

# 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 adaptive 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.

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 Nevada, 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-adaptation 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 Shackleford 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 ( <i>E. caballus</i> )	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.
	Przewalski Horse ( <i>E. przewalski</i> )			
	Burchell's Zebra ( <i>E. burchelli</i> )			
	Mountain Zebra ( <i>E. zebra</i> )			
TYPE II	Domestic Donkey ( <i>E. asinus</i> )	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.
	African Wild Ass ( <i>E. africanus</i> )			
	Asian Will Ass ( <i>E. hemionus</i> )			

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 adaptations 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 (Haupt & 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 (Haupt *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

(Miller 1981). Bands occupy a familiar home range, the size of which varies with the availability of resources within it. Occasionally bands join together to form large herds, e.g. around a scarce water resource, as in the horses of the Red Desert in Wyoming. These large associations are generally temporary, but within them inter-band recognition and dominance hierarchies have been shown to exist, suggesting the presence of social structure even in these temporary large associations (Miller & Denniston 1979).

## 12. Stallion Behaviour

Interactions between harem stallions generally involve much posturing, squealing and displays of marking behaviour i.e. ritualised dunging. Stallions tend to dung repeatedly on heaps known as 'stud piles' (Tyler 1972) and studies have shown that the dominant individual is last to dung on a pile during marking display bouts (Carson & Wood-Gush 1983b).

As in most social species overt aggression is costly and most encounters are resolved before the escalation of display into actual conflict. Fights resulting in death of one of the opponents have been recorded during battles over the possession of harems. However, most conflicts end in stallions parting and herding their mares away with characteristic snaking movements of the head and neck (Waring 1983).

Despite the popular macho image of the stallion, equine family bands are generally led by mares, and a study by Houpt & Keiper (1982) showed that in feral and domestic horse groups, stallions were neither the dominant nor most aggressive animals in their herds, and that all stallions studied were subordinate to some of the mares in their groups.

## 13. Reproduction

Reproduction in horses is seasonal and the annual cycle of oestrus periods is related to day length. This can be artificially manipulated for some breeds e.g. the Thoroughbred (TB), but the majority of non-TB foals are born in the late spring and early summer months (Fraser 1992). This corresponds in temperate ecosystems with the peak period of vegetational productivity, providing optimum nutrition for the lactating mare, and ensuring maximum growing time for the foal in relatively mild climatic conditions before the onset of its first winter (Gill 1988).

Courtship under natural conditions begins several days before oestrus. The stallion actively discourages contact between the mare and other males. As the mare enters full oestrus the stallion will remain very close to her. He will begin to test her readiness to mate by licking and nuzzling her, which stimulates the mare to urinate and adopt a standing position with back legs straddled and tail raised and arched to one side. This posture is exhibited prior to full oestrus when the mare urinates if approached but at this stage the stallion's advances will be rejected with much squealing, tail lashing and stamping. The stallion will often exhibit flehmen

in response to the mare's urine, and he will assess the mare's willingness to mate by nudging and nibbling at her flanks, hindquarters and hind legs. The stallion may also place his head on her rump before assuming the relatively vulnerable position behind her where he may be kicked if she is not ready to be mated. When full oestrus is reached and successful mating has taken place the pair will remain together for several days and mate repeatedly. This natural form of sexual bonding ensures the optimum conditions for fertilisation to occur (Waring 1983).

Gestation takes around 11 months and 80% of foals are born at night. Many mares leave their social group to give birth and can delay parturition if they are disturbed, presumably as an anti-predator device. The udder may become swollen and wax may accumulate on the teats several days before birth, but onset of the first stage of labour is usually indicated by sweating and restlessness around one to four hours prior to the birth. The final stages of labour are very rapid, and the majority of foals are delivered when the mare is recumbent. Expulsion of the foal can take as little as 10–30 minutes after which the mare continues to lie still for an average of 15–20 minutes. After this recovery period she will usually rise and begin to lick the foal for up to 30 minutes, during which time the mother-foal bond is established. Almost immediately after birth, foals begin to make struggling movements with the legs and to tilt the head upwards. After gaining its feet it begins making random teat-seeking movements, exploring the underside of the dam, and eventually finding the udder. To suckle the foal is required to adopt a parallel and opposite position with the mare and to extend and rotate the head and neck. To facilitate nursing the mare flexes the opposite hind leg tilting the pelvis, and therefore the udder, towards the foal (Fraser 1992).

#### **14. Behavioural Development**

Foals are precocial developers and can stand and suckle within two hours of birth. Those born at night in the open are generally capable of keeping up with their mothers by dawn, which is essential as foals follow their mothers, rather than lying in undergrowth as is the case for fawns or calves. In the first weeks of life foals stay very close to their mother's side but between one and two months of age they begin to make exploratory trips away from the mother, practising locomotory skills, and begin playing with other foals (Carson & Wood-Gush 1983a; Crowell-Davis 1986). From two to three months foals begin to spend much of their time associating with other foals and begin to form peer groups. Weaning takes place naturally at around 8–9 months, though some mares will continue to suckle their foal until shortly before the arrival of their next foal (Gill 1988). Foals in feral and free-ranging horses remain with their natal groups until they approach maturity. During this time young horses learn social and survival behaviour *e.g.* habitat and forage selection, which contribute to reproductive success in later life. In some managed free-ranging populations in the UK, *e.g.* the New Forest where stallion numbers are relatively low, some mares and their female offspring remain together throughout much of their lives.

As the age of the peer group increases, group activities change from play and rest to increasing amounts of grazing time. Foals move between peer groups and their mothers in a variety of activities (Crowell-Davis *et al.*, 1987). As a result the primary social bonding is in kinship groups at weaning. Within peer groups close pair bonds develop between individuals which can persist throughout life, particularly between mares. Pair bonded individuals associate closely together and appears to derive social support from the bond, particularly during agonistic interactions with other individuals. Bonded pairs exhibit many affiliative interactions including mutual grooming, neck overlapping and resting head-to-tail fly swishing. Bouts of mutual grooming also occur within peer groups and may initiate play bouts (Crowell-Davis *et al.*, 1986).

Play has a vital role in the development of the horse with up to 75% of the kinetic activity of foals devoted to it. Solitary and object play appear to develop within the first month of life when foals remain close to their mothers. Social play develops from around 4 weeks of age as foals begin to interact with their peers and other members of the social group (unpublished data, Hughes & Goodwin). Social play in peer groups may involve chasing games, and biting and wrestling which may escalate into low intensity agonistic fighting. Fraser (1992) argues that during the process of domestication, and during socialisation to humans the naturally high levels of movement-related and social play have been channelled into forms of work and recreational activities. He believes this explains how the horse has dealt competently with domestication, while preserving certain behavioural characteristics, such as reactivity, which make it able to survive in the wild.

Young horses leave their natal groups as they approach maturity. The majority of fillies leave when they are between 1.5 and 2.5 years old when 80% join other existing harems, the remainder begin new ones with bachelor stallions. A study by Monard *et al.* (1996) has shown that fillies leave not because of intrasexual competition, since they are not treated aggressively by the mature mares of the band, but because they do not accept matings from males in the natal group. If sexual advances were made by the males in the natal group the dams of the young females were observed interrupting the male's advances. This lack of sexual interest in males of the natal group is seen in many social mammals, including humans, and is thought to be a means of avoiding inbreeding.

Juvenile colts leave, or may be expelled from their natal bands by the stallion, and form bachelor groups where they practise the skills necessary for the acquisition of their own band of mares. Solitary horses are rare and are usually deposed harem stallions, though these may join bachelor groups because of the companionship and safety afforded by them.

## 15. Communication

Horses are primarily visual communicators though vocal communication is also evident (Fiest & McCullough 1976). The meaning of individual sounds may be complex and context dependent. Vocal communication can serve to maintain contact

over long distances, indicate excitement, deter contact in social interactions, or initiate approach between a mare and her foal. Odours are used for communication over time through marking behaviour, in courtship and in establishing the mare foal bond. Touch is used for communication at close range, it promotes and maintains pair bonds during mutual grooming and can be a form of social support in stressful situations. The latter may be derived from the foal pressing its body against the dam during novel or disturbing events.

Horses are extremely sensitive to subtle changes in the body language of their companions. As they generalise their communication to include us, they also react to our body language whether this is intentional on our part or not.

Body outlines are very important in equine communication. High rounded outlines indicate excitement and low straight outlines are associated with relaxation (Rees 1993). Interestingly these outlines also have a psychological effect on humans and the way horses and humans are portrayed in art. Kings or Emperors were often pictured mounted on horses displaying high rounded outlines, whilst people of a more lowly disposition are usually mounted on horses displaying a low outline.

The alarm posture of the horse serves to alert the herd to possible danger, and it is, therefore, a posture of high tension. This sensitivity in the horse to bodily tension is an aspect of their communication, which they generalise towards their communication with humans. Horses react to tension in humans with the same alarm that they would if exhibited by equine companions. They are so subtle in their perceptions that it can be very difficult to hide feelings of human nervousness from them.

Many parts of the body can be used independently as signalling structures. The tail can be used to signal excitement, arousal, fear and aggression. Legs can deliver redirected threats. Ears can be moved independently and towards the direction of sounds of interest, they can indicate the direction of the horse's attention and its state of arousal.

Even more complex signals are portrayed by the face and can indicate relaxation, irritation, tension and even pleasure (Rees 1993). Relaxation is seen in drooping eyelids, ears and lips. Wrinkling around the mouth and nostrils indicates intense irritation, and may be displayed by some horses when confronted with a saddle, or when a disliked horse or person passes near to them. Tension is associated with a deep triangle that appears above the mouth, and the lips are held tight, often with a dimpled chin. A long nose without tension and half-closed eyes are often associated with the pleasure of grooming, either rubbing against a convenient object or when provided by a horse or human companion.

## **16. Agonistic Signalling**

Like many social animals horses show escalated warnings of aggression, and due to the consequences of ignoring these they have received more attention in the literature than other aspects of equine communication and behaviour. Much of the aggression seen in domestic horses is ultimately due to management conditions and

may have a variety of causes *e.g.* competition over small amounts of highly nutritious food, failure by handlers to respond to more subtle threat signals, or unrecognised pain.

The aggressive threat signals of the horse show a general pattern of escalation, which may begin with relatively mild nose wrinkling and ear flattening, and then proceed through head jerk, teeth bearing, tail lashing, stamping a foreleg and charging. Aggressive threats generally culminate in biting (Rees 1993). The general pattern can show individual variation and be complete or become truncated if appropriate avoidance is not shown. A direct attack without warning is usually a learnt response directed towards humans who have failed to respond repeatedly to more subtle equine threat signals.

Defensive threats begin with the same signals of nose wrinkling and ear flattening, possibly allowing the horse time to decide whether to react aggressively or defensively to an aggressor. They then escalate through blocking body movements, tail flattening and rump presentation, raising a hind leg, backing up and hind leg kicking (Waring 1983). It is interesting to note that defensive threats culminate in kicking, rather than biting, due to the reduced risk to the vulnerable head and neck.

In comparison there are few obvious signals of submission in the horse, submission appears to be expressed by moving away from a threat or desired resource, possibly with ears half back. It is possible that very subtle signals exist which biologists have failed to notice, but due to the horse's regard for ownership of space, it may be that acknowledged control of space within the herd makes signals which are obvious enough for humans to recognise unnecessary (Fraser 1992). There are a number of signals that some have claimed to indicate submission but on closer examination this may not be the case. Foals exhibit snapping or mouthing towards other horses which is characterised by drawing back the lips and snapping the jaws, with the head and neck outstretched. This is a common juvenile gesture and generally ceases to be expressed after puberty, though snapping persists in some adults. Snapping was originally considered to be submissive, but Crowell-Davis *et al.* (1985) observed that snapping failed to inhibit aggression from con-specifics and may even trigger aggression in some cases, therefore, if it is a submissive gesture, it is an inefficient one. Crowell-Davis *et al.* (1985) suggested that it may have multiple meanings depending on context, or that it is a displacement activity derived from nursing or grooming behaviour. However, as snapping also occurs during greeting behaviour of zebras (Schilder *et al.*, 1984) it may have a similar meaning in horses.

Licking, chewing, and head-lowering are considered important submissive signals by some horse trainers, who believe that licking and chewing are the adult form of snapping, which they consider to be submission. However, licking and chewing may be displacement activities exhibited when horses experience conflicting motivations. These signals have been reported by Houpt *et al.* (1978) to occur when horses are expecting food and they could be explained by conflicting desires of wanting to begin feeding, but having to wait for the approach of the human feeder. Alternatively, these oral movements may be self comforting following a period of

anxiety and subsequent adrenalin production, which tends to dry the mouth, by distributing saliva over the mucosa of the mouth (McGreevy *pers. comm.*).

Isaac and Goodwin (1998) studied head-lowering and snapping in free-ranging New Forest ponies in the New Forest, Hampshire, UK. They reported snapping by New Forest foals during interactions with members of their natal group. Snapping was observed during aggressive and non-aggressive interactions, which agreed with earlier work, by Crowell-Davis *et al.* (1985). They also observed that head-lowering in New Forest ponies only took place during the approach phase of interactions, but was never observed in response to aggression. They concluded that head-lowering was, therefore, not a submissive signal but may instead be a distance-reducing and affiliative signal. Another example of a distance-reducing, affiliative signal is the 'Tail Up' signal in the domestic cat (Cameron-Beaumont 1997).

Isaac (1998) also reported that snapping was shown by adults and foals of the social Chapman's zebra during greeting behaviour and postulated that snapping in domestic foals may, therefore, also be a greeting behaviour which could explain why it induces both affiliative and aggressive reactions from conspecifics. Adult and foal Chapman's zebra also showed head-lowering during the approach phase of interactions. Adult and foal Grevy's zebras also exhibited head-lowering during the approach phase of interactions, but only Grevy's zebra foals showed snapping during interactions directed towards the herd stallion and this was associated with non-aggressive avoidance.

Although further study is necessary to gain a better picture of the form and function of submissive signalling by horses, this must be undertaken with due diligence as it may be prompted more by a human cultural desire to recognise submission than by its importance in equine behaviour.

## 17. Conclusion

Whilst the horse has undoubtedly benefited from some aspects of domestication *e.g.* in the provision of food, shelter, protection from predators and care during illness and injury, many of the constraints imposed on domestic horses conflict with their evolutionary adaptive behaviour. The success of feral horse populations around the world indicates that the adaptive behaviour of the horse has changed very little in 6000 years of domestication. However, it can not be assumed that the feral condition equates with optimal welfare, as many feral and free-ranging populations survive in sub-optimal environmental conditions (Waran 1997).

The ability of domestic horses to adapt to some current intensive management regimes seems to be unacceptable for a rising percentage of the equine population. Stabling and restriction of foraging time have been associated with the development of abnormal behaviour in competition horses (McGreevy *et al.*, 1995). In a recent survey, up to 29% of leisure horse owners reported experiencing problem behaviour in their horses in relation to some aspect of their management and stabling (Sommerville *et al.*, 2001). Studies of feral and free-ranging horses can be used as indicators of behaviour that is important to horses and can be useful in determining

possible causes of maladaptive behaviour in domestic and captive horses. It is also likely that domestic horse welfare could be improved by meeting the need to perform highly motivated behaviour identified from studies of feral and free-ranging horses.

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