

Behavior Problems of Equids in Zoos

Lee Boyd, M.S.*

The stresses of captivity often lead to behavior problems in zoo animals. Meyer-Holzappel points out that abnormal behavior is not necessarily unadaptive for the animal if it allows the individual to cope with captivity.¹⁸ Nevertheless, prevention and alleviation of these behavior problems should be a major concern, as some abnormal behaviors may be injurious to the animals' health, and zoo visitors are often distressed by witnessing aberrant behavior. Zoological parks are currently moving toward exhibiting animals in naturalistic surroundings, but much of the aesthetic quality of these exhibits is lost if the animals within them appear neurotic or depressed. As zoos assume an increasingly important role in the conservation of endangered wildlife, any behavior problems that threaten the lives of individual animals or reduce their chances of breeding successfully will be of primary concern to the zoo veterinarian.

Zoo equids are prone to many behavior problems. In the wild, equids spend 60 to 70 per cent of their time grazing and roam several kilometers daily while foraging. Equids are gregarious and are seldom solitary by choice. Przewalski's horses (*Equus przewalskii*), domestic horses (*E. caballus*), plains zebras (*E. burchelli*), and mountain zebras (*E. zebra*) form stable harem groups, whereas Grevy's zebras (*E. grevyi*), the African wild asses (*E. asinus*), and the Asiatic wild asses (*E. hemionus*) are territorial and form less permanent associations.¹⁴ In captivity, lack of exercise, quick consumption of concentrated rations, and the artificial grouping of possibly incompatible animals all contribute to behavior problems. Steps taken to prevent the development of behavior problems are generally the best long-term solution to these problems, because behavior problems are difficult to eradicate once the animal has established the aberrant behavior pattern.

MILLING AND PACING

Skiff describes milling as constant locomotion that is frequently interrupted by stops and changes in direction.²⁵ No fixed path is fol-

* Department of Physiology, New York State College of Veterinary Medicine, Cornell University, Ithaca, New York

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lowed. Pacing equids walk or trot along certain paths, usually near a fence or wall, and the motion is relatively uninterrupted, with turns occurring at specific locations.²⁵ As described by Hediger, the animal generally turns into the barrier along which it is pacing (Fig. 1).¹ In equids, the majority of pacing occurs in a straight line adjacent to fences, although a few individuals also pace in a figure-eight pattern. Meyer-Holzappel cites the following causes of pacing:

1. Motor constraints experienced by active animals in a small enclosure.
2. Lack of stimulating surroundings to divert the animal into other activities.
3. Anticipation of food.
4. Escape response when stressed by the approach of visitors, veterinarians, and so forth.
5. Escape response when subordinate animals are threatened by dominant animals.
6. Separation stress when an animal can see, hear, or smell former companions near by.¹⁸

All of these causes of pacing are relevant to zoo equids.

The zoo equids most often seen pacing are solitary individuals. These are generally bachelor males being kept in small enclosures as reserve breeding stock. The pacing is ameliorated somewhat if the bachelor can be turned out into a larger pasture to graze, but some pacing may still be seen daily. For example, a solitary Przewalski's stallion in a grassy 10-acre pasture spent 4 per cent of his time pacing ($n = 10.25$ hours of focal animal observation). Far less pacing is seen in small enclosures when equids are housed in groups, although milling is still fairly common. The size and complexity of the exhibit have an important effect. Skiff found more milling and pacing in herds of

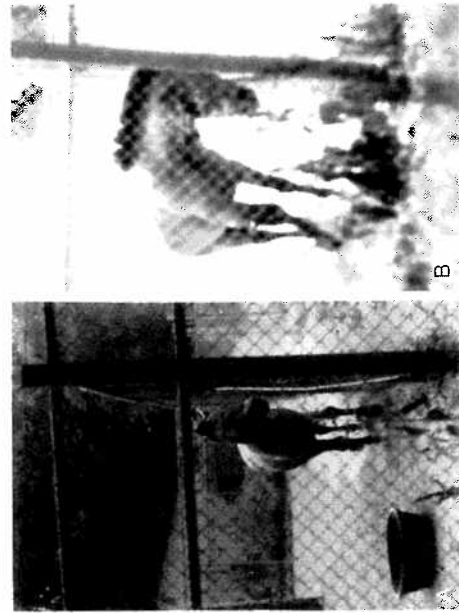


Figure 1. Pacing in a Przewalski's horse stallion. A. Pacing usually takes place along a fence or some other barrier. B. The animal turns into the barrier at specific locations.

Przewalski's horses when they were kept in small, barren enclosures than when the same herds were turned out into a grassy nine-acre pasture.²⁵ When herds of zoo equids are kept in large, grassy pastures, pacing and milling are virtually nonexistent, even when grain is anticipated. Only in unusual circumstances, such as separation from other herd members or harassment by dominant animals, does pacing appear. A herd of 8 Przewalski's horses in a grassy 30-acre pasture spent 0.1 per cent of their time pacing ($n = 111.75$ hours of focal animal observation). All observed pacing was performed by one mare during the time that the herd was confined in a small paddock prior to hoof-trimming. Instead of channeling energy into pointless motion, herds of equids housed in pastures expend their energy by moving in search of forage and interacting with other individuals.

In summary, most pacing can be alleviated by providing solitary animals with companions. If resources permit, pacing and milling can be virtually eliminated by housing equids in large pastures where the animals can occupy their time with foraging.

In many instances, pacing, although it is distressful to watch, is not injurious to the individual's health. It can cause severe soil erosion, however, when the same pathway is used repeatedly. In addition, pacing may be indicative of other more serious problems, because individuals being harassed by other herd members may pace as part of a thwarted escape response. Pacing can also be life-threatening in warm weather. The stallion in Figure 1 could see the weaned foals that had been removed from his herd and placed in a nearby enclosure. He paced whenever the foals were visible—sometimes for 45-minute stretches in 100° weather, which left him lathered with sweat and exhausted. This behavior persisted for weeks until the foals were permanently removed from his sight.

CRIBBING AND WOOD CHEWING

Cribbing (aerophagia or wind sucking) equids grasp an object with their incisors and then pull back on the object as they swallow a gulp of air. An inanimate object such as a hayrack may be used, or the animal may crib on one of its companions (Fig. 2A). Wood-chewing animals may do extensive damage to wooden fences, doors, and buildings. Cribbing is a dangerous vice, for it can result in colic and excessive incisor wear (Fig. 2B).^{2,9}

Both cribbing and wood chewing seem to result from boredom and a lack of oral stimulation. Because wild equids spend 60 to 70 per cent of their time grazing, captive equids who finish their concentrated rations in an hour or two are particularly prone to these problems. No matter how much concentrated feed they are receiving, zoo equids in grassless enclosures eagerly ingest every fallen leaf and every blade of grass that projects into their pen. Willard and colleagues reported that domestic horses fed a concentrate diet spent significantly more time chewing wood than did horses fed hay.²⁸ Once cribbing and

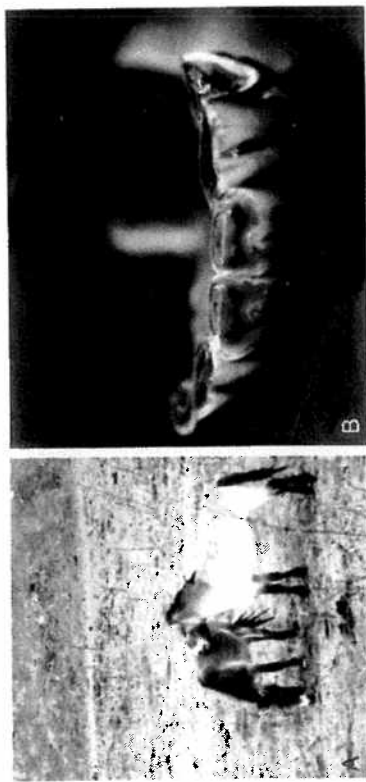


Figure 2. Cribbing in a Przewalski's horse. A, The wind sucking mare was the dominant female and cribbed on all other herd members except her own foal and the stallion, who was dominant to her. B, Mandible of the cribbing mare in part A, showing excessive incisor wear.

wood chewing become established, they are difficult behavior patterns to extinguish. Placing the animals on pasture does not always help. The mare in Figures 2A and 2B was kept in a small, grassless enclosure for 7 years and began cribbing during that time. When transferred to a 4-acre grassy pasture she continued to crib at rates of up to 11 times per minute. This behavior did not diminish throughout the 3 years that the mare spent on pasture until her death at age 10.

The best solution for these behavior problems is prevention. Zoo equids should be fed a lower proportion of concentrated rations and a higher proportion of roughage, so that a more natural length of time will be spent feeding. Some form of roughage should be available ad libitum.

COPROPHAGIA

Coprophagia is a species-typical behavior in young foals. Coprophagia is usually not seen in adult wild equids but is a common behavioral aberration in zoos. Because zoo equids are wormed routinely, this behavior does not increase parasite loads; however, it is distressing to zoo visitors who observe it.

This behavior problem is seen primarily in animals housed in small, grassless enclosures and is probably a result of boredom and a lack of oral stimulation. Willard and colleagues found that domestic horses fed a concentrate diet exhibited significantly more coprophagia than horses fed hay.²⁸ Providing palatable roughage ad libitum seems to ameliorate the problem. Only one herd of Przewalski's horses in a grassy pasture exhibited coprophagia. These animals were temporarily locked out of their barn and spent much of the daylight hours

standing on a barren patch of ground near the gate to the barn. The horses started consuming the old, dry feces that began building up from the frequent use of this area. As soon as the horses were given free access to the barn, they ceased lingering in this barren area, and coprophagia was not seen again.

AGGRESSION

Przewalski's horses are usually less aggressive and more tractable than other equids (author's personal observations).⁶ According to Crandall, kiangs (*E. h. kiang*) and kulans (*E. h. hemionus*) are more ill-tempered than onagers (*E. h. onager*), and some zebras may also be quite aggressive and dangerous.⁶ Much individual variation exists within a species. Within the current world population of Przewalski's horses, there are some individuals who are tamer than the average domestic horse, the majority of individuals who are neither tame nor aggressive, some individuals who are extremely unpredictable, and others who can be counted on to chase their keepers up the nearest fence.

Skiff found that Przewalski's horses were more aggressive toward one another in a small enclosure, than when out in a 9-acre pasture.²⁵ For some stallions, the size of the harem appears to affect their level of aggression. The Przewalski's stallion Bars became more aggressive toward other herd members when his harem size exceeded 13 mares.⁵

Some stallions are aggressive only toward particular mares. The Przewalski's stallion Rococo had a harem of three mares. He was quite compatible with two of the mares but did not get along with the third mare, and she had to be removed. Stallions often become aggressive toward their own offspring when the offspring reach puberty. For example, the stallion Basil became aggressive toward his 22-month-old daughter, and the stallion Rolmar became aggressive toward his 18-month-old daughter.⁵ In the wild, this aggression would drive the young females out of their natal band. This may be a mechanism of inbreeding avoidance. Aggression problems of harem stallions can be minimized by keeping herds small, especially if the herd is exhibited in a small enclosure. Offspring should be removed when 1 to 2 years of age. No matter what precautions are taken, some animals are going to be incompatible and will have to be separated.

In the wild, stallions who do not possess harems form bachelor groups of two or six males. In captivity, surplus stallions should also be kept in bachelor herds, because horses are gregarious by nature and are apt to pace in the absence of companions. Grouping males also cuts down the number of enclosures needed. Serious aggression is usually not a problem when young, inexperienced males are placed together. More care is needed when older, experienced breeding stallions are retired into bachelor groups. These stallions are often very aggressive toward younger males and may seriously injure them. For example, one 8-year-old experienced Przewalski's stallion perma-

nently lamed a 3-year-old male when he was introduced into the younger male's pasture. Several techniques may be used to facilitate the formation of bachelor herds that are to contain older males. The herds should be set up in areas large enough to allow the juveniles to flee and take cover if aggressed against. The younger males should be introduced to each other and the enclosure first, and allowed several weeks to become accustomed to the new conditions, so that when the older stallions arrive, the young males may have a home court advantage. Including several young males in the group spreads out aggression from the older animals, and if the young males are previously acquainted, they may form coalitions as a defense against persecution. Reindl and Tilson successfully used this protocol at the Minnesota Zoo to establish a bachelor herd of Przewalski's horses containing stallions ranging from 1 to 9 years in age.²³ In spite of all precautions, some groups of males are going to be incompatible. Newly formed bachelor herds should be watched closely, and holding facilities should be available in case individuals have to be separated. Several combinations of males may have to be tried before a compatible grouping is formed.

Mares may also exhibit aggression problems. The mares in a herd have a dominance hierarchy. Each mare directs most of her aggression toward the mare just below her in rank.¹⁶ Thus, when new mares are added, the subordinate mares in the herd are generally the most aggressive toward the newcomers in an attempt to relegate them to the lowest ranks.



Figure 3. A Przewalski's mare deters a stallion from breeding another mare by kicking him. (Photo by Judy Rosenthal.)

Several Przewalski's mares have interfered with the stallion when he attempted to breed other females in the harem (Fig. 3). The interfering mare is often the dominant mare in the harem. Upon hearing or observing courtship behavior, she may run over 100 m to bite and kick the stallion, inserting herself between him and the other mare. This behavior seems to be fairly effective in thwarting breeding. In two cases, the interfering mare had to be removed until the other mares in the harem conceived. Such behavior is probably adaptive to the interfering mare in securing the stallion's attentions for herself and preventing competing mares from conceiving.

IMPOTENCE

Pickett and Voss commonly observed impotence in domestic stallions that had been isolated or that had been treated roughly by mares during breeding.²² They also noted that excessive use of 2- and 3-year-old stallions for breeding resulted in a slower arousal and a tendency to savage mares.

Positive experience with mares seems to be a prerequisite for successful breeding in zoo equids. A Przewalski's stallion who was orphaned at an early age grew up with only another male as a companion. When placed with mares as an adult, he repeatedly bit his sheath and flanks until he was separated from the mares. Another Przewalski's stallion was placed with mares who were dominant and highly aggressive to him. Whenever he attempted to mount, they cornered him and kicked and bit him. He quickly became impotent, and the mares were sent to another stallion, who was an experienced breeder and was able to dominate the mares and impregnate them. When the mares were returned to the impotent stallion a year later, he was able to dominate them, but became overly aggressive and was still impotent. Although he attained an erection and mounted, he always dismounted without intromitting or ejaculating. Asa and colleagues previously reported that dominance affected the reproductive performance of two domestic pony stallions.¹ The stallion who was dominant to his mares copulated more than did the stallion who was subordinate to some of the mares in his herd. The number of females may also be important. Wild stallions seldom have harems of more than five or six females. When the Przewalski's stallion Basil was kept with 18 mares he became apathetic about breeding. He was removed from the herd while the number of females was reduced, and when he was reintroduced, his libido returned to normal.

According to Waring, masturbation may reduce libido.²⁷ This has not been the case in zoo equids. Most successfully reproducing Przewalski's stallions have been observed to masturbate, and there is no indication that this behavior reduces the likelihood of siring offspring.

Treatment for males who are behaviorally impotent involves placing the stallion in a new environment and introducing him to a small harem of one or two new mares who are known to have docile tem-

peraments. Pickett and Voss report that housing an impotent domestic stallion near mares and allowing him to watch breeding increases the stallion's libido when he is eventually given his own mares.²²

The best way to prevent impotence in zoo equids is to duplicate as closely as possible the natural processes of dispersal and mate acquisition that occur in the wild. In feral horse populations, juvenile males remain with their natal band for 1 to 2 years before joining bachelor herds.^{4, 13} They remain bachelors until they mature at 4 to 5 years of age (author's personal observation),¹³ then they begin to obtain females, with the older, more dominant bachelors generallyousting subordinate males.^{13, 17} The first mares in a newly formed harem are generally the 1- to 2-year-old fillies that are just dispersing from their natal bands.⁴ To duplicate these processes, juvenile zoo equids should be left with their natal bands for at least a year so that they can observe several breedings before being removed and placed in bachelor herds. The bachelors should not be used for breeding until they are fully mature at 4 to 5 years of age. The most dominant bachelor in the group should be the first to be used for breeding, as this individual would have been the one who acquired the mares in the wild.^{8, 13} One or two younger mares should be placed with the stallion. Additional mares can be added later once the stallion gains experience.

STALLION-LIKE BEHAVIOR BY MARES

Stallion-like behavior has been reported in domestic mares who are pregnant²⁴ or are experiencing anovulatory estrus¹ and in mares with masculinizing ovarian tumors.¹⁰ Two Przewalski's mares in different zoos have exhibited stallion-like behavior. A mare at the Bronx Zoo mounted other females in the herd (Fig. 4). A mare at the Topeka Zoo exhibited stallion-like behavior only toward the stallion. She approached the stallion giving the guttural nicker characteristically heard from courting stallions. She nibbled the stallion's flanks and side and then mounted until he moved away or kicked her. This behavior continued for 50 days and then ceased. Both the Bronx mare and the Topeka mare were 3 months pregnant with male foals while exhibiting this behavior.

Stallion-like behavior seems to be linked to conditions that cause elevated serum testosterone levels in the mare.³ Between day 100 and day 200 of gestation, fetal domestic horses' testes grow rapidly, owing primarily to an increase in size and number of the interstitial cells. By day 150, the weight of the fetal gonads exceeds the weight of the maternal ovaries. Perhaps testosterone production by the fetal gonads was responsible for the temporary masculinization of behavior in the two Przewalski's mares. The Topeka mare conceived another male foal the subsequent year but exhibited no stallion-like behavior during that pregnancy.

Mares exhibiting stallion-like behavior should be tested to de-



Figure 4. Stallion-like behavior by a pregnant Przewalski's mare. This is the same mare shown kicking the stallion in Figure 3. (Photo by Judy Rosenthal and Amy Kasuda.)

termine that it is pregnancy and not a tumor that is causing the hormone imbalance. Because pregnancy-related stallion-like behavior is a transient phenomenon, as long as the other herd members tolerate the mare's attentions, no special therapy is needed.

INFANTICIDE

Domestic stallions have been reported to kill colts that were sired by other stallions.⁷ This behavior also occurs in zoo equids. The Przewalski's stallion Ulan killed three 5- to 6-month-old colts when he was placed in the harem with which his father Vampir had previously been associated.⁵ Ulan was also aggressive toward two additional foals, a mare and a colt, but they were removed from the herd in time. One mare was 6 months pregnant when Ulan was introduced. Her colt was found dead shortly after it was born. It was covered with contusions, and Ulan was presumed to be the culprit.

Another Przewalski's stallion, Basil, sired over 40 foals without incident at several European zoos before coming to the United States. Two mares at the San Diego Wild Animal Park were carrying colts sired by other stallions when Basil was introduced into the herd. One of these mares foaled 3 months after Basil arrived. Her colt was found dead on the day of its birth. The cause of death was trauma to the neck region. Five months after Basil arrived, the second mare foaled. Basil was observed to attack the colt by grabbing its neck, shaking it, and flinging it into the air. The colt subsequently died of its injuries. The dam immediately conceived by Basil, and the next year, she and an-

other mare gave birth to colts sired by Basil. Basil attacked neither of these colts.

Generalizations about equid infanticide are difficult to make until more cases have been studied. With the case of Ulan excepted, infanticide appears to be directed primarily toward very young foals who are unrelated to the stallion. By killing these foals, a stallion eliminates future competitors who do not share his genes. Non-kin male foals are more commonly victimized than non-kin female foals, perhaps because male foals grow up to be competitors, whereas female foals represent future mates.⁷

By killing young non-kin foals, a stallion might also benefit by freeing the mares from the physiologic stress of lactation, which improves their chances of producing a foal by him the next season. Domestic mares in the weight range of Przewalski's horses (200 kg) have peak lactation requirements for protein and energy that are approximately twice maintenance levels (National Research Council 1978). The nutritional stress imposed by the demands of lactation may impair a mare's subsequent reproductive performance. Nishikawa and Hafez report that prenatal mortality is frequent in lactating mares who conceive early in the breeding season.²¹ Domestic mares in poor body condition during gestation and lactation had lower conception rates and higher embryonic mortality than mares on a higher nutritional plane.¹² Nutritional stress compounded by the physiologic demands of lactation caused a Thoroughbred mare to abort twin conceptuses, whereas a nonlactating mare bearing twins was able to carry one of the fetuses to term.²⁶ Keiper found that a population of feral mares in which the duration of lactation was shortened by removal of the foals at 6 to 12 weeks of age had an average foaling rate of 74 per cent, whereas mares in a population in which foals were not removed had an average foaling rate of only 57 per cent.¹³ Thus, the killing of foals before peak lactation occurs would improve the chances that the mare would conceive by the infanticidal stallion and carry his foal to term.

That infanticide does not occur predictably is illustrated by the following case. One zoo maintains several herds of onagers. To promote outbreeding, stallions are rotated yearly between herds, so that the foals born in a stallion's current harem were sired by the preceding stallion. This breeding program was implemented for 8 years without incident. Then two stallions who had previously participated in the rotational breeding system became infanticidal. The first foals born in their herds happened to be females, and these fillies were found battered and dead within a week of birth. The stallions were presumed to have caused the deaths, and one of the stallions was observed attacking the next foal born in his harem, a colt. The stallions were immediately separated from their harems, and no more infanticide occurred.

Infanticide is preventable by introducing stallions only to harems containing nonpregnant mares and older foals, who are less likely to be attacked. Alternatively, mares pregnant by other stallions could be isolated prior to foaling, although this disrupts the normal social struc-

ture of the herd. The harems of wild stallions have relatively stable membership, and a harem stallion's tenure may be 4 years or more.¹⁹ Zoos must strike a balance between the need to rotate stallions frequently to promote gene flow in inbred populations and the increased risk of infanticide brought about by this practice.

SUMMARY

Behavior problems in zoo equids commonly result from a failure to provide for needs basic to equine nature. Equids are gregarious, and failure to provide companions may result in pacing. Wild equids spend 60 to 70 per cent of their time grazing, and failure to provide ad libitum roughage contributes to the problems of pacing, cribbing, wood chewing, and coprophagia. Mimicking the normal processes of juvenile dispersal, bachelor-herd formation, and mate acquisition reduces the likelihood of agonistic and reproductive behavior problems. Infanticide can be avoided by introducing new stallions to herds containing only nonpregnant mares and older foals.

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Department of Physiology
New York State College of Veterinary Medicine
Cornell University
Ithaca, New York 14853

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