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A Preliminary Assessment of Shade and Shelter Use in Paddock-Kept Horses in Australia: A Pilot Study

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Abstract

There is increasing evidence to support the recommendation of providing horses with adequate shade, either natural or man-made, to safeguard their welfare. Weather conditions, particularly extreme temperatures, influence horses' shade-seeking behavior and ability to thermoregulate. However, there is limited research on other factors that may influence equine shade-seeking behavior. The aim of this study was to investigate the influence of weather conditions and shade type available on horses' shade-seeking behavior in non-extreme conditions, i.e. not in the intensity of summer, using animal-based behavioral indicators. Shade-seeking behavior of 19 university-owned horses was observed over a period of six days. Horses were kept in groups (n = 7 to 12 individuals) in paddocks with free access to an artificial shelter (AS) and natural shade (NS). The location of each horse was recorded at hourly intervals during the day along with the time of day, ambient temperature, and prevailing weather conditions. Shade use was not related to the time of day, and horses spent most of their time in non-shade (85.5%), compared to natural shade (10.2%) and artificial shade (4.3%; $H_2 = 187.85$, $p < 0.0001$). However, horses were more likely to seek artificial shade in foggy or cloudy conditions and natural shade when it was partly cloudy ($Chi^2_{12} = 30.14$; $p < 0.05$). Horses preferred natural to artificial shade, spending 78% of their shade-time in natural shade. Although horses spent the majority of their time not in the shade in this study, it does not mean that shade is not important for the thermal comfort and wellbeing of the horse. Horses still displayed shade-seeking behavior during conditions not deemed extreme, for example, in fog and reduced visibility conditions. Further research could be beneficial to understanding shade-seeking behavior in horses in order to determine what constitutes acceptable shade provision to optimize horse welfare.

Keywords

Equine; behavior; welfare; natural shade; artificial shelter; weather

1. Introduction

The modern-day domestic horse lives under largely controlled conditions and therefore relies heavily on humans to provide an appropriate environment in which to live. Horse health, welfare, and more recently 'wellbeing' have become increasingly important due to public awareness of shortfalls. This has contributed to a potentially challenged social license to operate to the extent that demands for improvement in how horses are managed are global [1,2]. The Five Domains Model framework enables the assessment of an animal's welfare, either positive or negative, using four physical domains (nutrition, environment, health, and behavioral interactions) and the fifth domain, mental state [3–5], to determine the likely quality of life and can be applied to assess horse management practices [6,7].

It is widely agreed that as non-human animals, horses are sentient beings and as such, their mental wellbeing should be considered in detail [8]. While horses cannot fully avoid negative experiences such as inclement temperatures, this can be managed in such a way that it does not unduly compromise individuals' quality of life. As Mellor [9] pointed out, it is the balance between positive and negative experiences an animal has over an extended period of time that is important.

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Furthermore, the ability of individual animals to exercise agency and make choices to control their environment (for example, whether they stay out in the open or secure shade) is also becoming increasingly recognized as an important contributor to positive wellbeing [9,10].

Shelter for horses can be broadly divided into natural, such as that provided by trees and hedges, and artificial, e.g., man-made structures. Proops *et al.* [11] demonstrated that equids seek shelter under a variety of environmental and climatic conditions. Therefore, it is necessary to provide an environment that affords protection from extreme and less favorable weather conditions. This can promote subjective experiences contributing to positive equine wellbeing [5]. This is particularly important for horses that live outdoors for the majority, or all, of the time [12].

Australian animal welfare legislation is state-based and deems the failure to provide adequate shelter (shade) an act of cruelty [13–19]. However, while what is considered 'adequate' shelter remains underdefined, anecdotal observations suggest that practice is inconsistent and often to the detriment of horse welfare. The majority of research investigating the importance of shade to horses has focused on extreme cold or heat as well as wet weather conditions. There is a paucity of research into the importance of shade provision in temperate climates, including where horses are exposed to high temperatures over consecutive days.

The horse's thermoneutral zone (TNZ) is 5-25°C [20] with minor variations due to age, breed, body condition, diet, season, and climate [21]. Horses deploy heat accumulation and dissipation strategies to maintain a core body temperature of 37-40°C [22]. When the ambient temperature exceeds the equine TNZ, physiological responses occur including increased respiration rate and sweating to dissipate heat through evaporation to eliminate excessive heat and stabilize core body temperature [23,24]. Behavioral responses such as flared nostrils, head nodding, and apathy may also be exhibited [25,26]. When ambient temperatures drop below the TNZ, horses seek shelter and stand in close proximity to each other and may shiver [27,28]. In cold, windy, wet conditions, horses protect themselves by turning their heads away from the wind with their tails facing the wind or seek shelter in lieu of the prevailing wind.

Equine shade-seeking behavior (SSB) is notably influenced by weather conditions [29,30]. In hot conditions, access to shade can help with the maintenance of core temperature. Horses frequently exhibit SSB during hot, sunny conditions [29,31,32]. However, shade and shelter use are not only associated with high temperatures. Indeed, Jørgensen *et al.* [30] reported that horses were more likely to seek shelter (either natural or artificial) when ambient temperatures are outside of the equine TNZ (i.e., above or below the TNZ). Interestingly, the effect reported by Jørgensen *et al.* [33] indicates an apparent inherent 'need' for shelter, given that horses wearing rugs to help them more easily maintain their core body temperatures in cold conditions still sought shelter. Similarly, significant increases in shelter occupation have been reported by Snoeks *et al.* [21] during rain, cold (between -4°C and 3°C), and windy conditions [34].

Limited research exists directly comparing the benefits of natural vs. artificial shelter types for horses. Heleski and Murtazashvili [34] suggested that some horses preferred to stand next to artificial shelters rather than in them, possibly to avoid certain horses and/or maintain an unobstructed range of vision. In contrast, Snoeks *et al.* [21] reported a 25.6% greater use of artificial shelters compared to natural shelter in extreme temperatures and weather conditions.

Animal-based indicators are particularly important when assessing the adequacy of environmental provisions [8,27]. Therefore, understanding equine SSB in countries such as Australia that regularly experience an extreme range of temperatures, frequently exceeding 40°C for many consecutive days in the summer and well below 0°C in winter in the southeast and mountainous regions [35], is fundamental to determine what constitutes adequate shelter provision for horses.

The aim of this study was to investigate the influence of weather conditions and shade type available on equine SSB in non-extreme conditions. Individual horse behavior was used to assess natural shade and artificial shade use by paddock-kept horses in Australia.

2. Materials and Methods

2.1. Animals

Nineteen Thoroughbred and Standardbred horses belonging to Charles Sturt University were observed on six days between June 29th and July 8th, 2020. These dates fall within the Australian winter period (June 1st to August 31st). Data collection days were determined by COVID lockdown-related considerations, not by prevailing weather conditions. All horses were in good health and lived in established herds in paddocks for the entire observation period (i.e., not stabled). The horses were not regrouped for the purposes of this study. Group 1 comprised four mares and three geldings (mean age 8.86 ± 2.12 years), while Group 2 comprised 12 geldings (mean age 8.00 ± 2.76 years).

2.2. Materials

2.2.1. Weather Monitoring

Ambient temperature and wind speed were monitored using the Weatherzone application, which sources information from the Australian Bureau of Meteorology on an iPhone (iPhone 8, iOS 13.5.1). The study location was set to Estella. Weather conditions (cloudy/windy) were determined through direct observation at the beginning of each recording session.

2.2.2. Paddocks and Shelters

Groups 1 and 2 were observed in Paddock 1 (0.375 Ha - native grasses) and Paddock 2 (0.67 Ha sown with grazing oats), both at 0.05 Ha/horse stocking density. Both paddocks contained trees and bushes >2m on the boundaries, providing natural shade, along with a two-sided artificial shelter **(Figure 1)**.

Photograph by the authors (2020)

Figure 1: Horses (in Group 1) utilizing artificial shade, natural shade, and non-shade at Charles Sturt University.

2.3. Data Collection

Time of day, ambient temperature (°C), weather conditions (cloudy– sun not visible, fog, fog/cloud, partly cloudy – sun partially visible, partly cloudy/wind – greater than 10 km/h, sunny, sunny/wind), paddock being observed, total number of horses in the paddock, number of horses in natural shade, number of horses in artificial shelter, and number of horses in non-shade areas (sun) were manually recorded onto a Microsoft Excel spreadsheet.

Scan-sampling was conducted on the hour from 09:00 h to 16:30 h over three consecutive days in one week and a further three days the following week, from outside of the paddock. Horses were observed in a set order during all observation periods. The location of each horse was identified and recorded before moving on to the next horse. No other behaviors were recorded.

Horse location was categorized as 'Natural shade' if more than 50% of their body was in the shade. When the sun was temporarily obstructed by clouds, horses were classified as standing in natural shade if they were standing adjacent to trees/bushes that would ordinarily cast natural shade if the sun was not obstructed.

Horses were identified as standing in 'Artificial shade' if they were either standing in the shelter or standing in the shade produced by the shelter, with at least 50% of their body shaded.

2.4. Data Analysis

Horse location data were collated and analyzed in Microsoft Excel 2018 (Version 16.16.26). Anderson-Darling tests conducted in GraphPad online determined the distribution of the frequency of horses displaying SSB and shelter/shade occupancy percentages. As neither were normally distributed (AD = 12.4; $p < 0.001$ and AD = 12.4; $p < 0.001$, respectively) non-parametric Kruskall-Wallis tests were applied to assess shade type use. Chi-squared tests of association were then applied to determine the relationships between shade type preference, shade type, and weather conditions.

3. Results

A total of n = 96 observations of horses' locations and shade use were obtained over the two-week period.

3.1. Shade Type Preference

There was a significantly greater use of non-shaded areas (median = 7.5 horses; range 1–12) compared to both natural (median = 0 horses, range 0–5) and artificial shade (median = 0 horses, range 0–3), and more use of natural shade than artificial shade (Chi-squared = 33.152, $p < 0.00001$). However, horses overall made significantly greater use of natural shade than that afforded by artificial shelters (Mann Whitney; $p < 0.001$; **Figure 2**).

3.2. Weather Conditions

Throughout the observation periods, the mean temperature was 11.6°C ± 3.3°C (ranging from 4.5°C to 15.5°C). Weather conditions influenced the type of shade used ($Chi^2 = 30.14$; $p < 0.05$; **Table 1**).

4. Discussion

During this study, the 19 paddock-kept horses in Australia in winter spent the majority of their time in non-shade areas, compared to natural shade (NS) and artificial shade (AS). Although AS and NS were not utilized for the majority of the time during this study, it does not mean that they are not important for thermal comfort and consequently for promoting positive equine welfare.

4.1. Shade Type Preference

Horses spent a significant amount of time in non-shaded areas compared to NS and AS. There may be a number of reasons why horses in this study preferred being in the non-shaded areas, such as pasture availability (as observed by Heleski and Murtazashvili [34]) and the horses spent more time grazing rather than seeking shade/shelter; the mild temperatures and weather conditions did not provoke them to seek shade/shelter.

In this study, horses spent a greater percentage of time occupying NS as opposed to AS. This is contradictory to Snoeks *et al.* [21] finding that horses preferred artificial over natural shade in extreme temperatures (below 7.1°C or above 25.2°C) and weather conditions (rain and/or wind), with a 25% greater use of artificial compared to natural shade. Horses rarely utilized NS in cold conditions, suggested to be due to NS not sufficiently providing protection against cold and precipitation. In the current study, however, horses showed a preference for NS, although during foggy/cloudy conditions sought AS. It is possible that in thick foggy conditions the AS which had solid sides afforded the horse greater protection from the 'wet' that accompanies the fog than the natural shelter, bearing in mind the horses in this study are never rugged.

Table 1: Standardized residuals for Chi-squared test to determine the influence of weather conditions and shade type use.

	Weather Condition						
	Cloudy	Fog	Fog + Cloudy	Partly Cloudy	Partly Cloudy + Wind	Sunny	Sunny + Wind
Natural shade SR	-0.21	-0.3	-1	1.06	-0.18	-0.2	0.86
Artificial shelter SR	0.42	0.79	3.35	-0.57	-0.47	-0.01	-0.53
Non-shade SR	0.01	0.05	0.01	-0.09	0.03	0.02	-0.07

Cloudy – sun not visible due to cloud cover. Partly cloudy – sun partially visible due to cloud cover. Wind – >10 km/h from any direction. SR = standardized residual.

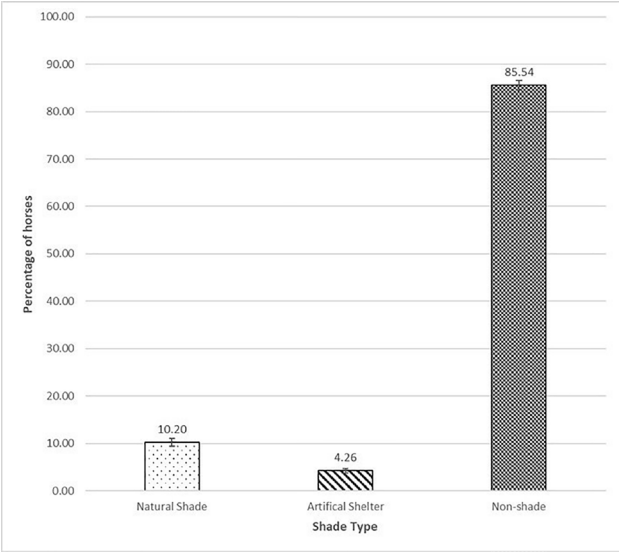

Figure 2: Outcome results for shade type preference of horses.

4.2. Weather Conditions

The temperatures observed during the current study were typical for midwinter in Wagga Wagga [36]. Although these temperatures (11.6°C ± 3.3°C) were mild compared to the extreme temperatures observed in other studies [11,28,30,33], horses still displayed SSB and a relationship between weather conditions and SSB was evident (**Table 1**). Since it did not rain during the current study, rain could not be a contributing factor to SSB as highlighted in other studies [21,28,30,33,34].

Interestingly, horses sought AS when the sun was occluded by clouds or fog. This was during day four of the study, which was also when the lowest temperatures were recorded. Although it did not rain during this study and the temperature was not as cold compared to other studies [21,28,30,33], the condensation of the fog may have created sufficient moisture for the horses to exhibit SSB. AS, which had solid sides, was preferred during foggy conditions with reduced visibility.

This is supported by the observation that during partly cloudy conditions, horses were more likely to seek natural than artificial shade.

In this study, horses were offered a choice of shelter type, i.e., artificial or natural, as well as non-shaded areas. Contemporary animal welfare assessment emphasizes the importance of agency to individual animal welfare. By being provided with a 'choice' of locations within the paddock enabled the horses to display agency [37], therefore providing an environment which could go some way towards optimizing equine welfare [5,9].

5. Limitations

It was noted that the horses in the larger Paddock 2 did not occupy AS throughout the study. There may be two reasons for this. First, the shelter was located at the far end of the paddock away from the gate to which horses gravitated at particular times of the day through previous conditioning to the arrival of feed during times of the year when supplementary feeding is required [38]. It is worth noting that during this study, horses did not receive supplementary feed due to sufficient pasture growth and feed availability. The orientation of the shelter (artificial shade location) may also influence occupation as its open sides face away from the gate to the paddock, and due to its orientation, make it difficult for occupants to maintain full sight of the herd, as highlighted by Heleski and Murtazashvili [34] as influential.

Other factors that may contribute to SSB, but were outside the scope of this study, include relative humidity, solar radiation, wind speed, temperature inside the artificial shelter, temperature under shade, the presence of insects [11,39,40], core body temperature, and time post feeding. While the impacts of these factors on horse SSB have been reported, commonly individually, for groups of horses in various locations worldwide, a funded longitudinal study of equine SSB taking into account all of these factors, over all four seasons in Australia, would be valuable, where horses typically live out on a permanent basis and are exposed to extreme weather events and variations on a daily basis.

Despite the identified potential limitations of this study, baseline data collecting using similar methods to the published studies cited in this paper are provided for further investigations of shade/shelter use by horses in Australia and countries with similar climates and fluctuating weather conditions.

6. Conclusion

Although artificial shelter and natural shade were not utilized the majority of the time in this proof of concept study of paddock-kept horses in Australia, they are important for the thermal comfort of the horse. Environmental conditions during this study were mild compared to other studies, possibly indicating that during temperate/mild weather conditions, shade or shelter may not be as essential. However, horses still displayed SSB during conditions deemed non-extreme, such as foggy conditions, indicating the importance of providing horses with the option of shade/shelter regardless. The use of equine behavior (namely individual horse location within a paddock) in this study has yielded data which contribute

to understanding both the importance of providing suitable shelter and the relevance of SSB in horses to equine welfare.

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Authors' Contributions

Marina Douglas co-designed the study, collected and analyzed the data and wrote and edited the paper. Hayley Randle co-designed the study, assisted with data analysis, and assisted with writing and editing the paper.

Data Availability

The data supporting the findings of this study are available on request from the corresponding author.

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This paper has not received any funding.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

Ethical Approval

Approval for this study was granted by Charles Sturt University's Animal Ethics Committee (Authority A20079). The study has followed the guidelines of the Declaration of Helsinki.

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