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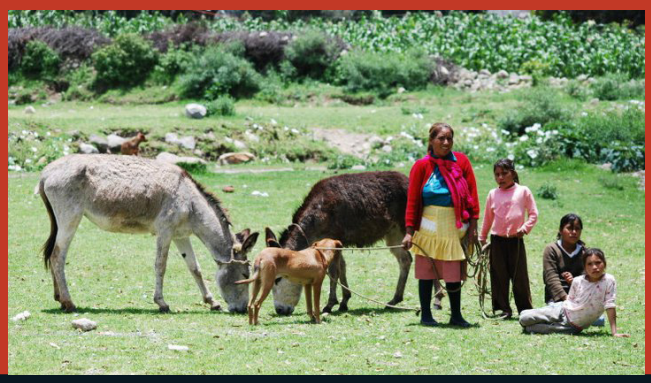

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Editorial

Working equids play a fundamental role in human society, strengthening the human livelihoods and improving the resilience capacity of communities through their contribution to economic, environmental, and social capital. Donkeys, horses and mules facilitate access to vital resources including water and health care. Furthermore, their use in traction, cargo and transportation can be regarded as a significant clean and renewable energy resource, providing a wider, systemic contribution to the sustainability of agroforestry-based economies in a wide variety of ecosystems, such as mountain regions.

Despite playing multiple roles, these animals are largely disregarded, predominantly ignored by decision and policy-makers and seemingly by the scientific community given the minimal number of peer-reviewed publications focused on working equids' health and welfare, especially when compared with research focused on sport equids. That said, this Special Issue is centered on gathering the latest studies and findings regarding this matter, as well as human-equid interactions, which will, undoubtedly, impact positively on the future of these animals, cementing their contribution to human health and livelihood.

On the one hand, El-Hage *et al.* (2023) and Duran *et al.* (2023) present the most common health and welfare issues of working ponies and horses visiting veterinary clinics in Indonesia and Chile. Azelhak *et al.* (2023), on the other, highlight the effects of chronic encircling hobbling in donkeys, a specific management practice with important health and welfare consequences still practiced in many regions of the world.

Working practices, including the type of work, equipment selection and working hours can have important effects on equids' health and welfare. Rodrigues *et al.* (2023) provide important details on the effect of different designs of collars used for logging work over heart rate and include the use of technologies such as dynamometers to assess the force exerted by donkeys while working. Secondly, Lagos *et al*. (2023) incorporate thermography and pressure sensors in the assessment of the impact of different loads on the back of mules doing pack work.

In order to establish successful intervention strategies that can improve the welfare of both, equids and humans, it is pivotal to understand the complex interaction between human and equids, considering and including the perceptions of the caretakers. Here, Watson *et al*. (2023) highlight the importance of incorporating a multifaceted approach that allows building human capacity and empowerment of owners and other stakeholders involved with working equids. Finally, Cousquer (2023) provides a new approach on how we can encourage attitudinal shifts that allow the formation of positive human-equid relationships through partnership and dialogue.

We hope you enjoy the Vol. 55 Nº 1 Special Issue of *Austral Journal of Veterinary Sciences* and find within this several studies the critical contribution working equids have made through our history developing societies, which leads us to encourage its health and welfare.

Guest Editorial Committee
"Working equids" Special Issue, *Austral Journal of Veterinary Sciences*

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ORIGINAL ARTICLE

Diagnosis, treatment and outcome following chronic encircling hobbling wounds in a group of working Donkeys in Morocco

Rabiaa Azelhak[a*], Gigi R. Kay[a], Patrick J. Pollock[b]

ABSTRACT. Owners of working equids in Morocco, as in other low and middle-income countries hobble their animals around the pastern using different materials (wire, baling twine and ropes). Resulting wounds are very common and can cause serious damage. Some hobbles even embed into the soft tissue and bony structures of the pastern. Using a retrospective study of The American Fondouk hospital's clinical records, the diagnosis, treatment and outcomes of embedding hobbling injuries are described. From 2012 to 2020, sixteen donkeys were presented suffering from unilateral severe lameness (4/5 to 5/5 lameness on AAEP scale) associated with hobble wounds. Circumferential wounds and/or fibrosis in the pastern were present in all these cases. Because of the suspicion of the presence of wire or baling twine, radiographs of the pasterns of all animals were routinely taken. Ten out of sixteen showed wire in situ encircling the pastern and the others showed a ghost outline of a baling twine hobble with similar periosteal reactions. All animals were treated by surgical removal of the hobble, wound flushing, systemic antibiotics, and bandaging. The outcome was good to excellent in all cases. In these authors' knowledge, this is the first report in the literature of the diagnosis, treatment, and outcome of embedded hobbles in Equidae.

Keywords: Donkey, working equid, Morocco, hobbles, ischaemia, wound.

INTRODUCTION

In Morocco, in common with many low and middle-income countries, working equids are rarely, if ever, kept in paddocks or stabled. Instead, the vast majority rest outside their owners homes while not working, usually restrained by hobbles attached around the pastern.

The choice of equipment used to hobble these animals is often entirely inappropriate and may result in serious injury. The most detrimental hobble type is that made of baling twine or wire as these materials, when neglected or forgotten, can rapidly become embedded within the soft and bony tissues of the limb. These embedded hobbles lead to a significant, and classically recognized, periosteal reaction around the affected bone, and result in severe lameness, however, clinical signs can resolve surprisingly rapidly once the hobble is removed. Despite the fact that the encircling materials are deeply and chronically embedded within the soft and bony tissues of the limb, ischemic necrosis or synovial structure contamination is apparently rarely encountered. This is in stark contrast to other reports in the veterinary literature of acute wire laceration, or entanglement causing prolonged inadequate perfusion in the distal limb, resulting in severe ischaemic damage and even hoof capsule loss (De Gresti *et al.*, 2008; Jackson, 1969; Ruzickova *et al.*, 2017; Stanek, 1981). This retrospective case series describes the presenting signs, diagnosis, treatment and outcome of 16 donkeys presented to a working equid hospital in Morocco with severe lameness that was associated with hobbles embedded in the soft tissues and/ or the bone of the pastern region.

To the knowledge of the authors, this is the first report of neglected baling twine or wire hobbles embedded around the pastern in equids and yet it is a common and debilitating problem for vast numbers of working equids across the globe. With relatively simple and cheap treatment, the prognosis for affected animals is excellent, in our experience.

MATERIAL AND METHODS

This was a retrospective clinical study and involved a search of the clinical records of all working equids presented to the American Fondouk Hospital in Fez, Morocco, with radiographic evidence of embedded hobbles which was then confirmed at surgery, between 2012-2020.

Any animal presenting with severe lameness plus a draining fistula on the pastern or evidence of scarring or fibrosis around the pastern would routinely be radiographed at this authors hospital, for suspicion of embedded hobbles.

The following information was recorded for each affected case; signalment, reason for presentation, clinical signs, any imaging performed, treatment, type of material used to hobble, length of hospitalisation, outcome, and long term follow up, if available are shown in Table 1.

Radiographs were obtained using a Fujifilm (FCR) capsula system. Latero-medial and/or dorso-palmar/plantar views were available for all cases.

RESULTS

CASE DETAILS

Sixteen cases met the inclusion criteria, and all were adult donkeys with an age range of 2-10 years. All involved

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hobbles around the pastern, 13 of which had been placed on the forelimbs and 2 on the hindlimbs.

There was no mention in the notes for case 16 of which limb was affected. Ten of the donkeys had been hobbled with wire and six with baling twine. Case details and history are presented in Table 1.

HISTORY AND PRESENTING SIGNS

Histories taken from animal owners reported lameness and or discharging tracts dating from one month to as much as one year, and yet most of the owners claimed to be unaware of the continuing presence of the hobble around the pastern. All donkeys were presented with lameness that varied from two weeks to one year. At presentation, the majority were significantly lame at walk (4/5 lameness grade on the AAEP lameness scale). The lesions ranged from small-healed circumferential scars around the pastern with a single draining tract to massive fibrosis and ulceration (Figure 1 A y B).

Radiographic examination identified the presence of wire encircling the pastern in 10 animals (Figure 2 A) and baling twine hobbles, were identified by periosteal changes which suggested the presence of a non- radioopaque foreign body in 6 animals (Figure 2 B).

In the others, bony and periosteal changes ranged from mild new bone formation to extensive changes.

TREATMENT

All embedded hobbles were removed surgically after sedation with xylazine[1] (0.2-0.4 mg/kg) and butorphanol[2] (0.01mg/kg). In addition, an abaxial sesamoid nerve block was required to anaesthetize the distal limb using 2 ml of lidocaine[3] medially and laterally. If a draining tract was present close to the area of the knot as viewed on the radiographs, small curved mosquito forceps were used to localize the wire and exteriorize it such that it could be sectioned. A small incision was then created on the opposite side of the pastern, the hobble exteriorized, and a second cut made through the hobble material so that it could be removed in two sections. The wire or twine was then carefully grasped at the point of the knot and pulled through the overgrown tissue.

Once all hobble material was removed from the wound, the circumferential tract was flushed copiously with sterile saline and an intravenous regional perfusion (IVRP) was performed using ceftiofur (750mg)[4]. The wound was dressed using a medical grade honey dressing[5] and a half-limb single layer bandage was placed. The bandages were changed either daily or every other day until wound healing. Excess granulation tissue was not encountered in any of these animals.

All cases were treated with antimicrobials benzylpenicillin procaine[6] (20000 IU/kg i.m, q12h) with treatment ranging from 4 to 8 days and gentamycin sulphate[7] (6.6 mg/kg i.v., q24h) with treatment ranging from 3-6 days. All donkeys were treated with flunixine meglumine [8](1.1 mg/kg i.v. BID) or phenylbutazone (2.2 mg/kg to 4.4 mg/kg i.v. or p.o., q 12h)[9],[10]. A subcutaneous injection of tetanus antitoxin[11] (1500IU) was performed systematically to all treated cases.

OUTCOME

The details of species, wound location, history when available, lameness grade at presentation, post-surgery and at the point of discharge, presence of wire or baling twine, radiographic changes, treatment protocol and number of days hospitalized and outcomes were all recorded and are presented in Table 1.

In all cases recovery after hobble removal was uneventful. The clinical records from our hospital record the post-operative degree of lameness in seven animals. Of these three were completely sound, immediately after hobble removal and two were rated as 2/5 lame at walk. A further two were rated 3/5 lame at walk. Each of these donkeys had presented on the same day as surgery either toe touching or non-weight bearing lame, suggesting that the presence of the foreign body, rather than associated infection or inflammation was the most significant source of pain.

Hospitalization time varied between one week and six weeks with the majority of animals discharged within a month of presentation. Details of the degree of lameness at discharge were available for 13 of the cases. Of these all were considered by the treating veterinarian to be sound enough to return to work in the context of a working equid. Five were recorded as sound, six as 2/5 and one was reported to have a residual lameness of 3/5 although even that individual returned to work effectively.

1 Aspen Veterinary Resources, USA.

2 Merck Animal Health, Germany.

3 Vetoquinol, France.

4 Aspen Veterinary Resources, USA.

5 Jorgan Kruuse A/S, Denmark.

6 KELA N.V. Belgium.

7 Provet , Rabat, Morocco.

8 Livisto, El Salvador.

9 Vétoquinol, France

10 Atlas vétérinaire, Casablanca, Morocco.

11 Serum institute of India , Hadapsar.

Table 1. Clinical information of cases in the study.

Case Number	Duration of lameness at presentation	Limb affected	Lameness at presentation	Wound Description	Radiographic findings	Hobble material	Treatment	Lameness post surgery	Lameness at hospital discharge	Duration of hospitalisation
Case 1	2 weeks	LF pastern	4/5 lame	Circumferential wound	Full circumferential soft tissue defect	Baling twine	Baling twine removed, 3 IVRP	NI	Sound	8 days
Case 2	NI1	RF pastern	4/5 lame	Circumferential wound with draining tract laterally	Periosteal reaction P1 + baling twine outline	Baling twine	Baling twine removed, 2 IVRP	NI	2/5 lame	21d
Case 3	1 year	RF pastern	4/5 lame	Circumferential wound +extensive fibrosis + bone exposure	Periosteal reaction P1 + baling twine outline	Baling twine	Baling twine removed, no IVRP mentioned	2/5 lame	2/5 lame	25d
Case 4	4 months	RF Pastern	NI	Circumferential wound	Periosteal reaction P1	Baling twine	Baling twine removed, 2 IVRP	3/5 lame	NI	34 d
Case 5	3 months	LF Pastern	4/5 lame	Circumferential wound	Periosteal reaction P1+ baling twine outline + foreign body visible	Baling twine	Baling twine removed, no IVRP	NI	2/5 lame	19 d
Case 6	2 month	RF pastern	4/5 lame	Circumferential extensive fibrosis and scaring with a single draining tract laterally	Periosteal reaction P1 + baling twine outline	Baling twine	Baling twine removed,3 IVRP	Sound at walk	Sound	40 d
Case 7	> 4 month	LH4 pastern	5/5 lame	Circumferential scarring with single draining tract dorsally	Periosteal reaction P1 + wire visible	Wire	Wire removed, 4 IVRP	2/5 lame	3/5 lame	20 d
Case 8	2 weeks	RF pastern	5/5 lame	Circumferential wound with draining tracts	Periosteal reaction P1+ wire visible	Wire	Wire removed, 3 IVRP	Sound at walk	Sound	20d
Case 9	NI	RF pastern	4/5 lame	Circumferential wound with single draining tract dorsally	Periosteal reaction P1+ significant Defect	Wire	Wire removed 3 IVRP	3/5 lame	2/5 lame	33d

Case Number	Duration of lameness at presentation	Limb affected	Lameness at presentation	Wound Description	Radiographic findings	Hobble material	Treatment	Lameness post surgery	Lameness at hospital discharge	Duration of hospitalisation
Case 10	NI	RF3 pastern	5/5 lame	Circumferential wound	Periosteal reaction P1+wire Visible	Wire	Wire removed 3 IVRP	NI	2/5 lame	54D
Case 11	NI	LF pastern	4/5 lame	Circumferential wound with a single draining tract dorsally	Periosteal reaction P1	Wire	Wire removed 3 IVRP	NI	NI	10d
Case 12	NI	RF pastern	4/5 lame	Circumferential fibrosis and scarring with single draining tract lateraly	Periosteal reaction P1 + wire visible	Wire	Wire removed, 3IVRP	Sound at walk	Sound	10 d
Case 13	NI	RF pastern	4/5 lame	Circumferential wound	Periosteal reaction P1+ significant defect	Wire	Not mentioned	NI	NI	28d
Case 14	NI	LF3 pastern	4/5 lame	Circumferential wound	Periosteal reaction P1 + wire visible	Wire	Wire removed 3 IVRP	NI	Sound	NI
Case 15	NI	RH4 pastern	5/5 lame	Circumferential scarring with single draining tract dorsally	NI	Wire	Wire removed, no IVRP mentioned	NI	2/5 lame	NI
Case 16	NI	NI	4/5 lame	Circumferential fibrosis with single draining tract dorsally	Periosteal reaction P1+ significant defect+wire visible	Wire	Wire removed, 2 IVRP	NI	NI	NI

NI: no information available.
IVRP: Intravenous Regional perfusion.

DISCUSSION

Working equids, that is horses, donkeys and mules, play a critical role in supporting the income generating capacity of their owners in low and middle income countries and are essential in both agricultural and urban arenas (Fielding, 1991). Poor management strategies, as a result of ignorance and poverty, are at the root of many of the health problems encountered in this population (Lindberg *et al.*, 2003). The incorrect use of hobbles, or the use of incorrect material for making hobbles, is one example of poor management (Kay & Ouassat, 2002).

The use of hobbles for containing working equids is ubiquitous in Morocco and in many other countries in the developing world where access to paddocks is limited (Pritchard *et al.*, 2005). The use of these hobbles entails many risks. All over the world, the safe containment of horses poses challenges. Post and rail paddocks probably represent the gold standard in horse containment and yet even this type of fencing can lead to injuries. In one survey of 180 horse owners run by The Equine Research Centre in Guelph Ontario, 27% of respondents reported accidents caused by fencing, of which 63% were caused by wire fencing and 13% caused by post and rail (Virginia Cooperative Extension, 1999). In many developing world countries, these containment issues are hugely compounded by the fact that access to grazing is transient and temporary and therefore paddocks are largely unknown. Instead, working equids are more often than not, kept tied up, often on long ropes to allow maximum grazing, and left unsupervised outside to forage. In Morocco, entanglement in these grazing ropes is very common and the resultant acute injuries range from mild rope burns to catastrophic lesions with associated musculoskeletal problems including torticollis and fractures. Attaching grazing animals using hobbles around the pasterns causes chronic limb lesions ranging from mild abrasions to tendonitis, laceration, ischaemia and tetanus (Kay *et al.*, 2004).

Previous studies in working equid populations from a number of low and middle-income countries have shown that nearly all working equids have visible lesions or scars from hobbles. In Ethiopia a study of 497 equids reported 98-100% of animals had hobble lesions (Mekuria *et al.*, 2013) and in a multi country study from Afghanistan, India, Egypt, Jordan and Pakistan involving over 4000 animals, between 62 and 88.8% of animals showed lesions or scars from hobbles (Pritchard *et al.*, 2005). In Morocco a study of 1713 equids showed 10% of animals with current lesions and a further 20% with evidence of previous lesions (Kay & Ouassat, 2002).

The severity of the lesions associated with hobbling the limb of an individual animal will depend on the material used for the hobble and how long the hobble is left on (Kay & Ouassat, 2002). In the 16 cases reported here, hobbling had been carried out with baling twine or wire, the cheapest, most readily available and probably most inappropriate of materials. Hobbles are sometimes left on the animal permanently, irrespective of underlying inflammation and this explains how these hobbles, with time, had come to embed themselves deeply within the soft tissues of the pastern.

Diagnosing the presence of an embedded hobble is reasonably straightforward. Presenting signs are almost pathognomonic and all equids suspected of having embedded hobbles were subject to radiographic views. All the donkeys in this case series presented with one or all of the following signs: a small draining tract at the level of mid pastern, an associated circumferential lesion (Figure 1 A), which may have been almost entirely healed by the time of presentation or may show massive soft tissue proliferation and severe lameness (4/5 to 5/5 on AAEP lameness scale). The severe lameness was a feature of all the animals in this case series. Notably the hobble could not be visualized, nor palpated at the skin surface on any of our cases. Radiography confirmed the diagnosis in all cases with wire hobbles (Figure 2 A) and in all but one of the animals with a baling twine hobble, periosteal changes were evident that suggested the presence of a non-radio-opaque foreign body (Figure 2 B). The majority of the cases presented here had evidence of massive periosteal and bony reactions to the presence of the foreign body, both wire and baling twine. An image of the first phalanx of a donkey that had presented many years previously and been euthanased prior to hobble removal shows the typical effect of this wire on the periosteum of the pastern (Figure 2 C).

Embedded hobbles are a problem of equids in low and middle income countries where most veterinarians will not have access to radiography, however the clinical picture is so consistent that even without radiographic evidence, exploring the pastern for an embedded hobble would be worthwhile in any equid presenting with the clinical signs described here. Once diagnosed, treatment is remarkably simple and effective and requires no special equipment or even hospitalization. Recovery can be dramatic with many animals being immediately sound after removal of the foreign body, and all of our cases were discharged as sound enough to be useful as a working equid. There was no evidence in any of our cases that the hobble had penetrated any joint or synovial structure. Any joint contamination or osteomyelitis would be expected to result in severe lameness even after hobble removal which was not the case in our series of animals. Similarly, there was no evidence of associated tendon injury despite radiographic evidence that indicated extreme constriction and even penetration of the cortex (Case 1 and Case 14). Any palmar constriction around the pastern might logically have been expected to lead to tendon transection, tendon laceration or severe tendonitis, however, post-surgery, no individual showed any evidence of loss of support to the limb, or alteration in posture or function, any of which would be indicative of severe tendon injury or transection. Complete tendon

Figure 1. A) Circumferential wound on the right hind pastern with a draining tract and soft tissue swelling around and above the hobbling materiel (wire in this case); B) Extensive circumferential fibrosis with severe swelling (the hobbling materiel in this case was a bailing twine).

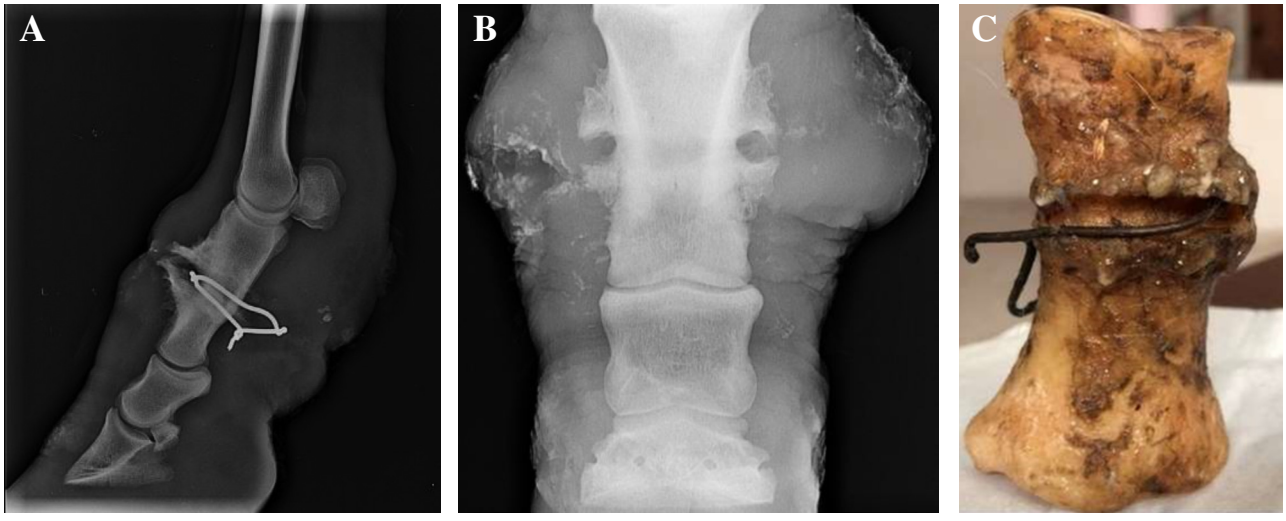

Figure 2. A) Latero-medial radiographic projection of the right forelimb. Note the encircling radiopaque foreign body at the mid first phalanx with extensive periosteal reaction; B) Dorso-palmar view of the right forelimb first phalanx with axial and abaxial extensive periosteal reaction forming an outline of the embedded foreign body (baling twine); C) Post mortem findings of a donkey with embedded wire in the pastern associated with extensive periosteal reaction.

transection is associated with significant alterations in limb conformation under loading, although partial severance or tears may not alter tendon function (Smith, 2008). Because of this, palpation of the palmar or plantar aspect of the pastern was routinely performed once wound healing was complete and if the animal remained lame.

Donkeys showing evidence of heat or pain focused on the palmar aspect of the pastern would have an ultrasonographic

assessment. None of the animals that were evaluated showed any discernible tendon abnormality either in shape or size, however longitudinal tears of the DDFT are often difficult to assess ultrasonographically (Smith, 2008) and the very small size of the donkey pastern makes ultrasonography of this region challenging. The existence of tendon tears or mild tendonitis cannot therefore, be completely ruled out as a cause of the mild residual lameness that was seen in 7 of our cases at discharge.

Localized infection was evident in most of our cases although generally this was restricted to the pastern. The extensive cellulitis, that is a common sequelae to many distal limb injuries in horses (Ruzickova *et al.,* 2017), was not evident in any of our cases, although all were treated with distal limb IVRP and/or systemic broad spectrum antibiotics as a precautionary measure. Many donkeys presenting with embedded hobbles had few external wounds except for single draining tracts, and wound treatment in these cases was restricted to flushing the tract after wire or twine removal, followed by bandaging as support and prevention of further contamination. Where cutaneous wounds were evident, sterile Manuka honey dressings were applied and changed daily. Whilst the evidence for the use of medical grade honey is somewhat conflictual, it has been shown in several recent studies on iatrogenically inflicted wounds on both forelimbs, that application of Manuka honey dressings reduces wound area by reducing retraction and that treated wounds remain smaller than contralateral controls and heal faster overall (Bischofberger *et al.*, 2011; 2013).

It is hypothesized that Manuka honey owes its antibacterial properties to a number of factors, most important of which are the small quantities of hydroperoxide and methylglyoxal (MGO) otherwise known as UMF - Unique Manuka Factor. These factors combined with the low pH (around 4) of honey inhibit bacterial growth and potentially stimulate fibroblastic activity (Carnwarth *et al.*, 2014). Contaminated sloughing and necrotic wounds, particularly those which require ongoing debridement are ideal candidates for the use of medical grade Manuka Honey (Carnworth *et al.*, 2014) and this made it the dressing of choice for the more severe cutaneous wounds in our group of donkeys. The downside of this dressing is cost and availability. Manuka honey dressings are a relatively expensive option in a working equid context and not available in many developing world countries. Localized infection was evident in most of our cases although generally this was restricted to the pastern. The extensive cellulitis that is a common sequelae to many distal limb injuries in horses (Ruzickova *et al.*, 2017), was not evident in any of our cases, although all were treated with distal limb IVRP and/or systemic broad spectrum antibiotics as a precautionary measure.

Some hobbling injuries can be associated with fatal outcomes, either through fractures or the development of tetanus, particularly so in parts of the world where working equids are not routinely vaccinated. All animals in this case series were treated with tetanus antitoxin as hobble lesions have been reported as one of the main causes of tetanus infection amongst working equids. In one study of 56 equids with tetanus, and 7 animals were thought to have developed tetanus through contamination of hobble lesions (Kay & Knottenbelt, 2007).

Distal limb lacerations, in all equidae, frequently involve vascular compromise with subsequent ischeamic damage and even sloughing of the hoof capsule (Ruzickova *et al.*, 2016). In our series despite the apparent tightness and bilateral constriction of the hobble identified radiographically in most animals, hoof sloughing or ischaemic damage was not a feature. It is probable that the chronic, insidious, nature of vascular compromise associated with hobbling allowed the development of alternative vasculature. Indeed, it has been shown that collateral vessels can develop in the 2-4 weeks following vascular damage (Keen *et al.*, 2008) and this adaptability may have been protective in these cases. Imaging modalities such as digital venography or arteriography have been used to visualize the vascularity of the equine digit (Redden, 2001; Walker *et al.*, 2017) and it would have been interesting to evaluate any compromise of the vessels of the digit in our cases.

The species distribution of our case series is notable. Despite having a case load in this hospital of approximately equal numbers of horses, mules and donkeys, it is only donkeys that have ever been presented with hobbles embedded around the pastern. This may be a function of their intrinsic value; being of less value than the horse or mule, less care is taken over their wellbeing. Or alternatively it may be a function of their stoic nature; owners may feel that they are less likely to cause themselves harm therefore less care is required in their maintenance and therefore owners may choose to use wire rather than a more appropriate material. It is also striking that in both of the studies on the incidence of hobbling lesions, donkeys are much more likely to show lesions than horses or mules. In the Pritchard study, 88.8% of donkeys had lesions or scars compared with 62% of horses and, in the Kay study from Morocco, 45% of donkeys as opposed to 28% of horses showed lesions or scars. This is some indication that owners will expend more thought and care on the choice of hobble materials for more valuable animals and that there is some understanding of the risks of using wire and twine to tether horses. Much work has been done in various countries and by various Governmental and non-governmental organizations to educate owners on improved hobbling practices and limit the devastating consequences of this poor management practice.

A program of owner education and supply of appropriate non traumatic hobbles has been in place for many years in Morocco, set up by this author at working equid clinics throughout the country (Kay & Ouassat, 2002). Although it is clear that much benefit to welfare can be achieved through educating owners on the use of non-traumatic

hobble material such as thick cotton rope, it is much more challenging to suggest a cost effective means of allowing animals to graze that does not rely on long grazing ropes. An obvious answer would be to use electric fencing which would allow animals to temporarily graze different areas. Unfortunately, the cost involved in purchasing such a set up would make this unworkable for the vast majority of working equid owners.

In conclusion, this is the first report on the treatment and successful outcome of a group of working donkeys treated for chronic encircling hobbling injuries of the distal limb. Clinicians treating working equids, should be aware of the clinical signs, classical radiographic appearance, even in the absence of radio-opaque hobbling material, and excellent prognosis following treatment despite severe presenting clinical signs.

COMPETING INTERESTS STATEMENT

The authors declare that they have no competing interests.

ETHICAL STATEMENT STUDIES

A verbal consent form was obtained from animal's owners.

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None.

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ORIGINAL ARTICLE

The welfare and access to veterinary health services of mules working the mountain trails in the Gorkha region, Nepal

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ABSTRACT. Working equid populations are mainly present in low to middle-income countries, their work directly contributing to the lives of people reliant on their presence. Although assistance from working equids is important to support people and their communities in these regions, their welfare is often poor. This study aims to provide insight into the welfare status of mules distributing supplies in the Gorkha region of Nepal; a population of working equids which has been largely overlooked and under recorded. The welfare of mules was assessed via the Equid Assessment Research and Scoping (EARS) tool using a trained assessor; livelihood surveys gathered basic demographic and ownership information; and semi-structured interviews gained the perspectives of 26 key informants. Mule body condition was found to be ideal in many cases, but their management was in the majority of cases inappropriate; characterised by integumentary trauma from equipment use and inhumane handling, unsuitable dietary provision, and insufficient access to water. This difficult situation was compounded by inadequate access to suitably qualified, experienced veterinary professionals able to offer appropriate levels of support. Organisations aiming to improve welfare in these remote locations need a multifaceted approach where owners are facilitated and empowered to improve the welfare of their own equids; in addition, industry professionals are encouraged to improve training and provision within veterinary services.

Keywords: working equids, equid welfare, EARS, veterinary services, welfare assessment, equid behaviour, diet, harnessing equipment.

INTRODUCTION

This prospective study will document the welfare of mules distributing supplies along the mountain trails of the Gorkha region of Nepal; an under recorded mule population and environment. Using a combination of qualitative and quantitative data collection the welfare issues around working mule management including diet, access to water, harness equipment, behaviour and owner access to veterinary services will be investigated.

Throughout history, equids have been used for work alongside people. Though the industrial revolution overcame their usefulness in most higher income countries as mechanisation took over (Alves, 2018; Heinberg, 2006), their importance in low- to middle-income countries (LMIC) has persisted. The global equid population is estimated to be approximately 112 million (FAO, 2019; Norris *et al.*, 2021), of which around 43% can be found in Asia (Mitra & Valette, 2017). Working equids continue to be an economic necessity for the poor communities they support in LMIC (Alves, 2018), though they are now in decline in some areas where people can afford to give mechanisation precedence (Starkey, 2010).

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There is heavy reliance on working equids within remote, hard to access mountain communities (Rodrigues *et al.*, 2017), where they contribute to food security, income, traction, transport, sustainable agriculture, employment, and social status (Bettencourt *et al.*, 2015; Brooke, 2021). Though there are many positive benefits of animal ownership it does not come without risks; the transmission of zoonotic diseases in the absence of adequate animal and human health programmes (Bettencourt *et al.*, 2015), lack of owner awareness and lack of access to basic services increases risk of harm from disease transmission (Stringer, 2014). Many of the world's poorest people live in remote rural communities (FAO, 2022) and a lack of access to resources can have a real impact on the health and welfare of domestic animals (Letsoalo *et al.*, 2000; Wild *et al.*, 2021), people, on the wider environment and wildlife (Pinillos *et al.*, 2016).

Animal Nepal (AN), a non-governmental organisation (NGO) aiming to improve animal welfare throughout Nepal, has been operating in the Gorkha district since 2016 offering owners free advice, vaccinations and treatments for their working mules. Despite their presence, the prevalence of injuries, wounds and disease continues to pose a serious threat to mule health and welfare (AN, 2016). To understand the scale of the challenges facing working equids operating in this region this study utilised previously evaluated methodology (Kubasiewicz *et al.*, 2022; Nye *et al.*, 2021; Watson *et al.*, 2020). The Equid Assessment Research and Scoping (EARS) tool (Raw *et al.*, 2020) is used to assess welfare, livelihood surveys gather demographic information, and semi-structured interviews gain insight into owner perspectives about the management, health and care of their mules.

MATERIALS AND METHODS

We used a mixed methods approach based around semi-structured interviews (SSIs), livelihood surveys, and equid welfare assessments using the EARS tool (Raw *et al.*, 2020). Prior to each interview, livelihoods surveys gathered basic data from participants regarding both their own demographics and mule ownership or handling. All interviews and assessments with owners were undertaken whilst owners and equids were at rest. The sites varied but most were in communal areas within village boundaries while a few were conducted in owner's yards.

STUDY SITE AND ACCESS

Fieldwork was conducted 12th November to 25th November 2018 in Gorkha, Nepal. This region was chosen due to its proximity to Kathmandu where a partner organisation, Animal Nepal (AN), is located. AN provided logistical support, working knowledge of the study area and interpreters able to communicate in local dialects and who were also fluent in English.

The Gorkha study sites comprised the communities of Arkhet Bazar, Soti Khola, Maccha Khola, and Tatopani. Gorkha is a region characterized by mountains and steep sided inter-mountain valleys, where subsistence farming takes place alongside hospitality businesses supporting the mountain tourism trade. Most villages were accessible only on foot, with the exception of Arkhet Bazar and Soti Khola, although the types of vehicles that could access these villages were limited to off-road vehicles and some trucks/ buses (excluding livestock vehicles).

PARTICIPANT RECRUITMENT

Participants, both human and mule, were secured in some locations whilst attending veterinary intervention clinics organised by AN, whilst others further up the trails had to be sought on an *ad hoc* basis within each village environment. There were no time limits for our interactions with people and mules, though owners/ drivers did sometimes have to leave for work. All interviews were conducted with individual owners/ drivers apart from one mule owner/ driver group who were interviewed together. Participation was voluntary and unpaid, inclusion criteria being that a person was a mule owner, driver or trader and over 18 years old. Consent was obtained verbally and audio-recorded.

Human population density in the region is very low; the number of mule owners/ drivers was thus limited. This created opportunity for longer interviews, where participants' availability permitted.

DATA COLLECTION

Quantitative data – livelihood surveys. Each survey was recorded electronically on a digital device using an Open Data Kit (ODK) Collect (Hartung *et al.*, 2010) form containing pre-set questions (see supplementary materials). Questions recorded demographic information such as age, gender, ethnic group, religion, job role and income, and details about mule ownership. Data were uploaded to a UK based server when reconnected to the internet. The survey formed part of a comprehensive survey for use in a wider project but for the purposes of this article basic demographics of age, gender, job role and the main issues that concerned owners about their mule health and welfare are included.

Quantitative data – EARS assessments. Welfare assessments were conducted by one trained assessor (TW) on a total of 166 mules (geldings = 156, stallions = 10), belonging to 17 owners following the scoping protocol for the EARS tool. For full guidelines on the EARS scoping methodology see Raw *et al.* (2020). Not all sections of EARS were used but are part of a wider study; the sections of EARS pertinent to this study have been added to supplementary materials.

Due to the nature of the field study locations some mule owners removed their animals for work before assessments could be undertaken, and a group of mule owners were interviewed after work without their animals present; so, assessments were not completed for the equids of all owners. Body condition was scored using a scoring system developed specifically for donkeys (Thiemann *et al.*, 2018), where 1 = poor (very thin), 2 = moderate (underweight), 3 = ideal, 4 = overweight (fat), 5 = obese (very fat). There are currently no body condition scoring systems developed specifically for mule assessment, the donkey body condition scoring system has been found to be sufficiently accurate for use until a system is designed for mule assessment (Burden, 2012). Where possible, welfare assessments were performed whilst interviews were taking place. Data were inputted into an ODK Collect (Hartung *et al.*, 2010) form on a digital device (phone or tablet). ODK Collect is a data collection app, used to gather raw data in a convenient way onto any digital device. Data was transferred to the UK server once the equipment reached an internet connection.

Quantitative data were uploaded to the software package R version 4.1.3. (RCoreTeam, 2022). Data were explored using Tidyverse, which enables data visualisation and the plotting of graphs (RCoreTeam, 2022; Wickham, 2021). We present the results as a percentage of the total number of people that answered that questions, and percentage of mules that were assessed and presenting for each particular aspect of EARS.

Qualitative data – semi-structured interviews. Semi-structured interviews (SSIs) were conducted by TW and LMK, and lasted between 20 – 54 minutes with twenty-four mule owners/ drivers including one mule trader, and two veterinary technicians; interview length was dependent on the availability of owners. SSIs gave scope for richer data capture of the personal experiences of those working

with mules. Core questions (see supplementary materials) based on pre-determined themes formed the initial basis of interviews, but as owners relaxed and spoke freely unexpected themes emerged inductively. Participants were allocated a code to ensure all data were anonymised. SSIs were conducted in Nepalese via Nepalese interpreters from AN, from questions given in English by LMK and TW. They were recorded by Dictaphone and translated during the recordings. Qualitative data were uploaded and analysed using the software package Nvivo (Nvivo 12 qualitative data analysis software, V.12.5.0, QSR International). During coding, although some themes were predetermined, an iterative inductive approach allowed analysis and identification of new emerging themes; saturation was reached when no new codes were being generated. For this article themes concerning mule welfare, access to veterinary services, and behaviour were included.

RESULTS

LIVELIHOOD SURVEYS

Twenty out of the 24 equid owning participants (83%), including one mule trader, expressed their primary job role as being a mule owner; the remaining four (17%) expressed their primary job role as hotel or shop owner, these four relied upon mule drivers to handle their equids.

Length of ownership varied from 1 year to 20 years, with the mean being 8.4 years. Twenty one percent (n=5) of mule owners were female. The largest cohort of mule owners 67% (n=16) were in the age range 30-50 years old, 25% (n=6) were 18-30 and 8% (n=2) were over 50 years old.

Owners reported that colic 28% (n=6), nasal discharge 24% (n=5), trypanosomosis 24% (n=5), lameness 19% (n=4), and tetanus 5% (n=1) were the main concerns affecting their mule health and welfare.

EARS WELFARE ASSESSMENTS AND QUALITATIVE DATA

All of the assessed equids were mules, there were no other equid species observed in this region whilst undertaking the study. Mules were assessed during their rest periods either before or after work. The primary role of all the mules was as a pack animal carrying goods for distribution to households and businesses along the trails as part of mule trains handled by either their owner or a hired driver. Mules were used to transport goods which were too heavy for people to carry such as bags of rice or oil, and building supplies including bags of sand and cement, and reinforcing rods (to make houses more resistant to earthquakes). Inhabitants did not own a mule for any reasons other than work, and all those without mules relied on mule trains to distribute heavier or bulky goods which were difficult to transport on foot.

BEHAVIOUR

Equids were afforded some degree of social contact; while at rest mules were tethered to a long rope line connecting a group of familiar equids at intervals along its length, each group belonging to an individual owner. Equids were able to touch their immediate companions and some were able to mutual groom. Five percent (n=3) showed minimal injuries which seemed to be of equid origin e.g., bites on neck and face. Some owners did recognise that their mules bonded or had particular companions they preferred to work alongside which would help the stability of the group when managing them.

> […] but in the morning when he saw he was dead [a mule] and there was another mule which was his partner, his partner was always walking with him, he can't walk without him and now he gets lost. (Mule owner)

Counter to this we observed the mule trader separating bonded companions for sale and, despite any mules being separated exhibiting stressed behaviour (becoming highly mobile, straining at their tethers and vocalising), the mule trader continued keeping bonded mules apart.

Mules were assessed for behavioural responses; 49% (n= 81) were either aggressive, head shy, showed the whites of their eyes, and/or showed startle/ unpredictable responses to assessor approach; 51% (n=85) were friendly on initial approach, though 4% (n= 6) of these then showed unpredictable or sudden movements whilst being assessed. There was some relationship between body condition and behaviour; mules showing ideal body condition exhibiting positive relaxed behaviours compared to those with thin/ moderate or very thin/ poor condition (Figure 1). Of the 2% (n =3) equids exhibiting apathetic behaviour, all showed other signs of ill health having open wounds, nasal and eye discharge; one mule was in particularly poor health being expected to continue working with a broken hind leg and wounds infested with flies; particularly warble flies. One mule, on closer inspection by a veterinary surgeon, was suspected to be suffering from glanders.

AGE OF MULES

Over half the mules (54% n=88) could not be aged due to their aversive or aggressive behaviour or being removed by the owner before being assessed. Of those that could be assessed 44% (n=34) were over five years old, 24% (n=19) were over three years old but under five years old, and 31% (n=24) were over one but under three years old. Only one animal assessed was over 20 years old.

INTEGUMENTARY TRAUMA

Eight percent (n=14) of mules could not be assessed for integumentary trauma either due to aversive behaviour or

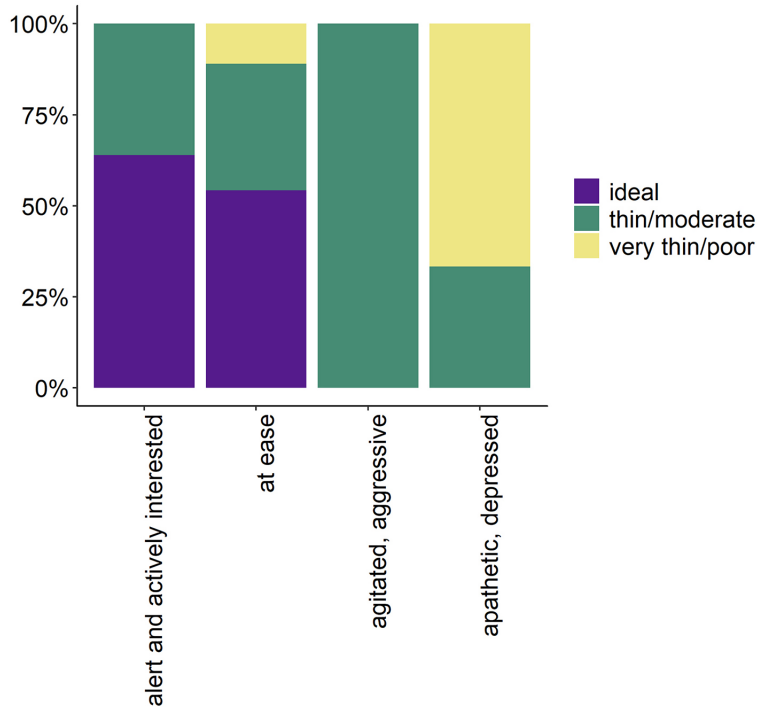

Figure 1. Proportion of mules (n=166) according to their body condition for each behavioural state

because of equipment covering their bodies. Of the 92% (n=152) which could be assessed for skin alterations, 92% (n=140) showed some form of integumentary trauma. All these mules had scars and/or open wounds on the upper midsection of their backs associated with packsaddle placement (Figure 2). Eighteen percent (n=28) had scarring or wounds around the base of their tails from crupper use. Four percent (n=6) of mules which did not have skin alterations in either of these locations had scarring around the pectoral area consistent with breast collar/strap equipment. Two percent of mules (n=3) showed wounds in areas of the body (hindquarters) where mule handlers were seen using stones to drive their mules forwards or change their direction; the injuries were consistent with the use of excessive force (Figure 2). One percent (n=2) had open wounds on the labial commissures of the mouth from ill fitted or poorly designed bits (the metal bar of a bridle inserted in an equids mouth to aid control).

Of the 33 (22%) animals exhibiting open wounds (Table 1), 50% had wounds located in the upper midsections of their bodies. Eighteen percent (n=6) of open wounds were located on the hindquarters, mainly associated with crupper use which is considered an essential harness equipment for pack animals working steep terrain. The integumentary trauma we recorded was highlighted by the local veterinary technician as being an issue of concern.

> I see the wounds in the tail, the back […] It happens because of the tight belt (crupper and girth), taking heavy loads for a long time, they don't get a proper rest, so I think if we do those things like, loosen the belts and clean and see whether the belts are old or not, and get [mules] rested, then I think we can solve that. (Veterinary technician)

Most open wounds (94%) were localised (n=31) with one mule showing diffuse lesions of unknown origin in vertical stripes down all four legs. Seventy eight percent (n=25) of open wounds were of partial thickness, 16% (n=5) were full thickness and 6% (n=2) were superficial. All wounds in the partial and full thickness categories were associated with equipment failure, in fact almost all integumentary trauma was related to pack saddle use (Figure 3). Superficial wounds were associated with self-trauma (3% n=1) or direct injury (3% n=1) from ectoparasites such as flies and leeches.

Table 1. Location of skin alterations – open wounds (n=32) in mules.

Location of wounds	Number of mules	Percentage
Upper Midsection	16	50
Hindquarters	6	19
Lower Midsection	5	16
Front Legs	3	9
Head	2	6
Total	32	100

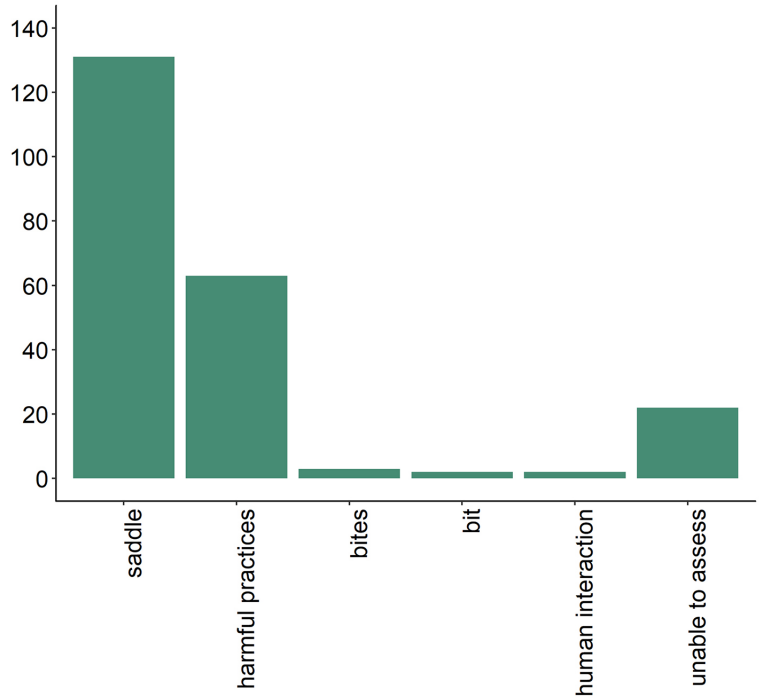

Figure 2. Causes of skin integumentary trauma in 166 mules assessed.

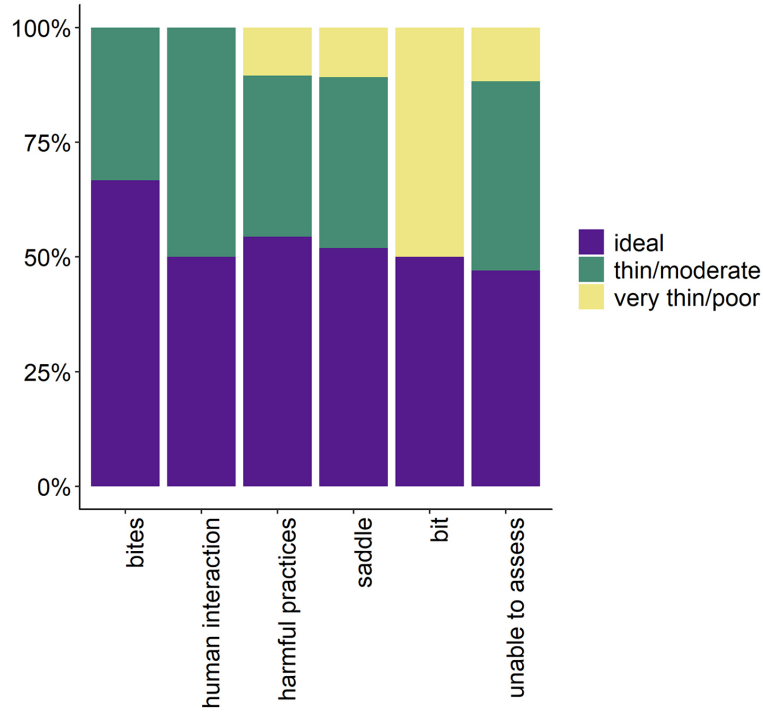

Figure 3. Distribution of mules according to their body condition and cause of wounds.

All mules were subject to tethering whilst not in work – each mule was tied, via a rope attached around one front pastern, at a distinct interval along a rope connecting all the mules owned by each individual owner. Forty percent of mules (n=67) showed skin alterations such as areas lacking hair in the location, and 9% (n=3) had open wounds on the front legs associated with these harmful practices (though one had bleeding legs from leeches). A further 9% (n=3) had wounds associated with insect bites and associated eye rubbing where mules tried to relieve the irritation.

Approximately 50% of mules with wounds for which we were able to determine the cause were of ideal body condition. The majority of the remaining mules **(40%)** were thin/ moderate in all categories, 10% of mules were in very thin/ poor condition (Figure 3).

BODY CONDITION AND DIET

Fifty two percent (n=87) of mules presented with ideal to fair/ lean body condition, 34% (n=56) presented with thin/ moderate, 9% (n=15) were thin/poor, the remaining mules (4% n=7) could not be assessed due to aversive behaviour (Figure 4). Highly calorific, starch-based foods were offered by owners at distinct time intervals, once in the morning and once at night, with no access to forage until late in the afternoon when equids were given a limited opportunity to graze.

There was limited access to water when mules were working, and owners failed to offer mules sufficient water at rest times; despite mules ingesting exclusively dry, cereal-based feed via nosebags, they were not offered water before starting work. After work, mules were tethered and offered water from buckets handed round by owners; mules were not given an opportunity to drink until satiated. Every evening mules were usually tethered by a short rope within the confines of their owner's yard with no free access to water during this time. Throughout the day, access to water was either absent or very limited as mules were continually driven on whilst working or were tethered away from water sources when resting.

In Soti Khola, a mule owner ran a pipe from a stream to a large vessel placed at the exit/ entry point of the village giving access to all mule owners to permit their mules to stop and drink any time they were passing. Despite this opportunity, many owners/ drivers were witnessed driving their mules fast past the water point without allowing them to drink (TDS, field notes, 2018).

HOOF CONDITION AND LAMENESS

Of the 151 mules assessed for lameness, 95% (n=144) showed no apparent lameness. The remaining 5% (n=7) were lame but still working, despite three being severely lame and barely able to bear weight; a score of 5 using the American Association of Equine Practitioners (AAEP) lameness scale where '5: Lameness produces minimal weight bearing in motion and/or at rest or a complete inability to move' (Keegan *et al.*, 2010). Two percent of mules (n=4) had signs of hoof neglect or disease; the rest appeared in good condition.

OTHER SIGNS OF ILLNESS

Though integumentary trauma was very visible and occurred in the majority of mules, during the livelihood surveys when owners were specifically asked what they felt were the main issues with their mules, integumentary trauma was not reported as being an issue. During interviews all owners expressed their stress about losing mules to illness, particularly about the costs of replacement.

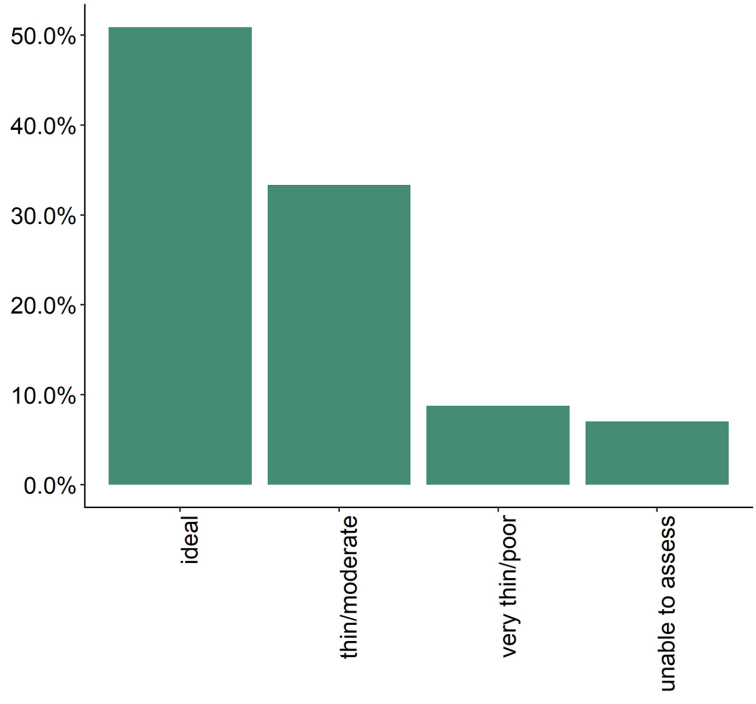

Figure 4. Distribution of the assessed mules (n=166) according to their body condition

> I am worried, we will have lots of tensions [if a mule dies] because one mule costs one Lakh[1] to 85,000 or 95,000 [Nepalese Rupees] so I lose that money [when each mule dies], and when I have lots of tension, I drink. (Mule owner)

They expressed concerns about the dangers of working the mountain trails.

> In the high up hills, there are certain places where the stones fall down continuously […] and the terrain is so slippery that they [the mules] fall down [the steep slopes]. (Mule owner)

One female owner had lost six out of her thirteen mules when she employed a driver to work her mules for her on the routes, the mules mainly died falling on the slopes but others from drinking contaminated water and from heat stroke. She suspected the mule driver was not taking due care of her mules and had been driving them too fast and hard, she had since employed a new driver.

> We have to make him [mule driver] act more responsibly and make him aware of the routes and the walking styles of our mules […] because of his [the mule driver] irresponsibility and lack of understanding [of mule needs] my six mules fell down and died, I did not want to keep him so I replaced him and now he [the new mule driver] is ok. (Mule owner)

During welfare assessments, suspected trypanosomosis (from onsite veterinary assessment but not further diagnostic tests) was the most common cause of illness recorded by the assessor (Table 2). Though not recorded during assessments (as the episodes happened with mules outside of assessments), the AN vet and assessor treated mules suffering from impaction colic with regularity during the field work. Some mules were recorded exhibiting pica of equid dung and soft plastics such as that used for bags and sheeting (TDS, field notes, 2018).

Table 2. Other signs of illness in mules recorded during assessments.

Other signs of illness	Number of Mules	
Trypanosoma	10	37
Nasal Discharge	7	26
Eye discharge	6	22
Infestation of *Oxyuris equi* in limbs	2	7
Blindness (in one eye – mule still at work)	1	2
Glanders (suspected due to enlarged lymph nodes in neck, veterinary checked)	1	2
Total	27	100

VETERINARY SERVICE PROVISION

Though there was some veterinary support given by Animal Nepal, this was largely through occasional but regular field clinics given in Soti Khola. These clinics cannot provide the more routine services which owners caring for animals require on a more frequent, sometimes daily basis, for instance if an animal is sick. Routine veterinary services were being provided by the placement of veterinary technicians at two of the villages in the study area, Soti Khola and Macchkhola. Their service provision was limited to administration of over-the-counter medicines not requiring prescription; having to depend on other input when prescribed medication was required by either calling a qualified veterinarian over the phone for guidance or through the occasional visits by veterinarians via field clinics (with NGOs).

Both technicians had specialised training of 15 months duration which focused on other livestock and companion animals; the equid related training consisted of one week and was given by another organisation in Kathmandu after the main course had ended. Supervision occurred during the training period but once qualified the technicians were expected to operate alone from their posting with only limited support from veterinarians via the telephone.

> I have to do the diagnosis of the disease according to the symptoms and try to find out what should I give and what should I not give, I learned lots of the things from my seniors [veterinarians], according to that I implement that in the field and I try, if I don't get it [understand the symptoms or possibly if the animal does not respond to treatment] I call my seniors and ask, and I then go back out and try to do my best in the field. (Veterinary technician)

Despite this being the case, they did admit to treating animals with drugs requiring prescription, without a veterinarian giving permission.

> Normally - I can't [treat trypanosomosis] without a prescription but I know the signs and symptoms, so I can give the medicine. (Veterinary technician)

The veterinary technicians treated 2-3 mules per day, although they raised concerns that the numbers of mules they were seeing was increasing as the cost of buying mules was decreasing from one Lakh to below 80,000 rupees, sometimes even 50,000 rupees. When asked about the common issues they saw they believed internal parasites

[1] One Lakh or 100,000 Nepalese Rupees is equivalent to approximately 640 GBP/ 800 USD.

were now being treated more regularly by owners because of their advice so they infrequently treated mules suffering from worm burdens; they most regularly dealt with colic, trypanosomosis and glanders. They also raised concerns about equipment failure, rough terrain and inhumane handling practices.

> […] they walk on the rocks so they have joint pain and pain in the feet, and some of the harness are not good so they get the harness wound, and some even get the wound because the small boys throw stones at them to control the animals so I see that type of wound […] I keep on telling them, if the harness is very old I suggest to them to change it and when the harness is not too tight or lose, I suggest to make it lose or make it tight depending on the situation and I treat the wound that happened due to it and I keep on telling the boys don't hit your mules with the stone and they keep on telling me, when I'm angry, I'll do that. (Veterinary technician)

When a mule becomes ill or injured, owners will try to access services in either Macchakhola or Soti Khola, where the two veterinary technicians are based, however, as the veterinary technicians' knowledge is limited often owners will still have to phone a veterinarian for advice, and this adds further challenges as connectivity is not always guaranteed in the mountains.

> As soon as our mules started to get sick, if there is a phone connection, sometimes there is no phone connection, as soon as we receive a connection, then we talk to doctor [vet] and we follow his treatment, but sometimes we have to use our own herbal medicines. (Mule owner)

The lack of veterinarians being physically present was clearly an issue when mules fell ill, but owners also raised concerns about the mule related knowledge and expertise of veterinarians if they did attend to their mules.

> Previously there used to be a doctor [veterinarian] who used to come here and couldn't handle [the mules], and would tell us to handle [the mules], but people from [Animal] Nepal they come there and handle [the mules] themselves, and treat the mules, so we feel like they are the real doctors [veterinarians]. Previous ones are not. (Mule owner)

Both veterinary technicians felt that there was some difficulty in persuading owners to adhere to advice or to give their mules adequate time for recovery after illness.

> I keep telling them, but I don't think lots of them listen to me; if there is a fever and I give medicine to them and in the morning the fever is gone, they take their animals to work, so they don't listen to me – what else can I do? […] I see a lot of them and I feel like the owner thinks they should carry the loads until they can't, that's the difference between the mules and other animals, other animals if they are sick other animals get rest, but mules never get a rest. (Veterinary technician)

Some participants had little or no experience of keeping mules before buying them to start their goods distribution businesses, and guidance on treatments they receive may or may not be good for mule welfare.

> Now at the time, I don't know anything about what is this urinary stop [the mules stop urinating]. Later I came to know [learn what the problem was] after talking with my friends even I know that now they need the medicines which will recover them. (Mule owner)

This particular mule owner lost one group of mules to this issue, all collapsed and died. Sometime after this event his peers explained what treatment should have been administered to his mules to aid their recovery.

DISCUSSION

We present a small but representative sample of the mule populations in this sparsely populated region of Nepal. Mule roles in Ghorka region were quite specific; mules were used purely to distribute goods, and did not include other purposes such as draught power to cultivate, saddle animals for carrying people, or for carrying manure, fertilizers, wood or other household goods, unlike other studies of rural equid use (Arriaga-Jordán *et al.*, 2005; Arriaga-Jordan *et al.*, 2005; Von Keyserlingk, 1999). Most mules were geldings, which fits with the findings of Saez *et al.* (2013) and Tadich *et al.* (2008) where geldings were preferred to mares and stallions due to their ease of handling. Our findings conflict with other studies (Ali *et al.*, 2015; Frohlich *et al.*, 2020; Pritchard *et al.*, 2005) where stallions were most commonly used due to lack of veterinary service provision where castration would pose a significant risk to welfare. Lack of access to veterinary provision is also an issue in the mountains of Nepal, but as all equids are imported from elsewhere there may have been easier access to castration services at point of origin in India and this could explain the prevalence of geldings in our study.

Nearly half the mules had negative responses when interacting with the assessor, which may indicate a lack of experience or indeed a lack of positive experiences when being handled or approached by people. The remaining half were mainly friendly, though some showed some nervousness after the initial response when being more closely interacted with. This reaction is not altogether surprising as mules are prey animals

and survival behaviours may surface when interacting with unfamiliar stimuli or if an equid has either limited or negative associations when interacting with people (Burn *et al.*, 2010; Hausberger *et al.*, 2008). Most mules had some form of integumentary trauma which could still be causing discomfort or have been painful previously, the association of pain with being harnessed and handled would increase the potential of mules reacting negatively or aversively, escalating adverse owner handling which would exacerbate mule fear responses (Pritchard *et al.*, 2005). There seemed to be some relationship between body condition and behaviour where mules exhibiting ideal body condition displayed more positive behaviours compared to those with thin/ moderate and thin/poor condition. This could indicate a fragile mule-owner relationship in mules with less-than-ideal body condition, perhaps through financial insecurity, inadequate knowledge, or fear of handling (of both human and mule) and a resulting lack of adequate care (Kubasiewicz *et al.*, 2022). Three mules showed apathetic behaviour, a negative welfare state where energy is being conserved due to a lack of available reserves (Upjohn & Wells, 2018) limiting an animal's responsiveness to stimuli and often associated with the presence of additional debilitating health conditions, pain, exhaustion (Pritchard *et al.*, 2005), stress or learned helplessness (Burn *et al.*, 2010; Hall *et al.*, 2018; Swann, 2006); in our study one mule had a broken leg and others had nasal and eye discharge which indicated a potential infection, glanders was suspected. Apathetic behaviour can lead to negative labelling by owners where the equid is seen as lazy or stubborn and may result in owner handling becoming more physically severe (Swann, 2006).

Only one mule was assessed to be approximately twenty years old. Limited numbers of older animals may reflect a short life span for mules in the mountains or because of replacement by owners as mule work efficiency decreased as they aged (Luna *et al.*, 2017; Saez *et al.*, 2013), counter to previous studies where equids were working beyond 20 years of age (Arriaga-Jordan *et al.*, 2005). However, considering over half the mules in our cohort study could not be aged, it could indicate that mules avoiding assessment were older and, therefore, more handling-averse from being caught and worked hard every day (Hall *et al.*, 2018). Of those remaining, over half were under five years old, which supports the findings of other research where equids are forced to work before being fully mature (de Aluja, 1998; Upjohn & Wells, 2018; Watson *et al.*, 2020). Ideally equids should not begin work before four years of age when their body reaches zootechnical maturity (Abdelbaset-Ismail *et al.*, 2016; Saez *et al.*, 2013). The mules in this study had already worked in India before being put to work in the mountains which means their bodies had been put under musculoskeletal strain before being fully developed, promoting permanent damage (Abdelbaset-Ismail *et al.*, 2016; Upjohn & Wells, 2018).

Integumentary trauma was present in nearly 90% of the mules assessed, which is higher than seen in other studies. It is generally accepted that harnessing creates many of the injuries in working equids (Ali *et al.*, 2016; Farhat *et al.*, 2020; Frohlich *et al.*, 2020; Luna *et al.*, 2017; Mohamed *et al.*, 2021) when the harness equipment is not well fitted to the mule's body (Cousquer, 2015). Lack of harness care and cleaning can be associated with trauma from harnessing equipment (Burn *et al.*, 2008; Farhat *et al.*, 2020), and the use of non-breathable materials (particularly in such dusty, gritty conditions) would exacerbate rubbing when mules sweat or work in wet conditions. The majority of pack saddles used non-breathable padding created from either nylon or plastic sacking. Owners claimed to use this arrangement only during monsoon to keep mules dry whilst working, however, our fieldwork was undertaken during the dry season and these materials were still being used. Wounds were also visible in the tail and lower midsections of mules where crupper and girth equipment were fashioned from alkathene (hard plastic) pipe, nylon or similar non-breathable materials. These remote regions may lack competent harness makers who are skilled at using locally available resources to supply equipment within the constraints of owners on limited budgets (Heleski *et al.*, 2015; Upjohn & Wells, 2018). In the absence of adequate veterinary knowledge of harnessing, as noted in other studies (McLean, 2012), this leaves owners with minimal knowledge or understanding of harnessing principles to create or modify their own harnessing equipment, having adverse welfare consequences for the working equids. However, solely supporting communities to adjust and design better fitting equipment cannot succeed in isolation where the cause of general welfare issues is not also addressed (Pritchard *et al.*, 2018; Swann, 2006; Upjohn & Wells, 2018).

Although some scarring or hair loss was seen from tethering, few mules had open wounds from this practice, which could indicate that the materials being used were fit for purpose such as being soft, wide, breathable, clean and correctly tensioned. It could also be an indication of the settled social structure of the groups tethered together (Christensen *et al.*, 2011; Fureix *et al.*, 2012) or a lack of salient resources (food, water, mares) to compete over (Pierard *et al.*, 2019), which would reduce aggressive and associated avoidance interactions meaning straining at tethers was minimised, this is corroborated by the lack of conspecific bite injuries seen during assessments. Companion bonding was highlighted by some owners as being important for their mules, appreciating that some mules worked better or kept in close contact with specific mules. This may suggest some owner understanding of their mules' management needs, or possibly just that owners were unable to afford to regularly purchase and replace mules, a process which would disrupt the social cohesion.

A small percent of mules in our study showed open wounds due to inhumane handling practices which is lower

than in other studies (Ali *et al.*, 2016; Farhat *et al.*, 2020). Handlers were seen using stones to direct their mules but the lack of obvious injuries on most of the mules in regions of the body targeted in this practice may mean that direct contact was usually avoided by most handlers indicating some degree of understanding and communication skills between owners/ drivers and mules which avoided conflict and escalating maltreatment (Farhat *et al.*, 2020). Low numbers of mules showed lameness or hoof deformity counter to other studies (Pritchard *et al.*, 2005). Such a low number of mules showing signs of hoof neglect or disease may be due to some owners trimming, some mules being trimmed by the veterinary technicians, or could indicate some form of self-trimming from movement probably due to the coarse rocky terrain the equids were driven over every day (Frohlich *et al.*, 2020).

Numerous concerns were raised by owners regarding the welfare of their mules including the use of drivers to work their mules who may not have the expertise, commitment (as the mules do not belong to them) or the 'interdependent relationship' (Pritchard *et al.*, 2005) to look after the mules well. This is a subject area of interest in other livestock sectors where it is widely understood that the attitudes, behaviour, personalities and levels of stress of people working with livestock has a pivotal role in animal welfare (Coleman *et al.*, 2003; Hansen & Osteras, 2019; Lensink *et al.*, 2016). In many studies a recurring theme highlights that disconnection between pay, knowledge, skills and ultimately stockperson morale can have significant impacts on the productivity and wellbeing of the livestock in their care (Daigle & Ridge, 2018; Losada-Espinosa *et al.*, 2020; Waiblinger *et al.*, 2006); under a one health/ one welfare perspective (Pinillos *et al.*, 2016) the health and wellbeing of both is inextricably linked (Valadez-Noriega *et al.*, 2018). Owners also expressed fears about working the trails, indicating fear and anxiety about falling rocks, loose substrates, and natural hazards which caused fatalities in their mules and would be a constant concern with regards to their own safety, the loss of income, and financial burden of replacement costs if they lose mules. Intriguingly, all owners failed to mention concerns about integumentary trauma considering it was the most obvious and prevalent issue seen in all the mules. People often completely rely on the income from their equids in these remote communities (Rodrigues *et al.*, 2017), so perhaps as mules could continue working with integumentary trauma it was less of a concern than other welfare issues.

Although the diet of mules in this study were sufficient to support the maintenance of body condition in at least half of the cohort, the type and intervals for food intake are not appropriate for long-term health and welfare. Calorific, starch-based foods given without adequate access to water (Wild *et al.*, 2021), and in the absence of limited access to adequate foraging opportunities to ingest foods of higher water and fibre content, can lead to gastrointestinal disturbances such as colic (Cohen *et al.*, 1999; Curtis *et al.*, 2019). Colic was reported by owners as being of concern and was witnessed and treated by the authors during the fieldwork. This type of dietary provision can contribute to the development of abnormal oral behaviours (Hothersall & Casey, 2011; McBride & Long, 2001; Nicol *et al.*, 2005) and in this study mules were frequently observed exhibiting coprophagia or pica of other mules' dung and soft plastics (TDS, fieldnotes, 2018). This practice (with faeces only) is a common and important behaviour in foal development (Lindenberg *et al.*, 2019; Siskova *et al.*, 2006) but rare in adults. When observed in adults, coprophagia may be indicative of a deficient diet of high concentrate, low protein and low fibre (Boyd, 1988; Hanis *et al.*, 2020; McDonnell, 2003). In this study mules had very restrictive high concentrate diets and limited access to foraging opportunities either at liberty or from forage materials offered by owners. Coprophagia may increase the risk of ingestion of internal parasites (Hanis *et al.*, 2020; Studzinska *et al.*, 2020), and may also be a contributing factor in the colic episodes recorded during fieldwork, which in a population of equids with limited access to veterinary services is of concern.

There are substantial difficulties for mule owners when trying to access veterinary support in these remote regions and with such limited or patchy access to veterinary services there is heavy peer to peer reliance and knowledge sharing, which is of high importance when considering mule welfare. Lack of access to adequately trained veterinary health professionals is a common issue in LMICs, leaving domesticated animals, particularly working equids, vulnerable to ill health and poor welfare (Frohlich *et al.*, 2020; Schott *et al.*, 2019; Upjohn *et al.*, 2014) and at the mercy of owners potentially lacking in mule management understanding where peer to peer knowledge sharing may exacerbate poor welfare (Nye *et al.*, 2021; Watson *et al.*, 2020). Though two veterinary technicians were embedded within two villages on the trails, working equids did not feature in their specialised training; further additional voluntary equid training was sought by the technicians after graduation via an external organisation. Though they are only permitted to provide non-prescription remedies their daily services veer into delivery of prescription-only treatments, sometimes diagnosing and treating if symptoms are recognised; and often only when treatments failed to relieve symptoms was a veterinary surgeon contacted for guidance and support. The delivery of prescription only treatments without veterinary supervision is of global concern; in studies investigating antimicrobial stewardship in animal health, informal service providers with little knowledge, understanding and certainly no training, dispensed antibiotics without veterinary diagnosis or prescription, potentially contributing to antimicrobial resistance (Chauhan *et al.*, 2018; Nye *et al.*, 2020).

The veterinary technicians raised concerns about the harnessing equipment causing integumentary trauma, inhumane handling and the hazards of working mules on

such rough terrain, though their major concerns were around the number of cases of colic, glanders and trypanosomosis they were treating, trypanosomosis was also raised as a concern by owners. Glanders and trypanosomosis are zoonotic infections; although *Trypanosoma evansi* was previously believed non-transmissible to humans but a recent case in Asia has disproven this assertion (Van Vinh Chau *et al.*, 2016).

Clinical signs indicating trypanosomosis was the most commonly recorded sign of illness recorded during assessments, and was a significant issue raised by owners. The protozoan is transmitted via blood sucking vectors such as flies, infections are often acute and fatal in equids (OIE, 2021), there are effective trypanocidal treatments if infection is caught in the early stages but after this the only effective control is the slaughter of infected animals, there are no vaccines. There have been recent outbreaks of trypanosomosis in Europe due to the movement of infected animals into non-endemic areas (Buscher *et al.*, 2019), which is of significance in Nepal where working equids are moved considerable distances through open borders with limited or no checks (AN, 2016).

Although only one mule showed definite signs of glanders, another 13 had eye and nasal discharge. Whilst this discharge could be due to irritation from dust, it could also be an indicator of early-stage infection. The organism responsible for glanders infection, *Burkholderia mallei,* causes acute disease in donkeys and mules; death follows swiftly following infection (Barrandeguy & Carossino, 2018). Discharge from the nares and through the respiratory tract from coughing disperses infectious droplets which facilitate transmission when in close contact with either the mule itself or via something contaminated such as water, food or harness equipment. If people contract the disease in its acute form the mortality rate can be as high as 95% within three weeks if antibiotic treatment is not accessed. Though *B. mallei* is susceptible to desiccation outside a host if exposed to sunlight for 24 hours, the agent can remain infectious and active in water for at least one month (OIE, 2018). This has implications for animal and human health when considering the dependency of the Nepalese mountain dwellers on streams and rivers for their water supplies, as well as the long monsoon season, where the protozoan could potentially remain viable in the environment for some time (OIE, 2018, 2022). The lack of adequate hygiene, and the propensity to house mules in close proximity to people's living quarters, also significantly increases the risk for transmission. The transportation of working equids, if infected, could also introduce glanders into glanders-free areas via the translocation of equids.

Equids that are already stressed from poor nutrition, concurrent diseases, and the demands of excessive work will be more susceptible to infection, which is then compounded by a lack of access to veterinary services. Infected mules may not be effectively dealt with (euthanised or the disease notified) and the carcass safely disposed of, leaving potential sources of infection within the environment. In remote communities with limited access to health services themselves, the health and welfare of the owners is intrinsically linked to the health and welfare of their mules and the environment they all inhabit; an important reminder that to truly create sustainable change a one welfare approach (Pinillos *et al.*, 2016) needs to be adopted.

For non-governmental organisations and service providers these rural communities pose challenges when trying to gain access to and understand the complex needs of these demanding environments and the actors within them. The high prevalence of integumentary trauma, negative behavioural responses and poor dietary provision is of great concern, particularly when there is a lack of access to well trained, suitably supported and adequately provisioned veterinary and harnessing services within these rural communities.

This study gives a detailed understanding of the husbandry and welfare status of mules working the trails in the Gorkha region, Nepal. It supports a call for a more unified approach to tackling equid welfare and supporting the marginalised, resource poor communities they underpin. Facilitating capacity building for owners, supporting improved training for equid service professionals, and the continued lobbying of policy makers to effect political and social change to keep working equids high on their agendas.

STUDY LIMITATIONS

To enable access to sites and provide interpretation during interviews the organisation Animal Nepal assisted. Animal Nepal provided veterinary interventions to some of the villages (Arkhet Bazar and Soti Khola) within the study so acknowledgement is given that this may have influenced interview and survey responses of some participants. Without this assistance, however, language interpretation would have been impossible, and many mules would have had severe colic symptoms left untreated with potentially fatal consequences.

COMPETING INTERESTS STATEMENT

The authors declare that they have no competing interests.

ETHICS STATEMENT

Project code 2018-VOD-NEPAL. The study was conducted in accordance with the Declaration of Helsinki (WMA, 2021); the protocol was approved by the Ethics Committee of The Donkey Sanctuary, UK.

Recruitment of participants was on a voluntary basis, due to literacy levels of participants verbal informed consent was gained from each person and recorded. All participants were anonymised and were given the right to withdraw within a two-week time period by contacting a member of the Animal Nepal team, no participants withdrew. All mules were welfare assessed using non-invasive techniques throughout.

AUTHOR CONTRIBUTIONS

TW, LK, NC: conceptualisation. TW, LK, NC: methodology. TW, LK, ST: investigation and data collection. TW, LK, CN data curation. TW, LK: data analysis. TW: writing of original draft. LK, CN, ST, NC, FB:

revision of original draft. LK, FB: supervision. All authors: manuscript revision and approval of the submitted version.

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ORIGINAL ARTICLE

May the force be with you: an investigation into logging methods using donkeys

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ABSTRACT. Working equids represent major sources of energy worldwide, and assume an increasingly important role in line with increasing requirements for sustainable energy. The effectiveness of their contributions relies on welfare, especially in the case of donkeys that, due to their size, face more adverse working conditions compared to larger equids. In this study, heart rate and force exerted were monitored while logging using three methods: direct pull, sled, and vehicles. A swingle tree incorporating a dynamometer and data logger was developed for this project, allowing continuous recording of forces. It was hypothesized that logging techniques that suspend (partially or totally) the load from the ground, reduce the force exerted, thus reducing physical effort. This study also aimed to understand if heart rate can be used as an alternative proxy measure when pulling different loads using different methods. Results showed that the greatest force was measured during direct pull (369.66 N), requiring 20% greater force compared to the sled (299.10 N, P <0.001), and 60% greater force than the vehicle (125.11 N, P <0.001). The sled required an additional 58% of force compared to the vehicle (P <0.001). This determines vehicles are the best option for reducing the force exerted by donkeys. Affordability and skills needed to work with this technique, however, are important considerations. Sleds represent a user-friendly solution; reducing the force needed when compared to direct pull, requiring less skills and equipment. The dynamometer proved an excellent method for force monitoring. Heart rate as a proxy measure for force didn't provide accurate data for lighter loads. Increasing load weight, followed by the increasing force requirements, correlation and explanatory power became greater, indicating that with heavier logs, or methods that display greater force requirements, heart rate may be used as a proxy method for force, but further studies are needed.

Keywords: Working donkeys, dynamometer, logging techniques, heart rate, animal welfare.

INTRODUCTION

Working equids still play a relevant role in industrial and agroforestry activities such as logging, and represent a major source of energy worldwide (Almeida & Rodrigues, 2017; Fernando & Starkey, 2004; Norris *et al.*, 2020), especially in low and middle-income countries (Norris *et al.*, 2020).

In recent years, a growing interest has been observed in the use of workings equids in high-income countries, as part of a general awareness of sustainable energy sources, and sound techniques in small-scale agriculture, forestry, and environment management (Rodrigues *et al.*, 2017). This, in turn, supports food security and economic self-reliance through a reduction in the consumption of external resources (Stringer, 2014). Such trends are likely to increase due to the recent global energy crisis affecting fossil fuels (Birol, 2022).

The effectiveness of the contributions made by working equids to future sustainability is reliant on their welfare, and one of the most important determinants for overall health and welfare is that of harness (Rodrigues, Garrett, *et al.*, 2021), combined with the weight and nature of the load, the quality of equipment used, general health, and the standard of animal training and management (Pearson & Krecek, 2006).

Among working equids, donkeys tend to be overloaded due to their smaller size, while working with equipment primarily designed for other species, causing inefficient use of animal power and directly affecting their health and welfare (Demelash & Woldemeskel, 2006; Rodrigues *et al.*, 2020).

This study aims to understand how the use of different methods during logging operations can reduce the work effort of working donkeys, thus creating knowledge to share with those who will benefit the most - donkey owners and users around the world.

The first hypothesis in the present study claims that the use of logging techniques that allow lifting and suspending (partially or totally) the load from the ground can reduce the force exerted by the donkeys (in Newtons - N), thus reducing the physical effort.

The second hypothesis asserts that there is a strong correlation between the force exerted by donkeys and heart rate (measured in beats per minute - BPM), considering other studies where heart rate and exercise intensity share a direct, linear relationship: the more intense the exercise, the higher the heart rate (Sloet Van Oldruitenborgh-Oosterbaan *et al.*, 2010). The aim is to understand if the latter could be used as a cost-effective alternative proxy measure force used to pull different loads using different methods.

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MATERIALS AND METHODS

DONKEYS

Three healthy Zamorano-Leones gelding donkeys (ages 8, 10, and 13 years old) of similar size and phenotype were used in this study. Donkeys were selected based on their working skills, which must include being used to pull/being hitched to a vehicle.

At the commencement of the study, individual bodyweights (BW) were accurately obtained (354, 345, and 340 kg), using *The Donkey Sanctuary* nomogram (The Donkey Sanctuary, 2018).

The body condition score chart developed by The Donkey Sanctuary was used in this study. All donkeys presented an ideal body condition (BCS =3).

An experienced equid vet (JBR, first author) monitored the donkeys' health and welfare throughout the study. A complete veterinary examination was performed before the transects, and basal heart and respiratory rates were confirmed, ensuring fitness of the study group to participate.

LOGGING OPERATIONS

Logs. Four logs of Scots pine (*Pinus sylvestris*) of 5 meters each were used in this study. Logs were prepared by a professional logger to present a known volume (Ministry of Forests, Lands and Natural Resource Operations, 2011): 0.03 m^3, 0.05 m^3, 0.07 m^3, and 0.1 m^3. The front aspect of the logs were rounded to reduce situations where they may become stuck, reducing the effect of the environment in the reading of the dynamometer.

Using a professional log volume –weight converter (Timberpolis, 2022)– the weight of the logs used were 26.4 kg, 44 kg, 61.6 kg, and 88 kg, respectively. These weights correspond to 8%, 13%, 18%, and 26% of the average BW of the three donkeys, respectively.

Logging techniques. Three logging techniques were applied, corresponding to the most common logging methods used in forestry:

– Technique 1: Direct pulling, with donkeys dragging logs (Figure 1);
– Technique 2: Forest sled made from recycled metal, with logs resting on the sled on one end, and dragged on the other end (Figure 2).
– Technique 3: Forest vehicles: a combination of a forecart (developed and manufactured by the first author) and two ATV log haulers manufactured by Iron Baltic© (Vatsla, Estonia), and adapted for this study. Logs are completely suspended on wheels (Figure 3). Any commercial forecart equipped with a tow ball and designed for a single equid use is valid for the purpose of this study.

Logging chains were used in all 3 techniques.

HARNESS

Collars. Three different collars were used in this study (Figure 4), based on previous results of pressure and area of contact obtained elsewhere (Rodrigues, Garrett, *et al.*, 2021). Collars with the best results within each group were selected:

- A **prototype collar**, developed by the harness makers' team involved in the project, designed specifically for donkeys to be adjustable, cheap, and easy to manufacture, using local materials.
- An adjustable commercial **full collar** designed for horses.
- A straight commercial **breast collar**, designed for horses.

All collars were checked and adjusted at the beginning of each transect by the harness makers' team, following standard protocols for harness fitting.

Harness. Techniques 1 and 2: collar, pair of traces, swingle tree, and a light trace carrier completed the harness system used. Technique 3: collar, pair of traces, swingle tree, cart saddle, breeching, and a belly band.

Force exerted by the equids
Load cell and data logger

The School of Technology and Management, Polytechnic Institute of Bragança (ESTiG-IPB) team developed a swingle tree with the dynamometer and the data logger incorporated, allowing a continuous recording of the pulling force exerted (N) by the equids during the work, with a frequency of 1 force measurement per second (Figure 5). The device was switched on and off immediately before and after each transect, respectively. Time and date were also recorded for each one of the transects and used as a reference to crossmatch with data provided by the Polar software, used for monitoring heart rate. All data were stored on a micro-SD card and downloaded to a laptop as csv. files. The design, implementation, and metrological characterisation of this device is published elsewhere (Coelho *et al.*, 2021).

HEART RATE DURING WORK

A horse heart rate sensor (Polar©) was attached to the donkey's harness and used to continuously monitor the heart rate of the equids during the transects, and during the recovery period, with a frequency of 1 BPM measurement per second. The recovery period started after a set of transects (please see *transects* section). In this study 44 bpm were considered as basal values for heart rate.

This system includes a GPS locator, allowing researchers to understand when the animals are in motion during the

Figure 1. Donkey being led during a transect, using the direct pull technique to move the log, and using a collar, a pair of traces, a trace carrier, a swingle tree, and a logging chain.

Figure 2. Use of the sled during the trials, with the front part of the log resting on the sled, greatly reducing the area of contact with the ground. The sled is a simple system, easy to manufacture, and is attached to the swingle tree via a "V" shape chain, in the front part.

Figure 3. Vehicles in use while carrying the 0.1 m^3 log. Note that 2 logging arches keep the log fully suspended (rear and front logs). The front log is then attached to the forecart via a tow ball. Note the complete cart harness in place, using a breeching and a cart saddle.

Figure 4. Three collars tested: collar 1: manufactured using canvas for external padding, wool for internal padding, and fence post as hames. Collar 2: manufactured with large plywood hames, padding area of natural leather filled with natural wool. Collar 3: manufactured with beta/biothane/synthetic leather, and filled with sponge. A = front view and B = rear view.

transects, and link the dynamometer values with the heart rate values. Data obtained using the horse heart rate sensor (heart rate and GPS position) were extracted directly from its online software and downloaded as csv. files.

TRANSECTS

Donkeys moved the logs 100 meters in a straight, horizontal transect (confirmed using the altimeter incorporated in the Polar© software), along a forest floor. This distance is considered ideal when logging with equids in real conditions.

A total of 108 transects were carried out during the study, taking two weeks to complete all the transects.

Each donkey had a minimum resting period of 60 minutes between each set of transects (moving 4 logs using a specific collar and logging technique), ensuring full recovery from previous physical effort. Animals were kept in a small paddock, with access to shade, water, and hay.

A table was created where authors crossed the information donkey-collar-method, to guarantee a homogeneous distribution of the work performed by each animal within the timeline of the project. This parameter allowed to reduce to a minimum any possible overwork by one or more animals involved in the study.

Donkeys were led during the transects, ensuring a constant speed, with care taken to ensure that the handler did not interfere with normal movement.

STATISTICAL ANALYSIS

All statistical analysis was performed using R v3.6 (R Core Team, 2018) and RStudio v1.2 (Racine, 2012). Data transformations, summary statistics, and graphs were prepared using the R package tidyverse (Wickham *et al.*, 2019). A mixed model approach via restricted maximum likelihood generalized additive model (GAM) was used from the R package mgcv (Wood, 2001) to understand differences in force between load and method, whilst accounting for time. Time was treated as a cubic spline random effect; 10 knots was found to be appropriate with a k-index of 1.03 and a P-vale of 1. Initial exploration of the data showed that there was a significant difference between the donkeys ($P = 0.01$) and collars ($P < 0.001$) used in the trial. As such donkeys were included as a factor smoothed random effect to account for differences with 2 knots which was found to be the best optimization with a K-index of 1.01 and a $P = 0.73$. Collars were also included as a factor smoothed random effect to account for differences with 2 knots which was found to be the best optimization with a K-index of 0.99 and a $P = 0.32$. After optimization, the GAM model consisted of interaction between load and method with collar, donkey, and time as random effects. The resulting model fulfilled GAM assumptions, did not require transforming, and explained 83% of the variation. To explore the pairwise comparison and interaction difference in the GAM model Tukey-HSD test was applied (De Mendiburu & Simon, 2015). Tukey-HSD identifies significant differences between factor levels, the Tukey model was optimized to account for the unbalanced experimental design (De Mendiburu & Simon, 2015) and reports both groups and P-values for interactions between factor levels. The Tukey-HSD groups function in the R package agricolae (De Mendiburu & Simon, 2015) provides letter groups for treatments, where treatments or interactions between treatments share a letter, and groups mean are not significantly different from each other. All significance testing was carried out at the 0.05 level.

GAM models for heart rate (BPM) were also constructed using the same procedure as above. Time was treated as a cubic spline random effect; 10 knots was found to be appropriate with a k-index of 1.01 and a P-vale of 0.49. Donkeys and collar were included as a factor smoothed random effect to account for differences with 2 knots which was found to be the best optimisation with a K-index of 1 and a P-vale of 0.74 for donkeys and K-index of 1 and a P-vale of 0.55 for collars. The resulting model fulfilled GAM assumptions, did not require transforming, and explained 86% of the variation.

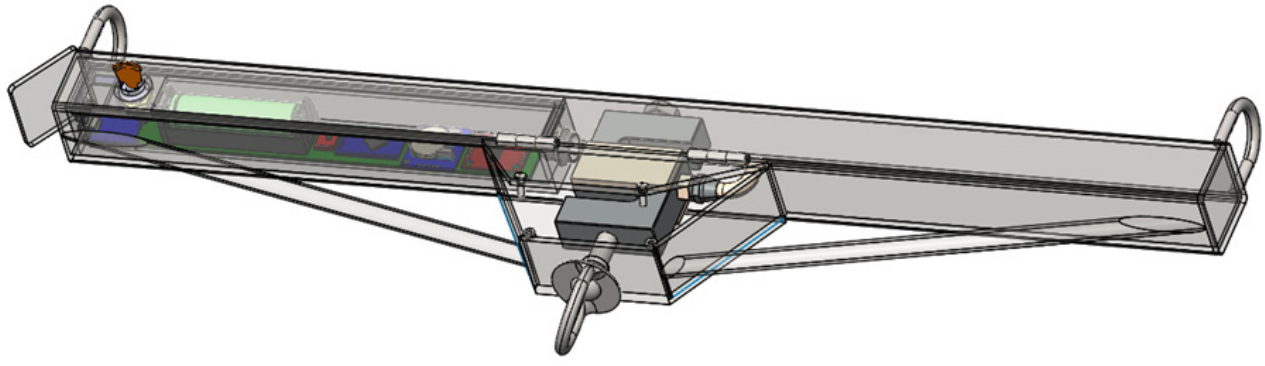

Figure 5. Swingle tree with dynamometer and data logger incorporated.

Pearson's correlation test was used to evaluate the association between force and BPM to understand if BPM could be used as a cost-effective alternative proxy measure for force used to pull different loads using different methods. Pearson correlation was chosen as a linear dependence between two variables (BPM and force), as it is a parametric correlation test BPM and force were tested for normality using Anderson-Darling Test. As both BPM and force were not normally distributed both were Box Cox transformed before the Pearson correlation test.

RESULTS

The greatest force was measured using the direct pull method (369.66 N) which required 20% greater force compared to the sled (299.10 N, P <0.001) and 60% greater force than the vehicle (125.11 N, P <0.001). The sled required an additional 58% of force compared to the vehicle (P <0.001, Figure 6A) There was a significant increase in the force exerted when moving the greater loads (P <0.001, Figure 6B). There was an increase of 24% force measured between 0.03m^3 (183.57 N) and 0.05m^3 (243.18 N), with an increase of 16% force between 0.05m^3 and 0.07 m^3 (291.83 N). A 34% increase in force required was observed between 0.07m^3 and 0.1m^3 (439.48 N, P<0.001).

Greater BPM was observed when using either the sled or the direct pull methods to transport logs compared to using the vehicle (P < 0.001, Figure 6C). Independent of the method used to transport the load, as the load increased, the BPM of the donkeys significantly increased (P < 0.001, Figure 6D). BPM increased 5% between pulling 0.03m^3 and 0.05m^3, 10% between pulling 0.05m^3 and 0.07m^3, and 12% between pulling 0.07m^3 and 0.1m^3.

There were significant interaction effects between the force required to pull the different loads and methods used (P <0.001, Figure 7A). At a load of 0.03m^3, there was no significant difference in the force required between directly pulling and transporting the load using a sled (P = 0.99). However, significantly less force was required to transport the 0.03m^3 load using the vehicle with 43% less force than the sled (P<0.001) and 41% less force than directly pulling (P<0.001) the load. When transporting 0.05m^3, directly pulling required 49% (P <0.001) greater force and transporting the load using a sled required 40% (P

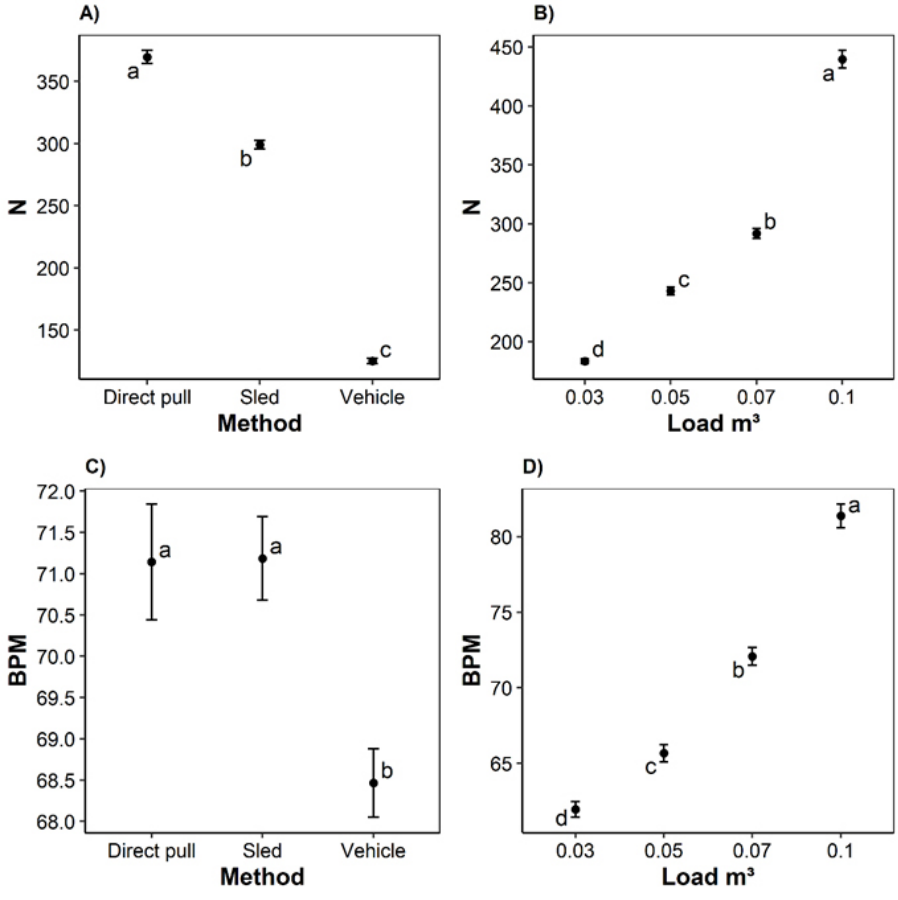

Figure 6. Points represent the mean, and the error bars represent the upper and lower confidence intervals for A) force (N) for each method of transportation, B) force for the different loads, C) Beats per minute (BPM) for the different transportation methods, and D) BPM for the different loads. Letters represent Tukey-HSD groups where different letters on each plot denote significantly different groups at the 0.05 level.

<0.001) more force than transporting 0.03m^3 using the same method. There was no significant increase in force required to transport 0.05m^3 using the vehicle compared to transporting 0.03m^3 (P = 0.83) with only 4% more energy required to move the larger load. At a load of 0.05m^3, as with transporting 0.03m^3, the vehicle required the least energy to transport the load (120.77 N), which was 51% less (P <0.001) than using the sled, and 72% less effort than using the direct pull method (P <0.001). At 0.05m^3 using the direct pull method required 20% greater effort to transport 0.05m^3 than using a sled (P <0.001). When transporting 0.07m^3, both the direct pull (24%) and sled (21%) methods required significantly more force than transporting 0.05m^3 (P <0.001). However, there was no significant increase in force required to move 0.07m^3 compared to 0.05m^3 using the vehicle (1%, Figure 7A). At 0.07m^3, the direct pull method required 21% more force than the sled (P <0.001), and 67% more force than the vehicle (P <0.001). Transporting 0.1m^3 required the greatest force for all three methods and required significantly more force than transporting 0.07m^3. At 0.1m^3, the direct pull required the greatest force, which was 26% greater than using a sled (P <0.001), and 76% more force than using a vehicle (P <0.001).

Significant interaction effects were also observed for the BPM of donkeys when pulling different loads using different transportation methods (P < 0.001, Figure 7B). At 0.03m^3 the greatest BPM was observed using the vehicle, which was significantly greater than using either the sled or the direct pull method (P < 0.001). When pulling 0.05m^3 there was no significant difference in BPM between any of the methods (P >0.05), although the BPM did significantly increase when using the direct pull method and pulling the greater load (P < 0.001). When pulling 0.07m^3 both the direct pull and sled transportation methods resulted in a greater BPM than observed when using the vehicle (P < 0.001). At 0.07m^3 the BPM significantly increased compared to when pulling 0.05m^3 (P < 0.001). When transporting 0.1m^3 the direct pull method resulted in the greatest BPM, with the sled resulting in lower BPM compared to the direct pull, but greater BPM than using a vehicle (P < 0.001). When moving from a load of 0.07m^3 to 0.1m^3, the BPM using both the sled and the direct pull method significantly increased (P < 0.001) however, there was no significant increase using the vehicle (P = 0.26).

Donkeys recovered to basal values of heart rate (after a set of transects) within the first 5 minutes of the recovery period.

When comparing BPM and force exerted there was a weak correlation (r^2 = 0.36, P <0.001), indicating that using BPM would not be accurate as a proxy measure for the force exerted whilst transporting different loads using different methods. The sled method had a lower explanatory power for the relationship between BPM and

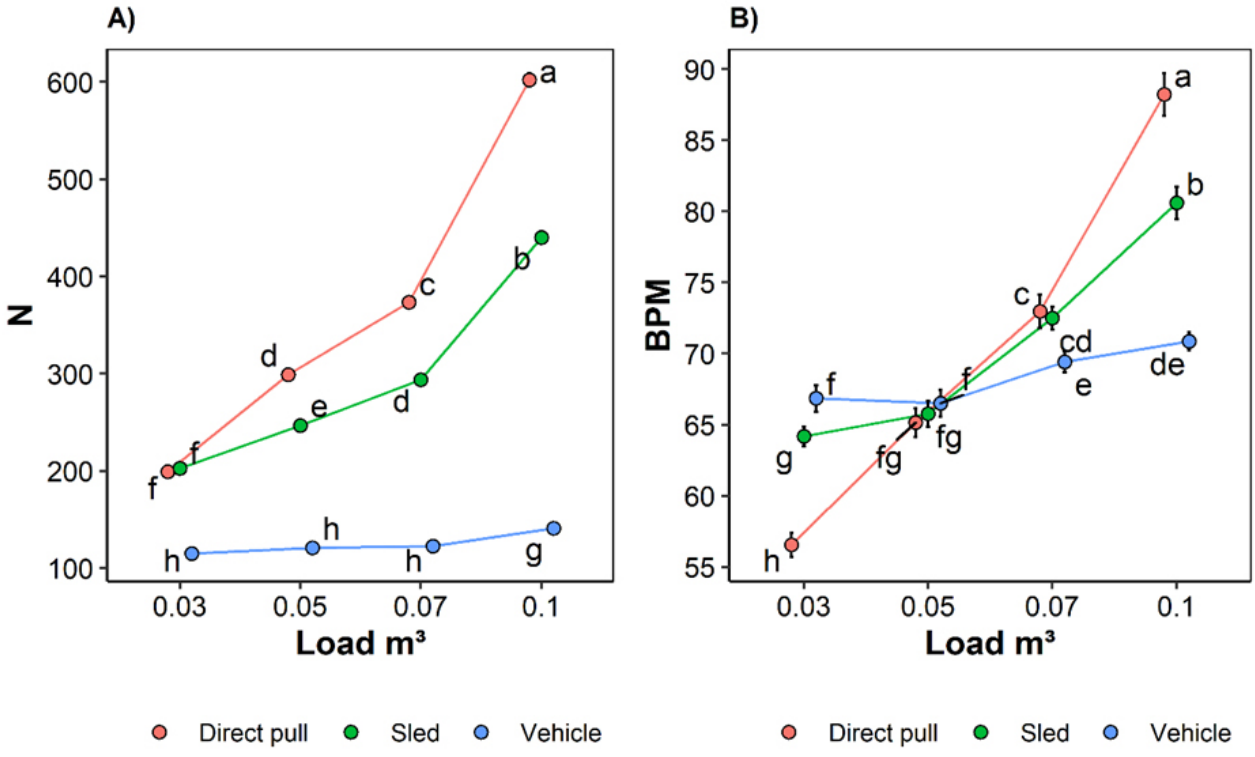

Figure 7. Interaction between the three methods and all loads. Points represent the mean A) force (N) and B) Heart rate in beats per minute (BPM). Error bars represent the upper and lower confidence intervals. Letters denote Tukey-HSD groups based on GAM results. Where letters are different there is a significant difference at the 0.05 level.

force (r^2 = 0.30, P <0.001), the direct pull method had a greater explanatory power of BPM and force (r^2 = 0.58, P <0.001), with the vehicle method having the lowest explanatory power between BPM and force (r^2 =0.061, P = 0.007). The correlation between BPM and force for the different types of transportation method suggest that BPM has a weak to moderate use as a proxy measure for force. However, as the force required increases (Figure 7A) the explanatory power becomes greater.

DISCUSSION

GENERAL CONSIDERATIONS

Poor working conditions may lead to health and welfare issues affecting working equids (Demelash & Woldemeskel, 2006; Farhat *et al.*, 2020; Norris *et al.*, 2020; Rodrigues *et al.*, 2020). To ensure the welfare of working donkeys they must work within their physical capacity while respecting their health and mental boundaries. It is, therefore, fundamental to welfare to quantify and provide insights into the load profile of donkeys while carrying out tasks and identify solutions when needed.

An important aspect to consider is that the draft capacity of an animal tends to increase in line with its body weight (Watson, 1983), and as such, horses (and mules to a lesser degree) are preferred for forestry activities compared to donkeys (Rodrigues, Raw, *et al.*, 2021). However, in many places donkeys are the only possible (or chosen) option, and in those cases, it is easier to overload them beyond their working capacity due to their lower weight compared to horses and mules, highlighting the importance of the solutions tested.

Logging methods. Direct pull, using a swingle tree and skidding chain where animals drag the log behind them is the most common technique used in logging operations and the most efficient in terms of the time needed to move the logs between two points at short distances. Although, results obtained in this study highlighted that these are also the most demanding in terms of force and heart rate (Figure 6A, C).

The use of vehicles (a combination of forecart and log haulers) proved to be the technique where the donkeys needed less force to move the load, demonstrating an even more noticeable difference as the weight increases, due to the presence of wheels and complete lack of contact between log and soil (Figure 7A).

Some technical aspects, however, deserve a deeper reflection: the correct harness needed to move (and brake) a vehicle is more complete in comparison to the one used for direct pulling techniques used only to move the load. Apart from the breast or full collar, traces, and swingle tree used in the direct pull, the cart saddle needs to be added, as it takes the vertical force of the weight when it occurs. Breeching must also be used to prevent the vehicle from running forward into the animal when it stops, and a belly band is required to prevent the cart from tipping backward when an unbalanced load is applied (Damerow & Rice, 2008; Ellis *et al.*, 1980; Leslie, 2015; Pearson *et al.*, 2003).

It is common to see working donkeys with incomplete and ill-fitted harness (Pearson *et al.*, 2003), and the more complex the harness system is, the more likely it is that important parts for its correct functioning are missing. In turn, this increases the likelihood of inefficient transfer of power, leading to discomfort, fatigue, and even body injuries that ultimately decrease working efficiency and output (Demelash & Woldemeskel, 2006; Farhat *et al.*, 2020; Rayner *et al.*, 2020; Rodrigues *et al.*, 2020).

The skills needed to load the logs in the log haulers, and then the ability to drive and manoeuvre the complete set into the forest are also aspects to consider. Aware of the need for training, The Donkey Sanctuary developed an online training platform –The Donkey Academy– where scientific findings, such as the ones reported in this paper, can be communicated via simple, clear, online educational resources, enabling better dissemination of knowledge with other professionals, donkey owners and handlers worldwide (Rodrigues, 2022).

The price of the equipment is another key aspect to consider: the cost of the complete set of vehicles exceeds 2100 € (approximately 2215 USD). Despite being of favorable pricing compared to conventional machinery used in forest management, it is a very high price for most donkey owners and handlers (Watson *et al.*, 2020), considering the world distribution of donkeys (Norris *et al.*, 2021; Starkey & Starkey, 2000). While there are online resources explaining the process of making similar implements from recycled material in detail (Log Splitters plans, 2022), the high price and skills required for manufacturing remain important considerations.

Sleds proved to be a good option to reduce the force needed to move the load, with differences about direct pull gradually increasing with increasing log weight. This technique reduced the area of contact of the log with the ground, by lifting the front part of the log, thus reducing the friction and resistance between the log and the ground, as only the sled runners and the last portion of the log were in contact with the floor (Figure 7A).

The force required for logging also depends on the soil conditions, although there is less influence when compared to tillage operations, where other aspects such as working depth or implement used may play a major role (Batey, 2009; García-Tomillo *et al.*, 2017; Schmidt, 2022). During the direct pull, logs contact the soil throughout its length, so such conditions can play a more relevant role.

Sleds can be pulled over rough terrain, work well in traversing slopes (where a vehicle might tip over), and are much easier to manoeuvre inside the forest. Being low to the ground, they are very easy to load up, and more stable than vehicles (Koroleff & Bryant, 1925; Langsner, 1978).

From a harness point of view, the same harness used to move the logs using direct pull is used with the sled. This is an advantage, as the sled can be used as a quick complementary logging method when the load to be moved is too heavy for the donkey, without the need to change harness or hitch the donkey to a vehicle.

Sleds do have issues on downhill runs, due to the lack of a braking system. In such situations, and depending on the slope of the terrain, the higher friction observed during direct pull can be an advantage, by slowing down the log. When the logs are pulled downwards, the pulling capacity of the animal's increases, so direct pull may be the best option (Ferris, 2019).

The sled used in this study was manufactured using scrap metal, based on existing models (Langsner, 1978). The manufacturing price is very low, and the degree of complexity of the construction process is much simpler when compared to the log haulers.

The present study provided relevant information about how the use of logging techniques that allow lifting and suspending (partially or totally) of the load from the ground can reduce the force exerted by the donkeys (thus reducing the physical effort), corroborating the first hypothesis raised in the present study.

Vehicles are by far the best options in terms of reducing the force exerted by donkeys, but the technical aspects mentioned must be considered. Sleds represent an easy-to-use solution that reduces the force needed to move logs.

The weight of the logs used in the present study (in terms of the percentage of BW of the donkeys) was somewhat conservative, considering the real working conditions donkeys may face while logging, however, they were enough to highlight differences between techniques.

Use of dynamometer and animal welfare. The dynamometer proved to be an excellent method to assess and monitor the force exerted by donkeys during forestry work using different techniques, and thus a good tool to monitor animal welfare. Overloading donkeys while pulling is still a common bad practice worldwide, directly affecting their health and welfare (Demelash & Woldemeskel, 2006; Rodrigues *et al.*, 2020).

The results obtained here open the door to further studies focused on determining the "cut-off" weight load acceptable according to the logging technique, or in any other activity where donkeys are used to pull loads.

Such a method, however, does not allow real-time results, and therefore it is not possible to adapt or correct the work being carried out at that moment. As such, operators must be very aware of early signs of fatigue in donkeys, such as slowing down, stopping, abnormal behavior, reluctance to move, increasing respiratory rate, and excessive sweating (Jagjiwan *et al.*, 2013). Despite this current limitation, further work will look at transmitting information from the dynamometer to a tablet/smartphone for real-time monitoring.

Heart rate as a proxy measure for force. Heart rate monitoring (measured in BPM) is being increasingly used to assess exercise and fitness in pleasure and sport horses (Kingston *et al.*, 2006; Williams *et al.*, 2019), but few studies seem to be focused to assess workload and physical state in working equids.

The use of HR as a proxy measure for the force exerted whilst transporting different loads using different methods did not provide good results for all the tests performed in the present study, thus rejecting the second hypothesis formulated.

Limitations of the study. The reduced number of donkeys used in this study may be also considered a limitation. Although, the authors believe that the high number of transects performed by the animals somehow compensates for this limitation. The careful selection of the donkeys based on their working skills results in the reduction of similar donkeys available for the present study. All three donkeys used in this study regularly work in agroforestry activities using these logging techniques. It is important to highlight that donkey´s physical and mental state can also affect HR, with an untrained, excitable animal spiking faster and higher than a calm, trained, steady animal (The Donkey Sanctuary, 2018), so behavior and unpredictable external factors may have a direct influence in the heart rate results if the selection of animals is not judicious.

Regarding the use of heart rate as a proxy measure for force, the fact that the first logs were so light, representing 8% and 13% of the body weight, may have affected the results obtained for HR, with the physical effort required to move the 0.03 m^3 and 0.05 m^3 logs being higher when using sled and vehicle, due to the weight of the implements, and this factor may explain the higher HR observed for these techniques.

With the weight of the logs increasing, followed by the increasing force requirements, the correlation and the explanatory power became greater, so these results indicate that with heavier logs or methods that display greater force requirements, BPM may eventually be used as a proxy method for force, but further studies are needed.

COMPETING INTERESTS STATEMENT

The authors declare that they have no competing interests.

ETHICS STATEMENT

This study adheres to UK animal welfare legislation and Regulations including the Animal Welfare Act 2006 and was reviewed and approved by The Donkey Sanctuary, Sidmouth, Devon, UK. The Donkey Sanctuary follows a rigorous research review process and does not permit invasive research of any kind, or any study that compromises animal welfare. The protocol was approved by the Ethics Committee of The Donkey Sanctuary under project code 2018-AIM2-PRT.

All donkeys in this project regularly work in agroforestry activities, so the effort required for this study was within their normal tolerance.

AUTHOR CONTRIBUTIONS

JBR, CG, FC, and AJ conceived the original idea. JPC, LQ, and FA developed the technology linked with the load cell and data logger. JBR, CG, FC, AJ, and FA carried out the experiment. SLN performed all the statistical analysis. JBR, FA, and SLN interpreted the results. JBR took the lead in writing the manuscript. All authors provided critical feedback and helped shape the research, analysis, and manuscript.

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ORIGINAL ARTICLE

From Domination to Dialogue and the Ethics of the Between: Transforming Human-Working Equine Relationships in Mountain Tourism

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ABSTRACT. The welfare of working equines is born of the relationship co-created with humans and the relational practices humans bring to this work. Our understanding of this relationship remains elusive, however, for it involves attending to that which arises both within and between the equine and the human. Attempts to study such relationships have, arguably, been confounded by the liminalities of relational practices, power literacy and the limitations of language, propositional knowing and the dualistic thinking that characterises many scientific disciplines. This paper presents the theoretical framework that underpins an experiential awareness-based Action Research approach to transforming human-equine relations within the international mountain tourism industry. This approach privileges curiosity, compassion and *primary* or *contemplative knowing* and the development of self-awareness. Drawing on the work of Martin Buber on genuine dialogue and of Otto Scharmer on generative dialogue, this paper provides insights into what can arise in the *between* when attitudinal shifts are encouraged and facilitated that allow humans and equines to meet genuinely and be fully present to each other. This ultimately involves surrendering control, letting go, the dissolution of subject-object awareness and access to non-dualistic ways of knowing. An awareness of the importance of such shifts and of the source from which we operate is of fundamental importance to the realisation of the co-creative project that humans and equines can engage in. Failure to appreciate this distinction, arguably, leads and gives rise to relationships, whether human-to-human or human-to-horse, characterised by domination rather than partnering, absencing rather than presencing, by monologue rather than dialogue. The ethical and practical implications of this awareness are profound, with implications felt at the level of the individual, for whom the *I* deepens the more you pay attention, and at the level of the relationship, but also at the level of communities, whether these be constituted locally, nationally, internationally or indeed globally.

Keywords: human-equine relationship, Domination, Dialogue, Partnering, Martin Buber, Awareness-based Action Research, Working equine welfare.

INTRODUCTION

The complex working relationships that humans and equines have created throughout history have somewhere close to their heart, an equally complex relationship with, and understanding, of power. Whether the working equine is carrying, pulling or being ridden; they are contributing labour and are mandated (Coulter, 2016; Cousquer & Alison, 2012) to do so. As such, they are vulnerable to exploitation. Their owners and handlers are often, however, similarly mandated to work and are themselves easily dominated and exploited. This paper sets out to explore how this (ab) use of power can be understood and how power-literacy and awareness of the *source* from which we operate can inform and transform relational practices and therefore the welfare of working equines and the communities that dependent on them. This paper further sets out to explore how an awareness based systems change practice that privileges sensing journeys can be applied to industries that have historically exploited pack mules and muleteers.

The literature on power is spread across many disciplines, ranging from pedagogy (Freire, 2000) to theology (Wink, 1992; 1999), human ecology (McIntosh, 2004) and deep ecology (Macy & Brown, 2014) to peace studies (Galtung, 1996), public and planetary health (Baquero *et al.*, 2021) and more-than-human biopolitics (Baquero, 2021). Any synthesis of this literature with a view to critiquing the powers that impinge on the welfare of working equines, of necessity needs to adopt a transdisciplinary One Health approach (Baquero, 2021) when seeking to promote the health that stems from healthier, more equitable and reciprocal relational practices. What follows recognises that there is a need to bring the inner science characterising awareness-based Action-Research (Pomeroy *et al.*, 2021) and collective trauma studies (Hübl, 2020) into conversation with the more traditional objectivist sciences that have tended to dominate the literature on working equine welfare. This challenges us to adopt a systems approach and "shift our focus from objects to processes and relationships, from hierarchies to networks and from objective knowledge to contextual knowledge" (Harding, 2006: 38). In doing so, we start attending to the question of what it means to be human and recognising how it is inextricably intertwined with the question of who we will be to each other. By doing so, we are better able to compassionately inquire and live into the questions that confront us when we seek to promote better human-working equine relations. In tending to the interplay between inner life, outer life and the life we co-create together, in mapping out and drawing attention to the ways deeper levels of listening and awareness can be transformative, it is hoped that those working with communities who rely heavily on working equines can

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better appreciate their roles as critical pedagogues, capable of supporting these communities, who are all-too-often powerless, to transform the conditions that contribute to their pain and to the transmission of that pain to working equines. This work requires us to bring the domination system and the practices of domination that sustain it into view. By getting the "system in the room" (Senge *et al.*, 2008) we can then start considering what it takes to move from relational practices of domination toward practices of reciprocity and partnering.

Any understanding of the journey from domination to partnering (Eisler & Fry, 2019) requires us to understand what gets in the way of *genuine meeting* and *dialogue* (Buber, 2000) and the inner work required if we are to become available to the other. As Thich Nhat Hanh (2021: 187) says "in true dialogue, both sides are willing to change"; this willingness however is usually lacking for our wilfulness gets in the way and we typically lack both the intention to listen deeply and the necessary training in listening.

This paper explores the question of how we move from domination to dialogue in three parts. It starts with an overview of the history of the human-horse relationship, focussing on how systems of domination and oppression establish themselves. This allows the oppressor mindset rooted in the necessity of conquest, where "to be is to have", to be named and unmasked (Wink, 1992) and made available for inquiry. In the second part, this paper presents an alternative that is distinct from the ways Human Animal Studies scholars have considered human thought within multi-species relations (McVey, 2017), drawing on an established Action Research approach (Arts *et al.*, 2021; Koenig *et al.*, 2021) that delivers transformational change through deep listening. This approach draws its inspiration from Martin Buber's dialogical encounter with a horse to explicate how *turning* to the *I-Thou* can transform our selves (the *I*) and our relational practices. In doing so it explores the promise offered by dialogical theory and practice, highlighting the transformational power of genuine dialogue. This *turning* represents a key threshold that we must learn to cross in developing relational practices within an awareness-based systems change programme. A brief outline of this constructivist methodology is provided (with an emphasis on why Action Research privileges experiential and presentational knowing over propositional knowing) before moving to the third and final part of this paper. In this section the application of this shift from domination to partnership and the accompanying eschewing of "power over" in favour of "power with" (Macy & Brown, 2014) is explored by considering what we choose to place in the mouth of working equines and how we then engage in partnering. It will do so, drawing on empirical examples drawn from a review of, and reflections on, ten years of ethnographic and awareness-based Action Research field work (Cousquer, 2018) on how the international mountain tourism industry became aware of and addressed the welfare issues associated with systems of control – specifically the traditional Moorish bit. – and co-created opportunities for pack mules and muleteers to develop relationships based on deep listening, where compassionate inquiry is privileged leading to greater self-awareness and awareness of the mule.

A HISTORY OF DOMINATION

To understand and better appreciate the oppressor mindset, it can help to examine the long history of collective and generational trauma that has marked humans and equines and their working relationships and that we are caught up in and enculturated into.

The domestication of equines provided horsepower and a means of transport that revolutionised the way humans could farm the land, control and trade resources, travel and fight each other (Bendrey, 2012; Hallberg, 2008; Hall, 2005; Levine, 2005; 1999; Mitchell, 2015). According to Buffon (1791: 306), "the reduction of the horse to a domestic state is the greatest acquisition from the animal world, which was ever made by the art and industry of man". The term 'reduction', however, hints at the manner in which such a powerful creature came to be, not domesticated, but 'dominated' (Baratay, 2003: 21). Vignes (2011) suggests that domestication represents the ultimate phase of the intensification of the relationship between animals, plants and humans, hinting that such domination only became possible for animistic and totemic human societies when they abandoned the view that they existed on the same hierarchical level, changing "their horizontal conception of the World into a vertical one". This suggests a shift in the relationship from one of equals to one of subjugation, from a networked system to a hierarchy.

Buffon (1791) praises the horses' perceived merits, but in doing so, appears to paint over the horse's own intentions, preferences and welfare, creating an impression that horse and master share the same intentions, qualities and pleasures:

> Equally intrepid as his master, he encounters danger and death with ardour and with magnanimity. He delights in the noise and tumult of arms, and annoys the enemy with resolution and alacrity. But it is not in perils and conflicts alone that the horse willingly co-operates with his master… (1791: 306).

The stories humans tell about horses thus render the horse's exploitation justifiable, admirable even. As Paolo Freire (1985: 73) points out: "the relationships between the dominator and the dominated reflect the greater social context. … Such relationships imply the introjection by the dominated of the cultural myths of the dominator." Elsewhere (1985: 71), he states that "in the fields as well as in the circus, the apparent work of horses reflects the work of men". The dominator is thus able to impose objectives on the dominated (whether they be human or

equine) without the latter being aware of this or having much choice. It is then, arguably, convenient to deny the possibility of an equine having intentions and goals that could be aligned with those of a human. This makes their exploitation easier to prosecute because, not only are the methods to keep the exploited under control presented as entirely necessary but the myth that this oppressive system is fixed in the order of things is also imposed and any means to contest this denied.

This does not mean, however, that the impact on equine welfare was entirely invisible. Buffon recognises at least some of the effects of the devices and practices used to dominate, direct and exploit the horse:

> If sometimes permitted to roam in the pasture, he always bears the marks of servitude, and often the external impressions of labour and pain. His mouth is deformed by the perpetual friction of the bit; his sides are galled with wounds or furrowed with cicatrices… (1791: 307).

These quotes juxtapose the many ways humans have come to know horses and other equines with the invitation offered - when we detect signs of the real impact of our practices and actions on the equine - to attend to, know and care about the equine. Berger (2009: 21) commends Buffon's "tenderness towards animals which temporarily reinstates them as companions" at a time when the Cartesian division of body and soul had reduced the animal to the status of a machine. This leads us to consider to what extent the horse's experiences and welfare were accessible to Buffon and others and what might render it more-or-less invisible. How then are we to know both the equine and the knower who claims to know the equine? What does this then say about the relationship that they share and the extent to which systems of domination prevail because they remain unnamed, veiled and are not engaged?

Historically, the human-equine relationship was founded on militaristic ideas and culture; a culture in which the male values of control and domination came to characterise the relationship (Birke & Brandt, 2009; Enoff, 2014; Goldstein, 2004; Van Weeren, 2017). That is not to say that such practices are entirely born of cruelty and brutality for we must remember that the harsh life of the desert nomad (Thesiger, 2007) gives rise to what the Général Daumas refers to as "les moeurs du desert"[1] and that the love the Arabs bear for the horse reflects this (Abd el Kader & Daumas, 2008: 95-107). Cousquer (2018: 202) argues, however, that while these practices may be the product of circumstance and necessity, they are also "born of singularity – of a hierarchical way of ordering the world that leaves little room for tyranny to be challenged and reimagined". This hierarchical and typically paternalistic way of being and acting in the world informs thinking around communication and relational practices, including training in what communication is or might be, in communication practices and the ends to which communication is used. According to Hall *et al.* (2008), the "main aim of traditional training techniques is often stated as gaining control over the behaviour of the horse". This is further reflected in Esterson's (2014: 6) description of the bit's role and purpose in which it is asserted that "fundamentally all bits have the same purpose: to allow us to control our horses better." This should be contrasted with alternative characterisations of the bit (and alternatives to the bit) that place listening (or at least communication[2]) at the heart of the relationship, emphasising mutuality understanding and trust as essential constituent parts of the relationship (Cook & Kibler, 2018; Cook, 1999; 2013) – of which more later.

For much of history, the equine was a tool or servant that served the needs of man. In terms of how we are, view and communicate with the equine: doing prevailed over being, unilateral telling or demanding (Argent, 2022, p.45) over asking, monologue over dialogue. This then is the domination system that privileges the perspective and realities of the dominator and obscures those of the dominated.

TURNING FROM DOMINATION

In this, the second part of this three-part paper, we consider how the domination system has been disrupted and consider alternatives to domination based on the dialogical principles of respect, mutual reciprocity and the self-transformation that arises when we open ourselves to the possibility of change and create space for other possibilities to emerge. We start with stories for as Donna Haraway (2016, p.12) says

> It matters what matters we use to think other matters with; it matters what stories we tell to tell other stories with; it matters what knots knot knots, what thoughts think thoughts, what descriptions describe descriptions, what ties tie ties. It matters what stories make worlds, what worlds make stories.

The stories we tell about equines evolved whenever a shift in emphasis occurred from what we do with horses to who we are with each other. Bieri (2008) argues that literary works such as Anna Sewell's "Black Beauty" created animal biographies that have allowed the reader to identify with the animal and develop a "sympathetic imagination"

[1] This phrase can be translated as the ethics or honour code of the desert nomad.

[2] All too often we listen to speak rather than to hear. There are thus significant differences between listening and communication. Communication can often be practised without shifting the source from which we listen in order to listen more deeply.

that allows us to empathise with the suffering they endure at our hands. Élisabeth de Fontenay distinguishes between two ways of writing for animals, distinguishing between two types of author, those who make animals speak and those who speak of them:

> Car après tout, ce *parler des bêtes* on peut l'entendre en deux sens. Comme un *génitif subjectif*: les bêtes parlent, disons que nous les faisons parler. Ou bien comme un *génitif objectif*: nous parlons d'elles. Je placerai ceux qui font parler les bêtes du côté de la *mimesis*, de l'allégorie, de la prosopopée, et ceux qui parlent des bêtes du côté de la *diegesis*, du récit, de la narration, de la description[3] (2008: 27).

There is thus a choice of narrative voice that can speak for and help us know the equine. These are to be distinguished from the animal voices produced when co-opting an animal into the human family and into spectacle (Berger, 2009: 26), marginalising their needs and turning them into human puppets, projecting "the pettiness of current social practices ... onto the animal kingdom". Animals are thus marginalised, not just physically but culturally; this represents a barrier to knowing. Bringing non-human animals back in and giving non-human animals them their voice is no easy matter, however: As Buller (2015: 376) puts it: "What is required are approaches to animals that do not rely upon wholly human representative accounts – the animal as it is seen (Derrida, 2008: 82) but find other ways of letting animals speak – the animal that sees".

Murphy (1991: 50), in his call for "an ecofeminist dialogics" in which humans learn to read the dialects of animals, claims that "non-human others … can be constituted as speaking subjects rather than merely objects of our speaking". Donovan (2008: 50) argues that it is possible to pay attention to and study what is signified by such things as body language, eye movement, facial expression and habits, thereby restoring these absent referents to discourse "allowing their stories to be part of the narrative, opening in short the possibility of dialogue with them". This, however, raises intriguing questions about what form(s) that dialogue might take and whether there is a need for perceptive people to translate or otherwise plug the gaps that exist between our understanding of animals and their own lived experiences. It is to the filling of the gaps that we now turn.

Temple Grandin (2008) has drawn on her own perceptual abilities as an autistic person to develop an empathic understanding of how cattle can experience fear and panic in the abattoir environment and how this awareness can be used to transform the design of American slaughter plants. Despret (2009), in her critique of Grandin's work, recognises that whilst animals and autistic people may be visual rather than verbal thinkers and therefore "geniuses of perception", this suggests that being able to understand the animal and speak for them is something of an exceptional quality. These are qualities of attunement, empathy and listening but are they exceptional or simply unrealised possibilities? Grandin (2008) argues that cattle and other animals think in pictures and that her own autism has allowed her to imagine herself in an animal's body and see things from their perspective: thinking in pictures without words, tuning into the fear that she believes is the dominant emotion in both autistic people and animals such as deer, cattle and horses. I have argued in my own Action Research work, that the use of well-taken film and still images (presentational knowing) captures a story and allows the viewer to revisit, explore and make sense of that story.

Whilst the ability of words and pictures and therefore of story to help us see and care about animal suffering is undeniable, it is also easily dismissed as anecdote by those (see for example Hall *et al.*, 2008; Waran & Randle, 2017) who argue that objective measures (i.e. 'scientific evidence') are required for us to know that an animal suffers. This reflects the perception that sufficient evidence is required to persuade practitioners to evolve (or transform) their practices, to change themselves. It also reflects a hierarchy of epistemologies in which our ability to see and feel an animal's fear and know they are afraid is demoted, whilst other forms of knowing are arbitrarily promoted. We thus end up with the proxy of cortisol blood levels being accorded more importance than the look of fear we read in an animal's eyes. This raises interesting questions about the criteria used, not for truth, but for sufficiency. How is it that we lose sight of people's willingness to disbelieve the evidence of their own eyes? Why is that responsibility for knowing is delegated to those who can see and (or?) gather persuasive evidence; how is it that we, as Hinchliffe (2005: 644) puts it, "divide human off from the non-human" and "matters of choice from matters of fact"? Hall *et al.* (2008) argue that quiet, withdrawn (and even calm, bombproof) equines should not be assumed to be "happy" and "relaxed". This represents a challenge to the orthodoxy that an unhappy equine shows obvious behavioural problems and encourages us to consider the subtler, harder to interpret signs that hint at a disturbance of their inner world. They bemoan, however, the lack of "scientific work in this area"[4]. In doing so, they point to a gap in our knowledge, an 'information gap' (Brown,

[3] Translation: "After all, speaking of animals can be understood in two ways. As a *subjective genitive*: animals speak, that is to say we make them speak. Or as an *objective genitive*: we speak of them. I would place those who make animals speak on the side of mimesis, allegory and prosopopoeial and those who speak of animals on the side of diegesis, narrative, narration and description."

[4] They do not, however, question the limited "ways of knowing of positivist-oriented academia" that Heron and Reason (2008, p. 367) "see as based primarily on abstract propositional knowledge and a narrow empiricism".

2015) and draw our attention to how such gaps have historically been plugged by those with vested interests and orthodox views. Attending to these narratives is thus as much about noticing how information is organised and strung together as it is about noticing how information gaps are plugged to allow a story to hold together. This is why alternative narratives can be so destabilising (Buller, 2013) and disruptive. McManus (2014: 120) proposes that "orthodoxy may be little more than the heresy that won, and we are becoming more sensitive to the voices of the defeated". Françoise Wemelsfelder, who has devoted much of her career to validating our ability to understand the rich inner life of other species and language animal expressivity expresses this beautifully when she proposes that "the notion of sentience is about standing in relation, about 'relationing' humans and animals into an evolving story" (2012: 244). When we learn to deepen our listening, compelling alternative narratives become available. We no longer feel compelled to dismiss their story and can seek alternative ways of staying with the trouble (Haraway, 2016), of sitting with the challenges involved in understanding how (not whether or to what extent) the equine suffers.

In France, Pierre Enoff (2014) has articulated (and, through his own >40 year example, enacted) a particularly strong challenge to the traditional cultures and beliefs that have resulted in horses being broken, shod, stabled and denied grazing and social interaction with other horses. Birke (2007: 236)[5] provides an account of the emergence of "natural horsemanship" (NH), concluding that the movement is, in many ways, a reaction against the instrumentality and brutality that exists in the horse-world, advocating instead that we need to find ways of working with equines based on kindness and respect:

> The growth of NH forces the horse's well being and relationship with humans into the spotlight: Whatever methods we use should take into account the horse's point of view.

Whilst the rejection of 'horse breaking' in favour of 'joining up' represents a revolution in horsemanship and a clear rupture with the exercise of force (Miller & Lamb, 2005), it is still, ultimately "concerned with getting into the saddle. Horse riding …. is its teleology" (Smith, 2011: 10). Treating the equine with kindness – and it should be stated that there will always have been some horsemen that were kinder than others - is, for some, still not enough. It is not enough to question how we do something, we need to question what we do and why. Letting go of any claim that horse riding reflects a shared intention, letting go of a pre-determined objective and focussing instead on what the horse might truly want means attending to the horse. This is beautifully captured by David Walser's account of Delgado's and Pignon's training approach to their Lusitano stallion, Templado:

> Instead of saying to themselves, as they had done so far, "How can I get this horse to do what I want, albeit in the kindest possible way?" they learned to ask, "What would this horse *like* to do?" Then slowly but surely they built on what the horse told them. Instead of thinking of themselves as teachers, they had to become pupils. They felt they were entering new territory, one that could only be explored by an absolute determination to put the horse on a more equal footing with themselves and to abide by an immutable set of principles, based on respect and love. (Pignon *et al.*, 2009; 17-18).

This example of "relational practice not only eschews forceful dominance and the subjection of the horse by restraint, pressure and coercion into fearful compliance, it also advocates an appreciation of the horse as a sentient being whose interests and inclinations need to be respected" (Smith, 2011: 10). The interplay between the need to dominate and the need to care for and be kind has perhaps been present as a constant throughout the history of horsemanship (Morgan, 1962). With the arrival of animal behaviour science, a distinction was made between negative reinforcement (e.g. pressure and release) and positive reinforcement techniques (e.g. clicker training); see for example Foley (2007), Grandin and Johnson (2009), Karrasch *et al.* (2000), Kurland (2007), Waran *et al.* (2002) and Warren-Smith and McGreevy, (2007). This has given rise to intense discussion about the relative merits of goal-focussed versus process-focussed approaches[6].

Methods of shaping horse behaviour through positive reinforcement, whilst gentler and more responsive (Grandin & Johnson, 2009: 135) cannot escape, however, "the critique of subjugating the horse's natural inclinations to the actions the trainer wants the horse to perform" (Smith, 2011: 12). Such critiques challenge us to consider the extent to which the intentions of equines and humans are aligned. Knowing the equine is thus a complex undertaking for it requires us to consider not only how (and how well) we know the equine but also the ends to which that knowledge is applied. Questioning the ends to which we exploit our power over animals reflects the increasing tendency to view and treat animals as subjects and the increasing attention being paid to animal's capabilities and their moral consideration (Armstrong & Botzler, 2008; DeMello, 2012; Fennell, 2012a; 2012b, Gruen, 2011; Markwell, 2015). Holding ends up to scrutiny encourages us to take responsibility and develop response-ability (Haraway, 2008). McVey (2017) recognises a shift of responsibility onto the rider/student that comes when pedagogy privileges a coaching

[5] See also Birke and Brandt (2009).

[6] Process focussed approaches tend to respect core values as a priority over delivering outcomes.

approach over traditional didactic learning, where knowledge transfer and rote learning are emphasised. Such approaches recognise that the student

> must activate their own learning, reflect on their own performance and take an evaluative role in choices that enable 'partnership' to flourish between horse and human. They must 'reach out' towards an infrastructure of information from a position of bounded responsibility (2017: 103).

This switch in emphasis highlights the opportunities to transform welfare that avail themselves when training interventions shift their focus from explicit and tacit embodied epistemologies to self-transcending epistemologies (Scharmer, 2016). This involves opening ourselves to change and learning to listen deeply. To do so, however, "we must cease merely asking, telling and demanding. Rather, we must listen, with all of our senses, with openness, with care, and with humility" (Argent, 2022: , p.47). This section has traced elements of the evolution of the human-equine relationship and of the stories we tell about these relationships. Our need to dominate the equine and impose our own intentions and priorities on the relationship has seen knowledge about horsemanship challenged by knowledge about the equine's inner life, their well-being and the cultivation of our own ability to see, understand and care about the relationship we create. This represents a "turning" and a radically pivotal one, where "to turn is to give up the false self-asserting self, but not to give up the "I" and "the ever-new turning toward relationship is turning to deep bondedness" (Kramer, 2003: 159)[7]. Caring about the other thus gives rise to concern about the relationship we co-create together. Gala Argent (2022: 43) has argued that horses make communicative bids that we can answer by turning toward, away from or against. She proposes that "the attentional and emotional availability shown through turning toward fosters attachment, connection, and trust which allow both partners to feel calm and safe" (p.43). The next section builds on this account of how turning from domination to partnering (Eisler &and Fry, 2019) can give rise to a qualitative shift in the human-equine relationship from the "hard narratives of control and management to the soft narratives of care, respect and enlightened equitation" (Smith, 2011: 15). The next section explores what surrendering control creates space for and considers how being present to ourselves, to the equine and to the "space between" (O'Donohue, 2008) contributes to how we can better nurture relations that privilege power with rather than power over. This section is thus about the emergence of embodied possibilities, where being with in the present moment brings us back into the present, into our own bodies[8] and into whatever is waiting to emerge through us when we are fully present on this co-creative frontier.

Embodied knowing: of centaurs and hybrids. Ann Game's (2001: 1-2) exploration of the relationship and deep connection that can develop between a horse and a human, allows her to propose that "we are always already part horse and horses part human; there is no such thing as pure horse or pure human. The human body is not simply human". Game emphasises that "people who live with animals experience connectedness and cross-species communication daily" and, arguably, shatters any illusions that we might have that we are separate from the other and unable to communicate or connect across the species divide. The capacity we have for 'horseness' goes beyond a process of entraining, of tuning into one another. It is what Gaston Bachelard (1969: 14-15) described as an 'inhabitation', when horse and rider come to inhabit riding. And, when the rider achieves "the ideal of a horseman who knows full well that he will never be unseated" (Bachelard, 1971: 31), a true humility is reached for the rider has surrendered to the Self and has become one with the horse. Game describes this moment of connection, of flow[9], as a 'rapture' (2001: 10) and declares that "Connectedness in living the image of the centaur comes of opening ourselves to the otherness of horse and letting go of self in order to be open to a connecting spirit." There are echoes here of Snyder's "in-between world", a world we can enter, one that is "not exactly human, not exactly animal, where rain might look like fire and fire might be rain" (1990: 177).

The relationship is, arguably, not just one of co-being and intra-action (Maurstad *et al.*, 2013); it is one of co-creation. It is what is created together although this still leaves open the question as to how contributions are made equitable and to what extent the self is allowed to slip away and is replaced by oneness. Drawing on the grammar of the social field, proposed by Scharmer (2016: 231-253), this 'letting go' and a 'letting come' is the essence of presencing. It should be noted that the concept of the 'centaur' also figures strongly in the humanistic approach to Action Research (Rowan, 2006). This emphasises the transpersonal as a form of psycho-spiritual development that concerns itself with experiences that involve "an expansion or extension of consciousness beyond the usual ego boundaries and beyond the limitations of time and / or space" (Grof, 1979: 1555). The shift from the mental ego to the Centaur stage is marked by peak experiences that are considered a harbinger of change and transition;

7 Citing Smith's translation of Martin Buber's *I-Thou*.

8 The body, together with the breath offer us two important anchors to the present moment.

9 This term should be understood in the sense used by Mihaly Csikszentmihalyi (2014).

it is part of the call to adventure. In this case, the change or transition is an important one, both at the personal level and at the level of the horse-human hybrid:

> The name Centaur was chosen to mark the contrast with the Mental Ego stage, where the basic image is of a controlling rider (the intellect) on a controlled horse (the emotions and body), separate and distinct. At the Centaur stage we think in terms of bodymind unity instead. (Rowan, 2006: 107).

To understand this better, we have to recognise the unity of living source across species that gives rise to multiplicity in unity. Difference, however, appears first and one is left struggling to recognise oneness. According to Bortoft (2012: 119), the "organism of the work is an inexhaustible multiplicity in unity of self differences, which are the work's own possibility of meaning manifesting in a variety of contexts and situations". For Buber (2000), oneness comes first and comes to develop a separate identity, as objectifying relationships are formed[10]. The resulting *I-It* seeks and is capable of returning to the inborn *Thou.* For Buber, truly becoming a human person requires us to meet the World as *Thou*. (Kramer, 2003)[11]. The embodied oneness that can arise between horse and rider may therefore represent an immanence (Smith, 2011), a genuine encounter, a return to the *Thou*.

This transformation in human-equine relationships can be summarised as a journey from domination towards and into dialogue. It is so much more than that, however: In turning to the other, we are opening a listening organ within ourselves and letting go of our own agendas. It is this willingness to co-create rather than command and coerce that gives rise to what Buber terms *genuine meeting* and *dialogue* and Scharmer develops further in his work on *presencing* and *generative dialogue*. How can we realise the transformative potential that knowing through the body and through the present moment makes when possible when we turn to the working equine? To understand this, we must consider how to cross the threshold and meet genuinely. It is to the knowing of such encounters that we now turn.

Knowing through shifting our source of attention. In seeking to understand how to deepen one's sense of self as a relational being, one has to go deeper and explore new fields of awareness. In the same way that Ingold (2010: S122) reminds us that "a mindful body that knows and remembers must also live and breathe", we recognise that there are aspects of life and of being that we often fail to attend to. Knowing the equine involves becoming present to ourselves, to the other and to the world whilst learning to recognise when and how we absent ourselves (Scharmer, 2016). Absencing arises when the judging, dualistic, thinking mind intervenes and imposes itself. Staying mindfully present provides us with an opportunity to observe the mind and see how non-humans are judged and categorised. In doing so, non-human orderings and 'otherings' are exposed and it becomes possible to question the authority of those who insist that "their statements are literal depictions of a reality thereby made manifest" (Law, 2004). Staying present thus challenges us to attend to the lived encounter, wherein, according to Donovan (2008: 48), "humans pay attention to –listen to– animal communications and construct a human ethic in conversation with the animals rather than imposing on them a rationalistic, calculative grid of humans' own monological construction". This is essential if we are to know the other according to Heron and Reason (2008: 367) for whom failure "to honour the experiential presence – through premature abstraction, conceptualisation and measurement, or through a political bias which values the experience only of socially dominant or like-minded groups – ignores the fundamental grounding of all knowing". The extent to which one can suspend habitual ways of seeing and open up an organ of seeing is thus a key step to deepening awareness. Scharmer (2016) describes this as "suspending judgment," proposing that this involves a shift in the source of our attention from *I-in-Me* to *I-It*. In suspending judgment, curiosity becomes available to us. A further deepening of awareness becomes possible when we suspend our reluctance to feel (our cynicism) and embrace compassion as a way of knowing. This involves a shift in our source of attention from *I-It* to *I-Thou.* This reluctance to feel, traps considerable energy within our bodies and any shift into sensing[12] therefore represents a significant barrier to awareness but one we must learn to navigate if we are to transform working equine welfare and the human-equine relations that shape the equine's faring. This barrier can be thought of as a threshold, one that must be explored if we are to move beyond factual knowing and engage empathically and more holistically with the systems that enact welfare. Crossing this threshold requires us to understand how to turn to the other and be present to the other and to the between. There is perhaps no better way to summarise this than by means of Martin Buber's life work that distinguishes between *I-Thou* and *I-It* relationships (Buber,

[10] This represents the interplay between alternating ways of engaging with the other: meeting them in the realm of *I-Thou* and acting in the realm of *I-It*.

[11] Whilst the World of *It* is necessary for human life, one who lives continuously and exclusively in the World of *It* does not become fully human (p. 74). A healthy alternation between *I-Thou* meetings and *I-It* mismeetings is interrupted when humans and institutions overemphasize or valorise the *I-It* approach to experience (p. 46).

[12] According to Art et al (2021, p.129) "sensing refers to expanding one's perception by moving beyond one's own 'bubble' as an individual observer to begin to perceive reality from the social field. It involves shifting the inner place of observation from the head to the heart."

2000). In the former, the *I* is open to the other and the mutuality and reciprocity experienced is dialogical. An *I-It* relationship is, by contrast, a "one-sided experience of knowing, using and categorising people and things" (Kramer, 2003: 42). According to Buber, the most powerful moments of dialogue occur when *I* and *Thou* meet: Genuine meeting, requires unconditional trust and a willingness to be vulnerable to the other. Remarkably, one of Buber's early insights into how we meet the other came, at the age of 11, from a dapple-grey horse:

> When I stroked the mighty mane … and felt the life beneath my hand, it was as though the element of vitality itself bordered on my skin, something that was not I, was certainly not akin to me, palpably the other, not just another, really the Other itself; and yet it let me approach, confided itself to me, placed itself elementally in the relation of *Thou* and *Thou* with me. The horse … very gently raised his massive head, ears flicking, then snorted quietly, as a conspirator gives a signal meant to be recognisable only by his fellow-conspirator; and I was approved. (Buber, 1967: 26-27).

Somewhere within this exchange, there is an element of non-judgemental awareness, of approval, of acceptance. This is a genuine meeting. When, later, the stroking becomes pleasurable, something shifts, the other is objectified, judgement creeps in and dialogue ceases.

Buber distinguishes such genuine meetings (*Begegnung*) from mismeetings (*Vergegnung*). Only in the former do the most powerful moments of dialogue appear; these are transformative, leaving the "man who emerges from the act of pure relation" with "something more in his being, something new has grown there of which he did not know before and for whose origin he lacks any suitable words" (Kramer, 2003: 47). This is what David Whyte (2016) means when he advises us that "alertness is the hidden discipline of familiarity" and that the *I* deepens the more you pay attention (Figure 1).

CREATING OPPORTUNITIES TO MEET GENUINELY AND NURTURE THE "BETWEEN"

Having presented the theoretical underpinnings to transforming the human-equine relationship through awareness based Action Research, this next section provides a brief overview of the research approach followed by an empirical example to illustrate how the seed of compassion we all carry (Hanh, 2021) can be nurtured and a shift from domination to dialogue promoted. This example is drawn

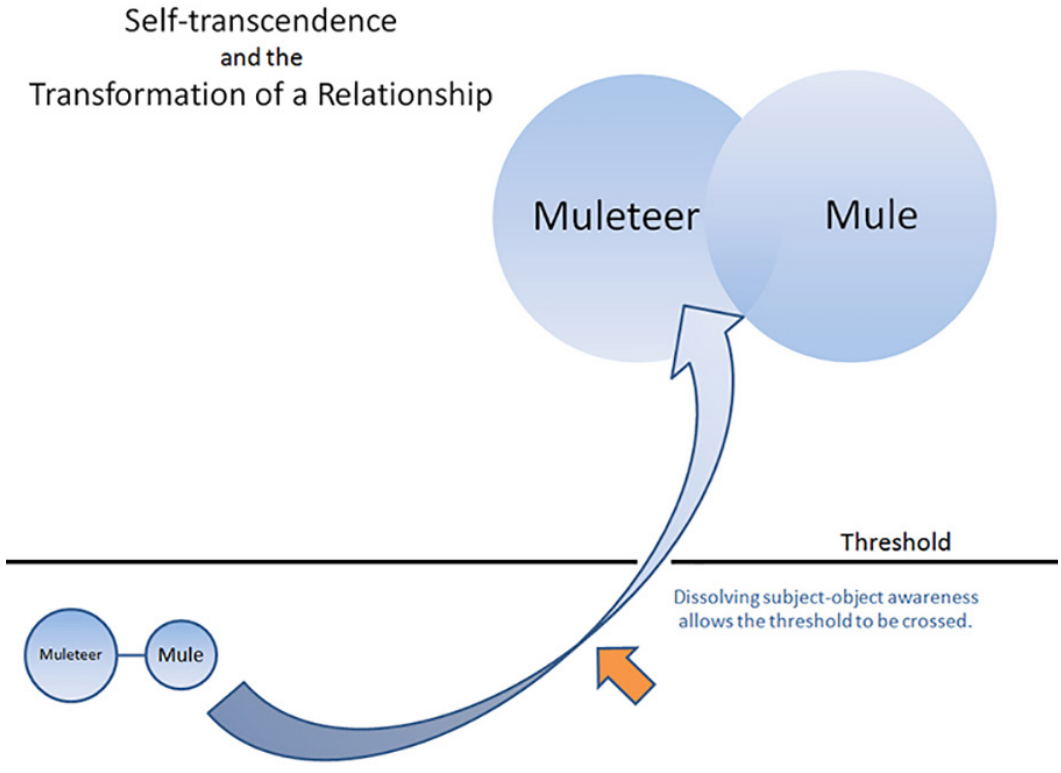

Figure 1. The tendency for the muleteer to view and treat the mule as an object rather than as an extension of himself has come to define the relationships that exist between man and mule. Transforming the self and the relationship requires us to see ourselves in the other. It is this that allows us to transcend and dissolve subject-object awareness and attain a new, higher level of awareness. Both mule and muleteer grow through this transformative process as they let go of the ignorance, judgement, cynicism and fear that limited who they could be.

from ten years of multi-sited ethnographic and Action Research fieldwork in the international mountain tourism industry, studying and transforming how pack mules and humans meet and communicate.

Methodology for action. Action Research according to Reason and Bradbury (2008: 1) is "not so much a methodology as an orientation to inquiry in which qualities of engagement, curiosity and question posing are brought to bear on significant practical issues". It brings together a range of "practices of living inquiry", "engaging those who might otherwise be subjects of research" in "more or less systematic cycles of action and reflection". These cycles integrate knowing and action, "responding to a desire to act creatively in the face of practical and often pressing issues", opening new "communicative spaces in which dialogue and development can flourish" (Reason & Bradbury, 2008: 3). It "draws on many ways of knowing" and is "values oriented, seeking to address issues of significance concerning the flourishing of human persons, their communities and the wider ecology in which we participate" (Reason & Bradbury, 2008: 4). Perhaps most importantly (Reason & Bradbury, 2008: 4) , it is a "living, emergent process that cannot be predetermined but changes and develops as those engaged deepen their understanding of the issues to be addressed and develop their capacity as co-inquirers. The approach developed within this project has been extensively reported elsewhere (Cousquer, 2018; 2022) and it is beyond this paper to provide anything more than the briefest of introductions to help explain how the theoretical underpinnings presented in the first half of this paper, inform the practical systems change work. The reader will see that the researcher makes extensive use of still images (and video) as part of the iterative cycles of experiential learning, reflection and development of practice undertaken with muleteering teams working for a number of travel agencies. These agencies learnt from the reports on mule welfare and muleteering practice and were willing to create safe spaces and learning and development opportunities for their teams to evolve their practice.

Nurturing the between. A primary welfare concern identified early on in the work concerned the bitting injuries hidden away within the cave of suffering that is the mule's mouth. Prototyping alternatives to the traditional Moorish bit, especially for ground work but also for ridden work, demonstrated how creating the "new" can render the old obsolete.

This section explores how the bit was replaced and the between nurtured and is arranged in two parts. First, the traditional bit as a monological device and tool of domination is presented. This allows us to name and unmask the powers and the stories told to justify the use of power over. We then consider how space was created for genuine meeting and dialogue and present the dialogical relationships characterised by respect and mutual reciprocity that emerged.

The traditional bit as a monological device and tool of domination. The traditional Moorish bit has, for centuries, been placed as a "communication device" in the mouths of horses and mules. It has a high port that can be pushed up into the hard palate and thin bars that press down onto the bars of the mouth[13]. To understand the various ways the traditional bit ensures communication is one-way, or "monological", we need to understand how the lived experience of the mule is denied, how feedback is blocked and how this lack of feedback comes to limit awareness of self and of the equine and of what might arise when partnering rather than domination is privileged. This allows the use and abuse of power-over to be named and unmasked and then engaged.

Cousquer (2018) reports how, during his fieldwork he became used to hearing claims that mules were too "strong" to be worked without a traditional bit. He came to recognise this as a prime example of habitual listening or downloading (Scharmer, 2016): a single truth that, once accepted, leaves little space for others. It was, a reaction rather than a considered response, a reading of the situation based on a lack of self-awareness and an inadequate knowledge of the mule. It was a reading that he profoundly disagreed with and devoted years to unmasking and developing a more adequate response for. To understand this better, it is helpful to consider how the traditional bit hides many sinister truths about the downstream physical, mental and spiritual impact of the bit on the mule and the upstream motivations and assumptions of the human. To render these visible requires us to start paying attention differently – to look in the mouths and the eyes of the mules, to explore the minds and hearts of the muleteers and ultimately to work in the liminal in-between space to transform the relationship (the spiritual connection born of two conscious intelligences).

Looking into the mouth of mules served as a starting point and from there it was possible to encourage the wider community to interest themselves in what lay hidden in the mouth (using still images, slide shows and film) and in the mule welfare. This led them ultimately to "turn the camera back on themselves" (Scharmer, 2016) and consider the source of their own actions.

Cousquer (2018) tells of his first meeting with an old, emaciated mule carrying guest suitcases up to a hotel above Imlil (Figure 2a). Concerned by her state, he asked the staff there to send him the mule to examine. What he found inside her mouth (Figure 2b) moved him to tears and angered him for he felt her pain and the pain of all the other mules who suffered in similar ways. Unseen and

[13] A more detailed account of the bit's construction and action is provided below, together with images (see figures 2b-5a).

Figure 2a. Hassan's emaciated mule labours up the path, carrying the suitcases of a holidaying couple who have walked up separately, oblivious to the state and suffering of the mule carrying their bags, oblivious to the traditional bit and horrendous injuries in her mouth, oblivious to the lack of polices in place to protect mule welfare. They, of course, were on holiday! And, as such, oblivious to their responsibilities. But who would spare this mule a second glance and, attending to her respectfully, recognise her emaciated sate? Who would see and feel and act on her behalf?

unknown to all those[14] who exploited her failing body, this mule had suffered extensive trauma to the bars of her mouth, resulting from the abuse of the traditional bit (Figure 2c) that had been used to drive her on and keep her working.

> The mule looked so uncomfortable; I could literally see the pain in her eyes, not to mention the blood in her mouth. What I found in her mouth surprised and shocked even me though!! The bars on both sides of her mouth had deep wounds where the bit had been pulled into the mucosa, cutting it up and leaving it raw and bleeding. No wonder she had not been able to eat. As we set about cleaning out the wounds, Brahim went past. He leant over the wall and commented – "elle mange pas bien henh? It is striking how the bottom line for many owners is their mule's appetite and they appear to have some difficulty seeing beyond that. Earlier, when coming past the Kasbah, we had seen a thin mule (perhaps even this one) and Brahim had said – "elle est très fatigué!"[15]

Eating badly, very tired: these descriptions of the lived realities of an old mule reflect how she is attended to. Her lack of appetite and energy are statements of fact. Or, perhaps, euphemisms for getting old and being unfit for work. Where Brahim and Hassan, the mule's owner, saw a mule who was unable to do what she should be doing (eating and working), Cousquer (2018) describes seeing an old, abused mule who needed to be retired or euthanased.

The injuries were so severe that, despite being rested for several weeks, the mule died. Her plight had gone largely unnoticed by the tourists whose bags she had been

[14] There is no finger pointing here as the exploitation is hierarchical, the poor mule owner just as exploited as the mule because no one has stopped to consider his situation with curiosity and compassion.

[15] Field Notes 9, page 10 (5th May, 2014). "She is not eating well" … "She is very tired".

Figure 2b. Hassan's mule, when viewed from the front, has a fearful and pained look to her. There is blood pooling inside her lower lip and the traditional bit that has been used to force her to work is hanging from her mouth.

Figure 2c. The traditional bit removed from the mouth of Hassan's mule is the obvious cause of the injuries she has suffered. If this were true, replacing it with a smooth modern bit would address the problem. Sadly, a focus on the equipment obscures more fundamental problems. These include the relationship between mule and handler, the muleteer's lack of access to education, training and equipment and the circumstances that allow them to purchase and then work a mule that is unfit for work.

carrying, her suffering effectively ignored by those who had employed her owner to transport the luggage. Ignored yes. Obscured too by her work, her load, her passing and our inability to question. A few months later, Cousquer (2018) describes how he met Hassan with a new mule, again being worked in a traditional bit.

> He told me that he had bought a new mule, a younger mule, for 5000 MAD from Asni. He showed me the mule and told me, when I asked why he was using a traditional bit, that it was because she was too strong.[16]

The up-stream causes of the horrendous injuries in this and other mules' mouths were unclear, however. Where do we look for causes and causal mechanisms (Scharmer, 2016), to what should we attend? Superficially, one might be able to single out the traditional bit for it was this *Causa materialis* that had directly caused the trauma to the bars of the mouth. If this was true though, simply replacing the bit with a modern (wider, smoother, stainless steel) more humane alternative would solve such problems. Why then, he asks, did he feel so uncomfortable seeing Hassan's mule being given a well-made snaffle bit?

In the case of Hassan's old mule, the problem was not that she was strong. It was not that she needed a different bit or even a head collar; she was simply unfit to work and her owner needed to work. In the absence of a viable solution that respected the mule's need for rest and retirement[17], she was given a bridle with a snaffle bit. This is symptomatic of the impotence one is faced with when trying to solve a much bigger problem: unable to see and address the underlying causes, one is left addressing a false

[16] Field Notes 16, page 12 (7th August, 2014).

[17] She was subsequently offered retirement by a retired British couple who were in the process of setting up a Donkey Sanctuary near Marrakech but died without being able to take up this offer.

cause. In the case of Hassan's new mule, he was needing to work her but did not have the means (the equipment, time, training and ability) to establish a trusting, respectful relationship with her. The bit is thus used to force a mule to work not because she is strong but because there has been no investment in the between.

Looking into the minds and hearts of the muleteers becomes possible when spending weeks and months with them and their mules in the field. Key to disrupting the status quo is opening the mind and heart such that a deeper awareness of the whole can develop and the bit be seen more clearly for what it does. Helping them to see and sense into the mouth and lived experience of the mule became part of the research approach with multi day treks undertaken in ways that promoted opportunities to do just this. Sitting down, of an evening at the end of a long day's trekking, with a team of muleteers allowed images and footage of the day to be viewed as well as slide shows of images, collected of the mouth injuries from the village of Tizi Oussem.

These injuries are easily overlooked, even by professionals, if one does not notice the subtle clues that lead one to seek out the injury inside the mouth. And it was important that these muleteers started noticing the tell-tale signs so that their awareness deepened.

> The last mule that came in for examination arrived with a young lad on her back. I could see at a distance that there was blood in the mule's saliva and noted the force with which the young boy yanked on the bit. Houda did not spot the lesion – but it was not easy to find for it was hidden in a fold of mucosa under the tongue.[18]

The mule in question had been examined as part of a study[19] on the welfare of the mule in the two neighbouring valleys. The blood in this mule's saliva (Figure 3) drew attention to the bitting injury and to the fact that oral examinations[20] were not very thorough and were probably missing a lot of pathology. This highlighted the fact that these examinations were not evaluating the roof or the bars of the mouth or the bars for signs of repeated trauma and would have missed injuries that were no longer bleeding.

This pathology is better known to archaeologists studying the origins of domestication (Bendrey, 2007a, 2007b, 2011, 2012) and to veterinary practitioners trying to study the relationship between bone pathology, the bit and the horse's experience (Cooke, 1999, 2011). Attending to the physical signs of trauma left behind by the bit is thus a clinical matter, founded on an ability and willingness to examine the mouth: An ability, or competency, born of training, of familiarity, of an awareness of where the teeth lie and of how to examine without being bitten or upsetting the mule. Attending to the trauma is also, however, pathological and archaeological. In this sense, the materiality of the bit appears in the mouth (a place) and across time, both in terms of an individual's lifespan and the histories[21] of the domination and domestication of the horse. These materialities are different, hinting at the multiplicity of narratives the bit gives rise to.

The traditional bit's material productions lie hidden inside the mouth, beneath the overlying soft tissues, inscribed in the periosteum and in the nerves, mind and spirit of the equine. Hidden too by the gap between the stimulus of the bit and the response of the equine, a gap that is easily filled with the narrative threads that suit the intention of the storyteller. When attending to the loaded mules being worked with bits in their mouths, I saw the meals denied, the grass that wasn't there, the calmness denied; when, later, we sat down together to look at images of the mouth injuries I had recorded, we attended to what should not have been there. That which these narratives make present or absent is therefore welfare.

Attending to the relationships that the bit enacts allows us to appreciate how the bit transmits messages (Figure 4) and the directive, monological nature of those messages, how it renders a mule compliant, productive and invisible! Designed, made and used by man to direct and control, it is a telling device, not a listening device. It supports the status quo, imposing and sustaining a singular narrative. This both limits and determines how mules and mule welfare are known.

Mol (2002: 31) shows that, by foregrounding the "instruments that unveil the hidden reality of atherosclerosis", an atherosclerosis is enacted that is entirely dependent on the microscope. Cousquer (2018) similarly demonstrates that the instrument that is the bit, enacts a man-mule dyad and the welfare contingent on that one-sided relationship. He has furthermore shown how the bit enacts unequal exploitative relationships in which downloading (Scharmer, 2016) and the abuse of power deny mules the right to reply, eat and drink (Enoff, 2014). By attending to that which the traditional bit brings into being, it is possible to understand how its brutal efficiency and insensitivity can render those who use it inattentive, insensitive and even brutal. Possible too to understand the nature of the relationship between mule and muleteer that the bit creates through its redistribution of power. Power does not necessarily corrupt but it can be abused where humility and integrity are lacking (McManus, 2004). In cultures where we value task accomplishment over relationship building,

[18] Field Notes 6, page 12 (17th April, 2014)

[19] The study was undertaken by a final year student from the Institut Agronomique et Vétérinaire Hassan II, in Rabat. I had been charged with supervising the student and we had been collecting a wide range of data on different aspects of mule welfare.

[20] that the student had been conducting

[21] There are of course many ways of trying to piece together that history.

Figure 3. The blood-tinged froth on the gums and lips of this mule, the similarly coloured drop of saliva that is about to fall from this mule's lower lip might draw the attention to the fact there is an injury within the mule's mouth. The curled tongue, the open mouth, the owner's clenched fist, the control, the unnaturalness of it all, might all invite curiosity and concern… The easily missed bloody saliva prompted me to undertake an oral exam and determine the location and nature of the injury. This is not something the average owner, guide or tourist would ever do. It requires skill, confidence, curiosity and consideration.

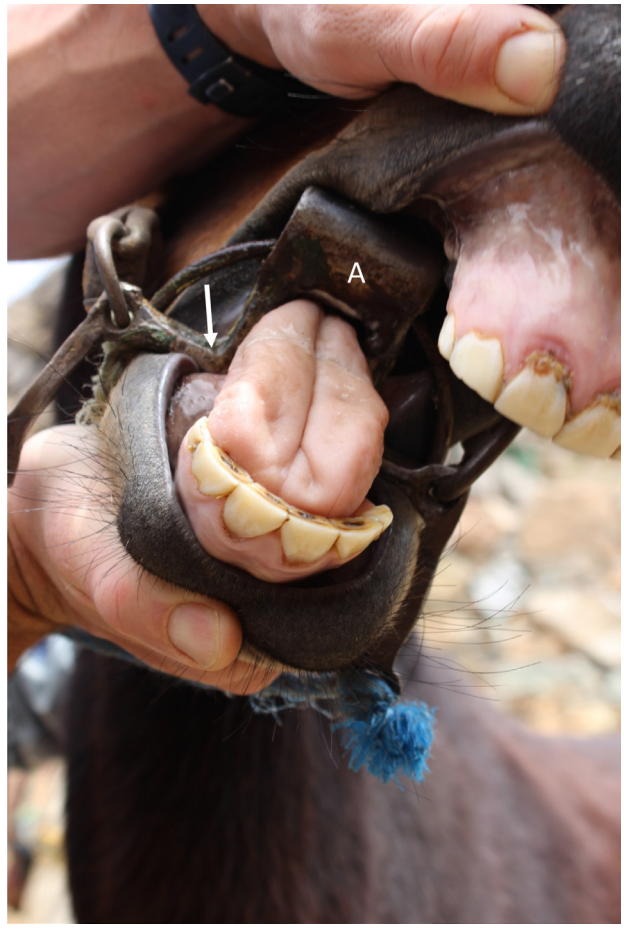

Figure 4. This young mule has a traditional bit in her mouth. The bit's action commands her attention. The right-angled bar of the bit (arrow) is in contact with the bars of the mouth and can easily traumatise both the bars and the sublingual tissues. The port (A) is raised into the roof of the mouth when the reins are pulled, forcing the mouth open.

the "culture of do and tell" dominates and we fail to inquire humbly of the other (Schein, 2013) and fail to see that with great power comes great responsibility.

(ii) Creating space for genuine meeting and dialogue

To transform the *I*, it is essential that the source of attention be shifted from *I-in-Me* and *I-It* to *I-Thou.* When attending and available in this way, genuine meeting becomes possible, providing the other is similarly available. From a pedagogical perspective the Holy Grail becomes to create space for and facilitate such encounters.

The shift from *I-in-Me* attention where the ego's world view is downloaded requires a shift into curiosity that allows disconfirming information to be noticed. This can be thought of as facilitating open-mindedness. A further shift into compassion is required for genuine meeting to occur and this requires an opening of the heart. It can be helpful to think of these two steps as (i) seeing and (ii) sensing. Facilitating these encounters requires the guide to be familiar with the territory involved and to have developed their own seeing and sensing practices.

The photos shared with the muleteers were collected during the earlier survey work that had taught Cousquer (2018) to attend to clinical signs. Restraining, handling, examining then lead to diagnosing and awareness. These were his seeing practices and he had to understand and draw on them to help others learn to see and to attend, to then feel and care. Looking carefully. Looking care-fully, attending fully with care. His own practice provided a window into

the mouth, one that led him to attend to the many actions of the traditional bit. What else lay hidden in the mouth or elsewhere? What was he not seeing? Where did he need to redirect his attention? One starting point was to consider how the traditional bit sits in the mouth (Figure 4) and functions[22]. But he also needed to step back and consider the issue more holistically: He needed to contemplate its appearances. As Bortoft (2012) emphasises we need to take appearance seriously and attend dynamically, paying attention to the material appearance and the way something comes into appearance in our minds and in our hearts. There is thus a need to move upstream, from the bit, through the reins, to the hand that pulls the bit, to the mind that causes the hand to clench and be moved backwards and thence to the heart that causes hands to be hard and minds unseeing.

But how do we engage the mind and the heart when it is so well defended? Cousquer (2018)'s account of the work required to establish working relationships and opportunities to explore this draws attention to the many fears that lead mule handlers to rely on the bit and on power over.

When proposing that muleteers abandon the bit and eschew power over, there was no appetite for this hard work. On the morning after sharing the slideshow, Cousquer (2018: 164) asked the muleteers if any of them would be willing to try the head collar he had brought with him. There were no takers! They were all of the opinion the mules were too strong and would run off. His invitation refused, he was left to ponder his next move. He needed to get into their map and, in turn, ask them to step into his, to understand each other's world maps (Wagner, 1986). The picture he was getting was that the traditional bit, their local tethering practices and their willingness to ride a loaded mule were all quite normal to them and they did not really see a need to change. His map had, at its centre, mule welfare and the pathological and psychological traumas of oppressive muleteering practices, theirs a muleteering practice that worked well and that they were satisfied with. And, if he imposed his map, he would be exerting power-over when what was needed was to free both the oppressed and the oppressor.

A few days later, he waited on a col for the mules and watched another group of mules arrive:

> One of the shepherds arrived on his grey mule with a large log of juniper in the *chwari*. As he reined up his mule, the mule's mouth was forced open and she appeared to lift her head to relieve the discomfort provoked by the action of the bit.[23]

The image he captured captures a moment of attention. As the shepherd smiled and greeted him, he saw distress written across his mule's face. He could not return the greeting. He could not absent himself from the signs of discomfort and pain that he was learning to recognise. This image (Figure 5a) would, come to symbolise the hidden discomfort endured by mules and other equines working in traditional bits across Morocco. It is captured and glorified in images used to promote the country and the Moroccan's so-called mastery of the horse. The open mouth was something that Moroccans were familiar with and did not see the need to question (Figure 5b). McLean and McGreevy (2010) similarly comment on the need to recognise that "on the bit head and neck posture" seen in classical dressage (and hyperflexion in particular) is unnatural and typically achieved through force. The challenge was therefore not to fight the old but to create the new so that the old became obsolete.

This shift from fighting the old into creating the new proved liberating. It was also a significant commitment that involved spending months training a young mule to work in a head collar and then training her handlers to work to overcome their fears and establish a depth of trust and respect that had hitherto been unknown within the industry (Cousquer, 2018). Once the proof of concept had been established, trekking agencies were persuaded to send their teams for training workshops and treks where they gradually learnt to work with their own fears and those of their mules, learning to presence themselves and tune into the emotional state of their mules, checking in systematically as part of an ongoing two-way communication. Over a two-year period, the trekking teams working with the core members of the Expedition Providers Association were trained up to a point where their regular muleteers were confident working their mules in head collars rather than in bits and had developed an impressive ability to read situations and engage in reciprocal respectful working practices.

Mohamed was one such muleteer and his story exemplifies the shift from the bit to the between (Cousquer, 2018), exemplifying what can arise when an attuned handler turns to their mule and grows into and through the relationship, becoming with, becoming Mohamed-Mule, developing into someone who can find this path repeatedly and guide others along a similar journey.

Cousquer (2018) introduces Mohamed as a young twenty-year-old whose family make their living from a small shop and renting out rooms in the gîte they have built. Mohamed had recently become a father; his own father previously worked as a shepherd and now runs the shop. The family's one mule was worked by Mohamed and his younger brother. Mohamed was encouraged by his employer, James Kniffen, of The Mountain People, to take an interest in improving the welfare of his own mule and that of the mules they employed. This is the story of the co-sensing and co-creating journey undertaken

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[22] Clayton (1985) describes how this can be undertaken fluoroscopically. See also McLean and McGreevy (2010).

[23] Field Notes 16, page 36 (11th August, 2014)

Figure 5a. A sharp yank on this mule's reins forces the mule's mouth open and brings the mule to an abrupt stop. The nostril is flared and the mule appears to be crying.

by Mohamed. This story captures how a safe collective holding space (Scharmer, 2016) was created in which a small team came together and supported Mohamed as he undertook a deep inquiry into how relations and working practices between man and mule could be transformed for himself, his family, his employer and his mule.

To do this, Mohamed had to give of himself. He listened attentively. He organised meetings for the muleteers from his village at which he spoke passionately. He put in hours of training to develop his groundwork and riding skills, he organised training treks, participating in three of these and organised and gave riding lessons. This is classical fast-cycle learning (Scharmer, 2016, p.210) that constantly iterates the existing prototype and integrates feedback to improve practice. Mohamed's contribution is thus highly significant for he helped prototype strategic microcosms of change as a "landing strip for the emerging future" (Scharmer, 2016: 210-212).

Figure 5b. The same mule continues to hold her mouth open after being stopped. Her ears are back, she is clearly uncomfortable and distressed. The bit thus ensures that she attends to her master even if he does not attend to her. The bit is not designed for this for it is a monological device.

Mohamed's journey started with his exposure to the generative dialogue James and Cousquer engaged in about the challenges involved in improving mule welfare. Both Mohamed and his father attended the Expedition Providers Association (EPA) workshop in March 2015 and, a few months later, Mohamed was taking lessons. *Turning to* his mule came easily to Mohamed and in opening to her, he opened his mind and heart to her welfare. In integrating head, heart and hand (Scharmer, 2016), he was discovering and embodying a different way of being and dialoguing with a mule.

Reporting on their early work together, Ellen Cochrane[24], describes Mohamed's early progress as his awareness of how his mule feels and communicates emerges:

> The relatively simple tasks of grooming and picking up the mule's feet have been made possible with the increased level of understanding in behaviour that Mohamed has now developed. The first time he worked on grooming his mule and picking up her feet she was quite difficult and giving him warning signals to stop. However, by taking the right steps to make her more comfortable with him doing this, it has become very easy and enjoyable for them both.[25]

Ellen and Mohamed progressed from groundwork onto riding. This was made possible by Mohamed's willingness to "let go" (Scharmer, 2016) of control, to "surrender" (Buber, 2000) and to explore new ways of communicating with his mule, as they emerged dialogically.

> Mohamed has also worked hard on developing his groundwork and handling skills … on using his body language and voice commands to communicate his intentions. He has been working on the ability to stop and turn his mule while leading her, and is also able to do this without anything on her head.[26]

Communicating his intentions was something Mohamed could do gently for he was able to develop an awareness of, and feel for, his mule's response under his hands. His mule was listening and responding. Like a seam of mineral ore, this could be mined for Mohamed knew the value of such *I-Thou* moments. Mohamed progressed to

[24] For details of Ellen's background and approach to horsemanship see Cochrane, 2017.

[25] Cochrane (2015d, p. 19).

[26] Cochrane (2015d, p. 20).

leading his mule with a hand resting on the top of her neck (Figures 6a-6b) and could reproduce this degree of subtle dialogue when riding (Figures 6c-6d).

> An improved understanding of communication when riding has developed Mohamed to the point where he is able to ride his mule without a bridle, that is to say, without anything on her head at all. … The communication between himself and his mule is at the point where he can ask her to turn by placing his hands on her neck, and can ask her to stop by the use of a voice command. He has given a great example of more advanced work by performing trot to halt without a bridle.[27]

Genuine meeting is born of mutual reciprocity and unconditional trust between two uniquely whole persons (Kramer, 2003). Mohamed's mule told us when this was absent, when Mohamed was not seeing her truly, when his "hinterland" got in the way. She was virtually blind in her left eye, making her wary of people behind her or approaching on her blind side. This had to be captured on film before Mohamed came to know this of his mule.

> On a few occasions, Mohamed approached his mule quite suddenly on her blind side, without talking to or reassuring her. This frightened her, causing her to spook. She would slightly kick out, as she was aware something was there but didn't know it was Mohamed.[28]

Over a series of training treks, Mohamed learnt to recognise the need to empathise with her and adapt his behaviour so that she was not startled by his approach. This then helped us develop a similar awareness with his colleagues, during which he saw how they thought and how he no longer thought!

> We then looked at Mohamed's mule and … how he stopped his mule with his voice. They agreed that he had an excellent contact. … There were other clips where his communication was not so good. They recognised that he had scared her but it took a while for them to recognise why. Their first suggestion was that maybe he had used the stick. They then suggested that he did have a stick in his hand when approaching her. Ellen asked what was particular about this mule. She had to ask specifically whether the mule could see Mohamed. Initially they said yes. It took them a while to recognise that she is blind in her left eye and that, because he did not speak to her, she did not know it was him approaching her. Ellen asked them how they thought the mule was feeling. They recognised that she was scared. Ellen pointed out that she calms down very quickly.[29]

Mohamed's muleteers recognise that mules fear sticks. In this instance, however, they had to suspend judgement and redirect their attention to what the mule was feeling and why. Over time, Mohamed came to understand that he needed to talk to his mule and indicate his intentions to her, especially if approaching from her blind spot. His awareness was growing and with it, trust. Mohamed was growing through developing that part of him that was part-mule. Growing through the other (Rohr, 2016: 140-141), developing Buber's dimension of the *between*, Law's of partial connections (2004: 62-65).

During a later trek, Mohamed, in a hurry, did not place his mule's bridle correctly over her head, leaving the cheek strap over her left eye. When this was pointed out to him, he replied that it didn't matter as she was blind in that eye, prompting the question whether repeated stimulation of his own eyelashes was bothersome. He agreed that it would bother her, further developing his awareness of her World map. Mohamed was then able to share this awareness with his fellow muleteers to help them understand that all mules have blind spots, can be startled and are, indeed, unique persons.

The degree to which Mohamed cares about mule welfare was well demonstrated during a training trek in July. On this occasion, we encountered Abdellatif who was setting out with a newly purchased, mule on a multi-day trek with a Canadian client. We encountered them on the Tizi Tamatert. There we saw a young grey mule with a traditional bit in her mouth; she was uncomfortable and breathing hard.

> We did not have a head collar to give him. It was clear, however, that he wanted one and was willing to give up his traditional bit. Fortunately, and to our surprise, Mohamed stepped in and gave his own bitless bridle to Abdellatif. This meant that Mohamed would be continuing to Tachedirt with neither a head collar nor a bridle! He placed Abdellatif's bridle in his panniers and we all headed off together. At one point, he and Abdellatif held hands and it was clear that something significant had happened[30]

I suggest this was an *I-Thou* moment. Mohamed felt empathy for both Abdellatif and his mule. He persuaded Abdellatif that the bit is cruel and unnecessary. He overcame any cynicism or fear Abdellatif might have that his young mule might be difficult to manage and, in lending his equipment, in letting go of any means of physically controlling his own mule, he turned to his mule

27 Cochrane (2015d, p. 21).

28 Cochrane (2015d, p. 24).

29 Field Notes 36, p. 17 (11th June, 2015).

30 Field Notes 38, page 16 (27th July, 2015).

Figures 6a-6b. Mohamed leads his mule with his hand resting over her poll. Subtle directional indicators help her to understand when she is being asked to walk on and when she is being asked to turn.

Figure 6c. When riding, Mohamed can ask her to turn around a series of poles with a gentle tap to her neck. Soon, just by raising his hand he can instigate a turn. This, however, is less efficient on her left side where her eyesight is deficient.

Figure 6d. The trot is controlled using hand and voice commands to communicate Mohamed's intention to turn and stop.

and opened himself up to an emergent future. Mohamed thus surrenders himself to whatever the next few days of the trek will throw at him and sets out to explore ways of managing his mule with nothing on her head (Figures 7a-7d).

These experiences allowed Mohamed to prototype a good relationship with his own mule. This, in turn allowed him to provide instruction to muleteers who were to accompany him on treks with The Mountain People. Creating a holding space for training is not easy though: Mohamed had the support of his father and employer; he could afford to take time out from work. Many muleteers are reluctant to give up their time - especially when they could be working or socialising - and, unlike Mohamed, are not easily persuaded of the merits of training.

The investment required to establish a relationship is significant. The significance of such an investment is perhaps best appreciated by considering the consequences that can manifest themselves when there is no trust. Ellen and Mohamed visited one mule who behaves aggressively when she sees or hears the traditional bit and saw the manifest absence (Law, 2004) of a good relationship:

> … he explained that when someone approached with the traditional bit the mule was worse. … The handler could approach the mule in her stable without any problems the first time. He then carried the bridle and shook it so that the mule could hear the bit. At this point, the mule turned to kick the handler but caught the door causing it to shut. When the door was reopened, the handler stayed on the outside of the stable and the mule proceeded to charge at him through the doorway. It was very clear that this mule knew what the traditional bit was and didn't want it in her mouth.[31]

The owner could not see the mule's fear, the mule's dislike of the bit and that he was betraying the relationship by insisting on the bit despite her protestations. Mohamed's awareness and understanding of the mule's fear meant that he could communicate this to the owner and help him turn to her and understand that there might be another path… Mohamed could not insist on this, however, for to do so takes us into yet another dimension, that of the mule as private property.

And yet he can do that at work. To understand this, we need to consider his role and his responsibilities as James's head muleteer. The company have a policy of no traditional bits and expect all their muleteers to work their mules in head collars or bitless bridles. Those who don't and who have not attended training, receive a lower daily rate than those who do. This gives Mohamed some leverage. Enforcing rules is easy. Training staff and helping them experience and develop a feel for best practice is more difficult for rules cannot influence an individual to turn to their mule. This knowing must be experienced. For this to happen holding spaces are needed in which muleteers and their mules can meet.

Mohamed's story shows us what is possible. Forsaking the bit for the *between* can travel from training to the work place, from ground work to riding and into situations where the desire and need to control (the *I-It*) dominate. The realities of work for Mohamed are tidy; he can resolve incoherences. His reality is one that can be centrally coordinated because he can, seek, enact and deliver a singular welfare (Law, 2004). What happens however when, this is attempted in a larger company where a variety of truths, a multiplicity of welfares exposes incoherences? This is explored in Cousquer (2018) but is beyond the scope of this paper.

CONCLUSION

This paper has reviewed the long history of domination and power-over that has characterised the relationship humans impose on equines. Such relationships are closed to the necessary feedback that allows awareness of the self to deepen (Macy & Brown, 2014). Recognising that opening to feedback is essential for self-transformation and wider systems change, this paper has then reviewed the literature on how approaches that privilege deep listening can lead to transformative change and the nurturing of relationships based on another understanding of power – that of power-with. Such relationships are founded on listening, mutual reciprocity and dialogue. This paper has argued that the journey from domination to dialogue is one born of an opening of the mind and heart to feedback and that this is dependent on a *turning* to ourselves and to the other, of being fully and compassionately present to our own inner condition and to the inner condition of the equine. This *turning* requires a shift in the source of our attention and mode of listening, a shift that can be facilitated if spaces are created for genuine meeting and dialogue. What does this mean for the relationships that humans and equines co-create? In the first instance, it means that our availability, openness and attunement develops future-oriented ways of knowing that allow us to better know and care for the humans and equines we exploit whether in modern industries such as leisure and tourism or older ones such as transport, agriculture and mining and other perhaps less industrial fields of collaborative endeavour such as warfare and sport. This allows dominatory practices to be increasingly seen for what they are and the absencing and justificatory narratives that sustain them questioned, challenged and forged anew into a more equitable alloy, one born of the *between* that arises dialogically, not monologically, when humans turn to equines.

This may seem somewhat romanticised and a strong cautionary note needs to be struck. In the wider equine world, there have been many attempts to explore partnering approaches and for these to be presented as improvements, without holding up to scrutiny the extent to which this

[31] Cochrane (2015d, p. 12).

Figures 7a-7b. Mohamed and Abdellatif walk hand in hand; ahead of them Abdellatif's grey mule is wearing Mohamed's mule's bridle. Mohamed therefore manages his mule without any headwear. This helps develop his awareness by encouraging him to anticipate and manage potential hazards such as passing cars.

Figures 7c-7d. Approaching a steep descent, Mohamed guides his mule forwards with his arm cupping the side of her face. Further on, on the track, recognising that she loves thistles, he explores another way of asking her to move forwards.

is then used to justify ongoing exploitation or overlook welfare concerns and the extent to which deep listening is practised. It is therefore essential that we constantly revisit and engage with questions about the equine's wellbeing. This requires us to doubt and to practice curiosity as part of an ongoing process of inquiry into the wellbeing of the equine. This process of questioning involves accessing and interacting with reliable explicit knowledge. McVey (2017: 107) describes this as integrating "the right information in order to enable the relationship to flourish". In terms of deep listening practices, this arguably equates to a shift in the source of attention that allows us to engage with open-minded curiosity; this is what Scharmer (2016) would describe as Level 2 Listening (Debate) and Buber describes as Technical Dialogue. In order to facilitate transformational change, however, it is argued that we need to deepen our listening, moving out of our heads and opening the heart mind through sensing journeys (Art *et al.*, 2021) that involve meeting genuinely. Experiences of the *I-Thou* by definition change us. This leads me to sound two further cautionary notes: Firstly, these encounters can be very hard to interpret and the integration of such experiences and insights may require skilled facilitation. Secondly, these experiences cannot be sustained for we always move back to the world of *I-It*. This means that we should suspend any notion of a perfect authentic relation and recognise that we are born in relation and are always co-creating something together. It is therefore important to distinguish between what might seem an idealised end goal (a more authentic connection) and the listening practices that gradually allow individuals to become more open to feedback, to learning and development. We cannot escape the ongoing politico-ethical challenges that accompany the exploitation of power in the workplace and need to recognise that there will always be situations where domination cannot be escaped and that claims to practice 'partnership' may be overstated. This is why there is a need to develop power literacy so that we are better able to unmask, name and engage the power (Wink, 1999). By nurturing power literacy and self-awareness, benefits can be felt both in the relationship we have with ourselves and in the relationships we co-create with others, whether they be human or equine. McVey (2017) has highlighted the value of coaching as a way to nurture response-ability and I want to end with a vision for a community of practice, learning and co-creation that is encouraged by organisations who recognise that by providing opportunities for facilitated experiential learning they can nurture individual and collective awareness that can evolve our relational practices and our workplace culture.

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SHORT COMMUNICATION

Veterinary aid clinic assessments of working ponies in West Nusa Tenggara province, Indonesia: A retrospective study

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ABSTRACT. Working ponies in the West Nusa Tenggara (NTB) province of Indonesia are relied upon as the principal mode of transport. They have important cultural, logistical and One Health significance for the local community. Given the tropical climate, these ponies face well recognised health and welfare challenges . Parameters relating to the general health and welfare of the ponies were assessed following data analysis of clinical records from three veterinary clinics held in 2018 and 2019. Records relating to 454 clinical examinations of ponies (n=365 stallions) aged between 1 to 25 years (mean 7.59 ± 4.70) were analysed. The mean body condition score (1 to 5 scoring system) across all clinics was 2.89 (±0.49; range 1.5, 4.5), with no significant difference between clinics (P= 0.297). The majority of ponies (84.57%; 95% CI 80.50, 87.92; 307/363) assessed presented with tachypnoea, 37.24% presented with tachycardia (95% CI 32.78, 41.92; 159/427), 14.80% (95% CI 11.10, 19.46; 41/277) recorded rectal temperatures considered hyperthermic (>38.5°C), and 38.0% did not show obvious evidence of sweating (95% CI 32.21, 44.16; 95/250). Ponies examined at the April/May 2019 clinic were more likely to be considered hyperthermic (P=0.009) and/or presented with tachycardia (P<0.001), whereas ponies examined in the November 2019 clinic were more likely to present with tachypnoea (P=0.001). In general, the objective measures of body condition and health indices of these ponies were considered adequate. Some abnormalities relating to prolonged recovery following exercise whilst working were considered likely related to thermoregulatory stress. Parasite burdens were found to be low, no haemoprotozoan parasites were detected and median faecal egg count was zero. Measures to encourage cooling and greater frequent rest periods continued surveillance and monitoring the health of these ponies will result in both enhanced welfare and advances in One Health initiatives.

Keywords: Ponies, Indonesia, thermoregulation, intestinal and blood-borne parasites, body condition score.

INTRODUCTION

The province of Nusa Tenggara Barat (NTB) in Indonesia comprises a cluster of islands in the southeast of the densely populated archipelago. The indigenous people of this region have traditionally relied heavily on ponies (predominantly breeds under <142cm (14 hands)) for the transport of people and goods, in addition to significant recreational and cultural activities (Anonymous, 2020; Pinsky *et al.*, 2019). The role of working equids is well recognised in lower to middle income communities where their welfare generally impacts the livelihood of dependents (Burn *et al.*, 2010; Sturgeon, 2021). Welfare issues associated with equids working in warmer climates have been recognised as particularly detrimental (Burn *et al.*, 2010). Such impacts on welfare and working lives of these equids has important ramifications, including reliance on transport of people and goods are given their well-recognised One Health role in such communities (Sturgeon, 2021). Volunteer veterinary aid clinics are regularly provided by international and Indonesian veterinarians and volunteers.[1]

Working in tropical climates poses thermoregulatory challenges for horses due to high ambient temperatures and humidity. Reliance on evaporative cooling in horses is vital for exercise-induced heat production, hence high humidity compromises any cooling effects of sweating (McCutcheon & Geor, 2014; McEwan, Jenkinson, Elder & Bovell, 2006). Given the challenges of working in such a tropical climate, parasitic infections that may result in a range of diseases, including anaemia and hypoproteinaemia, will not only limit the working lives of ponies but may indeed be fatal (American Association of Equine Practitioners, 2019; Febriyanti *et al.*, 2019; Nugraha *et al.*, 2018; Nurcahyo, Yowi, Hartati, & Prastowo, 2019).

Although studies have reported on the prevalence of gastrointestinal and vector-borne parasitic diseases, such as Piroplasmosis and Trypanosomiasis, of equids in many provinces of Indonesia (Febriyanti *et al.*, 2019; Nugraha *et al.*, 2018; Nurcahyo *et al.*, 2019), to our knowledge there have been no reported studies of such in NTB.

The aim of this study was therefore to investigate key health and welfare indices of working ponies in NTB including assessment of body condition score (BCS), clinical parameters and recovery following exercise,

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[1] Veterinary aid clinics sponsored by charitable organisations Animal Aid Abroad, Gili Eco Trust and Horses of Gili. From April 2020 the Covid-19 pandemic restrictions interrupted the regularity of these clinics which are anticipated to resume in mid to late 2022.

haematological indices and direct examinations for intestinal and blood-borne parasites. We anticipate that this pilot study will provide the basis for more intensive and targeted future studies.

MATERIAL AND METHODS

STUDY DETAILS

Clinical records from a total of 454 clinical examinations of ponies were analysed following three veterinary aid clinics conducted on four islands within NTB province, Gili Trawangan, Gili Meno, Gili Air and the south-eastern region of the larger Lombok Island (Gerung and Mataram). Data from biannual clinics conducted from November 2018 to November 2019 were analysed.

The average maximum daily temperature during the periods that the clinics were conducted, in April-May and in November, ranged from 30-31.5°C and humidity from 76% to 80% respectively (Anonymous, 2019).

Clinical data, observations, and general history were recorded on a veterinary record proforma for each pony presented to the clinic (refer to Supplementary Item A1). The proforma was informed by previously designed and validated assessment tools, including the Animal Welfare Indicators (AWIN) (Dalla Costa *et al.*, 2017) and the Standardised Equine-Based Welfare Assessment Tool (SEBWAT) (Sommerville *et al.*, 2018). The form was modified, with practicality and safety in mind, to suit field examinations in a population consisting primarily of stallions i.e. excluding many parameters that may have put the veterinarians safety at risk. Practicalities relating to these examinations, such as time constraints and veterinary resources, were also considered in the prioritisation of fields recorded. At the commencement of each clinic, veterinary examiners were trained and supervised by a senior veterinarian (CME) and a veterinary epidemiologist (PLH) on conduct of the examinations and recording of information on the proforma. It was estimated that between 55-85% of the annual working pony population from the Gili Islands were represented in each clinic (Delphine Robb, Gili Eco Trust, personal communication). Ponies were examined in central locations on the islands. Following arrival at the clinic, ponies were offered water and shade. Details of the pony and owner were recorded prior to clinical examination, including horse sex, horse age (years), and estimated height and weight. Only ponies ≥1 year of age were included in analysis of clinical assessments (n=4 foals excluded). Clinical assessment of parameters was performed in most cases at least 30 minutes after exercise was completed. Temperature (°C), heart rate (HR, beats per minute), respiratory rate (RR, breaths per minute), mucous membranes (normal, pale, dark); skin tent and capillary refill time (CRT) (1 second, 2 seconds, ≥3 seconds); and body condition score (BCS 1 poor; 5 very fat) were recorded. Abnormal clinical signs were classified as respiratory rate (tachypnoea >30 breaths/minute), heart rate (tachycardia >44 beats/minute) and rectal temperatures (hyperthermia > 38.5°C) (Flethøj *et al.*, 2014; Hubert & Beadle, 2002; Jenkinson, *et al.*, 2007; MacKay, *et al.*, 2015; Mayhew & Ferguson, 1987). For entire male ponies, a subjective visual assessment of the degree of scrotal relaxation in terms of pendulousness was also recorded (+ scrotum contracted close to the body; ++ scrotum in normal position; +++ scrotum fully descended). Given the potential risk of close contact with the inguinal region, no objective measurements were taken. Evidence of sweating, or absence of, was recorded either by noting moisture or staining of skin during the April/May and November 2019 clinics only**.** The absence of sweating (observed anhidrosis) was only recorded when at least one clinical parameter was elevated (RR, HR, and or pyrexia) that would be considered stimulatory to a sweat response in horses.

FAECAL EGG COUNTS

Fresh convenience faecal samples were collected from ponies following defecation during the November 2019 clinic (n=19). Samples were processed and analysed in the field by faecal floatation using a saturated sodium chloride floatation solution, following a modification of the protocol in the AAEP Parasite Control Guidelines (American Association of Equine Practitioners, 2019). Four grams of faeces were suspended in 4 mL of water and mixed with 52 mL of floatation solution. Two chambers of the McMaster slide were counted (1 mL total) giving a detection limit (multiplication factor) of 15 eggs per gram (EPG). Samples were left to settle in the McMaster slide for 5-10 minutes prior to microscopic examination.

BLOOD SAMPLING

Blood samples were collected and analysed from ponies in the November 2018 clinic (n=18). Venepuncture was performed from the jugular vein of ponies. Five ml whole blood was collected into an EDTA vacutainer tube (BD Vacutainer® EDTA Tubes, https://www.bd.com/en-us), refrigerated at 4° C and transported to the Faculty of Veterinary Medicine University of Gadja Mada Jogjakarta Indonesia (UGM). Haematological analysis was performed using an Abaxis HM5© (https://www.abaxis.com). In addition, blood smears were prepared and stained using the Giemsa stain for microscopic examination. Blood smears were examined for protozoal parasites including *Trypanosoma evansi* and the haemoprotozoans *Theileria equi*, and *Babesia caballi.*

DATA ANALYSIS

Mean and standard deviations of physiological parameters prevalence, and Wilson score 95% confidence intervals (95% CI) of ponies with abnormal clinical signs

are presented. To determine whether BCS had changed across the three clinics we used the Kruskal-Wallis rank test. To determine differences in the proportion of abnormal clinical signs over successive clinics we used logistic regression. Analyses were conducted in Stata/SE Version 15.1 (College Station, TX: StataCorp LLC). Summary descriptive statistics (percentage detected, mean, standard deviation, median, range) were generated for the faecal egg count and haematological results using Microsoft Excel (Redmond, WA: Microsoft Corporation).

RESULTS AND DISCUSSION

CLINICAL DATA

Records for 143 ponies were available from the 26-30 November 2018 clinic, 145 ponies from the 22 April to 3 May 2019 clinic, and 166 ponies from the 25-29 November 2019 clinic were available. Descriptive characteristics of ponies and results of clinical evaluations are outlined in Table 1. The mean age of ponies was 7.6 years (±4.7; range 1 to 25 years). The majority of ponies were stallions (365/447, 81.7%), with 50 mares (11.2%) and 32 (7.2%) geldings.

The mean BCS across all clinics was 2.89 (±0.49; range 1.5, 4.5; n=362), with no significant difference between clinics (P= 0.297). Eighty-five percent of ponies (95% CI 80.50, 87.92; 307/363) assessed presented with tachypnoea, 37.24% presented with tachycardia (95% CI 32.78, 41.92; 159/427), 14.80% (95% CI 11.10, 19.46; 41/277) recorded rectal temperatures considered hyperthermic (>38.5°C), and 38.0% showed no evidence of sweating after exercise (95% CI 32.21, 44.16; 95/250) with neither moisture nor evidence of evaporation and staining of skin in typical areas under friction. Ponies examined at the April/May 2019 clinic were more likely to be considered hyperthermic (P= 0.009) and/or present with tachycardia (P<0.001), whereas ponies examined in the November 2019 clinic were more likely to present with tachypnoea (P=0.001), when compared to the other clinics.

Thirteen percent of ponies (43/321) presented with pale or dark mucous membranes; 3% with ≥3 seconds of skin tenting (12/404) or capillary refill time (11/400), with such parameters often indicative of cardiovascular compromise including dehydration or illness, however, it is difficult to quantify without more precise analysis than in the field (Pritchard, Barr, & Whay, 2006). Forty-nine percent (95% CI 42.42, 54.79; 120/247) of stallions examined were considered to have extensive scrotal relaxation (+++) consistent with cremaster and dartos muscle relaxation.

Faecal samples from 19 adult working male ponies from the November 2019 clinic were collected and analysed (refer Supplementary Table S1). Strongyle eggs were detected in eight of the nineteen ponies (40%). The mean count was 111 EPG (median 0; range 0-540 EPG). Only two ponies recorded counts over 100 EPG. One faecal sample revealed the presence of an adult pin worm (*Oxyuris Equi*). Other parasitic diseases evident clinically included ocular habronemiasis in four ponies and onchocerciasis was suspected with acute pruritic dermatitis over the dorsum and ventral midlines in two ponies.

Blood samples were collected from 18 ponies during the November 2018 clinic. No protozoal organisms typical of piroplasmosis or Trypanosomiasis were detected following Giemsa staining and microscopic examination of whole blood (Woods & Walker, 1996). Haematological evaluation was performed at the UGM veterinary laboratory using their reference ranges (Southwood, 2013). Most ponies recorded haemograms within normal limits (refer Table S2). Seven ponies recorded marginally low haemoglobin levels (between 10-11 g/dl normal >11g/d), with the Packed Cell Volume (PCV) of two ponies below 32% (Laboratory reference minimum), one of these recording a low red blood cell count (4.8×10^6 cells/μL, Laboratory reference range 6.2–10.2 $\times 10^6$ cells/μL) consistent with anaemia. Mild hypereosinophilia was detected in two ponies (1.03 and 1.23 (Laboratory reference range 0-1.0 $x10^3$/μL). One pony recorded a leucocytosis of 12.8 (Laboratory reference range 4.9 –12.5 ×103 cells/μL). Neutropaenia was evident in a single pony (Neutrophils 0.69×10^3 cells/μL (Laboratory reference range 2.2–9. 5×10^3 cells/μL).

Although parasitic skin diseases were clinically evident in several ponies, an obvious hypereosinophilia was detected in only two ponies. Such a finding in horses is generally associated with either parasitism or atopic-type responses (McKenzie, 2013), however there were no clinical abnormalities detected in these two ponies.

No haemoprotozoan parasites were obvious upon direct examination of stained blood smears Although relatively insensitive compared to specific serological tests (Nugraha *et al.*, 2018; Nurcahyo *et al.*, 2019), these examinations provided some insight into the health status of the ponies. Given the health consequences of Piroplasmosis and Trypanosomiasis and their presence on other islands of Indonesia continued surveillance is indicated for these vector-borne diseases.

The general health, parasite burden, and body condition of the ponies surveyed in NTB were considered consistent with good health and condition. In addition, the ponies were also considered free of disease as a population. However, abnormal clinical parameters were recorded in a high proportion of ponies, tachypnoea being evident in the majority, as was reported in a previous study of this population (Pinsky *et al.*, 2019). This was likely due to the ambient temperatures >30°C and humidity >75% resulting in challenging thermoregulatory conditions for otherwise clinically healthy working ponies. As well as this, it was usual practice for the majority of ponies to exercise in most instances pulling a cart for greater than 10 minutes trotting prior to arrival at a central location away from most stables. A minority of ponies presented without pulling a cart however it was extremely rare

Table 1. Details for 454 clinical examinations of ponies during clinics conducted on four islands of Nusa Tenggara Barat province relating to clinical abnormalities that could be associated with thermoregulatory stress (n: number of ponies), 2018 to 2019.

	November 2018 N=143*			April 2019 N=145			November 2019 N=166		
	n	Mean (sd)	Range	n	Mean (sd)	Range	n	Mean (sd)	Range
Age (years)	109	8.21 (4.80)	1, 25	126	7.58 (4.79)	1, 25	136	7.10 (4.51)	1, 20
Estimated height (hh)	131	12.2 (1.1)	9, 15	105	13.0 (1.1)	10.2, 15	112	12.2 (0.8)	10.5, 15
Estimated weight (kg)	123	318.86 (27.73)	180, 450	56	256.07 (58.55)	120, 450	92	246.68 (49.28)	150, 400
BCS (1-5)	129	2.88 (0.36)	1.5, 4	119	2.86 (0.59)	1.5, 4.5	114	2.93 (0.50)	2, 4
Temperature (°C)	97	37.70 (0.64)	36.6, 39.9	102	38.15 (0.87)	36.7, 40.7	78	37.80 (0.61)	36, 39
Heart rate (beats/min)	132	41.17 (7.78)	28, 76	139	48.40 (10.14)	28, 82	156	44.21 (8.80)	28, 80
Respiratory rate (bpm)	89	48.46 (23.01)	16, 148	121	54.63 (29.82)	10, 160	153	55.77 (17.75)	15, 116
	n	%	95% CI	n	%	95% CI	n	%	95% CI
Sex									
Male entire	111	81.0	–	116	80.6	–	138	83.1	–
Male gelding	10	7.3	–	10	6.9	–	12	7.2	–
Female	16	11.7	–	18	12.5	–	16	9.6	–
Skin tents (sec)									
1	77	61.6	–	117	86.7	–	104	72.2	–
1 to 2	19	15.2	–	1	0.7	–	–	–	–
2	25	20.0	–	14	10.4	–	35	24.3	–
≥3	4	3.2	–	3	2.2	–	5	3.5	–
CRT (sec)									
1	55	43.0	–	105	79.0	–	67	48.2	–
1-2	29	22.7	–	–	–	–	–	–	–
2	43	33.6	–	25	18.87	–	65	46.8	–
≥3	1	0.8	–	3	2.34	–	7	5.0	–
Mucous membranes									
Normal (pink)	74	91.4	–	108	90.8	–	96	79.3	–
Pale pink	7	8.6	–	10	8.4	–	25	20.7	–
Dark pink	0	0.0	–	1	0.8	–	0	0.0	–
Scrotal relaxation‡									
+	6	12.2	–	9	9.4	–	12	11.8	–
++	19	38.8	–	40	41.7	–	41	40.2	–
+++	24	49.0	–	47	49.0	–	49	48.0	–
Abnormal clinical signs	n	%	95% CI	n	%	95% CI	n	%	95% CI
Temperature (>38.5°C)	8	8.25	4.24, 15.44	24	23.53	16.35, 32.63	9	11.54	6.19, 20.50
Tachycardia (>44 beats/min)	27	20.45	14.46, 28.12	79	56.83	48.53, 64.78	53	33.97	27.01, 41.71
Tachypnoea (>30bpm)	69	77.53	67.82, 84.96	95	78.51	70.38, 84.89	143	93.46	88.39, 96.41
No observed sweat	–	–	–	54	42.18	33.98, 50.85	41	33.61	25.84, 42.38
Obvious scrotal relaxation (+++) ‡	24	48.98	35.58, 62.53	47	48.96	39.19, 58.80	49	48.04	38.59, 57.63

*Excludes n=4 foals (<1 years of age); † n=1 excluded, classified as pigmented; ‡ assessed in entire males only. Skin Tents -time to restored position after manual pinching/tenting, CRT = Capillary refill time noted on mucous membrane after digital pressure applied.

for drivers or riders to walk these ponies to the clinics. Under such ambient conditions recovery time to resting respiration rate after exercise may also be increased (Correa *et al.*, 1966; Hubert & Beadle, 2002) above what is considered normal clinically normal in equids (Hodgson, 2014a, 2014b; Lekeux *et al.*, 2014) These signs are a reflection of the greater oxygen requirement increasing respiratory rate and blood flow to maximise cooling processes (McCutcheon & Geor, 2014). Further evidence of thermoregulatory stress was confirmed in almost half of the stallions surveyed with obvious scrotal relaxation and distension indicative of cremaster and dartos muscle relaxation, mechanisms to dissipate heat (McCutcheon & Geor, 2014). Of concern was a lack of obvious sweat response in more than one-third of ponies following exercising in tropical conditions, although definitive diagnosis of non-sweating (anhidrosis) would require intradermal stimulation, this condition is often described as an observation following heat distress in horses lacking an associated sweat response (Hubert & Beadle, 2002; Jenkinson *et al.*, 2007; Mayhew & Ferguson, 1987; McCutcheon & Geor, 2014; McEwan *et al.*, 2006). Recognition and further surveillance and investigation into anhidrosis are warranted given the welfare consequences of this condition in these ponies.

Haematological assessment of ponies provided a valuable addition to clinical examination particularly relating to erythron and leucon values with few ponies recording marked abnormalities. Although one pony was considered anaemic, these results provided a degree of assurance that the ponies in general were not suffering from obvious inflammatory conditions indicated by leucocytosis and or anaemia.

Although blood samples were collected at least 30 minutes after exercise, the erythron parameters in some ponies may have been elevated due to splenic contraction associated with exercise and possible hypovolaemia (McKenzie, 2013). Ideally further clinical pathological measurements may have assisted estimation of any circulatory compromise, that was suspected in ponies with delayed skin tent and CRT. Unfortunately, logistical issues in the field compromised more expansive clinicopathological testing.

Faecal floatation with sodium chloride allows for the detection of strongyle, ascarid, and cestode infections (Dryden, *et al.*, 2005; Norris *et al.*, 2018), although the technique is not considered sensitive enough to reliably detect cestode infections (Tomczuk *et al.*, 2014). The lack of ascarid eggs was not surprising given that all ponies were mature, a stage where immune responses are likely to suppress ascarid infections in horses (American Association of Equine Practitioners, 2019). The correlation between faecal worm egg counts and intestinal worm burdens remains unclear hence the difficulty in attributing clinical significance (American Association of Equine Practitioners, 2019; Saeed *et al.*, 2010; Saeed *et al.*, 2019). Current parasite control guidelines categorise horses shedding levels of 200 EPG or lower as low-level shedding, requiring minimal anthelmintic treatments and less likely to contaminate pasture (American Association of Equine Practitioners, 2019; Kaplan & Nielsen, 2010). Seven of eight (88%) with strongyle shedding ponies recorded low FECs. The pony that recorded the highest FEC of 540 EPG was able to graze, as it was kept on a small paddock with other horses. The high prevalence of low FECs in this study could be due to several factors. These include the likelihood that the limited grazing available on the Gili Islands has minimised exposure to larval pickup. The majority of ponies are stabled and fed rice flour, cut grass as well as pelleted feed in elevated troughs (Pinsky *et al.*, 2019). Although there are some zoonotic parasitic infections of horses, those studied in this work were not considered to be of major One Health significance compared to other relevant issues in this space to about working ponies of NTB.

This study provides some initial guidance regarding the ongoing welfare of working ponies in the NTB province. We found that the general health and body condition of our study population was considered acceptable, and the FEC was considered low in the majority of samples, this was reflected clinically in the lack of obvious signs of intestinal parasitism. Of concern was that many ponies recorded prolonged recoveries from exercise, with tachypnoea being evident in most. Given the general health of the ponies, most of which had been accustomed to working, it is possible that they were suffering from a degree of thermoregulatory stress. We recommend that authorities allow provision for shade and cooling of these ponies and ensure regular breaks during hot periods of the day to minimise physiological stress associate with exercise in tropical conditions. Though most of our findings are to be expected, they have not been well documented for working equids in this region. Future studies should be conducted with more objective health and welfare measures and on larger sample sizes, where practical, to confirm these findings. Methods to identify ponies over subsequent clinics more efficiently may also aid in understanding improvements within individuals as well as at the population level**.** Investigation of associations between prior exercise undertaken, tachypnoea, tachycardia, hyperthermia, and other important welfare issues such as underlying pain due to musculoskeletal injuries or respiratory problems, should also be explored to understand the full welfare burden on these ponies. Though COVID-19 restrictions disrupted the biannual clinical surveys, continuance of these in the future, and improved forms of data capture will aid in monitoring of the health and welfare of these ponies over time. Not only will these assist initiatives to improve welfare, it may provide important One Health impacts that assists ponies, their owners and carers and may also assist the ongoing support of tourism in the NTB province and beyond.

COMPETING INTERESTS STATEMENT

The authors declare that they have no competing interests.

ETHICS STATEMENT

Although retrospective in nature any clinical samples taken were as part of health assessments were performed under the licence and ethics permit of University of Gadja Mada, Jogjakarta, Indonesia. Owners or their representative's informed consent was obtained prior to taking blood and faecal samples and conducting veterinary examinations.

AUTHOR CONTRIBUTIONS

Conceptualisation and methodology, PLH and CME; data analysis, AD and JV under supervision of PLH; laboratory analysis, DA JV and AJ; data collation, JV, SM, AD and PLH; original draft preparation, AD, PLH and CME; review and editing, all authors. All authors have read and agreed to the published version of the manuscript.

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SHORT COMMUNICATION

Use of thermography and pressure sensors to evaluate the effect of load on pack mules

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ABSTRACT. Mules performing pack work can develop skin wounds and lesions on harness related areas of the body, but also muscular and bone damage that are not always visible during clinical examination. Thermographic imaging and pressure sensors have emerged as non-invasive diagnostic alternatives that can provide valuable information about the welfare of working equids. The aim of this study was to assess the effect of different loads on the back of mules through thermographic images and pressure sensors. A crossover design was used with twelve mules carrying three different loads (80, 105, and 130 kg) for two kilometers. Four pressure sensors were placed in the harnessing system to assess the pressure (N) of the loads. Thermographic images of the back were taken daily before and up to five days after the harnessing work. The results show that the heavy loads (105 and 130 kg) generated a significant increase of temperature in all the analysed areas of the mules' back, with no significant differences between anatomical areas. The pressure sensors did not reveal significant differences between treatments or between anatomical areas and no evidence of a correlation between pressure and temperature. Further studies including physiological and behavioral measures to assess the effect of different loads are required to better understand the effect on working equids welfare.

Keywords: mule, load, pressure, inflammation, welfare, working equid.

INTRODUCTION

One of the main problems reported in working equids that carry loads on their backs (i.e. pack work) are those associated with wounds, injuries, and pain caused by the harnessing (Burn *et al.*, 2010; Sells *et al.*, 2010) affecting the mule's welfare and decreasing their efficiency and work capacity. The most common factors involved in the presentation of harness related injuries are those associated with body condition, age, weight of load transported, type of load, work distance, cleanliness of the harness, work frequency, design, and adjustment of the harness (Biffa & Woldemeskel, 2006; Norris *et al.*, 2020; Pritchard *et al.*, 2005). Usually, studies in working equids focus on the evaluation of back wounds, but absence of visible wounds does not imply absence of lameness or pain (Lesimple *et al.*, 2013). Therefore, it is important to evaluate the effect of load work on back health and its effects on welfare and performance. However, detecting equids back problems is difficult to perform based only on behavioural modifications, even for veterinary specialists (Lesimple *et al.*, 2013), and the use of complementary methods, such as ultrasound, radiography, and scintigraphy, are not always possible to perform under field conditions or for a large number of animals because of the cost and availability (Cauvin, 1997). This may mean that existing back injuries in working equids are likely to be underestimated (Lesimple *et al.*, 2013).

Several studies have evaluated the influence of riders and saddles on the thoracolumbar area of horses in equestrian sports, finding that incorrect positioning and poor adjustment of the saddle cause greater pressure on the spinous processes, especially in the area of the withers, which is sensitive to pressure, causing pain (Cauvin, 1997; Greve & Dyson, 2015). In addition, the weight and ability of the rider to balance the weight correctly, added to the level of symmetry of the equine's back, affect the pressure on the thoracolumbar region in a complex interrelation (Dyson, 2017; Greve & Dyson, 2015). Broster *et al.* (2009) evaluated the presence of pain in the thoracolumbar area in working horses, finding behavioural signs of pain in 75% of them. Considering that this measurement was made based on palpation only, using the the support of any complementary technique, it is expected that the diagnostic sensitivity would increase.

In recent years, technological advances have been developed in the diagnosis of equine back pain. One of them is the incorporation of thermography as a complementary diagnostic technique in clinical practice (Soroko & Howell, 2018). This non-invasive technique allows identifying areas of increased heat, facilitating the identification of inflammatory processes in the thoracolumbar area in horses (Talas & Talas Jr., 2017). Another method used to evaluate the adjustment of the saddles, weight distribution and balance of the rider is the use of electronic sensors that allow quantification of the force exerted on the horse's back, which allows specific information about the places and times when the back receives greater pressure to be obtained (Desbrosses-Déléage *et al.*, 2019). These techniques have the advantage of providing information that can be useful to assess

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inflammation, saddle adjustment and load balance in working equids. Therefore, the objective of this study was to evaluate the effect of load weight on the back of working mules using thermography and pressure sensors.

MATERIAL AND METHODS

Twelve adult working mules between 8 and 13 years and mean live body weight of 364 kg (292-497 kg), resulting from the cross of Baudet du Poitou, mixed Poitou, local cross breed Jack and mixed breed mares, were used for the study. All the mules belonged to the mountain detachment Nº3 "Yungay" of the Chilean army. Before the test, all mules were Clinically examined for health problems and body lesions. All individuals were sound at the time the evaluation was performed. Each mule used the same saddle harness model, a Schneider model (weight 23 kg), commonly used by the Chilean army. The harness had two belly webbing straps to keep it in place. A wool blanket and a piece of leather was used for padding. The saddle harness was checked and adjusted by a specialist from the Chilean army.

Three weigh-carrying treatments were used (80, 105 and 130 kg, including the harness weight). A crossover design was used where all mules carried each load for a 2 km outdoor circuit in a randomized order. The load consisted of gravel kept in sacks, distributed in two sacks for the 80 kg treatment evenly balanced on each side of the harness, and in three sacks for the 105 and 130 kg treatments, two sacks placed on either side of the harness and one on the top. The 2 km hand guided walk was conducted in November and December at the Army enclosure in a mountainous area of central Chile, with a temperature that fluctuated between 32 and 39ºC, average humidity of 24%, and at an altitude between 856 and 878 meters above sea level. The average speed was 4.6 km/h with a pace of 12.4 min/km. Obtained from a Garmin® forerunner 645 and an anemometer Benetech® GM816. There was a resting period of 10-12 days between different treatments.

Before and after each circuit, the mules were examined for the presence of wounds. Wounds bigger than 2 cm^2 or 1 x 3 cm on the harness area of skin contact were assessed (Popescu & Diugan 2013; Sells *et al.*, 2010). An image of the thoracolumbar region was taken using a thermographic camera Flir, E85 in an indoor area. The indoor area, the barn where mule stalls are located, was protected from solar radiation and wind. The camera was situated at 2 m over the mule's withers. Thermal images of the thoracolumbar region were taken at six sampling times: Time 0 (before work, at rest and before harnessing); Time 1 (ffter work, 10 min after unharnessing); Time 2 (2 h after unharnessing); Time 3 (24 h after unharnessing); Time 4 (72 h after unharnessing); and Time 5 (105 h after unharnessing).

During the complete sampling period, mules were kept inside the barn, in individual stalls.

For the thermographic analysis, the thoracolumbar region image was divided into four quadrants, two anterior/cranial (right and left) and two posterior/caudal (right and left), in order to evaluate symmetry. Furthermore, the average temperature of the dorsal midline and the wither were also analysed. The average, minimum, and maximum temperature of each area was obtained with the Flir® Software.

Four 5 x 5 cm pressure sensors were placed between the harness and the padding in each thoracolumbar quadrant, in order to assess the pressure of the carrying load and its balance. Before loading the mules, the sensors were calibrated to zero. Sensors registered the pressure every 3 to 3.5 seconds, then erratic data was eliminated and average, minimum and maximum pressure were analysed.

A field test was used to assess inflammation by using Serum Amyloid A (SAA) as a marker. For this, the semiquantitative EquiCheck^{TM} ELISA test from Accuplex Diagnostics was used at three sampling points: before work, 72 h after work, and 120 h after work. A blood sample from the jugular vein was obtained at each sampling time and the sampler applicator from the kit was immediately used to add the blood to the test cassette as indicated in the instructions, the results were read after 10 minutes.

Statistical analyses were performed using SPSS Software (version 26, IBM, Armonk, NY, USA). Distribution of data was assessed with Shapiro Wilk Test. Analysis of variance was used to analyse differences in thoracolumbar temperature and an analysis of variance for repeated measures was performed to evaluate differences between sampling times and the post-hoc Dunn's test to identify differences with basal temperatures. To evaluate differences in pressure recorded in Newtons (N) between the four sensors analysis of variance was applied for each treatment and between treatments. In order to evaluate the relationship between the pressure recorded by the sensors and the thermography, a linear regression analysis was performed between the average pressure of the sensors and the images of each quadrant at times 1 and 2. Differences in inflammation degree within and between treatments were analysed with a Kruskal-Wallis non parametric test. Statistical significance was accepted for $P< 0.05$.

RESULTS AND DISCUSSION

One of the main welfare problems of working equids are the presence of wounds and injuries caused by saddles when carrying heavy loads on their backs (Sánchez-Casanova *et al.*, 2014; Sells *et al.*, 2010). Therefore, it is important to determine how well load is positioned on the animals back and the amount of load the animal can carry without causing harm. In the present study, the clinical examination did not detect the presence of wounds in any of the three treatments associated to the contact areas of the harnessing system. This can be explained due to the short distance travelled (2 km). In addition, it is important

to consider that most evaluations of injuries in working equids have been conducted in individuals that maintain a constant job over time and for several hours a day (Sells *et al.*, 2010), while army mules perform sporadic work. However, thermographic images showed a significant increase in temperature for the four quadrants evaluated with the 105 and 130 kg treatments at 2 h (T2) and 24 h (T3) after the 2 km circuit had ended, compared with the baseline temperature, indicating the presence of inflammation in the area, which was confirmed with the SAA inflammation test where a significant increase of this acute phase protein was observed for the 130 kg treatment at 72 h after work (Figure 2). The SAA is a positive major acute phase protein in equids with low or undetectable concentrations in sound individuals, but with a rapid increase after infectious or non-infectious inflammatory stimuli, reason why it is used to monitor inflammation during colic episodes, respiratory disease, and inflammatory response to exercise (Long & Nolen-Walston, 2020). The SAA can rapidly increase the concentration with peaks between 24 and 48 h post inflammatory stimuli and returning to basal levels 15 days after (Hultén *et al.*, 2002). Athlete equines can exhibit an inflammatory response after exercise (Page *et al.*, 2017) that can be monitored by an increase in SAA associated to glycogen depletion in working muscles (Fallon *et al.*, 2001). For example, Cywinska *et al.* (2013) found significant increases after training in racing horses and in inexperienced endurance horses. One limitation of the present study is that the first sample to monitor SAA was taken 72h after work and may not reflect a more acute response in all treatments at 24 or 48 hours after exercise. Also, the position of the gravel sacks on the back of the mule for the 105 and 130kg treatments could have an effect since part of the load was on the top. We reproduced the way in which the army would distribute loads, but further studies are needed to understand how different distributions may affect pressure.

Overloading is one of the main welfare issues reported in working equids (Bukhari *et al.*, 2021), and calculation of load limits is a challenge since it depends on both animal related factors (i.e. species, age fitness to work) and also on external factors (i.e. environmental temperature and humidity, type of terrain and quality of harnessing system) (Lagos *et al.*, 2022). One limitation of the present study is that the circuit travelled by the mules was short (2 km) compared to the work performed by most working equids worldwide and that we did not include more physiological and behavioural indicators (for a complete review see Bukhari *et al.*, 2021). Nevertheless, this short work already revealed significant increases of back temperature and SAA of mules, returning to basal temperatures five days after work (Figure 1 and 2).

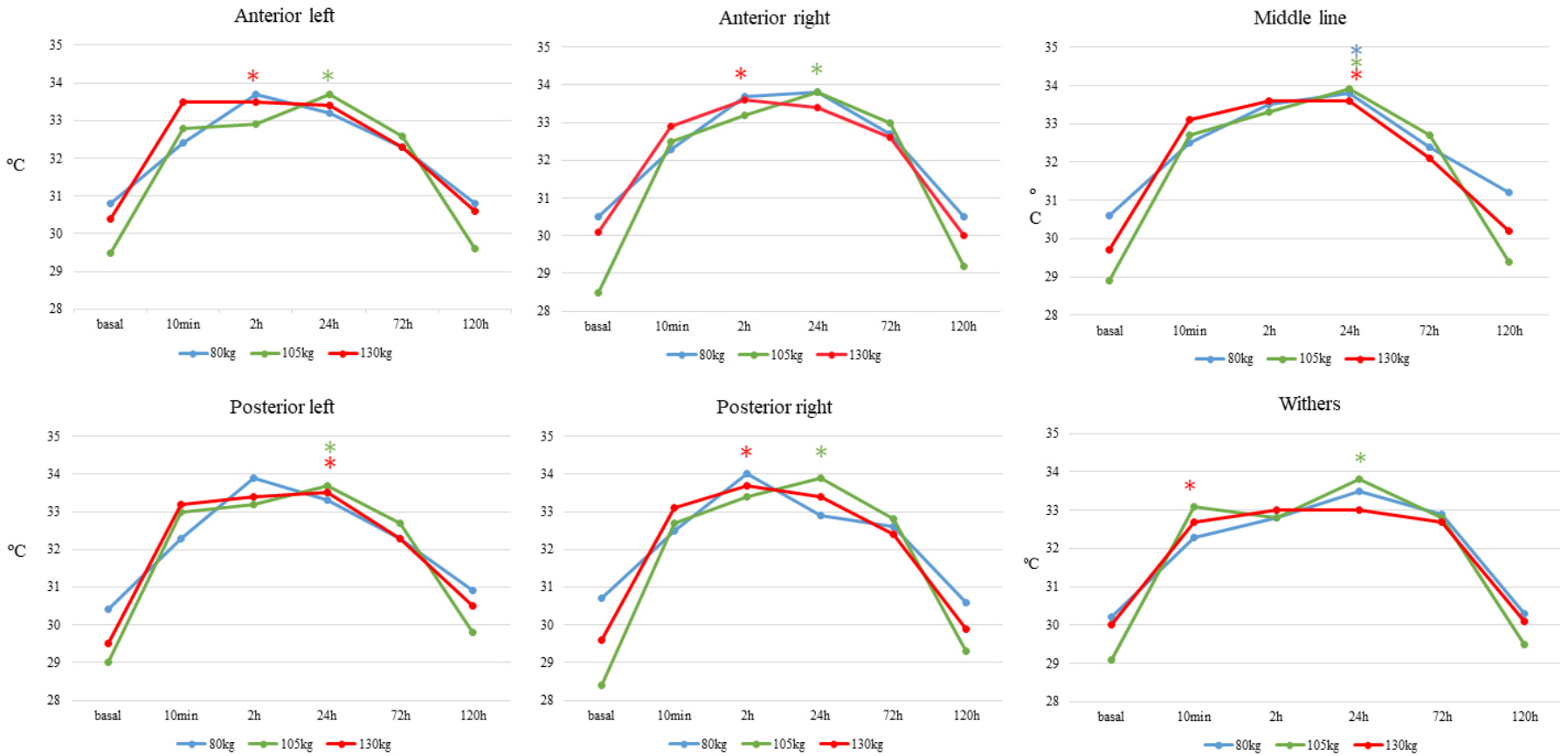
The asymmetric distribution of load on the back has been associated with difficulties in the functioning of the thoracic and lumbar area and the presence of pain or injuries (de Siqueira *et al.*, 2019; Dyson *et al.*, 2020). This asymmetric distribution often results from problems at the time of tacking, where the load is not well distributed or it is not well fixed, moving during the work. The results of the temperature and pressure analysis between the four quadrants in this study (Figure 1 and Table 1) did not report significant differences between them, suggesting that the weight distribution was symmetrical, which could be related to a correct strapping of the harness on each mule and to the fact that the loads located on each side had the same weight, were well tied and balanced, allowing a good weight distribution.

The withers area is one of the most injured areas in working equids (Sells *et al.*, 2010). In this study, although there were no visible wounds, an increase in temperature

Table 1. Mean, maximum and minimum pressure (N) detected by the pressure sensors according to their location on the back of the mules (FR: front right; FL: front left; PR: posterior right; PL: posterior left) and load treatment (80kg, 105kg and 130kg).

Variable	Sensor location	Load Treatment		
		80 kg	105 kg	130 kg
Mean pressure (N)	FR	2.23 ± 1.00	3.28 ± 1.24	2.74 ± 2.07
	FL	3.30 ± 2.11	2.78 ± 2.30	3.81 ± 2.80
	PR	2.62 ± 1.76	4.39 ± 2.96	3.49 ± 1.52
	PL	2.50 ± 1.46	1.89 ± 1.31	2.06 ± 0.78
Maximum pressure (N)	FR	5.42 ± 1.30	7.19 ± 3.42	7.53 ± 4.80
	FL	8.58 ± 1.84	10.0 ± 4.78	8.26 ± 2.53
	PR	13.68 ± 13.58	10.06 ± 6.14	10.01 ± 5.56
	PL	6.54 ± 4.33	7.78 ± 3.05	7.42 ± 4.14
Minimum pressure (N)	FR	0.78± 0.34	0.93 ± 0.10	0.72 ± 0.37
	FL	1.07 ± 0.60	0.58 ± 0.34	1.70 ± 2.98
	PR	0.69 ± 0.44	0.95 ± 0.61	0.64 ± 0.42
	PL	0.89 ± 0.27	0.66 ± 0.39	0.64 ± 0.38

Figure 1. Mean temperature (°C) for each anatomical region of the back of the assessed mules (anterior left, anterior right, posterior left, posterior right, middle line and withers) according to load treatment and time at which the thermographic image was obtained.



* Indicates sampling time at which a significant difference (P<0.05) with basal temperature was found. Color indicates the treatment for which the significant increase was reported.

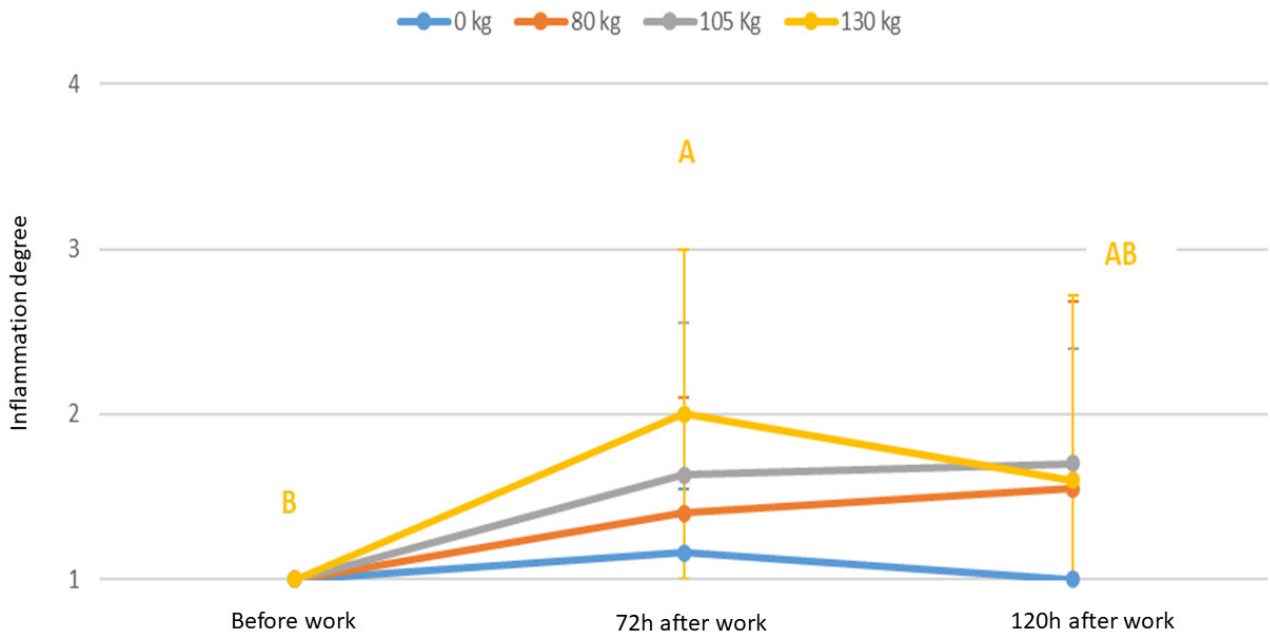


Figure 2. Average inflammation score (1= no inflammation; 4= severe inflammation) for the SAA semi-quantitative test according to time and treatment for the 12 mules in each load treatment. Different letters indicate significant differences ($p<0.05$) between sampling times for treatment 130kg compared to baseline before work.

for the 105 kg at 24 h (T3) and for the 130 kg treatment at 10 minutes (T1) after completing the circuit was found. These can be associated with an incorrect adjustment of the saddle too far ahead, generating greater friction (Arruda *et al.*, 2011) or being too loose making the load move towards the wither's area when walking downhill.

The dorsal midline is an area with few soft tissues, and it should not have direct contact with the shoulder strap; however, the dorsal midline presented an increase in temperature in all treatments 24 h (T3) (figure 1). This can be the result of the padding used, which is intended to help distribute the loads over a larger surface (Pearson *et al.*, 2003), causing friction, greater pressure in that area because of the characteristics of the padding, because it is not correctly positioned, as well as not having the necessary thickness to provide adequate protection. Another point to consider in the effect of pressure distribution is the level of training, muscular development, and symmetry of the back (Kotschwar *et al.*, 2010).

The 105 and 130 kg treatments caused an increase in temperature in different areas of the mules' back, while for the 80 kg treatment an increase in temperature was observed only in the dorsal midline (Figure 1). Other studies have evaluated the relationship between the rider's weight and the temperature in the horses back, finding that heavier riders cause significant increases in average temperature compared to riders of lower weight (Wilk *et al.*, 2020), as well as greater asymmetry (Michelotto *et al.*, 2016; Soroko *et al.*, 2018), injuries and behavioural changes associated with pain (Dyson *et al.*, 2020).

No significant differences were found between the treatments in the average, maximum and minimum pressure, and in the pressure values between the four sensors ($P>0.05$). Therefore, it is not possible to conclude that the weight of the load affects the pressure force or magnitude and the balance. Nevertheless, due to technical problems such as errors in the registrations and damage to the sensors or their cables, it was possible to obtain data for only six mules for the 80 kg and 105 kg treatments and for nine mules in the 130 kg treatment, thus the smaller sample size per treatment may have affected the ability to detect small differences. Roost *et al.* (2020) found that light riders (between 10 and 12% of the horse's weight) generate significantly less pressure than heavier ones, while very heavy riders (more than 20% of the horse's weight) cause more pressure on the caudal than cranial area of the horse. In this study, mules carried between 16% and 44% of their live body weight, but it has to be considered that, unlike a rider, the load used here does not move by its own, while riders are in constant movement creating vertical ground reaction forces (von Peinen *et al.*, 2009). In addition, other studies on pressure sensors have found asymmetries in the distribution of weight on the back of saddle horses (Meschan *et al.*, 2007). The riders' ability to maintain balance and posture has a relevant role on pressure and thermal activity in the back of saddle horses (Dittmann *et al.*, 2021; Gunst *et al.*, 2019). On the other hand, load carrying depends on the distribution of weight and fixation that it has on the harness, so the effects of this "dead load" could be

different from those in riding horses. A recent study by Haddy *et al.* (2021) found that equids used for carrying loads have more wounds than those used for riding, this suggests that there would be differences in the impact generated on the back by a saddle and a harness.

No association was found between the thermographic images and the pressure obtained by the sensors. Only one previous study was found where the relationship between thermal activity and pressure on the back was evaluated with sensors and, with similar results as in this study (Mackechnie-Guire *et al.*, 2021). Thermography and pressure sensors have been used as a practical tool to assess saddle fit in equines, by measuring the magnitude, pressure distribution, increased metabolic activity, and skin blood flow (Desbrosses-Déléage *et al.*, 2019; Soroko *et al.*, 2018). However, in working equids, up to our knowledge, there are no previous studies that use these technologies to evaluate the impact of the load on the back of working equids. Still, a limitation of the present study is the small sample size and the short length of the circuit done by mules, since working equids are usually subjected to long working hours, and with lower quality of harnessing systems than those used by the army. Nevertheless, the results can be used as a preliminary step to better understand how different amounts of load can induce inflammation after a short period of work.

In conclusion, heavier loads, of 105 and 130 kg for 2 km, resulted in a significant increase in the superficial temperature in all the areas of the back evaluated in relation to basal values. For the heaviest load, the increase in temperature was detected earlier and was also associated to an increase of acute phase protein SAA. Nevertheless, it was not possible to establish a relationship between the measurements obtained by pressure sensors and thermography.

ETHICAL STATEMENT

This study was approved by the Institutional Animal Care and Use Committee of the Universidad de Chile, authorization number 18185-VET-UCH.

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SHORT COMMUNICATION

Working equids presented at a veterinary reference center in southern Chile (2015-2021)

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ABSTRACT. In Chile many families still rely on working equids as a fundamental source of income. Their use is particularly important for harnessing and transport of people and goods, in agriculture as well as in the leisure industry. Information on common emergency and clinical conditions in working equids is important to identify foci for owner education and to guide action towards disease prevention and animal welfare. The aim of the report was to highlight details about the clinical presentation of working equids at a veterinary reference center in southern Chile.

Hospital records from working equids presented *pro bono* from 2015 to 2021 at the Equine Clinic of the Veterinary Teaching Hospital of the Universidad Austral de Chile were evaluated and included.

A total of 107 working equid cases were recorded. The age range went from 1 day of age to 19 years (8.2±5.19 years). Most cases were not hospitalized and discharged on the same day of presentation (n=52). Horses were presented for evaluation of reproductive status (23%), lameness (15%) and castration (13%). Common reproductive diagnoses were uncomplicated castration (13%), barren (9%) and pregnant (8%) mares. Causes of lameness included laceration and wounds (40%), distal limb fractures (15%) and foot abscesses and/or poor foot care (10%). Only 4 cases of colic (3.7%) were presented over the years. Transrectal ultrasonography was the most used imaging tool, followed by radiography and endoscopy. Laboratory analysis was only performed in 15% of all cases.

This is the first report on clinical presentation of working equids at a veterinary care reference center in southern Chile. Most working equids seek veterinary care to aid reproduction and treat conditions related to their use. Findings suggest that animal use, husbandry and welfare can be improved.

Keywords: working horses, diseases, treatment, south America.

INTRODUCTION

Although Chile is classified by the world bank as a high-income country (FAO, 2021), social inequality is high and many families still rely on working equids, both in rural areas and in cities, as a fundamental source of income. Their use is particularly important for harnessing and transport of people and goods, in agriculture as well as in the leisure industry.

Animal health and disease prevention are important to ensure adequate performance and overall welfare of working equids (Tadich *et al.*, 2008; Tadich *et al.*, 2014; Tadich, 2020). Gathering information on common emergency and clinical conditions in working equids, including presentation, diagnostics, treatments and outcome, is important to identify foci for owner education and guide action towards disease prevention and animal welfare. Thus, the aim of this report was to highlight details about the clinical presentation of working equids at a veterinary reference center in southern Chile.

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MATERIAL AND METHODS

A convenience sample of cases seen from 2015 to 2021 at the Equine Clinic of the Veterinary Teaching Hospital of the Universidad Austral de Chile, Valdivia, Chile was included. The equine clinic provides *pro bono* veterinary care for working equids of low-income owners at said hospital, through an institutional volunteer program and private donations (AMIVECC, Equine Program, School of Veterinary Sciences, Universidad Austral de Chile). Data from working equids were collected from paper records. The hospital had full diagnostic and surgical facilities and a 24-hour emergency service. Data were retrieved on case presentation, presenting complaint, diagnosis, and outcome. Working equids were defined as equids used for harnessing and transport of people and goods, in agriculture and/or domestic use.

Cases were excluded if the record was missing. When there were multiple appointments for one animal for the same condition in the same period, only the initial visit was recorded and data from subsequent visits were only analysed to determine the outcome (e.g. hospitalization, discharge, euthanasia). If an animal presented with more than one condition at a single visit, multiple morbidities were recorded. Descriptive statistics were used for data analysis.

RESULTS AND DISCUSSION

A total of 107 working equid cases were recorded from 2015-2022 (Table 1). Four of the 107 horses were

Table 1. Breed, age, sex, body condition score (BCS), presenting complaint, diagnosis, procedures, and outcomes of 107 working equid cases presented from 2015 to 2021 at the Equine Clinic of the Veterinary Teaching Hospital of the Universidad Austral de Chile, Valdivia, Chile.

Year	Cases (n)	Breed	Age (mean±SD)	Sex (years) BCS (mean) (1-9)	Presenting Complaint	Diagnosis	Procedures + Outcome
2015	15	Mixed Breed (n=15)	7.5±6.1			Castration=14 No records= 11 Barren mare= 10 Pregnant mare= 9 Skin laceration w/ lameness= 8 Healthy animals=7 Colic of unknown origin=4 Cycling mare= 4 Asthma= 3 Preputial abscesses=3 Distal limb fracture= 3 Pneumonia=2 White muscle disease= 2 Septic funiculitis= 1 Umbilical and abdominal herniation=1 Selenium deficiency=1 Suspect EGUS= 1 Septic polyarthritis= 1 SCC eyelids= 1 Foot abscess/poor hoof care= 4 DDSP, laryngitis= 1 Cryptorchid= 1 Annular ligament lesion= 1 Impaction colic (large colon)= 1 Lice= 1 Parturition= 1 Penetrating wound=1 Periostitis= 1	<u>Procedures</u> Surgical castration= 15 Foreign body removal=1 Hernia reduction=1 Joint lavage= 1 Surgical wound debridement= 1 <u>Imaging</u> Ultrasonography= 19 Radiography= 7 Endoscopy= 3 <u>Lab work</u> CBC=6 Serum Chemistry= 3 Fecal egg counts=2 Bacterial culture= 1 BAL=1 Synovial fluid analysis= 1 GPx=2 Colostrum check= 1 <u>Outcome</u> Discharged= 53 Euthanasia= 4 NR= 50 Hospitalized 1-7d= 32 Hospitalized >7d= 18
2016	15	Mixed Breed (n=14) Chilean Breed (n=1)	5.8±4.1		Theriogenology Consult= 25 Lameness= 20 Castration=14 General health check= 7 Colic= 6 Skin lacerations - wounds= 10 Complications post castration= 3 Cough=3 Skin neoplasia= 2 Weight loss/ weakness= 4		
2017	12	Mixed Breed (n=10) Chilean Breed (n=2)	10.9±4.8	Mares= 55 BCS= 4			
2018	17	Mixed Breed (n=12) Chilean Breed (n=5)	9.4±4.2	Males= 31 BCS= 4			
2019	17	Mixed Breed (n=17)	6.3±5	Geldings= 10 BCS= 4			
2020	15	Mixed Breed (n=15)	10.3±6.2	Stallions= 11 BCS= 5			
2021	14	Mixed Breed (n=14)	7.6±4.9				

mainly used for transport of goods and sporadically riding activities. The age range went from 1 day of age to 19 years (8.2±5.19 years). Sixty five percent of horses (69/107) were under 10 years of age and 28.9% (31/107) over 10 years. The mean body condition score per sex group ranged from 3 to 5/9. A similar number of cases were presented per year (15±1.7 cases). Most of the cases were not hospitalized and discharged the same day of presentation (n=52). Nevertheless, data regarding hospitalization and discharge from 50/107 horses were not recorded. Cases were hospitalized for short periods of time (7±32.1 days) and most were discharged. Most horses were presented for evaluation of reproductive status (23%), lameness (15%) and castration (13%). Final diagnosis was recorded in 93 cases, where the most common reproductive diagnoses were uncomplicated castration (13%), barren (9%) and pregnant (8%) mares. Common cases of lameness were laceration and wounds (40%), distal limb fractures (15%) and foot abscesses and/or poor foot care (10%). Only 4 cases of colic (3.7%) were presented over the years. Transrectal ultrasonography was the most used imaging tool (n=19), followed by radiography (n=7) and endoscopy (n=3). Laboratory analysis was only performed in 16 cases (Complete Blood Cell count n=6, Serum Chemistry n=3, Fecal Egg Counts n=2).

This is the first report on clinical presentation of working equids at a veterinary care reference center in southern Chile. There are data on general health, welfare, and field veterinary care in this population from previous studies (Tadich *et al.*, 2008; Tadich *et al.*, 2010; Fortini *et al.*, 2011; Tadich *et al.*, 2014; Tadich, 2020). The

predominance of younger horses in this population (65% of all cases were under 10 years of age) could suggest a shorter life span of working horses, possibly due to poor nutrition or insufficient healthcare. Alternatively, there could have been less interest in seeking veterinary care for older animals not used for reproduction with less working capacity, although this should be unlikely due to the *pro bono* nature of the teaching hospital´s program for these horses. Similar data was reported in a study from a *pro bono* field healthcare programme provided by Universidad Austral de Chile´s School of Veterinary Sciences from 1997-2009 (Valdivia, Chile) (Sáez *et al.*, 2013). In that study, most horses did not have draught-type morphological characteristics, which coincides with this study´s findings, and could well be explained from the fact that draught breeds consume more roughage and entail higher maintenance costs for their owners. Although draught breeds and draught crosses are available through government-sponsored programs in the country[1], the lack of draught-type horses in these studies suggest owners´ preference for lighter breeds of lesser maintenance costs. Nevertheless, other more practical reasons like costs of transport or access to field veterinary care could also explain this finding. Malnutrition, however, was not recorded in any of the cases, although it is a significant problem in working equids worldwide (Burn *et al.*, 2010). This could also be related to the predominance of Chilean and Chilean-cross horses in this population, a pony breed which is recognized for its hardiness and ease of maintenance. Interestingly, 8% of this study´s patients consisted of pregnant mares, which indicates an interest of owners in breeding their animals. A significant subset of patients consisted of specifically evaluated barren mares, which also suggests that working horse owners could be interested in, or benefit from, veterinary programs focusing on equine reproduction.

Wounds and lameness problems were frequent presenting complains in this study population, concurring with the study mentioned above, which reported a predominance of skin and hoof lesions, lameness, and respiratory system signs (Sáez *et al.*, 2013). Detailed information on provided treatments were not specified in all records. Nevertheless, common treatments for the reported problems (lameness, wounds, lacerations, castration, etc.) include the administration of anti-inflammatory drugs and broad-spectrum antibiotics, which is consistent with previous findings (Sáez *et al.*, 2013). Targeted antimicrobial use was only recorded for one case, which could be explained by poor record keeping or cost limitations, but certainly needs to be revised since it is not in agreement with current antibacterial resistance prevention measures. It is noteworthy that fecal egg counts were only reported in two cases, despite the low cost of the procedure and the recognized usefulness of coproparasitological examination and widespread prevalence of parasite problems in equine populations both locally and worldwide (Geurden *et al.*, 2022; Hernández, 2016). This suggests clinician's dependence on empirical treatment of horses without coproparasitological guidance, and possible misuse of anthelmintic drugs.

Animal welfare was not directly evaluated in this report, but general health is a classical welfare approach (Burn *et al.*, 2010; Broom, 1991). Overall health problems in the studied population were similar to those reported in pleasure and sport horses, but skin lesions and wounds were overrepresented. The presence of skin lesions is common in working horses, generally due to poor fitted harnesses, dermatitis and ectoparasite infestation, as well as injuries while grazing in public green areas (de Aluja, 1998; de Aluja, *et al.*, 2000; Biffa & Woldemeskel, 2006; Burn *et al.*, 2008; Tadich *et al.*, 2010; Tadich *et al.*, 2011; Burn *et al.*, 2010; Sáez *et al.*, 2013). Lameness is one of the main problems affecting working equids (Broster *et al.*, 2009; Fortini *et al.*, 2011; Putnam *et al.*, 2014) and was also one of the main presenting complaints in this report, probably related to climate, animal use, husbandry, and care. There were two confirmed cases of white muscle disease due to selenium deficiency, a well-recognized issue in southern Chile (Rioseco *et al.*, 2013). This could justify preventive monitoring of selenium nutritional status, or empirical supplementation, in this population.

A majority of the cases reported here were evaluated on an ambulatory basis, or hospitalized for short periods of time. Reasons for this are unclear, but could be related to owner's availability or limited funding.

In conclusion, these results show that most working equids seek veterinary care to aid reproduction and treat conditions related to their use. Findings suggest that animal use, husbandry and welfare can be improved. Educational and preventive programmes as well as further research are required to reach adequate health and welfare of this working equid population.

DECLARATIONS

Authors declare no competing interests.

Owner consent for animal evaluation and treatment is provided for all cases presented at the Veterinary Teaching Hospital. Patient and owner confidentiality was kept for data use and analysis.

AUTHOR CONTRIBUTIONS

CDe, CDu and BU participated in case management. CDe collected data from the analyzed records. CDu analyzed the data and wrote the manuscript. CDe, CDu and BU worked on manuscript finalization.

[1] Ramirez-Reveco AR. Generación de un banco de semen de caballos fina sangre de tiro pesado, a partir del diseño de protocolos de Criopreservación para uso en inseminación artificial (IA) en el Plan Nacional de Fomento Equino (PNFE). Programa FONDEF n° D08I1076, Conicyt, Chile.

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