# INTRODUCTION

Ticks are among the most significant ectoparasites of livestock, serving as vectors of diseases that pose major challenges to livestock farming worldwide. Their infestations may lead to discomfort, soreness, self-inflicted injuries, irritation, inflammation, allergic reactions, blood loss, and consequently, weight loss (Rechav et al. 1980; Rajput et al. 2006; Randolph, 2008). They also transmit diseases such as anaplasmosis, babesiosis, cowdriosis, theileriosis, and rickettsiosis, which critically impact livestock health (Manzano-Román et al., 2012). For example, In West Africa, *Amblyomma variegatum* and the invasive *Rhipicephalus microplus* are among the most prevalent tick species of economic importance (Boka, 2017; Heylen et al., 2023; Kasaija et al., 2021). These ticks are known as vectors of heartwater disease, caused by *Ehrlichia ruminantium*, in West Africa (Bare & Uilenberg, 2010; Some *et al*., 2023a, Some *et al.*, 2024b).

Tick life stages cause similar but varying levels of impact on their hosts, as transmission potential differs by stage. Adult ticks are generally bigger than nymphs, and have a larger capacity for consuming blood, causing greater discomfort to their hosts. Male and female ticks also differ in their effects on hosts. Females, with their larger feeding sites, induce significant physical damage such as irritation, inflammation, and secondary infections (Kamaraj et al., 2022; Randolph, 2008). They are also more likely to intensify future infestations and disease transmission due to their reproductive capacity. Additionally, female and male ticks sometimes harbour different microbiota, which contributes to differences in the diseases they transmit (Van Treuren et al., 2015; Desta, 2016).

Ticks display preferences for certain predilection sites on their hosts (Opara and Ezeh, 2011). For example, *A. variegatum* has in many studies shown notable preference for targeting the mammary breast area of livestock in some studies (Stachurski, 2006; Addo 2024; REFERENCE). This has been associated with significantly reduced milk production, severe wounds (Stachurski, 2000). These preferences are influenced by factors such as the ability to attach to the host skin, cattle species, hair density, body temperature, blood vessel proximity, species-specific evolutionary traits, and environmental and microclimatic conditions (Nyangiwe et al., 2018; Biguezoton et al., 2016; Dantas-Torres & Otranto, 2013; Desta, 2016). While this is so, it therefore may imply that certain taxa or sex or life stages of ticks would show special preference for part of the tick body. This would also change the community dynamics, since certain taxa may tend to be favourably found in one predilection area and not another. However, there is a scarcity of studies that have investigated the occurrence preference of ticks. Also, there have been high-level demographic non-overlaps in species, we do not know if species of ticks present in Nigeria have predilection preference or if the diversity of ticks differs by predilection site of the cattle. Aside learning the number of ticks present in the cattle sites, it would be important to estimate community level variations in ticks present at the predilection, as this would be needed for

In southwestern Nigeria, most cattle are sourced from the northern states or close neighbouring countries like Niger and Chad. Many cattle in the southern parts of Nigeria can be traced to their breeding in the northern region of the country. They are a rich source of meat, hides, and milk and hold significant cultural and economic value in Nigeria and much of Sub-Saharan Africa. Livestock farming in rural areas is crucial for sustaining livelihoods and supporting income generation (Mafimisebi et al., 2013). However, tick attachment to cattle results in substantial economic losses for farmers due to prolonged attachment periods and their role as vectors of veterinary pathogens. Despite the burden of tick infestations, Fulani pastoralists, who dominate cattle rearing in the region, seldom use acaricides (Awogbade, 1979; Bayer & Maina, 1984).

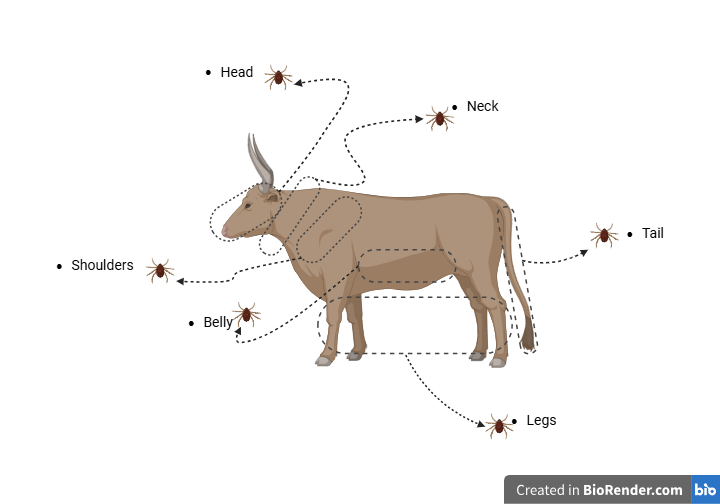
The biodiversity and abundance of ticks on cattle in Nigeria remain poorly studied. While some studies have examined tick prevalence at predilection sites, no research has evaluated species-specific preferences for these sites. The invasive Brazilian tick, *Rhipicephalus microplus*, was first reported in Edo State by Adane et al. (2019). However, no follow-up studies have investigated its spread. This is an indication of scarcity of data which would be needed for tick control, especially for livestocks that is of great economic importance to Nigeria.

Most studies on ticks in Nigeria focus on single-, double-, or triple-species infestations, providing limited insights into co-infestation patterns or community-level structures. Comprehensive studies using multivariate community level approaches are needed to address these gaps. Understanding tick distribution and community structure can inform control measures, enhance disease management strategies, and assist pest regulatory agencies in mitigating tick-borne diseases (Farahi et al., 2016; Smith & Parker, 2010).

This study aims to address the knowledge gaps surrounding tick infestations in Edo State, Nigeria. Specifically, it seeks to [1] estimate tick diversity and abundance on a cattle ranch in Edo State, [2] examine the community-level structure of ticks across different predilection sites on cattle, and [3] investigate whether certain tick species, life stages, or sexes exhibit preferences for specific predilection areas.

# MATERIALS AND METHOD

2.3. Sampling and data collection



**Figure 1:** Schematic representation of the cattle predilection site where ticks were sampled

## 2.4. Statistical analysis

For this study, we used the R software (Version 4.4.0) and Paleontological Statistics (PAST) Version 4.03 software (Hammer & Harper, 2024) to analyse the tick data we collected. All data aggregation and manipulation was done in R.

Margalef indices at each predilection site for individual cattle were calculated using PAST software as a measure of the species richness of each tick community.

Margalef index: *D = (S - 1) / ln(N)*

Where: D is the Margalef Index; S is the total number of species; N is the total number of individuals; ln is the natural logarithm.

Overall, species richness was estimated using the Chao 2 and Jacknife 2 estimators. In addition, a species accumulation curve (SAC) was used to visually show how much sampling effort influences the observed species richness. We calculated the tick prevalence (%) by calculating the percent of infested cattle from the total number of cattle examined.

A negative binomial model compared ticks' mean abundance and species richness across all cattle predilection sites. This was computed using the ‘glm.nb()’ function of the “MASS” package in R (Venables & Ripley, 2002) . As a post hoc to assess significant differences in abundance and across each predilection site, Tukey tests (α = 0.05) for multiple comparisons were computed using the ‘glht()’ function from the "multcomp" package (Hothorn et al., 2008), given the existence of five distinct habitat levels. Also, a Kruskal-walis test was computed on the calculated Margalef index to compare its difference across all predilection sites, using the ‘kruskal.test()’ function in the “dunn.test” package.

Non-metric Multidimensional Scaling (NMDS) was used to analyze and visualize the overall dissimilarity of the tick community at the cattle predilection sites, using the Bray-Curtis coefficient to create similarity matrices. Two dimensions adequately captured the pattern in the data. We employed Permutative Analysis of Variance (PERMANOVA) to check for significant changes in the tick community compositions for Sex, life stage and predilection sites, determined through 9999 permutations using the ‘adonis2()’ function from the “Vegan” package in R. As a post hoc, we used the ‘pairwise.adonis()’ function to check for significant differences (α = 0.05) between communities. Also, we tested for homogeneity of multivariate dispersion, which is a good way to represent the tick community variance between the predilection sites of the cattle. This was done using the ‘betadisper()’ function of the “Vegan” package.

# RESULTS

In this survey, 75 of the 95 sampled cattle were infected with at least one tick species, revealing a prevalence of 78.95%. Each tick-infested cattle had a median of 3 distinct species of ticks. Overall, 1930 ticks consisting of 1679 females and 251 males were collected in the surveys. From this, 1689 were adults while 241 were nymphal stage ticks. Ticks were collected from all 6 predilection sites: belly (432), head (356), leg (417), Neck (282), shoulder (99) and tail (344). Four (4) genera of ixodic ticks were identified genera (*Amblyomma, Boophilus, Rhipicephalus and Haemaphysalis)*, consisting of twelve (15) species of ticks as shown in Table 1. The most prevalent tick species were *B. annulatus, B. decoloratus* and *B. geigyi* with prevalence level of 65.26%, 72.63% and 66.32%, respectively*.* Similarly, thesetickswere the most abundant ticks sampled*,* with relative abundance of42.38%, 29.38% and 20.93% for *B. annulatus*, *B. decoloratus*, and *B. geigyi,* respectively. These three species of ticks made up over 92% of ticks collected from all tick-positive cattle.

Relatively rare species, including *R. quilhoni*, *H. laechi*, and an unidentified species from the *Boophilus* genus, were observed. Each of these tick species was found on a single cattle, with a prevalence of 1.05% for each.

Table 1: Tick species prevalence (%)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Species** | **Belly** | **Head** | **Leg** | **Neck** | **Shoulder** | **Tail** | **Overall** |
| ***A. coharenses*** | 0.23 | 0.56 | 0.48 | 0.71 | 0 | 0.58 | 0.47 |
| ***A. variegatum*** | 1.62 | 1.69 | 3.6 | 1.42 | 0 | 4.36 | 2.44 |
| ***B. annulatus*** | 49.31 | 37.36 | 41.97 | 41.84 | 21.21 | 45.93 | 42.38 |
| ***B. decoloratus*** | 30.32 | 28.09 | 33.57 | 25.89 | 44.44 | 22.97 | 29.38 |
| ***B. geigyi*** | 17.36 | 20.79 | 19.18 | 27.3 | 28.28 | 20.35 | 20.93 |
| ***Boophilus sp.*** | 0 | 0 | 0 | 0 | 0 | 0.87 | 0.16 |
| ***H. laechi*** | 0 | 0.28 | 0 | 0 | 0 | 0.58 | 0.16 |
| ***R. gulhoni*** | 0 | 3.09 | 0 | 1.06 | 2.02 | 0.87 | 0.98 |
| ***R. lunulatus*** | 0.46 | 2.53 | 0.96 | 0 | 4.04 | 2.03 | 1.35 |
| ***R. muhsame*** | 0.23 | 1.4 | 0.24 | 0.35 | 0 | 0.58 | 0.52 |
| ***R. quilhoni*** | 0 | 0.28 | 0 | 0 | 0 | 0.29 | 0.1 |
| ***R. sanguineus*** | 0 | 3.09 | 0 | 1.06 | 0 | 0 | 0.73 |
| ***R. senegalensis*** | 0.23 | 0.56 | 0 | 0.35 | 0 | 0.58 | 0.31 |
| ***R. fanguineus*** | 0.23 | 0 | 0 | 0 | 0 | 0 | 0.05 |
| ***R. gemma*** | 0 | 0.28 | 0 | 0 | 0 | 0 | 0.05 |

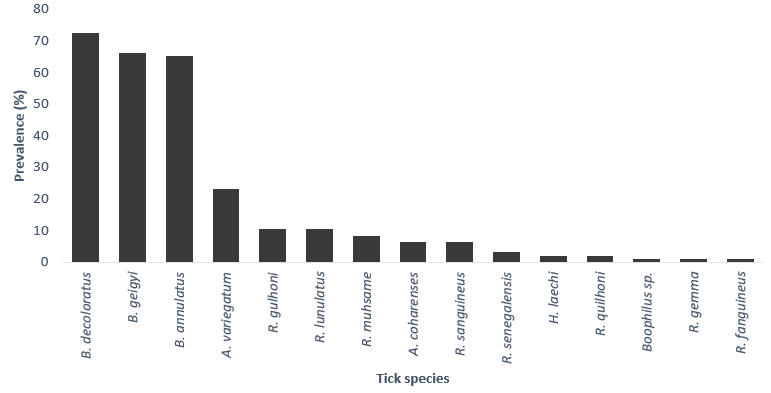


Figure \_: Tick infestation overall prevalence (%) across all 95 cattle sampled.

**Tick community composition at the predilection areas**

The tick community composition of ticks at the predilection sites is represented in the NMDS plot (Figure 1). Visually, the plot shows that the six predilection areas have a high overlap in composition and level of dispersion of the ticks. In alliance with the NMDS plot, the PERMANOVA test revealed no significant difference (P> 0.05) in the overall community structure of ticks at the predilection areas. Nonetheless, there were non-significant differences between the tick’s community in all predilection areas, as shown in Table 2. Furthermore, the test for homogeneity of dispersion showed no significant difference (P> 0.05) amongst the predilection sites.

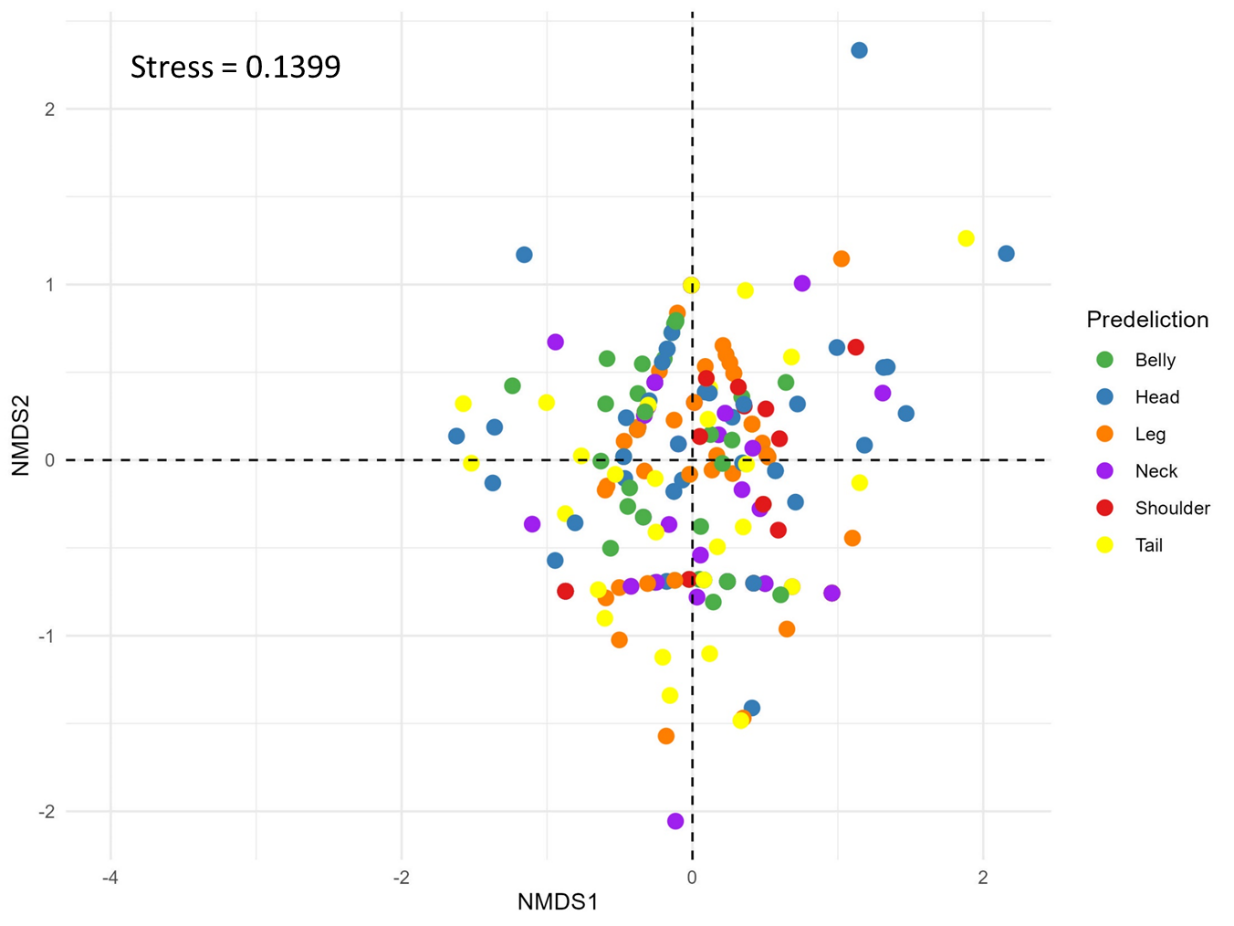


Figure 1: Non-metric multidimensional scale (NMDS) plot showing points representing the tick community in predilection sites. Points are coloured according to predilection sites.

Table 2: PERMANOVA test comparing the community structure of ticks at the predilection sites.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Predilection pairs** | F-Model | R2 | P-value | Adjusted P-value |
| **Belly vs Head** | 1.899 | 0.016 | 0.082 | 1 |
| **Belly vs Leg** | 0.711 | 0.005 | 0.553 | 1 |
| **Belly vs Tail** | 0.329 | 0.003 | 0.832 | 1 |
| **Belly vs Neck** | 0.686 | 0.006 | 0.592 | 1 |
| **Belly vs Shoulder** | 3.321 | 0.039 | 0.011 | 0.165 |
| **Head vs Leg** | 0.774 | 0.006 | 0.547 | 1 |
| **Head vs Tail** | 0.941 | 0.008 | 0.442 | 1 |
| **Head vs Neck** | 0.936 | 0.009 | 0.427 | 1 |
| **Head vs Shoulder** | 1.054 | 0.013 | 0.404 | 1 |
| **Leg vs Tail** | 0.700 | 0.006 | 0.592 | 1 |
| **Leg vs Neck** | 0.741 | 0.006 | 0.544 | 1 |
| **Leg vs Shoulder** | 0.955 | 0.011 | 0.424 | 1 |
| **Tail vs Neck** | 0.414 | 0.004 | 0.817 | 1 |
| **Tail vs Shoulder** | 2.536 | 0.034 | 0.035 | 0.525 |
| **Neck vs Shoulder** | 2.249 | 0.032 | 0.072 | 1 |

**Male and Female Tick community composition.**

Based on Sex, the tick community structure of ticks is represented in the NMDS plot (Figure\_). Visually, the plot shows that the male ticks have higher dispersion and heterogeneity compared to the female ticks which looked relatively homogenous. PERMANOVA test revealed a significant difference (P< 0.001) in the community structure of males and ticks. Similarly, the test for homogeneity of dispersion showed significant differences (P< 0.001) amongst both sexes.

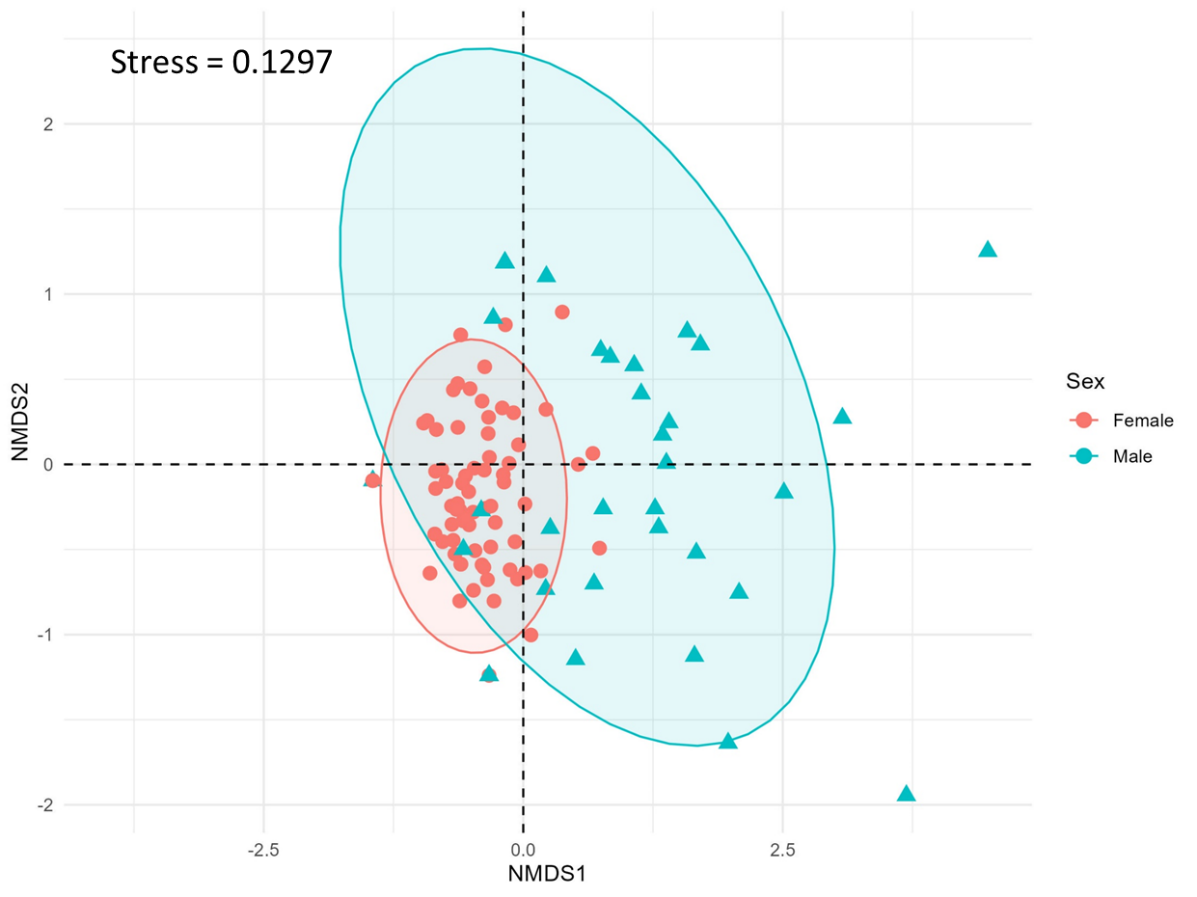


Figure 1: Non-metric multidimensional scale (NMDS) plot showing points representing the tick community in predilection sites. Points are coloured according to tick sex.

**Tick stage and community composition.**

Two tick stages were identified: nymph and adult. The NMDS plot in Figure \_ shows the community structure of both tick stages. However, the NMDS of both communities shows non-significant dissimilarity (p>0.05) in its homogeneity of dispersion. PERMANOVA test further shows a significant difference (p<0.001) in the community composition of both tick stages.

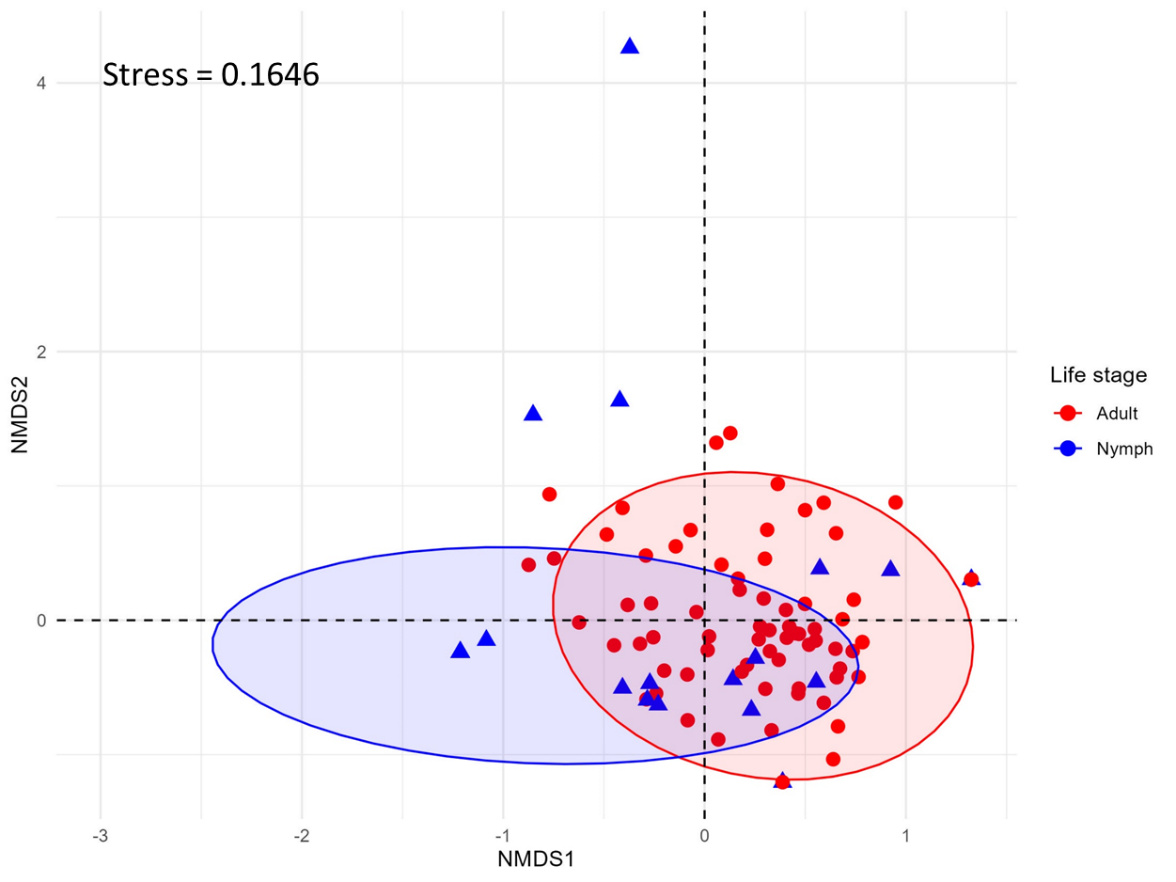
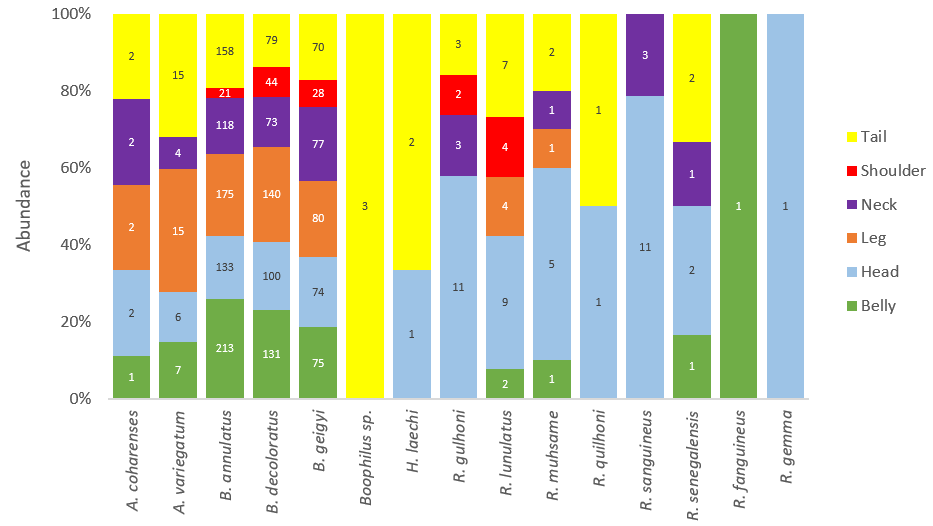


Figure 1: non-metric multidimensional scale (NMDS) plot showing points representing the tick community in predilection sites. Points are coloured according to tick life stage.



**Figure 4**: Relative abundance (%) of tick species at each predilection site of cattle.

The most abundant ticks were well represented in all predilection sites of the cattle (figure 4). This is especially in the highly abundant *B. annulatus, B. decoloratus*, and *B. geigyi*. Further to this, *A. coharenses* and *A. variegatum* were observed in all predilection areas except shoulders. All *R. gemma*, *R. fonguineus* and *Boophilus* sp. were found in just one predilection site each – Head, belly and tail, respectively. *H. laechi* and *R. sanguineus* were present only in the head and tail of the cattle.

**Species richness of ticks**

Figure 5 is a species accumulation curve (SAC) that estimates the species richness of ticks sampled at the cattle ranch. The observed number of tick species was 15. However, the SAC shows a mildly upward trend, which suggests that more sampling (of ticks) from more cattle would have revealed additional tick species. Furthermore, the Jackknife 2 and Chao 2 species richness estimates also support this trend. That is, in line with the prediction by the SAC curve, Chao 2 estimates a tick species richness of 16 species, while Jackknife 2 predicts that 19 species are in the area.

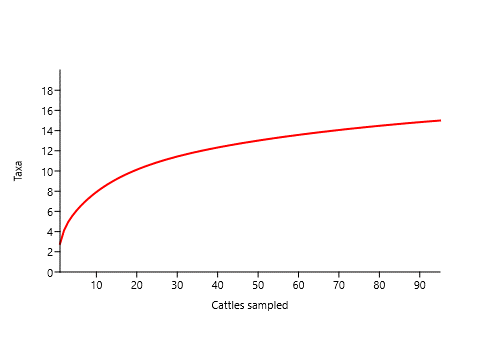
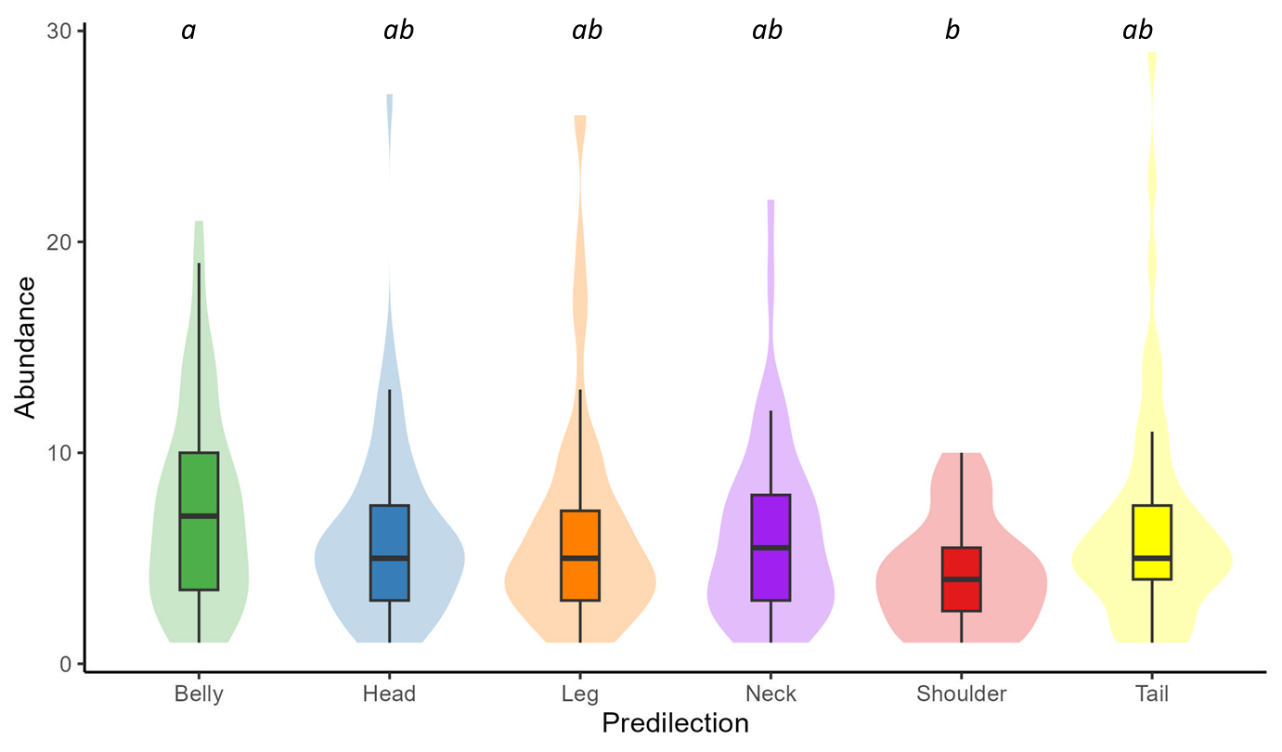
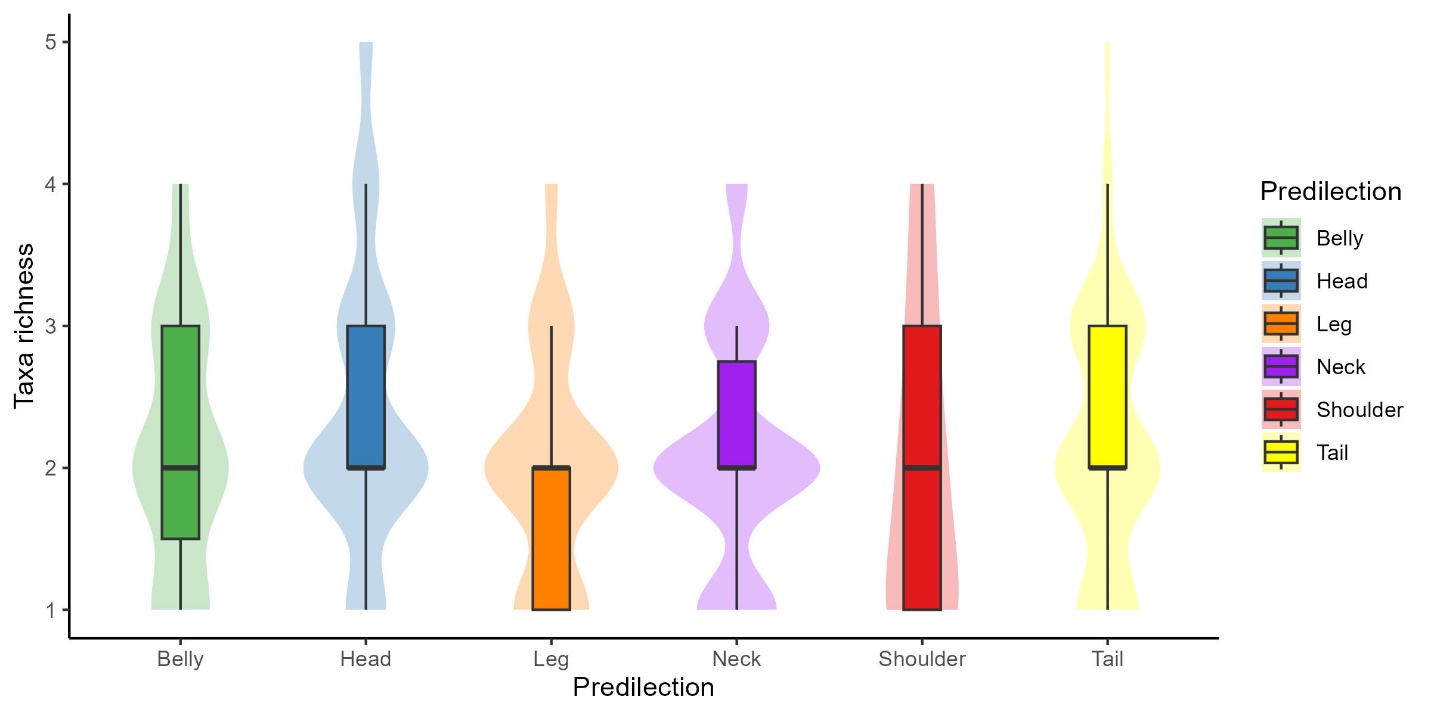


Figure 5: Species accumulation curve (SAC) of ticks sampled from 95 cattle in the ranch.



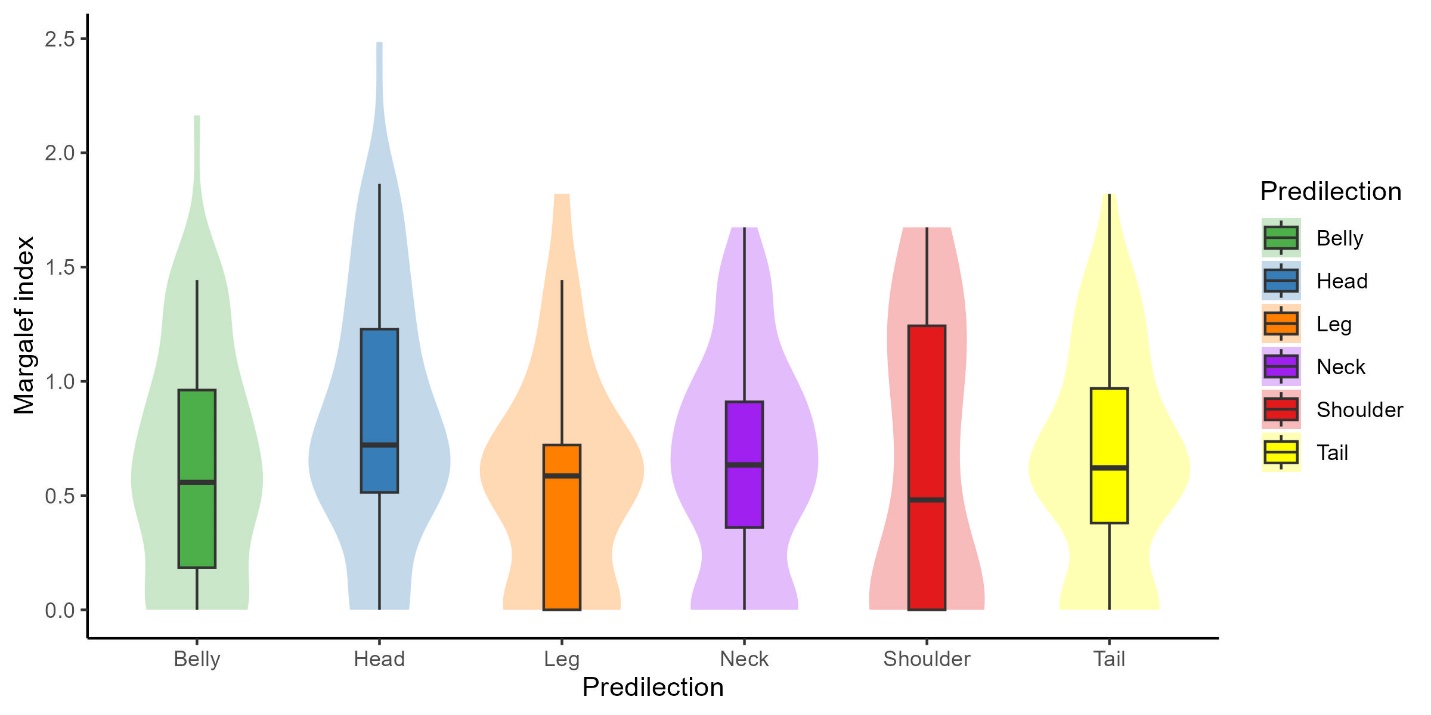
Figure\_: Abundance of ticks at the predilection areas in cattle sampled. different letters show significant differences between predilections.

The tick species abundance is represented in the figure\_. The tick community in the belly had the highest mean abundance (7.32±0.62), followed by the tail, leg, neck and head, which had a mean abundance of 5.49+0.77, 6.51+0.68, 6.13+0.64 and 6.03+0.55. Particularly, the Shoulder had the lowest number of ticks with mean abundance of 4.30+0.55. The negative binomial model showed that the abundance of ticks at the shoulders were significantly (P<0.05) lower than those in the belly.



Figure\_: Species richness of ticks at the predilection areas in cattle sampled.

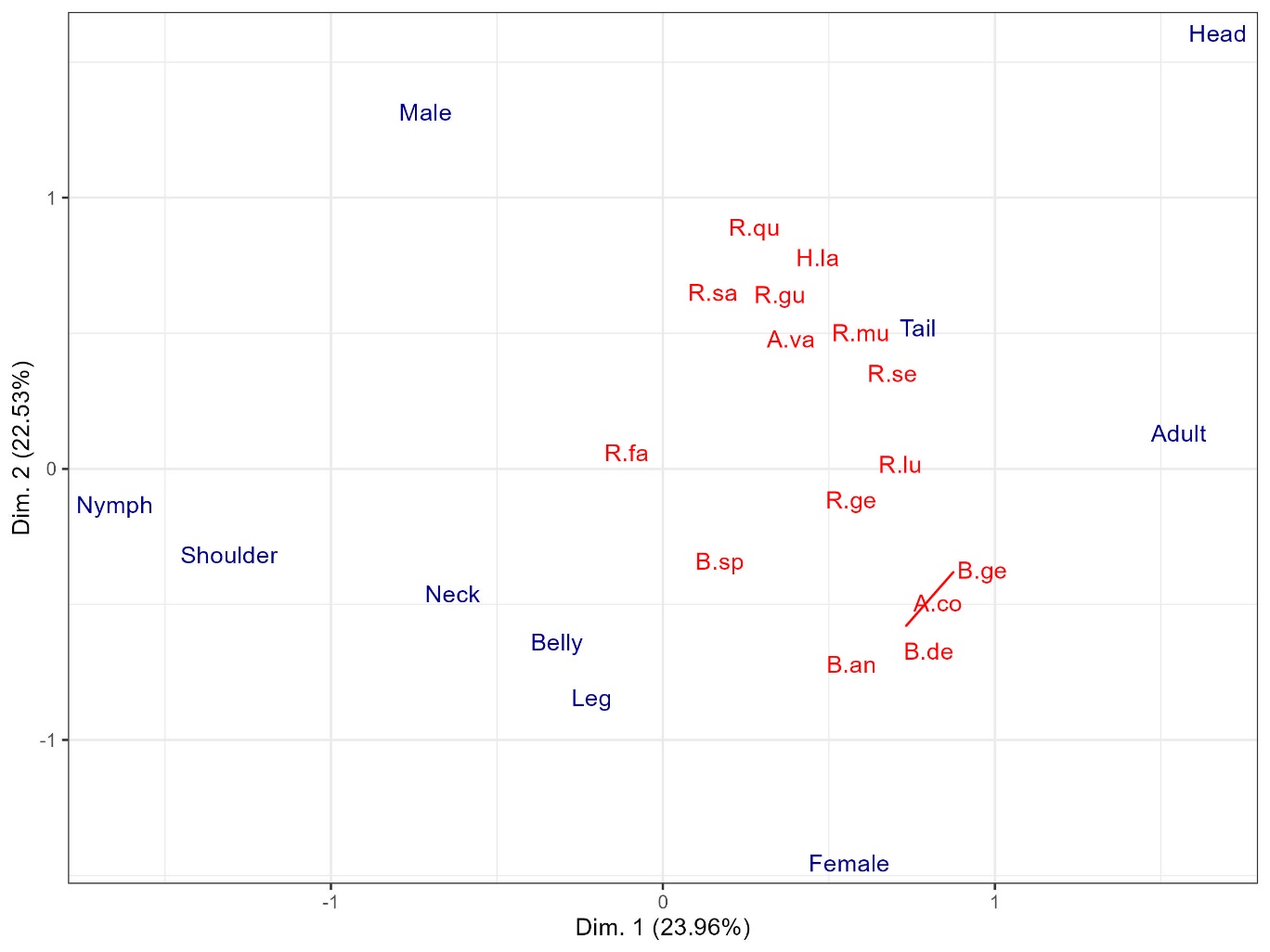
The median species richness was 2 across all predilection sites Figure\_. However, non-significant variation in tick richness persisted. For example, the cattle’s head had the highest mean tick-species richness of 2.42+0.55, followed by tail, belly and neck which had a richness of 2.19+0.77, 2.13+0.62 and 2.09+0.64, with the lowest observed in legs (1.98+0.68). Additionally, a few cattle had up to 5 distinct tick species infestations in the head and tail.



Figure\_: Margalef index of ticks at the predilection areas in cattle sampled.

Margalef diversity estimates of ticks at the predilection sites are shown in Figure\_. While this index statistically did not vary significantly (P>0.05), slight differences were observed. The Tick head had the highest mean Margalef index (0.83+0.07), followed by the tail (0.65+0.07), neck (0.64+0.07), belly (0.63+0.07) and shoulder (0.62+0.13). The legs had the lowest Margalef index (0.57+0.06) amongst all predilection sites.

The FAMD explains 46.5% of the variance in the tick data using the two dimensions only, with the first and second explaining 23.96% and 22.53%, respectively. The FAMD has revealed notable differences in the qualitative variables (Tick life stages, Predilection area and Sex) of the ticks. The FAMD plot shows that the ticks community show no notable dissimilarity in their preference for certain predilection areas. However, the adult and Nymph stages of ticks would contain different tick species compositions as shown in their high disparity on the FAMD plot. The neck, belly and leg of the cattle are qualitatively more similar.



***Figure \_: Factorial design of predilection site, life stage and species of ticks in the cattle ranch. A.va, A. variegatum; A.co, A. coharenses; B.an, B. annulatus; B.de, B. decoloratus; B. ge, B. geigyi; H.la, H. laechi; R.gu, R. gulhoni; R.lu, R. lunulatus; R.mu, R. muhsame; R.sa, R. sanguineus; R.se, R. senegalensis; B.sp, Boophilus species; R.qu, R. quilhoni; R.ge, R. gemma; R.fa, R. fanguineus.***

# DISCUSSION

In this study, we were able to investigate—at a community level—the prevalence of ticks at predilection sites of cattle, after sampling ticks from 6 predilection areas of 95 cattle in a trade market in Edo State, Nigeria. Generally, our survey has shown that 78.95 % of cattle were infected with at least one tick species. This was far significantly higher than in Adane *et al*. (2019)’s study in a cattle trade market in Edo State, from which a prevalence of \_% was reported.

To the best of our knowledge, this study has shown the highest diversity of ticks from a single cattle market/ranch in Nigeria. The observed species richness is 15, and the Chao 2 and Jacknife2 estimates suggest that while a substantial number of tick species were recorded, further sampling is likely to reveal additional species in the cattle ranch.

Based on the community dynamics since Adene et al. (2019)’s study, we had seen significant changes in the species of ticks found. In our study, each cattle have a median of 3 distinct species of tick, and overall of 15 species. This is much way higher than in Adane et al. (2019)’s report of 3 species of ticks (*A. variegatum*, *Rhipicephalus* sp., *R. microplus*) as the total in 209 out of 258 tick-infested cattle in the ranch. In this study, we find that *B. annulatus, B. decoloratus and B. geigyi were the most abundant ticks in the cattles sampled, constituting* 42.38%, 29.38% and 20.93% of the total ticks sampled from the cattles. However, Adene et al. (2019) had only *A. variegatum*, *R. microplus* and a *Rhiphicephalus* species. In this study, the exotic *R. microplus* was not present, but had a significantly high prevalence (21.5%) in Adene et al. (2019)’s survey. A study in Maiduguri, Northern Nigeria by Musa et al. (2014) showed *B. microplus*, *Am. variegatum*, *Hyalomma* spp., *Rh.* sanguineous and *Ornithodorus* spp. as the only ticks present in the area.

The high level of tick diversity and prevalence in the cattle trade area of Edo state, Nigeria calls for quick public animal health intervention. Most of the species of ticks that are highly prevalent in our survey are known to transmit multiple tick-borne diseases (TBDs). For example, *Boophilus* *decoloratus*, a common tick species in Africa, is an important vector of several tick-borne livestock diseases. It transmits *Ba. bigemina* and *An. marginale* to cattle, causing babesiosis and anaplasmosis respectively (Akinboade et al., 1981). Additionally, *B. annulatus*, the, is capable of transmitting *Anaplasma marginale* through transstadial transmission, leading to anaplasmosis (Samish et al., 1993). *B. geigyi* is recognized for its ability to transmit the protozoan parasite *Babesia bovis*, which can be detected in tick eggs, larvae, and hemolymph during various stages of infection (Akinboade & Dipeolu, 1981). *B. geigyi*, has been identified as a carrier of *Borrelia theileri*, the agent responsible for bovine borreliosis, in Mali (Mccoy et al., 2014). Also, *A. variegatum* has been collected in cattle from multiple regions in Nigeria such as in North-central Nigeria (Ogo et al. 2013), Borno (James-Rugu & Jidayi, 2004), Kano (Unsworth, 1952), Nigeria.

The female ticks in our study showed greater homogeneity in the overall community structure on all tick-infested cattle. This means that the community of tick species that were females were less diverse in structure compared to males with higher diversity. However, there were more counts of female than male ticks in our survey. Therefore, this means that just a small set of tick species account for most of the female community structure of ticks. Many studies have shown that female ticks are typically the main carriers of TBD, as they feed for longer periods and consume more blood than males, making them more likely to acquire and transmit pathogens (Kamaraj et al., 2022).

A larger female tick population increases the risk of disease spread to both cattle and humans. Additionally, since female ticks can lay thousands of eggs, a higher number of females could lead to a larger overall tick population, heightening the chances of future infestations and the spread of TBD (REFERENCES). While male ticks are less likely to transmit diseases due to shorter feeding times, their diverse population, as shown in this study, may still pose indirect risks by contributing to the ecological dynamics that support female ticks' survival and reproduction.

This study revealed that, at median, each tick-infested cattle was infested by approximately three distinct tick species. The presence of multiple tick species on a single host raises concerns about the potential for co-infections with tick-borne diseases (TBDs), as different species may serve as vectors for various pathogens. Adult ticks are often more involved in disease transmission due to their longer feeding duration and greater blood meal sizes compared to nymphs. The higher prevalence of adult ticks on cattle could elevate the risk of transmitting tick-borne diseases to both cattle and potentially humans.

The diversity of tick species, as measured by the Margalef index, did not significantly vary across the different predilection sites on the cattle. This suggests that the diversity of tick infestation is relatively uniform across the body (at least for the predilection areas we investigated), with no specific predilection site harbouring a significantly more diverse tick population. The non-significant difference in tick diversity between body regions also points to the fact that ticks may not exhibit strong site preferences when it comes to attaching to their hosts. Thus, each predilection site—whether head, tail, belly, or leg—had similar levels of tick diversity.

The absence of significant differences in tick diversity between predilection sites also implies that factors such as cattle movement, environmental exposure, and host immune responses are likely to play a more substantial role in determining tick attachment and diversity than the physical characteristics of the predilection sites themselves. For this cattle ranch study, we have shown that at a community and population level, there is no obvious attachment preference at the predilection sites. However, this, in many ways, contrasts with previous studies that suggested certain body areas, could be more favourable for tick attachment due to easier access or proximity to blood vessels (REFERENCES).

While we have observed 15 species, some are however rare, we do not doubt that further sampling would have revealed more tick infestation in the cattle at the ranch. The SAC, Jackknife 2 and Chao 2 estimates also attest to this claim. We are limited on how many species of ticks are there. The cattle trade market is known to receive cattle from every part of Nigeria. This is of public health importance. This is a resounding call for country-wide monitoring of ticks. Cattle in Nigeria are mostly raised by the Hausa herdsmen, and these people are largely not formally educated.

Interestingly, we did not find the invasive species, *Rh. microplus* which was reported in Adane *et al*. (2019)’s study. Since our study site is a cattle market where cattle are brought from the North and other far places, there is a high tendency that this species has spread across many parts of Nigeria. Lorusso et al. (2013) also had no detection of this invasive species in their survey in central Nigeria.

Our results are similar to Lorusso et al. (2013) who *had Rh. decoloratus, Rh. annulatus, Rh. guilhon* and *Rh. geigy* as their most abundant species. Similar to our results, too, Lorusso et al. (2013) reported a disproportionately higher ratio of females to males in these ticks, except for in *Rh. guilhoni* which was having a higher number of males (2.3 male:1 female). However, it is important to note that it is not so special a deal that more ticks are females. Many studies have reported otherwise, especially with other taxa of tick (Opara and Ezeh, 2011).

Since there is an overlap in species similarity between predilection sites, we can infer that ticks sampled from one predilection area would be a good estimator for what is available at another at the taxa level. This is supportive of the observations of low taxon preference for the sites. However, we cannot exactly say same thing for sex of ticks, as there seems to be high taxonomic diversity and variation in males than females. Though we find that most ticks are females, the majority of them are from a small subset of tick species, while males have high species variation.

**Limitations and future studies**

We acknowledge that smaller or immature ticks may be overlooked in the field, and hence my bias in the sampling. Therefore, our estimations on the proportion of mature to immature tick population may not be a true representation of what is in the field. We are away that we cannot say much on the nomenclature, age and sex of the cattle. Furthermore, results on abundance should also be taken with caution, as cattle size, age, breed, area and nature of predilection area can affect the result.

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