Evaluation of Horse Coat Color Preference in Ticks (Ixodidae: *Ixodes sp.*) in College Station, Texas

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Abstract: Ticks are a major ectoparasite known to vector a large variety of diseases to both humans and animals. Most tick species have a host species preference, however it is unsure if they have a color preference within that species. For this experiment, the prevalence of ticks on horses with specific coat colors in College Station was recorded in order to determine if certain tick species have a particular coat preference. During two days in mid-fall, ticks were collected from 15 horses of varying coat colors, such as chestnut, bay, paint, grey, black, and blue roan. Of the ticks collected, 77% were found on chestnut horse, 15% on the paints, and 8% on the grey-coated horses. No ticks were collected from the bay, black, or blue roan horses. All of the ticks collected were from the genus *Ixodes sp.*, which could suggest that ticks from the genus *Ixodes sp.* have a coat preference towards chestnut horses. However, there was not a significant difference ($p>0.05$) between the number of ticks found on the various colors of horses, so the coat preference color could not be confirmed. Further experiments, such as testing the prevalence of ticks on different age groups in chestnut horses or other individual color groups, could potentially provide insight on what factors make certain horses more susceptible to ticks than others, and would allow improved care of those susceptible horses.

Keywords: Ticks, Acari, *Ixodes*, Horses, Color preference

Adult ticks are 4-legged creatures that fall under the phylum Arthropoda. Further classification includes order: Parasitiformes and families: Ixodidae, Argasidae, and Nuttelliellidae (Black and Piesman 1994). Ticks are ectoparasites, meaning that they feed externally on their host for blood meals. Ixodidae (hard ticks) and Argasidae (soft ticks) both blood feed and are responsible for economic losses to the livestock industry (Dantas-Torres et al. 2019). In fact, the losses caused by ticks is estimated to be at least $7 billion annually in the cattle industry (Gray 1985) Tick-borne diseases (TBD), especially

Lyme Disease are of major public health and veterinary concerns as ticks are the second most medically important arthropod behind mosquitoes (Niesobecki et al. 2019).

Because ticks are ectoparasites that feed on their hosts, they can easily spread diseases to their hosts from the pathogens they carry. A few of these diseases include Lyme borreliosis, Tick-borne encephalitis (TBE), Q fever, and Rocky Mountain Spotted Fever. The symptoms of these often include fever, poor appetite, vomiting, fatigue, nausea, and pain (Dantas-Torres et al. 2012). Although these diseases aren't fatal, especially when treated, they still have a large health impact on humans, and economical impact on the livestock industry. In livestock, this impact can be shown through great economic loss since the animal will not be gaining weight or producing as is often required in the livestock industry thus lowering efficiency. Gaining weight and reproducing is important for economic gain. As mentioned, the cattle industry is estimated to lose $7 billion annually due to ticks. (Gray 1985) Because ticks would likely affect a significant amount of the livestock, the lowered efficiency can result in a significant economic impact not only for that producer, but for the industry as a whole (Paddock and Goddard 2015). Ticks and the pathogens they carry also have medical importance to humans. Even though humans are typically incidental hosts, the pathogens ticks carry can still infect humans and have an unfavorable effect on the health of those affected (Williams et al. 2009). Common tick hosts include humans, farm animals, companion animals, and wildlife animals (Baneth 2014). Farm animals include cattle and horses, companion animals include cats and dogs, and wildlife animals include skunks and raccoons.

The most prevalent tick species in this region of East-central Texas include *Amblyomma americanum, Amblyomma maculatum, Dermacentor variabilis,* and *Ixodes scapularis* (Rodriguez et al. 2015). *Amblyomma americanum* is responsible for vectoring a number of diseases including Tularemia, Ehrlichiosis, Southern Tick Associated Rash Illness or STARI, and a specific serotype of Rocky Mountain Spotted Fever *Rickettsia parkeri* (Breitschwerdt et al. 2011). *Amblyomma maculatum* is the primary vector of *Rickettsia parkeri*, which can cause Rocky Mountain Spotted Fever (Fritzen et al. 2011). The American dog tick, *Dermacentor variabilis*, vectors Tularemia, Ehrlichiosis, Tick Paralysis, and also is the main vector of the causative agent of Rocky Mountain Spotted Fever, *Rickettsia rickettsii* (Fritzen et al. 2011). *Ixodes scapularis* are known to transmit Anaplasmosis, Ehrlichiosis, Tick-borne Encephalitis, Babesiosis, and most importantly Lyme Disease (Gulia-Nuss et. al. 2016).

In Northern Sudan, a study was conducted to determine what coat color a population of ticks preferred of 13-20 camels. The study was ongoing for two years and ticks were collected and recorded monthly. Ticks harbored on camels throughout the year and more ticks were found on grey coated camels than brown coated camels (Elghali and Hassan 2009). Another study conducted in Northeastern Nigeria from March to October determined the cattle coat color preference of ticks. 1,095 out of 3,150 cattle in the area were infested with ticks. Among the cattle infested, the majority of ticks were found on white colored cattle, followed by brown, black, then mixed coloured cattle had the least amount of ticks (Opara et al. 2019). This study aims to perform a similar smaller scale experiment to determine whether ticks have a preference of coat color in horses, and if so, compare that preferred color to that of the experiments just mentioned.

Materials and Methods

The Ticks were collected from the bodies of horses at The Stables at Millican Reserve, 19888 State Highway 6 South, College Station, TX 77845, on 2 different days. Horses were selected based on coat colors. The horse owner's permission was required for all horses observed. Ticks were collected at different times of the day in order to account for the fact that different horses get groomed at different times depending on their owner.

The first tick collection occurred the morning of October 27, 2019, 9:00am. The weather was sunny, and the temperature was 24.4°C. The weather and temperature was determined by using a weather app (weather.com) on a cellular device. Nine horses of varying color and ages were selected, and their approximate age, sex, and breed was recorded. Each horse was searched for ticks by hand and ticks were extracted using metal tweezers (Revlon New York City, New York).

The second tick collection occurred on the afternoon of November 09, 2019. The weather was sunny, and the temperature was 20°C, at the same location, using the same cellular device to determine weather and temperature. Ten horses (some of which were the same ones from the first day depending on owner's permission) were selected and their information was recorded. Each horse was searched for ticks the same way as the first collection day.

All ticks collected were counted and sorted according to the coat color of the horse they were found on. Ticks were identified down to the genus *Ixodes sp.* with a stereo microscope using a dichotomous key (Pratt and Litig 1962) and were stored in HEB Texas Tough Double Zipper Sandwich bags (HEB San-Antonio, Texas), in a freezer.

Results

As seen in Figure 1, a total of 15 horses were used for this study; 4 chestnuts, 4 bays, 3 paints, 2 greys, 1 black, and 1 blue roan.

Horse, age (years)	Coat Color	Ticks
Bonnie, 2	**Blue roan**	**0**
Gidget, 10	**Bay**	**0**
Ringo, 3	**Grey**	**1**
Temple,14	**Black**	**0**
Callie,12	**Chestnut**	**0**
Indy,14	**Paint**	**2**
Crow,26	**Chestnut**	**35**
Sparky,23	**Chestnut**	**6**
Lakota, 20	**Bay**	**0**
Betty,13	**Bay**	**0**
Sally Grace,17	**Bay**	**0**
Stetson,11	**Paint**	**0**
Pearl,20	**Paint**	**0**
Bretta,28	**Grey**	**0**
Splash,13	**Chestnut**	**4**

Figure 1. The horse name, age, coat color and total number of ticks found on that

A one-way ANOVA test was run to compare whether the variation in coat color of these horses (excluding Crow) would cause a significant difference in the number of ticks found on each horse. The horse named Crow was excluded from this test and all figures because this horse is notorious for attracting ticks and having generally poor hygiene (to no fault of the owner). According to the ANOVA test, there was not a significant difference ($p>0.05$) in the number of ticks collected per each horse coat color. However, as seen in Figure 2, ticks found on chestnut horses made up 77% of the total ticks collected with ticks found on paint horses making up 15%, and ticks found on grey horses making up 8%. Figure 3 shows that chestnut horses (excluding Crow) had a total of 10 ticks, paint horses had a total of 2 ticks, and grey horses only had a total of 1 tick. No ticks were found on any of the bay, black, or blue roan horses observed. The genus of all collected ticks was *Ixodes sp.*

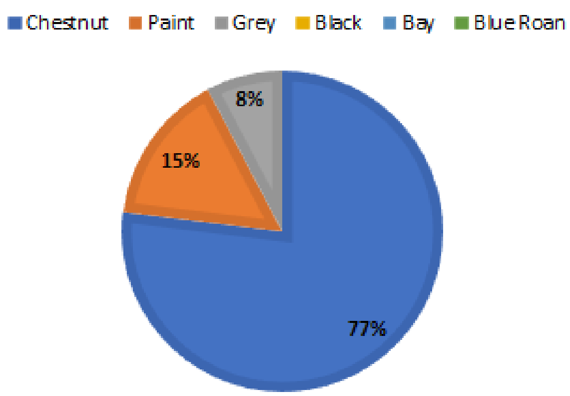

Figure 2. Percentage of the total ticks collected according to each coat color category.

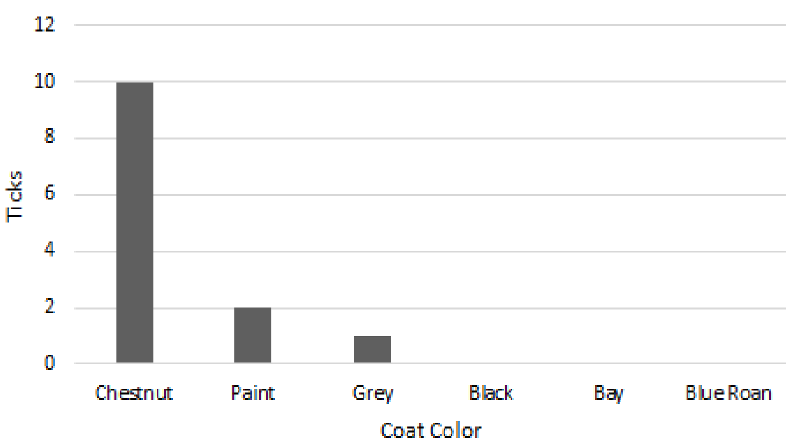

Figure 3. The number of ticks collected overall per each horse coat color category. Does not include Crow. There was not a significant difference ($p > 0.05$) between the various coat colors.

Discussion

This study was done to determine if the ticks (*Ixodes sp.*) found feeding on horses had a preference in a certain coat color of horse. According to Figure 3, there was no significant difference ($p>0.05$) in the number of ticks collected according to the various coat colors of the horses. Tick preference in coat color of horses cannot be validated. According to Figure 2, the majority (77%) of ticks collected throughout this study were found on chestnut horses. This observation might suggest that ticks prefer chestnut colored horses, but since the results were not significant, this cannot be supported.

The inconclusive results of this study may be due to the small sample size of horses, n=15, which was restricted because the only horses that could be observed were those whose owners gave permission for their animals to be used in this study. Another factor is that the sample of horses was restricted to the same location, so the use of a variety of locations in the area would assist with increasing the sample size as well as giving a better variety of data to analyze.

As seen in Figure 1, there is a specific horse named Crow who had almost six times as many ticks than the horse with the next highest number of ticks, Sparky. Crow is one of the older horses observed in this study, but according to his owner, Crow has always been very prone to skin conditions and tends to have more problems with ticks, flies, and other pests than your typical horse does. Because of this, Crow was excluded from the ANOVA test and both Figures 2 and 3, so as to now skew the data. It is unknown why Crow is so notorious for attracting pests and having bad skin, but it is possible that factors such as age or, considering the observations from this study, the fact that Crow is a chestnut horse could influence why he attracts so many ticks. A way to examine if this is true would be to test the number of ticks found on chestnut horses per age group and from varying locations. Experiments such as these have the potential to be beneficial for current and future horse owners as to give some insight on which horses are shown to be more susceptible to ticks at a certain age and with certain coat color.

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