Belg. J. Zool., 134 (2/1) : 97-103 July 2004

Do season and habitat influence the behaviour of Haflinger mares in a coastal dune area?

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ABSTRACT. This study was performed to gain more knowledge about the behaviour and habitat use of Haflinger mares, free-ranging in a low-productivity dune area. Detailed data on these animals' time budgets were collected over a full year, through the focal animal observation technique. On average the Haflinger horses spent 68% of the daytime grazing, 18% resting and 8% walking. Seasonal features influenced horses' behaviour, mainly through a change in grazing time. Shorter grazing time in summer allowed the animals to rest longer than during the other seasons. We suggest that especially the decreased forage quality and quantity of the grazed habitats in the non-growing season account for the increased grazing time in autumn and winter. In all four seasons the horses preferred grazing in the grassy habitat. However, habitat use showed seasonal variation. Grey dunes were grazed more intensively in winter and spring, compared to summer and autumn. The contribution of roughage, scrub and woodland to the habitat use was low over the entire year. For several response variables the observed variation could be partly explained by the differences between individual animals.

KEY WORDS : horse, free-ranging, habitat use, time-budget, grazing behaviour, non-grazing behaviour.

INTRODUCTION

Several authors have reported (daylight or 24 hours) time-budgets of feral horses (SALTER & HUDSON, 1979; JARRIGE & MARTIN-ROSSET, 1987) or free-ranging horses living in natural or semi-natural conditions (DUNCAN, 1980; DUNCAN, 1985; VAN DIERENDONCK et al., 1996; BERGER et al., 1999; BOYD & BANDI, 2002). On the whole, time-budgets of free-ranging and feral horses show large similarities, with highest time-investment in grazing. Resting, moving and alertness take most of the remaining time. However, behavioural differences due to environmental conditions, such as habitat, forage quality and weather are reported, as well as a relationship with intrinsic aspects such as age, sex and reproductive state.

The aim of the present study was to describe the behaviour and the habitat use of Haflinger horses, introduced into an old coastal dune area with low primary production. This low-productivity environment offers the herbivores rather low levels of forage quality and quantity, in comparison with more nutrient-rich systems. These nutrient and energy restrictions are even more pronounced during the non-growing season, i.e. the season with low plant production (from October to March in temperate regions). Free-ranging herbivores have to make many foraging decisions at different resolution levels (SENFT et al., 1987; STUTH, 1991), resulting in a foraging strategy that meets the large herbivores' nutrient and energy requirements. These decisions are primarily made in relation to forage availability and quality, which are in turn determined by environmental conditions. We expect that the rather low levels of forage quality and quantity will be reflected in the foraging behaviour of the Haflinger horses, in particular by long grazing times. Furthermore, we suppose that the horses adapt their behaviour and habitat use to the seasonal changes in their environment. According to the literature we may assume that this adaptation will result in an increased grazing time as well as a broader habitat use outside the growing season.

MATERIAL AND METHODS

Study site and animals

Research was performed in the nature reserve Ghyvelde (60 ha), an old dune area close to the northern French coastline and bordering an equally old dune ridge in Belgium (Adinkerke). Ghyvelde is located in a coastal region with mild winters and mild summers. Mean annual temperature is 9.8˚C. The average minimum temperature of the coldest month (January) is –7.2˚C, average maximum temperature of the hottest month (August) is 28.4˚C. Mean annual precipitation is min 520 mm and max 870 mm. In summer, autumn, winter and spring mean monthly precipitation is 60.7 mm, 74.8 mm, 56.5 mm and 48.5 mm, respectively (means over the period 1963-2002) (Meteo WVL vzw).

Two thirds of the area is covered by open habitat, mainly formed by *Carex arenaria*-dominated grassland (*Plantagini-Festucion* community), alternating with grey dunes, dominated by mosses and lichens and a sparse cover of grasses and forbs (*Thera-Airion* community). One central afforested area and several dispersed, small patches of trees shape the woodland at the site (approximately 23% of the area). Approximately 7% of the area is scrub vegetation, consisting of *Hippophae rhamnoides*, *Ligustrum vulgare*, *Salix repens* and *Sambucus nigra*.

During the study, a herd of 14 to 18 Haflinger horses grazed the site. They were introduced to decrease or hamper the encroachment of competitive plant species that tend to form species poor to monospecific vegetations. They graze year round and no additional food is given. The horses have access to one artificial water point for drinking. We chose three adult mares as the focal animals for the observations : one had a foal, the other two were non-lactating. All three mares were in good condition.

Behavioural observations

Data were collected through continuous focal animal observation (ALTMANN, 1974). From May 2000 until April 2001 we conducted 31 sessions of six hours. All observations took place during daylight (between 9:00h and 19:00h) and were done by one observer. During a six-hour period we continuously monitored the behaviour of one focal animal, chosen at random from the three mares that were a priori selected for this study. Most of the horses are habituated to man and can be approached within a range of 1 m without causing any visually observable influence on behaviour.

We recorded the duration (accuracy : 1 s) of the different behavioural types, as well as vegetation type and vegetation height. We registered and took into account grazing as well as non-grazing behaviour (drinking, walking, standing alert, resting upright, laying down, rolling, grooming, mutual grooming, defecating, urinating). To analyse the data the different vegetation types considered in the field were lumped into five habitat types : 'grassy vegetation', 'grey dune', 'roughage', 'scrub' and 'woodland', which cover 35%, 32%, 3%, 7% and 23% of the area respectively. For vegetation height we used a scale related to the animal's physiognomy : 'no height' (in case of no vegetation), 'shortly grazed', 'hoof', 'knee', 'belly', 'spine' and 'higher'. We have no data on the relative availability of each of these height classes. Season definition follows the plant productivity periods in temperate regions, i.e. summer (June-August), autumn (September-November), winter (December-February) and spring (March-May).

Data analysis

The calculation of the time-budget was based on the total time spent per day on each behaviour. The correlation between the total time of the different behaviours was analysed separately for each individual mare (since we found individual variation). A Bonferroni correction (adjustment of the p-value with k=3) was performed to draw conclusions about the correlations for the three mares. Pearsons correlations were calculated if data were distributed normally; if not, we used Spearman correlations.

Variation in the time-budget was investigated by the use of the following response variables : mean time per day spent in a certain behaviour, mean number of bouts, mean number of periods of a certain behaviour per day, mean duration of a bout and mean duration of a period of a certain behaviour. A 'bout' is a phase in which a certain behaviour is performed without interruption. A 'period' is the accumulation of several bouts of the same behaviour if they are not interrupted for more than five minutes. For example, the horse can stop a grazing bout to scan its environment. After a few seconds or minutes it can prolong its grazing behaviour and stop this to start a resting period. That grazing period (called a 'meal') consists of two bouts. The short interruption is not seen as a break of the meal, but is not included in the calculation of the meal duration, which is only the effective grazing time during a meal. Main attention focussed on the behavioural types grazing, resting and walking. Additionally, we considered standing alert, grooming, mutual grooming, drinking, defecating, urinating and rolling. We investigated whether the observed variation in the response variables was affected by seasonality. We were aware of the possibility that differences in behaviour between individual animals could explain, at least partly, the observed variation. Therefore, we used mixed-model ANOVA to investigate the effect of the fixed factor 'season' on the variation in mean time, mean number of bouts and mean bout duration, and included the random factor 'individual' into the model. If the random factor was not significant, we consequently excluded it from the model. The Scheffé multiple comparison procedure was used as post hoc test. In case of inconsistency with the assumptions for the use of ANOVA, we used Kruskal-Wallis One Way Analysis. However in such cases we could not incorporate a random factor. This meant that for the analysis of the effect of the factor 'season', the impact of possible individual differences could not be regarded. Secondly, we had to analyse the potential effect of 'individual' with a separate analysis.

To investigate the habitat use of the horses we considered the variable mean grazing time per day per habitat type or per vegetation height. When on a given day an animal was not grazing in a certain habitat or height, null values were included to calculate the mean grazing time. In the ANOVA-model we considered two fixed factors 'season' and 'habitat type' or 'height category', their interactions and the random factor 'individual'. We eliminated a non-significant random factor or interaction from the final model. We investigated the use of the five different habitat types a second time by taking into account the availability of the five habitat types. Therefore we multiplied the mean grazing time per day per habitat type with a correction factor, derived from the relative occupancy of the habitat types.

All analyses were performed using SPSS 11.0 for Windows.

RESULTS

Time-budget

Table 1 gives an overview of the time budget of the three Haflinger mares. In general grazing took the main part of the time-budget; on average 68% of the observed time. On average, the horses spent 18% of their daytime resting, 8% walking and 3% standing alert. Grooming, drinking, nursing, mutual grooming, defecating, urinating, rolling and interactions accounted for only 4% of the total daytime. Fig. 1 illustrates the time-budget over the whole year and the variation between seasons. For each of the three mares we found a significant negative correlation between total grazing time and total resting time per

TABLE 1

Time (minutes) per 6 hours day and number of bouts per 6 hours of each behaviour: mean, minimum (min.), maximum (max.) and Standard Error (SE). Sample size: 3 individuals; 31 observation days.
Fixed effect of season and random effect of individual (ind.) on mean time per day and mean number of bouts were investigated: ***: p<0.005; **: p<0.01; *: p<0.05; n.s.: not significant

	Time				Effect		Number				Effect	
Behaviour	**Mean**	**Min.**	**Max.**	**SE**	**season**	**ind.**	**Mean**	**Min.**	**Max.**	**SE**	**season**	**ind.**
Grazing	242.6	128.3	291.0	16.1	*	***	92	44	112	5.9	n.s.	n.s.
Resting	63.8	25.5	153.2	12.0	***	***	9	3	29	2.4	n.s.	***
Resting up	59.4	7.3	152.3	12.8			9	2	28	2.5		
Lying down	4.4	0.0	25.8	2.3			1	0	3	0.3		
Walking	27.9	15.5	37.4	2.1	n.s.	n.s.	76	56	91	3.4	n.s.	n.s.
Standing alert	12.3	3.3	33.2	2.9	n.s.	**	25	8	45	4.2	n.s.	n.s.
Grooming	4.0	0.9	9.1	0.8	n.s.	n.s.	11	5	17	1.4	***	***
Drinking	2.0	4.2	4.8	0.4	n.s.	n.s.	2	1	5	0.4	n.s.	n.s.
Mutual grooming	1.4	0.0	6.3	0.6	n.s.	n.s.	2	0	7	0.6	n.s.	n.s.
Defecating	0.8	0.2	1.9	0.1	n.s.	n.s.	4	1	6	0.5	n.s.	*
Urinating	0.6	0.2	1.0	0.1	n.s.	n.s.	3	1	5	0.4	n.s.	n.s.
Rolling	0.1	0.0	0.4	0.0	n.s.	*	0.4	0	1	0.1	n.s.	n.s.
remainder	0.1											

day. We could not conclude this for the three mares together, since the significant correlation did not remain after Bonferroni correction (p=0.057).

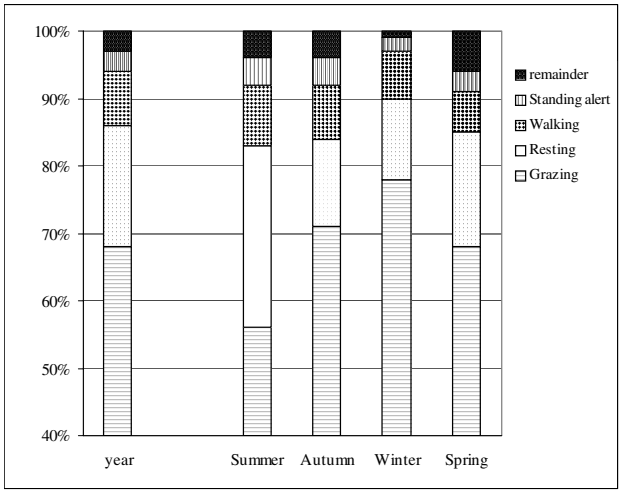

Fig. 1. – Time-budget of the Haflinger horses over the entire year, and in summer, autumn, winter and spring. Percentages are based on mean time spent per day.

Grazing behaviour and habitat use

Mean grazing time per day was affected by season (p=0.030). The random factor individual could not be deleted from the statistical model as it had a significant effect. Post-hoc tests showed that summer had a significantly lower mean grazing time compared to autumn and winter (Su : 56% of six hours; Au : 71%; Wi : 78%; Sp : 68%).

Average duration of a meal, average duration of a grazing bout, average number of meals and average number of grazing bouts were not different in the four seasons. However, the observed variation in meal duration, grazing bout duration, number of meals and number of grazing bouts could be explained to a certain extent by the differences between individual animals.

To investigate the habitat use of the horses we considered the differences in average grazing time per habitat type per day. The horses grazed 176 min/6 hrs in grassy vegetation and 54 min/6 hrs in grey dunes. In comparison, grazing times in other habitat types were much lower : 2, 7 and 4 minutes in roughage, scrub and woodland, respectively. Table 2a illustrates the ANOVA results : significant main effect of habitat ($p < 0.001$), significant interaction season x habitat ($p < 0.001$) and a significant random effect. Similar results were found when we analysed the habitat use with the correction for habitat availability (grazing time in grassy habitat : 167 min/6 hrs; grey dune : 60 min; roughage : 19 min; scrub : 33 min; woodland : 6 min)(Table 2b; Fig.2). The significant interaction illustrates the seasonal changes in habitat use. Grey dunes were grazed more in winter and spring than in summer and autumn, and this was at the expense of the grassy habitat. Roughage was only foraged in autumn. In autumn, winter and spring scrub was grazed a bit more, compared to summer. The woodland was visited for grazing a bit more often, compared to the other seasons. Nonetheless, the contribution of roughage, scrub and woodland to the habitat use was low, throughout the year.

TABLE 2

Results of the mixed-models ANOVA examining the effects of the fixed factor 'Habitat type', 'Season', the interaction, and the random factor 'Individual' on the variable Grazing Time.
a) without correction for availability of the habitat types. B) with correction for availability of the habitat types

		df_1	df_2	F	P
a	Habitat	4	33	152.634	**<0.001**
	Season	3	33	0.880	0.462
	Habitat*Season	12	33	4.347	**<0.001**
	Individual (Random)				significant
b	Habitat	4	33	69.149	**<0.001**
	Season	3	33	1.739	0.179
	Habitat*Season	12	33	2.988	**0.006**
	Individual (Random)				significant

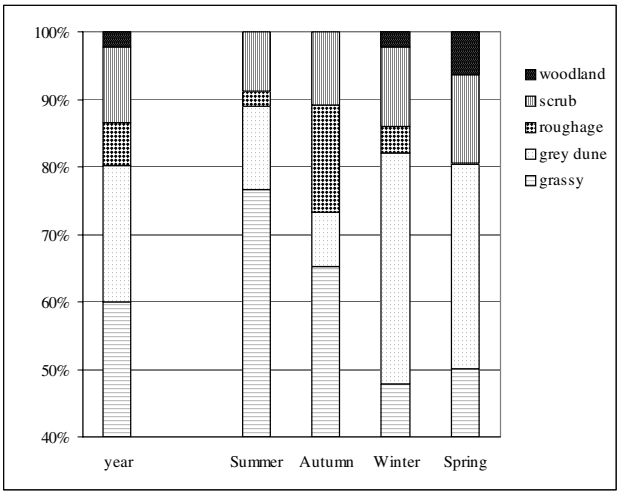

Fig. 2. – Habitat use of the Haflinger horses over the entire year and in summer, autumn, winter and spring. Percentages are based on mean time grazing per day, corrected for the availability of the five distinguished habitat types.

We analysed the effect of vegetation height on grazing time when the horses were foraging in grassy habitat and grey dune. The Haflinger mares were grazing in hoof high vegetation 57% of the time that they were grazing in grassy habitat or grey dune, and 40% in shortly grazed vegetation. This difference seemed more pronounced in summer and spring than in autumn and winter, so we also analysed if there was a significant interaction between the effect of height and the effect of season. There was a significant effect only of height ($p=0.029$). No significant interaction or significant random effect of individual was found.

Resting behaviour

The mean resting time per day was significantly different between seasons ($p=0.005$) and between individual animals. In summer significantly more time was spent resting compared to autumn, winter and spring (result of post hoc-tests) (Su : 27% of six hours; Au : 13%; Wi : 12%; Sp : 17%). The duration of a resting period and the duration of a resting bout were similar in all seasons and for all individuals. The factor season had also no effect on the average number of resting periods. Number of resting periods and number of resting bouts were significantly different between individual animals. Resting behaviour was only observed in grassy vegetations and grey dunes, never in roughage, scrub or woodland.

Walking behaviour

The mean walking time per day was not affected by the factor season. In summer, autumn, winter and spring the Haflinger mares on average walked respectively 33 min, 30 min, 24 min and 22 min/6 hours. Individual horses did not differ in mean walking time per day. There were no seasonal or individual differences in the average duration of a walking period, average number of walking periods, average walking bout and average number of walking bouts. Horses mostly walked in the grassy vegetations and grey dunes, and rarely moved around in roughage, scrub or woodland.

Other behavioural aspects

We considered here the behaviours standing alert, grooming, mutual grooming, drinking, urinating, defecating and rolling. We found no seasonal variation in the mean time per day spent on these behaviours. For the behaviours standing alert and rolling we found significant individual differences. The mean grooming frequency per day was significantly different between seasons ($p=0.004$) and between individuals. Individual variation was also found for the mean defecating frequency. The mean time of a bout was different between seasons for defecating and different between individual horses for grooming.

DISCUSSION

Time-budget

On average, the Haflinger horses spent 68% of the daytime grazing and 18% resting, of which only 1% was lying down. The horses were walking around for 8% of their time and spent 3% standing alert. This daylight time-budget is in line with time-budgets of other free-ranging and feral horses. JARRIGE & MARTIN-ROSSET (1987) reported that feral horses spend 50-73% of their time grazing during daylight. Przewalski horses in a nature reserve in the Mongolian steppes only grazed an average of 49% of the daytime (VAN DIERENDONCK et al., 1996). DUNCAN (1985) concluded that feeding of Camargue horses generally occupies 50-70% of a whole day and resting 20-30%, the remainder being spent in alertness and movement. We suggest that the rather long grazing times of the Haflinger horses reflect the poor nutritive quality and quantity of the grazed habitats. BERGER (1986) reported high grazing times (68.3% & 78.1% for non-reproductive and reproductive mares) in low quality home ranges as opposed to lower grazing times (58.5% & 65.8% for non-reproductive and reproductive mares) in high quality home ranges.

We found low daily resting times, and resting occurred mainly in the standing position. As DUNCAN (1985), MAYES & DUNCAN (1986) and PRATT et al. (1986) already indicated for other horse breeds, we consider it very probable that the Haflinger horses also rest more at night, in the standing as well as in a recumbent position, than during the day. Paradoxical sleep occurs in the recumbent resting periods (BOYD, 1998; WARING, 2003); however, standing, not recumbency, is the posture of minimal energy demand for horses (WINCHESTER, 1943). Environmental factors influence the horse's resting behaviour (WARING, 2003), while individual variation has been reported as well (DUNCAN, 1980). However, we believe that there is a minimum level for resting critical to equid well-being, as also suggested by DUNCAN (1992). Increased resting time above this threshold is possible when other maintenance requirements are fulfilled. In nutrient-poor systems horses will be more time-limited, in comparison with horses in nutrient-rich systems, owing to the increased foraging effort needed to meet their energy and nutrient requirements. We suggest that on the one hand the maximum grazing time of horses is determined by a threshold for other maintenance activities, in particu-

lar resting. On the other hand "free" time to increase the resting time is mainly determined by the time spent on the horses' main activity, i.e. grazing. Since the Haflinger horses forage in a nutrient-poor system, we hypothesise that even if the horses rest more at night, the proportion of the time spent resting in a 24-hour period would remain low, in comparison with other studies (DUNCAN, 1985; BOYD, 1998). Furthermore, diet is one of the factors affecting patterns of sleep. Stabled horses increased their total time lying down when fed on a higher quality diet (DALLAIRE & RUCKEBUSH, 1974). DUNCAN (1985) found a positive correlation between time spent lying and protein concentration in the diet. The Haflinger horses were mainly foraging on grassland dominated by *Carex arenaria*, which has indeed a low protein content, especially in the non-growing season (COSYNS, unpubl.).

Seasonal variation in time-budget

During autumn and winter the horses increased their grazing time, while in summer feeding time dropped to a minimum. This is in line with previous studies in temperate regions (DUNCAN, 1985; VAN DIERENDONCK et al., 1996; BERGER et al., 1999; COSYNS et al., 2001; MENARD et al., 2002), as well as in subarctic conditions (SALTER & HUDSON, 1979). We suggest that especially the relatively higher quality and availability of forage in summer accounted for the drop of grazing time compared to the non-growing seasons. Horses perform most of their foraging behaviour during the daylight period (DUNCAN, 1985; PRATT et al., 1986). Therefore, we might expect that in autumn and winter the grazers had to concentrate their grazing more in a shorter daylight period, than in summer and spring, when they can spread their grazing activities over a longer daylight period. Although this could partly explain the increased daylight grazing time in autumn and winter, we also find this pattern in studies which have calculated time-budgets based on observations spread over twenty-four hour periods (DUNCAN, 1985; BERGER et al., 1999; MENARD et al. 2002). Thermoregulation during hot summer days could result in more grazing during the late evening or night. However, we rarely observed horses seeking shade. Therefore we assume that this factor was of minor importance in explaining the seasonal variation in daylight grazing time. Some authors have suggested that the observed drop in foraging time in summer is mainly caused by a response to attacks by biting flies (DUNCAN, 1985; MAYES & DUNCAN, 1986), which is also seen in reindeer (HAGEMOEN & REIMERS, 2002). Though we did not measure this parameter, we think that biting insects are not present at the study site in such numbers that they would influence the horses' behaviour strongly. The lack of seasonal variation in grazing bout duration and number of grazing bouts could reflect the lack of disturbance by external factors, such as biting flies. Concluding, as mentioned above, we suggest that seasonal differences in forage quality and quantity play a major role in the seasonal variation in grazing time of the Haflinger mares in the present study. Grazing time is generally lowest when forage is abundant and of good quality, and highest when forage is of low quality or availability is limited (VALLENTINE, 1990; STUTH,1991). DUNCAN (1985) suggested that horses increased their feeding time in winter to a maximum possible value in an attempt to maintain a high quality diet. LAMOOT *et al*. (unpubl.) found longer grazing times, but lower bite rates, in autumn and winter compared to summer and spring, for donkeys and ponies. At the level of the grazed patch, a prolonged searching time for plants or plant parts to be consumed to achieve a diet of acceptable quality, might increase the grazing time (and diminish the bite rate).

The Haflinger horses in the present study spent more time resting per day in summer, in comparison with the other seasons, mainly as a result of the (non-significantly) higher number of resting periods in summer. There was no seasonal variation in walking time per day. As discussed above, we assume that the increased resting time in summer was related to the decreased grazing time in summer. In summer the grazing horse could meet its nutritional requirements more easily and in less time. Consequently, this resulted in "free" time available to spend resting. Seasonal variation in resting time and the lack of seasonal variation in walking time are not in line with the findings of DUNCAN (1985). He found longer walking times in summer, and little seasonal variation in time spent resting. This might be due to the differences between study sites. In our study site palatable patches are available in a more or less continuous pattern. Therefore, seasonal variation in walking time is not expected. In the Camargue insect harassment in summer could result in more moving around. We suggest that insects are not present in our study site in such numbers that they would influence the horses' behaviour strongly.

Seasonal variation in grooming frequency per day was found, with more grooming bouts in spring, which could be related to the moulting season, as was also suggested by TYLER (1972). We did not find differences between seasons for any of the other behaviours considered. Mean frequency of drinking at Ghyvelde was 2.1 time per 6 hours. Feral horses are reported to drink only once or twice in a 24 h period (FRASER, 1992). At pasture, frequency, but not duration of drinking bouts increased as temperature increased (CROWELL-DAVIS *et al*., 1985), a phenomenon not found in the present study. KIMURA (1998) reported seasonal variation in mutual grooming, probably due to changes in distances between individual horses. No seasonal differences in mutual grooming behaviour were found in the present study. Although we did not measure distances between horses, our field observations did not indicate remarkable seasonal changes in individual spacing.

Habitat use

Taking in account the availability of the distinguished habitat types, we found that the horses grazed, over the entire year, mostly in grassy habitat, i.e. grasslands dominated by *Carex arenaria.* However, the habitat use of the Haflinger horses showed seasonal variation. In winter and spring grey dunes were grazed more intensively than in summer and autumn. The grassy habitat was grazed less intensively in winter and spring. The contribution of roughage, scrub and woodland to the habitat use was poor over the entire year, although there was a limited use of scrub that remained constant over the entire year. A slightly increased use of roughage was observed in autumn, and woodland was used a little more in spring.

When grazing grassy habitat and grey dune, the mares grazed significantly more in patches with 'hoof' height, compared to shortly grazed patches. This figure did not provide any indications on preferences, however, as there are no data about the relative availability of the different vegetation heights. We hypothesised that the Haflinger horses would show seasonal variation in habitat use, which is confirmed by our results. However, we expected that the horses would graze more in scrub and woodland during the non-growing season, due to the depletion of the preferred grassy habitat. It remains unclear why the Haflinger horses did graze more in grey dunes, and not in woodland or in scrub. A possible reason could be the presence of a relatively large number of winter annuals in these grey dunes, which might serve as relatively good quality winter forage. Nonetheless, the total primary production of these winter annuals remains very low. Our results are in line to some extent with the findings of GORDON (1989), who investigated vegetation community selection on the Isle of Rhum (Scotland). Out of four different ungulates (cattle, red deer, goat and pony) ponies performed the smallest seasonal changes in vegetation use. Only in autumn ponies broadened their vegetation community use. PRATT et al. (1986) reported that grasslands remained of major importance throughout the year for New Forest ponies, which is consistent with our results, but the ponies showed a greater flexibility in foraging behaviour over the winter months. Especially woodland was grazed more in winter. Also DUNCAN (1985) concluded that the Camargue horses were more dispersed over the various vegetation complexes in the cooler season.

Variation among individual horses

In the Camargue the time-budgets of free-ranging horses were investigated over several years (DUNCAN, 1980). On the basis of the differences in time-budget, he could divide the animals into three groups, e.g. adult females, yearlings and adult males. However, the overall picture was one of remarkably similar investments of time in all activities, especially with regard to foraging time.

Prior to the present study period we selected three adult mares for observation. Consistent with the findings of DUNCAN (1980) and because the horses were foraging as a herd, we did not expect far-reaching differences in time-budget between the mares. However, for the analysis we wanted to take into account possible variation among individuals, especially because we noticed during observations that one mare, older and presumably high on the dominance rank, was grazing less than the other two. Our results demonstrate that the time-budgets indeed differed between the observed mares. We suggest that bias through individual variation could be avoided to some extent by increasing the number of focal animals for the data collecting through the focal animal observation technique. The individual variation in time-budgets has far-reaching consequences for data analysis. When investigating environmental differences in behavioural aspects, one has to keep in mind that variation between observed individuals can bias the results, if not incorporated in the statistical analyses. In the present study we aimed to investigate seasonal variation in time budgets. Using ANOVA-models we could take into account the role of the random factor 'individual' on the observed variation. In some cases the outcome of the test changed, if we tried the analysis without this random factor, which illustrated its importance. This opportunity is not available in non-parametric tests. Generally, in cases where assumptions for parametric test are not met, a non-parametric alternative is used. It is now questionable which choice is the best : violating assumptions or not taking into account variation due to a random factor? Again, we suggest the need for a large sample size when investigating the behaviour of a herd of horses.

CONCLUSIONS

The Haflinger mares performed time-budgets similar to the ones presented in literature, with grazing as the main time-investment. They showed rather long grazing times, which could be a response to their low-productivity habitat. Seasonal features influenced horses' behaviour, mainly through a change in time spent grazing. The drop in grazing time in summer made time available for resting. Most of their grazing, as well as their non-grazing behaviour, took place in *Carex arenaria*-dominated grassland, with short sward height, and this during the entire year. In winter and spring grey dunes were grazed to a greater extent, compared to summer and autumn. Although not expected, individual variation explained at least partly the observed variability of many variables.

ACKNOWLEDGEMENTS

We would like to thank Le Conservatoire du Littoral, Le Direction du Service des Espaces Naturels and Conseil Général du Nord for permission to conduct research in the nature reserve Ghyvelde. We thank S. Vanacker and G. Van Spaendonk for the support of the Access database, and Prof. L. Lens for his remarks on the used statistics. I. Lamoot has a grant supplied by FWO Flanders (Foundation of scientific research- Flanders).

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