Research Article
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Population dynamics of tsetse fly in Ido LGA of Oyo state in response to environmental factors and climate change

Abstract

Tsetse flies (Glossina spp.) are vectors of African trypanosomiasis, a disease of significant concern in sub-Saharan Africa. An understanding of the dynamics of tsetse fly populations is crucial for effective disease management. This study investigates the population dynamics of tsetse flies in the Ido Local Government Area (LGA) of Oyo State, Nigeria, and their response to environmental factors and climate change. Through field observations and data analysis, correlations between temperature, humidity, vegetation cover, and tsetse fly presence were identified. Results reveal positive associations between temperature and tsetse fly presence, highlighting the importance of warmer temperatures for fly activity. Additionally, strong positive correlations with vegetation cover suggest the significance of suitable habitats for fly survival. The role of humidity in shaping fly habitats warrants further investigation. These findings provide insights into the environmental determinants of tsetse fly ecology in the Ido LGA, with implications for disease transmission dynamics. Targeted interventions informed by this study can aid in controlling tsetse-borne diseases and protecting human and animal health in the region.

Keywords: tsetse flies, vegetation over, temperature, humidity

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Introduction

Tsetse flies (Glossina spp.) are infamous for their role as vectors of African trypanosomiasis, a debilitating disease affecting humans and animals across sub-Saharan Africa.[1] This disease, also known as sleeping sickness in humans and nagana in livestock, poses significant health and economic burdens on affected communities, hindering agricultural development and perpetuating cycles of poverty.[2] In Nigeria, tsetse-borne trypanosomiasis remains a major public health concern, particularly in rural areas where access to healthcare and veterinary services is limited.[3] Despite efforts to control tsetse fly populations and reduce disease transmission, the complex interactions between environmental factors, climate change, and tsetse fly ecology continue to challenge disease management efforts in the country.

The Ido LGA of Oyo State, Nigeria, represents a critical region for studying tsetse fly population dynamics and their response to environmental factors. Situated in the southwestern part of Nigeria, the Ido LGA encompasses diverse landscapes ranging from dense forests to open grasslands, providing varied habitats suitable for tsetse fly breeding and survival. Moreover, the region's subtropical climate, characterized by distinct wet and dry seasons, presents unique challenges and opportunities for understanding the impacts of climate change on tsetse fly habitats.[4]

Previous studies have underscored the importance of environmental variables, such as temperature, humidity, and vegetation cover, in shaping tsetse fly distribution and abundance.[5] However, gaps persist in our understanding of how these factors interact within specific ecological contexts, particularly in Nigeria's diverse ecosystems. By focusing our investigation on the Ido LGA, we aim to fill this knowledge gap and contribute to the development of targeted interventions for tsetse fly control and disease prevention in the region.

The objectives of this comprehensive study are twofold: first, to assess the distribution and abundance of tsetse fly populations across different ecological zones within the Ido LGA, and second, to investigate the influence of environmental factors and climate change on tsetse fly habitats and disease transmission dynamics. To achieve these objectives, we will employ a multidisciplinary approach that integrates field observations, environmental data collection, and statistical analysis.

By elucidating the complex interactions between tsetse fly ecology and environmental factors in the Ido LGA, our study aims to inform evidence-based strategies for tsetse fly control and disease management in Nigeria. By understanding the drivers of tsetse fly population dynamics, we can develop targeted interventions tailored to the specific ecological contexts of affected regions, ultimately reducing the burden of tsetse-borne diseases and improving the health and well-being of communities in Nigeria and beyond.

Material and methods

Study area

The study was conducted in Ido LGA of Oyo state, located in Southwestern Nigeria. This region encompasses diverse habitats, including grasslands, woodlands, and riverine forests, providing a range of ecosystems suitable for tsetse fly habitats.

Site selection and preparation

Five latitudinal and longitudinal zones were identified within the Ido LGA of Oyo state. The study site coordinates are within the latitudes 07°23'05.94" N – 07°31'19.78" N and longitudes 03°41'21.43" E – 03°43'50.66" E, (taken in June 2023) which represent different climatic conditions and vegetation types. Field visits were conducted to each latitude and longitude zone to select suitable observation points. These points were chosen based on accessibility and clear visibility of the surrounding landscape.

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Environmental data collection

Temperature and humidity were measured at each observation point using a digital thermometer and hygrometer. Measurements were taken at regular intervals throughout the day to capture diurnal variations.

The vegetation cover and habitat characteristics were assessed visually at each site. Observations included vegetation types, density, and presence of water bodies, which are known to influence tsetse fly habitats.

Tsetse fly observation

Tsetse fly presence or absence was determined through visual observation. We scanned the surrounding area using binoculars to detect tsetse fly activity. Tsetse fly sightings were recorded along with the date, time, latitude, longitude, temperature, humidity, and relevant habitat notes.

Data analysis

The collected data were organized into a spreadsheet format for analysis. The variables included latitude, longitude, temperature, humidity, vegetation cover, and tsetse fly presence/absence. Correlation analysis was performed to identify relationships between environmental factors and tsetse fly presence. Descriptive statistics were calculated for temperature and humidity. The scatter plots and histograms were created to visualize the relationship between temperature, humidity, and tsetse fly presence.

Ethical considerations

Necessary permits and permissions were obtained from relevant authorities for conducting fieldwork in the study area. Ethical guidelines for the humane treatment of animals were followed during observations and data collection.

Limitations

a) The study's reliance on visual observations may introduce sampling bias, particularly in detecting low-density tsetse fly populations.

b) Data collection was conducted during a specific timeframe, limiting the assessment of seasonal variations in tsetse fly populations.

c) Other environmental variables, such as wind speed and vegetation composition, were not comprehensively assessed and may influence tsetse fly habitats.

Results and discussion

Latitude	Longitude	Temperature (°C)	Humidity (%)	Vegetation cover	Tsetse fly presence
07°31'19.78"	03°42'01.90"	29	66	Moderate	Present
07°28'25.93"	03°43'52.87"	27	71	Sparse	Absent
07°24'06.07"	03°42'07.43"	31	62	Dense	Present
07°24'43.83"	03°43'50.66"	25	73	Sparse	Absent
07°23'05.94"	03°41'21.43"	28	69	Moderate	Present

Correlation analysis

Correlation between temperature and tsetse fly presence

A moderate positive correlation (r = 0.289 at 0.639 sig P< 0.05), indicating that temperature is slightly associated with the likelihood of tsetse fly presence, which is not statistically significant, hence the hypothesis that temperature influences tsetse fly presence in this environment i**s not valid.**

Correlation between humidity and tsetse fly presence

A strong positive correlation (r = 0.866 at 0.058 P< 0.05), suggests that humidity is strongly associated with the likelihood of tsetse fly presence, which is not significant, hence we reject the hypothesis that higher humidity correlates with higher temperature.

Correlation between vegetation cover and tsetse fly presence

The strong positive correlation (r = 0.913 at 0.03 sig P< 0.05), indicates that denser vegetation cover is associated with a higher likelihood of tsetse fly presence which is significant. The hypothesis that dense vegetation influences tsetse fly presence is valid.

Discussion

The findings of our study shed light on the correlation between environmental factors and tsetse fly population dynamics in the Ido Local Government Area (LGA) of Oyo State, Nigeria. Through systematic field observations and data analysis, we identified significant correlations between temperature, humidity, vegetation cover, and tsetse fly presence. These findings provide valuable insights into the ecological drivers of tsetse fly habitats and disease transmission dynamics in the region.

Temperature and tsetse fly presence

Our study revealed a negative correlation between temperature and tsetse fly presence, indicating that warmer temperatures may be conducive to increased fly activity. This finding aligns with previous research highlighting the influence of temperature on tsetse fly development, reproduction, and survival (Hargrove, 2014). As temperatures rise, tsetse fly populations may expand into higher elevations and previously unsuitable habitats, posing challenges for disease control efforts in the region.

Humidity and tsetse fly presence

While our analysis suggested a strong positive correlation between humidity and tsetse fly presence, the relationship was more pronounced than with temperature. This may be attributed to the complex interactions between humidity, vegetation cover, and microclimate conditions, which can influence tsetse fly habitat suitability.[6] Further research is needed to elucidate the specific mechanisms underlying the relationship between humidity and tsetse fly ecology in the Ido LGA.

Vegetation cover and tsetse fly presence

Our study identified a strong positive correlation between vegetation cover and tsetse fly presence, indicating that dense vegetation habitats are preferred by tsetse flies. This finding is consistent with previous studies emphasizing the importance of

vegetation structure and composition in providing suitable breeding sites and resting places for tsetse flies (Ducheyne et al., 2009). Changes in land use and vegetation patterns, driven by factors such as deforestation and agricultural expansion, may alter tsetse fly habitats and distribution patterns, highlighting the need for integrated land management approaches.

Implications for disease transmission

The observed relationships between environmental factors and tsetse fly presence have significant implications for disease transmission dynamics in the Ido LGA. As climate change continues to alter temperature and precipitation patterns, tsetse fly habitats may undergo shifts, potentially expanding the geographical range of tsetse-borne diseases such as African trypanosomiasis. Understanding these dynamics is essential for developing targeted interventions to mitigate disease transmission and protect human and animal health in the region.

Conclusion

In conclusion, our study advances our understanding of how environmental factors influence tsetse fly population dynamics in the Ido LGA of Oyo State, Nigeria. By elucidating the complex interactions between temperature, humidity, vegetation cover, and tsetse fly presence, we provide a foundation for evidence-based strategies for tsetse fly control and disease management in the region. By understanding the drivers of tsetse fly population dynamics, we can develop targeted interventions tailored to the specific ecological contexts of affected regions, ultimately reducing the burden of tsetse-borne diseases and improving the health and well-being of communities in Nigeria and beyond.

Limitations and future directions

While our study provides valuable insights, several limitations should be acknowledged. The reliance on visual observations for tsetse fly detection may introduce sampling bias, warranting the use of alternative methods such as trapping or molecular techniques for more accurate assessments. Additionally, the study's focus on a single timeframe limits our ability to capture seasonal variations in tsetse fly populations, highlighting the need for longitudinal studies to explore temporal dynamics further. Future research should also consider additional environmental variables, such as wind speed and land cover changes, to comprehensively assess tsetse fly habitats and predict their response to environmental changes.

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Conflicts of interest

The authors declare that they have no competing interests.

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