# **RESULTS**

A total of 510 ticks were collected from the 30 cattle inspected. The ticks belonged to four (4) distinct species: *Amblyomma variegatum* (189), *Hyalomma impressum* (229), *Boophilus geigyi* (83) and *R. sangiuneus* (9). The number of ticks collected across the predilection sites is presented in Table 1. The highest collections were made from the belle (99) and the least from the shoulders (63). Overall, 24 cattle were affected in at least one predilection area of their body, resulting in a prevalence of 80%. Furthermore, *A. variegatum* was the most prevalent tick species (80%) followed by *H. impressum* (70%), as shown in Figure 1.

Interestingly, all of the infected cattle had multiple infestations from different tick species (Table 2). 13.3% of cattle surveyed had all 4 species of ticks’ infestation and 63.3% of cattle had at least three (3) distinct species of ticks parasitizing them. Also, all 24 infected cattle were infested with *A. variegatum*. Additionally, 21 cattle had *H. impressum* infestations, while *Boophilus geigyi* and *R. sanguineus* were found on 18 and 8 cattle, respectively.

**Table 1**: Ticks collected from the six predilection sites of cattle at trade market, Edo state.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Predilection site | *A. Variegatum* | *H. impressum* | *B. geigyi* | *R. sangiuneus* | Total |
| Belly | 41 | 35 | 20 | 3 | 99 |
| Head | 24 | 51 | 9 | 4 | 88 |
| Leg | 48 | 30 | 13 | 0 | 91 |
| Neck | 29 | 46 | 6 | 1 | 82 |
| Shoulder | 21 | 31 | 10 | 1 | 63 |
| Tail | 26 | 36 | 25 | 0 | 87 |

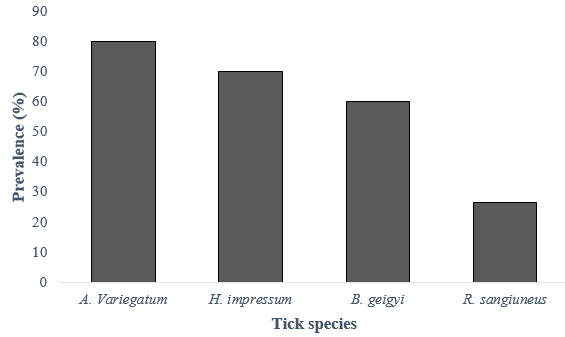
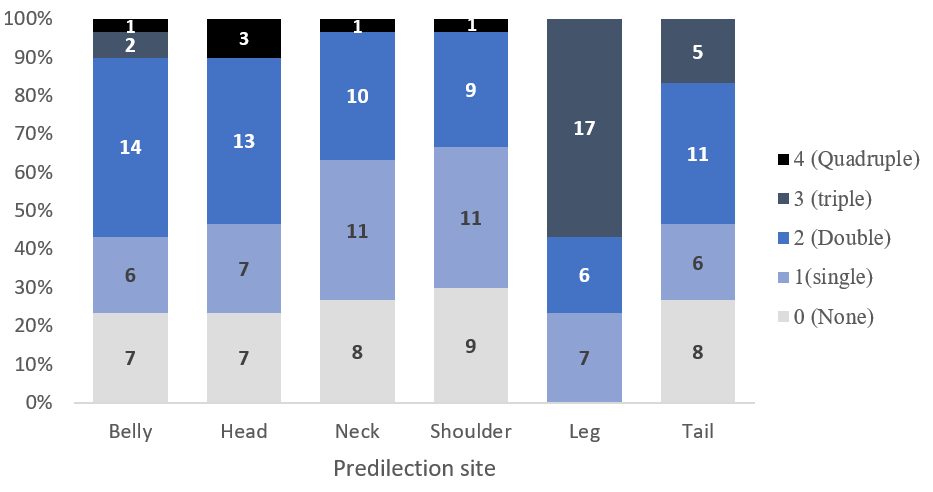


Figure 1: Overall prevalence of ticks on from each cattle at trade market, Edo state.

Table 2: Single and multiple tick infestations in the cattle.

|  |  |  |
| --- | --- | --- |
| Number of Tick Species | Number of cattle infested | Prevalence (%) |
| 1(single) | 0 | 0 |
| 2 (Double) | 5 | 16.7 |
| 3 (triple) | 15 | 50 |
| 4(Quadruple) | 4 | 13.3 |

While most of the cattle sampled for tick infestations had multiple tick infestations, some disparities when checked for per predilection site (Figure 2). All cattle had at least one (1) tick species infestation on their legs, with 17 cattle having triple tick species infestation. Moreover, there were 7-9 cattle without any tick infestation at all predilection sites except the legs. Also, Head, neck, shoulders and belly of the cattle had quadruple infestations (i.e., infestations from the four distinct species of ticks), with 10% of cattle having all four tick species present in the legs and the other quadrupled-tick-infested sites from just one cattle each.



**Figure 2**: Number of cattle and their respective number of distinct tick species infestation. *The bars are colour-graded from light to dark(er) with respect to the level of zero to multiple tick species infestations. The stacked column bar chart represents the count of cattle in their relative abundance (%) for each predilection site. Numbers within the bars represent actual counts of cattle with 0-4 distinct tick species in the respective predilection site. None: Zero tick infestation; Single: 1 tick species infestation; Double: 2 tick species infestation; Triple: 3 tick species infestation; Quadruple: 4 tick species infestation.*

# **Discussion**

In this study, we surveyed the bodies of cattle at a trade market in Edo state, Nigeria, to examine tick infestation prevalence. We did this based on six predilection sites (head, neck, shoulder, belly, legs and tail) of the cattle and examined for zero, single and multiple (taxonomically distinct) tick species infestation. This is important since the last published study by Adane et al. (2019) showed high level of ticks’ infestations.

We recorded an overall tick prevalence of 80%, meaning that of the 30 cattle investigated/surveyed, we found that at least 24 were infested with at least one species of ticks. This prevalence is approximately four times higher than what was reported in Adane et al. (2019)’s study which had a prevalence of 21.5%. One important thing to note is that Adane et al. (2019) had (reportedly) done a whole body count of each cattle for tick infestation. Similar high prevalence has been observed in the past. For example, Musa et al. (2014) observed a 63.4% prevalence out of 205 cattle examined in Maiduguri, Nigeria.

We also further surveyed six predilection sites, to see for consistency in these findings. Interestingly, the legs were the only predilection site where (at least) a tick was always found. As many as 7-9 cattle had no infestation in some sites. While this was so, we see that the head of 3 cattle had all four tick species. This was also seen in one cattle each for shoulder, neck and belly. However, it is noteworthy that most of the cattle legs we sampled had triple-tick species infestation.

Musa et al. (2014) observed high levels of *Hyalomma* spp. in their 205 cattle inspection for ticks in Maiduguri, Nigeria. These were observed mostly in the eye, ears, inner thigh and tail region of the cattle. In our study, *H. impressum* was the most abundant tick collected across all 30 cattle examined. However, it was second to *A. variegatum* in infestation prevalence (70%; Figure 1) which can also be termed as high. This species of tick was not observed in Adene et al. (2019)’s study, and may be the first official report of it its infestation of cattle in Edo State, Nigeria. *H. impressum* was found in low numbers (n=2) from camels examined in Kano, Northwest Nigeria. They found that it was the least prevalent of all 5 species of *Hyalomma* (genus) collected in the study. Also, Mamman et al. (2021) found 9 *H. impressum* out of 240 ticks investigated in Zamfara, and 15 *H. impressum* out of 254 ticks collected in cattle from Sokoto, Nigeria. These tick species are of significant health concern, amongst which is the recently discovered *Theileria annulata* discovered by Mamman et al. (2021). This parasite causes tropical theileriosis: a severe disease affecting cattle mostly in North Africa and Asia (Hashemi-Fesharki, 1988; Liu et al. 2022).

The *A. variegatum* was the second most abundant tick in the study, and also the most prevalent tick of the cattle we sampled. This is not surprising as many studies in west Africa have reported similar high occurrence and infestation prevalence of this tick species in cattle (Lorusso et al., 2013; ). On the contrary, Adene et al. (2019) observed a relatively low abundance of *A. variegatum* compared to other three tick species they surveyed. Additionally, we observed a high prevalence of *A. variegatum* (up to 80%) while Adene et al. (2019) found just a 17.58 overall prevalence.

It can be argued that the high prevalence of ticks observed in our study may be temporally related to the timing and seasonality of sample collection. Adene et al. (2019) noted the highest abundance of ticks occurring between May and July, which aligns with our sampling period conducted in June and July. Nevertheless, the prevalence in our study was significantly higher, suggesting that additional, unaccounted-for factors may contribute to the observed occurrence. For example, a study in Maiduguri, Nigeria, by Musa et al. (2014) showed that younger cattle aged less than 3 years had a higher prevalence (of 85.4%) compared with adult cattle aged between 3 – 7 years with a prevalence of 55.8%. Furthermore, Musa et al. (2014) reported that cattle over 7 years had the lowest prevalence of tick infestation (35.0%). They also investigated the differential prevalence of ticks by breed types of cattle, for which they observed that the Wadara and Kuri cattle had higher prevalence compared to Rahaji, Gudali and Bunaji. These cattle breeds are very common in Edo State, Southern Nigeria, where we carried out this study.

It is acknowledged that larger cattle are likely to have a greater external body surface area for ticks to attach to, making cattle size a potential factor influencing our results. Rehman et al. (2017)’s study showed that larger livestock had a higher abundance of ticks compared to smaller ones, in their comparison between cattle, buffalo, goats and sheep. They also found that female livestock generally carried higher number of ticks compared to their male counterparts. Additionally, other variables such as cattle age, breed, and phylogenetic background likely affect their susceptibility to tick infestations (Rehman et al., 2017).

Despite these considerations, the consistently high occurrence observed raises critical questions about the extent to which vector control agencies are effectively managing this ectoparasite. The observed prevalence highlights a critical concern regarding the control and management of tick infestations in the region. The high prevalence of ticks in our study may be attributed to the trade market setting, where cattle from diverse regions converge, increasing the chances of cross-infestations. Additionally, the absence of rigorous tick control measures in trade markets could contribute to the observed high infestation rates. A study in Cameroon, West Africa, has shown that the invasive *R. micropylus* becomes more easily established from intense movements that occur in cattle trade areas (Lontsi-Demano et al., 2020). The preference of ticks for the legs may be attributed to their proximity to the ground, facilitating attachment during. The high rate of triple-tick-species infestations on the legs also suggests that this site is particularly conducive for multiple species coexistence. the presence of multiple tick species on individual cattle increases the likelihood of co-infections, which can exacerbate disease severity and complicate treatment strategies.

The findings of this study highlight an urgent need for improved tick control measures in Edo State and other regions of Nigeria. Integrated tick management strategies, including regular acaricide treatments, rotational grazing, and the use of tick-resistant cattle breeds, should be prioritized. Public awareness campaigns targeting cattle owners and traders can also play a vital role in reducing tick infestations and associated health risks. Moreover, the potential introduction of novel control methods, such as biological control agents and vaccines against ticks, warrants further investigation. Collaborative efforts between veterinary authorities, researchers, and policymakers are essential to develop and implement sustainable tick management programs that address the specific challenges faced by cattle farmers in Nigeria.

# **Conclusion**

This study serves as an updated record to the state of tick infestation in cattle in Edo State, Nigeria. Tick infestations in cattle are poorly monitored and this is concerning, especially since ticks are of great medical, veterinary and economic importance to Nigeria. We find four tick species in a completely distinct genus: *A. variegatum, H. impressum. B. geigyi* and *R.* *sangiuneus*. But interestingly, most of the cattle had multiple tick species infestations. On examination of the predilection site of cattle, we find that the legs contained the most tripled-tick-species infestation. This multi-species infestation and the high level of tick prevalence in cattle in of great public health importance and necessitates rapid response by the government, vector control agencies and animal monitoring agencies to look into this issue.

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