

Leveraging Local Ecological Knowledge for Bat Conservation: Insights from a Community-Based Study in the Ebo Forest Reserve, Littoral Region of Cameroon.

ABSTRACT

Aims: This study aims to examine local perceptions of bats among communities surrounding the Ebo Forest Reserve in Cameroon, highlighting the significance of local ecological knowledge (LEK) for enhancing bat conservation efforts.

Study Design: A mixed-methods approach was employed to gather quantitative and qualitative data from community members.

Place and Duration of Study: The research was conducted in communities adjacent to the Ebo Forest Reserve, Cameroon, between January and July 2024.

Methodology: The majority of the respondents (59%) were from the Iboti community, while 41% were from the Lognanga community to assess their knowledge, attitudes, and engagement in bat conservation. The survey included questions about ecological significance, perceived threats, and cultural associations related to bats. Statistical analyses included descriptive statistics (frequencies, percentages and standard deviations) and inferential statistics, such as Chi-Square Tests of Independence, analysis of variance were conducted to evaluate the relationships between demographic factors and attitudes toward bats.

Results: The survey revealed that 100% of respondents recognized bats' ecological importance, primarily as frugivores. While attitudes were generally neutral to positive, misconceptions about disease and cultural associations were prevalent. Statistical analyses indicated significant relationships between age and attitudes toward bats, with older individuals exhibiting more positive perceptions ($p < 0.05$).

Conclusion: The findings underscore the critical need to integrate LEK into conservation strategies to foster community engagement and support for bat conservation initiatives. Addressing misconceptions and enhancing awareness can significantly improve conservation outcomes in the region.

Keywords: Bats, Conservation, Local Ecological Knowledge, Human-Wildlife Interactions

BACKGROUND

The conservation of bat populations is increasingly recognized as critical due to their vital ecological roles, including pollination, seed dispersal, and pest control [23]. However, bat populations are experiencing significant declines globally, primarily driven by anthropogenic activities such as habitat destruction, hunting, and persecution [14]. These declines pose serious threats to ecosystems, as bats contribute to biodiversity and the functioning of various ecological processes [7]. Understanding human

perceptions and attitudes towards bats is essential for effective conservation strategies, particularly in regions where cultural beliefs and economic factors influence human-bat interactions [7].

Globally, bats are often viewed with a complex mix of fascination and fear. Their nocturnal habits and unique morphology have led to associations with the supernatural and death in many cultures. In some regions, bats are revered for their ecological contributions, while in others, they are vilified as pests responsible for agricultural damage [4]. This dichotomy in perceptions complicates conservation efforts, as negative attitudes can lead to direct persecution and habitat degradation [14]. For instance, fruit-eating bats are often targeted in agricultural settings due to their perceived threat to crops, resulting in significant economic losses for farmers [36].

In Africa, the situation is similar, with many bat species facing threats from habitat loss due to urbanization, agricultural expansion, and deforestation [21]. The continent is home to a rich diversity of bats, yet many species are understudied and lack adequate protection [27]. In regions like Southeast Asia, unregulated hunting for bushmeat further exacerbates the decline of bat populations, as bats are considered a delicacy in many urban areas [5]. In Africa, bats are not only hunted for food but also face threats from traditional practices and superstitions that may lead to their persecution [16]. However, conservation efforts for the non-game and non-charismatic wild creatures such as bats should not only focus on the environmental issues, but also on social and cultural matters [13]. Assessing resident's perception and level of awareness toward bats in general on their demographic structures, can provide important insight into how to improving urban wildlife management. Furthermore, the general public attitude towards bats has not been investigated extensively throughout the world [28].

Bats currently face several threats to survival that have caused significant declines in various bat populations. Wind turbines are one such threat [43,9]. There are some hypotheses as to why bats are attracted to turbines. Bats may interpret turbines as tree-like structures, and have actually been observed foraging around them, even trying to land on them [43]. Another hypothesis is they may be attracted to the gaps formed by turbine corridors; a feature they are attracted to on the landscape level [43]. Many estimates have been made on how many bats are killed in the U.S. as a result of wind turbines, and they range from 200,000 to over 800,000 individuals killed annually [43].

Bats have shown evidence of being sensitive to fragmentation from agricultural and or urban expansion [37,36, 41]. Fragmentation, and habitat loss, are responsible for the decline of many wildlife populations [1]. Some research has found evidence indicating that urbanization and fragmentation may negatively impact bats [25].

Cameroon, located in Central Africa, reflects these broader trends in bat conservation. The country is characterized by diverse ecosystems, including rainforests, savannahs, and mountainous regions such as Mount Cameroon which provide critical habitats for numerous bat species [34]. However, like many African nations, Cameroon faces significant challenges related to habitat loss and degradation. Deforestation driven by logging, agriculture, and urban expansion has resulted in the fragmentation of bat

habitats, impacting their foraging and roosting sites [34]. Furthermore, local communities often engage in hunting and trapping of bats for food, which poses additional threats to their populations [34].

Despite these challenges, there is a growing recognition of the importance of incorporating local ecological knowledge (LEK) into conservation strategies. Community-based conservation approaches that leverage LEK can enhance the effectiveness of bat conservation efforts by fostering local stewardship and promoting sustainable practices [7]. LEK encompasses the understanding, skills, and insights that local communities possess regarding their environment, and it can provide valuable information on species distribution, habitat use, and ecological interactions [7]. Furthermore, assessing the perceptions of local communities towards bats can provide critical insights into the factors that influence their attitudes and behaviors. Social demographics, such as age, gender, education level, and cultural beliefs, play a crucial role in shaping perceptions and can act as predictors of community engagement in conservation efforts [27].

It's worth noting that, bats species provide services to humans, which can equate to a large amount of economic value. Bats are also important components of cave environments, where the accumulation of guano supports a diverse invertebrate community [6]. This study leverages local ecological knowledge for bat conservation: insights from a community-based study.

MATERIALS AND METHODS

Study area

The Ebo Forest is situated in the Littoral Region of Cameroon, spanning the coordinates 4°42'59" N and 10°35'56" E. It lies to the north of the Sanaa River, bridging the Nkam and Sanaga Maritime Divisions, and includes several subdivisions such as Yingui, Yabassi, Edea 2, Ngambe, and Massock-Songloulou[2]. This forest represents more than half of the key biodiversity area in Yabassi and is a significant component of the Yabassi landscape [29].(Fig.1).

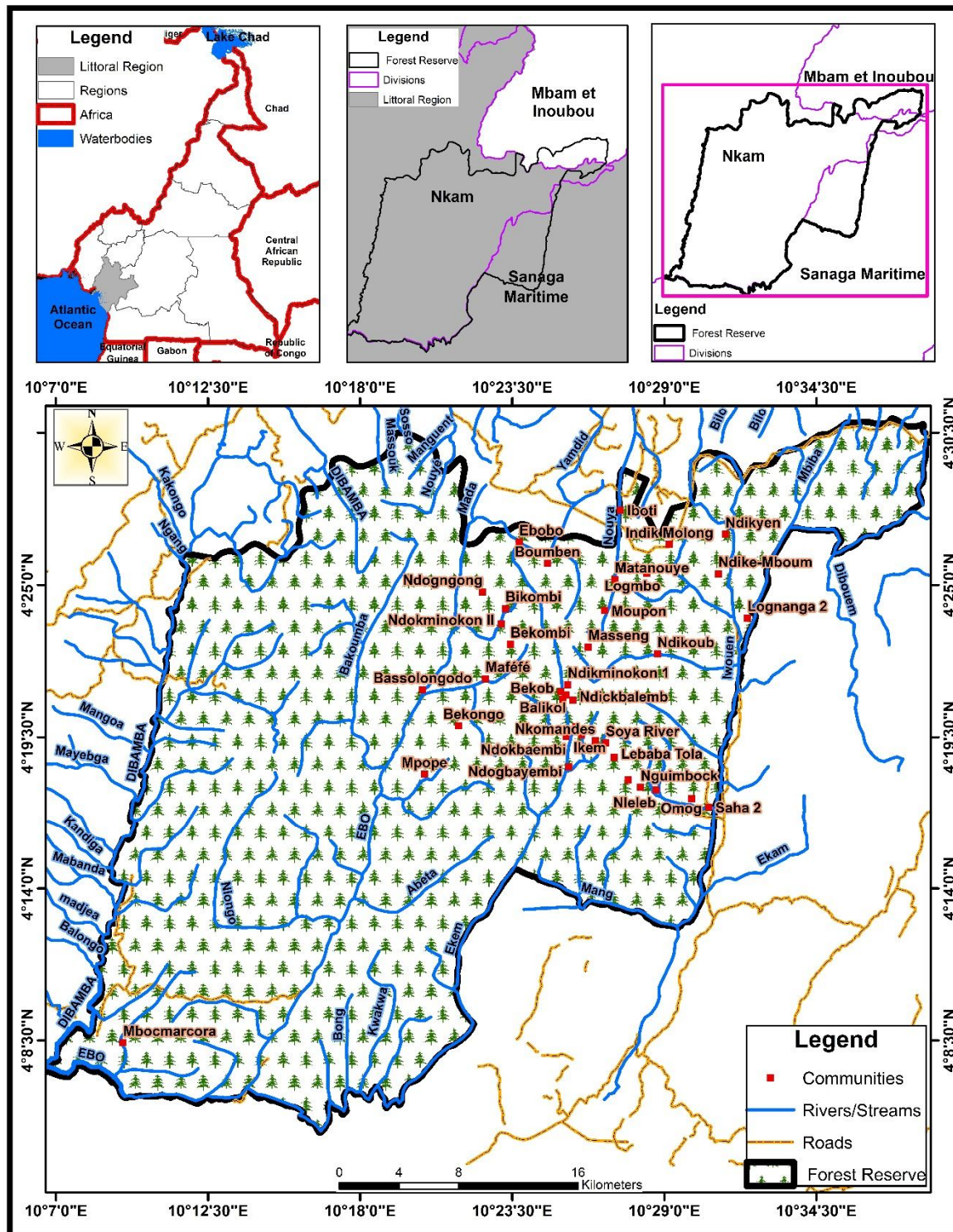


Fig 1: Location map of the study area

Methods

The target population for this study comprised the residents of the two major communities surrounding the Ebo Forest Reserve in the Littoral Region of Cameroon. These communities, Iboti and Lognanga,

were selected using a purposive sampling technique [15]. The selection criteria included proximity to the Ebo Forest Reserve [14], accessibility for data collection [14], and the willingness of community leaders and members to participate in the study [14]. The geographical boundaries of each community were clearly defined using a combination of GPS coordinates, local knowledge, and existing administrative maps [11]. Within each community, a purposive sampling approach was used to select the households for the study [15], with a sampling frame developed by listing all the households and using a random number generator to select the participants.

Data collection methods included a structured questionnaire to gather quantitative and qualitative data on local knowledge, community engagement, conservation awareness, and potential involvement regarding bats [33]. Focus group discussions were conducted in each community to gain a deeper understanding of the local perspectives, cultural significance, and community-based initiatives related to bats [23]. In-depth interviews were also carried out with key informants, such as community leaders, traditional authorities, and local conservation experts, to gather insights on the research topics [18]. Researchers conducted observations in the communities to document community interactions with bats, traditional practices, and any existing conservation initiatives [33].

The demographic data of respondents was collected which showed that respondents span a range of age groups, with the largest proportion (42.2%) being in the 36-45 age group, followed by the 26-35 and 46-55 age groups (both at 21.7%). The 56+ age group represents the smallest proportion (14.5%) of the sample. A significant proportion of the respondents (36.1%) have no formal education, 28.9% have primary education, 27.7% have secondary education, and only 7.2% have university-level education. The majority of the respondents (63.9%) are married, while 28.9% are single, and 7.2% are widowed. The majority of the respondents (78.3%) have lived in the area for more than 20 years, while 15.7% have resided there for 11-20 years, 3.6% for less than 5 years, and 2.4% for 5-10 years. The respondents' primary occupations include farming (28.9%), hunting (21.7%), non-timber forest product (NTFP) collection (14.5%), business (13.3%), artisanal logging (7.2%), fishing (7.2%), and livestock rearing (7.2%).

The study employed a mixed-methods approach, utilizing both quantitative and qualitative analyses. Quantitative analysis included descriptive statistics (frequencies, percentages, means, and standard deviations) and inferential statistics, such as Chi-Square Tests of Independence, Analysis of Variance (ANOVA), and Correlation Analysis [44,45]. Qualitative analysis involved thematic analysis of the open-ended questions to identify common themes, patterns, and insights [46], as well as multivariate analysis, including multiple regression analysis, to explore the combined effects of multiple variables on the key outcomes of interest [47].

The integration of quantitative and qualitative analyses provided a comprehensive understanding of the survey findings, enabling the development of evidence-based strategies to enhance community engagement and support the conservation of bats in the local context. The study was conducted in

accordance with ethical guidelines for research involving human participants [42], with informed consent obtained from all participants and confidentiality and anonymity ensured.

RESULTS AND DISCUSSION

Indigenous knowledge and conservation awareness of Bats.

All (100%) respondents indicated that they have knowledge about bats. This shows that the entire sample of respondents is knowledgeable about bats in the Ebo Forest Reserve. The majority of respondents, (78%), reported that bats feed on fruits. The remaining (22%) stated that bats feed on plants/leaves. This suggests that the respondents have a good understanding of the dietary habits of bat species found in the Ebo Forest Reserve, with the majority recognizing that bats are primarily frugivorous (fruit-eating). The results indicate that all the respondents in the study have knowledge about bats, which is a positive finding for conservation efforts in the Ebo Forest Reserve. This knowledge about the dietary habits of bats is important for understanding the ecological role of bats in the forest ecosystem and can inform conservation strategies that aim to protect bat populations and their habitats. The high level of knowledge about bats among the respondents suggests that there is existing awareness and education programs in the area, or that the local community has a strong understanding of the bat species found in the Ebo Forest Reserve (Figure 2).

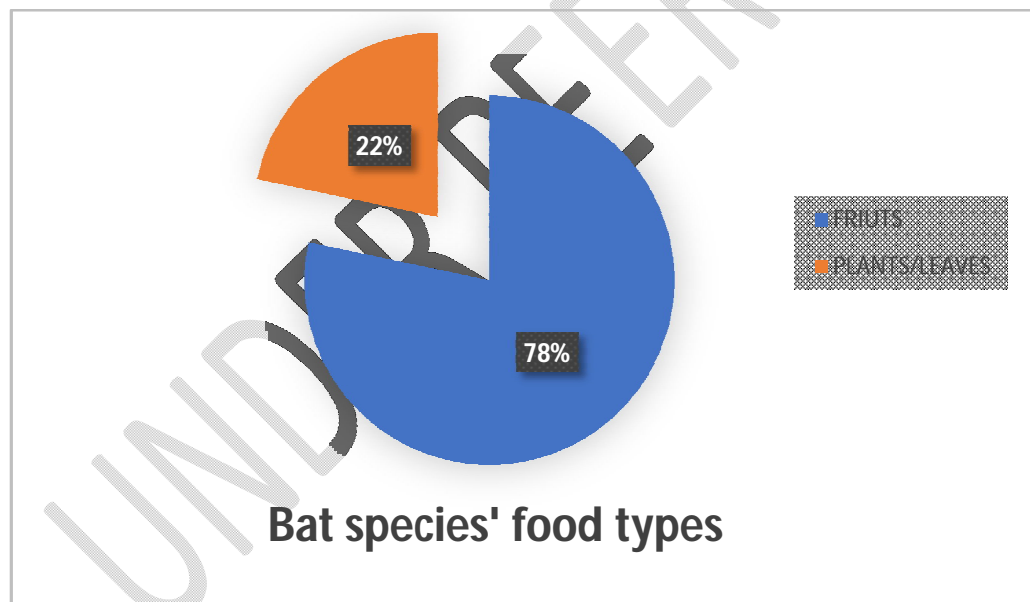


Figure 2: Respondents knowledge about the dietary habits of bat species found in the Ebo Forest Reserve

The majority of respondents (71%), reported that they last sighted bats in the village. The remaining (29%) stated that they last sighted bats in the forest. This suggests that the local community members have more frequent encounters with bats in the village areas compared to the forest areas within the Ebo Forest Reserve. The data on the last sighting location of bats indicates that a significant proportion of the

respondents (71%) have observed bats in the village areas, rather than in the forest. This finding suggests that bats are more commonly visible in the village environments and that the local community members have more opportunities to observe bats in the village settings compared to the forest areas. The higher frequency of bat sightings in the village areas is also due to various factors, such as: Bats attracted to resources or habitats found in the village (e.g., fruit trees, roosting sites). The village environment also provides more opportunities for the community members to observe and interact with bats. Bats are more visible or accessible in the village areas compared to the dense forest environments. This information on the spatial distribution of bat sightings can be valuable for understanding the habitat preferences and movement patterns of bat species in the Ebo Forest Reserve (Figure 3).

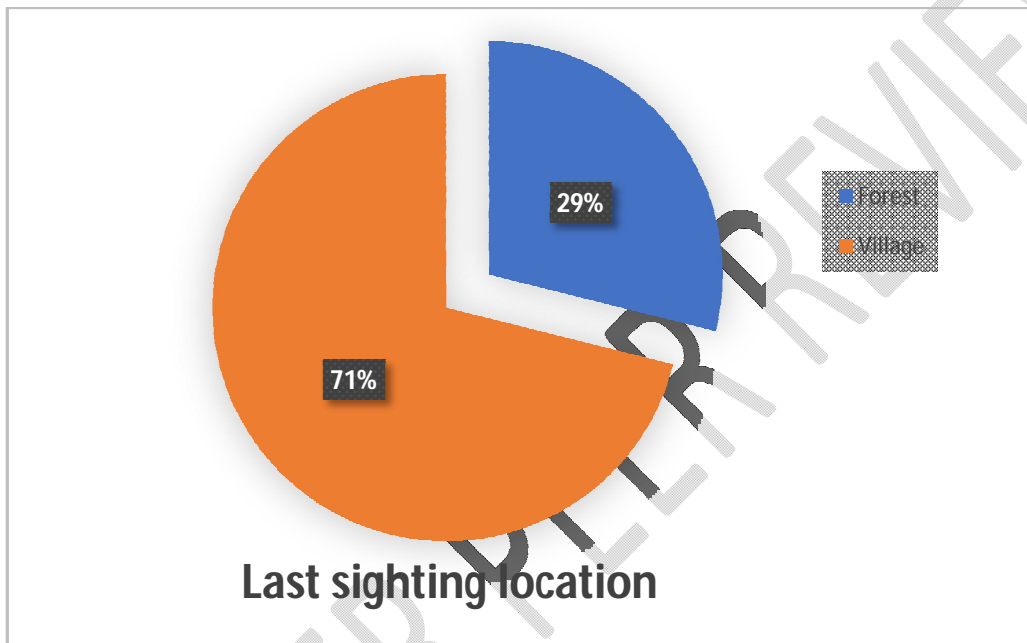


Figure 3: Respondents Last Sighting Location of Bat species

With respect to sighting time, the majority of respondents (71%), reported that they had recently sighted bats while (29%) stated that they had sighted bats a long time ago. This suggests that the local community members have had relatively recent encounters with bats, indicating a continued presence of bats in the Ebo Forest Reserve area. The data on the last sighting time of bats shows that a significant proportion of the respondents (71%) have observed bats recently, rather than a long time ago. This finding suggests that bat populations in the Ebo Forest Reserve area have maintained a consistent or even increasing presence in the recent past, as perceived by the local community. The high percentage of recent bat sightings (71%) could be indicative that Bat populations in the area have remained stable or are recovering, allowing for more frequent encounters with the local community. The local community members have become more aware of and attentive to the presence of bats in their surroundings. They also indicated seasonal or temporal patterns in bat activity and visibility that result in more recent

sightings during the dry season. This information on the timing of bat sightings provides insights into the population trends and dynamics of bat species in the Ebo Forest Reserve (Figure 4).

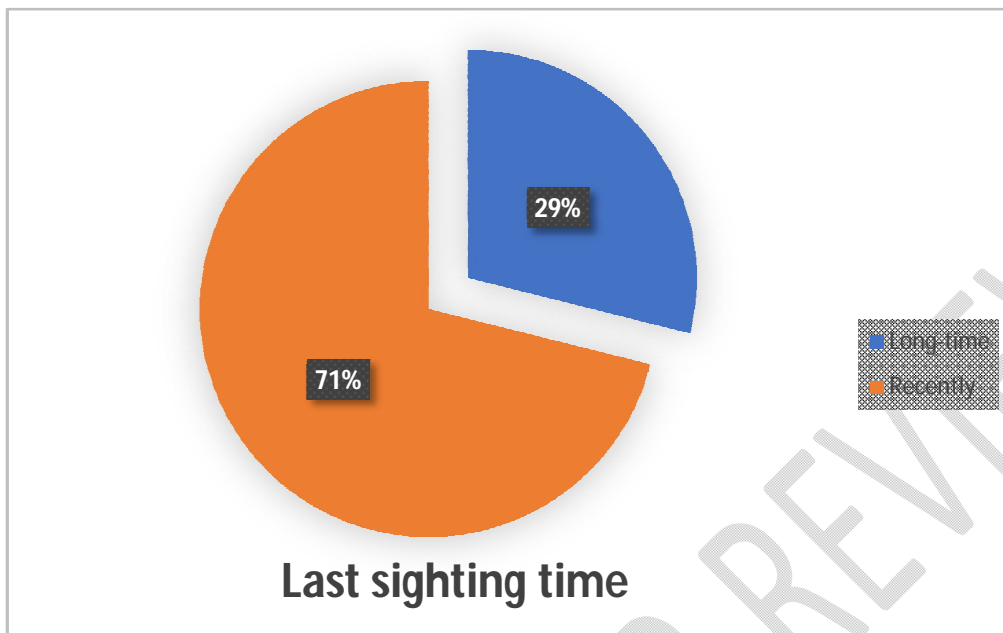


Figure 4: Respondents Last Sighting Location of Bat species

The data on the observation frequency of bat species suggests that the local community members have varying levels of exposure and interactions with bats in the Ebo Forest Reserve area. The majority of respondents (64%) report that they sometimes observe bat species, indicating that bat sightings are not a daily or constant occurrence, but rather intermittent or seasonal as they reported more during the dry season. The significant proportion of respondents (22%) who rarely observe bat species suggests that there may be certain areas, habitats, or time periods where bat presence is less frequent or visible to the local community. The smaller percentage of respondents (14%) who always observe bat species was indicative of the fact that these individuals live in close proximity to bat roosting sites or foraging areas, leading to more frequent encounters. So, they have a heightened awareness or interest in bats, resulting in more consistent observations (Figure 5).

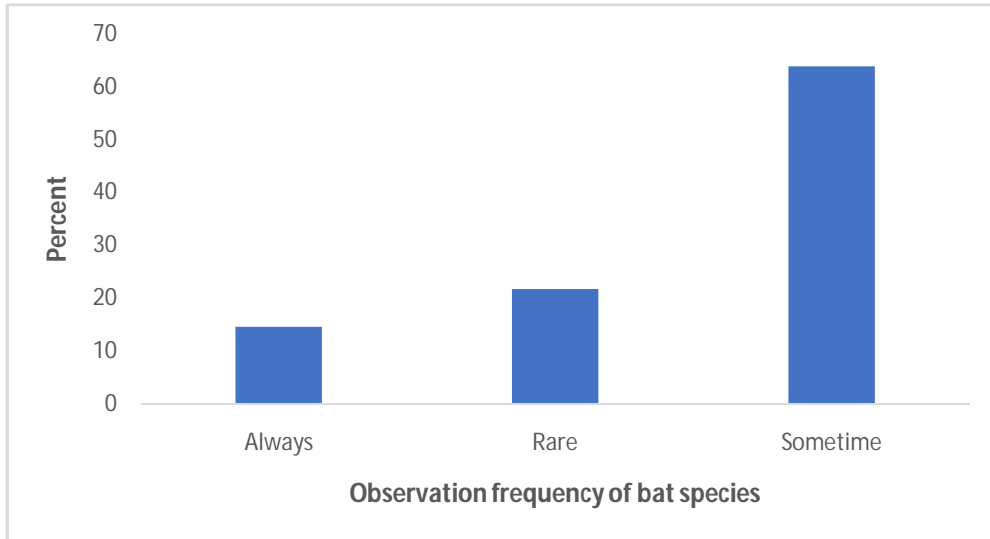


Figure 5: Respondents Observation frequency of Bat species

The findings indicate that the socio-demographic factors of age, occupation, gender, and educational level do not have a significant influence on the observation frequency of bat species in the Ebo Forest Reserve. This suggests that the local community's interactions and observations of bats may be driven by other factors, such as individual experiences, proximity to bat habitats, or other socio-demographic or environmental variables.

The majority of the respondents (51%) reported that the bat species population in the Ebo Forest Reserve has remained stable over the observed period. A significant proportion of respondents (35%) reported that the bat species population has reduced, indicating a concerning trend. While only a small percentage of respondents (14%) reported that the bat species population has increased. The cumulative percentage of respondents who reported either an increase or a reduction in the bat species population is 49.4%, suggesting that nearly half of the respondents have observed changes in the bat population, with more reporting a reduction than an increase. These findings suggest that the local community has observed a mix of trends in the bat species population, with the majority reporting a stable population, but a substantial proportion reporting a reduction (Figure 6).

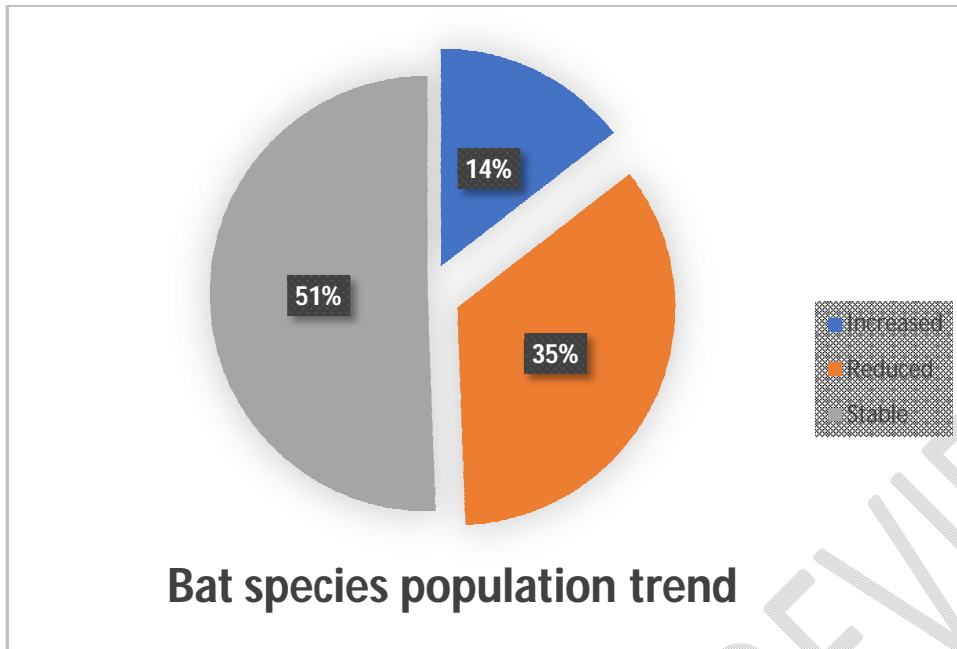


Figure 6: Respondents Observation on Bat species population trend

The majority of the respondents (72%) reported that the observed change in the bat species population in the Ebo Forest Reserve has been recently whereas significant proportion of respondents (28%) reported that the observed change has been over a long time. The cumulative percentage of respondents who reported either a long-term or a recent change in the bat species population is 100.0%, indicating that all respondents have observed some change in the bat population. These findings reveal that the local community has observed changes in the bat species population in the Ebo Forest Reserve, with the majority of respondents reporting that these changes have occurred recently. This information can be valuable for understanding the timeline of the observed changes and the potential factors that may have contributed to these changes. The high percentage of respondents reporting recent changes in the bat species population may indicate a more acute or noticeable shift in the population, which could be related to various environmental, ecological, or anthropogenic factors. On the other hand, the significant proportion of respondents reporting long-term changes suggests that the local community has been observing gradual or ongoing transformations in the bat population over an extended period (Figure 7).

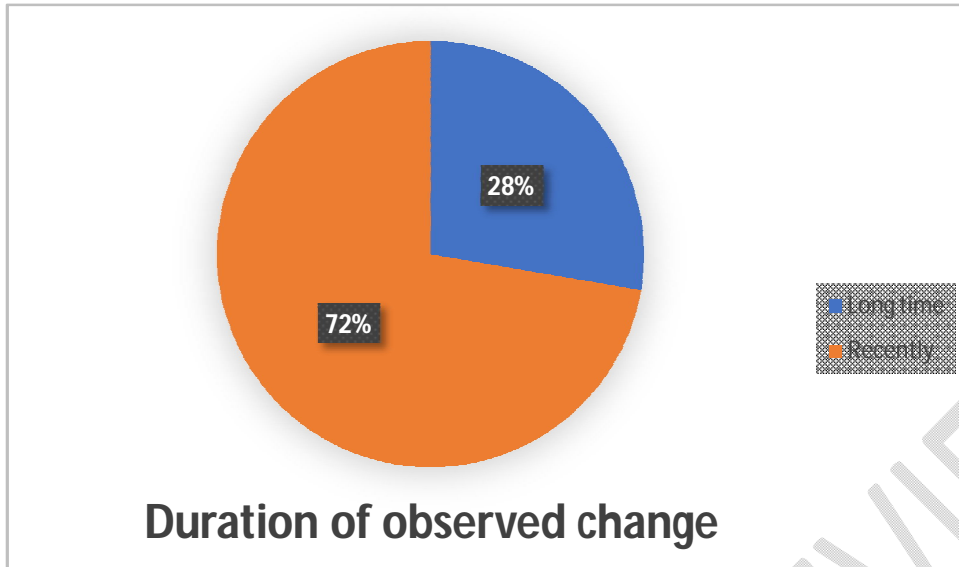


Figure 7: Duration of observed change in Bat species population trend

Results indicate that the majority of the respondents (57%) have a neutral perception towards bats, while a significant proportion (43%) have a positive attitude. The findings suggest that the local community's thoughts and feelings about bats are predominantly neutral, with a substantial portion also holding positive views towards these animals. The results show that all respondents (100.0%) reported that there are no cultural beliefs associated with bats in the Ebo Forest Reserve indicating that there is a consensus among the respondents that there are no cultural beliefs related to bats in the local context. This finding suggests that the local community's perceptions and interactions with bats are not significantly influenced by cultural beliefs or traditional practices. The lack of cultural beliefs associated with bats in the Ebo Forest Reserve indicates that the local community's attitudes and interactions with these animals are not strongly shaped by traditional beliefs or practices. However, a notable fact is that the respondents lacked knowledge on the ecosystem contributions of butterflies (Figure 8).

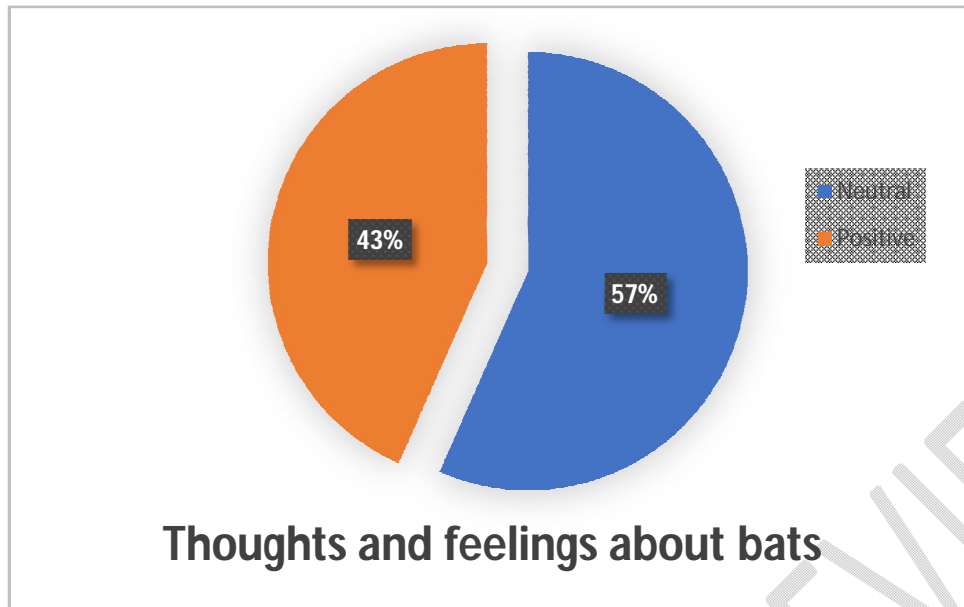


Figure 8: Respondents thoughts and feelings about bats

The Pearson Chi-Square test statistic is 0.072 with a p-value of 0.788. The Continuity Correction value is 0.001 with a p-value of 0.971. The Likelihood Ratio test statistic is 0.072 with a p-value of 0.788. The Fisher's Exact Test has a two-sided p-value of 0.820 and a one-sided p-value of 0.487. The p-values for all the chi-square tests (Pearson, Continuity Correction, Likelihood Ratio, and Fisher's Exact Test) are greater than the significance level of 0.05. This indicates that there is no statistically significant relationship between gender and thoughts/feelings about bats. In other words, gender does not appear to be associated with the respondents' attitudes towards bats. The Phi and Cramer's V values are both 0.029 with a p-value of 0.788, further confirming the lack of a significant association between gender and thoughts/feelings about bats. The results suggest that the local community's perceptions of bats are not significantly influenced by the gender of the respondents.

The Pearson Chi-Square test statistic is 18.903 with a p-value of 0.000. The Likelihood Ratio test statistic is 25.559 with a p-value of 0.000. The p-values for both the Pearson Chi-Square and Likelihood Ratio tests are less than the significance level of 0.05. This indicates that there is a statistically significant relationship between age and thoughts/feelings about bats. The Phi and Cramer's V values are both 0.477 with a p-value of 0.000, suggesting a moderately strong association between age and attitudes towards bats. The results suggest that the respondents' age is a significant factor in shaping their perceptions and attitudes towards bats. Further examination of the crosstab reveals that the younger age group (26-35) has a higher proportion of neutral attitudes, while the older age groups (46-55 and 56+) have a higher proportion of positive attitudes towards bats. This finding suggests that age-related factors, such as life experiences, environmental awareness, or cultural influences, may play a role in the local community's thoughts and feelings about bats. Gender is not significantly associated with the local

community's thoughts and feelings about bats. Age is a significant factor in shaping the local community's perceptions and attitudes towards bats, with older respondents more likely to have positive attitudes compared to younger respondents. The lack of a significant relationship with gender suggests that conservation efforts can be tailored to the broader community, while the age-related differences in attitudes indicate the potential need for targeted outreach and education programs to foster a more positive and informed understanding of bats among all age groups.

With 1.1% of respondents indicated that education and awareness campaigns are the primary community contribution to bat conservation. 28.9% of respondents mentioned monitoring and data collection as a community contribution. This suggests that the local community recognizes the importance of raising awareness and educating people about bats as a key contribution to conservation efforts. And 71.1% of respondents reported being aware of community initiatives related to bat conservation while 28.9% of respondents were not aware of any such initiatives. This indicates that a majority of the local community is aware of the ongoing efforts and initiatives focused on bat conservation. 63.9% of respondents reported being not familiar at all with bat conservation efforts whereas 36.1% of respondents were somewhat familiar with such efforts. This suggests that while a majority of the community is aware of conservation initiatives, a significant proportion lacks familiarity with the details and specifics of these efforts. Results also showed that 63.9% of respondents reported having no information sources about bats while 36.1% of respondents mentioned community meetings or workshops as a source of information about bats. This highlights the need to improve the availability and accessibility of information about bats within the local community. The majority 56.6% of respondents expressed interest in supporting conservation activities and 28.9% were interested in volunteering for monitoring activities while 14.5% were interested in participating in research or educational programs. This indicates that the local community has a strong interest in contributing to bat conservation efforts, with a particular focus on supporting conservation activities and participating in monitoring efforts. Results indicates that the local community perceives the availability of resources, such as funding and technical support, as a significant barrier to their active involvement in bat conservation efforts (Table 1).

Table 1: Bat conservation awareness

Community contributions to bat conservation	Frequency	Percent
Education and awareness campaigns	59	71.1
Monitoring and data collection	24	28.9
Total	83	100.0
Awareness of community initiatives		
NO	24	28.9
Yes	59	71.1
Total	83	100.0
Familiarity with bat conservation efforts		
Not familiar at all	53	63.9
Somewhat familiar	30	36.1
Total	83	100.0
Information sources about bats		
Community meetings or workshops	30	36.1
NONE	53	63.9
Total	83	100.0
Interest in participating in bat conservation		
Participating in research or educational programs	12	14.5
Supporting conservation activities	47	56.6
Volunteering for monitoring activities	24	28.9
Total	83	100.0
Needed community support		
Financial support for community projects	59	71.1
Training and capacity building	24	28.9
Total	83	100.0
Foreseen challenges in community engagement		
Lack of awareness	24	28.9
Limited resources	59	71.1
Total	83	100.0

The p-value for the Pearson Chi-Square test is 0.226, which is greater than the 0.05 significance level. Therefore, there is no statistically significant relationship between gender and community contributions to bat conservation at the 0.05 level of significance. The p-value for the Pearson Chi-Square test is 0.066, which is greater than the 0.05 significance level. Therefore, there is no statistically significant relationship between gender and awareness/involvement in community initiatives at the 0.05 level. The p-value for the Pearson Chi-Square test is 0.032, which is less than the 0.05 significance level. Therefore, there is a statistically significant relationship between gender and familiarity with bat conservation efforts at the 0.05 level. The p-value for the Pearson Chi-Square test is 0.032, which is less than the 0.05 significance level. Therefore, there is a statistically significant relationship between gender and information sources about bats at the 0.05 level. The p-value for the Pearson Chi-Square test is 0.012, which is less than the 0.05 significance level. Therefore, there is a statistically significant relationship between gender and interest in participating in bat conservation at the 0.05 level. The p-value for the Pearson Chi-Square test is 0.226, which is greater than the 0.05 significance level. Therefore, there is no statistically significant relationship between gender and needed community support at the 0.05 level. The p-value for the Pearson Chi-

Square test is less than 0.001, which is less than the 0.05 significance level. Therefore, there is a statistically significant relationship between age and community contributions to bat conservation at the 0.05 level. The p-value for the Pearson Chi-Square test is less than 0.001, which is less than the 0.05 significance level. Therefore, there is a statistically significant relationship between age and awareness/involvement in community initiatives at the 0.05 level. The p-value for the Pearson Chi-Square test is 0.759, which is greater than the 0.05 significance level. Therefore, there is no statistically significant relationship between age and familiarity with bat conservation efforts at the 0.05 level. The p-value for the Pearson Chi-Square test is 0.759, which is greater than the 0.05 significance level. Therefore, there is no statistically significant relationship between age and information sources about bats at the 0.05 level. The p-value for the Pearson Chi-Square test is less than 0.001, which is less than the 0.05 significance level. Therefore, there is a statistically significant relationship between age and needed community support at the 0.05 level. In summary, at the 0.05 level of significance: Gender is significantly related to familiarity with bat conservation efforts, information sources about bats, and interest in participating in bat conservation. Age is significantly related to community contributions to bat conservation, awareness/involvement in community initiatives, and needed community support. There is no significant relationship between gender and community contributions, awareness/involvement in community initiatives, or needed community support. There is no significant relationship between age and familiarity with bat conservation efforts or information sources about bats. These findings suggest that gender and age are important factors in understanding the local community's engagement and support for bat conservation efforts in the Ebo Forest Reserve.

Results from regression analysis revealed an R-squared value of 0.422, indicating that the model explains 42.2% of the variance in the dependent variable (interest in participating in bat conservation). The adjusted R-squared value is 0.392, which suggests that the model has good fit and generalizability. The ANOVA table shows that the overall model is statistically significant (p-value < 0.001), meaning that the independent variables (occupation, gender, age, and educational level) collectively have a significant influence on the dependent variable. Occupation has a positive and statistically significant coefficient (p-value < 0.001), indicating that occupation is a significant predictor of interest in participating in bat conservation. Gender and age are not statistically significant predictors of interest in participating in bat conservation (p-values > 0.05). Educational level has a positive but marginally significant coefficient (p-value = 0.083), suggesting a potential relationship with interest in participating in bat conservation. Occupation is a strong and significant predictor of interest in participating in bat conservation. Gender and age do not have a significant direct effect on interest in participating in bat conservation. Educational level has a marginally significant positive relationship with interest in participating in bat conservation. These results suggest that the community's occupational background is a key factor in understanding their interest and willingness to participate in bat conservation efforts.

DISCUSSIONS

The results indicate a high level of indigenous knowledge about bats among the respondents in the Ebo Forest Reserve. The finding that all respondents possess knowledge about bats and their dietary habits, with the majority recognizing bats as frugivorous, underscores the importance of local ecological knowledge in conservation efforts. This knowledge can be leveraged to design conservation strategies that align with the local community's understanding of the ecosystem. Such alignment is essential for the success of conservation programs, as it ensures that local practices and cultural beliefs are respected and incorporated into conservation planning [7].

The high level of knowledge and awareness about bats among the local community in the Ebo Forest Reserve is consistent with studies on indigenous ecological knowledge in other parts of Africa. For example, a study in Ghana found that local communities had extensive knowledge about the diversity, ecology, and cultural significance of bats, which was crucial for informing conservation efforts [35]. Similarly, research in Uganda has highlighted the important role of traditional ecological knowledge in understanding and protecting bat populations [3]. The findings from the Ebo Forest Reserve align with these broader trends, underscoring the value of engaging with local communities to leverage their existing knowledge for effective bat conservation.

The frequent sightings of bats in village areas, as opposed to the forest, suggest that bats might be drawn to resources such as fruit trees and roosting sites within the village. This spatial distribution of bat sightings highlights the potential for human-bat interactions in village settings, which could be crucial for both conservation and community engagement initiatives. Increased sightings of bats in recent times may indicate a stable or increasing bat population, which is a positive sign for biodiversity conservation. However, it also necessitates monitoring to ensure that human activities do not negatively impact bat populations [22].

The local community's understanding of the dietary habits of bats, with the majority recognizing their frugivorous nature, is also reflected in studies from other parts of Africa. A review of community-based bat conservation initiatives across the continent found that local knowledge about the ecological roles of bats, such as seed dispersal and pollination, was crucial for designing conservation strategies that address the needs of both bats and the local ecosystem [32]. The insights from the Ebo Forest Reserve contribute to this growing body of evidence on the importance of incorporating indigenous knowledge into bat conservation efforts.

The spatial distribution of bat sightings, with more observations in village areas compared to the forest, aligns with findings from other community-based studies in Africa. Research in Tanzania, for example, has shown that local communities often have more frequent encounters with bats in human-modified landscapes, such as villages and agricultural areas, due to the availability of resources and roosting sites

[40]. This information can help guide the development of targeted conservation interventions that address the specific threats and management needs in both the village and forest environments within the Ebo Forest Reserve.

The perceptions and attitudes towards bats among the respondents were generally positive, with a majority expressing a neutral to positive attitude towards bats. This positive perception can be a valuable asset in conservation efforts, as it indicates a lower likelihood of human-wildlife conflict and a higher potential for community support in bat conservation initiatives. Studies have shown that positive attitudes towards wildlife are critical for the success of conservation programs [10,12].

However, there were still misconceptions about bats, such as associations with witchcraft and disease transmission. Addressing these misconceptions through targeted education and awareness campaigns can further improve community attitudes towards bats and reduce unnecessary fear or persecution. Effective communication strategies that dispel myths and highlight the ecological benefits of bats can foster a more supportive environment for bat conservation [19].

The finding of a significant relationship between age and the local community's perceptions of bats in the Ebo Forest Reserve is consistent with studies from other parts of Africa. A study in Uganda found that older community members tended to have more positive attitudes towards bats compared to younger individuals, which was attributed to differences in cultural beliefs, traditional knowledge, and personal experiences [3]. This suggests that age-related factors may play an important role in shaping community perceptions of bats, which should be considered when designing outreach and engagement strategies.

The study found significant gender differences in knowledge about bats and attitudes towards them. Men were more likely to have detailed knowledge about bat species and their ecological roles, while women were more likely to express neutral to positive attitudes towards bats. These gender differences in knowledge and attitudes are consistent with findings from other studies, which have shown that men and women often have different levels of engagement with wildlife due to their distinct roles in society [21,31].

The local community's awareness of ongoing bat conservation initiatives in the Ebo Forest Reserve is relatively high compared to findings from other studies in Cameroon and across Africa. For example, a review of community-based conservation projects in Cameroon found that a lack of awareness and information about conservation efforts was a common challenge [20]. The relatively higher awareness in the Ebo Forest Reserve may be a result of ongoing efforts to engage the local community, though the need to improve the accessibility of information remains.

The community's interest in supporting bat conservation, with the majority expressing a willingness to contribute, aligns with findings from other community-based conservation initiatives in Cameroon and Africa. Studies in the Takamanda-Mone landscape of Cameroon and the Ugandan Albertine Rift have

reported high levels of community engagement and support for conservation efforts when the local context and needs are adequately addressed [38,3]. The insights from the Ebo Forest Reserve suggest that the local community has the potential to be valuable partners in bat conservation, provided that the perceived barriers, such as the availability of resources, are addressed.

The significance of gender and age as determinants of the local community's engagement in bat conservation in the Ebo Forest Reserve is consistent with findings from other studies in Africa. Research in Uganda and Tanzania has highlighted the importance of tailoring outreach and engagement strategies to address the specific needs and perspectives of different demographic groups to enhance the effectiveness of community-based conservation initiatives [3,40]. The insights from the Ebo Forest Reserve contribute to this growing body of evidence on the need for inclusive and equitable approaches to community-based conservation. Understanding these gender dynamics is crucial for designing inclusive conservation programs that address the specific needs and contributions of both men and women. Incorporating gender-sensitive approaches in conservation planning can enhance the effectiveness of conservation efforts and ensure that all community members are engaged and supportive [31].

CONCLUSION

The study highlights the critical role of local ecological knowledge in shaping community perceptions and attitudes towards bats in the Ebo Forest Reserve. While residents demonstrate a strong awareness of bats and their ecological roles, persistent misconceptions must be addressed through targeted education and outreach efforts. The significant influence of age on attitudes suggests that conservation strategies should be tailored to engage different demographic groups effectively. By leveraging local knowledge and fostering community involvement, conservation initiatives can enhance the protection of bat populations, ultimately contributing to biodiversity conservation in the region. Future efforts should focus on bridging the gap between community knowledge and conservation practices, ensuring that local perspectives are integral to sustainable wildlife management.

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