GRAZING PATTERNS OF PANTANEIRO HORSES. AN ELEMENT OF ADAPTABILITY TO THE PANTANAL REGION, BRAZIL

HÁBITOS DE PASTOREO DE CABALLOS PANTANEIROS. UN ELEMENTO DE ADAPTABILIDAD AL PANTANAL BRASILEÑO

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SUMMARY

Seasonal foods and habitat use of Pantaneiro horses were determined in two Pantanal sub-regions: Nhecolândia (March 1990 to February 1991) and Abobral (December 1993 to October 1995).

In both sub-regions, a direct pasture observation method was used in two daily sessions (morning and afternoon). The forage plants eaten and habitat occupied by animals were recorded every five minutes.

Habitat use for feeding was determined using the percentage of all observations which were recorded in the landscape unit 'i' (Ui). Pantaneiro horses exhibited a selective grazing habit which varied seasonally and spatially. This must be taken into consideration for range and breed management and conservation strategies. The herd was apparently healthy during all study period, indicating adaptability to the Pantanal rangeland.

RESUMEN

El hábito alimenticio fue estudiado en el caballo Pantaneiro en dos sub-regiones distintas en el Pantanal brasileño: Nhecolandia (marzo/1990 a febrero/1991) y Abobral (diciembre/1993 a octubre/1995).

Los registros del pastoreo fueron obtenidos a través del método de observación directa, dos horas por la mañana y dos horas por la tarde, durante las que se registró cada cinco minutos el hábitat usado por los animales y los forrajes consumidos. El uso del hábitat para la alimentación fue determinado en función del porcentaje de las observaciones realizadas en el período para el área de pasto. Los caballos Pantaneiros presentaron selectividad alimenticia estacional y espacial. Estas informaciones son muy importantes para el establecimiento del manejo alimenticio y conservación de áreas naturales. Los caballos aparentemente se encontraban sanos indicando una buena adaptación a los pastizales.

INTRODUCTION

The Pantanal is a vast floodplain of 140,000 km^2, located in Central-Western, Brazil (16 22° S, 55 58° W). The Pantanal supports many wild herbivores, such as marh deer (*Blastocerus dichotomus*), pampas deer (*Ozotoceros bezoarticus*), capibara (*Hydrochaeris hydrochaeris*), which share areas of natural rangeland with livestock species, such as cattle and horses. In this region, beef cattle ranching is the main economic activity. Farming systems are extensive and native forage is the cattle's main feeding source. Given the differing biomasses of native and exotic ungulates that inhabit the Pantanal, it is necessary to know the grazing behavior of the different herbivores that make up these ecosystems. The Pantanal presents different landscape units, variable within and among sub-regions. The quality and availability of native pasture changes seasonally due to flood and dry periods.

Cattle and horses were introduced in the region in the 16th century during the colonization period. Pantaneiro horses probably originated from Iberian horses introduced by Spanish settlers, and are a product of natural selection – over the last three centuries with little or no human action. Pantaneiro horses are adapted to the bioclimatic conditions of this region. They constitute an economically and socially important factor, being a must for the cattle industry and for regional transportation (Santos *et al.*, 1992). The impact of domesticated animals introduced in the region, such as horses and cattle, happened so long ago that there are no records of changes that occurred or organisms that were lost.

Adaptability to the local environment is the most important trait in native breeds, thus it is necessary to know the grazing patterns of these breeds and then provide a basis for range and breed management and conservation strategies. The purpose of this study is to evaluate the diet and habitat use of grazing Pantaneiro horses (**figure 1**) in two sub-regions of the Pantanal.

MATERIALS AND METHODS

The experiment was conducted in two sub-regions of the Pantanal: Nhecolândia and Abobral (**figure 2**). Nhecolândia sub-region is one of the most important area of extensive cattle ranching. The vegetation forms a complex mosaic and is generally related to topographic features. It is characterized by the presence of *permanent or temporary ponds*, *open grasslands* ordinarily subject to seasonal inundation and *semideciduous forest* on ridges of sandy soils. All observations were made in an area of about 75 ha, with the presence of twenty-five brood-mares, including two with a foal at foot, under continuous grazing, from March 1990 to February 1991. Only horses were kept in the area. The study area is normally flooded with local rainfall. For the purpose of this study, the area was stratified into five landscape units: *open grasslands* (OG), *permanent ponds* (PP), *ponds edge* (PE), *temporary ponds* (TP) and *semideciduous forest* (SF). Abobral sub-region is a

Figure 1. *Pantaneiro horse.* (Caballo Pantaneiro).

true floodplain because the area is flooded by riverine overflows. Savanna and grassland are the most common vegetation types. The study was carried out in a transition area, which had some ponds. The study area has vast grassland areas and only a small amount of small woodlands (forest islands). The soils are sandy. All observations were made in an area of about 300 ha. Ten horses and about 90 heads of cattle were allowed to graze, under continuous grazing, from December 1993 to October 1995. For the purpose of this study, the area was stratified into OG, PP, PE, TP and *forest islands* (FI).

In both sub-regions, a direct observation method was used in two daily sessions (morning and afternoon). The morning grazing observation was from 8:00 to 10:00 am, the second one was from 15:00 to 17:00. The forage plant parts eaten and habitat occupied by animals were recorded every five minutes (scan sampling). The main species selected were expressed as a percentage of the total ingested plants observed.

Habitat use for feeding was determined using the percentage of all observations which were recorded in the landscape unit 'i' (U_i). The observed use by season was compared with an expected value calculated from the percentage of the area covered by each habitat using a chi-square test. The normalized index of preference (P_n) described by Duncan (1983) was employed in this study:

$P_n = \log (P_c + 1)$,

P_c is the conventional index of

preference Pc=Ui/Ai, where Ai is the percentage of the area covered by landscape unit 'i'. Higher values indicate increasing degrees of preference.

Samples of important forage species were collected in each season and analyzed for crude protein (CP), calcium (Ca) and phosphorus (P). CP
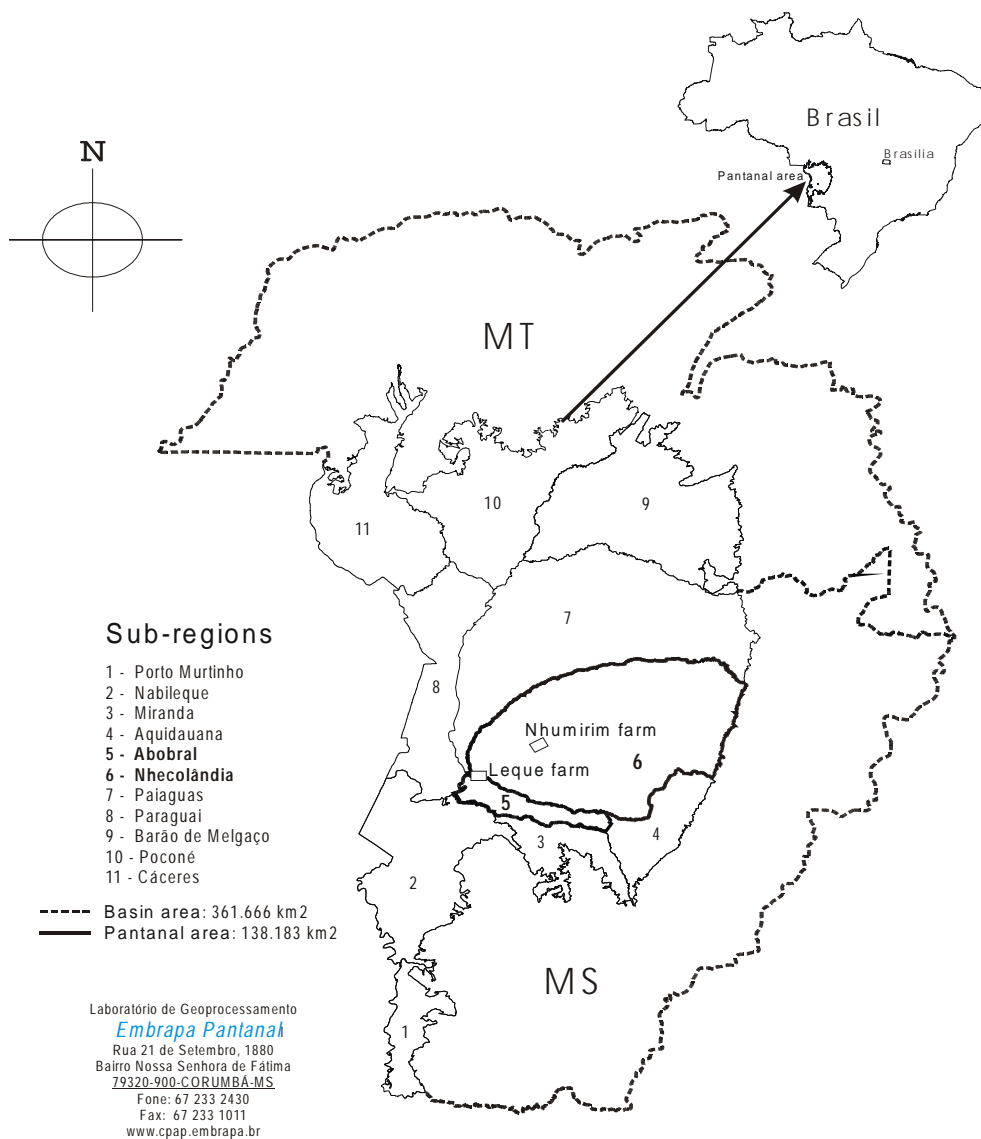

Figure 2. *Pantanal Map.* (Mapa del Pantanal).

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was determined by the Kjeldahl method (AOAC, 1975), Ca by atomic absorption (Harris and Popat, 1954) and P by colorimetry (Fick *et al*., 1976). Data were expressed on a percent dry matter basis. Mean dietary quality was calculated for each season as per McInnis and Vavras (1987).

In Nhecolândia sub-region available herbage was sampled in each landscape unit from random quadrats of 1m². The plants in each plot were cut at ground level, sored by species and weighed fresh. In Abobral sub-region, the Botanal method (Tothill *et al.*, 1978) was used.

Table I. *Mean forage species and dietary composition of selected seasonal diets by Pantaneiro horses, Nhecolândia sub-region, Pantanal, from March 1990 to February 1991.* (Promedio de las especies en el pastizal y la composición estacional de la dieta seleccionada de caballos Pantaneiros, sub-región de Nhecolândia, Pantanal, marzo de 1990 a febrero de 1991).

Species	Family	Dry Period	Rainy Period	Habitat[1]	Habitus
Andropogon selloanus	Gramineae	1.5	11.5	OG	bunch grass
Andropogon spp.	Gramineae	0.8	5.4	OG	bunch grass
Axonopus purpusii	Gramineae	18.7	40.0	OG	short grass
Eleocharis acutangula	Cyperaceae	6.6	1.3	PE, TP	emergent rush
Hymenachne amplexicaulis	Gramineae	5.0	0.0	PE, TP	emergent grass
Mesosetum chaseae	Gramineae	1.9	5.0	OG	procumbent grass
Panicum repens	Gramineae	3.4	13.0	OG	Short grass
Pontederia cordata	Pontederiaceae	5.0	0.0	PE, TP	Fix macrophyta
Reimarochloa brasiliensis	Gramineae	28.3	4.0	PE, TP	short grass
Richardia grandiflora	Rubiaceae	2.6	5.6	OG	surface laying herb
Setaria geniculata	Gramineae	6.2	0.6	PE, TP	short grasss
Percentage which all of the above species contributed to total diets		80.0	86.4		
Mean dietary quality[2]					
Crude protein (percent)		9.3	7.5		
Calcium (percent)		0.29	0.21		
Phosphorus (percent)		0.11	0.11		
Herbage availability, kg/ha[1]		737.4	1034.7		
Total rainfall (mm)		870.5	280.4		
Mean temperature °C		27.6	21.9		

[1]OG = open grasslands; PE= ponds edge; TP= temporary ponds.
[2]Dry matter (percent).

RESULTS AND DISCUSSION

Pantaneiro horses exhibited a preference for certain species and plant parts, which varied between sub-regions and seasonally. The animals primarily consumed grasses throughout the year. *Axonopus purpusii* and *Reimarochloa brasiliensis* were grazed throughout the year in both sub-regions (**table I** and **II**, respectively). Several other species were taken only in certain

Table II. *Mean forage species and dietary composition of selected diets by Pantaneiro horses, Abobral sub-region, Pantanal, during rainy period (RP) and dry period (DP), in two years.* (Promedio de las especies en el pastizal y la composición de la dieta de caballos pantaneros, sub-región de Abobral, Pantanal, durante el periodo seco (PS) y lluvioso (PL), respectivamente).

Species	Family	Dry RP	Year DP	Rainy RP*	Year DP	Habitat[1]	Habitus
Axonopus purpusii	Gramineae	18.0	5.5	4.7	0.8	OG	Short grass
Eragrostis hypnoides	Gramineae	0.0	3.7	0.0	0.0	OG, EP	Short grass
Eleocharis minima	Cyperaceae	0.0	0.0	0.0	11.6	PE, TP	Short sedge
H. amplexicaulis	Gramineae	0.9	6.6	1.1	0.0	PE, TP	Emergent grass
Leersia hexandra	Gramineae	0.0	2.1	8.8	5.2	PE, TP	Emergent grass
Pontederia cordata	Pontederiaceae	0.0	0.0	7.9	0.0	PP,PE, TP	Fix macrophyte
Panicum laxum	Gramineae	8.0	3.5	3.4	11.9	OG,PE, TP	Short grass
Paspalum oteroi	Gramineae	14.5	3.8	13.5	23.3	OG	Short grass
Paspalum plicatulum	Gramineae	0.0	0.7	0.0	11.9	OG, TP	Short grass
R. brasiliensis	Gramineae	19.2	36.6	21.8	10.7	OG, PE, TP	Short grass
Richardia grandiflora	Rubiaceae	31.3	16.3	7.2	9.7	OG	Low herb
Percentage which all of the above species contributed to total diets		92.8	78.8	68.4	85.1		
Mean dietary quality[2]							
Crude protein (percent)		11.4	10.4	10.9	9.2		
Calcium (percent)*		0.49	0.43	0.30	0.41		
Phosphorus (percent)		0.10	0.11	0.11	0.10		
Herbage availability, kg/ha[1]		1937.0	2776.3	238.1	30.0		
Total rainfall (mm)		486	145.2	476.1	60.1		
Mean temperature °C		24.0	23.8	27.5	24.1		

[1]OG= open grasslands; PE= ponds edge; TP= temporary ponds; PP= permanent ponds.
[2]Dry matter (p.100).

·The horses were taken off the area (April to June) due to flood.

sub-regions like *Paspalum oteroi* Swallen and *Panicum repens* L. Three aquatic species were very frequent beside *permanent ponds* and *temporary ponds*, *Pontederia cordata* L., emergent, *Hymenachne amplexicaulis* and *Leersia hexandra* Swarts, with floating stems. They were particularly used during the rainy periods. Seasonal differences in the diets of horses have been found in other studies (Archer, 1973; Hansen, 1976). The preferred species had more green growth, indicating that stage of plant development is a factor determining the preference exhibited by grazing animals. Other plants like *Diodia Kuntzei* K. Schum., *L. hexandra*, *Richardia grandiflora* (Cham. & Schltdl.), *R. brasiliensis* were pulled out of the soil and completely consumed.

The dietary quality and availability of forage varied with sub-regions and seasonally (**table I** and **II**). Differences between sub-regions were probably due to factors such as innundation level and stocking rate. Abobral sub-region produced more forage during the dry period because during the rainy year, the area remained completly flooded for four months. In Nhecolândia sub-region, dietary crude protein was 7.5 and 9.3 in rainy and dry period, respectively, while in Abobral sub-region it was similar among all periods (about 9.0 percent). Taking into consideration that horses require 8.5 percent CP, 0.32 percent Ca and 0.24 percent P for maintenance (NRC, 1978), the diets in these studies were probably adequate for CP except for the rainy period in Nhecolândia sub-region. However, diets were deficient in Ca and P. Estimates of Ca of the

diets of horses in Abobral sub-region may have been overestimated because estimates of dietary quality were based on forage species consumed. The analyses showed high levels of calcium, due to two factors: first, when horses collect two of the consumed species, *R. grandiflora* and *P. cordata*, they also collect some amount of soil; second, *R. grandiflora* presents a high value of oxalate. However, this deficit can be avoided in native pastures where horses eat a mixture of species.

Habitat use (Ui) that represents the percentage of all recorded in observations in the landscape unit 'i' was variable between sub-regions, years and seasons (**figures 3**, **4** and **5**). The hypothesis that horses used the habitats for feeding randomly was rejected for each period studied ($p < 0.001$, χ^2 test), showing that they were selective in both sub-regions. Duncan (1983) evidenced that the primary function of selection of feeding habitat by horses is to maximize their intake of high quality food.

In Nhecolândia sub-region, the horses used more *open grassland* in the dry period (April/September) and *permanent ponds* edges in the rainy period (October/March), with values of 64 and 38.0 percent, respectively (**figure 3**). The preference index (Pn) varied between 0.08 (low preference) and 1.06 (high preference), indicating greatest preference for feeding in *temporary ponds* during all year **(table III)**.

In Abobral sub-region, the habitat use was variable between years. In the dry year, the horses used more *open grassland* (77 percent) during the rainy period **(figure 4)** while in the rainy

Rainy period   Dry period

☐ Open grassland

■ Temporary ponds
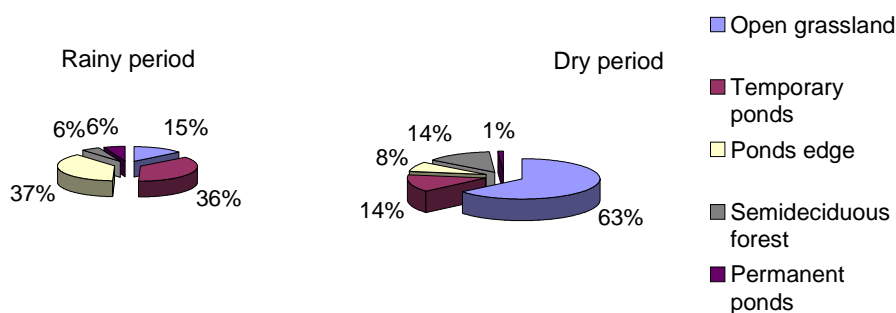
☐ Ponds edge

■ Semideciduous forest

■ Permanent ponds

Figure 3. Habitat use (Ui, percent) of the Nhecolândia sub-region landscape units by Pantaneiro horses for feeding in the rainy period (October/March) and dry period (April/ September) from March 1990 to February 1991. (Uso del hábitat (Uh p.100) de las unidades de paisaje en la sub-región de Nhecolândia por caballos Pantaneiros en el periodo de lluvia (octubre/marzo) y de sequía (abril/septiembre) de marzo/1990 hasta febrero/1991).

year, the animals used more *open grassland* (68 percent) during the dry period **(figure 5)**. *Permanent ponds* edge (U= 30 percent) and *forest islands* (U= 4 percent) were used only during the rainy year. In the rainy year the horses were taken off the area (April to June) due to the flood. The preference index (Pn) varied beteen 0.0 (no

preference) and 0.83 (high preference), indicating greatest preference for feeding in *temporary ponds* in both years **(table III)**.

Since water and shade should not be limiting, changes in selection of habitats can be related to pasture seasonal differences such as biomass availability, crude protein levels and
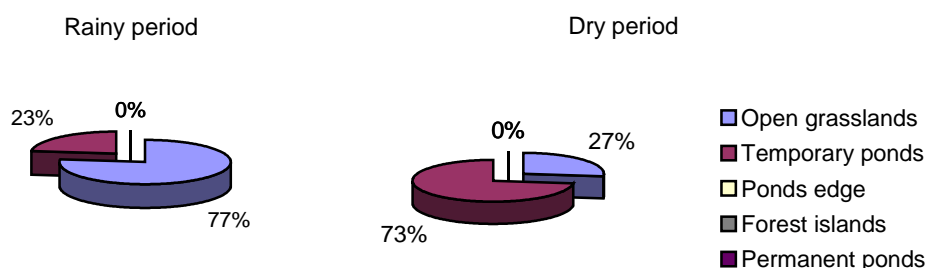
Rainy period   Dry period

☐ Open grasslands

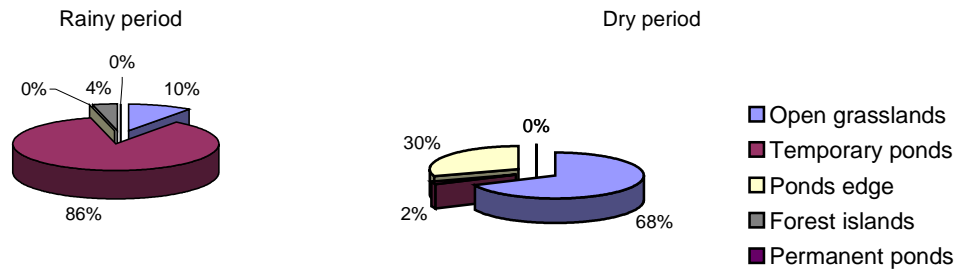■ Temporary ponds

☐ Ponds edge

■ Forest islands

■ Permanent ponds

Figure 4. Habitat use (Ui, percent) of the Abobral sub-region landscape units by Pantaneiro horses for feeding in the rainy period (December/April) and dry period (June/October), during dry year. (Uso del hábitat (Uh p.100) de las unidades de paisaje en la sub-región de Abobral por caballos Pantaneiros en el periodo de lluvia (diciembre/abril) y de sequía (junio/octubre), durante un año seco).

Figure 5. *Habitat use (Ui, percent) of the Abobral sub-region landscapes units by Pantaneiro horses for feeding in the rainy period (December/February) and dry period (August/ October), during rainy year.* (Uso del hábitat (Uh p.100) de las unidades de paisaje en la sub-región de Abobral por caballos Pantaneiros en el periodo de lluvia (diciembre/abril) y de sequía (agosto/octubre).

preference. *Open grasslands*, the forage class with the highest use during all year, had high forage quantity

Table III. *Index of preference (Pn) of the landscape units selected by Pantaneiro horses in the Nhecolândia sub-region and Abobral sub-region.* (Índices de preferencia de unidad de paisaje seleccionada por caballos pantaneros en las sub-región de Nhecolândia y Abobral).

| Habitat[1] | Nhecolândia | | Abobral | | | |
	DP	RP	DP	RP	DP	RP
OG	0.28	0.08	0.34	0.15	0.32	0.06
PP	0.08	0.34	0.0	0.0	0.0	0.0
PE	0.32	0.81	0.0	0.0	0.40	0.0
TP	0.70	1.06	0.40	0.78	0.05	0.83
SF	0.28	0.14	-	-	-	-
FI	-	-	0.0	0.0	-	0.26

1–OG= open grassland; PP= permanent ponds interior; PE= permanent ponds edge; TP= temporary ponds; SF= semideciduous forest; FI= forest islands.
2–DP= dry period; RP= rainy period.

(mainly *A. purpusii*). *Temporary ponds*, the forage class with the highest use in this study, had high quantity in the rainy period, mainly *R. brasiliensis*.

During the study, grazed and ungrazed areas were also observed. According to Duncan (1983), ungulates rarely range randomly; more often they have areas which they prefer and others which they avoid. In Nhecolândia subregion, ungrazed patches occurred mainly in *open grasslands* with predominance of *Andropogon bicornis*.

Today, the major challenge in rangeland management centers on how to manipulate grazing and browsing animals in regions with spatial and temporal variation so as to maintain the ecological sustainability. So, horses populations must be kept at appropriate levels to assuage detrimental impacts to habitats (Crane *et al.*, 1997). Datas observed in this study indicated that any detrimental impacts from excessive number of horses would first be apparent in the *permanent and temporary ponds* in both Pantanal sub-regions.

In summary, Pantaneiro horses

exhibited a selective grazing habit which varied spatially and seasonally. Thus, it is necessary to consider the grazing patterns of these breeds for range and breed management and conservation strategies. They showed some degree of mixture in their grazing, which appears very important for optimal nutrition because the herd was apparently healthy during all study period, indicating adaptability to the Pantanal rangeland.

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