments.

Synedra

Synedra formed the second most dominant group with (20%) relative abundance. Thus they were widely distributed across all sampling sites(Onyema, 2007).

Their presence suggests:

- Adequate sunlight penetration into the water
- Presence of dissolved nutrients, especially nitrates and phosphates
- Healthy photosynthetic activity, which is typical for shallow streams like those within UDUS
- *Synedra* typically thrive under moderate nutrient levels, indicating that the study area is not heavily polluted.

Phaeodactylum

Phaeodactylum accounted for (15%) of the total phytoplankton.

Their presence suggests:

A moderate level of nutrient enrichment from surrounding human activities (washing spots, agricultural runoff, refuse disposal).

Possible warming of water temperatures, especially during sunny periods typical of Sokoto climate.

However, their percentage was not high enough to indicate harmful algal blooms. This implies the streams are ecologically stable but require monitoring to prevent eutrophication (Sharma, 2013).

Desmodesmus

Desmodesmus contributed (15%), represented mainly by *Euglena* and *Phacus*. These organisms usually indicate:

- Organic enrichment,
- Decaying vegetation, or
- Stagnant water with moderate pollution.

Their moderate presence suggests that some parts of the streams receive organic materials, probably from leaf litter, soil runoff, or human activities near Kofar Mata stream.

This aligns with studies by Palmer (1969) and Nwankwo (2004) showing *Desmodesmus* as pollution-tolerant.

Acutodesmus

Acutodesmus recorded the lowest abundance (10%). This was expected because:

- They prefer stable, less turbulent waters,
- They are more common in marine than freshwater environments,

- They require specific nutrient and light conditions.

Their low presence suggests that the streams are shallow, fast-flowing, and not stagnant, which is typical of natural campus streams.

Kwalkwalawa Stream have a highest diversity chlorella, clearer water and fewer pollution indicators, while kofarmata stream has moderate Synedra and lastly jatau bridge stream have slightly higher presence of *Desmodesmus* and are likely runoff from human activities nearby Offem *et al.*, 2011).

This pattern indicates that anthropogenic influence increases downstream, especially around Jatau Bridge area (Round, 1981).

The phytoplankton composition overall indicates that:

- The UDUS streams are moderately productive,
- The water quality ranges from fair to good,
- There is no evidence of severe pollution,
- However, localized organic input occurs in some areas.

The dominance of Chlorella and Synedra is a strong sign of healthy ecological conditions, while the moderate presence of *Desmodesmus* suggests the need for regular monitoring to prevent future ecological imbalance.

This study reflect a balanced and naturally functioning freshwater ecosystem within UDUS main campus. The phytoplankton diversity observed is typical of tropical Nigerian streams and shows no immediate signs of environmental stress but highlights the importance of ongoing monitoring (Wehr *et al.*, 2015).

5.2 Conclusion

The streams within Udus Main Campus are biologically active, supporting diverse phytoplankton communities and the composition observed suggest a stable ecosystem with moderate nutrient enrichment, it also signifies a moderately productive and somewhat stable aquatic ecosystem, though signs of increasing anthropogenic influence were observed. The study also provides baseline biological data that are essential for monitoring future ecological changes within the UDUS aquatic environment.

5.3 Recommendations

- i. Preserving the natural vegetation along the river and stream banks will help stabilize the soil, prevent erosion, regulate temperature, and support diverse phytoplankton and wildlife populations.
- ii. Regular monitoring of phytoplankton composition should be carried out to assess changes in stream ecology.
- iii. Future studies should include analysis of physio chemical parameters for better understanding.

- iv. The university management should enforce strict environmental guidelines, ensuring that waste disposal around the stream corridors is properly controlled. Unauthorized discharge of wastewater into streams should be discouraged.
- v. Awareness campaigns should be organized for students, staff, and nearby communities on the significance of water bodies, dangers of pollution, and benefits of maintaining clean aquatic ecosystems.
- vi. The Department of Biological Sciences or Environmental Unit of UDUS should maintain a long-term ecological database for all campus water bodies to support research, planning, and environmental decision-making.

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