



## Review Article

## Donkeys Are Different

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## ABSTRACT

As a unique species of equine, the donkey has certain specific variations from the horse. This review highlights the origins of the donkey and how this impacts on its behavior, physiology, and propensity to disease. The donkey is less of a flight animal and has been used by humans for pack and draught work, in areas where their ability to survive poorer diets, and transboundary disease while masking overt signs of pain and distress has made them indispensable to human livelihoods. When living as a companion animal, however, the donkey easily accumulates adipose tissue, and this may create a metabolically compromised individual prone to diseases of excess such as laminitis and hyperlipemia. They show anatomic variations from the horse especially in the hoof, upper airway, and their conformation. Variations in physiology lead to differences in the metabolism and distribution of many drugs. With over 44 million donkeys worldwide, it is important that veterinarians have the ability to understand and treat this equid effectively.

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## 1. Introduction

The domestic donkey is a unique and much undervalued species whose ancestors the African Wild Ass evolved to survive in semiarid, mountainous environments with sparse food sources and intermittent access to water. Domesticated only for approximately 5,000 years, the donkey has been and still is used for draught and production purposes and working and living alongside humans all around the world [1,2]. More recently, the donkey has also found a role as a pet and companion. In some cultures, donkey milk and meat is also much prized. Although the donkey has a rich and important role in human development and history including featuring in many religious texts and historical stories, the donkey has often been denigrated as a lowly beast of burden and is frequently looked on as the “poor relation” to its oft more respected “cousin” the horse.

Those who own or work with donkeys know that although there is shared heritage between the donkey and

horse, they are remarkably different in their physical traits and behavior. The difference in chromosome numbers (horse 64 and donkey 62) renders crosses between the species infertile. Donkeys are famed for their longevity giving rise to the saying “donkeys years” with many living in excess of 30 years and offering a lengthy “working” life [3]. Commonly held beliefs that donkeys do not feel pain and are stubborn or stupid are almost certainly due to people looking at donkeys and judging them using the wrong behavioral and physical scales, most notably those of the horse [4]. It is the authors' experience that donkeys display more subtle behaviors than does the horse and may exhibit different behavioral repertoires when frightened, in pain, or pressurized. Similarly, veterinary care of the donkey must take into account the many physical differences that the donkey has when compared with the horse.

The donkey is a unique species with many important differences that should be noted and appreciated when working with, managing and treating; it is no longer acceptable to simply look on the donkey as a small horse. This review aims to provide the reader with an overview of the nature of the donkey and how best to care for and treat donkeys to improve their quality of life.

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## 2. The Origins of the Donkey

Descended from African Wild Asses, the domestic donkey has retained many traits of its ancestors who would naturally live in semiarid and often mountainous environments [5], characterized by sparse vegetation, dispersed water sources, and widely fluctuating temperatures. Steep terrain with narrow, rocky mountain paths contrasts with the ancestral home of the donkeys' cousin the horse that would inhabit open grassy plains.

Donkeys' evolution in sub-Saharan Africa has adapted them to coexist with a number of diseases that are considered "exotic" or transboundary, this partly accounts for their use as draught animals in regions where horses cannot thrive [6]. The evolution of the donkey as a desert dwelling animal able to survive in some of the harshest conditions on earth has been used and exploited by humankind often with little thought for the true nature of this important species.

## 3. Donkey Behavior

The natural behavior of the donkey has been shaped by its origins. The natural environment of the donkeys' ancestors may, on occasion, offer plentiful enough food and water to support the formation of small donkey herds, which imitate the larger "herd" structure adopted by horses with dominant stallions ruling a harem of mares [7]; horses are capable of living in such a manner as food and water in their natural plains habitats is normally in abundant enough supply to support many equines. In the natural environment of the donkey, such plentiful resources are rare, the donkey has therefore adapted to live in very small groups of two or may be found as solitary animals, only coming together to breed or when resource availability improves [8]. To improve the chances of finding mates, a donkey jack may hold a "territory," often around a water source [9]. Jenny donkeys may also guard food and water resources by establishing a territorial range, such territorial behavior is different to that displayed by free-ranging wild horse populations who are not generally territorial [10]. This explains why domestic donkeys may display territorial behavior when living alongside other animals. Such behavior may lead to the donkey coming into conflict with other species that it does not perceive as "belonging," reports of attacks on small livestock or predators by donkeys (and mules) are relatively common and consideration should be given to this entirely natural behavior when mixing new animals with donkeys [11]. These guarding instincts have been harnessed by people around the world by using the donkey as a guardian to protect sheep, goats, and other livestock from attack by predators such as dingoes and coyotes [12].

As herbivores with many natural predators, the donkey has evolved with a natural "flight or fight" reaction. For many millions of years, the donkeys' ancestors have chosen to run away from predators or when they feel threatened. However, if the situation warrants it, they will use their natural weapons of teeth, feet, and bodyweight to "fight." The fight instinct of the donkey is more easily engaged than that of the horse whose default reaction is nearly always

flight [13]. As donkeys frequently live on their own or with their foals, fleeing is often not the best mechanism of defense; fleeing as part of a pair, you or your offspring are always likely to be the slowest and may end up being caught, and fleeing in mountainous terrain also poses particular hazards. Therefore, donkeys are much more apt to consider their response to a threat, and when fleeing does not appear prudent, they will engage their "fight" response [14]. For practical purposes, this means that clinicians and handlers need to allow a donkey time to work a problem out, avoid being crushed between a donkey and obstacle and in many ways enjoy working with an animal less inclined to panic than the horse.

Donkeys are naturally gregarious animals, and despite the often solitary existence of their ancestors in the wild, they prefer and thrive when provided with company of their own species. Donkeys bond strongly, and studies have shown the phenomenon of lifetime or long-term "pair-bonding" in donkeys [15]. Although donkeys will live contentedly with other equines for company, research has shown that when given choice, they will tend to choose to bond and socialize with other donkeys when placed with a choice of donkeys, ponies, and mules [16]. The complex nature of donkey bonding is not fully understood, but practical experience at The Donkey Sanctuary has demonstrated the importance of not underestimating this trait. For example, donkeys may become stressed and refuse food or water when removed from a bonded companion which may put them at risk of developing the potentially fatal disease hyperlipemia.

Despite many sayings to the contrary, the donkey is neither stubborn nor stupid [17]. Unfortunately, the donkey's natural propensity to freeze when threatened or frightened and their calm, stoic dispositions have led people throughout history to brand the donkey as such. Recent research carried out at The Donkey Sanctuary showed that both donkeys and mules outperformed horses (and in the case of mules they outperformed dogs) in a test of spatial cognition and perseverance abilities. Both donkeys and mules were more accurate and faster problem solvers when challenged to detour through a changing gap to reach a food reward [18]. It is always important to take account of this quick learning ability when training donkeys and mules, as they are able to learn both wanted and unwanted behaviors very quickly.

## 4. Nutrition for Donkey and Mules

The ancestors of the domestic donkey evolved as browsers as well as grazers and survived on lignin rich, low energy, fibrous plants, which they would have to range for many miles to obtain, spending 14–18 hours per day foraging over distances of 20–30 km per day [19]. Donkeys kept in domestic environments rarely have the opportunity to exhibit this combination of natural behaviors.

The donkey is a hindgut fermenter and has evolved to have a steady trickle of fibrous plant materials moving through the gut at all times. When compared with horses, donkeys are highly efficient at digesting poor nutritional quality fiber, the donkey's maintenance energy requirements are considerably lower with stated levels varying

between 50%–75% of that which would be required by a horse of the same size [20]. Studies have shown that the daily appetite of the donkey for maintenance purposes is 1.3%–1.8% of bodyweight in dry matter per day [21]. Many significant health problems of donkeys result from over provision of energy—for example, obesity, metabolic or hormonal imbalances, hyperlipemia, and laminitis [22]. In all these conditions, an excess storage of energy as metabolically active adipose tissue can lead to inappropriate mobilization of lipid, insulin resistance, and enzyme dysregulation.

Little research has been carried out to establish the protein, vitamin, and mineral requirements of donkeys. Protein metabolism and utilization in the donkey appears to be complex, and experience would indicate that donkeys can survive on low-quality protein containing diets than can horses as evidenced by their ability to survive, breed, work, and grow on forages containing low-quality protein (F. Burden personal communication). Vitamin and mineral levels advised for horses appear to provide optimal levels for donkeys and can be safely extrapolated [23].

Practical feeding of fit, healthy donkeys should focus on providing greater proportions of highly fibrous feedstuffs such as cereal straw (barley or wheat straw, checked to have few seed heads) or coarse, low energy hay (ideally with an energy level of less than 8 MJ/kg DM) to provide “bulk” with greater energy fiber sources such as grass, hay, haylage, alfalfa, and beet pulp being fed as required according to body condition, life stage, and workload. Regular dental examinations should ascertain that the donkey is able to cope with a highly fibrous diet and any transition to this type of diet made gradually to avoid the risk of a gastrointestinal impaction. Safe logs and branches should also be provided to satisfy the donkey’s natural browsing behaviors. Donkeys rarely require energy-rich cereal grains, sweet feeds, or highly molassed products; the feeding of such products is poorly tolerated, often wasteful and frequently associated with the development of health issues such as laminitis, gastric ulceration, hyperlipemia, and colic [22,24]. Where cereal grains or molasses are included to increase the palatability or energy density of feeds, it is advised that combined starch and sugar levels (non structural carbohydrates) do not exceed 15% and ideally should be  $\leq 10\%$ . Care should be taken with diets for growing young stock, pregnant jennies, and geriatric donkeys with poor dentition, as these may require supplements or short chopped diets.

Donkeys are renowned for their thirst tolerance, which should not be confused with their water requirements. Water requirements for donkeys are similar to that of horses and will vary considerably depending on workload, ambient temperatures, and during pregnancy and lactation.

## 5. Anatomy

Obvious anatomic differences can be viewed as perfect adaptations for the environment donkeys evolved in; the large ears are useful to receive communication from disparate groups and to aid in heat dissipation. The angled epiglottis, narrow nasal meatus, and expanded naso-

pharyngeal recess play a role in production of the characteristic resonant bray of this species that can carry across many kilometers [25]. The bones of the head are much larger than a comparably sized pony with a very powerful jaw capable of grinding lignin-rich plants and shrubs [26]. The short neck and protruding manubrium support the heavy skull, leading to an increased thickness of the cutaneous colli muscle. The distal punctum of the nasolacrimal duct opens far dorsomedially within the nostril, well placed to avoid rapid blockage with sand [27]. The upright hooves and typically close limbs are suited for movement in difficult terrain rather than speed [28]. The dorsal top line of the donkey with its low withers, straight back and smooth, slow paces has encouraged its use as pack and draught animals rather than athletes of the equine world. There are a number of other subtle differences from the horse, knowledge of which may help in some clinical situations for example placement of epidural injections, catheterization of the cervix [29,30].

### 5.1. Feet

Donkey hooves are visibly different to those of horses but have also evolved to have a different microstructure with a more open tubule structure than that of the horse hoof. This enables any moisture in the environment to be drawn into the hoof [31], although this adaptation is of benefit in the low rainfall areas of the donkey’s ancestral home it is the cause of many problems for donkeys in temperate climates [32]. When kept in wet conditions, the donkey foot will become waterlogged, which predisposes to hoof problems such as white line disease and abscess formation.

Radiographic studies of the donkey hoof have confirmed that there are a number of structural differences, which affect clinical decision making in the event of laminitis and other disease of the hoof [28,33]. Most notably the distance between the extensor process of the third phalanx and the coronary band is given as 10.4 mm ( $\pm 3.7$  mm). The hoof wall is at a steeper angle than in the horse and the frog is set further caudally, values given for hoof wall angle in donkey front feet are  $61.6^\circ$  (standard deviation [SD], 5.24) vs. horse  $50.5^\circ$  (SD, 5.03) [34]. The mean integument depth at the midpoint of the distal phalanx (indicative of dorsal wall thickness) was found to be 25% greater in the donkey than the pony, although breed differences are evident, with large breeds of donkeys showing greater values. Trimming of donkey hooves must be done with such differences in mind to prevent lameness and promote good hoof balance and health.

### 5.2. Body Condition Scoring

The Donkey Sanctuary has found that weighing or weight estimation and condition scoring are extremely useful tools for assessing the general condition and health status of donkeys when carried out on a minimum of a monthly basis. Often the first sign of deteriorating health is a gradual loss of weight; conversely if weight is being gained, this is easiest to deal with if noticed early. Weight can be measured using electronic scales; however, most

owners do not have access to such facilities; in such cases, the use of a weight estimation calculator should be encouraged alongside a condition scoring system designed specifically for donkeys (further details on weight estimation and condition scoring can be found at [www.thedonkeysanctuary.org.uk](http://www.thedonkeysanctuary.org.uk)). In our experience, the Henneke et al [35] system of body scoring for horses is less useful for companion donkeys as many of these animals may be overweight and show very regional deposition of adipose, particularly in the crest along the spine and buttocks. Even when overall weight is lost, these regional deposits can remain and the observer must carefully assess the overall condition.

### 5.3. Dentistry

The differences in donkey and horse dental anatomy have been documented by du Toit [36] and du Toit et al [36–38]. Most notable is the accentuated curve of spee and the greater degree of anisognathia. Donkeys may unfortunately be excluded from routine prophylactic dentistry because of their role as companions rather than ridden equines. The effect of poor dentition on systemic health has been studied by Du Toit et al [39] and shown to lead to an increased risk of hyperlipemia, colic, weight loss, and low body condition score. As donkeys age, the proportion of severe dental abnormalities increases: in the study by du Toit et al [40,41], older donkeys had a high prevalence of diastemata (86%), overgrown teeth (86%), periodontal disease (28%), and worn teeth (84%).

More recently, other workers have examined different groups and breeds of donkeys, and their findings suggest that dental disease has an impact on other donkey populations [42].

The challenge as clinicians working with donkeys is to ensure that owners recognize the importance of regular dental care and that appropriate treatment, analgesia, and dietary management changes are made for donkeys with dental disease.

## 6. Veterinary Care

### 6.1. Behavioral Assessment of Pain and Sickness in the Donkey

When assessing and treating the donkey patient, it is often essential to have their bonded companion present, and this is especially true if the sick animal is to be moved for further treatment. It is also important to understand that donkeys display different signs and symptoms of pain and sickness than horses or other species. The donkey is often described as stoic, which goes some way toward understanding donkey pain behavior; however, a more accurate description may be “subtle” [43]. Contrary to the beliefs of many, the donkey does feel pain and does display signs of pain, and there is as yet no evidence that the donkey has a different pain tolerance to that of other equines. Recent research carried out by Grint et al demonstrated a similar or greater cerebral cortical response to a noxious stimulus as measured by an electroencephalogram during castration than that demonstrated by ponies undergoing the same procedure. This

would in fact indicate that differences in behavioral display of pain behaviors are not due to a difference in cortical processing [44]. Table 1 describes common behavioral signs of pain or sickness in the donkey [43] and a description of the behavior.

### 6.2. Clinical Assessment of the Donkey

When assessing the donkey, it is important to ensure that the correct baseline is being used. Although many of the same techniques can be used to assess the health of the donkey, different reference ranges often need to be used.

### 6.3. Physiology

The donkey has different temperature, pulse, and respiration ranges when compared with horses; reference ranges for adult donkeys are shown in Table 2 [45]. As many donkeys are not worked and can be hard to exercise in hand, it is useful to use rebreathing bags to check for subtle lung disease and evaluate the cardiorespiratory systems in light of a low work load or unfit animal. Respiration rate and character are easily affected by temperature and workload and should be judged in light of these factors. Of note is an apparently less developed cough reflex seen in the donkey when compared with the horse [46].

### 6.4. Biochemical and Hematological Parameters

Donkeys have a unique physiology when compared with the horse, and a different set of reference ranges should be used when assessing the donkey patient. For example, red blood cell counts and packed cell volumes are significantly lower in the donkey than the horse, whereas mean corpuscular volume is significantly greater in the donkey. Likewise, biochemical parameters may also differ; in the donkey, total bilirubin levels are significantly lower, and serum triglyceride levels are significantly greater than in horses. Details of up-to-date reference ranges can be obtained from The Donkey Sanctuary ([www.thedonkeysanctuary.org.uk](http://www.thedonkeysanctuary.org.uk)) or Wikivet ([www.wikivet.net](http://www.wikivet.net)). Many reference ranges are in the process of being created for donkeys and specific breeds of donkeys, and the interested clinician is urged to seek breed-specific differences where possible [47,48].

### 6.5. Hyperlipemia

Hyperlipemia is a complex metabolic disturbance, which may accompany almost any other disease of the donkey, and many “stressors” may contribute to the development of hyperlipemia [22]. Avoidance of hyperlipemia is imperative in the dull donkey, hyperlipemia secondary to another clinical issue is common (72% of hyperlipemia cases in one study), and unfortunately, the mortality rate for such cases is high at 49% [22]. Prevention through reduction of stress and maintenance of appetite is important; dealing with pain associated with the primary disease process may assist as will offering small tasty meals and forages along with browse and fresh grass. Where appetite is reduced, the vet may need to consider

**Table 1**

Common behavioral signs of pain and/or sickness in the donkey, adapted from [43] using authors' experience.

| Behavioral Sign  | Description  |
|--|--|
| Inappetence or anorexia or reduced appetite  | Donkeys often display reduced intake of food and/or water when sick or in pain. This is often the first sign of a developing clinical problem.   |
| Generalized dullness   | Carers often describe the donkey as dull or "depressed" showing less interest in the environment, companions, and less frequently displaying "luxury" behaviors such as allogrooming and rolling.  |
| Sham eating  | Donkeys may appear to be eating but in fact merely pretend to eat by nuzzling food although intaking none, careful observation, or hand feeding of the donkey are essential for assessment.  |
| Lowered head carriage  | A general sign of ill health characterized by the head being placed below the withers of the animal, this is occasionally accompanied by swelling of the muzzle.   |
| Unresponsive ears (little movement in response to changes in noise)                        | Ears may not be responsive to noise or other stimulus and are less mobile than expected.   |
| Lowered ear carriage   | Ears are carried low and/or backward. Often referred to as "helicopter" ears.  |
| Social isolation   | In latter stages of disease, donkeys may attempt to isolate themselves from a group and appear uninterested in others they are bonded to. In some cases, the "herd" may exhibit aggressive behavior toward a sick donkey.  |
| Increased recumbency   | Increased frequency of lying down or lying down for longer periods of time than usual, sometimes accompanied by fecal or urine staining. Donkeys may also experience difficult getting up or down to rest.   |
| Decreased recumbency   | In chronic conditions, donkeys may become reluctant to lie down to rest as they become less able to rise and experience pain as a consequence.   |
| Weight shifting or limb guarding or potterly gait  | Lameness in the donkey is often more subtle than that seen in the horse and is difficult to assess as many donkeys are not "athletic." Donkeys rarely show the classic laminitic stance as seen in horses but are more often regarded as having a stuttering "pottery" gait or display weight shifting of the front limbs. |
| Hypersalivation, drooling, difficulty chewing  | Commonly seen in donkeys with dental disease and often accompanied by signs of partially chewed food, halitosis, and food pocketing in the mouth.  |
| Anhedonia (depression—an inability to respond positively to normally pleasant experiences) | Generalized depression is common in the donkey and can be assessed by tempting the animal with something that would normally be viewed as pleasurable. For instance, a very tasty, high-sugar treat such as a ginger biscuit may be offered, a companion offered or interest in other animals assessed.                    |
| Tail twitching   | This is commonly seen in "painful" donkeys but should not be confused with tail swishing associated with aggression, confusion, or in response to flies. Only to be used in combination with other indicators.   |
| Excessive lacrimation, rubbing of eyes, and blinking                                       | Indicative of eye issues but should be used in combination with other clinical indicators as may be due to fly irritation or weather conditions.   |

nasogastric tubing, IV fluids, or total parenteral nutrition to maintain a positive energy balance until voluntary feeding is reestablished [49,50].

### 6.6. Pharmacokinetics

The pharmacology of many drugs in donkeys and mules is poorly understood due to a lack of studies in this species; however, as a more desert-adapted species, there are variations in fluid balance, water partitioning, and drug clearance in this species as may be expected leading to subtle variations in pharmacokinetics of drugs, further information may be found in Grosembough et al [51], Matthews and van Loon [52], and Matthews et al [53]. From a clinical perspective, it is useful to be aware that many of drugs used are "off-label" as few are licensed for the donkey. For most of the nonsteroidal anti-inflammatories, there is a requirement for more frequent dosing to

achieve adequate analgesia. With regard to anesthesia, although donkeys respond well to standard doses of alpha agonist, they metabolize ketamine faster and have slower metabolism of guaifenesin when used in "triple drip" recipes, requiring adjustment of the doses to achieve safe anesthesia. For most of the antibiotics that there is donkey-specific data about, an increase in dose frequency for standard donkeys is recommended, but individual data sheets and up-to-date references should be consulted in all cases.

### 6.7. Castration

Donkeys have an increased risk of hemorrhage when castrated by an open method, although the underlying reason for this is not identified. It is recommended that the spermatic cord is ligated in donkey jacks during castration. Many donkeys store excess fat in their scrotal area, and the surgery may need to be modified in mature jacks to ensure minimal risk of infection using an inguinal approach [54].

### 6.8. Control of Parasites in Donkeys

Donkeys are host to a number of endoparasites and ectoparasites; the life cycles of such parasites are often similar to that seen in horses; however, there are some

**Table 2**

Normal physiological parameters for adult donkeys.

| Parameter   | Units       | Average    | Range                |
|-------------|-------------|------------|----------------------|
| Temperature | °C, °F      | 37.1, 98.8 | 36.5–37.7, 97.7–99.9 |
| Pulse       | Beats/min   | 41         | 31–53                |
| Respiration | Breaths/min | 20         | 13–31                |

notable differences [55]. Donkeys are regarded as the reservoir host for *Dictyocaulus arnfieldi*, the equine lungworm; although healthy donkeys tolerate large burdens and can act as significant environmental contaminators, cograzing horses and ponies can be susceptible to clinical manifestations of infection [55]. Similarly, donkeys are frequently infected by the liver fluke *Fasciola* species with few reported clinical effects in healthy animals, and again donkeys can act as reservoirs of infection for other susceptible species including livestock [56]. Of final note is the lifelong susceptibility of the donkey to infection with *Parascaris equorum*, in contrast to horses where immunity to this parasite develops with increasing age, and clinical issues are rarely seen in adult horses and ponies and infection with *P. equorum* in the donkey is found in all age groups and can cause resultant clinical disease; furthermore, donkeys of all ages may act as a significant reservoir for infection of other equids [57].

Treatment of donkey parasites follows the same principles as those for horses although anthelmintics are rarely licensed for use in donkeys; however, experience shows that similar dosing regimens can be used to those recommended for horses and ponies. Parasite control should always focus on prevention rather than treatment particularly in light of increased reports of drug resistance in donkeys [55]. Parasite control systems should focus on reducing environmental contamination with eggs and/or larvae in the case of endoparasites and adult and nymph stages in the case of ectoparasites. Good husbandry can contribute significantly to reducing parasite infestations; for example, ensuring low stocking densities, quarantine of new animals, regular disinfection of buildings and fomites, regular collection of dung from pasture along with correct composting, and ensuring animals are otherwise in good health.

## 7. Conclusions

Donkeys can be seen as challenging by equine practitioners, and their worth is often undervalued in the equine world. An appreciation of their role in supporting human livelihoods, and as lifelong companions or therapy animals, leads to an understanding of how well they have adapted to their original arid environments. Although behavioral, anatomic, and physiological variations exist between the donkey and horse, a careful and methodical approach to donkey care can be very rewarding. There is an increasing interest in this species and a number of sources of information, research advice, and support.

## 8. Further Reading

Further excellent sources of information include:

- The Donkey Sanctuary—[www.thedonkeysanctuary.org.uk](http://www.thedonkeysanctuary.org.uk)
- Wikivet (Donkey)—[en.wikivet.net/donkey](http://en.wikivet.net/donkey)
- The Professional Handbook of The Donkey, fourth Edn, Svendsen, Hadrill, and Duncan, 2008
- Anatomic Differences of The Donkey and Mule. S. Burnham, AAEP Proceedings 2002

- Burden, F. [2012]: “Practical feeding and condition scoring for donkeys and mules”. Equine Veterinary Education, 24: pp. 589–596.
- Pharmacology and therapeutics in donkeys. D.A. Groenbaugh et al, EVE, 2011
- Anesthesia and analgesia of the donkey and the mule. N.S. Matthews and J.P.A.M van Loon, EVE, 2013

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