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Isabella Heiwe

Husdjursagronomprogrammet, Uppsala 2015

Studentarbete
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Avancerad A2E, 30 hp, husdjursagronomprogrammet, Examensarbete i Husdjursvetenskap, EX0566

Handledare: Margareta Stéen, SLU, Inst. för husdjurens miljö och hälsa, Nationellt centrum för djurvälfärd, Box 7068, 750 07 Uppsala
Examinator: Peta Hitchens, SLU, Inst för husdjurens miljö och hälsa, Box 7068, 750 07 UPPSALA

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Sveriges lantbruksuniversitet
Fakulteten för veterinärmedicin och husdjursvetenskap
Institutionen för husdjurens miljö och hälsa
Box 234, 532 23 SKARA
E-post: hmh@slu.se, **Hemsida:** www.slu.se/husdjurmiljohalsa

Sammanfattning

I Sverige har jordbruket förändrats markant under 1900-talet och med detta även antalet djur som betar i skogsmarker och utmarker, dvs. marker som historiskt sett inte har ansetts tillräckligt produktiva för att brukas. Det finns flera anledningar till förändringen, bland annat minskande befolkningsmängd på landsbygden och färre jordbruk. Jord och skogsbruket ser också annorlunda ut idag med moderna produktionsmetoder, statliga bidrag för bättre beten och en större användning av konstgödsel.

Denna studie på masternivå undersöker möjligheten att hålla Gotlandsruss på extensiva beten och ingår i en större studie med namnet ”The Gotland pony as a conservationist – a way to promote biodiversity and conserve an endangered breed”. Gotlandsponnyn är för övrigt den enda inhemska ponnyrasen i Sverige och anses väl anpassad till det nordiska klimatet då den är lättfödd och härdig (1998/99:MJ244). Rasen är en del av det svenska kulturarvet och är en av de husdjursraser som Sverige har bevarandeansvar för (Rapport 2010:14).

I studien ingick ettåriga hingstar som Sveriges Lantbruksuniversitet (SLU) har köpt från olika uppfödare. Hästarna delades upp i tre grupper med fyra hingstar i varje grupp. I Sverige är det inte tillåtet med stödutfodring för djur som betar på betesmark med höga natur- och kulturvärden, av skäl som att fodret kan införa frö och därmed arter som inte hör hemma i naturbetesmarken (Jordbruksverket, 2015). Hästarna i studien fick därför klara sig på att söka föda i de hagar och skogar som de hålls på i studien. Normalt är detta inte tillåtet enligt Svensk lag då hästar och andra boskap måste stödutfodras om betestillgången inte anses tillräcklig, dvs under vinterhalvåret (SFS 1988:534; DFS 2007:6 L101). Hästarna undersöktes, såväl fysiskt som beteendemässigt, vid fyra tillfällen under perioden september-december enligt det formulär som utvecklats enligt Welfare Quality® av Viksten et al. (submitted). Den fysiska delen innehöll parametrarna hullklassificering, pälskvalitet, hudstatus, man- och svans-status, ögon- och nosflöde, hälta- och, hovstatus, termisk komfort och andning. Den beteendemässiga undersökningen fokuserade på hästarnas reaktion gentemot personen som utförde undersökningen och hästarnas vilja till fysisk kontakt. Testen som användes kallas “human approach test” och “avoidance distance test”.

Resultatet visade ingen signifikant skillnad mellan grupperna när det gäller poängen för hullstatus. Den genomsnittliga hullpoängen var 3,1 vid den första observationen i september och minskade till 2,5 vid den sista observationen som gjordes i december (Carroll & Huntington, 1988; Wright et al., 1998). Hullpoängen förändrades markant mellan november och december ($P<0,0001$). Observationsdatum hade en signifikant påverkan på förekomsten av hudskav, med en högre förekomst av skav vid observationerna de två första månaderna jämfört med de två sista ($P<0,028$). Undersökningen visar också en ökande tendens till sämre hudstatus för den andra perioden av studien men resultatet var inte signifikant. Vid undersökningen av ”The human approach test”, visade det sig vara skillnader mellan såväl grupper ($P<0,001$) som observationstillfällen, ($P<0,006$). I grupp 1 visade hästarna mindre intresse för observatören än i de andra två grupperna. Samtliga hästar visade även mindre intresse för observantören vid observationstillfället i november jämfört med september och oktober. Den andra delen ”The avoidance distance test” kunde inte analyseras statistiskt på grund av för låg varians.

Gotlandsrussen klarade av att hålla ett acceptabelt hull under tiden för studien, dvs. under perioden september till december. Individuella skillnader förekom då vissa individer lyckades hålla ett bättre hull än andra. Förmågan att ansamla fett under vår och sommarmånader är viktig, då det påverkar hur väl hästarna lyckas behålla ett bra hull under vintermånader. Ingen häst underskred vid något observationstillfälle den fastställda undre gränsen för hullpoäng, men under nästkommande månader är det troligt att vissa individer inte kommer kunna hålla ett acceptabelt hull. Framtida studier bör fokusera på när man bör stödutfodra hästar som hålls extensivt och även undersöka hur väl ston klarar sig utan stödutfodring vintertid. Gotlandsrusstudien visar på alternativ för bevarandet av rasen och gynnar samtidigt den biologiska mångfalden i så väl flora som fauna.

Abstract

In Sweden the use of forests and outfields as pastures for livestock has decreased during the 20th century due to modern forestry, a diminished human population in the countryside, government grants for better pastures and a more widespread use of artificial fertilizers. This has resulted in a radical change when it comes to biological diversity. As part of a resolution, large grazers such as cattle and horses can be used as tools to preserve landscapes and improve the diversity of vegetation.

In this masters thesis the possibility to keep Gotland ponies on extensive pastures has been examined as a part of a wider project called "The Gotland pony as a conservationist- a way to promote biodiversity and conserve an endangered breed". The Gotland pony, the only national native pony breed in Sweden (1998/99:MJ244), was a suitable breed for the project since it is considered to be well adapted to the Nordic climate among other things. The pony is also regarded as a part of the Swedish cultural heritage and is one of the domestic breeds Sweden has responsibility to preserve (Report 2010:14).

All horses used in the study were one year old stallions purchased from various breeders by the Swedish University of Agriculture Sciences (SLU). The horses were divided into three groups with four horses in each of the enclosures. In Sweden no supplementary feed is allowed on valuable grasslands for reasons that the feed can introduce seed and thus plant species that do not belong in the natural grassland (Swedish Board of Agriculture, 2015). The horses in the study had to manage solely on foraging and browsing on the grasslands and in the forests. According to Swedish animal welfare regulations this is not allowed elsewise, since horses and other livestock must be offered additional feed during winter months (SFS 1988:534; DFS 2007:6 L101). Welfare assessments, both physical and behavioural, were performed during four occasions ranging from September until December. All assessments were performed according to a protocol developed in line with Welfare Quality® by Viksten et al. (submitted). The physiological parameters included body condition score, coat quality, skin problems, mane and tail problems, ocular and nasal discharges, lameness, hoof quality, thermal comfort and respiration. The behavioural parameters focused on the horses' reaction towards an observer and their acceptance of physical contact; assessed pursuant to a human approach test and an avoidance distance test (Viksten et al. submitted).

According to the results there were no significant differences between groups when it comes to body condition score. The mean value for body condition score was 3.1 for the first observation in September and decreased to 2.5 for the last observation in December, and no horse scored lower than the limit (score 2). The body score changed significantly between observation dates November and December ($P<0.0001$). Observation date had a significant effect on the prevalence of chafes, with a higher number of chafes during the first two months of the study compared to the last months ($P<0.028$). A tendency for more skin problems was seen for the second period of the study i.e. November and December, but the results were not significant. For the Human Approach Test there were differences between both groups ($P<0.001$) and observation dates ($P<0.006$). Horses in group one showed less interest towards the observer compared to group two and three. All horses did also show less interest in November compared to September and October. The Avoidance Distance Test could not be analysed statistically due to too low variance.

The Gotland ponies managed to maintain an acceptable body condition score on extensive pastures during a period from September until December, but some individuals maintained a higher body condition score than others. The possibility to accumulate fat during spring and summer is of vital importance since it has a considerable effect on the body condition during the late fall and winter months. The Gotland pony project could give an alternative for preserving the breed, however as some individuals may be at risk during winter months, it is recommended that future studies focus on if and when supplementary feed is necessary. In this project only stallions were used and it is important to see how well mares manage during winter months as well. Further studies should look at different group constitutions with both mares and stallions, to get a more detailed view on how well horses manage on extensive pastures.

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Introduction

This study aims to investigate the possibilities to keep horses on extensive pastures without supplementary feed. The master thesis is part of a wider project called “The Gotland pony as a conservationist- a way to promote biodiversity and conserve an endangered breed”. The hypothesis of the study was that horses can be kept on non-fertilized extensive pastures without any supplementary feed and maintain an acceptable body condition score and general health during a period ranging from September until December. All welfare assessments, both physical and behavioural, were conducted during the fall 2014. The assessments were performed according to a protocol developed in line with Welfare Quality® by Viksten et al. (submitted).

The original intent of the wider project was to find an alternative for the protection of the Gotland pony and also study the effects of grazing on natural grasslands and forests. The Nordic Gene Bank for Farm Animals (NGH) works to protect rare breeds in the Nordic and Baltic countries and the Gotland pony is one of the breeds listed as endangered according to NGH (Saastamoinen & Mäenpää, 2005). The population size of the breed is around 8000 animals and the Gotland pony is the only national native pony breed in Sweden. The breed is considered to be well adapted to the cold climate and natural habitat in Sweden (Saastamoinen & Mäenpää, 2005). To be able to preserve rare breeds as the Gotland pony it is important to find new possible uses for the breed and increase the number of animals to diminish the risk of inbreeding.

According to the Swedish Board of Agriculture (2015) no fertilizers or supplementary feed is allowed when keeping animals on particular valuable grasslands. Few studies have been conducted to investigate how well horses manage to consume enough energy for maintaining a body condition score of 3 during Nordic winter conditions and if it is possible to keep horses under such conditions and still comply with the Swedish Animal Welfare Act (SFS 1988:534). The Swedish Board of Agriculture states that horses should be fed individually adapted feed rations with a well-balanced nutrient content and enough roughage to maintain an acceptable body condition for their use (DFS 2007:6 L101). If this is possible for horses kept under extensive conditions during fall and the first winter month will be further examined in this masters thesis.

The Gotland pony project could give an alternative for preserving the Gotland pony and also maintaining habitats in forests and meadows that would otherwise disappear due to the decreased number of grazing animals.

Review of Literature

Re-wilding of Horses

Dedomestication or “re-wilding” is a process where species are de-adapted to captivity and humans and turned into self-sustainable wild or semi-wild animals (Gamborg et al., 2010). Dedomestication is a long process that is often part of a wider nature restoration project, with the expectation that within a number of generations, genetic changes will take place that to some extent reverse earlier changes in the genome of the animals. One of the best examples of a back bred species is the Konik horse, bred from the mid-twentieth century resembling the extinct wild European equine the Tarpan (Gamborg et al., 2010). Dedomesticated horses and other large grazers can be used as a tool to preserve vegetation in nature reserves and in some cases return the naturalness to these areas (Darinot & Morand 2001).

Reintroducing horses to nature reserves or abandoned land areas can also be the answer for saving populations that face extinction. The first species that have been reintroduced to their native habitat after living in zoos for many generations are the Takhi or also called the Przewalski horses in Mongolia. The mountain steppe in the Hustain Nuruu Mountain Steppe reserve has shown to be a potentially suitable habitat for establishing a Takhi population due to the low mortality rates and high reproduction (Dierendonck et al., 1996).

Another example of reintroduced large grazers is the Konik poski horses that were released in enclosed meadows at Lake Pape in Latvia by the Latvian World Wildlife Fund (WWF) in 1999. The aim of that study was to observe the dynamics of grazing pressure in different seasons along with the growth of a herd of horses and to find out the first signs of overpopulation by the horses (Prieditis, 2002). In total the horses inhabited an area of 130 ha, divided into two parts that were separated by a road serving as a border. One harem group was restricted to the Northern part (50 ha) whereas another harem group had access to the rest of the territory. During the period from 1999 to 2001 the number of horses increased from 18 to 35. All horses had a good body condition score in the Southern part. In the Northern part lowered body condition of some horse was observed. The results of their study implied that the first signs of overpopulation occur during winter when lawn-like patches in autumn exceed 20 %, as it did in the Northern part. From the autumn of 2000 to the spring of 2001 the browsing pressure (the level of impact grazing animals have on the land on which they are grazing) increased to 92.9 % in the Northern part which is very high, whereas it only increased to 50 % in the Southern part. Other findings were that winter browsing of trees and shrubs stimulate their regrowth during next summer.

The effects of grazing on herbage

The effects of grazing by large herbivores have an impact on the regeneration, establishment and dispersion of plant species (Vera, 1997). Low and moderate level of grazing can stimulate the primary production of plants whereas intense or extreme level of grazing reduces the photosynthetic capacity of vegetation (Oba et al., 2000). After defoliation, grasses produce new biomass that in many cases is richer in nutritional substances than the biomass from ungrazed plants. The grazed plants consist of more young tissues than ungrazed plants (Skarpe, 1991).

In the beginning of the 21st century Loucougaray et al. (2004) investigated the respective effects of monospecific grazing by horses and cattle in contrast to mixed grazing. The study showed that the overall species richness always was higher with horse and mixed grazing treatments than with cattle alone. Both species foraged selectively and produced a mosaic of vegetation by grazing in a patchy way. In the mixed treatment cattle grazed on latrine areas, which decreased the dominance of some plant species, creating a higher diversity than with horses alone due to the compensatory effects between the two herbivores, i.e. a complementary use of plant resources. Mixed grazing or grazing by horses alone also increased the available micro-habitats for insects due to the variation in height and structure of the vegetation. The study implied that mixed grazing creates the most species-rich and structurally diverse swards (Loucougaray et al., 2004). One problem using large grazers to preserve vegetation is that conflicts can arise if horses or cattle are kept in fragile areas together with high-vulnerability plants (Miraglia et al., 2008). However that can be solved by monitoring the stocking rate of grazers in the area. According to Kuiters & Slim (2003) some plant species that are toxic or thorny are avoided by grazers and in that way providing safe sites for brows-sensitive species to grow. The nutrient requirements of de-domesticated horses are primarily limited to the water availability for vegetation in the summer months. Limited rainfalls in the summer months could result in inadequate grass production, thus worse conditions for the horses (Miraglia et al., 2008).

Parasites

To be able to withstand parasite infections, de-domesticated horses and other large grazers can graze the leaves and bark of some tree species, for example aspen and salix (Aas, 2003). The condensed tannins in the leaves and bark are believed to have an effect on parasites (Aas, 2003). In cattle and sheep, studies imply that condensed tannins support the immune system along with decreasing the protein loss in the gut caused by parasites. There is also a possibility that condensed tannins inactivate parasite larvae during its passage through the stomachic-intestinal canal (Aas, 2003). Moreover, pastures with a large diversity of plant species and a good soil structure may also have a larger diversity of microorganisms in the soil, making it harder for parasites to survive. But the diversity is dependent on resting of the pasture. The eventual overcrowding of animals in a nature reserve is regulated by parasites because weaker animals are forced to eat contaminated feed (Aas, 2003). Depending on the management of nature reserves, animals can be supported with extra forage during rough winter months with scarce feed, but then the number of animals has to be regulated in another way.

The body condition of feral horses

The balance between energy intake and output is significant when it comes to the body condition of animals. When feed intake is insufficient, fat reserves and lean body tissue will be lost, since there are not enough nutrients to replace energy expended through daily activities (Rudman & Keiper, 1991). According to Pollock (1980) the main reasons for loss in body condition depends on food availability, food quality and climate. In an investigation concerning ponies in New Forest, England Pollock found that there was a significant association between lower body condition score and mortality. However, no connection between number of worm eggs and body condition was found.

Worm egg counts can be unreliable as indicators of the severity of intestine parasite infestation (Pollock, 1980). Other results from the investigation indicated that stallions were better able to maintain fat reserves than mares and those mares without foals generally were in better body condition than mares with foals. Horses breed and give birth in spring which means that mares have to manage the high nutrient demands without having the benefits of summer vegetation (Rudman & Keiper 1991). This disadvantage applies for stallions as well since they have to defend the harem during the breeding season. According to Rudman & Keiper (1991) gender, reproductive status and habitat have an effect on body condition score.

Equine welfare

Previously there has been no established methods for measuring equine welfare but body condition score and index of mental welfare (performance of stereotypic behaviour) have been suggested as parts of a broader equine welfare scheme (Christie et al., 2006). When horses and other animals are restrained from performing natural behaviours such as foraging and social interactions, the frustration can cause stereotypic behaviours as a result (Christie et al., 2006). For example, the incidence of horses having an oral stereotypy decreased 0.94 times for every additional hour the horses are allowed to spend at a pasture with grass (Christie et al., 2006). De-domesticated horses in nature reserves are not restrained from performing motivated behaviours, making stereotypic behaviours uncommon. However, periods with feed shortage may have an impact on the horses' behaviour and mental welfare. A long term lack of feed with sufficient nutrients may decrease social interactions among the horses since they are deprived of resources and must use their energy searching for feed (Frazer, 1997).

At present welfare assessment protocols with emphasis on animal-based measures have been developed and are considered to be the most adequate indicators of equine welfare according to the EFSA (2012). One example is the The Animal Welfare Indicator Network that recently released AWIN welfare protocol for horses (AWIN, 2015). This protocol has been developed mainly to assess animal welfare at farm level, but compare to the assessments used in this study with physical assessments, body condition scoring according to Carroll & Huntington, (1988) and Wright et al., (1998), resource-based parameters and some behavioural parameters. However the protocol also includes parameters that are specific for farm animals housed in stalls.

In this study the physical assessments give knowledge about the presence or absence of injuries and diseases. The thermal comfort of the horses indicates whether the housing and enclosures are good enough to avoid discomfort from weather or low temperatures. Discharges of eyes and nose, breathing, coat quality, skin problems and main and tail indicate if there are any signs of diseases and wounds and lameness are indicators of injuries. Coat quality and skin problems can also be a result of bad nutrition (AWIN, 2015). Bad hoof quality can be an indicator of neglect, if the horses cannot manage to wear the hooves naturally in their environment.

Some animal welfare organisations claim that `The Five Freedoms of Animal Welfare', developed by the UK Farm Animal Welfare Council (1979), is of importance when evaluating the well-being of animals. The five freedoms are the freedom of hunger and thirst, the freedom of discomfort, the freedom of pain, injury and disease, the freedom to express normal behaviour and the freedom from fear and distress (Farm Animal Welfare Council, 2012).

Wild or tame? An ethical debate.

There is a debate regarding animals that are undergoing de-domestication, whether they should be treated as wild or tame since they tend to fall into a grey zone when it comes to animal welfare regulations (Gamborg et al., 2010).

For example ethical questions have arisen about one of Europe's largest and most ambitious nature reserves, The Oostvaardersplassen. In the reserve large grazers such as horse, elk, wisent and cattle are kept out in the open all year with no supplemental feeding (Vera, 2009). The re-wilding process has begun and the populations are regulated through selective pressures, i.e. lack of feed during winter time, diseases and exposure to parasites. According to the ICMO (2006) mortality rates up to 50 percent can be expected some years in plant-herbivore systems such as the Oostvaardersplassen.

The re-wilding process is considered to be animal cruelty by some critics, since the animals get no supplemental feed or veterinary care whereas advocates claim mortality rates to be natural and an expression of population dynamics (ICMO, 2006).

Large grazers as conservationists in Sweden

In Sweden, the use of forests and outfields as pastures for livestock has decreased due to modern forestry, a diminished population in the countryside, government grants for better pastures and a more widespread use of artificial manure (Kardell, 2004; Aronsson 2006). This has resulted in a radical change when it comes to biological diversity since natural and grazed forests are completely different biotopes compared to production forests (Axelsson Linkowski, 2010). In the beginning of the 20th century it was even considered to be incompatible with good forests management to have animals grazing on these lands. Today grazing of forests has been resumed in many areas to preserve the landscape. Grazed forests show more diversity when it comes to topography, soil quality and distribution of tree species (Andersson et al., 1993). In addition to grazing, keeping animals on forests and outfields also have impact on plant species through treading, breaking damages on vegetation and faeces. Treading can create soil blots that increase the establishment of mushroom and moss. Rot fungi can benefit from the breaking damages on the vegetation and faeces give nourishment to all sorts of plants (Andersson et al., 1993).

In Sweden, an environmental goal strategy has been established by the Parliament to confront the challenges associated with conserving natural environment and decreasing climate changes (The Cabinet Office, 2015). In this strategy it is stated that the biological diversity and variety of species in Sweden should be protected (The Environmental Protection Agency, 2015). The condition of forests and arable lands are dependent on grazing animals among other things to maintain unique habitats for animals and plants.

To promote the conservation of landraces the Swedish Board of Agriculture has rated some breeds as worth preserving (The Swedish Board of Agriculture, 2010). Landraces have a larger genetic variety than animals intensely bred for production and they still have the ability to nourish on lean feed, take good care of their offspring and stay healthy at older age (The Swedish Board of Agriculture, 2011). The Gotland pony, one of the breeds rated, has existed on Gotland for several thousand years and is one of the oldest horse breeds in Europe. The breed may originate from the wild tarpan (*Equus ferus ferus*) (Ejendal & Hollström, 2004).

The Gotland pony used to roam free in the southern areas of Gotland, but in the late 19th century a severe decline of the population took place as a result from hunting and selling of

the ponies. In the beginning of the 20th century only 8 individuals remained, from which all Gotland ponies today originate (Hollström, 2010).

There is a unique nature reserve on the island of Gotland in Sweden called Lojsta Hed, aimed at the conservation of the ponies in a historical form. So that even today Gotland ponies are allowed to roam over the forests of Gotland as semi wild animals.

Materials & Methods

All of the horses used in this study were one year old stallions of the breed Gotland pony (n=12), purchased from various breeders in Sweden by the Swedish University of Agriculture Sciences (SLU). The horses were divided into three groups, with four ponies in each group. The enclosures used were located at Krusenberg estate Uppsala, made up of two to three ha of grassland and about seven ha of forest (see figure 1). By estimating the feed intake consumed by twelve ponies over a one year period, the appropriate size of the enclosures could be determined. During the previous year cattle had been grazing the grassland part of enclosure one and two, whereas the grassland in enclosure three had been harvested.

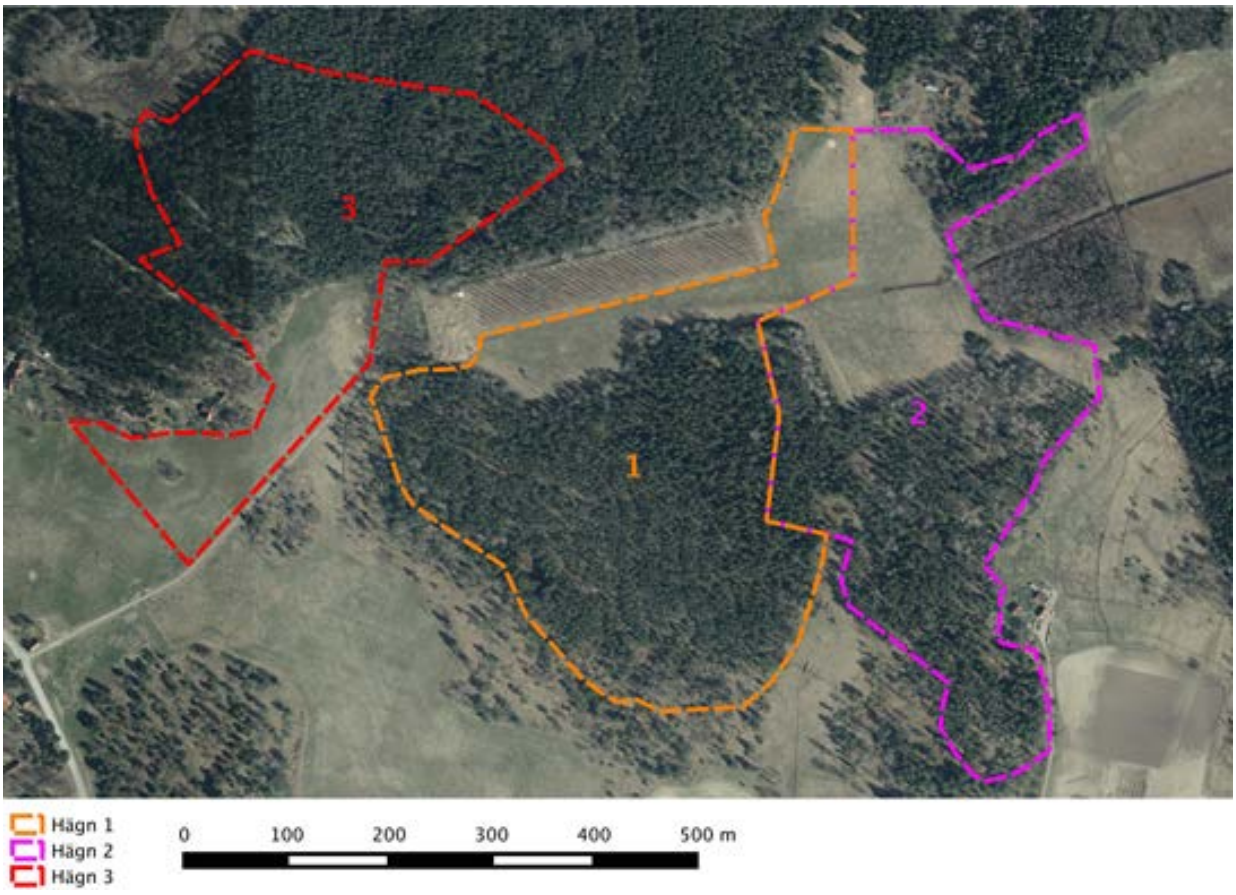


Figure 1. View of enclosures one, two and three.

Horses have never been kept in any of the enclosures before and the forest parts of the enclosures have never been grazed by any kind of livestock. Horses purchased from the same breeder were divided into different enclosures and the color of the horses was also taken into consideration when the groups were determined. Horses of different color are easier to

recognize and keep apart. Some of the horses were provided with GPS head collars, about two ponies in each group, primarily for other studies conducted during the project. Horses were not given any supplemented feed during the period of the study but they were offered salt enriched with trace elements since vegetation in Sweden lack sodium (Na) and selenium (Se). Water was offered in automatic water troughs located in the forest area of each enclosure. All horses did also have access to a shelter with three walls and a roof, located in the grassland area.

In this study behavioural and- physiological parameters have been used as tools for measuring welfare of the horses. By using a protocol designed according to WQ® (Viksten et al. submitted) behavioural parameters could be assessed, including a human approach test and an avoidance distance test. Physiological parameters included body condition scoring and other assessments such as wounds or skin problems. The study was performed from September until December 2014 and all observations were measured on one occasion every month, i.e. in total four observations for every horse and enclosure. Behavioural parameters were tested before physical assessments because the horses would then not be negatively affected by the presence of humans.

Behavioural parameters

The human approach test

To be able to determine how well the ponies readjust to a natural environment and how they are affected by human contact, two behavioural parameters were measured for this study. The ponies were relatively unhandled by humans before they were introduced to this project and it was hypothesised that the handling of the ponies by humans involved in the Gotland pony project might result in some behavioural changes. The behaviour of the horses could change over time and there could also be differences among ponies in different enclosures. The human approach test focused on the reaction of the horses when a human approached in the enclosure. The observer walked towards the group of horses and their reaction was noted according to Table 1. The horses were aware of the observer approaching from at least 20 meters.

The avoidance distance test

The avoidance distance test focused on how easy the horses were to touch. The horses were approached individually, starting with the horse closest to the observer. By walking towards the horse in a normal gait and stretching out the hand closest to the horse, the observer could test if it was possible to touch the muzzle of the horse or if the horse avoided physical contact (see Table 1). If a horse had started to walk towards the observer, the assessment was done once the horse was close enough. The test started approximately five meters away from each horse. The avoidance distance test was performed after the human approach test.

Table 1. The description and score for the behavioural parameters.

Behaviour parameter	Score	Description
Human approach test	0	Positive, the horse move towards/turn its head or reach out for the person
	1	Neutral, no distinct movement against the person or only turn an ear without turning its head
	2	Aggression or avoidance, aggressive behaviour as ear flattening, bites or more threatening behaviour or avoidance by moving away
Avoidance distance test	0	Possible to touch the horse
	1	Closer than 50 cm but not possible to touch
	2	Between 50 and 100 cm before the horse turns away
	3	Not possible to come closer than 100 cm

Physiological parameters

To be able to determine if the feed intake was enough for the horses during the period of the study, individual body condition assessments were made. Certain areas of the body of the horse such as the neck, withers, ribs, ribs behind the shoulders and the crease down back and tail head were primarily observed. The observations were made both visually and through palpation. The measurements were carried out according to Carroll & Huntington (1988) and Wright et al. (1998) and the score reached from zero (very thin) to five (very fat) and included half points (see Table 3).

Half scores were used if different areas of the horse were scored with different points, so that the total score was averaged. If any horse was to score lower than fair (score 2), that individual would be transferred from the enclosure temporarily or permanently and provided with supplementary roughage.

Other physical parameters measured included breathing, thermal comfort, wounds, chafes, coat quality, main and tail, skin problems, ocular and nasal discharge, hoof quality and lameness (see Table 2).

Table 2. The description and score for the physiological parameters.

Physiological parameters	Score	Description
Respiration	0	No abnormal flank movements
	1	Abnormal flank movements (deep or quick)
Thermal comfort	0	No indication of problem with handling temperature or weather
	1	Shaking from cold, panting, sweating, huddling
Lesions and wounds	0	No significant lesions or wounds
	1	Hairless patches without perforated skin
	2	Wounds where the skin is perforated <3 cm
	3	Wound larger than 3 cm
Mane and tail	0	No chafes or broken hairs
	1	Chafes in mane/tail, hairless patches, abnormal broken hairs (10 cm in mane or 5x5 cm in tail)
	2	Abnormal broken hairs or hairless patches in combination with perforated skin
Chafes	0	No indication of chafes
	1	Indication of chafes
Coat quality	0	Sleek, glossy coat
	1	Dull, dry coat
Skin problem	0	No indication of skin problem
	1	Indication of skin problem (dandruff, crusts, dermatitis, sunburn and bites from insects) on few spots of the body
	2	Large parts of the skin affected
Ocular discharge	0	No ocular discharge
	1	Dirty eyes with mucus in the corner of the eye
	2	Dirty eyes with or without mucus in the corner of the eye and eye discharge (1 cm long flow)
Nasal discharge	0	No indication of nasal discharge or transparent discharge
	1	Indication of nasal discharge (colored or thick) in at least one nostril
Hoof quality	0	No indication of hoof problems
	1	Some cracks or long hooves
	2	Severe cracking or hooves overgrown from natural shape
Lameness	0	No indication of lameness or abnormal movement
	1	Irregular, short movement.
	2	Lame, the horse will not lean or support on one leg

Table 3. Assessments of the body condition score. Scored 0-5 with half points. (Carroll & Huntington, 1988; Wright et al., 1998)

Score	Description
0 **Very thin**	**Neck:** Bone structure easily felt- no muscle shelf where neck meets shoulder **Withers:** Bone structure easily felt **Back & Loin:** Points of third vertebrae easily felt **Ribs:** Each rib can be felt easily **Hind quarters:** Tail head and hip bones projecting
1 **Thin**	**Neck:** Can feel bone structure- slight shelf where neck meets shoulder **Withers:** Can feel bone structure **Back & Loin:** Spinous process can be easily felt - transverse processes have slight fat covering **Ribs:** Slight fat covering, but can still be felt **Hind quarters:** Can feel hip bones
2 **Fair**	**Neck:** Fat covering over bone structure **Withers:** Fat deposits over withers - dependent on conformation **Back & Loin:** Fat over spinous processes **Ribs:** Can't see ribs, but ribs can still be felt **Hind quarters:** Hip bones covered with fat
3 **Good**	**Neck:** Neck flows smoothly into shoulder **Withers:** Neck rounds out withers **Back & Loin:** Back is even **Ribs:** Layer of fat over ribs **Hind quarters:** Can't feel hip bones
4 **Fat**	**Neck:** Fat deposited along neck **Withers:** Fat padded around withers **Back & Loin:** Positive crease along back **Ribs:** Fat spongy over and between ribs **Hind quarters:** Can't feel hip bones
5 **Very fat**	**Neck:** Bulging fat **Withers:** Bulging fat **Back & Loin:** Deep positive crease **Ribs:** Pockets of fat **Hind quarters:** Pockets of fat

Resource- based parameters

Water access and cleanness was measured on the same occasion as behavioural and physical parameters (see Table 4). Moreover the ambient temperature and weather in general were recorded for that day and time. Water access from streams or trenches was not estimated in the study.

Table 4. The description and score for Resource-based parameters.

Resource-based parameters	Score	Description
Water access	0	Access to water
	1	No access to water
Water cleanliness	0	Clean, both water and bowl clean
	1	Partly dirty, water clean and fresh but bowl dirty
	2	Dirty, both water and bowl dirty

Statistical analyses

SAS statistical package (SAS Inst. Inc., Cary, NC) was used for the analyses of the body condition score of the horses. The effects of observation dates, group or the interaction between observation and group (observation*group) were tested by comparing group means using a repeated measures mixed model (PROC MIXED). Calculated least square means and t-values were then used to estimate if there were any differences between groups or observations. P-values decided whether the differences tested had a statistically significant effect at a 5% significance level.

The physiological and behavioural parameters were analyzed with Minitab, using a binary logistic regression model. Examination of odds ratios and p-values determined if there were differences in physiological and behavioural parameters between groups and observation dates. For the physiological parameters observation dates were analyzed separately and then the two first observations were combined and compared with the two last observations. The reason for this was that if the statistical variance was too low to get a significant result, combining of the first two and last two months could still give a significant result (see Table 6). The total prevalence of physiological parameters was calculated in percent for each observation date and is presented in Table 7.

Statistical Results

Physiological parameters

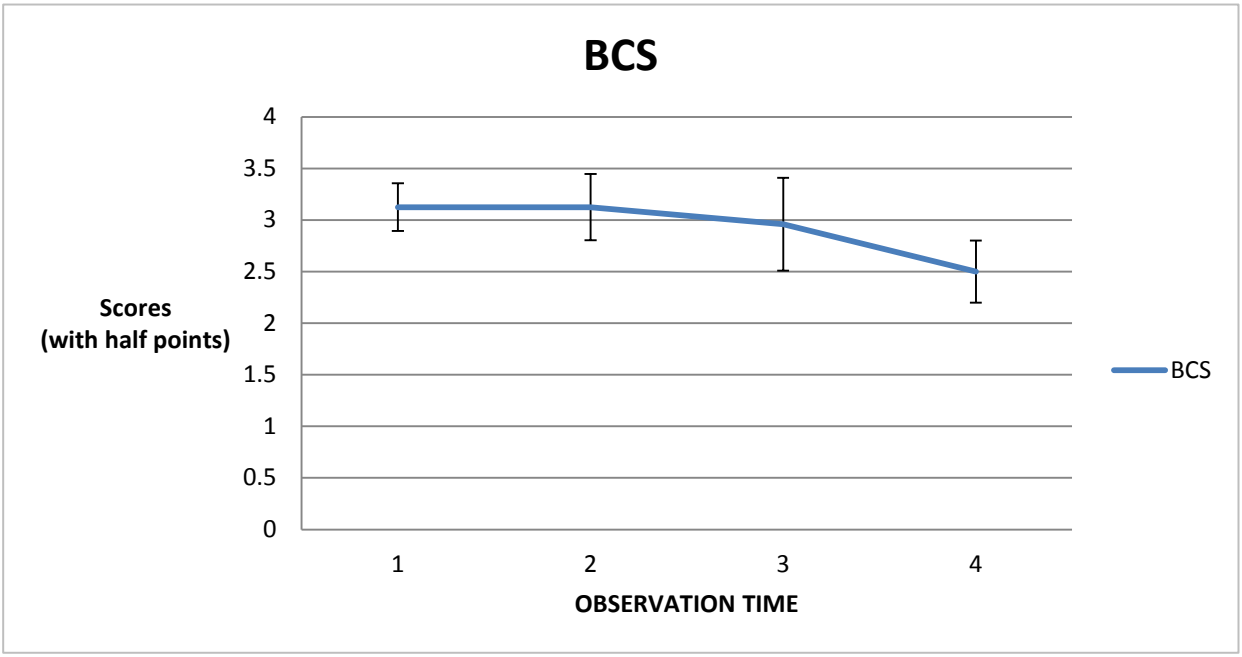
The statistical analysis showed that there were no significant effects between groups when it comes to body condition score ($P<0.501$). In other words, there was no considerable difference in body condition score between the different groups. However time had a very significant effect on body condition score since there were clear differences between observations ($P<0.0001$). Two horses in enclosure 3 did increase their body condition between the observation dates in September and October (2014-09-14, 2014-10-11), but remaining horses did either maintain or decrease their body condition score between observations. Though all horses had lowered their body condition in December (2014-12-15) compared to the first observation in September (2014-09-14). The interaction between observation date and group (observation*group) did not have a significant effect ($P<0.297$).

The statistical analysis showed that when horses were considered to be in one single group, body condition score clearly changed between observation dates November and December (see Graph 1). Time of the observation did have a significant result on body condition score ($P<0.0001$). The mean value for body condition score was 3.1 at the first observation date and decreased to 2.5 for the last observation (see Table 5). There were differences between observation dates regardless of whether groups were taken into consideration or not. No horse had a body condition score less than two for any of the observations.

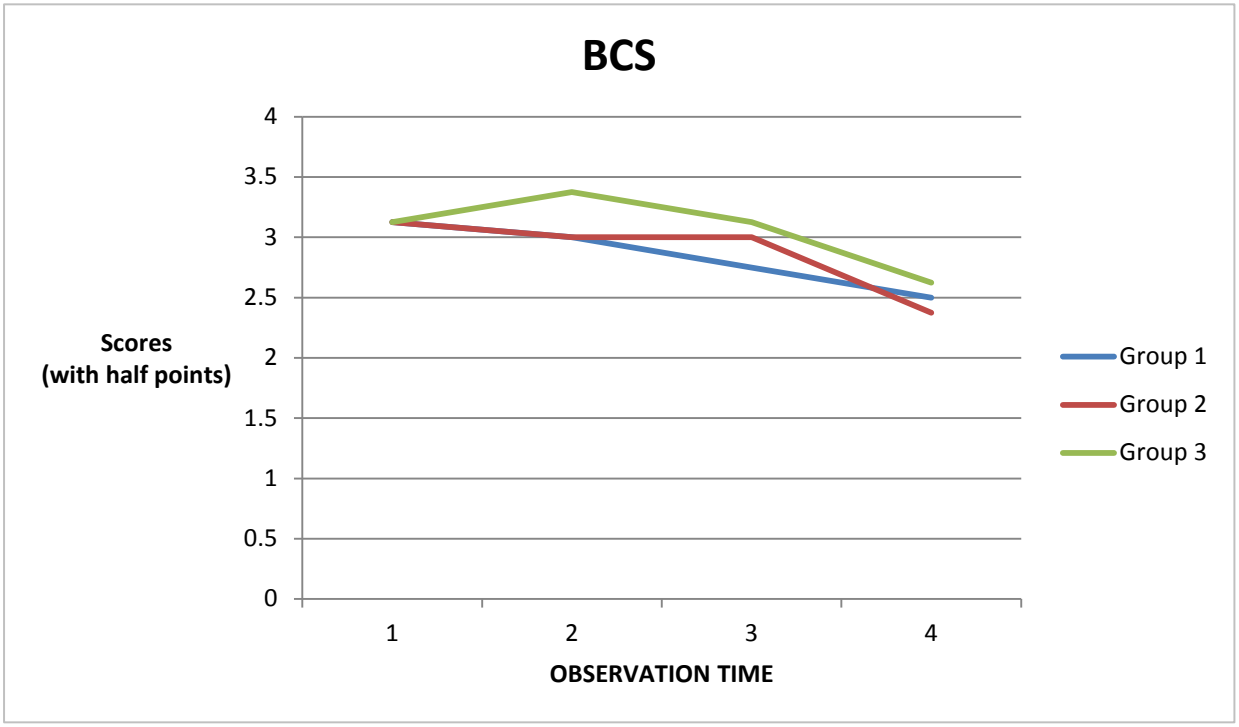
All horses could be assessed visually and by palpation except for one horse in enclosure three. This horse was only assessed visually.

Table 5. The Mean and standard deviation values for each group at each observation date (14/9, 11/10, 17/11 and 15/12). The total represents the horses assessed as one group (n=12).

	September		October		November		December	
Group	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***	***Mean***	***SD***
1	3.13	0.26	3	0.41	2.75	0.64	2.5	0.41
2	3.13	0.26	3	0	3	0	2.38	0.26
3	3.13	0.26	3.38	0.26	3.13	0.48	2.63	0.26
Total	3.13	0.23	3.13	0.32	2.96	0.45	2.5	0.3



Graph 1. Mean BCS and ±Standard deviation when all the horses were assessed as one group. Observation dates: 14/9, 11/10, 17/11, 15/12.



Graph 2. Mean BCS for different groups and observation times.

Observation dates: 14/9, 11/10, 17/11, 15/12.

Observation date had a significant effect on the prevalence of chafes, with a higher number of chafes during the first two months of the study compared to the last months (see Table 6). The chafes were mainly caused by the GPS head collars and were located at the bottom of the jaw. The prevalence of wounds was also higher during September and October, but the results did not show significance.

A tendency for more skin problems was seen for the second period of the study i.e. November and December with prevalence of dandruffs, but the results were not significant (see Table 6). During the second period of the study there were also higher scores for coat quality. Nearly half of the horses got duller coats during this period. On one occasion one horse was lame due to a previous escape from the enclosure. Remaining physical parameters did not show a significant effect for either groups or observations.

Table 6. Odds ratios and Confidence Intervals for the prevalence of chafes, skin problems and lesions/wounds during the two periods of the study.

Physiological Parameters	Observation dates	Odds Ratio	95 % CI	p-value
Chafes	Sep-Oct	Ref		
	Nov-Dec	0.20	0.04; 0.92	0.028
Skin Problems	Sep-Oct	Ref		
	Nov-Dec	2.00	0.49; 8.17	0.327
Lesions/Wounds	Sep-Oct	Ref		
	Nov-Dec	0.28	0.03; 2.93	0.252

The prevalence of other physiological parameters is shown in Table 7. During the first observation date (2014-09-14) two of the horses indicated signs of thermal discomfort. The weather was sunny and 18 °C and some of the horses did seek shelter and panted as a result. There were no other physical indications of thermal discomfort during the study.

Table 7. The prevalence of physiological parameters presented in percent, when all horses were assessed as one group (n=12). Lesions/wounds could be assessed as score 3, but it is not presented since there were no prevalence.

Assessments	Observation time and Score							
	1 (14/9)		2 (11/10)		3 (17/11)		4 (15/12)	
	1	2	1	2	1	2	1	2
Respiration	0	*	0	*	0	*	0	*
Thermal comfort	16.7	*	0	*	0	*	0	*
Lesions/wounds	16.7	0	8.3	0	8.3	0	0	0
Main & tail	8.3	0	0	0	0	0	0	0
Chafes	50	*	25	*	25	*	0	*
Coat quality	0	*	0	*	0	*	41.6	*
Skin problems	16.7	0	16.7	0	16.7	0	41.6	0
Ocular discharge	0	0	0	8.3	0	0	0	0
Nasal discharge	25	*	0	*	0	*	0	*
Hoof quality	0	0	0	0	0	0	0	0
Lameness	0	0	8.3	0	0	0	0	0

*- Indicate no possible score for the parameter.

Behavioural parameters

The human approach test

For the Human Approach Test there were differences between both groups and observation dates. The significant effect was P<0.001 for groups and P<0.006 for observations. The interaction between groups and observations could not be tested. Horses in group one showed less interest towards the observer compared to group two and three, with a higher prevalence of score one (see Table 8). During the third observation all horses in group one ignored the approach from the observer. All horses did also show less interest in November compared to September and October. There was also a tendency for less interest in December compared to October. No horses scored 2 on the Human Approach Test.

Table 8. Odds ratios for groups compared in the Human Approach Test.

Study factor	Score 0	Score 1	Odds ratio	95% CI	p-value
Group of horses					
1	7	9	Ref		
2	13	3	0.07	0.01; 0.72	0.026
3	15	1	0.01	0.00; 0.29	0.006
Date of test					
14-Sep	10	2	Ref		
11-Oct	11	1	0.37	0.02; 6.37	0.496
17-Nov	5	7	26.64	1.52; 468.01	0.025
15-Dec	9	3	2.15	0.18; 25.08	0.543

The avoidance distance test

The Avoidance Distance Test could not be analysed statistically due to too low variance in the data. All horses could be touched on the muzzle except for one horse that on one occasion did not allow physical contact from the observer.

Behavioural changes during the study

During the first period of the study (2014-09-14, 2014-10-11) the horses appeared to be using the shelters more frequently compared to the last two months (2014-11-17, 2014-12-15), probably seeking protection from insects or warm weather. The horses were often found grazing in the open grassland, whereas the horses did show a tendency to spend more time near or inside the forest during the last two months (2014-11-17, 2014-12-15). None of these behavioural changes were assessed statistically because scoring was not included in the WQ® protocol (Viksten et al. submitted).

Resource-based parameters

All horses had access to water throughout the study. There were no significant differences between groups or observations. The cleanness of the water was assessed as score one for observation time one, three and four for all enclosures. For enclosure three and one the water was assessed as score zero for the second observation whereas the water in enclosure two was assessed as score two.

Discussion

Performance of the horses

Several horses scored moderate or moderate fat (score 3 and 3.5 out of 5) for the first two observation dates (2014-09-14, 2014-10-11). These body scores were expected since the horses had been kept in the enclosures all summer and probably gained some body reserves and fat layers from the high nutritional pasture. There were no significant differences between groups but the assessments indicate that horses in group three (enclosure 3) had a slightly higher mean score for body condition compared to horses in the two other groups (enclosure 1 and 2, see table 5). One reason for the higher value of the body score for the horses could be that this particular enclosure (3) had been harvested the previous year whereas the other enclosures only had been grazed by cattle.

There was a significant decrease in body condition score from November to December. It was to be expected because grass growth drops dramatically during these months in the autumn and winter, resulting in a decreased grass intake for the horses and an increased need for foraging behaviour. Absence of grass growth forced the horses to find other foods to feed on, and the horses were moving more for their foraging and could not rest as much as they had done during the summer and first months of autumn. It can be expected that besides having a limited feed intake the horses probably spent more energy to cover their needs for foraging, resulting in a negative energy balance (Magnusson, 1993 through Gudmundsson & Dyrmundsson, 1994). According to Duncan (1992) the horses' resting periods get shorter when the fibre content in the pasture is high and it is the gut fill of the horses that mainly affects the grazing time. An indication of a change in the horses' behaviour during the last months of the study was that the horses spent more time near or inside the forests during the last observation dates (2014-11-17, 2014-12-15). The explanation for this behaviour can be either that the horses were searching for feed or for shelter, that they were protecting themselves from bad weather, or that they were forced to change their eating behaviour from grazing to browsing.

Further studies regarding the ponies at Krusenberg (conducted during a period between February and March 2015) showed that the ponies spent about 80 % of their time in the forests when the snow layer exceeded 20 cm and the average temperature was about 1 °C. When the snow started to melt the ponies returned to grazing, spending almost 90 % of their time in the open area of the enclosures. Browsing and gnawing appears to be negatively correlated to temperature (rho= -0.700: rho= -0.769), meaning that browsing decreased with increasing temperatures (Labartino, 2015).

Weather conditions and enclosures

The artificial shelters placed in the field area appeared to have been used more frequently during the first period of the study. This behaviour was in accordance with the findings of Mejdell & Bøe (2005) who carried out a study with Icelandic horses kept outdoors under Nordic winter conditions. In their study it was discovered that horses tend to move around more during weather conditions characterized by moderate to strong wind or decreasing air temperatures. Mejdell & Bøe (2005) results indicated that horses do not use shelters more as a consequence of decreasing temperatures, but decreasing temperatures combined with strong wind and/or rain did have a significant effect on time spent in the shelter by the horses.

According to McBride et al. (1984) the thermoneutral zone for mature horses ranges from approximately -15 °C to +10 °C when housed outdoors under weather conditions with no rain or wind. Temperatures below -15°C can result in an elevated metabolic rate. A six hours

exposure to acute cold has shown to increase the metabolic rate to 142 % of the basal metabolic values, thus demonstrating a need for an increased feed intake to cover the maintenance requirements for horses exposed to extreme cold. A horse weighing about 500 kg require an additional ME intake of 1534 kJ for every degree the effective air temperature decreases below the lower critical temperature (McBride et al., 1984).

According to Cymbaluk (1994) the metabolic rate can increase by 70 % in horses that are severely cold stressed, recommending an increased digestible energy for maintenance for adult horses with 2.5 % for every degree the temperature falls under the lower critical temperature.

In this study the temperature during the observation dates did not fall below +4 °C, however the temperature did exceed the upper critical temperature during the first observation date (2014-09-14) in September when it was sunshine and 18 °C during daytime. The horses did not seem to be notably affected by the temperature during this observation even though a couple of horses panted. Some of the horses did use the shelter this day as well. The metabolic rate was not tested in this study and is not likely to have been affected during the period of study, but since the horses were kept in the three enclosures in wintertime as well after this study, the lower temperatures in January, February and Mars may have affected the horses' metabolic rates and influenced their continued body condition score.

The effects of body condition on the welfare of horses

How well horses manage to maintain a good body condition score during the winter season depends on their ability to accumulate fat in the summer, among other things. Accumulated fat can be used as an energy source during winter if the nutrient intake is too low. In general horses have favourable growth rates compared to other livestock, even when kept on low nutritional pastures (Gudmundsson & Dyrmundsson, 1994). However additional feed is often required during winter since horses have a remote possibility to consume enough energy for maintenance from low nutritional vegetation (Cymbaluk & Christison, 1990).

In this study the horses were not given any additional feed during the winter months, generating higher demands on the horses' ability to search for food during these months. Some individuals did manage to maintain a higher body condition score than others, suggesting that there can be individual differences among horses in a certain breed.

In December two of the horses did score fair (score 2) but the average body condition score was 2.5. Two individuals did score moderate (score 3) for this observation date thus indicating that these horses either had managed to put on more weight and body reserves during spring and summer months or that they did have better basic conditions for grazing on extensive pastures. According to Pollock (1980) stallions are better able to maintain fat reserves than mares, suggesting a different result for body condition score if mares would have been included in the study as well. If so more horses would probably have reached the limit for body condition and as a result have worse possibilities to manage remaining winter months, making the gender of the horse an important fact to consider.

If horses would be used as restorers of landscapes and allowed to breed, the quality of the pastures would be of very high importance. Mares should be kept in a good body condition score all year around to maintain an efficient reproductive performance (Anderson, 1995). Mares with a body condition score less than moderate (score 3) might skip a breeding season and if they are lactating, nutrients are primarily used for milk production. Mares in late pregnancy require a higher concentration of protein, energy, calcium, phosphorus and vitamin A and lactating mares have significantly higher daily nutrient requirements (Anderson, 1995). As a result there should be high nutrient demands on pasture fed to reproductive mares.

Long term feed restriction can lead to severe health risks for horses and other animals. In a study conducted by Brinkmann et al. (2013) Shetland ponies were kept under simulated winter conditions with feed shortage during a four month period from November until February. In the study different blood parameters were recorded along with control of the weight and body condition score of the horses. During the period with feed restriction, the energy and protein levels were gradually lowered to 70 % of the ponies' requirements. The results showed that feed restricted ponies had elevated levels of non esterified fatty acids (NEFA) and total bilirubin (TB) in the blood when compared to a control group. The result did also indicate lower levels of total protein (TP) and beta-hydroxybutyrate (BHB) at the end of the study. Food shortage is often followed by insufficient glucose availability in the blood. To compensate the decreased glucose levels, the body increases lipolysis and proteolysis in order to generate energy. This results in higher concentrations of NEFA from the mobilization from lipid stores (Sjaastad et al., 2003). A large part of the NEFA is converted to ketone bodies by the liver, which can cause starvation acidosis in too high concentration, but since horses have limited ketone body generation, fatty acids are re-esterified into triglycerides. Too high concentration of triglycerides will lead to hyperlipidemia instead (Sjaastad et al., 2003).

NEFAs is also known for competing with TB for transport proteins in the hepatocytes and carrier protein (albumin) in the blood, so that elevated levels of NEFA can lead to hyperbilirubinemia (Kraft & Dürr, 2005). Lower levels of TP means fewer albumins as transport proteins for bilirubin from the blood to the liver. This will lead to free bilirubin molecules that can penetrate cells and cause cellular damage (Böcker et al., 2008). According to Brinkmann et al. (2013) the Shetland ponies did also decrease their body condition score during the study with 2.2 ± 0.8 point on the body condition scale ranging from 0 to 5 (Carroll & Huntinton, 1988) scoring fair to thin at the end of the study. The average loss of body mass was 18.4 ± 2.99 %. There was a lag between BCS and the change in body mass indicating that weight loss started with depletion of the intra-abdominal fat deposits. Thus it is important to evaluate the BCS frequently.

If supplementary feed was to be given to the horses in this study during winter time, there is a risk that the grazing pressure would not be as substantial and the positive effects on biodiversity may not be as great. It is during winter time especially that the horses are expected to browse in the woodlands (Kuiters & Slim, 2003), but the welfare of the horses must also be taken into consideration. The lower limit for body condition score during this study was fair (score 2). The limit was set to steer clear of health risks and due to the rough weather conditions that may occur in Nordic countries such as Sweden during winter, which would require some extra body fat reserves. However no horse did score lower than the limit during the period of the study. According to the Swedish Animal Welfare Act (SFS 1988:534) all animals should be given enough food and water.

The Swedish board of Agriculture further states that hoses should be fed well balanced feed rations with enough roughage to maintain an acceptable body condition score (DFS 2007:6

L101). The lowest score during the study was regarded as an acceptable body condition score, even if score 3 (moderate) is the most optimal one. This suggests that the management of the horses did comply with the legislation regarding body condition score during this period, even if some individuals are at risk to deviate from the legislation in following months. During winter months with snow, the horses are not provided with enough roughage since they cannot graze in the grasslands to the same extent as in summer months. Even if horses in this study are expected to browse in the woodlands instead, this may not comply with the Swedish legislation. The study did not investigate the balance of nutrients in the pasture either and thus it is not possible to determine if the nutrient content was sufficient.

The stocking rate i.e. number of horses per ha of pasture, has a significant effect on weight gain and body condition score of horses. Fertilization of pastures can increase stocking rate, however the individual growth performance of horses is not necessarily improved (Bjarnason & Gudmundsson, 1986). On low nutritional pastures such as mires on Iceland the stocking rate has shown to be approximately one head per ha during summer months (Gudmundsson & Dyrmundsson, 1994).

In this study four horses shared about three ha of grassland and seven ha of forest which gives a stocking rate of approximately 0.4, or rephrased 2.5 ha per horse in each enclosure. In accordance with Gudmundsson & Dyrmundsson (1994) this should be enough, at least during summer months, but there are few studies done in the scientific literature on over-wintering of horses on pastures.

A persistent positive energy balance can also affect the welfare of horses. In modern horse keeping it is common to confine horses in small paddocks and stalls, many times feeding them above maintenance levels. A high nutritional diet i.e. over feeding, in combination with too low levels of exercise can lead to obesity (Geor & Harris, 2009). An excess of adipose tissue has been associated with the risk for the development of insulin resistance, which can be characterized by a decreased insulin stimulated uptake of glucose in skeletal muscle combined with an impaired suppression of glucose output from the liver and a repressed ability of insulin to inhibit lipolysis in the adipose tissue (Schmidt & Hickey, 2009).

As a consequence insulin resistant horses are likely to suffer from dietary diseases such as the equine metabolic syndrome, often followed by laminitis (Schmidt & Hickey, 2009; Bamford et al, 2014). According to the genetic basis for the equine metabolic syndrome, ponies are more commonly affected, perhaps because they generally are easy keepers. The results from an intravenous glucose tolerance test show that ponies have a higher peak insulin concentration and lower insulin sensitivity when compared to Standardbred horses (Bamford et al., 2013). So the risk for developing dietary diseases such as the equine metabolic syndrome can vary among breeds. Based on this, the ponies in the study may benefit to some extent by the annual weight loss occurring during fall and winter months since the risk of obesity is reduced and the body fat reserves obtained during spring and summer are utilized as energy during the winter.

Other physiological parameters

The higher prevalence of chafes during the first period of the study was mostly caused by the GPS head collars. The thinner summer coat seem to be more easily chafed compared to the winter coat. In general skin problems and problems with coat quality increased during December. Several horses had a duller coat and dandruffs were also more common. Seborrhoea (dandruff) is a dry, flaky or oily discharge of the skin that can be caused by too low amounts of fat in the diet (Getty, 2009). The findings of duller coat and dandruff and the

higher prevalence can be explained since the horses presumably had a lower nutrient intake during the late autumn-winter months. Further studies (conducted February until March, 2015) did also notice signs of diarrhea in some horses with a low body condition score (< 2.5) (Labartino, 2015). According to Geor (2013) diarrhea in horses can be related to poor food quality, however signs of diarrhea was only found on two observation dates during their study. During the autumn and beginning of the winter there was a low prevalence of insect bites and ocular discharges in general, probably due to the season of the study. Insects may have influenced the body condition score and general health of the horses in previous studies but did not affect the horses notably during this period. The almost total absence of chafed mane and tails may also be due to the season of the study. Chafing of mane and tails can be a consequence of summer eczema for example. The low prevalence of wounds in this study may be explained by an already established hierarchy among the horses. The horses had been kept in the same enclosures since the previous spring, resulting in a decrease in aggressive behaviours. Generally the horses were playful with each other and did not show dominance behaviours to any extent.

Behavioural parameters

The results for the Human Approach Test show that there were differences between groups and observation dates. The horses in group three were kept in the enclosure located closest to the main road in the area. This could have influenced the horses' behaviour towards humans, making them more accustomed to human contact, since it is likely that humans passed by this enclosure to a greater extent in comparison with enclosure one and two. The results indicated that group one showed less interest during the Human Approach Test compared to both group two and three. The horses in group one and two were kept in enclosures located next to each other, thus making it difficult to find out the reason for this result. Perhaps the horses in group two and three were more handled by humans before they were introduced to the study, even though this is not very likely to have influenced the results since the horses came from different breeders.

All horses did show less interest towards the observer during the Human Approach Test in November. One reason for this could be that the horses were affected by the unkind weather, making them more distracted and less interested in humans. Another reason could be that the horses had to spend more energy on grazing and browsing, leaving them with less energy for their exploring behaviour. The horses had been kept in the enclosures for several months and the regular visits from persons taking part in the Gotland pony project may have become routine and therefor uninteresting. Even though the horses couldn't be considered to be wild, they had taken the first step in the direction towards de-domestication since their pursuits and routines were not affected by humans.

The horses were easy to touch in general, although this finding for the Avoidance Distance Test could not be analysed statistically. The horses had been handled in previous studies conducted during spring and summer, probably making them more accustomed to human contact and presence. Suggesting horses are to be used more frequently for landscape preservation, the handling of the horses will probably be of much importance since sicknesses and injures have to be taken care of. If grazers such as horses are to be kept in areas with humans nearby it is also important that the horses do not show aggressive behaviours towards humans.

The tests used in this study

Body condition scoring can give a fair overview of equine welfare if feed availability is already sufficient for the horses. However, additional tests measuring levels of hormones and blood samples should be conducted to confirm how well the horses manage on extensive pastures. Further studies have to be performed if mares are going to be kept on extensive pastures as well, since mares and stallions have different nutrient demands. The behavioural human approach test gave a satisfactory result for the study. The horses had been handled in previous studies, which probably generated different results compared to this study. Thus, it is suggested that the horses should be evaluated over a longer period of time to monitor changes in test results. The avoidance distance test did not give any significant results for the study since the observer could touch almost all horses on the muzzle, but the test may have been more rewarding in previous studies as well. This test could be improved with additional criterion such as for example touching the legs of the horse or introducing a halter to the horse, if it is desirable.

Conclusions

The Gotland ponies managed to maintain an acceptable body condition score on extensive pastures during a period from September until December. There were no significant differences between groups even though results indicate that some individuals manage to maintain a higher body condition score than others. The possibility to accumulate fat during spring and summer is of vital importance since it has a considerable effect on the body condition during the late fall and winter months. No horse scored lower than the limit determined for body condition during the period of the study, although some individuals will be at risk during following winter months.

The coat quality of the horses was somewhat impaired during December with a higher prevalence of dandruffs and duller coats. The prevalence of chafes was highest during September. The horses did not have any significant problems with the remaining physiological parameters. All horses except one could be handled during the study but the decreased interest towards the observer during November and December could be a result of a change in the horses' behaviour.

The Gotland pony project could give an alternative for preserving the breed and in the same time lead towards the conservation of Swedish landraces. However winter months are especially challenging for horses and further studies have to be made to examine how well horses manage during these months. Future studies should focus on if and when supplementary feeding is necessary with horses kept as restorers. In this project only stallions were used and it is important to see how well mares manage during winter months as well. It is therefore recommended that further studies look at different group constitutions with both mares and stallions, to get a more detailed view on how well horses manage on extensive pastures.

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Faculty of Veterinary Medicine and Animal Science
Department of Animal Environment and Health
P.O.B. 234
SE-532 23 Skara, Sweden
Phone: +46 (0)511 67000
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