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# Donkey and Mule Behavior



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## KEYWORDS

• Donkeys • Mules • Hinnies • Behavior • Cognition

## KEY POINTS

- Donkeys and mules behave differently from horses and require more patience.
- Studies and practical experiences suggest that donkeys and mules/hinnies should be trained, handled, and restrained differently from horses.
- High pain tolerance increases the difficulty to recognize and diagnose disease in donkeys and mules if horse standards are considered.
- Ingestive, social, and reproductive behavior is unique to the donkey.



Video content accompanies this article at <http://www.vetequine.theclinics.com>.

## INTRODUCTION

The donkey was the first domesticated equid more than 5000 years ago. This domestication was likely because of its gentle nature even though its natural defense is to fight and not to flee like horses and other equids (Video 1). Mules (jack × mare) and hinnies (stallion × jenny) inherit a combination of behavioral traits from both species. Based on the type of work and environment, some owners prefer mules and others prefer hinnies. However, there is no evidence that one hybrid is more suited than another for work. The historical importance of mules and donkeys brings up the question especially for mules, “How such an important beast of burden can be so challenging for so many people, yet still prove to be such an important thread in society?”

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Behavior has been a defining trait for both the donkey and its hybrids in terms of its appeal or lack of for professionals and owners. For example, mules tend to exhibit some behaviors that the owner or clinician must work around, such as being hard to catch or ear shy. Such behavior in horses would be less tolerated and generally overcome, whereas with a mule such behavioral differences may require years to overcome or a behavior that may never change. Establishing trust with mules may take years as well as shown in studies comparing their reaction or acceptance of routine procedures by familiar and unfamiliar people.<sup>1</sup> The steady increase in donkey and mule ownership has been raising awareness on their unique behavior and physiology, increasing the demand for knowledge and specialized veterinary care.<sup>2</sup>

Behavior of donkeys and mules is very different from horses; mistakes are made by owners and practitioners when assuming that all these equids behave similarly. There are many misconceptions about donkeys and mules; for example, stubbornness is often misunderstood when these animals are actually being cautious.<sup>2,3</sup> Working with donkeys and mules can teach patience and recognizing that the slightest variation in behavior could mean major health issues ([Video 2](#)). A new owner or practitioner should be aware of the distinctive demeanor of the donkey and its hybrids when compared with horses and learn how to deal with these behavioral differences and not against them.<sup>2-4</sup>

In general, most owners have acquired a great sense of patience in dealing with donkeys and mules,<sup>2,3</sup> and they may help practitioners provide veterinary care by translating the different nuances in behavior when compared with horses. It is a common consensus among owners and professionals that early intensive handling of newborn foals allows them to gain the trust and facilitate routine handling when adults ([Video 3](#)). Furthermore, modifying their behavior at later ages may not be an option once they have learned a particular behavior or fear of something. Understanding mule and donkey behavior could be the difference between life and death, as their demonstration of pain is less evident than in horses. Thus, the present review outlines the current state of knowledge and points out differences and similarities among donkeys, horses, and their hybrids, and offers guidelines on how to work with these animals and recognize key behaviors associated with diseases.

## **NORMAL BEHAVIOR: DONKEY MULE HINNY**

Mules and donkeys are creatures of habit and do not react well to changes in daily routines.<sup>2,4</sup> For example, a change in the feeding schedule can dismay the animal and create abnormal behavior.<sup>2</sup> More importantly, unfamiliar personnel may prevent a very gentle and friendly mule or donkey from being caught until the stranger leaves the premises.<sup>2,5</sup> These animals tend to bond with their caregiver(s) once trust has been established. Anecdotally, treats can be used as positive reinforcements along with a calm, soothing voice and/or tactile contact (eg, scratches or gentle touch with finger tips).

Donkeys, in general, are easier to work with than mules, even if they have not been handled from an early age. In many developing countries it is not uncommon to observe women and children working with donkeys. The gentle nature of the donkey is often taken advantage of, which results in poor welfare. On the other hand, although mules tend to be more challenging for owners/handlers and practitioners, they are subjected to harsher treatments.

Human interactions with mules tend to vary from excellent to very bad. In many cases, each partner seems only to tolerate the other, although interviews with mule

handlers and owners suggested that those who seem to understand mule behavior generally prefer mules over horses and sometimes donkeys.<sup>1,6</sup> Participatory research has indicated that owners and handlers who understand mules typically have worked with them from an early age<sup>1,4,7</sup> (Figs 1 and 2). In addition, mules handled properly from early ages are more tolerant interacting with unfamiliar personnel compared with those who are not handled.<sup>7</sup> Collectively, this is relevant for clinical practice, as while providing veterinary care to mules, these animals may require a familiar handler during approaching or treatment.

Owner preference, perceptions, and attitudes toward mules and donkeys vary according to their use and cultural differences and beliefs. Many mule owners have reported the most challenging routine care is administering an oral anthelmintic or trimming hooves.<sup>1</sup> Most owners have responded to survey questions that they would like more information on training mules and donkeys, and handlers have responded that all mules are aggressive.<sup>1,4,8</sup> Many mules are unruly because of poor handling and mistreatment.

Differentiating between normal and abnormal behavior is paramount to provide professional servicing to these animals. The stoic nature of donkeys and mules could mask pain. It has been suggested they have a higher tolerance to pain, but also it has been suggested that they may feel the same intensity of pain as horses. However, it is possible that disguising pain is a mechanism to prevent predatory attacks. For example, there is a misconception in the lay community that mules and donkeys do not have colic or lameness, but this is obviously inaccurate. However, these animals will show clinical signs of disease when the condition is often in advanced stages<sup>2</sup> (Video 4).

Rolling is normal donkey and mule behavior that could be misinterpreted as a colic sign. These animals appear to enjoy rolling in sandy/dirt areas, but excessive rolling or lying down can be abnormal. It is interesting that mules typically roll in an arbitrarily designated spot and when kept in a group, the different animals of the group tend to roll in the same spot. Again, the duration and frequency of rolling can tell us more about its behavior.

### **Key oncepts**

- Mules tend to exhibit more signs of pain compared with donkeys, but still, those signs may be subtle in comparison to horses.
- One of the most critical elements to managing the health and husbandry of mules and hinnies is knowing their behavior.



**Fig. 1.** Mule owner's foal is easy to handle and approach, handled from day one.



**Fig. 2.** Mule foal easily approached by unfamiliar person.

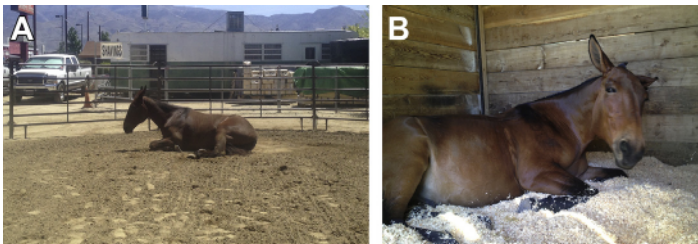
- Mules and hinnies, like donkeys, are very stoic animals; and an intuitive owner will be able to pick up on any behavioral changes and inform the practitioner ([Fig 3](#)).

### HOW TO APPROACH MULES AND DONKEYS

Behavior assessments can be conducted to evaluate the overall behavior, but often research has shown that mules especially are more likely to trust a familiar person compared with an unfamiliar person. When approaching a mule for the first time, approaching them head-on, meaning walking to the face versus the left side of their neck, resulted in more successful approaches.<sup>1,4,7</sup> Donkeys tend to be most tolerant of unfamiliar people and easier to approach than mules or horses.<sup>1</sup> Approaching the donkey's face and then the side after the animal has recognized and accepted the approaching person appears to be useful. A healthy donkey and mule will spend most of its day browsing or grazing, possibly part of it taking dust baths and grooming one another. A mule or donkey that is seen lying on the ground more than normal, not eating, or away from the other donkeys or mules is a reason to be concerned and to check on the animal ([Video 5](#)).

#### **Key concepts**

- Often mules and hinnies are perceived to be challenging to work with, especially among professionals and para-professionals working in the field on a routine basis with these animals.
- Mules and hinnies will often trust their familiar handler/owner and are less trusting of unfamiliar handlers.



**Fig. 3.** (A, B) Natural for mules and donkeys to express grooming behavior or rolling but excessive rolling is an indicator for abdominal discomfort.

- Read the body language from the posture of the head, eyes, nostrils, neck, and body, and watch the tail and uneven weight distribution on the hind limbs (Figs 4–6).
- Mules have a higher reasoning ability when compared with horses.<sup>6</sup>
- Mules tend to prefer more open areas rather than be confined.
- Owners may find a stronger preference for various stalled or confined areas compared with horses that tend to be more tolerant of small areas.
- Owners may find mules to display some behaviors that more or less need to be dealt with or accepted versus corrected (eg, ear shyness, hard to catch) (Video 6).

## SOCIAL BEHAVIOR

Donkeys and mules are social animals and prefer to have companion animals of the same species or not.<sup>4,9</sup> However, mules can become so attached to their companion that it can create an unmanageable situation when separating them from their companion (see Video 6). On the other hand, donkeys when losing a companion or mate will often become depressed, and the stress can trigger metabolic and endocrine imbalances, including fat mobilization and the risk of hyperlipemia.<sup>5,9</sup>

The gentle nature and social flexibility of donkeys make them an ideal companion for horses, foals, goats, sheep, and cattle.<sup>9,10</sup> Donkeys are often seen accompanying newly weaned foals as well as traveling partners for performance horses to reduce stress related to transportation and competition(s).

Playing and socialization are important in domestic donkeys and mules because it establishes a social hierarchy as well as aids in the development of dominating strategies such as learning to fight, biting in key locations such as the throat latch, and knees.<sup>9,10</sup> Excessive play resulting in fighting type behavior is not uncommon in male mules (Video 7); however, some jacks may become too aggressive toward other animals and castration may be required.

## ABNORMAL BEHAVIOR

The slightest change in behavior could be indicative of compromised health or disease in a mule or donkey. Learning to read their face from ear position to eyes to nostrils as



**Fig. 4.** Painful, avoidance, or aggression behaviors may present in similar ways with ears back and tense body, read the body language before proceeding and have familiar person on hand to assist.



**Fig. 5.** Mules and donkeys are better approached face on as this way we can read their body language on how to proceed. Note the ears are back and nostrils tightened. This is not a welcoming response which maybe caused by pain, discomfort, or fear.

well as head, neck, body, and tail movement can be more informative about the current status in these animals ([Video 8](#)). A mule or donkey lying on the ground for an extended period or with reduced food consumption along with superficial lesions from thrashing are indicative signs of discomfort. Identifying the source of discomfort is another challenge (see [Video 8](#)).

Donkeys tend to be even more challenging to detect signs of colic, but if one pays attention to the facial grimace by observing ear, head, and neck position, as well as the expression on their faces, then an intuitive practitioner can pick up on signs of abdominal pain. When using some diagnostic tools, such as hoof testers, practitioners have reported that mules and donkeys are less likely to show signs of foot pain, but the use of ancillary technologies (eg, ultrasonography, radiography) to assist with diagnosing lameness and other orthopedic conditions may prove useful.<sup>2</sup> Physiologic parameters should be taken into consideration and the differences between species. For example, the heart rate of the donkey is generally higher than that of a horse, and the mule's heart rate has been reported to be in the mid-40s.<sup>11</sup>

## STEREOTYPES

It seems that mules are more likely to display stereotypic behavior than donkeys. Mules may frantically paw, and walk back and forth in a stall especially when a buddy, mate, or companion has been taken away, bray excessively, and/or weave (see [Video 6](#)). There are no reports on mules or donkeys cribbing. One of the authors (AKM) encountered one donkey cribbing before it was given a cookie by the owner each time it displayed the behavior. So, the cribbing behavior was being reinforced



**Fig. 6.** Consider approaching mules at the face, touch the forehead, chin and then work your way to the neck.

by the food reward. Mules that weave or stall walk tend to express the behavior when they are alone, tied, or in a trailer, but generally this behavior will cease once another equid is brought nearby.

### BEHAVIOR ASSOCIATED WITH PAIN

Pain is an unpleasant sensory and emotional experience. Stress is associated with a response to discomfort, such as pain. Identifying behavior associated with pain that is linked with various diseases is key to moving forward with diagnostic and prognostic assessments. When diagnosing pain in mules and donkeys, one will have to look for subtle signs, such as a slight twitch of the tail, the body leaning in one direction or the other, or slight changes in facial expression. The face of a mule will tell the story by focusing on several key areas known as facial action units: ear position, orbital tightening, tension and expression above the eyes, prominent strained chewing muscles, mouth strained, pronounced chin, strained nostrils, and flattening of the lips (see [Video 8](#); [Videos 9](#) and [10](#)).

Attempts to define facial assessments in donkeys with acute pain are being developed, but most often advanced conditions are first noted in donkeys, such as chronic laminitis.<sup>12</sup> No attempts for pain scales or ethograms have been developed for mules yet, but the parameters created for other domestic animals, such as horse can be considered as a possible reference. Other behaviors to evaluate regarding pain include the overall body posture, sweating (which is more challenging to detect in donkeys), movement or lack of locomotion, appetite, response to an auditory stimulus, along with physiologic parameters, such as heart rate, respiratory rate, gut sounds,

and body temperature. [Video 9](#) shows a donkey in dystocia showing moderate to severe pain (see [Video 9](#)).

Stressful conditions (eg, disease processes) are systemically manifested by increases in heart rate, respiratory rate, body temperature, and behavioral changes,<sup>13</sup> which if severe also alter tissue perfusion (dry mucous membranes, prolonged capillary refill time, weak digital pulses) and organ function<sup>14,15</sup> (see [Video 10](#) colic case). In healthy animals, body temperature, heart rate, respiratory rates, and behavior are also influenced by the environment, circadian rhythm, age, gender, and physiologic status (eg, pregnancy).<sup>16–18</sup> Young donkeys (<4 years old) have an average rectal temperature of 37.4°C (99.32°F), heart rate of 42.6 beats per minute, and respiratory rate of 21.8 breaths per minute, and older donkeys (≥10 year old) have an average body temperature of 37.4°C (99.3°F), heart rate of 43.2 beats per minute, and respiratory rate of 20.5 breaths per minute.<sup>17</sup>

When trying to identify the source of pain, the entire scenario should be considered and the following questions could be asked:

- a. Is this a working mule or donkey, or animal used in production or for competition/recreation?
- b. How long has the animal been worked?
- c. How often and how long is the animal ridden in preparation for the trail or showing?
- d. Are other donkeys and mules in the same area displaying signs of illness by not eating or standing alone?

### **Key concepts**

- Look for focal points on the face of a donkey and mule for pain, such as ear position, blinking, and nostril flares.
- Consider the posture and presentation of the animal's body in relationship to pain or source of pain.
- Watch for tail swishing and movement in donkeys or mules in pain.
- When conducting a complete physical examination, move slowly and confidently and get to know your long-eared patient before beginning the examination; gaining trust from the mule or hinny will be key in proceeding.
- During clinical examinations that require lifting a limb, it is not uncommon for mules and donkeys to push back or apply weight toward you.
- When trying to identify the source of pain, consider the entire scenario (use of the animal, hours worked, conditions it is working or riding in, equipment and tack being used).

### **DIGESTIVE BEHAVIOR**

Donkeys are well-adapted to consume poor quality forages and maintain good body condition scores even in water-deprived conditions. They are regarded as browsers (ie, ingestion of leaves and bushes) and grazers (ie, ingestion of vegetation at or near the ground level). The narrow muzzle and prehensile-type lips of donkeys and mules is believed to make them able to be more selective when grazing.<sup>18</sup> Donkeys can take larger bites and drink water for a longer period compared with horses. They will often consume plants that are high in tannins, which produce a bitter taste and most livestock avoid.<sup>18</sup> When consuming forage, the donkey will chew food approximately 10 times before swallowing.<sup>18</sup> They do not chew faster than horses, but can consume fiber at a faster rate than most ruminants of similar size because of a more efficient dental and jaw apparatus that permits the ingestion of larger

feed particles.<sup>18</sup> Even though donkeys can swallow large feed particles, esophageal obstruction is rarely seen in these animals.<sup>2,18</sup> However, proper dental care for mules and donkeys should not be neglected, as is often the case (see [Video 8](#)).

On water restriction, donkeys will fully rehydrate at the rate of 17 to 20% of their body weight when offered water.<sup>19</sup> In general, donkeys are thought to have a lower water requirement when compared with other mammals, except the camel.<sup>19</sup> Water consumption in donkeys is dependent on the type of forage fed.<sup>20</sup>

The donkey's ability to thermoregulate and still provide enough saliva for mastication is essential for its ability to consume food after being dehydrated.<sup>21</sup> Often donkeys will consume hay before drinking water, even when dehydrated, to maintain feed and energy intake.<sup>21</sup> Donkeys can adapt to desert conditions and tolerate 20% of dehydration and continue to work.<sup>21</sup> Due to its ability to rehydrate quickly, regulate plasma volume despite reduced water intake, and rapid energy turnover rate, the donkey has been compared with other desert animals like the camel.<sup>21,22</sup> One study found that donkeys will drink enough water in 5 to 10 minutes to restore 95 to 98% of the water lost.<sup>21</sup> The same study found that donkeys that defecated immediately after drinking had feces containing 66% of water content, which was only 5% less than when the donkeys were hydrated (71%).<sup>21</sup> These traits make it possible for donkeys to live and survive in places such as Death Valley in the United States or the sub-Saharan regions of Africa.<sup>21–24</sup> The donkey's behavior also may play an important role in their efficiency.<sup>21</sup>

Most equid owners judge the health of their animals based on appetite; however, considering that donkeys have a strong appetite even at times of dehydration and disease, this behavior is not a reliable parameter to assess their health status.

Rarely, donkeys, mules, and hinnies overeat to the point to have an overloaded gut, but as previously discussed, they can develop metabolic conditions, laminitis, and gastrointestinal disorders.<sup>1</sup> Laminitis often occurs in all 4 feet and sometimes only in the rear.<sup>4</sup> Because of their ability to mask pain, signs of colic may not be evident, which could reduce survival.<sup>4,13</sup> Donkeys going off feed for days may have abdominal discomfort, resulting in stress and subsequent lipid mobilization and hyperlipemia.<sup>2</sup>

Feeding behavior of mules and hinnies is mostly based on observations and anecdotal experiences. It has been suggested that these donkey-horse hybrids can survive on less forage and nutrients than horses of comparable size. Laymen in Baja California claim that hinnies, like donkeys, can survive for a longer period without water. More information is still needed on feeding and water behavior of mules, hinnies, and donkeys.

### **Key concepts**

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- Donkeys are considered to be both browsers and grazers; they will seek out plants with higher nutrient qualities.
- Donkeys take larger bite sizes and will rehydrate in a shorter amount of time with longer drinking sessions.
- Donkeys continue to eat despite dehydration.
- Information on feeding behavior of mules and hinnies is limited.
- It appears that donkeys more commonly develop laminitis in all 4 feet, less commonly in the hind feet.

### **TRAINING MODIFYING AND RESTRAINING BEHAVIOR**

Worldwide, it is a common belief among mule and hinny owners and handlers that these animals should be handled from an early age to facilitate their training. Similar

to horses, mule and hinny newborn foals seem to benefit from the imprinting techniques (ie, scratching, petting, working with the legs while picking up the hooves, and rubbing from ears to tail) (see [Figs 1](#) and [2](#), [Video 3](#)). Mules and hinnies attending mobile veterinary clinics with early foal training tended to allow unfamiliar people to more easily approach them and provide treatment.<sup>7,25</sup>

When first approaching a mule, it is recommended to approach their face versus their neck, where they will often flee.<sup>25</sup> Mules tend to be at more ease with verbally provided commands compared with no sound.<sup>25</sup> Consider a plan of action for maintaining mules in the area of treatment, which may include snubbing to a post, keeping a companion animal close by, or the use of chutes or stocks. Mules and hinnies often respond well to treats, petting and scratching the neck and inside of ears, and verbal. If a routine health check or procedure cannot be safely performed, nose twitches can be used for restraining, especially a twitch with a long handle to hold or a string twitch.

Blindfolds to cover the eyes is effective to calm mules and hinnies during varied interventions from vaccinations and deworming to farrier work. Lifting an opposite leg and tying the leg up with a safety knot to a loop made around the neck of the mule that does not slip is another form of restraint may work but must be done by trained personnel.<sup>1,4</sup> When applying a restraint, especially to a mule, it must be applied slowly and correctly. Otherwise, this will incentivize the mule's fearful behavior.<sup>2</sup> Sedation with 2-adrenoreceptor agonists (eg, xylazine, detomidine) alone or in combination with opioids (eg, butorphanol) can be used as ancillary chemical restraint methods. Protocols for the use these drugs in donkeys and mules are outside the scope of this review and are discussed in the article by Nora Matthews and Johannes P.A.M. Van Loon's article, "[Anesthesia, Sedation and Pain Management of Donkeys and Mules](#)," elsewhere in this issue.

### **Key concepts**

- Mules and hinnies are creatures of habit, and changes in routines will make them wary of the situation and become harder to handle at times.
- Restraints may actually decrease the stress placed on the mule/hinny or donkey when they are resisting strongly.
- Nose twitches, not ear twitches, are effective on mules and hinnies for administering injections and are somewhat effective on donkeys.
- For mules or donkeys resisting treatment, consider blindfolds, tying up a front limb or hind limb, or the use of hobbles.
- Remain calm and use your voice, scratching, or positive tactile contact when working with mules and hinnies.
- Mules and hinnies are not for everyone; it takes a very patient person to work with them.

### **REPRODUCTION BEHAVIOR**

Under natural conditions, jacks are territorial breeders, they remain in a self-designated territory and will leave this territory only in case of lack of food and water.<sup>26,27</sup> However, as jennies are migratory animals, they are attracted to the jack's territory typically rich in water and food supply and shade in warm climates. In addition, contrary to stallions, jacks do not form harems and display no herding behavior.<sup>28,29</sup> Jennies, like jacks, defend their territory ferociously against intruders, particularly against other jacks; thus, this may explain the intermale aggression under domesticated situations.<sup>30</sup> On rare occasions, a jack may allow a subordinate jack to

live in its territory; however, this is not common.<sup>31</sup> The subordinate donkey may help with the defense of the territory.<sup>27</sup>

Jennies congregate into a sexually active group like cows and mount one another while in estrus, and this is thought to play a role stimulating the jack.<sup>28,32</sup> It is interesting that mouth clapping is the most typical estrus sign in jennies, whereas the clitoral eversion and frequent micturition and expansion of the hindlimbs are less frequent and more discreet than in mares.<sup>29,31,33</sup>

The precopulatory interactions between donkeys and jennies are intense and of short duration. Vocalization, olfaction, naso-nasal, and body parts, particularly the perineal area, and strong bits in the neck, hindlegs, flank, and vulva, is followed by a Flehmen response and a mount without an erection of 10 to 30 seconds<sup>31</sup> (Video 11). Another frequent observation is the rapid and slow withdraw, where the jack remains distant from the female, grazing and gazing around, and appears not interested in the female and then suddenly the penis is exposed, the jack starts masturbating and then approaches the female to copulate.<sup>27,31,33</sup> Other key behavioral signs that the jack is ready to expose the penis include clear liquid dropping from the nasal cavity, lowering his head and neck, a slight jerk upward, and oftentimes a kick with one hind limb straight back. The knowledge of this copulatory behavior can be explored in the controlled breeding situation, as the donkey can be brought near a teaser or female being mated (mare or jenny), then pulled away and kept distant until the penis is exposed and ready to be washed, and then the jack can be conducted to mount the female or dummy.<sup>27-30,32,34</sup>

Naturally, donkeys are more attracted to jennies than mares, partially because estrus mares are less receptive to jacks and the estrus signs are different.<sup>30,32,34</sup> A jack was able to identify estrus in all mares under pasture situation; however, only 31 to 41 of mares displayed estrus to the jack.<sup>34</sup> Mare receptivity to jacks while in estrus can be improved with time and constant exposure to jacks; however, some mares may violently refuse the jack's approach and may require sedation and physical restraining (ie, hock hobbles or twitch) if they are used as mounting females or natural cover.<sup>33</sup> When breeding jacks to mares or jennies, a quiet environment with familiar people and objects is generally best. Some jacks can be very shy and an unfamiliar person or place may increase the time it takes for the jack to show any interest in the mare or jenny or display signs of erection.

Female mules can display signs of estrus that are similar to mares and to a certain extent to jennies. One survey carried out with 100 mule owners in the United States showed that most owners did not have any concerns about their mules displaying estrus behavior, but some may elect to ovariectomize their mare mules to eliminate estrus behavior, especially those being used for competitions or shows.<sup>35</sup> Male mules and hinnies are commonly castrated to presumably suppress aggressive behavior.

### **Key concepts**

- Jennies will mount one another when in estrus, display mouth clamping, and exhibit behavioral signs of estrus all year.
- Seasonality tends to have less of an effect on donkey reproduction behavior compared with horses.<sup>36</sup>
- Teasing behavior of jacks usually includes vocalization and mounting without an erection.
- Jacks that have been trained to breed only mares may not breed jennies vice versa.

- Behavior before a jack begins to extend his penis includes clear liquid from the nasal passage, lowering of the head and neck, a slight jerk upward, and often a kick with a single hind limb, this natural behavior should not be discouraged.
- Jacks take a longer time to reach an erection and ejaculate compared with horses.<sup>36</sup>
- Breeding area should be quiet and only familiar people should handle the jack, as strangers, noise, or excitement may discourage some jacks from breeding.
- Jacks can be trained to be collected off a phantom.<sup>37</sup>
- Female mules and hinnies will exhibit signs of estrus similar to a mare.
- Male mules can show signs of aggression and play fight with other males, and castration may decrease these behaviors.

## SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at <https://doi.org/10.1016/j.cveq.2019.08.010>.

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