The Welfare of Horses

Animal Welfare

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Series Editor

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The Welfare of Horses

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ANIMAL WELFARE BY SPECIES: SERIES PREFACE

Animal welfare is attracting increasing interest worldwide, but particularly from those in developed countries, who now have the knowledge and resources to be able to offer the best management systems for their farm animals, as well as potentially being able to offer plentiful resources for companion, zoo and laboratory animals. The increased attention given to farm animal welfare in the West derives largely from the fact that the relentless pursuit of financial reward and efficiency has led to the development of intensive animal production systems, that challenge the conscience of many consumers in those countries. In developing countries human survival is still a daily uncertainty, so that provision for animal welfare has to be balanced against human welfare. Welfare is usually provided for only if it supports the output of the animal, be it food, work, clothing, sport or companionship. In reality, there are resources for all if they are properly husbanded in both developing and developed countries. The inequitable division of the world's riches creates physical and psychological poverty for humans and animals alike in all sectors of the world. Livestock are the world's biggest land user (FAO, 2002) and the population is increasing rapidly to meet the need of an expanding human population. Populations of farm animals managed by humans are therefore increasing worldwide, and there is the tendency to allocate fewer resources to each animal.

Increased attention to welfare issues is just as evident for companion, laboratory, wild and zoo animals. Although the economics of welfare provision may be less critical than for farm animals, the key issues of provision of adequate food, water, a suitable environment, companionship and health remain as important as they are for farm animals. Of increasing importance is the ethical management of breeding programmes, now that genetic manipulation is more feasible, but there is less tolerance of deliberate breeding of animals with genetic abnormalities. However, the quest for producing novel genotypes has fascinated breeders for centuries, and where dog and cat breeders produced a variety of extreme forms with adverse effects on their welfare in earlier times, nowadays the quest is pursued in the laboratory, where the mouse is genetically manipulated with even more dramatic effects.

The intimate connection between animal and owner or manager that was so essential in the past is rare nowadays, having been superseded by technologically efficient production systems, where animals on farms and in laboratories are tended by fewer and fewer humans in the drive to enhance labour efficiency. In today's busy lifestyle pets too may suffer from reduced contact with humans, although their value in providing companionship, particularly for certain groups such as the elderly, is increasingly recognised. Consumers also rarely have any contact with the animals that produce their food. In this estranged, efficient world man struggles to find the moral imperatives to determine the level of welfare that he should afford to animals within his charge. Some, such as many pet owners, aim for what they believe to be the highest levels of welfare provision, while others, deliberately or through ignorance, keep animals in impoverished conditions or even dangerously close to death. Religious beliefs and directives encouraging us to care for animals have been cast aside in an act of supreme human self-confidence, stemming largely from the accelerating pace of scientific development. Instead, today's moral codes are derived as much from media reports of animal abuse and the assurances that we receive from supermarkets, that animals used for their products have not suffered in any way. The young were always exhorted to be kind to animals through exposure to fables, whose moral message was the benevolent treatment of animals. Such messages are today enlivened by the powerful images of modern technology, but essentially still alert children to the wrongs associated with animal abuse.

This series has been designed to provide academic texts discussing the provision for the welfare of the major animal species that are managed and cared for by humans. They are not detailed blueprints for the management of each species, rather they describe and consider the major welfare concerns of the species, often in relation to the wild progenitors of the managed animals. Welfare is considered in relation to the animal's needs, concentrating on nutrition, behaviour, reproduction and the physical and social environment. Economic effects of animal welfare provision are also considered where relevant, and key areas requiring further research.

With the growing pace of knowledge in this new area of research, it is hoped that this series will provide a timely and much-needed set of texts for researchers, lecturers, practitioners, and students. My thanks are particularly due to the publishers for their support, and to the authors and editors for their hard work in producing the texts on time and in good order.

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PREFACE

In 2000 there were an estimated 58.8 million horses in the world (FAO 2000). This figure represents a decline in numbers from 96.4 million in 1938 (immediately before the Second World War), when agricultural practises were far less mechanised than they are now. Although the largest proportion of the world's horses are still used for traction and draught purposes this is likely to continue to decline as agricultural practises in the developing world change. The highest proportion of the world's population of horses within the western or developed world, is found in the United States (5.3 million). In Europe, Germany has the greatest numbers (476,000).

The main role of the horse within the developed world is as a recreational or sports animal. In the United States, the horse industry was estimated to be worth 15 billion US dollars in 1990 (see Ensminger 1990), and horse racing ranked third behind baseball and car racing as a spectator sport. Horses are increasingly being kept as pets or companion animals, often by those with no previous knowledge about their physical or behavioural requirements. Yet despite this, until relatively recently, very little research was directed towards investigating the welfare of the domestic horse.

Welfare is about 'quality of life'. Scientists have attempted to define this concept so that it may be objectively assessed, but ultimately scientific evidence must be interpreted subjectively. There are no simple, universally accepted scientific indicators of welfare. Welfare cannot be measured, and assessments based upon measurements of behavioural, physiological and immunological responses to environmental challenges, are accepted as the best indirect evidence we have of an animal's subjective state. Recently more direct measurements of an animal's needs have been developed. Here the animal is offered choices between environments and conditions, and the strength of the preference can be measured. This provides scientists with a method that takes a more animal centred approach (anthropocentric) in determining the resources that are of importance in ensuring a good quality of life.

The problem is that 'quality of life' is often difficult to judge, even when the behavioural and physical requirements of animals have been determined. In addition, a particular individual's perception of a situation may differ from another's, due for example, to its previous life experiences. This is particularly pertinent when discussing the welfare of those horses used as work animals in under-developed countries. It is often perceived that they experience working conditions and management that fall well below the standards we, in the developed world, might expect for the sports or pet horse. By contrast, it is often assumed that the sports horse enjoys better housing and working conditions, yet the intensive management of the performance horse may predispose it to a different range of problems. In other

words, the perceived welfare of horses kept for different purposes may differ from their actual welfare.

The aim of this edited book, is to provide the knowledgeable reader with a review of the current state of scientific research on the welfare of the horse. We hope that this will be used as an academic text, a reference book and as interesting reading for those who work with horses. To achieve this, the book begins with a discussion of the natural behaviour of the horse, and the effects of domestication. It then covers general issues that impact upon welfare, such as; nutrition, performance related clinical problems, housing and specific problems associated with intensive management, transportation and training methods. The book closes with two chapters in which the specific problems associated with the use of the horse either for sport or for work purposes are discussed.

In editing this book, I have learned a great deal and I have been surprised and encouraged by the extent of the recent work on horse welfare. I am extremely grateful to all of the authors of the chapters in this book. Their hard work and concern for horse welfare will be obvious to all those who read it. In addition I am grateful to all of my students. Their patience and their help with other aspects of my workload, reading chapters or providing a 'sounding board', has been invaluable. I am especially grateful to; Avanti Mallapur, Arnja Rose Dale, Shirley Seaman, and Anna Price. Sally West and Dot Marshall, are both thanked for their unfailing support at work and home respectively, especially during the editing process. I am also grateful to the series editor, Dr. Clive Phillips who was kind enough to encourage me to start this and also to carry out the final edit on all of the chapters.

Finally I want to thank my family, Chris, Kal and Conor, since without their tolerance, understanding and good humour, nothing would be possible.

Dr. Natalie Waran (2002)

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Chapter 1

HORSE BEHAVIOUR: EVOLUTION, DOMESTICATION AND FERALISATION

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Abstract. The evolution of the horse began some 65 million years ago. The horse's survival has depended on adapative behaviour patterns that enabled it to exploit a diverse range of habitats, to successfully rear its young and to avoid predation. Domestication took place relatively recently in evolutionary time and the adaptability of equine behaviour has allowed it to exploit a variety of domestic environments. Though there are benefits associated with the domestic environment, including provision of food, shelter and protection from predators, there are also costs. These include restriction of movement, social interaction, reproductive success and maternal behaviour. Many aspects of domestication conflict with the adaptive behaviour of the horse and may affect its welfare through the frustration of highly motivated behaviour patterns. Horse behaviour appears little changed by domestication, as evidenced by the reproductive success of feral horse populations around the world.

1. Introduction

Most standard texts on horse behaviour present the horse as a social prey species, which survives by fleeing from predators. Although this is undoubtedly true for some horses, at some times, in some locations, this tends to disregard many important features of horse behaviour. Over simplification of the definition of 'normal' behaviour risks some aspects of equine behaviour being labelled as abnormal when in fact they are normal, adaptive and have ensured the survival of the species for 65 million years.

When the horse was domesticated some 6000 years ago, humans began taking horses from environments in which they had evolved, and managing them under conditions which were convenient to humans. Six thousand years ago at Dereivka in the Ukraine (Levine 1999) domestic horses were initially maintained as a food source in herded groups within their natural environment. However, as the role of the horse in human culture changed and diversified, the constraints of domestication began to restrict many aspects of horse behaviour. Today we may restrict horses' freedom to roam and their freedom to choose food, shelter, mates and social companions, depending on the purpose that horses are kept for. We also expect horses to accept and interact with us, and to understand our instruction, even though we evolved as predators and our own behaviour has been shaped by a very different evolutionary history.

N. Waran (ed.), The Welfare of Horses, 1–18.

Therefore, if we are to begin to understand why the domestic horse behaves in the way it does, we must first understand something of its evolutionary history and how horse behaviour is adaptive in diverse and changing environments. The direct ancestor of the domestic horse is generally believed to be extinct, probably due in part to human predation. Dwindling prey numbers may also have prompted the initial domestication process. However, evidence that the behaviour of the horse has changed very little during 6000 years of domestication is provided by the success of many feral populations of horses around the world. Feral horse populations can provide information about many aspects of adaptive equine behaviour, *e.g.* social behaviour, mate choice and reproductive behaviour, habitat selection and foraging behaviour.

The way that some of the constraints imposed on contemporary domestic horses conflict with this behaviour will be dealt with by authors of later chapters.

2. Evolution

The generally recognised ancestor of the earliest equids existed in the Eocene 65 million years ago. *Hyracotherium*, often known as *Eohippus* the Dawn Horse, was a primitive perrisodactile ungulate about the size of a fox, which ran on four toes on the front feet and three on the hind feet. It was a browser, with small low crowned teeth and inhabited swampy regions in what is now Wyoming in North America. Its multi-toed feet were well adapted for locomotion in this marshy environment.

Most diagrams of equine evolution are so simplified that they fail to represent just how successful the predecessors of our modern horses were. At their maximum diversity in the fossil record there were some 13 Equid genera, of which *Equus* is the only surviving genera today, which included some 30 separate species (MacFadden 1994). Today there are just seven extant *Equus* species remaining.

There is considerable diversification in the fossil record during the Eocene as early equids began to exploit a range of new habitats. By the Oligocene, *Mesohippus* and *Miohippus*, had achieved the size of large dogs, and ran on three toes. It is not until *Parahippus* appeared in the Miocene period that adaptations for life as a grazer on the plains begin to appear in the feet and teeth. The lateral digits still carried digital pads, but were unlikely to touch the ground unless travelling on very soft earth, or cornering at speed. *Pliohippus* was the first equid to lose the lateral digits completely, just leaving the metacarpals as long thin vestiges, which are further reduced in *Equus* to short splint bones, though three toed horses are occasionally born today (MacFadden 1994).

Behaviour, being a transient expression of activity, doesn't generally fossilise very well. However, due to the abundance of equids in the fossil record and especially at some sites *e.g.* the Owyhee Desert in Navada, where many individuals are preserved together, paleoethologists have begun to piece together information about the social structure and behaviour of these early equids. Fossils from such sites have provided evidence that early equid species showed adaptations in their

population dynamics and behavioural ecology, which allowed them to exploit new and changing environmental resources. This trait may be viewed as a pre-adaption to domestication.

3. Social Organisation

Two general types of social organisation are recognised in extinct and extant equid species (Waring 1983; MacFadden 1994). Type I behaviour is seen today in the domestic horse, Przewalski horse, Burchell's zebra and the Mountain zebra and is characterised by a non-territorial family band of one stallion and up to six mares. Type I behaviour seems to be an adaptation to unpredictable environmental conditions and a regularly changing but constant food supply which may prompt migration. Type II behaviour is found in the domestic donkey, Grevy's zebra, African and Asian wild asses. Males are territorial and adults do not form lasting bonds. Females may range over several males' territories and will accept matings from any of these territory holders. This appears to be an adaptation to predictable but marginal semi-desert conditions.

An example of the adaptability of equine social organisation is provided by a population of feral horses on Shakleford Banks, off the coast of North Carolina in the USA where there is a population of territorial domestic horses (Rubenstein & Hohmann 1989). The island is sandy, about 11 miles long, less than 1 mile wide, and provides a very marginal habitat with high mortality rates within the population. On half of the island the horses adopt the usual non-territorial strategy, but in the eastern half of the island, where 2/3 of the island's 90 horses live, stallions actively defend territories. Access to very limited resources *e.g.* fresh water is so important that this population has adopted territoriality as a survival strategy. This is an exception to the norm, but it does demonstrate the flexibility of equine behaviour. This capacity for flexibility has played an important role in adaptation of the horse to the confines of the domestic environment.

4. Domestication

The earliest evidence for horses being associated with human culture comes from cave paintings made in France and Spain around 15,000 years ago when they were hunted for meat and hides. Around 9000 years ago the remains of wild horses become increasingly rare in archaeological sites in Europe. Around 6000 years ago the earliest evidence for the domestication of the horse begins to appear in the Ukraine, Egypt and western Asia. The first domestic equids may have been used as pack animals, then to pull sledges, and eventually wheeled vehicles (Clutton-Brock 1992). However, archaeological evidence from Dereivka suggests that horses were being ridden there at least 500 years before the wheel was invented (Levine 1999).

Table 1. Social organisation of extant Equid species

	Species	Territorial	Social group	Dispersal
TYPE I	Domestic Horse (*E. caballus*) Przewalski Horse (*E. przewalski*) Burchell's Zebra (*E. burchelli*) Mountain Zebra (*E. zebra*)	NO (Males defend harem)	Stable harem groups (Generally 1 male and multiple females)	Sub-adult males leave to join/form bachelor groups. Sub adult females join/form new harems.
TYPE II	Domestic Donkey (*E. asinus*) African Wild Ass (*E. africanus*) Asian Will Ass (*E. hemionus*)	YES (Males defend territories)	No lasting adult bonds (Females range over several male)	Sub-adult males join-form roaming bachelor groups. Sub-adult females range over several male territories.

Until the end of the eighteenth century there were two subspecies of wild horse in Europe and Asia, the Tarpan (*Equus ferus ferus*) in Central Europe and the Przewalski (*Equus ferus przewalski*) or Mongolian wild horse. Both are now extinct in the wild, but an attempt to reconstruct the Tarpan from domestic hybrids has been made in Poland. The Przewalski is maintained as a captive population now numbering around 1300 individuals, some of which have been released into semi-natural reserves in Mongolia (Clutton-Brock 1992).

Whether the Przewalski or the Tarpan can be claimed to be ancestors of the domestic horse is debatable. It is possible that, like the domestication of the dog from the wolf, domestication of the horse happened in several places throughout the ancient world, and local subspecies of wild horse will have contributed to domestic stock. The contribution of the Tarpan to the Konik in Poland is an example of this, as is the contribution of the Przewalski to the Mongolian ponies.

An alternative hypothesis is that all of the horses in the world today are descendants of those domesticated at Dereivka 6000 years ago. The benefits derived from domestic horses may have been so great to human culture that this single domestication event spread rapidly through the human population, as occurred following the domestication of the cat in Egypt 4000 years ago.

By the first millennium BC the importance of the ridden horse in human culture had been established. Although asses and hybrids were ridden and used as beasts of burden in ancient and classical history, horses became preferred as war mounts in ancient Greece and then Rome, as they could be ridden behind the withers, which was much more comfortable and secure than the donkey seat (on the hind quarters), especially at speed. The role of the horse has mirrored the changes in human society ever since, as warhorse, draft horse and today as a sporting and companion animal. Though human society has changed rapidly, these changes have taken place in a

very short period of evolutionary time. The fact that the behaviour of the horse has been little changed by domestication is evidenced by the ease at which it assumes a feral lifestyle, even in very marginal environments *e.g.* the Namib Desert, where there is a breeding population of horses descended from horses abandoned by soldiers at the end of the Second World War.

5. Breed Differences in Behaviour

It is possible that the diversity of type and behaviour within the domestic horse could pre-date domestication to some extent, if the multiple domestication event hypothesis is accepted. This could in part account for variations in the morphology and behaviour of northern and southern breeds.

Northern breeds (cold bloods/trotters/drafts) are generally heavier built, with deep bodies, short stocky legs, small ears, large heads, thick coats and less reactive temperaments (see Figure 1). These are all adaptations for energy conservation and survival in a cold climate.

The southern breeds, (the hot bloods/gallopers) are gracile with long slender legs, fine coats, small heads, large ears and other physiological adaptions to aid heat dissipation (see Figure 2). They are fast, highly reactive and enduring and are adapted to life in a hot arid environment. They are possibly best represented by the Jaf, or Persian Arab.

Figure 1. Exmoor ponies show behavioural and morphological adaptations to energy conservation in the cold and exposed environment of Exmoor.

Figure 2. This Anglo-Arab endurance mare and her foal show physiological and morphological adaptations to heat dissipation in hot environmental conditions.

This cline in geographically remote members of the same species is described by Bergman's Rule and Allen's Rule (Moen 1973). Similar variation is seen in other mammals with a large geographic range *e.g.* the Timber wolf and the Ethiopian wolf, the Scottish wild cat and the African wildcat.

Unpublished data (Whitmore *pers. comm.*) on blood typing and skeletal remains suggests the existence of a third ancestral type. These are the gaited breeds of which the Moroccan Barb is a good example, though very few purebreds remain. These breeds are adapted to high altitudes, and gaiting is a safe fast way to move on scree, as one or more feet always remain on the ground. Other adaptations include a long back, very sloping croup, slightly sickle hocks, long neck and a large head with a straight or convex profile. All features which are far from aesthetically pleasing to the northern Europeans. The Moroccan Barb's conformation coupled with their belligerent temperament may explain why many attempts to 'improve' them by crossing with Arabian horses have been made. However, it appears that a swathe of indigenous gaited breeds and their descendants stretch across the Eurasian landmass from Spain and North Africa to Tibet. Examples include the Andalucian and Lusitano of the Iberian Peninsular, the Skyros pony of the Greek islands, the Indian Marwari and Kathiawari and the ancestral Akhal Teke.

6. The Human-Horse Relationship

During the period that the horse has been domesticated there have been two basic approaches to the human-horse relationship (Goodwin 1999). One approach is similar to that employed during the domestication of the dog, where humans attempt to establish their dominance over the horse. This approach seems to foster a desire to identify signals of submission in the horse by some trainers, and some equestrian disciplines judge the horse-human relationship by the amount of submission shown by the horse to the rider.

The other approach is co-operative based on an understanding of the behaviour of the horse. Both approaches were apparent during the ancient and Classical period. The Scythians and Greeks were observers of horse behaviour and employed their understanding of the behaviour of the horse in management and training. The Romans did not appear to inherit the skills of horsemanship from the Greeks, and many employed force and coercion in horse training. The Christian concept of Man's dominion over the beasts continued the decline in the treatment and training of the horse. Horses were trained using force and punishment and the idea of the cessation of pain, being a reward, became established and continues in some equestrian traditions today (Barclay 1980).

During the 18th Century the Duke of Newcastle, amongst others, began to revive the principles of Greek horsemanship and a number of famous equestrian schools were established which heralded the beginning of a return to more co-operative horse training. Both approaches persist to varying extents in different traditions of equitation today. However, the numbers of young, healthy horses 'breaking down' during training, or being slaughtered for behaviour problems, suggest that present day horse management and training has much room for improvement (Odberg & Bouissou 1999).

7. Behavioural Ecology of Feral and Free-Ranging Horses

Though the horse remains physically and mentally adapted to life on an open plain or mountain, it can adapt to other environments, such as the woodlands of the New Forest, or the marshlands of the Camargue. Feral and free-ranging horses generally occupy a home range and will attempt to return to it if moved through human intervention (Russel 1976; Berger 1986). Tyler (1972) estimated that the home range of New Forest mares was 82–1020 ha and reported that their location varied little between years. Each home range contained a grazing area, shelter, water and a 'shade' where ponies congregate to avoid the attack of biting flies (Duncan & Vinge 1979) and to reduce energy expenditure through heat stress in the summer months (Joubert 1972). Movements to shading areas increase summer range sizes in the New Forest compared to the winter ranges.

Horses are preferential grazers but also browse on a wide range of forbs, sedges, shrubs and trees. Feral and free-ranging horses eat for up to 16 hours per day and forage in grasslands and other habitats containing a range of vegetational commu-

nities (Hansen 1976; Putman *et al.*, 1987). The diet of New Forest ponies shows changes through the year with seasonal abundance and primary productivity of forage species (Gill 1988). In the summer, grasses constitute 60% of the diet of New Forest ponies, but this drops to 30% in the winter, when ponies forage in more sheltered habitats provided by gorsebreaks and deciduous woodland. During the winter, gorse, heather, forbs, shrubs and holly form most of their diet.

Eliminative behaviour differs between domestic and free-ranging horses (Carson & Wood-Gush 1983b). Domestic horses confined to pasture exhibit an aversion to grazing near faeces that results in the development of separate grazed and latrine areas (Ödberg & Francis-Smith 1977). Welsh (1973) reported that Sable Island horses eliminated indiscriminately in their home ranges with the exception of marking behaviour. This has also been reported for a bachelor group of Przewalski horses in a semi-natural reserve (Goodwin & Redman 1997), which suggests that latrine use may be an adaptation to domestication, possibly as a parasite avoidance mechanism (Burton 1992). Free-ranging New Forest ponies defecate in latrine areas within grassland areas on the Forest, though their use is less pronounced during the winter when grass productivity is at a minimum during the year (Putman *et al.*, 1991). It appears, therefore, that the use of latrine areas in domestic horses shows a dynamic relationship between animal density and the availability of clean grazing.

8. Social Behaviour

The social behaviour of the horse contributes to group stability and social affiliations are essential to systems of collaborative behaviour such as social facilitation, which influences communal activities (Fraser 1992). In the wild, membership of a group is such an important anti-predator and therefore survival device that the social behaviour of the horse functions to minimise conflict within the group and so promotes its stability.

Horses readily form social order within their groups and overt aggression in feral horse bands is relatively rare, compared with horses in the domestic environment (Houpt & Keiper 1982). Circular dominance systems are common in horses. Dominance order is unidirectional, but may not be linear throughout the group, so that A may be dominant to B who may be dominant to C, but C may be dominant over A (Houpt *et al.*, 1978).

The group order may therefore be complex, but stable within stable populations, and though dominant animals may have been aggressive in the past, they do not need to be aggressive subsequently in all social situations in order to maintain their position. Once established the relationships of all horses within the group persist for as long as the group remains a closed unit.

In feral and free-ranging horses unsettled dominance relationships are usually only found between young horses, and free-ranging equine society could be said to function on kinship, recognition and respecting another's space. Dominance in horses is, therefore, related to control of space and avoidance of conflicts. In view of this the avoidance order is a better measure of the social system, than the aggres-

sion order (Fraser 1992). The avoidance order can become unstable if space is restricted, as happens in many domestic environments. The operation of an avoidance system is the key to understanding the social behaviour of horses. It is both obvious and subtly obscure, and so has been overlooked by many concerned with aggression and dominance in understanding the behaviour of the horse.

Social dominance is sometimes actively exerted by dominant individuals in feral groups, but is seen far more frequently in the domestic environment in competition for limited resources such as supplementary feed, or access to water troughs. This explains the high frequency of aggressive interactions recorded in domestic horses (Crowell-Davis 1993). But even here given adequate space, subordinate individuals will avoid moving too close to dominant ones. Another problem associated with the domestic environment, and particularly in livery yards (UK) and Barns (USA), is that the membership of the social group is constantly changing, and therefore never stable. This results in high levels of aggression and resultant injury, though there are ways of trying to minimise this, such as introducing newcomers gradually and preferably in pairs which have been previously accustomed to each other.

9. Maintenance Behaviour

Maintenance behaviour e.g. stretching and grooming, is exhibited by horses of all ages and play an important role in contributing to the well being of the horse (Waring 1983). Its importance may be easily overlooked as it may be short and varied, but these activities are repeated frequently through the day. Self-grooming includes rolling, rubbing and scratching, as well as licking and nibbling the coat. The face is groomed by rubbing against objects or the inside of a foreleg.

The horse needs around two hours of recumbent sleep during each 24 hour period though this may be taken in several short bouts due to the pressure exerted on the viscera. Horses have a unique stay apparatus in their hind legs which enables them to sleep or drowse on their feet for an additional five hours per day, and this is usually taken in relatively short bouts. Individuals take turns to sleep within a group while others remain alert as a predator avoidance strategy (Fraser 1992).

10. Predator Avoidance

Like many social prey species, the horse's sensory systems and social behaviour have adapted to facilitate early detection of approaching predators. The horse demonstrates two main predator defence strategies, which depend on environmental conditions and the nature of the predator. There is also some evidence of breed differences in the type of strategy employed.

Predation by Pantherine predators, which commonly kill by leaping onto the back and applying a kill-bite the throat, appear to been associated with the evolution of the rapid flight response which keeps the vulnerable head area as far away from

the predator as possible. This is characteristic of highly reactive breeds, *e.g.* the Arab, originating from hot arid areas where ground conditions are conducive to galloping and predation by big cats is probable.

An alternative predator defence strategy is directed towards canid predators and is common when ground conditions are boggy, or on mountain scree, when rapid flight may not be possible or would not be a good survival strategy due to the risk of injury. In these conditions horses will stand at bay and defend themselves with foreleg strikes, which are capable of smashing the skull of a dog or wolf. Iberian horses, the Moroccan Barb and many British native ponies employ this strategy.

Defence strategies against human predators have not been reported in the literature, but predator defence strategies must be acknowledged and avoided in human-horse interactions. Like most prey species, horses learn to distinguish hunting behaviour from other behaviour in constantly present predators. Fortunately another feature of anti-predator behaviour appears to have pre-adapted the horse to domestication, in that they generalise their behaviour to include other species.

Equids are social animals, preferring to associate with others of their own kind, though accepting other species as companions too *e.g.* zebra and wildebeest commonly associate on the African Savannah. As prey species, group living is an important survival strategy, as it increases the probability of detecting approaching predators, it also reduces the probability of any particular individual being caught and consumed. Domestic equids are, therefore, pre-adapted to forming associations with other species and to respond to the warning signals in the body language of other species (Goodwin 1999).

11. Matriarchal Society

Studies of feral and free ranging horses in the UK (Tyler 1972) and USA have shown that horse society is basically matriarchal and consists of stable associations between mares and their offspring (Wells & Goldsmidt-Rothschild 1979). These associations persist even in the absence of a stallion, as seen in some of the managed free-ranging populations of native ponies in the UK. These generally have very few stallions present, figures of one stallion to 60 mares have been recorded for ponies of the Gower peninsular in Wales. In the New Forest during the summer, ratios of one stallion to 30 mares are common (Gill 1988). During the breeding season, stallions may collect several family bands of mares together forming fairly large but temporary harems. In the past many of the stallions have been removed from the New Forest for the winter and the large harems disperse into their component small matriarchal groups again. Those stallions remaining on the Forest over winter generally associate with a preferred mare and her family group and do not attempt to maintain the large harems that they hold during the summer.

In feral unmanaged populations, harems or bands usually have a single stallion, though multiple stallion bands do exist. In these the dominant male secures most of the matings, but subordinate stallions do have access to some matings, making subordinate status more reproductively advantageous than life in a bachelor group