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[*]The behaviour of horses in different paddock sizes, with and without exercise

G.H.M. Jørgensen[*] *& K.E. Bøe.*

Department of Animal and Aquacultural Sciences, Norwegian University of life Science, PO-Box 5003. N-1432 Ås, Norway.

[*]*Corresponding author: Grete Helen Meisfjord Jørgensen, grete.meisfjord@umb.no, Telephone: +47 64 96 51 42 Fax: +47 64 96 51 01*

Introduction

Documentation on horse management in Norway is scarce, but in Switzerland, Sweden and Denmark most horses are kept individually with restricted turnout in paddocks (Bachmann and Stauffacher, 2002; Søndergaard, et al., 2002; Statens Jordbruksverk, 2004).

Swedish recommendations state that an individual paddock should measure at least 300 m^2 (Ventorp and Michanek, 1997), but Danish recommendations suggest 800 m^2 and in addition horses are recommended kept together in social groups (Søndergaard et al., 2002). There is, however little evidence to confirm that these individual paddock sizes are adequate for exercise and other activities. For Przewalski horses kept in groups, results indicate that horses in smaller paddock sizes perform more milling, pacing, aggression, and less resting, compared to when in larger paddocks (Boyd, 1988; Hogan et al., 1988).

The aim of this experiment was to investigate the effect of daily exercise and paddock size on the behaviour of individually kept horses. It was hypothesized that the general activity in the paddock would decrease when horses were exercised, and that the horses would perform more running and playing in a larger paddock size compared to a smaller paddock size.

Material and methods

Experimental design

The experiment was conducted during the summer of 2004, at the Norwegian Equine Centre (Starum), and it was designed as a 2 x 3 factorial experiment with exercise (no exercise / daily exercise) and paddock size (small: 150 m^2, medium: 300 m^2 and large: 450 m^2) as main factors. In both the no exercise (three weeks) and the exercise (three weeks) treatment periods, nine horses were exposed to all the three paddock sizes (one week for each paddock size treatment) for 2 hours daily. The order of paddock size treatments was rotated systematically. The three paddocks measured 10 x 15 m (small), 10 x 30 m (medium) and 10 x 45 m (large) respectively and had sandy soil ground with some grass and green plants growing on the outside of the fence, all around the perimeter of the paddock. Every day the horses were fed, exercised for 45 minutes daily in a circular walker (Kondi trainer, diameter

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20 m) at a speed of approximately 75 m/min (only in the exercise period) and then turned out to the paddocks.

Animals and feeding

Nine healthy horses (10-22 years old) from both cold- (CB) and warm-blooded (WB) breed types were selected. There were both mares (3) and geldings (6) and all horses were normally used in schooling, either riding or carriage driving. The horses were stabled in tie-stalls measuring 1.87 x 2.50 m in the same building, and they were fed individually adjusted rations of good quality hay (6-8 kg per day) four times a day, in addition to oat grain and barley pellets, three times a day, while housed.

Behavioural observations

Direct observations were done by a present observer located in a nearby building overlooking the paddock area, for two hours in the paddocks at the last two days of each paddock treatment period. The following mutually exclusive behavioural classes were scored using instantaneous sampling at one-minute intervals: Standing, walking, running, vigorous play, exploration, eating grass, standing alert, self- grooming, rolling, defecation, standing asleep, digging the ground, eating/ licking soil, eating/ licking the wooden fence. In order to simultaneously score the position of the horse, the paddocks were divided into squares marked with spray paint on the ground. This allowed us to calculate the number of squares crossed during the two hours and to give a rough estimate of the distance travelled by the assumption that the horses moved from the centre of one square to the centre of another. This will of course overestimate the approximate distance travelled.

Weather conditions

Every day air temperature, wind speed and precipitation was recorded for every observation session and categorised into four categories according to the chilling effect: 1: 5 – 10 °C, strong wind and moderate to heavy rain (n = 9), 2: 10 – 15 °C, no or slight wind, moderate rain (n = 45), 3: 10 – 15 °C, no or slight wind, no rain (n = 30), 4: 15 – 25 °C, no or slight wind, no rain (n = 18).

Statistics

In order to test the effect of different paddock sizes and exercise on the horses activity, a GLM-model was used including the class variables paddock size (small, medium, large), exercise (exercise,/ no exercise), day of observation (day 1, day 2), week (1, 2, 3), weather (categories 1, 2, 3 or 4) and individual animal (Hatcher and Stepanski, 1994). Least square means was used to test differences between means.

Results

In the non-exercise treatment period the horses walked significantly more, they travelled a longer distance, explored more and stood more alert in the paddock than in the period with exercise (Table 1).

Table 1. Effect of paddock size and exercise on horse activity. Means with different letters differ significantly [a,b,c] P<0.001, [d,e,f] P<0.05.

Behaviour (means ± SE % of obs.)	Paddock size				Exercise		
	Small	Medium	Large	*P*-value	No exercise	Exercise	*P*-value
Standing	61.8 ± 3.7 [a]	50.0 ± 4.0 [b]	34.2 ± 4.3 [c]	< 0.0001	44.4 ± 3.6 [d]	52.9 ± 3.5 [e]	0.01
Walking	6.0 ± 0.9	7.2 ± 1.4	8.3 ± 1.7	0.3	9.3 ± 1.4 [d]	5.1 ± 0.6 [e]	0.01
Exploration	2.7 ± 0.4	2.9 ± 0.5	3.5 ± 0.5	0.2	3.9 ± 0.4 [a]	2.2 ± 0.3 [b]	0.0008
Eating grass	22.5 ± 2.9 [a]	31.0 ± 3.7 [b]	44.3 ± 5.0 [c]	< 0.0001	31.2 ± 3.5	34.0 ± 3.3	0.20
Stand alert	2.0 ± 0.5	1.6 ± 0.5	1.9 ± 0.5	0.8	3.1 ± 0.5 [a]	0.6 ± 0.2 [b]	0.0001
Self-grooming	0.8 ± 0.1	0.9 ± 0.2	0.5 ± 0.2	0.3	1.1 ± 0.2 [d]	0.4 ± 0.1 [e]	0.02
Eating/licking soil/fence	0.7 ± 0.3	2.4 ± 0.6	2.7 ± 0.1	0.08	0.9 ± 0.3 [d]	2.98 ± 0.7 [e]	0.04
Number of squares crossed	27.0 ± 2.7 [a]	36.2 ± 2.8 [b]	43.9 ± 2.7 [c]	< 0.0001	38.3 ± 2.6	33.1 ± 2.2	0.06
Distance travelled (metres)	163.3 ± 18.4 [a]	272.2 ± 24.2 [b]	338.8 ± 26.4 [c]	< 0.0001	293.8 ± 24.7 [d]	222.4 ± 15.8 [e]	0.001

The horses stood more inactive, showed a higher frequency of eating/licking soil and eating/licking wooden fence and a lower frequency of self-grooming in the period with exercise (Table 1). Running (mean ± SE % of tot obs.; 0.4 ± 0.1), vigorous play (0.2 ± 0.07), digging the ground with one front foot (0.5 ± 0.2), defecation (0.4 ± 0.05), standing asleep (0.2 ± 0.07) and rolling on the back (0.3 ± 0.05) were rarely observed and were not affected by exercise treatment or paddock size.

The recorded behaviours did not change over time (from week 1 to 3) within the non-exercise period, nor within the exercise period. The horses were more active in the large paddock compared to the medium and small paddock (Table 1), and they also travelled a longer distance. The main reason for this increased activity was that the horses ate more grass from under the fence. The horses also stood inactive more often in the small paddock compared to the larger ones, but none of the other behaviours were affected by paddock size.

There were no significant interactions between paddock size and exercise treatment for any of the behaviours.
At low temperatures and rain (weather category 1), the horses were more restless, and walked significantly more than in warmer weather (weather categories 2, 3 and 4) (Fig 1).

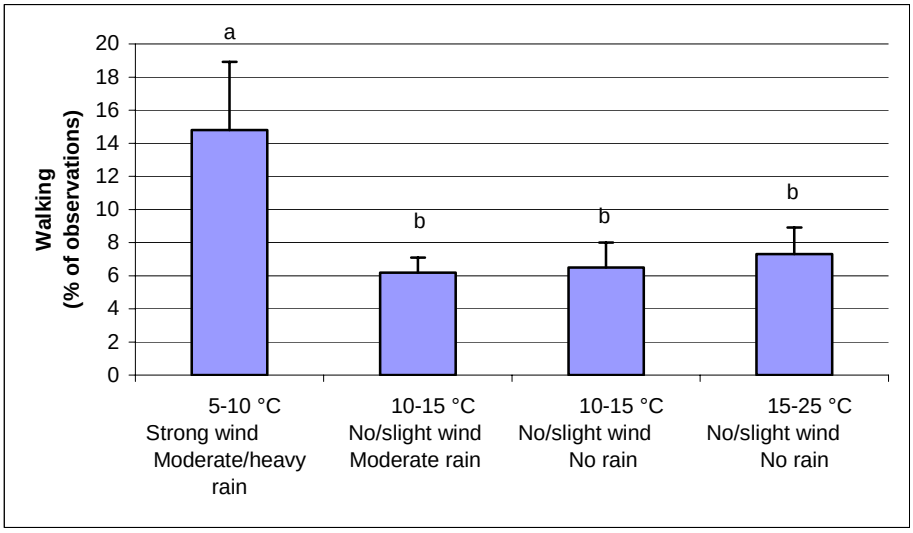

Figure1. Effect of weather on walking in individual paddocks (mean + SE). Means with different letters differ significantly, ^{a,b} *P<0.05.*

Although digging the ground with one front foot generally had a low frequency, this behaviour was more prevalent during cold weather (*P*<0.05), and the horses also stood more alert at low temperatures (*P*<0.05) (Fig 2). These findings could not be explained by any obvious disturbances in the paddock surroundings.

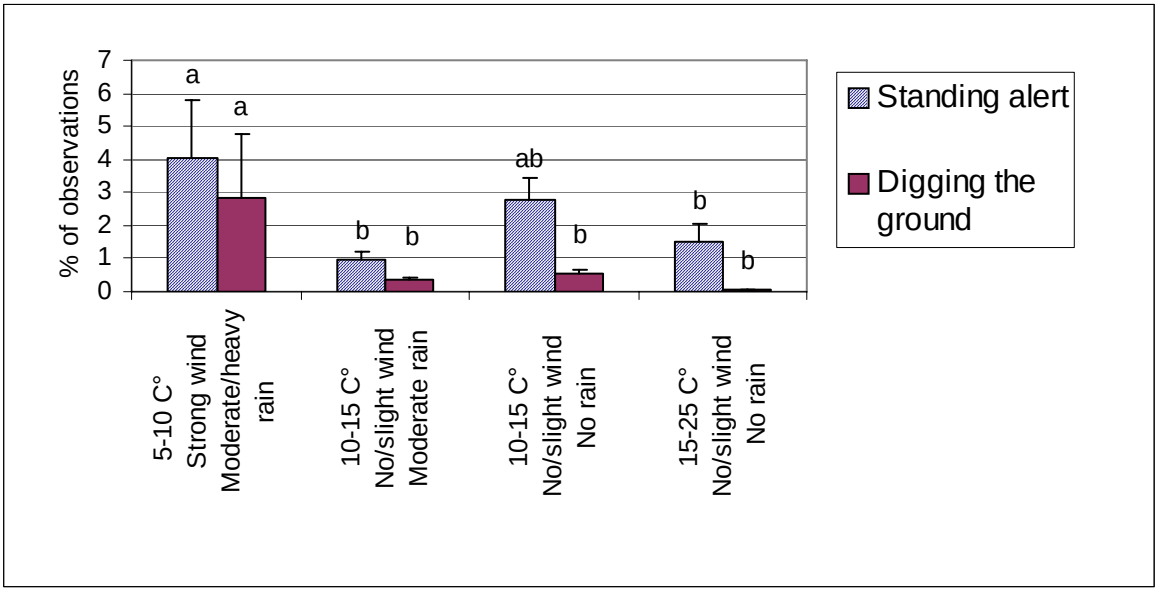

Figure 2. Effect of weather on standing alert and digging the ground in individual paddocks (means + SE). Means within the same behaviour bars with different letters, differ significantly, ^{a,b} *P<0.05.*

On the other hand, the horses tended to be standing more asleep at warm weather (category 4, 0.6 ± 0.4 %) compared to weather category 1 (0.0 ± 0.0), weather category 2 (0.12 ± 0.07) and weather category 3 (0.08 ± 0.06) (*P*=0.06).

Discussion

As hypothesised daily exercise significantly reduced the general activity as shown by decreased time spent walking, decreased distance travelled, less exploring of the environment and less standing alert. In comparison, Caanitz et al. (1991) found that horses under training were more relaxed at the stables than horses without training and Chaya et al. (2006) found an increased activity in horses turned out for only 2 h/week than horses turned out for 12h/week. There is however, important to distinguish between forced exercise (e.g. riding, pulling, and mechanical walker) and free exercise (paddock or pasture). Even though both the results from the present experiment and Caanitz et al. (1991) suggest that forced exercise reduce the motivation for movement and activity, it will not necessarily imply that the horses do not have an additional need for free exercise.

While the present experiment found a low frequency and no significant increase in running or vigorous play in the non-exercise period, Chaya et al. (2006) found that horses turned out for 2 h/week were more likely to trot, canter and buck than horses turned out for 12h/week. Similarly, Jensen (2001) found that calves performed more trotting and locomotor play after 3 days of confinement compared to calves with only 1 or 0 days in confinement. Possible explanations for the low frequency of running and playing in our experiment may be the high age of the horses and that these horses had been at this farm for several years and hence were very familiar with both the paddocks and the daily activities. As commented by Fraser (1992), play behaviour mostly occur in young horses.

Our hypothesis that a larger paddock size would increase running and playing was not confirmed, but time spent eating grass, the number of squares crossed and the distance travelled per se increased in addition to decreased passive standing when increasing the paddock size. Interestingly, the increased activity in the larger paddocks was mainly due to an increased time spent eating grass from under the fence. The longer fence perimeter of course exposed the horses to more grass. As the horses were fed just before turn out, the increased activity was probably not related to nutritional needs per se, but rather that grass was an interesting stimulus. It is possible that the effect of decreased passive standing could be extrapolated if increasing the paddock size further, however it is questionable whether increased paddock size under the present conditions would entail more running and playing (Danish recommendations: a minimum of 800 m^2).

During heavy rain and strong wind the horses increased the time spent walking, standing alert and digging the ground. Both the observed digging and repeated walking in the present experiment might be a behaviour expressing frustration of the weather conditions and impatience to get away from it. Rugs or blankets is often used in traditional horse keeping and will obviously reduce the climatic impact. However, the benefit of keeping a horse in a small paddock without shelter on days with heavy rain, eventually combined with strong wind is questionable.

In conclusion, daily exercise significantly reduced the general activity in the paddocks. Increasing the paddock size to 450 m^2, increased the time spent eating grass from under the fence and decreased the time spent standing passively.

Acknowledgements
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References may be acquired by contacting the corresponding author.