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Non-canine Research

Behavior of horses on pasture in relation to weather and shelter—A field study in a temperate climate

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ABSTRACT

The behavior and use of shelter by 426 domestic horses on 166 pastures was studied in relation to weather conditions in a temperate climate. The pastures varied in availability and type of shelter (artificial and/or natural). Observations were carried out once per pasture, but to increase the number of replicates in some classes of weather conditions, observations on some horses were repeated. Horses were observed without interfering with their everyday routine. At each sampling time, weather conditions, such as ambient temperature, humidity, wind speed, precipitation, and cloud cover were noted. A 5-point ordinal scale was used to score the horses' behavioral response to flies, defined as insect-avoiding comfort behavior. The mean use of the artificial shelters was 37.6% per observation moment. When dry air temperature was lower than 7.1°C or higher than 25.2°C, a 2-degree fit showed a higher artificial (man-made) shelter use. This is explained by the dampening effect of the artificial shelters on ambient temperature during cold circumstances, the temperature outside artificial shelter was lower than inside, whereas during warm circumstances temperature outside was higher. Regardless of temperature, but when wind speed was >2.8 m/s, shelter use was higher on rainy days than on dry days. Sheltering was also observed inside the thermo-neutral zone of horses (41.0% of the total observation time). This behavior could be explained by other micro-environment related aspects, such as insect harassment. These results suggest that having access to shelter seems important for horses.

Introduction

The Duke of Newcastle (Cavendish, 1743) wrote: "You ought to build a lodge in the pasture-ground into which you remove your mares, as well as in all others where they feed, to defend them from the inclemencies of the weather; for there is no creature to which cold is more injurious than to horses, neither will they endure much heat." However these days, there are still a lot of horses in pastures without access to a shed, creating societal concern, even when weather conditions are within the thermo-neutral zone (TNZ).

The TNZ is defined as the range of temperatures in which an animal maintains body temperature in the short term with little or no additional energy expenditure. Morgan (1998) concluded after a review of the existing research that the TNZ was estimated in general for horses to range from 5-25°C. The 5 main climatic variables that affect an animal's microclimate and thermal comfort are ambient temperature, global solar radiation, relative humidity, precipitation, and wind velocity. The collective effect of climatic factors has a different effect on the thermal comfort of an animal than each factor alone (NRC, 1989). The TNZ for horses also varies with number of days of exposure, age, body condition, breed, season, climate, and diet (Cymbaluk, 1994). In cattle, there are also effects of coat thickness (Finch et al., 1984) and color (Brown-Brandl et al., 2006). However, information about when horses may be experiencing thermal discomfort is scarce. Thermoregulation is achieved by changes in behavior (i.e., shelter-seeking and huddling) (Curtis, 1983; Cymbaluk, 1994; NRC, 1989).

The need for provision of shelter has been investigated in temperate areas for cattle (Rosselle et al., 2013; Van Laer et al., 2014; Van Laer et al., 2015), but not for horses. In temperate regions

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winters are not very severe and summers rather short, but there are intermittent extreme weather events such as hot spells, cold spells, or storms. These events are also difficult to cope with. When considering winter conditions, research has been done only in extreme climates with severe winters. The main conclusions of these studies were that horses used most shelters during rainy and/or windy days (Autio and Heiskanen, 2005; Berger, 1986; Boyd and Houpt, 1994; Duncan, 1985; Ingólfdóttir and Sigurjónsdóttir, 2008; Mejdell and Bøe, 2005; Michanek and Bentorp, 1996; Tyler, 1972). Some researchers explain this shelter use by the reduced heat loss due to radiation that horses might experience during shelter use, which saves energy for heating the animals' body (MacCormack and Bruce, 1991; Mejdell and Bøe, 2005; Redbo et al., 2001). Shelter seeking and shade use was highest on hot, sunny (solar radiation) days, no effect of precipitation or wind was observed (Heleski and Murtazashvili, 2010; Holcomb et al., 2014; Siskova et al., 2006). Access to shade affects the horse's physiological homeostasis. Individually housed horses without access to shade in a hot, sunny environment showed higher rectal and skin temperatures and respiration rates than completely shaded horses (Holcomb et al., 2013). Most of these studies used a limited number of animals in herds. Horses are herd animals and want to maintain group cohesion. Thermoregulation is not always the main motivation factor for sheltering in warm conditions. Feral horses in desert and island environments sought "refuges" from insect harassment during times of increased fly activity. Increased insect density has been suggested as a reason horses might avoid shade under vegetation (Keiper and Berger, 1982). Preference for artificial or natural shelter has not been investigated in horses, but cattle showed a preference for natural shelter in nature reserves (Van Laer et al., 2014).

The Belgian government regularly receives complaints from anxious citizens about the well-being of horses on pasture during snowy days (De Boitselier, 2011; personal communication). In addition, during inspections after such complaints, veterinarians have to decide whether horses should have shelter and if some measures must be taken. Therefore, the objective of this study was to observe sheltering of grazing horses, in relation to weather conditions in a temperate area, that is, Flanders, Belgium. The hypothesis was that even in a temperate climate horses will spend more time sheltering in cold, rainy and/or windy conditions or in hot, sunny conditions than in more moderate conditions. We also hypothesized that natural shelters will not cover the shelter need and will be rarely used. Two other presumptions are that insects also affect sheltering in summer and that there are some influences of horse characteristics.

Material and methods

Animals and locations

Pastures were found through personal contacts, by placing an ad in a newsletter from vzw Vlaams Paardenloket, an online forum for all questions about horses, or sometimes just by driving past them. A total of 426 horses on 166 pastures across Flanders (Belgium), with a mean of 3.6 horses per pasture and a range of 1 to 30, were included in the study. Most horses were mares (N = 226), 167 were geldings, 25 were stallions, and 8 horses were unknown, because the observer could determine the sex and the owner was unknown. Seventy percent were dark (brown, black, or chestnut) colored horses. Fifty percent of the observation time included dark colored, 4 to 20 years old mares or geldings. Because many owners did not know the exact age of their horses, every horse was allocated to an age class defined by the authors: <4 years (N = 61), between 4 and 20 years (N = 324), >20 years (N = 41). There were 123 Cold-blood horses and 303 crossbred horses. Fifty-two horses had access only to artificial shelter, 19 horses had only natural shelter available, and 355 horses had access to both. Artificial shelters (man-made) were stables, overhangs, or other man-made constructions that can protect horses against wind, rain, or sun. Of the 333 horses having a man-made shelter at their disposal, 47% had one made from wood with a metal roof, whereas others had shelters entirely of wood, wood and stone, or other rare combinations. Almost all of the artificial shelters had (partly) dry ground underneath, even during winter. Natural shelter, including trees and shrubs, high and dense enough so that they could give shelter, could be located in or adjacent to the pasture.

Behavioral recordings

All observations took place between the 25th of July 2010 and the 8th of May 2014, intermittently between 7:50 AM and 9:15 PM. The sequence of pastures to be observed was randomized. An appointment with the owner was made before starting observations, whereas horses from unknown owners were observed without scheduling or appointment. Before the observation period began, the owners provided a guided tour and some additional information about their horses and management. They were not present during the observations.

A total of 598 hours and 42 minutes of data were collected during 1090 observation moments. An observation moment consisted of a consecutive observation period of a horse on 1 day. Behavioral states and shed use were sampled instantaneous at 15-second intervals over a 15-minute period. Sometimes to increase the number of replicates in certain weather conditions a 30 or 60 minute period of time (Crowell-Davis, 1994; Martin and Bateson, 1993). Behavioral categories were eating, standing, lying, or moving, as defined by Jørgensen and Bøe (2007) and Mejdell and Bøe (2005). Shed use was noted as "inside artificial shelter," "next to artificial shelter," or "under natural shelter." "Next to artificial shelter" was noted when horses were using a shed or another construction as either a wind break, for shade, or as a rain shelter, and remaining within 3 horse-lengths of the shed or construction. Insect-avoiding comfort behavior, which we named "insect score", was scored after Mayes and Duncan (1986). It uses a 5-point ordinal scale indicating the behavioral response to flies: (0) none, (1) some tail swishing, (2) constant tail swishing and some head shaking, (3) constant tail swishing and head shaking, some stamping, (4) constant tail swishing, head shaking and stamping, rubbing, rolling, and other signs of discomfort. The insect scores were only measured in spring and summer, the seasons known for insect harassment. The observer stood outside the pasture, next to the fence. During the preparations the horses became accustomed to her presence. One can presume she did not disturb the horse's behavior.

Climatic observations

Weather conditions were recorded simultaneously at multiple locations in and beside the pastures. In an open unshaded area immediately outside the pasture, dry air temperature (T_{out}), relative humidity (HR), air pressure (AP), and wind speed were recorded (351077 Stratos Funk-Wetterstation, TFA, Weirtheim, Germany). These sensors were attached to support poles at a height of 1.6 m. On the same place, the black globe temperature (T_{BGT}; 925 type K, Testo, Ternat, Belguim) was recorded at 5-minute intervals. This sensor was attached to a support pole at a height of 1.4 m (Autio and Heiskanen, 2005). Air temperature and relative humidity in the man-made shelter (T_{in} and HR_{in}), under a natural shelter on the pasture (T_{na} and HR_{nar}), and beside an artificial shelter (T_{be} and HR_{be}) were measured with a USB logger (EL-USB-2, Lascar