Beweging

Werhahn et al., 2011: As a consequence of a life predominantly spent in stables, many horses suffer from diseases of the musculoskeletal system (Hertsch, 1992; Bell et al., 2001; Arnemann, 2003) and respiratory system (Mair & Derksen, 2000; Holcombe et al., 2001), as well as abnormal behavior (McGreevy et al., 1995b; Cooper & Mason, 1998; Bachmann et al., 2003). Earlier investigations have revealed that locomotion activity during turnout is reduced if horses are trained in a circular horse walker before turnout as compared with no training at all (Jørgensen & Bøe, 2007). It was concluded that training is able to partly fulfill a horse's exercise requirements. Furthermore, it was found that horses behave much quieter during turnout if it happens daily compared with turnout once a week (Chaya et al., 2006). Caanitz et al. (1991) observed that horses that were trained on a treadmill five times a week spent more time lying down at night as compared with a group that was not trained. The horses in the present study showed the highest frequency of appearance of all the behaviors in the stable ("standing alert," "dozing," "sternal recumbency," "lateral recumbency," "occupation with equipment," and "eating") in the treatment No Turnout (no free exercise, only training) compared with the treatments 2-hour Turnout After Training and 2-hour Turnout Before Training, although the total duration was not different. Therefore, the horses changed their behavior more frequently in this treatment, which indicates a greater degree of nervousness and restlessness (Mal et al., 1991). The horses seemed to be unsettled as well. Earlier studies also registered that the prevention of exercise leads to an accumulation of unspent energy (Hogan et al., 1988), as does a long-term stay in stimulus-poor environments (Houpt et al., 2001). The decreased aggressive behavior against their neighbors in the treatments with turnout supports the observation of a more relaxed behavior in these horses.

Luthersson et al., 2009: Several previous studies have demonstrated potential associations between equine gastric ulceration syndrome (EGUS) and level of exercise (Murray et al., 1996; Orsini, 2000; Lester, 2004; Jonsson and Egenvall, 2006). It is important to note that, in normal training as workload changes, so does the management both with respect to the type of feed provided and the nature of any housing. Future studies should, therefore, employ multivariable techniques to account for the confounding effect of many potential risk factors on each other and the outcome of interest.

Timebudget free-ranging horses
Free-ranging horses spend up to 16 hours a day foraging, which generally happens with a slow and steady walk (Duncan, 1980; Kiley-Worthington, 1990).

King (2002) Przewalski horses: In 1998, on average the harems spent 45% of the daylight hours grazing, 38% of the daylight hours resting and 16% of the daylight hours moving.

Rose-Meierhöfer et al., 2010: Wild horses cover an average distance of 6 km per day (Zeitler-Feicht, 2001*),* depending on seasonal pasture conditions, grass quality, climatic conditions, and the distance between watering places. A similar behavior can be found in group housing of horses in open barns.

Zeitler-Feicht, 2004: The daily distance covered by free-roaming horses depends primarily on feed growth, on the number and the location of water sources, and on climatic conditions. Under normal conditions, horses cover a distance of about 6-11 km (3.7-6.8 miles) daily. This data, however, was derived from observations restricted to New Forest ponies, Camargue horses, and Mustangs. It cannot be excluded that, given the same conditions, breeds with higher general exercise levels, such

as Arabians and Thoroughbreds, would cover greater distances. As long as sufficient feed is available, all equids are relatively stationary. If, in addition to feed, sufficient watering places are available, they rarely move more than 2-2.5 km (1.2-1.6 miles) daily. In arid areas, however, longer distances often have to be covered in order to reach the next water source. From observations in feral horses in Montana, for example, it is known that their resting areas are located up to 16 km (10 miles) away from the next water source. In this case, the animals are forced to walk great distances, because they usually require water at least every other day. Free-roaming equids migrate over longer distances in the course of the year, which is attributable to a change in climatic conditions and, as a result, feed growth. Daily weather changes also influence locomotion behavior. In windy, cold, and rainy weather, horses, especially youngsters, have an increased preference for movement.
Hampson et al., 2010a: The distance travelled by Australian feral horses in an unrestricted environment has not previously been determined. It is important to investigate horse movement in wilderness environments to establish baseline data against which the movement of domestically managed horses and wild equids can be compared. **Objectives:** To determine the travel dynamics of 2 groups of feral horses in unrestricted but different wilderness environments. **Methods:** Twelve feral horses living in 2 wilderness environments (2000 vs. 20,000 km2) in outback Australia were tracked for 6.5 consecutive days using custom designed, collar mounted global positioning systems (GPS). Collars were attached after darting and immobilising the horses. The collars were recovered after a minimum of 6.5 days by re-darting the horses. Average daily distance travelled was calculated. Range use and watering patterns of horses were analysed by viewing GPS tracks overlaid on satellite photographs of the study area. **Results:** Average distance travelled was 15.9 _ 1.9 km/day (range 8.1–28.3 km/day). Horses were recorded up to 55 km from their watering points and some horses walked for 12 h to water from feeding grounds. Mean watering frequency was 2.67 days (range 1–4 days). Central Australian horses watered less frequently and showed a different range use compared to horses from central Queensland. Central Australian horses walked for long distances in direct lines to patchy food sources whereas central Queensland horses were able to graze close to water sources and moved in a more or less circular pattern around the central water source. **Conclusions:** The distances travelled by feral horses were far greater than those previously observed for managed domestic horses and other species of equid. Feral horses are able to travel long distances and withstand long periods without water, allowing them to survive in semi-arid conditions.

Hampson et al., 2010b: The aims of this work were to (1) develop a low-cost equine movement tracking collar based on readily available components, (2) conduct preliminary studies assessing the effects of both paddock size and internal fence design on the movements of domestic horses, with and without foals at foot, and (3) describe distances moved by mares and their foals. Additional monitoring of free-ranging feral horses was conducted to allow preliminary comparisons with the movement of confined domestic horses. **Procedures** A lightweight global positioning system (GPS) data logger modified from a personal/vehicle tracker and mounted on a collar was used to monitor the movement of domestic horses in a range of paddock sizes and internal fence designs for 6.5-day periods. **Results** In the paddocks used (0.8–16 ha), groups of domestic horses exhibited a logarithmic response in mean daily distance travelled as a function of increasing paddock size, tending asymptotically towards approximately 7.5 km/day. The distance moved by newborn foals was similar to their dams, with total distance travelled also dependent on paddock size. Without altering available paddock area, paddock design, with the exception of a spiral design, did not significantly affect mean daily distance travelled. Feral horses (17.9 km/day) travelled substantially greater mean daily distances than domestic horses (7.2 km/day in 16-ha paddock), even when allowing for larger

paddock size. **Conclusions** Horses kept in stables or small yards and paddocks are quite sedentary in comparison with their feral relatives. For a given paddock area, most designs did not significantly affect mean daily distance travelled.

Ransom & Cade (2009): *see figure below.* Horses move as they graze; therefore, as long as the horse is feeding while it is moving, it should be considered as feeding rather than locomotion.

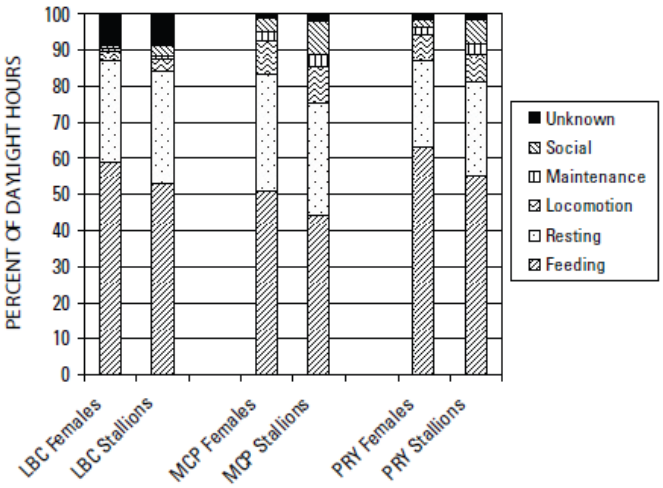

Figure 1. Observed daytime activity budgets of adult control female feral horses (n = 207, mean age = 7.79 yrs ± 0.33 SE, range = 2–21 yrs) and harem stallions (n = 110, mean age = 11.63 yrs ± 0.43 SE, range = 5–26 yrs) at Little Book Cliffs Wild Horse Range in Colorado (LBC), McCullough Peaks Herd Management Area in Wyoming (MCP), and Pryor Mountain Wild Horse Range in Montana (PRY), 2003–2006.

Grootte paddock/weide

Mills & Clarke, 2002: Kusunose et al. (1985, 1987) found that yearling horses were restricted in their canter in fields of 1.5 ha but not in fields of more than 2.1 ha and that the shape of the field also affected behaviour. In the latter study (Kusunose *et al.*, 1987) suggested on the basis of the type of movement shown, that square paddocks are preferable to those proportioned 1:2 or 1:4. Whilst the limitations of these studies are accepted, it does no harm to recognise and implement their recommendations where possible, given the relative paucity of scientific knowledge available to guide decisions.

Rose-Meierhöfer et al., 2010: The results of this group housing study indicated that the activity of horses is affected by space and functional areas. Using feeding automation for hay and concentrates in addition to a structured stable design, which in this study was defined as active barn, leads to a significantly higher activity behavior of horses compared with the conventional open barns.
It was observed that horses in open barns with paddock walk 1.2 km per day, whereas horses in boxes cover a distance of merely 0.17 km per day. In open barns with different functional areas and higher feeding frequencies, walking distance per day could be increased to 4.8 km (Frentzen, 1994). Therefore, group housing systems have positive effects on the activity of horses (Jørgensen & Bøe 2007). Increased space with leafy paddock or pasture also helps to increase the activity per day. However, an expanded sand-paddock (540 m^2 instead of 270 m^2 for six horses) has no influence on activity behavior (Hoffmann et al., 2009). The highest space restriction with the strongest negative effect on activity behavior can be found in individual stabling in boxes (Brehme & Rose, 2007).

Werhahn et al., 2011: German guidelines advise a minimum of 150 m2 for two horses (BMELV, 2009).

Erber et al., 2013: For initial training, horses are often transferred from group housing to individual boxes, which is a potential stressor. In this study, salivary cortisol concentrations, locomotion activity, and heart rate (HR) were analyzed and the HR variability (HRV) variables standard deviation of beat-to-beat interval (SDRR) and root mean square of successive RR differences (RMSSD) were calculated in 3-year-old mares (n = 8). Mares were transferred abruptly from a group stable with access to a paddock to individual boxes without a paddock and were studied from 4 days before to 5 days after changing the stable. Mares underwent routine equestrian training for young horses. On the days before mares were moved to individual boxes, cortisol concentrations showed a diurnal rhythm with values approximately 0.6 ng/ml in the morning and a decrease throughout the day. When horses were moved to individual boxes, cortisol concentrations increased to 1.8 ± 0.2 ng/ml within 30 minutes and did not return to baseline values within 6 hours (0.7 ± 0.1 ng/ml, $P < .05$ over time). On the following days, a diurnal rhythm was re-established but at a higher level than before the change of stable. Locomotion activity was higher when mares had access to a paddock than when kept in individual boxes. Heart rate increased for approximately 60 minutes when mares were separated from their group. In conclusion, separating young horses from their group and individual stabling are perceived as stressful.

4 uur vrije beweging, 1 uur training (belang 'vrije' beweging versus training)
Werhahn et al., 2011: In conclusion, this study shows that allowing or not allowing free exercise (ie, turnout in groups of 2 horses) and the particular time of turnout affects the behavior of horses in the stable as well as those in training and during turnout. The behavior of the horses in the stable was more relaxed when turnout was allowed in addition to training. The behavior during training was also more relaxed and the willingness to perform was not negatively affected by turnout. The horses showed less activity, and thus covered a smaller distance during turnout, when training was carried out before turnout (TAT). This result indicates that training does fulfill the demand for exercise at least to some extent. The fact that the horses still showed active behavior (walking, trotting, and cantering) when they were turned out after training (TAT), and thus still covered a certain distance (only about 35% less than before training), indicates that the demand for exercisewas not fulfilled entirely by training. Chaya et al. (2006) also observed significantly more active behavior in a group of horses that was turned out once a week as compared with a group of horses that was turned out six times a week, although both groups were ridden daily. They concluded that riding is not a sufficient substitute for turnout. This hypothesis can be supported by the present study. Therefore, the study indicates that training does not fulfill the exercise requirements of the horses.
Regarding the risk of injury caused by free exercise, it is advised to allow "2-hour turnout after training" (TAT) because locomotion activity is decreased with this order of events as compared with "2-hour turnout before training" (TBT). By contrast, the horses' willingness to perform was evaluated as being better when turnout was allowed before training (TBT).

Chaya et al., 2006: We examined if time spent in turnout influenced behaviour during turnout for horses maintained in stalls and given either 2 h/week (n = 7) or 12 h/week (n = 7) of turnout. Horses turned out for 2 h/week were more likely than those turned out for 12 h/week to trot, canter, and buck. Frequency of trotting and cantering was also higher and frequency of grazing lower in horses turned out for 2 h/ week. These results have welfare implications and support previous studies showing that horses react to confinement with increased activity when not confined. Stalls isolate horses, restrict their movement and behavioural options, and reduce environmental stimulation

(Kiley-Worthington, 1990; Mills and Clarke, 2002). Use in riding undoubtedly increases movement and behavioural options and is likely more stimulating than being kept in a stall. Despite being ridden at least 5 days per week, however, horses in the short turnout group showed the same compensatory locomotor activity noted for pregnant mares released from confinement in straight stalls (Houpt et al., 2001). Use in riding does not permit natural behaviours, particularly grazing, and limited grazing opportunity has been linked to increased activity (Hogan et al., 1988). Horses that must be maintained in stalls should have adequate turnout time to permit the occurrence of natural behaviours, such as grazing, and use in riding should not be viewed as a sufficient substitute for turnout.

Werhahn et al., 2012b: The aim of the present study was a systematic investigation of the effects of the prevention of free exercise and social interactions on the behavior in the stable, behavior during turnout and training, and on the degree of stress in competition horses under conditions of practice. This study shows that allowing or not allowing free exercise and its configuration (solitary or in groups of two) affects horses' behavior in the stable and during training, and also their degree of stress. The prevention of free exercise resulted in less lying and more occupation, which was interpreted as being a decreased demand for rest and as balancing the lack of occupation on pasture. When no turnout was allowed, all three heart rate variability parameters at rest were lower, indicating a higher degree of stress in this treatment. High temperature and relative humidity also caused higher values for low frequency/high frequency, thereby indicating the presence of stress. Group turnout resulted in the lowest degree of stress, but the difference was only significant in standard deviation of inter-beat-intervals compared with no turnout. The evaluation of training was best when turnout was allowed in groups, but the evaluation did not differ significantly between the treatments.

Behoeftes/mogelijkheden/weersomstandigheden

Lee et al., 2011: Rather than suggest that horses that are turned out alone need less time in the paddock, the results of this experiment show the benefit of exercising horses in groups, especially where the paddock groups are composed of socially compatible horses. What is the ecological need for exercise? To try the answer this question we measured the strength of preferences for three commodities and found that horses will not work as hard for the opportunity to exercise as for palatable food. The finding that horses do not prefer forced exercise is not surprising because moving at a gait faster than a walk is predator defense and, although it occurs in nature, it is a better indicator of poor than of good welfare.

Werhahn et al., 2012a: Houpt et al. (2001) and Chaya et al. (2006) observed that irregular turnout leads to more trotting, cantering, and bucking, whereas horses provided with regular turnout behave in a much more calm manner when released. In the German guidelines for the evaluation of equine housing systems regarding the aspects of animal protection (BMELV, 2009), experts point out that housing horses in single stalls without free exercise is not species-appropriate according to the horse's physiological demands and may lead to diseases of the musculoskeletal (Bell et al, 2001; Safran et al., 1988) and respiratory systems (Holcombe et al., 2001; Mair & Derksen, 2000), as well as to abnormal behavior (Cooper & Mason, 1998; Bachmann et al., 2003; McGreevy et al., 1995b). Nevertheless, this kind of housing remains in practice. The aim of the present study was to investigate the effect of free exercise on the behavior of competition horses in the stable, during turnout on pasture, and during training. The results show that the configuration of turnout (solitary or in groups of two) affects horses' behavior and activity during turnout. Behavior observations

revealed that a 2-hour turnout on pasture is predominantly used for eating but also for locomotion and social interaction. Even if solitary turnout was given, the horses tried to interact with the animals on neighboring paddocks. Aggressive behavior was not observed. The distance covered was greater in solitary turnout, which indicates that they behaved in a more restless manner when alone. Regular turnout led to calm behavior on the pasture in all the horses, especially when it happened in groups. Thus, if free exercise is permitted regularly and in well socialized groups, the risk of injury is decreased because of less activity. If these findings are considered and horses are warmed up before turnout (eg, by training), free exercise is also feasible for competition horses.

Jørgensen & Bøe, 2007: 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. 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 to 450 m2.
Caanitz et al. (1991) found that horses under training were more relaxed at the stables than horses without training.

Werhahn et al., 2011: Rivera et al. (2002) observed that young horses kept on pasture acclimatize easier to a training environment and equipment than those housed in a stable. They traced this observation back to the fact that horses on pasture train their ability to adapt to new situations better than those in a low-stimulus environment, such as a stable. The stalled horses also showed more activity, such as jumping and bucking.

Benhajali et al., 2008: On the contrary, the high density did not prevent the mares from a high level of locomotion; 27.9% of their time with 18% active walk which is high compared to other observations in wild and domestic horses (2–14.1% of time) (Boyd, 1988: 8.5–14.1%; Duncan, 1985: 5.2–12.7%) and this higher level of locomotion could be a sign of agitation (Houpt and Houpt, 1989).

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