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ANALYSIS OF THE INCOME DATA OF A UK EQUINE CHARITY, THE DONKEY SANCTUARY

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Analysis of the income data of a UK equine charity, The Donkey Sanctuary

Memoria presentada por **Elena Barrio Fernández**
Para optar al grado de Doctor
Enero 2022

Dr. IGNACIO DE BLAS GIRAL, Profesor Titular del Departamento de Patología Animal de la Facultad de Veterinaria de la Universidad de Zaragoza, y Dr. FRANCISCO JOSÉ VÁZQUEZ BRINGAS, Profesor Asociado del Departamento de Patología Animal de la Facultad de Veterinaria de la Universidad de Zaragoza, como Directores,

C E R T I F I C A N:

Que Dª. ELENA BARRIO FERNÁNDEZ ha realizado bajo nuestra dirección los trabajos correspondientes a su Tesis Doctoral titulada "Analysis of the income data of a UK equine charity, The Donkey Sanctuary" que se ajusta al Proyecto de Tesis presentado y cumple las condiciones exigidas para optar al Grado de Doctor por la Universidad de Zaragoza, por lo que autorizamos su presentación para que pueda ser juzgada por el Tribunal correspondiente.

Y para que conste, firmamos el presente certificado

En Zaragoza, a 11 de enero de 2022

Dr. Ignacio de Blas Giral Dr. Francisco Vázquez Bringas

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I cannot believe I find myself writing these words and getting close to finishing this journey. Whilst being a PhD student, life has continued its course and during this time, not only have lots of wonderful things happened, but also other events that have made achieving this interesting to say the least. So, in my case, it has taken two lovely children, three house moves, attaining British citizenship, returning to my home country after 15 years in the UK and a global pandemic to finish this thesis.

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.

“Nuestra recompensa se encuentra
en el esfuerzo y no en el resultado.
Un esfuerzo total es una victoria completa.”

Mahatma Ghandi

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Summary

In the United Kingdom, there are thousands of donkeys being cared for by charities; however, little is known about the reasons for relinquishment or their previous health status, with even less information available in published literature.

Such information could help to identify factors contributing to poor equine welfare and guide the development of appropriate educational resources.

The main objective was to describe the characteristics of the relinquished donkeys and to better understand the current preventative health care status of donkeys relinquished into The Donkey Sanctuary (TDS). The specific objectives included: the analysis and identification of demographics, reasons of relinquishment, donkey's preventative health status on arrival, specific areas within the UK where targeted education was most needed, prevalence of specific diseases during isolation, diet provided and husbandry of donkeys by private owners, mortality rate during isolation and investigating if geriatric age is a direct risk factor for mortality during isolation.

It is a cross-sectional observational survey, using admission data from donkeys relinquished into TDS. A total of 596 donkeys were admitted during a 30-month period. Each had a health check at arrival; previous management information was provided by the owner. Data were retrieved from TDS database, inputted into a specific Microsoft Access 2016 database then exported for analysis in IBM SPSS 19.0 for Windows®.

The typical animal admitted into TDS was an adult donkey gelding seems to differ from that found in small animal shelter admissions. Whilst the percentage of donkey stallions identified in this study was 15.4%. Data regarding the number of stallions entering other equine charities would be helpful to assess if this is a particular problem in donkeys.

Moreover, identifying the reasons why owners are keeping animals entire could provide vital information for the charities to evaluate strategies to help reduce overbreeding and numbers of unwanted equids. Whilst this study looked at the proportion of relinquished donkeys that were entire, it did not aim to look into reasons for not castrating donkeys.

This study identified that there was a large percentage of donkeys that arrived without a valid passport (32.3%) or microchip (49.7%). This has an impact on traceability with regards to welfare law enforcement and the ability to locate equids in the event of a notifiable disease outbreak; it is also very likely that there is an underestimation of donkey population from the CED (Central Equine Database).

The results showed that there was a lower percentage of donkeys that were fully protected against influenza and tetanus (23.2%) (according to manufacturer's guidelines) in comparison with reported national equine rates (40.0%). Lack of

vaccination increase the risk of disease for both, national herd and individuals. Furthermore, it reduces the number of routine veterinary visits and associated assessment of donkey's welfare and quality of life.

Approximately 35% of the donkeys were in need of anthelmintic treatment with a high burden of *Strongylus* spp. (no distinction was made between large and small *Strongylus* spp.), furthermore, although a smaller percentage, some of the donkeys were in need of specific treatment against liver fluke, lungworm, tapeworm and ascarids.

Donkey owners did not report results about faecal worm egg count as a reason for donkeys not having received any de-worming treatment.

This study confirms that geriatric donkeys have a higher risk of suffering moderate to severe dental disease. This indicates that those geriatric donkeys with pathological dental grades were in need of advanced dental treatments, change of dietary management and bedding type and that their quality of life was compromised by painful dental disease. Furthermore, 43.9% of donkeys received no dental treatment within the last year.

This study found that at least 26.3% of donkeys at admission were considered to have a Body Condition Score (BCS) of 4 and 8.6% were identified as obese (BCS=5).

This current study would also suggest that foot care is neglected for donkeys in the UK; only 24.0% of donkeys had been trimmed within 6 weeks of arrival; and 35.2% were seen by the farrier 6 to 12 weeks prior to admission. The Donkey Sanctuary recommends foot trimming every 6 to 10 weeks for pasture-based UK donkeys.

Main reason for donkey relinquishment was related to the owners health (24.2%) and donkey health was given as the third most common reason (11.5%). Reasons for relinquishment given by owners should be assessed to try to reduce unnecessary relinquishments.

The study indicated that owners did not considered dental disease to select donkey diet choice and in fact shows that owners were doing the opposite that would be recommended by TDS. There were more donkeys that had access to chopped feed diets with acceptable dental grades of 1 and 2 (34.0%) while fewer that were on the same feeds had pathological dental grades of 3 to 5 (22.6%). The Donkey Sanctuary recommends chopped forage feeds for donkeys with poor dentition. These finding could also have an impact on donkeys BCS as short chop diet in donkeys with good dentition could help to increase their body weight, and increase the risk of obesity.

The study also indicates that owners are not taking into consideration dental status when selecting type of bedding.

Identifying the right type of diet and bedding for a donkey can be vital especially on those with dental disease and could help to prevent life threatening conditions such as impaction colic and hyperlipaemia.

The study found no association between vaccination status, microchip identification, de-worming, dental frequency, dental grade and hoof conditions and donkeys region of origin within the UK which evidences a lack of preventative care across the UK.

To summarise, this study highlights the need for improving preventative health care in donkeys to ensure better welfare and biosecurity within the UK equine population. This study also demonstrated a deterioration in donkey care when compared with previous publications.

There is an opportunity for veterinary professionals to engage with donkey owners using evidence based health advice from TDS.

Resumen

En Reino Unido, cientos de burros están al cuidado de ONG. Sin embargo, se conoce muy poco sobre las razones de cesión de estos animales a los centros o sobre su estado sanitario previo. Además, se carece prácticamente de información al respecto en la literatura publicada.

Tal información podría ayudar a identificar factores que contribuyen a la mala calidad de vida de los équidos y a guiar en el desarrollo de recursos educacionales apropiados.

El objetivo principal fue la descripción de las características de los animales cedidos al centro y la mejor comprensión sobre el estado de la salud preventiva de los burros cedidos a The Donkey Sanctuary (TDS). Los objetivos específicos incluyeron: el análisis e identificación demográfica, las razones de cesión, el estado de salud preventiva a la llegada al centro de cuarentena, la dieta y manejo de los animales por parte de los propietarios, la mortalidad durante el periodo de cuarentena y la investigación de si la edad geriátrica es un factor de riesgo para la mortalidad durante la cuarentena.

Se trata de un estudio observacional transversal, usando los datos de burros cedidos a TDS. Un total de 596 burros fueron admitidos durante un periodo de 30 meses. Se realizó un examen a cada animal a la llegada; Se recogió información del propietario sobre su manejo previo. Lo datos se tomaron de la base de datos del TDS, se introdujeron en una base de datos específica de Microsoft Access 2016 y posteriormente se exportaron para su análisis en IBM SPSS 19.0 para Windows®.

El animal típico admitido en el TDS fue un burro adulto castrado; esto parece diferir de las admisiones encontradas en refugios para pequeños animales. Mientras que el porcentaje de burros enteros identificados en este estudio fue del 15.4%, los datos acerca del número de sementales admitidos en otras ONG de équidos, ayudaría a valorar si éste se trata de un problema en particular en burros.

Además, identificar las razones por las que el propietario mantiene a los animales enteros podría proporcionar información vital para que las ONG puedan evaluar estrategias para la reducción del exceso de reproducción y el número de équidos no deseados. Mientras que el estudio refleja la proporción de burros cedidos que estaban enteros, no se incluyen las razones por las que los propietarios no castraron a sus burros.

Este estudio identificó que llegaron un gran porcentaje de burros sin un pasaporte (o documento de identificación Equino) válido (32.3%) o microchip (49.7%). Esto tiene un impacto en cuanto a la trazabilidad conforme al cumplimiento de las leyes de bienestar y a la capacidad de localizar équidos en el evento de un brote de una enfermedad de declaración oficial. También es muy posible que el CED (la central de base de datos de équidos) esté subestimando la población de burros.

Los resultados muestran que había un porcentaje bajo de burros que contaban con una protección completa contra influenza y tétanos (23.2%) (según las instrucciones del fabricante) y si comparamos con la proporción nacional de équidos (40.0%). La falta de vacunación aumenta el riesgo de enfermedad para los individuos y para el grupo de équidos a nivel nacional. Además, reduce el número de visitas rutinarias por parte de los veterinarios y a las consecuentes revisiones de bienestar de los burros.

Aproximadamente un 35% de burros requerían tratamiento antihelmíntico con una alta carga parasitaria de *Strongylus* spp. (no se hizo distinción entre *Strongylus* spp. grandes o pequeños), además se encontró, aunque en un porcentaje más bajo, que algunos burros necesitan tratamientos específicos contra *Fasciola hepatica*, nemátodos pulmonares, céstodos y ascáridos.

Los propietarios de los burros no dieron resultados de cargas parasitarias (huevos por gramo de heces) como razón de no haber recibido desparasitantes.

Este estudio confirma que los burros geriátricos tienen un riesgo más alto de sufrir enfermedad dental de moderada a severa. Esto indica que aquellos burros geriátricos con grados dentales patológicos necesitaban tratamientos dentales avanzados, cambios de dieta y tipo de cama y que su calidad de vida y bienestar estaban comprometidos debido a una enfermedad dental dolorosa. Además, el 43.9% de burros no recibieron ningún tratamiento dental en el último año.

Este estudio encontró que al menos un 26.3% de los burros en su admisión tenían una condición corporal de 4 y un 8.5% fueron identificados como obesos (BCS=5).

Este estudio sugiere que hay una falta de cuidado del casco en los burros del Reino Unido; solo a un 24% de los burros se les había recortado los cascos en las últimas 6 semanas antes de su admisión; y un 35.2% de los burros habían sido vistos por el herrador de 6 a 12 semanas antes de su admisión. El TDS recomienda el recorte de cascos cada 6 a 10 semanas para burros en pasto en el Reino Unido.

La razón primordial por la que los burros fueron cedidos a la ONG estaba relacionada con la salud del propietario (24.2%) y la salud del burro fue la tercera razón más común (11.5%). Se deberían valorar las razones de cesión para reducir el número las cesiones innecesarias.

Este estudio indica que los propietarios no valoraron el estado dental a la hora de seleccionar la dieta para su burro y de hecho se observa que los propietarios hicieron lo contrario de lo aconsejado por TDS en cuanto a dicha selección. Se encontraron más burros que tenían acceso a dietas de fibra corta con grados dentales aceptables de 1 y 2 (34%) mientras que se encontró un número menor de burros con esa misma dieta que tenían grados dentales patológicos (de 3 a 5) (22.6%). El Donkey Sanctuary recomienda dietas de fibra corta para burros con dentición pobre. Estos hallazgos, podrían tener un impacto en la condición corporal de los burros con buena dentición que ayudaría a aumentar su peso corporal y aumentar el riesgo de obesidad.

Este estudio indica también que los propietarios no consideran el estado dental cuando seleccionan el tipo de cama. Identificar el tipo de cama y dieta adecuados para un burro puede ser de vital importancia especialmente en aquellos con enfermedades dentales y podría ayudar a prevenir enfermedades más graves que atenten contra la vida de los animales como el cólico por impactación y la hiperlipemia.

Se encontró que no había asociación entre el estado vacunal, la identificación por microchip, la desparasitación, la frecuencia de las visitas dentales, el grado dental y las condiciones del casco con la región de origen de los burros en Reino Unido; lo que evidencia una falta de cuidados preventivos generalizados en el Reino Unido.

Para resumir, este estudio destaca la necesidad de mejorar la salud preventiva y el cuidado de los burros para asegurarles un mejor bienestar; mejorando la bioseguridad de la población de équidos del Reino Unido. También demuestra el empeoramiento del cuidado de los burros cuando se compara con estudios previos.

La profesión veterinaria tiene la oportunidad de interactuar con los propietarios de burros, usando evidencias científicas sobre su estado de salud y consejos por parte de TDS.

1. Introduction

In the year 2000, the estimated donkey population in the United Kingdom (UK) was 10,000 donkeys, with over half of those maintained by The Donkey Sanctuary (TDS) (Starkey and Starkey 2000).

As part of the veterinary care provided, the author started performing mini-audits in order to assess some of the characteristics of the animals being admitted to the NAU (New Arrivals Unit). Some of the initial findings of these audits suggested that obesity and dental disease were significant health conditions amongst donkeys relinquished to TDS. The NAU audits provided an insight into some of the health conditions affecting donkeys entering TDS, but they also raised important unanswered questions, highlighting the need for a more in-depth study.

There are several recent publications analysing the intake and outcome data from small animal shelters (Marston et al. 2004; Marston et al. 2005; Morris and Gies 2011). These present results regarding animal shelter dynamics, the characteristics of relinquished animals, patterns of relinquishment and the reasons underlying euthanasia and relinquishment. Information generated from studies relating to small animals has been shown to have important policy and educational implications by informing the specific areas where targeted campaigns may improve the general welfare of small animals (Marston et al. 2004; Marston et al. 2005; Morris and Gies 2011).

Information collected for newly relinquished donkeys might reflect the standard of preventative healthcare of privately owned donkeys in the UK, and that of donkeys in guardian homes and subsequently returned to TDS. This could have a direct impact on the charity's policies, education, advice and donkey welfare.

1.1. The Donkey Sanctuary

1.1.1. Charity's structure

The Donkey Sanctuary is an international animal welfare and rescue charity based in Sidmouth, Devon, UK. Their mission is to transform the quality of life for donkeys, mules and people worldwide through greater understanding, collaboration and support, and by promoting lasting, mutually life-enhancing relationships (The Donkey Sanctuary, 2020a).

The Donkey Sanctuary was founded by Dr. Elizabeth Svendsen in 1969 and registered as a charity in 1973. In addition to her work on donkey welfare, Dr. Svendsen also established The Elisabeth Svendsen Trust for children and donkeys, to provide therapy for children with additional needs; today they are known as Donkey Assisted Therapy centres (DAT). In 2012, both charities merged into one (The Donkey Sanctuary, 2020b). Since its initiation, the charity has developed from being a UK based equine rescue charity to an international welfare organisation.

The Donkey Sanctuary is managed by 13 trustees who are responsible by law for the charity, its assets and activities (The Donkey Sanctuary, 2020c).

As part of a 5-year strategy between 2013 and 2018 The Donkey Sanctuary: cared for 7,000 animals; attended over 1,300 welfare complaints; increased the number of projects worldwide from 27 to 38; increased the number of donkeys in guardian homes in the UK and mainland Europe to nearly 1,900; and received around 50,000 visitors a year (The Donkey Sanctuary, 2020a).

The most recent financial review reported an income of £42.3 million with a total expenditure of £42.8 million; the charity's income is generated from private donation, legacies and trading activities, with legacy income being an important source of income (The Donkey Sanctuary, 2020d).

During the study period of June 2013 to September 2015, The Donkey Sanctuary had a total of seven farms in the UK including the NAU for the quarantine of new arrivals. All of the farms are managed by a farm manager and have a ratio of 1 groom per 20 donkeys. Grooms are responsible for the donkeys' day to day care on each farm. There were a total of six clinical vets based in the UK and one welfare vet. Vets were responsible for attending emergency calls to treat individual animals, as well as working with farm managers and grooms to implement herd health plans for around 2,500 animals. The veterinary team included five veterinary nurses, two hospital grooms, two equine dental technicians registered with the British Association of Equine Dental Technicians (BAEDT), two contracted registered farriers and six office-based people working as administrative support.

The Donkey Sanctuary has a fully equipped veterinary hospital specifically designed for donkeys, as well as a veterinary laboratory, a pathologist and a research department. The research department coordinates and facilitates non-invasive research projects that vary from small internal trials, to data research, and large collaborative projects with British universities and stakeholders worldwide. The trustee committee and TDS ethical committee must approve external research projects. The research department is also responsible for the management of nutrition and parasitology for the resident animals in the UK and Europe.

1.1.2. Charity core values and mission

In 2012 The Donkey Sanctuary established its core values of: compassion, collaboration and creativity (The Donkey Sanctuary, 2020a):

- Compassion: not turning away from donkeys and mules in need and people who rely on them for their livelihood.
- Collaboration: TDS aims to be collaborative in all its activities, working through a worldwide network of partner organisations, communities and individuals.
- Creativity: TDS resources are finite, so creativity must be exercised to meet the goals.

1.1.3. TDS schemes: relinquishment, guardian scheme, adoption and DAT

Donkeys and mules arrive into the charity for a number of different reasons, such as neglect, owner health, abandonment or lack of time.

1.1.3.1 Relinquishment process

The owner contacts TDS: donkey and mule owners that can no longer care for their animals can sign their animals over to TDS free of charge.

The owner contacts the welfare department to discuss relinquishment, the welfare department gathers details such as: the urgency of the relinquishment, the age of the animal and any companions, their management and veterinary history and any other concerns.

A welfare adviser visits the owner: a welfare adviser from the area arranges a visit to the animal in their current environment with the owner present if possible. The welfare adviser is responsible for informing the owner of the potential risks of moving a donkey/mule, completing management forms (including details of current health and any relevant history), relinquishment paperwork, and taking photographs of the animal. Relevant paperwork can be seen in Appendix 1. The welfare adviser sends this information to the welfare department.

NAU vet checks the information and decides if any further action is necessary according to TDS policy:

- Donkeys younger than 20 years old with nothing of concern in their medical history: the vet assesses the information and photographs provided to decide on the animal's fitness to travel. If the vet considers that the animal is fit to travel based on the information provided, they inform the welfare department and discuss NAU reception availability and transportation.

  However, if the vet has concerns about the animal's fitness to travel, or other aspects of their history, then the vet advises the welfare department to arrange a pre-admission medical. This pre-admission medical examination is performed by a local external equine practice; preferably from a previously selected list of veterinary practices known as "donkey friendly vet practices".

The pre-admission medical (PAM) includes a full clinical examination: dental examination with a speculum, blood sample for haematology and biochemistry, and a faecal sample for faecal worm egg count (FWEC) (Appendix 2).

Donkeys and mules with a lack of information regarding their ownership or origin during the preceding 2 years are termed unknown origin animals, as are animals where there is a suspicion that they may have entered the UK from abroad within the last 2 years.

If the donkey/mule is considered to be from an unknown origin, a blood sample is requested to test for the following diseases: equine infectious anaemia (EIA) and piroplasmosis in jennies and mare mules, equine viral arteritis (EVA), EIA and piroplasmosis in jacks and male mules (Appendix 3). The results must be received before movement can be considered.

- Donkeys older than 20 years require a pre-admission medical examination before they can be considered fit for travel and admission.

Actions taken after the PAM:

- If the external vet signs the pre-admission medical exam as "Fit to be transported to TDS in Devon": the information is then assessed by the NAU vet, and if the animal is considered to be in a high risk group (due to age, health concerns, etc.) then the animal is discussed further with the external vet, the welfare adviser, and the owner.

  If there are any minor concerns a fitness to travel certificate is arranged 24-48 h before transportation. Alternatively, if there are no concerns, the welfare department is informed and the owner contacted once transport and reception have been arranged. Cases are prioritised depending on the needs of the donkey/mule.

- If the external vet signs the pre-admission medical as "Fit to be transported- short distance only": the attending vet has considered that due to existing health conditions, the donkey can only be transported for a short distance. In this instance, TDS arranges for the donkey to travel the shortest distance possible, by using the closest holding base available. The NAU vet discusses any medical concerns and potential future requirements, and relays the information to the local veterinary practice responsible for the care of the animals at the holding base.
- If the external vet signs the pre-admission medical as "future", a discussion is held to decide if further diagnostics are required; whether the animal needs to be moved to the closest hospital or holding base; or if the possibility of the donkey staying at the current location needs to be considered.

- If the external vet signs the pre-admission medical as "unfit to travel": a discussion is had with regards to the animal's quality of life; this involves the NAU vet, the external vet, the owner and the welfare adviser. If the external vet is advising euthanasia, the owner is encouraged to follow this advice and make the decision to proceed with euthanasia. If the owner refuses to follow the external vet´s advice and the animal has a poor quality of life, or there are serious concerns with regards to their welfare, then the NAU vet and welfare adviser would usually try to encourage the owner to consider humane euthanasia. If the owner is still unable to consider euthanasia, a TDS welfare vet would visit the animal to assess the quality of life of the animal and offer a second opinion. If the same conclusion is reached and the owner is still refusing to meet the recommendation of euthanasia on welfare grounds, then the Royal Society for the Prevention of Cruelty to Animals (RSPCA) would be contacted for input to try and resolve the situation.
- If the animal is unfit to be transported and has a good quality of life, discussion would be held between TDS and the owner to try and resolve the situation in the animal´s best interest.

Movement meeting: it is held to discuss the arrival of relinquished animals into the NAU, and the outward movement of animals that have finished their quarantine period in the NAU. In the meeting the following people are present:

The NAU manager, general farm manager or representative, welfare department and NAU *veterinary* nurse (vet department). The objectives of the meeting are to discuss the following:

- The movement of donkeys into the NAU in order of priority: dates of collection/arrival, transport and logistics, location within the NAU farm, the formation of small groups of animals with similar needs where possible, any management and health concerns or requirements for special dietary management.
- The movement of animals that have completed their quarantine period, from the NAU to the farms: including farm availability and the suitability of their existing management groups for the animal's current veterinary or management concerns.
- The biosecurity status of the farms and the NAU: if the biosecurity status is compromised on any of the farms or NAU, the result is significant restrictions on the movement of animals.
- The potential selection of animals at the NAU for the guardian and DAT scheme.

Transport: once the day of transport is arranged, a lorry driver and lorry are chosen, and collection is agreed with the owner. The lorry driver has responsibility for the animals once they are in the transport. The lorry driver assesses the animal on arrival at the property, before loading them into the transport. If the lorry driver is unsure regarding fitness to travel or the animal presents a problem at the time; the lorry driver informs the vet department and discusses their concerns with one of TDS vets. The animal might need to be assessed by a vet at that time, who would then be able to advise on the next course of action.

1.1.3.2. Guardian scheme

The Donkey Sanctuary has a scheme to allocate healthy donkeys to guardian owners. The guardian home must provide approximately half an acre (2000m²) of suitable and safe grazing per donkey, an area of hard standing, access to shelter, and robust fencing. The ownership of the donkey remains with TDS and the guardian provides all the care for the donkeys or mules. A welfare adviser is assigned to the guardian home and visits the home every six months to provide support and advice and ensure the welfare of the animals (The Donkey Sanctuary, 2020e).

Donkeys are carefully selected for their guardians and must pass a medical examination for fitness, to ensure that they have no significant health issues. If any minor issues are detected, then these are thoroughly discussed with the potential carer so that they are fully aware of any special needs and can determine if the animal suits them. Donkeys with significant health problems are considered unsuitable for the scheme and remain under TDS care.

The farms select donkeys and create a guardian group; these donkeys receive specific behavioral training to suit the carer's experience. Once the staff feel that the donkeys are ready, the farm vet completes a full medical examination. This includes the following: full clinical examination, blood sample for haematology and biochemistry panels, faecal worm egg count, and dental examination by a vet. They receive any dental treatment required and have their hooves examined and trimmed as necessary by a qualified farrier before going to their new home.

1.1.3.3. Adoption

There are 22 donkeys and mules advertised as available for people to donate and adopt. The adoption pack that the charity offers includes a framed portrait, four postcards, a certificate, the donkey´s story and regular updates about the donkey. Donkeys are selected by farm staff and checked for their suitability by one of TDS vets (The Donkey Sanctuary, 2020f).

1.1.3.4. Donkey Assisted Therapy (DAT)

The Donkey Sanctuary has a number of centres that provide equine assisted therapy to children and adults who have a range of additional needs and disabilities. Donkeys are selected by farm staff and must pass a health examination. This includes full hematology and biochemistry panels, and a dental examination with a speculum by a vet. Donkeys are selected to fill demand by the centres and receive a fitness to travel examination before moving. Donkeys receive a health check by a TDS vet twice a year, whilst routine visits and emergencies are covered by local veterinary practices with the support of TDS.

1.1.4. Other TDS projects

Other TDS projects working towards improving the welfare of donkeys include the following: donkeys in production (meat, skin, and milk), feral donkeys, donkeys in tourism and leisure, donkeys in industry and donkeys in disaster.

2. Bibliographic review

2.1. Introduction

In the UK, there are thousands of donkeys being cared by charities, however, little is known about the factors behind relinquishment: demography, reasons and welfare status, with even less information available in published literature.

Recent data from the Central Equine Database (CED) estimates the population UK to be 27,592 donkeys (DEFRA, 2020a) with 16.4% (n=4,524) of these under TDS care.

The Donkey Sanctuary is a registered charity that aims to transform the quality of life for donkeys, mules and people worldwide through greater understanding, collaboration and support, and by promoting lasting mutually life-enhancing relationships (The Donkey Sanctuary, 2020a). The new governmental CED has made new data available to TDS, formerly National Equine database (NED), and compared with the TDS data (Figures 2.1 to 2.3).

Figure 2.1. UK donkey population based on The Donkey Sanctuary data

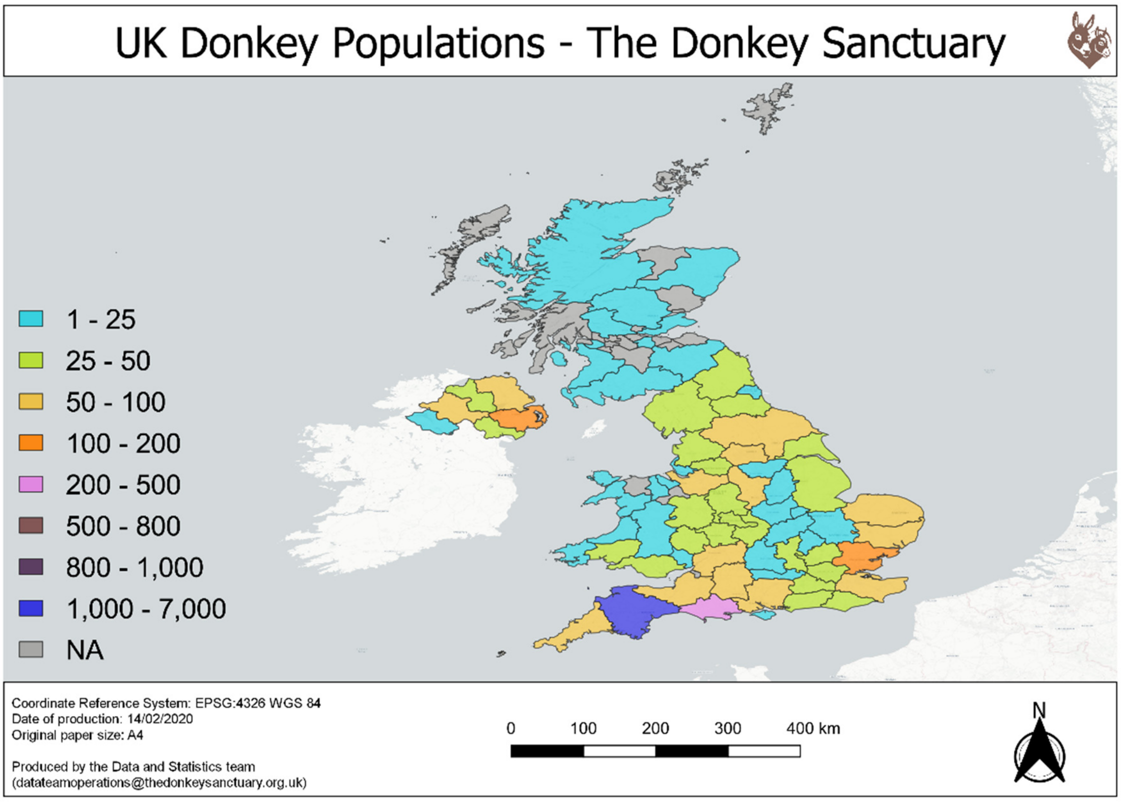


Figure 2.2. UK donkey population based on Equine Central Database

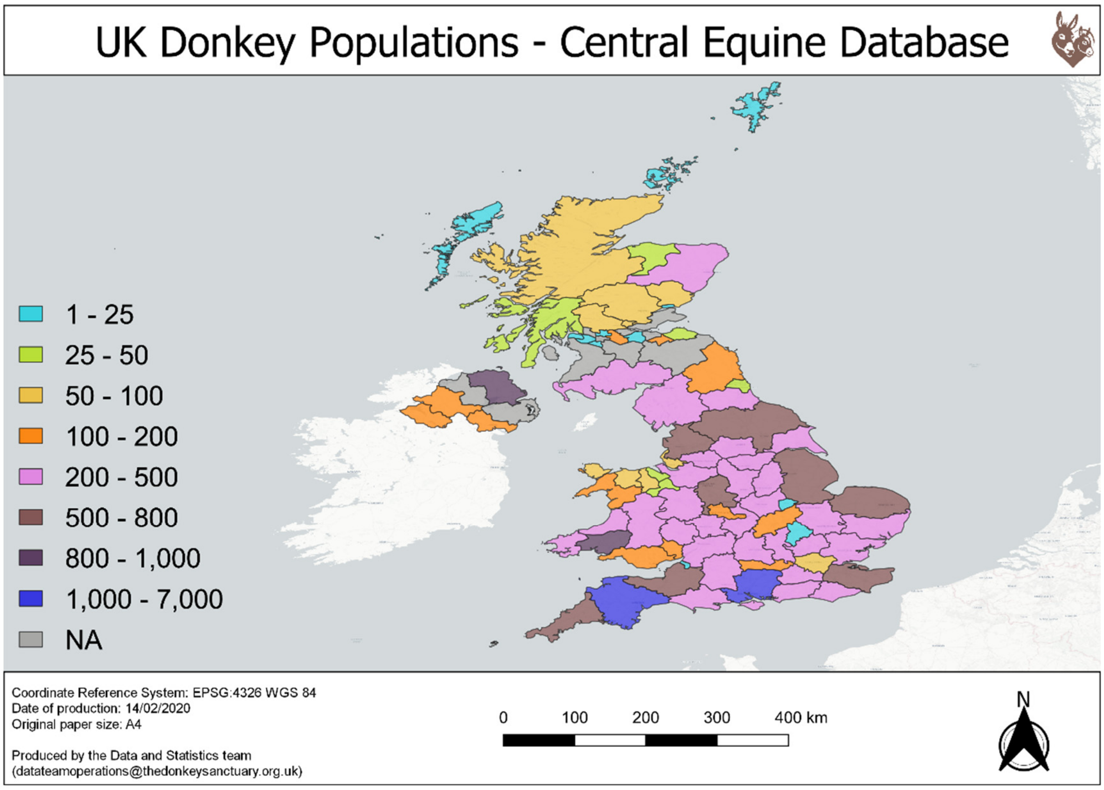
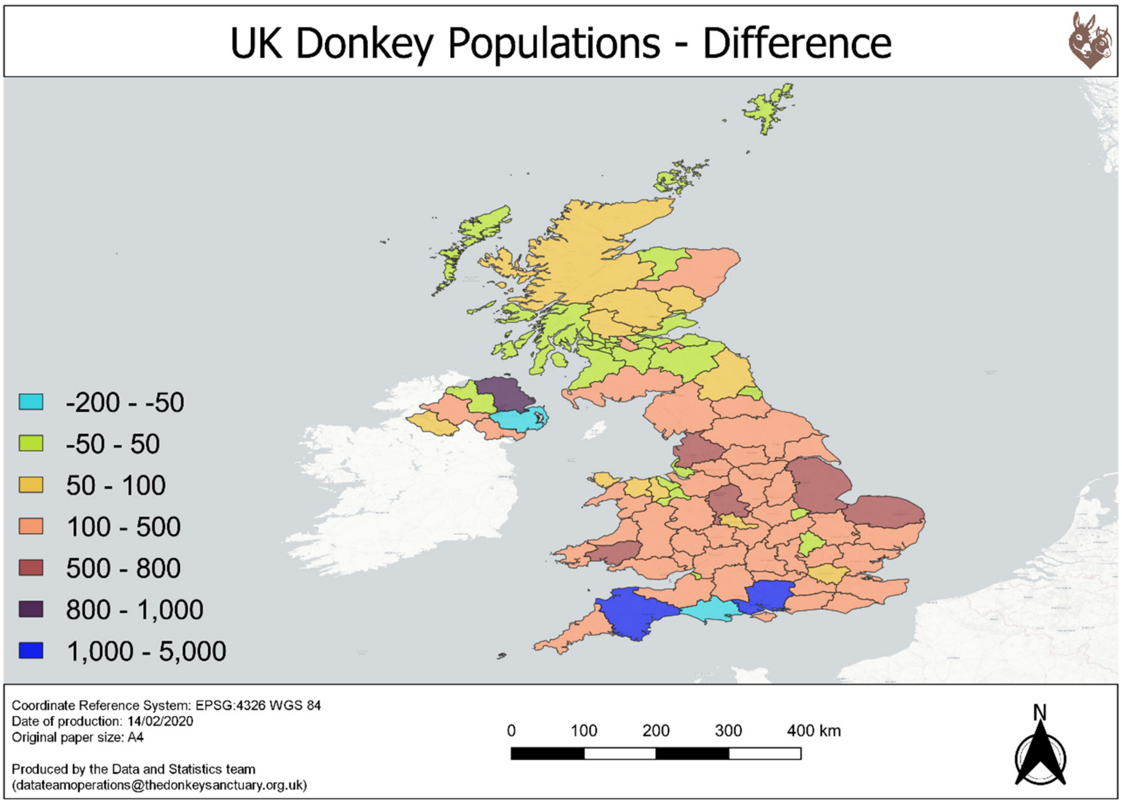


Figure 2.3. UK donkey population difference between TDS data and ECD data



At the end of the 1800´s, with the invention of the combustion engine, donkey numbers in Britain drastically declined but this decline was reverted in 1960´s when donkeys became popular as pets and companion animals (Camac, 1997). Despite of this large population, the literature regarding the demographics, management and health of the donkeys in the UK is very limited. Cox et al. (2010) studied a population of 1,432 donkeys that were own by TDS and were cared for by foster owners. The study determined the use of the donkey and some of the most common health problems in that population, which represented approximately 17 per cent of the total number of donkeys in the UK according to the total population estimated in 2007 by NED.

There are several recent publications analysing the intake and outcome data of small animal shelters (Marston et al., 2004; Marston et al., 2005; Morris et al., 2011) those have shown interesting results regarding animal shelter dynamics, characteristics of the typical relinquished animal, patterns of relinquishment, reasons underlying euthanasia and relinquishment. This data been demonstrated to have important policy and educational implications, and suggesting specific areas where targeted education campaigns may be required to improve the general welfare of small animals.

A recent study in horses listed in an equine charity identified specific factors related to rehoming strategies (Rosanowski and Vereheyen, 2019), while Hotchkiss et al. (2007) owner survey about horse demographic identified relevant information to health and welfare, specifically related to respiratory disease. Information regarding health and medical conditions of new arrival donkeys might reflect the standard of preventative care of privately own donkeys as well as Donkey Sanctuary returning fostered donkeys and could have a direct impact on charity policies, education advice and donkey welfare. Moreover, Thiemann et al. (2018) reported that inadequate preventative husbandry affects welfare and can impact on biosecurity issues for the wider equine community.

This information could help to provide focused advice, education and identify areas of research to enable the reduction of major contributing factors to poor equid welfare.

2.2. Shelter medicine

2.2.1. Definition and regulations

Shelter medicine has been described as a newly veterinary specialty, which deals with the management of health, housing and behaviour needs of animals living in a shelter. The objective of the vets specialized in shelter medicine is the prevention of disease outbreak and the maintenance of the good health and welfare of the animals in their care.

Although there are a large number of different animal shelters in the world, the care of the animals in welfare shelters remains unstandardized and unregulated in many countries such as USA (Anonymous, 2014). In 2008, the Association of Shelter

Veterinarians presented a first edition of a document to highlight optimal practices for shelter animals in the USA.

Shelter medicine has become a popular and important specialty within the veterinary profession and in 2001, the Association of Shelter Veterinarians was formed in the USA, counting with more than 800 members worldwide. Furthermore, more than half of the 28 vet schools in the USA offered shelter medicine courses and 24 of those schools were involved with shelter medicine in some way (British Equine Veterinary Association, 2014).

One of the universities in USA, Purdue University, started a shelter medicine program as a private initiative and the reported fund in 2014 was $400 million, dedicated to helping animal shelters, educating vets, students and the community about animal welfare. The program´s aim was to educate and train future leader in shelter medicine, practical and relevant research and public education (Anonymous, 2014).

The Association of Shelter Veterinarians in the USA had drawn up animal welfare documents to give guidance on neutering programs for animal shelters and on the standards of care (Anonymous, 2014).

2.2.2. Animal shelter medicine in the UK

Although there are a large number of animal shelters and registered charities in the UK, animal shelter medicine has not become a veterinary specialty until very recently.

A charity vet association was founded in 2013 and still in early stages. The UK association of charity vets second meeting was held at Nottingham University in November 2014 and concluded with a discussion of how the association could be taken forward, how many meeting should be held and format, a development of a website and membership fee (British Equine Veterinary Association, 2014).

2.2.3. Type of shelters

There is a spectrum of sheltering organizations for almost any companion or domestic animal species and for many exotic species as well. The types include different permutations: traditional open-admission shelters, care for life sanctuaries and hospices, home based rescue and foster care networks; virtual internet based animal transport programs; behavioural rehabilitation centers, limited or planned admission shelters; “No Kill” shelters; high volume adoption agencies (Anonymous, 2014).

A system of classification of small animals in shelters has been developed by the Asilomar group in the USA to assure consistent data collecting throughout animal welfare community. There are a large number of participant States within USA. The Asilomar Accords provide guidelines for classifying shelter animals, as “healthy”, “treatable-rehabilitable”, “treatable-manageable” and “unhealthy-untreatable”; allowing shelters to produce annual statistics and tracking their progress; providing transparency and information for the media; helping reducing euthanasia rates in local communities (British Equine Veterinary Association, 2014).

2.2.4. Small animal shelter medicine

Small animal shelter medicine has been reported to be a well-recognised discipline within veterinary medicine in the USA with a number of PhD research projects under way (British Equine Veterinary Association, 2014) as well as many publications.

The majority of studies focus on shelter dogs or cats and the studies look at one specific area in a particular shelter. There are a number of publications analysing some of the data from dog shelters, trying to identify the animal characteristics, euthanasia rates, behavioural concerns, looking at some of the common pathologies and its prevalence, reasons for relinquishment, characteristics of adoptability, shelter protocols and spay and neuter programs.

Three publications have been found where the authors are analysing intake data for small animal shelters: Marston et al. (2004), Marston et al. (2005) and Morris et al. (2011); but to date there are no publications found on any of the equine charities/shelters analysing their trend, income and major welfare concerns in the UK.

Marston et al. (2004) analysed 1 year data from three different Australian small animal shelters and the second part of the study, Marston et al. (2005) compares the three shelters. The study collected data and analysed it to identify the characteristics of the typical shelter dog; patterns of relinquishment, sales, reclamation and euthanasia; duration of stay, reasons for underlying euthanasia, relinquishment and post adoptive return. The second part of the study compares admission and outcome data in the three shelters where there are operational and philosophical differences with regards to euthanasia and type of animal admitted.

On the other hand, the study conducted by Morris et al. (2011) measures trends in small animal shelter intake and outcome data in rural and urban areas in Colorado, USA.

2.2.4.1. Animal characteristics and population in dog shelters

Marston (2004) found that the majority of canine admissions were strays and admissions in the shelter tend to be entire and small. The total population studies was 920,000 dogs with 18 animals shelters in 1 year. The author concluded that Desexing campaings were not reaching the owners of stray dogs and that targeted educational campaings may be required.

Most of the data of the study was obtained from paper records and the author explained that sometimes the records were incomplete missing information such as reasons for relinquishment, return or euthanasia. In the study, 20,729 admissions were recorded including characteristics of dogs admitted (admission type, age, size, gender, sexual status, outcomes and legal orders), length of time spent in shelter, reasons for relinquishment, reasons for euthanasia and reasons for postadoptive return.

2.2.4.2. Reasons for relinquishment in dog shelters

In the study done by Di Giacomo et al. (1998) in the USA and based on 38 interviews, canine behaviour problems, medical and accommodation reasons were the most common causes of relinquishments.

Accommodation, moving, financial pressures and lack of time were reported as major reasons in the study done by Salman et al. (1998) based on 3,676 cases. Di Giacomo et al. (1998) found that aggression was rarely given as a reason. Behavioural problems were cited as reasons in several studies, including hyperactivity, inappropriate chewing, elimination, and vocalization (Miller et al., 1996; Salman et al., 1998) and Arkow (1994) and Salman et al. (2000) cited behaviour as the primary reason for dog relinquishment in animal shelters in both of their studies.

Marston et al. (2004) found that the main reasons for relinquishment were: owners no longer willing to take care of them, other dogs were reported as strays by members of the public or by animal management officers and a small proportion of dogs were seized due to aggressive behaviour. The author also found that more dogs were admitted in the summer holiday months and that the most common reasons for relinquishment were owner related issues such as accommodation or moving, lack of time and owner health. In the UK, Ormerod (2012) reported that was estimated that every year, 140,000 people were forced to relinquish their pets when moving to care homes; creating a welfare issue for animals and people. Nowadays, many countries such as France, USA, Switzerland… have introduced laws to allow old people to keep their pets (Ormerod, 2012) which may help with some unnecessary relinquishments.

The next most common reason reported by Marston et al. (2004) was nonaggressive behaviour problems: escaping, hyperactivity and barking. There was a limitation reported by the author to the study, regarding finding the reasons for relinquishments or why a companion dog become strays; not all the reasons were recorded and that further research will be need it to clarify this.

However, New et al. (2000) and Neidhart and Boyd (2002) identified that dogs that were urinating and defecating in the house, were at a higher risk of relinquishment.

Giving the hypothesis that behaviour problems are best treated with prevention (Patronek, 1999); Herron et al. (2007) conducted a study looking at effects of preadoption counseling for owners on house-training and concluded that a brief counseling for owners enhances successful house- training of dogs.

2.2.4.3. Admission medical on arrival in shelter dogs

In the study done by Marston et al. (2004), all the dogs were examined on admission in the shelter for tags or microchips and in the case of strays the information was used to inform the owner that their dog was available from reclamation from the shelter.

After the mandatory holding period in that area to attempt to reunite the dog and owner; the dog would be owned by the shelter and assessed for sale using a behavioural and veterinary protocol. The relinquished dogs were assessed immediately and were euthanized or made available for sale.

2.2.4.4. Euthanasia rates and reasons in shelter dogs

It was reported by several authors (Patronek et al., 1995; Houpt et al., 1996; White and Shawhan, 1996) an estimation that as many as half of the dogs and cats in American shelters were euthanised every year. In the UK, Bailey (1992) also found that 33% of the relinquished dogs had conditions that could have been treated or corrected including behavioural or training problems.

Patronek et al. (1995) previously reported that about 38% of total admissions and 48% of relinquished dogs were euthanized, with owners requesting euthanasia in 17.2% of relinquishments; it was also reported that 18.8% of rehomed dogs were returned and half of those euthanised in the USA. Moulton et al. (1991) reported that 64% of relinquished dogs were euthanized (averaged over 4 years).

In the study done by Marston et al. (2004), 31.5% of the total shelter admissions were euthanized and one of the major concerns was the amount of healthy rehomeable dogs euthanized. 34.5% of all euthanasias were performed for health reasons, 24.1 % aggression and 9.6% behavioural issues. Entire, small and male dogs were more likely to be euthanized than female, desexed or larger dogs.

Marston et al. (2004) stated that encouraging early reclamation of dogs and modifying shelter procedures would enhance dog´s quality of life.

A more recent publication by Lund et al. (2010) looking at the attitudes towards euthanasia in Norway and Iceland concluded that there was a lack of statistical data on the reasons behind the owner’s decision to give away or euthanise their dogs and that many companion animals continue to be relinquished and euthanised worldwide each year.

On the other hand, the study conducted by Rogelberg et al. (2007) looked at the impact of euthanasia rates, euthanasia practices, and human resource practices on employee turnover in animal shelters and found that employee turnover rates were positively related to euthanasia rate. Practices mentioned in the paper that were linked to reduced turnover of employees were: provision of a designed euthanasia room, exclusion of other live animals from vicinity during the euthanasia and removal of euthanised animals from the room prior entry of other animal.

With regards to the veterinary profession and euthanasia; in the UK, the Royal college of Veterinary Surgeon's (RCVS) code of professional conduct states that the primary purpose of euthanasia is to relieve suffering (RCVS, 2020a).

These may include the extent and nature of the disease or injuries, treatment options, prognosis, quality of life, the likelihood of success of treatment, the animal's age and or other disease/health status and the ability of the owner to pay for private treatment (RCVS, 2020b).

In this last case, where there is inability of the client to pay for treatment the RCVS code of conduct indicates that it may be appropriate to make known the options for charitable assistance or referral for charitable treatment (RCVS, 2020b).

Moreover, the same code of practice states that no veterinary surgeon is obliged to kill a healthy animal unless required to do so under statutory powers as part of their conditions of employment (RCVS, 2020b); the same code states that euthanasia is not in law and act of a veterinary surgeon.

2.2.4.5. Re-homing or fostering small animals

Diesel et al. (2011) reported that some studies have shown that the time spent by dogs in kennels or a rehoming centre can be very stressful for a dog. Moreover, Beerda et al. (1997) stated that chronic stress can have a negative impact on health and behaviour.

Lister et al. (2011) identified respiratory and gastrointestinal signs on intake as risks factors for kittens and puppies that were delaying veterinary approval for adoption and concluded that prompt treatment may decrease length of stay in shelters.

2.2.4.6. Returning fostered dogs

Marston et al. (2004) reported that 7.2% of rehomed dogs were returned while Patronek et al. (1995) reported an 18.8 % in USA shelters. The author stated that an increased understanding of postadoptive returns will enable refinement of the assessment and matching process and possibly increase retention.

The main reason found in the study conducted by Marston et al. (2004) was due to owner related factors (moving or poor selection), dog related factors (size and health), and behaviour problems. These reasons contrast with the ones found at a study done by Neidhart and Boyd (2002) that found that the most common reasons given were that the dog did not get on with another pet or children and behavioural reasons.

The author concluded that improving the integration of new pets with an existing one, targeting the selection process and providing in-shelter rehabilitation might be effective venues for further research, as well as designing tracking programs for shelter dogs.

With regards to behaviour, Christensen et al. (2007) looked at aggressive behaviour on adopted dogs that passed a temperament test at their animal shelter and results suggested that the temperament test used failed to identify certain types of aggression and that efforts should be made to protect public health, taking into account shelter and foster behavioral evaluations combined with the test as well as offering pre and post adoption behavioral counseling for owners.

The study conducted by Martins Soto et al. (2005) looking at adoption for shelter dogs in a Brazilian community; assessed length of ownership, proportion of male and female dogs adopted and owner's characteristics. In this study, it was identified that 58% were males, mean ownership length was 14.8 months and of the adopted dogs, 40.9% lived with the owners, 34.9% had died, 15% were donated, 4.3% run away and 3.2% returned to a shelter. Although 57% reported no difficulties with the adoption, 23.1% stated that animal illness and death were the main difficulties. The author concluded that the results of the study motivate the town to design a new procedure for dog adoption in shelters.

On the other hand, Lord et al. (2014) conducted a study looking at the economic impacts of adoption and fundraising strategies in animal shelters in USA. Although the logical goal for animal shelter should be increasing the total number of animals adopted, their study concluded that increasing that number without increasing adoption fees and donations caused costs to increase faster than total revenues. Lord et al. (2014) also concluded that animal shelter managers should understand variable or animal related costs versus fixed costs and identify how they generate their revenue.

2.2.4.7. Differences in admission and outcome data when comparing shelters

The second part of the study done by Marston et al. (2005) was aimed to determine whether differences in admission and outcome data exist between shelters when these issues are constant. The study was looking at the admission characteristics of the dogs, length of stay and outcomes. The author stated that the identification of these may enable to establish "best practice" procedures and that the identification of reasons given for relinquishment between locations also may have policy and educational implications for animal control agencies.

The author aimed to characterize differences existing in canine admissions between shelters operating in a similar manner so that government can be informed by factors affecting shelter demographics. The authors collected descriptive data relating to the characteristics of the dogs admitted, patterns of admission, sale, reclamation and euthanasia, duration of stay, reasons for relinquishment, euthanasia, post adoptive return, and the outcomes for different types of admissions.

Marston et al. (2005) concluded that the results indicated that the sampled shelters have different strengths, being the suburban shelters preferred for relinquishment and adoption and better at integrating an adopted dog with existing pets while the rural shelters had a greatest success in reuniting stray dogs with their owner and appeared to filter effectively for the owner related factors that contributed to postadoptive returns.

The authors also concluded that there is a need of further analysis of the procedures used in each shelter to enable the formulation of best practice and benefit all the organizations as well as the need of analyzing dog admission data by municipal are to provide an insight into socioeconomic or cultural factors related to dog admissions. The relationship between relinquishment reason and location may enable to formulation of strategic educational interventions.

Morris et al. (2011) published a retrospective cohort study looking at a group of 104 animal shelters and rescue organizations from Colorado and its cat and dog intake. The authors analised annual intake data for trends in urban and rural shelters.

The authors concluded that the trends suggested that a number of unwanted dogs decreased whereas the unwanted cats increased. The study found that there were differences in trends between urban and rural data, suggesting different needs in each type of community. There was also found that the shelter dynamics for dog euthanasia have reached equilibrium and that transfers within all the regions were optimizing the chances for adoption.

2.3. Shelter medicine in equines

Although there are a large number of equine shelters around the UK and USA there are no many publications reporting their intake and outcome data.

Holcomb et al. (2010) reported the characteristics of relinquishing and adoptive owners of horses associated with US Nonprofit Equine Rescue Organizations, the author stated that nonprofit equine rescue organizations in the United States provide care for relinquished horses and may offer adoption programs. An “unwanted” 100,000 horses per year was estimated and the need of minimizing the number of unwanted horses and maximizing their successful transition to new caregivers was raised.

In order to find out the characteristics of the relinquishing and adoptive owners, a survey was completed in 37 states and 144 organizations. A total of 280 horses were relinquished between 2006 and 2009 and 73 were adopted.

The study found out that the majority of relinquishing owners were women, whereas adoptive owners were primary families or couples. Most relinquished owners had previous equine experience and had owned the horse for 1 to 5 years; about half owned other horse ad three quarters of the adoptive owners possessed additional horses housed on their property. These findings were thought that will serve to help develop effective education programs for responsible horse ownership and optimized acceptance criteria and successful adoption strategies of horses.

A much more recent study conducted by Rosanowski and Verheyen (2019) looked at factors associated with rehoming and time until rehoming for horses listed in an equine charity in the UK. One of the factors directly affecting time of rehoming was whether horses were suitable to be ridden by an experience rider or not; those able to be ridden by beginners were rehomed sooner than those requiring an advance rider.

Those horses were ownership was to be transferred were reported to be nearly three times more likely to be rehomed sooner than those that were only on loan. The authors also reported that it took longer to rehomed horses that were only suitable to be rehomed as pets and not to be ridden than those suitable for ridding. Lastly, the authors found that if there was a limited radius for rehoming the process was significantly longer.

Rosanowski and Verheyen (2019) concluded that these findings could be used to improve rehoming strategies by the charity.

2.4. Donkey shelters/ UK charities

2.4.1. Type of equine charities, location and cost

There are a number of equine charities based in the UK caring for donkeys and other equines (Tables 2.1, 2.2 and 2.3). Information in Table 2.1 was gathered and compiled by searching on the different charities websites.

Table 2.1. List of equine charities based in the UK

Name	Founded year	Base location
The Donkey Sanctuary (In: www.thedonkeysanctuary.org.uk)	1969	UK based Working in Europe and overseas
RSPCA (In: www.RSPCA.org.uk)	1824	UK location/ international work
World animal protections (WAP) (In: www.worldanimalprotection.org.uk)	1950 WFPA 1959 ISPA 1981 WSPA 2014 WAP	Animals in the wild, working animals, animals in communities, farming animals and animals in disasters
The Brooke Hospital for animals (In: www.thebrooked.org)	1934	International/ office in London Overseas: Africa, Asia and Latin America
Redwings (In: www.redwings.org.uk)	1984	Norfolk

Table 2.1 (cont). List of equine charities based in the UK

Name	Founded year	Base location
SPANA (Society for the protection of animals) (In: spana.org)	1923	London/ international North Africa and middle East
Bransby Horses (In: bransbyhorses.co.uk)	1968	Bransby, Lincoln (UK)
Raystede Centre for animal Welfare (In: www.raystede.org)	1952	Ringmer, East Sussex
Horse world Trust (In: www.horseworld.org.uk)	1952	Withchurh, Bristol
Safe Haven for Donkeys in the Holy Land (In: www.safehaven4donkeys.org)	2000	Israel and Palestinian territories
Friends of animals (In: www.friendsoftheanimals.co.uk)	1990	Warwickshire
The Langford Trust for animal health and welfare (In: langfordtrust.org)	1990	Bristol University
Isle Wight Donkey Sanctuary (In: www.iowdonkeysanctuary.org)	1987	Isle of Wight
Animal care in Egypt (In: www.ace-egypt.org.uk)	2000	Cambrisdgeshire
Island farm Donkey Sanctuary (In: www.donkeyrescue.co.uk)	2007	Oxfordshire
The Gambia horse and donkey trust (In: www.gambiahorseanddonkey.org.uk)	2002	UK based, but working in aiming to reduce rural poverty in Gambia by increasing the productivity of the working equines
The horse rescue fund (In: www.horserescuefund.org.uk)	-	Suffolk (UK)
Horse, pony and Donkey Sanctuary (Devon) and SW (In: dhaps.org.uk)	1980	Newton Abbot (UK)
Samboure Donkey Sanctuary (In: www.charitychoice.co.uk)	1994	Nr Studley Worcestershire (UK)
The Hillside animal Sanctuary (In: www.hillside.org.uk)	1995	-

Table 2.2. Activity of the equine charities based in the UK

Name	Number and type of animals reached	Number of sanctuaries/hospitals
The Donkey Sanctuary	Over 16,500 donkeys and mules UK, Ireland and mainland Europe	27 projects
RSPCA	Oldest charity in the UK	3 RSPCA equine-specific centres

Table 2.2 (cont). Activity of the equine charities based in the UK

Name	**Number and type of animals reached**	**Number of sanctuaries/hospitals**
World animal protections	Over 12,000 working donkeys and mules treated in 2014	
The Brooke Hospital for animals	Mules, donkeys and horses	Working in 11 countries
Redwings	1,300 horses, ponies, donkeys and mules	5 farms, 1 hospital
SPANA (Society for the protection of animals)	400,000 working animals (donkeys and horses)	19 animal hospitals
Bransby Horses	Home to around 400 horses, ponies, donkeys and mules. 10 resident donkeys	Two rescue centres It has reported to re-home hundreds of animals
Raystede Centre for animal Welfare	Over 1,500 animals/year 10 resident donkeys	Permanent home/sanctuary
Horse world Trust	Rescue, rehabilitate and re-homes horses, ponies and donkeys in need	140 horses, ponies and donkeys and over 300 in homes in the Southwest
Safe Haven for Donkeys in the Holy Land	Working and abandoned donkeys 600 working donkeys, mules and horses/week	Sanctuary in Israel: 148 donkeys Free veterinary care
Friends of animals	Rehoming and voluntary driving service	Veterinary treatments and working with dogs, cats, horses, donkeys, farm animals, wildlife and birds 480 animals at a rented land
The Langford Trust for animal health and welfare	-	Promoting the practice, advancement and teaching of veterinary science
Isle Wight Donkey Sanctuary	-	Sanctuary, permanent home
Animal care in Egypt	Communities and welfare on working donkeys and horses	Donkey and horse center in Egypt
Island farm Donkey Sanctuary	Elderly, ill treated and abused donkeys	100 rehomed 100 at the sanctuary
The Gambia horse and donkey trust	-	Basic veterinary treatment and have mobile clinics and hospital facilities at their centre

Table 2.2 (cont). Activity of the equine charities based in the UK

Name	Number and type of animals reached	Number of sanctuaries/hospitals
The horse rescue fund	Rescue, rehabilitate and rehome needy horses, ponies and donkeys	Around 100 horses, donkeys and ponies in adoptive homes and an unreported number at their base
Horse, pony and Donkey Sanctuary (Devon) and SW		-
Samboure Donkey Sanctuary	--	-
The Hillside animal Sanctuary	Rescued from farming industry	Home for over 300 horses, ponies, donkeys and mules

Table 2.3. Equine charities 3-years income (2012-2014)

	Total income		
Name	2012	2013	2014
The Donkey Sanctuary	£32,221,000	£30,722,000	-
RSPCA	-	£121,200,00	£125,900,000
World animal protections	£24,991,000	£27,892,000	-
The Brooke Hospital for animals	-	£15,804,555	£17,730,533
Redwings	£9,819,084	£9,963,178	-
SPANA (Society for the protection of animals)	£4,434,441	£5,974,785	-
Bransby Horses	£4,426,383	£3,723,025	-
Raystede Centre for animal Welfare	-	£2,088,311	£1,361,607
Horse world Trust	£1,059,552	£1,174,539	-
Safe Haven for Donkeys in the Holy Land	£570,861	-	-
Friends of animals	£521,731	£428,036	-
The Langford Trust for animal health and welfare	£423,007	£352,831	-
Isle Wight Donkey Sanctuary	£243,225	£376,153	-
Animal care in Egypt	£212,405	£220,017	-
Island farm Donkey Sanctuary	-	£141,510	£161,254
The Gambia horse and donkey trust	-	£105,655	£122,904
The horse rescue fund	-	£104,441	£115,118
Horse, pony and Donkey Sanctuary (Devon) and SW	£79,077	£161,988	-
Samboure Donkey Sanctuary	-	£12,469	£3,019
The Hillside animal Sanctuary	-	-	-

2.5. Equine welfare situation in the UK

2.5.1. Legislation

The National Equine Welfare Council (NEWC) has been responsible of the publication of a variety of advisory publications on key equine welfare matter, including the Code of Practice for Welfare Organisations involved in the keeping of horses, ponies and donkeys, the Code of Practice for Markets and Sales involved with selling of horses, ponies and donkeys and a Code of Practice for Tethering Equines. In 2002, the first edition of the Equine Industry Welfare Guidelines Compendium for Horses, Ponies and Donkeys was published; second edition was produces in 2005 in response to changes in the UK and EU legislations. Third edition was produced in 2009 in response to the arrival of the Animal Welfare Act 2006 and the Animal Health and Welfare (Scotland) Act 2006.

2.5.2. Equine welfare sector

In 2012, with the collaboration of a number of equine charities a report was produced to discuss the approaching equine crisis in England and Wales. It was reported that all of the major equine rescue ad rehoming organisations in England and Wales were under immense pressure due to the increasing number of horses, ponies needing their help. It was estimated that the welfare of 6,000 horses were at risk, with over 2,800 horses already in charity centers. There was a reason to believe that the equine welfare charities needed to make it clear that there was a need for public, government agencies and local authorities support.

Equine charities reported that in 2012, the number of horses being cared for had increased significantly over the past 5 years. World Horse Welfare had seen 50% rise in the number of horses taken into its centers since 2006. Redwings had a 28% increase in equines being taken in from 2006 to 2011; including a record 303 in 2009. The RSPCA took in more than twice the number of horses, 304, in the April to May 2011/2012 period as it did the corresponding period the previous year.

Horseman et al. (2016) published a 4-year research study highlighting the four priority welfare challenges facing horses in England and Wales, which were the following:

- *Unresolved stress/pain behavior*: the research findings suggested that this is compromised because behavioral indicators of stress and/or pain exhibited by horses often go unrecognized, or are ignored or dealt inappropriately by those caring for horses.
- *Inappropriate nutrition*: fed either the wrong type of food and or the wrong amount, resulting in negative physical and physiological effects. Overfeeding was reported to be a particular concern due to the number of horses affected by it and because it is a risk factor for other welfare compromising issues including laminitis.

- *Inappropriate stabling/turn out*: it has been reported not to be meeting their individual needs, or because they are kept in social isolation or exposed to inappropriate grazing conditions.
- *Delay death*: the research reported that the delay of the euthanasia of horses that have poor quality of life results in welfare com promise for horses in England and Wales. Furthermore, it was reported to be a perception that horses that become a low value and/or unwanted, perhaps due to physical or physiological problems, may be at risk of poor welfare if owners choose to sell them on rather than having them killed.

The research study also reported that the lack of knowledge on the part of the horse-owner and a lack of clear, consistent advice were both fundamental roots for poor welfare.

2.5.2.1. Space and rehoming

Horse charities reported a limited scope to act as they were running out of space in 2012 (RSPCA et al., 2012). Many organisations had to restrict admission for the previous 3 years due to lack of resources. The National Equine Welfare Council, which has more than 40 members who keep horses, estimated that the total number of spaces in these organisations was 2,800 in 2011, but less than 3% were available in 2012 (RSPCA et al., 2012).

Priority was given to welfare cases with many horses kept in private boarding, increasing costs and making it unsustainable. Some horses had to be directed to other equine charities or kept in situ for field staff to work with their owners to improve conditions.

The report described that despite of the increased number of rehomed horses, this alone was not thought to create enough space in the centers to take all horses in need (World Horse Welfare, 2012).

2.5.2.2. Factors influencing the equine crisis

The following factors to the equine crisis were described as part of the 2012 report compiled by different equine charities in the UK (RSPCA et al., 2012).

2.5.2.2.1. Overbreeding

The population of horses was estimated to be under one million (2012) and the vast majority of these were reported to be own privately for leisure (British Equine Trade Association Survey, 2011) being this one the most unregulated sector of the horses, unlike, those bred for horse racing.

The equine charities reported that irresponsible dealers were the heart of the problems in the equine market. Dealers were reported to still buying, breeding and importing horses but as the market had become saturated prices of ponies and horses had crashed. Animals were reported to be fund at sales for 5 pounds and still remain unsold.

Some owners were still believed that can still making profit from breeding horses. Prices of animas had dropped significantly. There was a problem for horse owners to rehome unwanted horses and also difficult to even given them away.

Horses have been also bred from hobby breeders; foals produced were often produced from poor stock and had little use or sale value, becoming welfare concerns if they were not kept by the owners (RSPCA et al., 2012).

2.5.2.2.2. Exporting and importing

Irresponsible dealers have been reported to also import and export horses from France and Ireland under the Tripartite Agreement which allows free movement of horses between these countries. But sales at the continent have also been depressed, so dealers had been left with more horses being supplied than there is demand (RSPCA et al., 2012).

2.5.2.2.3. Illegal grazing

There is estimated that one dealer alone had 2,000-3,000 horses fly grazing on public or private land without permission; this practice was reported to be common across England and Wales especially among the travelling or gipsy community. Fly grazing was reported to become a problem for landowners and local authorities and in some cases posing a risk to the public. This can also lead to welfare problems if the owner was no longer caring for the animals and animals sometimes were left to fend for themselves. These horses were also continuing to breed despite of being no market for them (RSPCA et al., 2012).

This situation puts pressure on the local authority, who may have no choice but to euthanize certain groups of horses if charities were unable to take them (RSPCA et al., 2012)

2.5.2.2.4. Where do the horses end up?

Some of those horses were reported to end in the meat trade. In 2012, there were five abattoirs operating in the UK and those horses with welfare problems were reported to end up in equine charities (RSPCA et al., 2012). Lees and Toutain (2013) reported that in the European Union in 2008 the known horse meat consumption was 96,000 tonnes, comprising 0.2% of the total meat consumption. The countries reported with a higher consumption were Italy and France. Some horses are excluded from human consumption with all medical treatments recorded in their passport; there is a section designed to be signed to indicate if they are not intended for human consumption and this is a legal responsibility under UK Horse Passport regulations (Lees and Toutain, 2013).

In the RCVS code of professional conduct 29.12 (RCVS, 2020c) is stated that veterinary surgeons must declare on the equine's passport, prior treatment, whether the medication to be administered would establish the equine's status as not intended, or intended, for human consumption. Failing to do so is considered to be a criminal offence, unless the owner or keeper has failed to produce the passport when requested. It is permissible for a veterinary surgeon in that case to provide the client with a form identifying the equine, stating the medication administered and advising the client that they need to contact the passport issuing office for a new passport (RCVS, 2020c).

2.5.2.2.5. Economics

In 2012, it was reported that the continued poor economic climate has meant that horses that can cost up to £ 100 per week to look after, are suffering. Horse owners were cutting costs by reducing veterinary checks and organisations reported hoof and worm problems (RSPCA et al., 2012).

2.5.2.3. Proposed solutions to the equine crisis

The charities thought that the situations were likely to get worse before getting better and it was thought that a holistic approach was need it to tackle the root cause of the horse overpopulation (RSPCA et al., 2012):

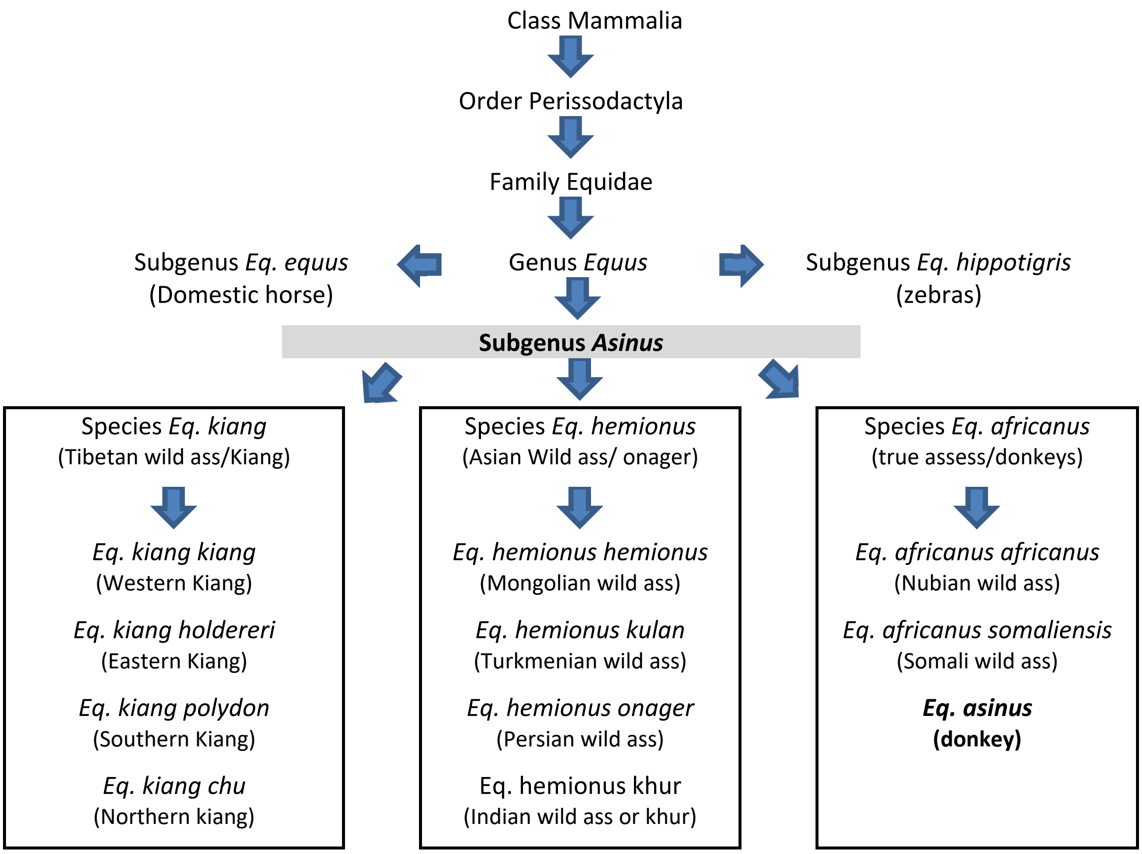
1. Criminal legislation to target fly grazers.
2. A better link between horses and their owners. A NED was considered a critical tool by the charities for enforcement, and a solution is thought to be needed to fund it.
3. Education, the charities advised that guidance should be given for when not to breed from a horse. The charities also advised that Government communication channels should be also used to discourage members of the public from breeding horses.
4. Help land owners resolve fly grazing cases quickly and punish fly grazers with fines and seizure of horses. The charities suggested that when difficult to link horses with owners (no microchip or branded), legislation should be amended to allow local authorities and landowners to seize and assume ownership of any horses left in their land.
5. Sharing best practice by liaising with the travelling community to stem fly grazing and tethering.
6. Improving enforcement, using best practice on improving coordination between the enforcement agencies, particularly for multiple horse cases involving dealers.
7. Governments to look at the tripartite agreement.
8. More assistance to help local authorities to enforce passport regulations.

9. Making sure the horse owner public recognise the crisis, the charities opinion is that they can play an important role in alleviating the crisis by rehoming horses and ponies from the charities and not breeding from their own horses.
10. Production o guidance notes for land owners to explain what they can do if horses are left on their land.

2.6. The donkey

Donkeys are deserted-adapted animals (Matthews and Taylor, 2000), North Africa has been found to be the most likely location of evolution of the domestic donkey (Beja-Pereira et al., 2004). Donkeys are believed to be first domesticated 5,000 years ago, although the location of this domestication is still unknown (Beja-Pereira et al., 2004). Donkeys, horses and zebras share a common extinct ancestor, *Dinohippus*. Over time, the *Equus* genus began evolving into its own species and subspecies. There are currently three species of the subgenus *Equus asinus* (Figure 2.4), each with a number of subspecies are currently recognized, that make up the large population of donkeys around the world (Du Toit, 2008).

Figure 2.4. Donkey phylogenetic tree



There are estimated to be 44 million donkeys in the world, almost all of which are maintained for work (Starkey and Starkey, 2004). Over 96% of world population are found in “developing “countries; China has the highest population followed by Ethiopia with the most common role is transport. Donkeys have been declining in numbers and importance in industrialised countries. From a worldwide perspective, only a small number of donkeys are kept specifically for breeding, showing, companionship or for guarding sheep (Starkey and Starkey, 1997).

In Europe a new growing interest for donkey milk has been reported mainly for human consumption but also for beauty products (Camillo et al., 2018).

Worldwide, there is a current crisis-affecting donkey’s welfare as demands for their skin meat and milk have grown for these animals, especially in China; donkey skin is used to produce a product called “Ejiao” which is extensively used in traditional Chinese medicine. Due to increased demands for this product, population of donkeys in China has decreased enormously. Illegal trading with other countries, in places such as Africa or South America has affected the livelihoods of people who need donkeys on day-to-day bases to earn their living and even affecting the economic stability of these countries. Donkey farming is also a growing industry and has a serious impact on donkey welfare, as it is often unregulated. Skin trade is also a global biosecurity hazard which could have a serious impact on the global equine population; donkeys are transported in large mixed groups, without health checks; moreover, donkeys are slaughter often without ante-mortem inspection and skins are stored and transport in unhygienic conditions (The Donkey Sanctuary, 2017; 2019).

2.7. The donkey in the UK

Cox et al. (2010) published that in 2010 the UK donkey population was believed to number at least 8,900 (National Equine Database, 2008). Although, there are no accurate figures of the current number of donkeys, Department of Environment, Food and Rural Affairs (DEFRA) estimates there are around 10,000 donkeys in the UK. A new method was introduced which could have helped to get a better idea and a census of the Equidae including donkey population in 2004. UK Equine (horses, ponies and donkeys) owners are required to obtain a passport for every equine they own since the horse passports (England) regulations 2004. The passport issuing offices were legally obliged to supply data to NED each month but since DEFRA´s contract with the National Database Ltd finished at the end of September 2012, NED services are no longer available. The British Equestrian federation stated in 2014 that with more than 75 passport issuing organisations and no central database, finding an equine owner and enforcing the regulations was effectively impossible.

Cox et al. (2010) reported that the NED estimated that there were 8,954 donkeys in the UK in March 2007, of which approximately 40% were owned by TDS, South West England. The next most populated region, with 1,011 donkeys, was reported to be the North West of England.

2.7.1. Use of the donkey in the UK

Most donkeys have been reported to be kept as companion animals or perform a low level exercise such as working on beaches/for children's riding or as therapy animals (Thiemann et al., 2018).

2.7.1.1. Breeding

There is not a lot of information specifically found regarding breeding donkeys in the UK; problems of overbreeding have been reported regarding horses and ponies and TDS encourage owners to breed responsibly although there is still a large number of mature stallions being relinquished to the charity.

There are 17 different breeds currently known in Europe (The Donkey Sanctuary, 2020g) with no specific UK donkey breeds reported. Squance (1997) tried to compile information regarding the European domesticated donkey breeds and stated the difficulties finding the information, the author reported then the following 16 breeds:

- France (5): Grand Noir Du Berry, Provence, Pryrennes, Normandy and Cotentin.
- Spain (4): Catalan, Mallorquin, Zamorano-Leones and Andalucian.
- Italy (7): Martina Franca, Ragusa, Pantelleria, Amiata, Asinara, Sardinian and Miniature Mediterranean donkey.

Camac (1997) reported that TDS was asked to help saving a rare breed from France from extinction, which was the Poitou donkey.

There is a charitable association in the UK called The Donkey Breed Society, which aims include to preserve and improve the standard of Donkeys by breeding (The Donkey Breed Society, 2020).

2.7.1.2. Keeping

The majority of donkeys in the UK are believed to be kept as pets or companions for other animals although there were thought to be approximately around 900 donkeys (in 2013) working in the UK beaches, especially at Weston super mare, Skegness, Scarborough and Blackpool.

In the study done by Cox et al. (2010) found that 92% of the fostered donkeys (Donkey Sanctuary owned) were used as pets, 38% as companions for other animals, 13% were used for walking, 7% there were used to be ridden, 3% they were used for driving, 1% for shows and the rest, in other uses including: draught, education/therapy, church processions, grass cutting/manure, animal sanctuary. Almost all the donkeys reported (99%) lived with a companion animal, most commonly another donkey (1,043 cases); other companions included horses (30) and goats or sheep (9). Only 13 donkeys (of 1,108 for which data were available) lived alone; the companion of live of these had recently died.

In a recent study done by Grint et al. (2015) it was found that the majority of the donkeys were kept with a companion (45.2%) or in a herd of three or more donkeys (45.2%). The study conducted by Murray et al. (2013) concluded that there is evidence of pair-bond formation and companionship among donkeys and that these have potential implications in their management, husbandry and welfare.

In the study Grint et al. (2015) received 93 questionnaires from donkey owners and it was thought that the demographics of the respondents were very similar to those of the Donkey Breed Society (DBS) overall membership. The study also identified that median (range) duration for a respondent to have owned a donkey was 15 (0.5-60) years. The median number of donkeys owned by each respondent was 3 (1-50). Grint et al. (2015) also identified that the majority of donkeys were kept with a companion (45.2% of respondent) or in a herd of three or more donkeys (45.2% of the respondent). Interestingly, in the same study, 57.6% of the owners that took part in the study had undertaken training courses and 96.8% read literature to develop their donkey knowledge.

2.7.1.3. Sale

Nowadays, donkeys in the UK can be bought from different sources. Donkeys can be bought from dealers, private owners and by social media.

The Consumer Rights Act (2015) states that If the donkey/s are bought via dealer implies certain conditions of sale as statutory rights. These are (The Donkey Sanctuary, 2020h):

- The donkey must be of ‘reasonable’ or ‘satisfactory’ quality – for instance, free of defects such as lameness – unless you have prior knowledge and accept the condition.
- The donkey must be fit for the purpose for which it was generally sold, or any purpose made known at the time of the agreement.
- The donkey must be ‘as described’. If your new 6-months old turns out to be an early-weaned 4-months old, as well as being a welfare concern, it is a breach of trading standards.

If one or all of these criteria are not met, the new owner will be entitled to a full refund or the difference in value between the donkey they thought they were buying and the one they got.

2.7.1.4. Disposal

If an animal dies or has to be put down in any type of premises, disposal must be arranged by the owner under animal by-products (ABPs) controls (DEFRA, 2020b).

This includes: entire animal bodies, parts of animals, products of animal origin and other products obtained from animals that are not for human consumption.

Dealing with ABPs must be done promptly to protect people, animals and the environment. In most cases, this will mean arranging for them to be taken away to approved premises, like rendering plants, incinerators, collection centres and storage plants (DEFRA, 2020b).

2.7.2. Donkey health and welfare concerns in the UK

It has been reported by Thiemann et al. (2018) that over one year 2015-2016 (for example) TDS recorded 87 incidents requiring complex welfare investigations of which 14 were severe enough to consider prosecution. Many of these cases required multi-agency collaboration with other equine charities and local authorities and relied upon the evidence of welfare officers and vets.

The detection of sickness or disease in the UK donkey can be made more difficult by it stoical nature (Duffield et al., 2008) being dullness and depression the only symptoms exhibited; and those ones have been identified as indicators of pain in the donkey (Thiemann, 2013). Dullness and inappetance have been described as the most common presenting signs of disease in the donkey (Burden et al., 2013).

Unfortunately, identifying the dull donkey is commonly delayed among donkey owners and carers for the following reasons (Thiemann, 2013):

- Lack of recognition of the donkey’s normal subtle behavioural repertoire.
- Many donkeys have a low work load/companion animal status, early signs are frequently overlooked.
- Owner and management factors: many donkeys are kept until they are geriatric and it can be hard to distinguished between the normal aging process and a genuine dull/sick donkey.

Although donkey owners seem to be concerned about the welfare of their animals, there may be incorrect or inadequate recognition of some health problems (Cox et al., 2010).

The causes of dullness were reviewed in TDS population, in a survey done by Duffield et al. (2002): colic, hyperlipaemia, respiratory disease, lameness and liver disease were found the most common causes of dullness in the donkey. Dullness has also been reported as the most common clinical signs noted for many severe and life-threatening conditions in the donkeys (Thiemann et al., 2018).

2.7.2.1. Obesity

Obesity is a great welfare concern in equines in the UK, including donkeys and mules. Donkey owners are likely to overfed them or keep them on inappropriate hyper caloric diets. This will increase the risk of several diseases, becoming especially worrying at the time of the relinquishment to TDS, when we are planning to change the environment and transport the donkeys. Transport has been seen to be a stressful factor, which will increase the chances of donkeys developing different conditions. Some of these conditions might be associated to the stress of the transport, such as acute bouts of laminitis, hyperlipaemia or colitis. Owners are frequently unaware of the problem and would not classify obesity as a disease. Moreover, Burden and Thiemann (2015) stated that when living as companion animals, donkeys easily accumulated adipose tissue, creating a metabolically compromised individual prone to diseases of excess such as laminitis and hyperlipaemia.

Mendoza et al. (2018) also reported that metabolic and endocrine disturbances are common in donkeys. The author also stated that donkeys are extremely efficient in energy storage and mobilization which predisposes to hyperlipaemia, obesity and metabolic syndrome. Mendoza et al. (2019) reported the donkey's ability to accumulate adipose tissue even when having access to poor quality diets.

Inappropriate feeding could be leading to the exacerbation of some of the conditions that donkeys are prone to develop such as laminitis, gastric ulceration, hyperlipaemia and fatty liver (Burden, 2012).

Cox et al. (2010) published a paper identifying some of the most common health problems in the UK donkey population. It was concluded that approximately one-third of the donkeys in the study were overweight. Obesity has also been previously described as a common problem in UK donkeys (Trawford and Crane, 1995) causing a significant welfare problem and predisposing to a number of diseases (Morrow et al., 2011). It was also found that obese donkeys have higher insulin values which were associated with history of laminitis (Du Toit et al., 2010).

Burden et al. (2013) also summarized that the major problems facing donkeys in the UK were obesity (Cox et al., 2010) and health conditions associated with it, including laminitis (Morrow et al., 2011), equine metabolic syndrome (Du Toit et al., 2010) and a predisposition to hyperlipaemia (Burden et al., 2011).

Donkeys require low energy feeds so they can satisfy their natural appetite without becoming obese (Burden, 2011). One of the problems is that owners still see the donkeys as a small horse and extrapolate the requirements from them which conclude in overestimating their requirements.

The Donkey Sanctuary has found that body condition scoring and weight estimation is essential in donkey husbandry, not only for the general condition but as a health indicator and has developed a body scoring system for donkeys (Burden, 2011).

Burden and Thiemann (2015) stated that one of the first signs of deterioration of health is a gradual loss of weight while weight gain is easier to deal with if notice early; however, body condition scoring for donkeys requires a different technique than in horses and fat deposits are located in different areas. Body condition scoring is a manual technique as donkey's coat can mislead into wrong condition scoring estimation as naturally the donkeys coat is very thick and the technique used in donkeys and mules is different to the one used in horses (Burden, 2011).

2.7.2.2. Hyperlipaemia

Hyperlipaemia is a common life threatening disease in the donkey; described as a complex metabolic disturbance, which may accompany any other disease of the donkey (Burden and Thiemann, 2015). The risk factors that have been identified are the following (Grove et al., 2008):

- Body condition: being the prevalence of the disease higher in fat and obese donkeys than in thin animals.
- Stress: donkeys are more susceptible to hyperlipaemia at times of stress, such as transportation or changes in environment, management or their social group.
- Age: younger animals are less prone to the disease than animals over 10 years.
- Late pregnancy and early lactation.
- Concurrent disease: PPID, laminitis, chronic renal failure, gastro intestinal disease, hepatopathy, dental disease, endotoxaemia and neoplasia.

One of the main concerns at the time of the relinquishment is the risk of the donkey developing hyperlipaemia in the first 6 weeks of arrival while still on the isolation period. This has been usually observed after two weeks of transportation and change of environment. Owners would be made aware of the higher risk. The quality of life of elderly animals would be assessed carefully before transport is arranged between the vet, welfare adviser and owner.

The management of a new arrival donkey would remain the same as what they had at home unless this is directly affecting their welfare, in order to avoid further changes and stress. Stress would be limited as much as possible and a blood sample would be taken after a week of arrival to monitor triglycerides levels. Prevention through reduction of stress and maintenance of appetite has been reported to be very important (Burden and Thiemann, 2015).

Donkeys would be monitored closely especially for signs of dullness and innapetence. Burden and Thiemann (2015) stated that avoidance of hyperlipaemia is imperative in the dull donkey.

Owners with considered high risk animals would be informed and all the options would be discussed with the owner and welfare adviser before deciding the movement.

Hyperlipaemia has been described to be common in donkeys (Thiemann, 2013), especially secondary to another clinical issues (72% cases in one study) (Burden and Thiemann, 2015). Mendoza et al., 2019 also reported that hyperlipaemia was usually secondary to other conditions. Prevalence has been reported to be 3-5% in the field population and 11-18% in hospitalised donkeys (Burden et al., 2011) having a high mortality rate, commonly quoted as 60 to 100% (Hammond, 2004) and 80% by Burden et al. (2011).

In the study done by Burden et al. (2011) in TDS population (3,829 donkeys) mortality was found to be 48.5%; the study showed that this population of donkeys often develops hyperlipaemia, particularly in response to stress or primary illness. Certain animals were found to have higher risk of developing hyperlipaemia, including pregnant and lactating females with high energy demands, obese individuals with insulin insensitivity, geriatric donkeys and those with poor dentition (Burden et al., 2011); and those would be considered carefully when being relinquished to TDS.

Harrison and Rickards (2018) stated that many cases are management related and therefore preventable. Client education regarding donkey's subtle changes in behaviour, specific nutritional requirements, and preventative care such as dental interventions will go a long way in reducing the incidence of hyperlipaemia (Harrison and Rickards, 2018).

2.7.2.3. Dental disease

Dental disorders have been recognized as having major clinical and welfare implications in donkeys (Du Toit et al., 2008). Du Toit et al. (2008) reported a high prevalence of dental disease of 93.4% in the study conducted in 349 aged donkeys. The authors also found an association between colic and the presence of cheek teeth diastemata.

Moreover, dental disease can be commonly found in donkeys in the UK and those living at TDS, especially in those older than 15 years old (Du Toit et al., 2009). Healthy, young donkeys own by TDS would receive regular preventive dental treatments at least once a year and geriatric donkeys or those with specific dental abnormalities would receive treatments as often as need it. Fostered donkeys would also be under the same protocol and external equine dental technicians or veterinarians would be providing dental routine treatments.

British Equine Dental Technicians (BEDTs) are suitable qualified professionals who are legally allowed to examine and evaluate equine mouths and allowed treatments include routine checks and rasping, any other procedures must be carried out by a veterinarian (following current dental regulations) (The British Horse Society, 2020)

The most common health problems found in the study done by Cox et al. (2010) were hoof, dental and oral problems in TDS fostered population. A total of 86% of donkeys in the study had a dental examination at least every 12 months, and at least 45% had at least one dental problem.

Dental disease has been reported to be very common in donkeys in the UK, with a prevalence of 73% having been observed in a population of donkeys with a median age of 23 years (Du Toit et al., 2009), Burden et al. (2013) described dental disease as a large welfare issue in donkeys with many donkeys having neglected mouths resulting in severe pain. One of the problems, is that early-stage dental-related clinical signs are often missed and routine dental care is not initiated (Burden et al., 2013) and that donkey owners may not realise the importance of regular dentistry in an equine that is not ridden, but severe abnormalities may be seen, especially in animals over 15 years of age (Du Toit et al., 2009).

Dental problems were reported in 45% of the donkeys; however, a significant proportion of the respondents were unable to identify specific problems. Therefore, Cox et al. (2010) concluded that the prevalence of dental disease may be underestimated in the UK population, since the occurrence of specific dental problems was unknown for a large proportion of donkeys.

The presence of dental diastemata in aged donkeys has been shown to be associated with colic as a cause of death (Du Toit et al., 2008) and donkeys from older aged groups were more likely to have dental disease, poor body condition score and suffered from previous colic episodes. The presence of dental disease has been also found to be associated to weight loss, colic, low body condition score and need for supplemental feeding (Du Toit et al., 2009).

Burden and Thiemann (2015) reported that clinicians challenge was to ensure that owners recognize the importance of regular dental care, and appropriate treatment, analgesia and that dietary management changes are made for donkeys with dental disease.

The Donkey Sanctuary developed a donkey grading system for assessing and monitoring welfare in donkeys; Thiemann et al. (2018) described dental disease as a major cause of poor welfare in donkeys. Table 2.4 describes the dental grades from 1 to 5 (Dacre, 2005; O’Klugh, 2005; Lilly, 2015).

Table 2.4. Dental grading system (Lilly, 2015)

Score	Label	Descriptors	Picture reference
1	Good dental health	Normal dentition for age, presence of minor to moderate sharp enamel points. Presence of deciduous caps, or other normal dental anatomy such as small focal hyper eruptions at 1/203 in a seven year old for example etc.	
2	Minor pathology	Minor overgrowths. Mild brachygnathia/prognathia (where the incisors still have some occlusion and with no ventral deviation of the premaxillae). Grade 1 caries. Individual accentuated transverse ridging, small focal overgrowths (under 4mm) affecting single teeth.	
3	Moderate pathology	Periodontal disease (grades 1-2), Grade 2 caries, diastema, large overgrowths (over 4mm) and / or affecting multiple teeth/whole mouth i.e. wave complex, displacements, moderately over-floated part mouth i.e. excessive reduction of lateral cingulae in some/all maxillary cheek teeth.	
4	Severe pathology	Periodontal disease (G3) soft tissue lesions, grade 3 caries, small localised epulis, loose/fractured teeth, severe overgrowths, frothy saliva, pain on palpation, severely over-floated whole or part mouth i.e. clinically unjustified reductions of the transverse ridging, grossly over-floating rostral premolars.	

Table 2.4 (cont). Dental grading system (Lilly, 2015)

Score	Label	Descriptors	Picture reference
5	Very severe pathology	Dysmastication, abscessation, severe periodontal disease (G4), Grade 4 caries, chronic and or severe soft tissue lesions, large epulis, frothy saliva, pain on palpation, equine odontoclastic tooth resorption and hypercementosis (EOTRH), grossly overfloated whole or part mouth, dysplastic teeth, apical disease (abscess and or apical periodontitis)	

2.7.2.4. Colic

The typical equine clinical signs of colic in the horse are rarely recognized in the donkey (Thiemann, 2013), as the signs can be regarded as non-specific, it is vital that donkeys presenting minor signs, such as: lying down, general depressed demeanour and refusal to eat, are given a full clinical examination. There is still a believe among some equine vets that rectal examination is not possible in donkeys and early signs of impaction or other types of colic might be missed. A rectal examination should always be carried out (Duffield, 2008).

Impaction colic has been previously identified as responsible for over half the colic episodes seen in UK donkeys at TDS in an aged population of donkeys (mean age of the population at the time of the study of approximately 25 years) (Duffield et al., 2002). An increased frequency of dental disease in donkeys that died or were euthanized supported the hypothesis that dental disease may be a risk factor for impaction colic (Pinchbeck et al., 2006).

The incidence of impaction colic in donkeys in the UK was found to be 3.2 episodes per 100 donkeys per year, and mortality was found to be higher than in horses in the study done by Cox et al. (2009): as well as identifying dental disease as a risk factor for colic, other risk factors were identified in donkeys such as musculoskeletal pain and reduce pasture.

Moreover, Cox et al. (2009) reported in the study that there was a small number of cases of colic reported and the authors speculated that the reasons of the low incidence could be due to the young age of the donkeys included in the study (fostered donkeys), the fact that they have fewer careers (dedicated foster careers), no concurrent illnesses and likely to be exercise.

2.7.2.5. Respiratory disease

Respiratory disease can be found commonly in donkeys and although the conditions are the same as those found in the horse, respiratory condition in the donkeys are usually diagnosed generally in an advance chronic stage of the condition, possibly due to the subtle clinical signs exhibited by the donkey, their stoical nature and the fact that donkeys are mainly used as pets in the UK and exercise less than horses.

Moreover, any disease process that reduces appetite in the donkey will lead to hyperlipaemia (Thiemann, 2013) making the disease a life threatening condition. Donkeys have been reported to suffer from poorly controlled recurrent airway obstruction and also severe fibrosing insterticial pneumonia (IPF), which may be linked to asinine herpesvirus infection (Thiemann, 2013) and to the fact that diagnosis might be delayed in the UK donkey.

In a survey done in 1,444 aged donkeys in the UK (Morrow et al., 2010), pulmonary fibrosis was found in 35.2% of all the donkey deaths, making this the most important respiratory cause of death followed by tracheal collapse (8.7%), guttural pouch disease was found in 4.9% of the donkeys, bronchial/alveolar disease (4.0%), nasal/paranasal sinus disease (0.8%) and malignant lung neoplasia (0.4%). Chronic interstitial pneumonia was also found in the lung of donkeys at post mortem examination in the UK (Thiemann and Bell, 2001). Geriatric donkeys would also have a higher risk of condition such as tracheal collapse, fibrosing pneumonia and neoplasia (Thiemann, 2011).

Pulmonary hydatidosis has also be found at post mortem in donkey at TDS with a higher prevalence in donkeys that originates from Wales and Ireland (Thiemann, 2011).

Infectious viral respiratory disease can also be found in donkeys displaying similar clinical signs than horses (Thiemann, 2013) and equine influenza and equine/asinine herpesvirus has been reported to be found in donkeys in the UK, with a range of herpesviruses isolated from donkeys (Thiemann, 2013).

In cases of parasitic respiratory disease, donkeys have been considered to be a source of infection for to horses with the parasite *Dictyocaulus arnfieldii* causing minimal clinical signs in the donkey, but some studies have shown that infection can be found in horses with no history of donkey contact (Matthews, 2002). The UK donkey has shown a relatively low prevalence of infection with lungworm (4%), compared with strongyle infection prevalence of 73% (Burden and Trawford, 2009)

Conditions of upper respiratory tract reported in the donkey includes false nostril atheroma, progressive ethmoidal haematoma, sinus disease, soft palate ulceration, laryngeal paralysis secondary to liver failure, guttural pouch disease and tracheal collapse/stenosis (Thiemann, 2011). Sinus disorders are reported to be similar to the horse with sinusitis due to fungal infection, cysts or neoplasia being less common than sinusitis secondary to dental disease (Thiemann, 2011).

Guttural pouch disease has also been described as not uncommon in the UK donkey (Thiemann, 2011). Moreover, Evans and Crane (2018a) reported that donkeys can be affected by *Streptococcus equi* subsp. *zooepidemicus* and *S. equi* subsp. *equi. Streptococcus equi zooepidemicus* has been reported to be capable of causing severe empyema and chondroids in the donkey's guttural pouches.

Evans and Crane (2018a) also described that donkeys can act as carriers and harbour the organism on the guttural pouches. The author's advice that cases of nasal discharge should be investigated further by taking nasopharyngeal swabs/washes and endoscopy then sent for PCR to a selected laboratory.

Available commercial serological tests for *S. equi* have not been validated in the donkey. Vaccination against *S. equi* is available in the UK but the authors do not mention the use of it in UK donkeys.

2.7.2.6. Lameness

Chronic hoof disease has been considered a major welfare concern in donkeys in the UK, with a high incidence of lameness within TDS population when comparing with other conditions. A high percentage of the lamenesses are caused by white line abscesses and another high percentage cause by chronic hoof conditions such as chronic laminitis. Conditions such as seedy toe are also very common among the UK donkey population. Lameness in the donkey is often also only recognized at an advance stage in the donkeys (Crane, 2008), especially on those kept as pets.

Donkeys feet are visibly different to those of horses but they also have different microstructure with a more open tubule structure which enables moisture from the environment to be drawn into the hoof (Burden and Thiemann, 2015). This property can be beneficial in deserted and dry terrain but when leaving in wet conditions, donkeys foot becomes weaker and prone to infection.

Common problems reported are pedal sepsis, which causes acute lameness (Crane, 2008) and can be a life threatening condition especially in elderly donkeys when they are also suffering from any other concurrent condition and their quality of life has been closely monitored. Those donkeys might not be considered to be surgical candidates and those cases would be euthanized.

Laminitis is also a common condition reported to be often unrecognized (Crane, 2008) with owners being unaware of the severity of the disease present (Thiemann et al., 2018) donkeys develop pars pituitary adenomas (Cushing´s disease) just as horses and this can contribute to laminitic episodes (Thiemann, 2013). Equine metabolic syndrome has been also seen especially in obese individuals. Both conditions may not be well recognized by owners and can progress insidiously (Thiemann, 2013). Thiemann et al. (2018) also reported that poorly managed laminitis, thin soles, twisted feet and overlong hooves are all commonly seen in donkeys in the UK.

Older donkeys can commonly develop upper limb arthritis of the shoulder, spine and hip joints (Thiemann et al., 2018). Morrow et al. (2010) recorded an overall prevalence of arthritis of 55 per cent in aged donkeys at post mortem examination. Clinical signs in these donkeys can be very subtle and can be often be missed by owners and professionals. Behavioural changes can indicate a sign of limb pain, such as kicking or pulling the limb back during trimming. Thiemann et al. (2018) reported that the most advanced cases may show some loss of muscle mass over shoulders and hindquarters with a slower gait, stilted and stiff. Some donkeys may show some difficulties rising or never lying down.

Cox et al. (2010) reported that all the donkeys received preventive health care during the study, most commonly treatment for endoparasites, farriery and vaccinations. Sixty per cent (60%) of the donkeys were reported to have had a hoof examination or treatment during the study although the author considered this to be underestimated, as routine farriery might have not been included in this category. Fifty-nine per cent (59%) of the donkeys suffered from at least one medical condition during the study, most commonly hoof and oral problems.

2.7.2.7. Liver disease

Liver disease is not uncommon in the donkey especially in the geriatric animal. Clinical signs can be very mild and might be found in a routine blood sample without any obvious clinical signs. Some owners would be totally unaware of abnormal liver function and might have not notice the progressive weight loss or they might have thought could be related to age.

Liver disease has been reported to often develop slowly in the UK donkey with mild clinical signs of malaise, weight loss, poor coat quality and a vacant/staring expression. Cases presented later will show signs of encephalopathy, extreme depression and anorexia (Thiemann, 2013).

2.7.2.8. Dermatology

The majority of skin conditions in donkeys are similar to those in horses. One of problems may be that skin problems in the donkeys are presented in an advanced stage as the thick coat can hide early problems (Evans and Crane, 2018b). Working donkeys tend to suffer from pressure sores and badly fitted harnesses wounds or bits.

Donkey skin is adapted to the effects of direct sun light and extreme heat, as they are originally from North Africa; donkeys preserve water by sweating against the skin limiting the loss of water by allowing the body temperature to rise (Knottenbelt, 2005). However, their skin is not hardy in some conditions and tends to get affected by lack of shelter or wet weather (Evans and Crane, 2018b). Donkeys will seek shelter if cold or wet conditions are present; prolonged wet skin conditions can predispose donkeys to *Dermatophilus* (Evans and Crane, 2018b).

Ectoparasitic infections, wounds and neoplasias might difficult to identify at an early stage due to the long coat especially if the grooming routine done not involve thorough skin examination.

It has also been reported by Evans and Crane (2018b) that the long coat can also affect topical skin treatments therefore pour-on treatments might be not that effective in donkeys.

Common skin condition in donkeys:

- *Dermatophytosis (ringworm):* diagnosed and treated as in horses and ponies; lesions can be less obvious with small alopecic areas which could be the only signs. Widespread alopecia with crusting has also been reported as possible signs of this zoonotic disease (Evans and Crane, 2018b).
- *Pediculosis*: lice infestation can be common especially in temperate climates; the long coat can often hide first signs of infection and some donkeys heavily infested may not show much signs of discomfort or pruritus; other donkeys with small burdens might show intense skin self-trauma.

  Lice have been reported to be common in donkeys in the UK (Knottenbelt, 2005); although Knottenbelt reported the presence of the chewing and biting lice; *Bovicola ocellatus* has been seen to be prevalent in the UK TDS herd also showing signs of resistance to topical permethrins (Evans and Crane, 2018b). Essential oils (topical application of 5% of tea tree oil product) have been identified to be effective in the control of the donkey's louse, *Bovicola ocellatus* in the study done by Ellse et al. (2015). The coat of the donkey also can affect the application of any type of treatment and in severe infestation cases clipping and exposing the skin to UV light might be advisable.
- *Flies and midges* (*Culicoides* spp.): flies have been seen to be biting lower limbs and causing pruritic papules and nodules especially in elderly donkeys with reduced mobility (Evans and Crane, 2018b). *Culicoides* can also cause a hypersensitivity reaction to the bite called sweet itch in donkeys. Recent studies are looking at the traditional fly traps and have identified that biting flies are not attracted by those and further studies are need it to address this welfare concern.
- *Neoplasia*: donkeys have been reported to be liable of suffering from several cutaneous tumors including sarcoids, squamous cell carcinoma, fibroma/ fibrosarcoma and rarely melanoma (Knottenbelt, 2005). Sarcoids has been identified to be the commonest problem in UK donkeys. The most common types are the nodular and fibroblastic although other types have also been seen and are the same shown in horses and ponies. The study conducted by Reid and Gettinby (1996) identified young male donkeys with short duration contact with other affected animals to be at higher risk of developing sarcoids; the authors also recommended

frequent examination of high risk groups to allow early diagnosis, therapeutic intervention and improved animals welfare.

Other skin conditions might be present but are the same to those affecting horses and ponies.

2.7.2.9. Behaviour

Donkeys have been described to be stoical animals and they do not often display pain in the same way than horses therefore can be easy to miss early signs of disease as they early clinical signs might be very subtle. Ashley et al. (2005) highlighted the importance of recognising individual donkey's normal behaviour and attitude as slight changes in the donkey's demeanor may indicate serious problems. Ashley et al. (2005) also reported that there is an agreement throughout the literature about the lack of obvious pain expression by the donkey and mules and that it could be due to a higher tolerance level, or our current inability to interpret fully the subtle behavioural changes presented.

Burden and Thiemann (2015) stated that donkeys when assessed and treat, it is essential to have them with their bond companion, especially if there is need to move the sick animal for further treatment.

Some of the common behavioural signs of pain or sickness in donkeys haven been described to be the following (Burden and Thiemann, 2015): inappetance/ anorexia/reduced appetite, generalized dullness, sham eating (pretend to eat), lowered head carriage, unresponsive ears (little movement in response to changes in noise), lower ear carriage, social isolation, increased recumbency, decreased recumbency, weight shifting/limb guarding/pottery gait, hypersalivation, drooling, difficulties chewing, anhedonia (depression-an inability to response positively to normally pleasant experiences), tail twitching, excessive lacrimation, rubbing of eyes and blinking.

Changes in demeanor relies in the owner's knowledge of donkey's normal behaviour; although general pain related behaviours have been described as subtle can be detected with experience (Thiemann et al., 2018). Thiemann et al. (2018) also reported that normal pain free donkeys should exhibit many behaviours including grooming, playing, resting and smooth transitions between recumbence and standing while donkeys showing pain behaviours typically will show lowered head carriage, ears that may be sideways or backwards pointing and are unresponsive to external stimuli.

Thiemann et al. (2018) reported that specific pain behaviours for severe lameness include point/rest a limb and even weight shift, but low grade lameness may present with reduced movement, increased recumbence and stiffness. Dental pain behaviours would include abnormal chewing but often would also present with persistent saliva discharge and show weight loss. Unfortunately, dental disease can also cause not obvious clinical signs but would be painful for the donkey; therefore, routine dental examination is highly recommended in donkeys.

Gradual decline in a donkey's behaviour may go undetected or be attributed to old age (Thiemann et al., 2018). Donkeys have been reported to have a quick learning ability when training, learning wanted and unwanted behaviours very quickly (Burden and Thiemann, 2015).

2.7.2.10. Notifiable diseases

There is limited epidemiological specific information regarding donkeys (Evans and Crane, 2018c); and although donkeys can be affected by the same diseases the epidemiology and clinical presentation may differ. Evans and Crane (2018c) reported that some diagnostic methodologies used in horses are not validated in donkeys with some drugs and vaccinations not license to be used in donkeys.

As per other conditions, prompt identification of illness can be challenging as donkeys may only exhibit dullness, depression and anorexia as the only clinical signs (Barrandeguy and Carossino, 2018).

At TDS unknown origin donkeys are tested for the following notifiable diseases independently if showing or not clinical signs of disease: equine infectious anaemia (EIA), equine viral arteritis (EVA) and equine piroplasmosis (EP).

- *Equine infectious anaemia (EIA)*

This notifiable viral disease (Lentivirus) is transmitted by biting insects and is usually subclinical in the donkey with very limited information on epidemiology in donkeys (Evans and Crane, 2018c).

Oliveira et al. (2017) reported that the majority of the studies regarding EIA have been conducted in horses and there is little information in other species such as donkeys and mules.

The study done by Cook et al. (2001) found that donkeys that had been inoculated with two strains of EIA virus remained asymptomatic except for a mild thrombocytopenia. The prevalence of EIA has been reported to be low; Getachew et al. (2016) reported 0.2% prevalence in a serological survey conducted in Ethiopia; moreover, another study conducted on 367 donkeys without obvious EIA clinical signs in Northeastern Brazil, found only 1.6% donkeys positive on serology (Oliveira et al., 2017).

- *Equine viral arteritis (EVA)*

This is an Arterivirus infection, transmitted by secretions from respiratory or reproductive system; although has been reported to be usually subclinical in the donkey; mild clinical signs may be seen, including: fever, depression, ocular or nasal discharge and conjunctivitis. Barrandeguy and Carossino (2018) stated that although very little is known about EVA in donkeys, are susceptible of infection and frequently exhibit similar clinical signs with donkey stallions involve in viral transmission (McCollum et al., 1995; Paweska et al., 1995).

The study conducted by Moreira et al. (2016) identified a seroprevalence of 53% in feral donkeys in Chile. A previous study conducted by Paweska et al. (1997) reported a wide distribution and increasing prevalence of antibodies in donkeys in South Africa.

Evans and Crane (2018c) reported that an asanine virus closely related has been isolated from donkey semen. On the other hand, affected male donkeys may become long-term carriers and may shed the virus in their semen acting as reservoir (Evans and Crane, 2018c). Equine viral arteritis has been advised to be considered by donkey breeding enterprises, specially due to the expansion in the donkey population and breeding activities in this specie (Barrandeguy and Carossino, 2018).

- *Equine piroplasmosis (EP)*

Tick born disease caused by the hemoparasites, *Babesia caballi* and *Theileria equi* (Barrandeguy and Carossino, 2018). In tropical and subtropical donkey and mule populations, the infection has been reported to be endemic (Kumas et al., 2009). The infection is also one of the six World Organisation of Animal Health (OIE) listed diseases that have been included in the model high-health high-performance veterinary certificate to mitigate risk of spreading the disease (Barrandeguy and Carossiono, 2018).

Kumas et al. (2009) reported that EP has been recognized as a problem of major economic importance because affected donkeys manifest decrease working capacity, lethargy and anorexia.

The infection is usually subclinical in the donkey although clinical signs can include (Evans and Crane, 2018c): congested mucous membranes, lacrimation, depression and fever. Once infected donkeys become asymptomatic carriers. Evans and Crane (2018c) also stated that stress from poor management, inadequate veterinary care, poor nutrition and overwork may exacerbate the impact of infection in working donkeys.

2.7.2.11. Parasitology

Evans and Crane (2018d) reported that one of the biggest challenges when managing parasites in donkeys is that of clinical assessment. Evans and Crane (2018d) also stated that donkeys with significant endoparasite burdens may appear healthy and it is rare to observe the type of clinical signs (diarrhea, weight loss, colic or poor condition) that are more common in horses and ponies. Moreover, Buono et al. (2018) reported that massive parasitic infections often are subclinical with an unclear donkey's clinical status.

Donkeys can be affected by the same type of parasites than horses and ponies but the lack of anthelmintic products licensed for use in donkeys and differences in parasite dynamics and treatment regimens have been reported in this specie.

Unfortunately, resistance to the majority available classes of equine anthelmintics has been recorded in donkeys; TDS recommends post-treatment testing to ensure effectivity of treatment. Burden and Getachew (2016) stated that control of parasites should focus on reducing risk of infection, maintaining good health and targeting drug treatments carefully.

Burden and Thiemann (2015) concluded that good husbandry can contribute significantly to reducing parasite infestations, for example ensuring low stocking densities, quarantine of new animals, regular disinfection of buildings and fomites, regular collection of dungs from pasture along with correct composting and ensuring animals are otherwise on good health.

- *Small strongyles (Cyathostomins)*

These have been reported to be the most commonly found parasitic nematodes in donkeys globally. Donkeys may not demonstrate clinical disease, particularly in populations where anthelmintics are being used. In the study done by Morrow at al. (2010) where they look at the post-mortem of 1,444 aged donkeys, it was found that cyathostomins were the most commonly recorded endoparasite with a frequency of 15%. Buono et al. (2018) also reported that *Cyathostominae* infections are widespread in donkey farms and can be correlated with poor management practices and lower frequency of endoparasites treatments.

The lifecycle is same as in horses, the egg develops into larvae in the soil and are then ingested and invade the wall of the large intestine. The period of larval encystment in the large intestinal wall plays an important role in the epidemiology and pathogenicity of infection and because they will infect all co-grazing equids.

Encysted larvae in donkeys can built up in large numbers and emerge synchronously. This may cause clinical or subclinical larval cyathostominosis. Donkeys do not appear to show the classical signs of larval cyathostominosis and are more likely to present with weight loss, colitis and abnormally low blood proteins. It may result in colic but rarely causes diarrhea. Mortality appears to be lower than is recorded in horses and ponies.

Encysted larvae are not detectable by routine faecal worm egg count (FWEC) analysis.

Buono et al. (2018) reported that anthelmintic treatments are the main strategy to control cyathostomins. In the UK, the only licensed product to be used against encysted cyathostomin is a 5-day course of fenbendazole, although widespread resistance to this anthelmintic type has been reported (Matthews and Burden, 2013). The study done by Buono et al. (2018) reported the presence of anthelmintic resistance to fenbendazole and suspected resistance to pyrantel against *Cyathostominae* in donkeys in Italy. Moreover, Trawford et al. (2005), reported the first case of moxidectin resistance. Veneziano et al. (2015) also reported a shorter *Cyathostominae* egg reappearance period (ERP) in donkeys treated with moxidectin.

However, Buono et al. (2018) confirmed that the efficacy of ivermectin and moxidectin against small strongyles remains high in donkeys. Buono et al. (2018) also stated that intestinal strongyles control programs in donkeys are very different than those used in horses and the donkey can be considered as an animal in refugia. The author also concluded that parasite control programs based on the extra-label use of drugs licensed for ruminants could contribute in future to the selection of resistance in donkeys; the study also recommended the need of large scale surveys on the presence of resistance and ERP for donkeys in farms.

- *Large Strongylus (S. equinus, S. vulgaris and S. edentatus)*

In donkeys, large strongyle infections have been reported to be a threat in working donkeys where there is erratic or absent anthelmintic treatments (Evans and Crane, 2018d). There is susceptibility to infection in donkeys with adult worms found in the large intestine; parasitic larval stages are migratory with time from infection to detection of eggs in faeces in the region of 6 to 12 months (Matthews and Burden, 2013). Adults forms are reported to be found in the large intestine, but parasitic larval stages are migratory (Evans and Crane, 2018d).

Large strongyle eggs are indistinguishable from those of small strongylus therefore FWECs are not reliable for guidance (Evans and Crane, 2018d).

Administration of moxidectin as once a year treatment has been considered to be sufficient to control large *Strongylus* (Evans and Crane, 2018d). Administration of macrocyclic lactones (MLs) has been recommended as treatment in donkeys. There are no current no reports of resistance to anthelmintics in the large *Strongylus* (Evans and Crane, 2018d). Treatment should be given with caution in those cases where anthelmintic treatment is unknown, erratic or absent.

- *Round worm (Parascaris equorum)*

Mature donkeys have been reported to be harbouring patent infections and may be important sources of pasture contamination and when compromised (ill health, overwork or poor nutrition), they may be at risk of *Parascaris* related disease (Evans and Crane, 2018d).

Life cycle is migratory an infection is in the form of an environmental resistant egg containing a second stage larva. Time from infection to detection of eggs in faeces is approximately 10 weeks. It has been reported to be common in large populations where animals graze permanent pastures.

Infection has been reported to cause clinical problems when infection intensity is high. The migratory pattern is hepato-tracheal therefore respiratory signs may be observed in donkeys. Other clinical signs in donkeys would include failure to thrive and direct effects on intestine in those with intense infections (Evans and Crane, 2018d).

Treatment failures have been reported in donkeys when using ivermectin, moxidectin and pyrantel embonate (Evans and Crane, 2018d).

- *Pinworm (Oxyuris equi)*

Eggs can be ingested and found in the last portion of the large intestine; female worms when gravid pass out of the rectum and lay eggs around the anus which stick to the skin. Time from the infection to females laying eggs is 5 months (Matthews and Burden, 2013). Eggs can be collected around the anus using sell tape test.

Few clinical signs have been reported although persist infection can lead to irritation and damage of the skin around the perineum and tail head.

Ivermectin, moxidectin and fenbendazol have shown to have efficacy against adult pinworm in horses and ponies; while pyrantel embonate has demonstrated efficacy against adult stages only. Lack of response to treatment has been reported at TDS with ivermectin and pyrantel embonate. Licensed products for treatment include ivermectin, moxidectin and pyrantel embonate (Evans and Crane, 2018d).

Hygiene recommendation has been also recommended to be followed with regards to pasture, housing and animal hygiene.

- *Tapeworm (Anoplocephala magna and A. perfoliata)*

There are only a few publications regarding donkey prevalence of this parasite. Unpublished TDS data identified a low prevalence of this parasite in new arrival donkeys by coprology (approx. 3%) (Burden, 2013); most tapeworms from the unpublished data originated from Ireland or Wales (Matthews and Burden, 2013).

The life cycle of this parasites is an indirect cycle involving an oribatic mite. Faecal egg counts are insensitive and ELISA-based tests have not been validated in donkeys.

Evans and Crane (2018d) recommended once a year treatment if the clinician is aware that tapeworm is common in the local area and or if eggs or segments have been identified by faecal egg count. Treatment is recommended to be carried out in late autumn or winter; specific license products should be used, pyrantel embonate at an increased dose (double dose). Praziquantel is not license for the use in donkeys and therefore should only be used under the cascaded system. TDS does not recommend the use of combination wormers and no data is available for the use.

- *Threadworm (Strongyloides westeri)*

Life cycle ad epidemiology has been reported to be the same in donkeys, horses and ponies.

- *Lungworm (Dictyocaulus arnfieldi)*

Matthews and Burden (2013) reported that this parasite was relatively common in donkeys. Burden and Getachew (2016) stated that donkeys are renowned as reservoir host for lungworm. An unpublished study by Burden (2013) reported a 4% prevalence in new donkeys arriving into TDS site.

Donkeys have been reported to be permissive of the entire lifecycle of lungworm; acting as a source of infection to co-grazing horses (Evans and Crane, 2018d). Adult worms are found in the respiratory passages and eggs are coughed up and swallowed and passed out in the faeces; which differs from other species where lungworm first stage larvae (L1) are usually detected in faecal samples*; Dictyocaulus arnfieldi* eggs hatch quickly (Matthews and Burden, 2013).

Diagnosis should include standard FWEC methods of fresh samples and or samples that have not been stored anaerobically and by Baermanisation for L1 (Rode and Jorgensen, 1989).

Donkeys do not often show clinical signs of disease and those at most risk of developing disease related to high infection are geriatric and or inmunocompromise donkeys (Matthews and Burden, 2013).

- *Liver fluke (Fasciola hepatica)*

This parasite affects mainly cattle and sheep, but can also infect many mammalian species with donkeys being susceptible to infection and being an increasing problem globally (Evans and Crane, 2018d). There is not a lot of information regarding liver fluke, unpublished TDS data indicated a prevalence of 4% with the majority of cases originated from Wales and Ireland (Matthews and Burden, 2013). Trawford and Tremlett (1996) reported in a different study that of 60 post mortem examinations performed on donkeys originally from Ireland *F. hepatica* was identified in 17% of the livers, of 200 faecal samples, 8.5% were positive for *F. hepatica* eggs. In another study done by Getachew et al. (2010) prevalence rate at post mortem and coprologically were in the region of 40-45%.

Fluke requires a water snail (*Lymnaea* spp.) to act as intermediate host therefore donkeys grazing wet and marshy paddocks would be more susceptible as well as donkeys co grazing with other infected livestock. Adult fluke is found in the bile ducts (Evans and Crane, 2018d).

Clinical signs are not usually observed in the donkey; however, Collins (1961) reported that thickened bile ducts and raised liver enzimes in serum may occasionally be noted in heavily infected animals. Faecal sample assessed using a sedimentation technique.

There are not specific license products to be used in donkeys; triclabendazole and other flukicides are used under the "cascade" (NOAH compendium, 2020) (Matthews and Burden, 2013).

2.7.2.12. Anthelmintic use in donkeys

Donkeys and horses have been reported to be susceptible to most endoparasites and these drugs (Table 2.5) have been shown to be effective to control natural parasitic infection at horse doses (Malan and Reinecke, 1979; Taylor and Craig, 1993; Trawford and Tremlett, 1996; Binev et al., 2005; Imam et al., 2010).

The most common anthelmintic drugs are described in Table 2.4; The use of mebendazole against lungworm has been described in donkeys (Clayton and Trawford, 1981), and has been used in cases where donkeys have been unresponsive to routine medication.

Table 2.5. Anthelmintics available for use in treating helminth infections in donkeys in the UK (Matthews and Burden, 2013)

Anthelmintic class	Active ingredient	Indication	Dose rate
Macrocyclic lactones	Ivermectin	Gasatrointestinal nematodes, *Dictyocaulus arnfieldi*	0.2 mg/kg bwt *per os*
	Moxidectin*	As above + encysted cyathostomin larvae	0.4 mg/kg bwt *per os*
Benzimidazoles	Fenbendazole**	Gasatrointestinal nematodes	7.5 mg/kg bwt *per os* or 7.5 mg/kg bwt *per os* for 5 days for cyathostomin encysted larvae
	Triclabendazole	*Dictyocaulus arnfieldi* immature and mature *Fasciola hepatica*	18 mg/kg bwt
Tetrahydro-pyrimidines	Pyrantel embonate	Gasatrointestinal nematodes	19 mg/kg bwt
		Anoplocephala perfoliata	38 mg/kg bwt
Pyrozino-isoquinolines	Praziquantel*	*Anoplocephala perfoliata* and other tapeworms	2.5 mg/kg bwt
Salicylanilides	Closantel*	Mature *F. hepatica*	20 mg/kg

*Not licensed for use in donkeys. Prescribed under the cascade.
**High levels of resistance to this anthelmintic reported in cyathostomins worldwide.

2.7.3. Welfare assessment of donkeys

Thiemann et al. (2018) stated that many donkeys in the UK suffer compromises to their wellbeing and welfare due to a combination of ignorance and neglect. Moreover, this is also accentuated in geriatric donkeys although donkeys of all ages can be affected.

There are several systems used worldwide to assess equine/donkey welfare; the use of the five freedoms and various others composite scales using health and behaviour parameters have also been reported (Parker and Yeates, 2012; Hockenhull and

Whay, 2014). There are also welfare assessment tools available for individual and group assessment of donkey welfare such as Animal Welfare Indicators, AWIN Donkeys (AWIN, 2015), and for working donkeys the Standardised Equine Based Welfare Assessment Tool, SEBWAT (Sommerville et al., 2018; Thiemann et al., 2018).

The Donkey Sanctuary currently uses the EARS assessment (Equid Assessment Research and Scoping) (Rodrigues et al., 2019) and QBA (Qualitative Behaviour Assessment) (Wemesfelder et al., 2000) for assessing group of donkeys and evaluate their welfare and health concerns. The Donkey Sanctuary also developed a clinical tool to assess individuals, which enable the owner/career to decide a more objective end life point with the help of a vet (QoL assessment) (Appendix 4); the assessment takes into consideration different parameters such as: body condition score and weight, feed, dental disease (dental grading system), blood sample results, medication, lameness and mobility, appetite and demeanor.

One of the system most widely used is the Five Freedoms (Farm animal Welfare council) that were originally developed from a UK Government report on livestock husbandry in 1965 and have been adopted by representative groups internationally including the OIE and Royal Society for the Prevention of Cruelty to Animals (Table 2.6).

Table 2.6. Five freedoms

1. Freedom from hunger and thirst	by ready access to fresh water and a diet to maintain full health and vigour
2. Freedom from discomfort	by providing an appropriate environment including shelter and a comfortable resting area
3. Freedom from pain, injury or disease	by prevention or rapid diagnosis and treatment
4. Freedom to express(most) normal behaviour	by providing sufficient space, proper facilities and company of the animal's own kind
5. Freedom from fear and distress	by ensuring conditions and treatment which avoid mental suffering

The Five Freedoms provide a model that is applicable across situations and species including animal shelters, but although can be used to define outcomes and imply criteria for assessment, do not describe the methods to achieve those outcomes (Webster, 1994).

At the time of the study the Irish financial crisis had a massive impact on TDS numbers and finance in the UK. Despite the efforts of TDS in Ireland to reduce number of relinquishment, large numbers of donkeys were being abandoned usually as entire young males. Number of donkeys starting collapsing the farms in Ireland and donkeys had to be shipped to TDS farms. Since then, the numbers of donkey relinquishment have been reduced using different strategies including castration clinics of young stallions and supporting donkey owners although there is still a welfare concern affecting the charity (The Donkey Sanctuary, 2020i).

3. Objectives

3.1. General objective

In the UK, there are thousands of donkeys being cared for by charities, however little is known about the factors behind relinquishment: demography, reasons for admission and welfare status, with even less information available in published literature.

This information could help to provide focused advice and shape education policy as well as identifying areas of research and thereby reducing the major contributing factors to poor equid welfare.

These large numbers of unwanted donkeys add significant pressure to the charity's finances and resources; especially if, as suspected, donkeys have poor preventative care and require treatment and attention once they are relinquished to the charity. One of the aims of the charity is to reduce the number of unnecessary relinquishments; therefore, a better understanding of the factors surrounding the process was deemed necessary.

The main objective of this study was to help the charity describe the demography of relinquished donkeys, to better understand the current preventative health care status of equids relinquished into The Donkey Sanctuary's care.

This could enable the charity's educational resources to be focused on specific educational needs, with the vision of reducing unnecessary relinquishments and improving donkey welfare in the UK**.**

3.2. Specific objectives

The aim of the thesis was to focus on the major areas of concern for the charity caused by the general equine crisis which is being experienced by the majority of UK equine charities due to large numbers of unwanted animals.

The specific objectives were the following ones:

- *Demographic analysis.* Description and characteristics of admitted animals, distribution of admitted animals by sex, species, age, origin, type of acquisition, month of relinquishment, possession of a valid passport and microchip. The aim was to assess if there was a trend and/or specific type of animal relinquished to the charity.
- *Analysis of reasons for relinquishment,* main and secondary reasons for relinquishments. We believed that identifying reasons for relinquishment could help the charity to target some areas and thereby reduce unnecessary relinquishments.

- *Analysis of the donkey's preventative health status on arrival.* Preventative health treatments such as vaccination, dentistry, farriery and anthelmintic use, in addition to the date of last dental and hoof trim and body condition score. Lack of preventative healthcare in donkeys was suspected, so identifying which areas were affected could help the charity invest resources to improve donkey welfare in the UK.
- *Identification of specific areas within the UK where targeted education was most needed.* Analysing specific welfare concerns identified by the study and stratifying them by UK region; with the aim of identifying which geographical areas would most benefit from targeted educational campaigns by the charity.
- *Identification of prevalence of specific diseases during isolation.* For example, hyperlipaemia, a life-threatening condition for donkeys, has previously been linked to the risk factors of transport and change of environment. Identifying if the NAU management is optimal and if any changes could be implemented to reduce certain conditions.
- *Analysis of the diet provided and husbandry of donkeys by private owners.* Are private owners considering the health status of their donkeys in management decisions such as types of diet and bedding?
- *Identification of the mortality rate during isolation and investigating if geriatric age is a direct risk factor for mortality during isolation.* There were concerns at the time about geriatric donkey relinquishments and their survival rate at the charity. Identifying the mortality rate of geriatric donkeys could help during the process of relinquishment to advise owners accordingly and improve welfare.

4. Material and methods

4.1. Study design and study population

This cross-sectional observation study used admission data from relinquished animals that were considered fit to travel and arrived at the NAU of TDS between June 1, 2013 and September 30, 2015.

The study population comprised all the animals accepted into the NAU at TDS, Sidmouth, Devon, UK, where donkeys spend 6 weeks isolated from the main herd and undergo health screening.

A number of donkeys and mules were not considered fit to travel after examination by external vets, or following discussion between TDS vets, external vets and owners. Donkeys assessed as having a reduced quality of life were euthanised in their home. Donkeys might have been directly rehomed during the study period and therefore these animals were excluded from the study.

4.2. Data collection

Information regarding the management of the donkey in their home was collected and recorded by a Donkey Sanctuary Welfare adviser in the Microsoft database of TDS.

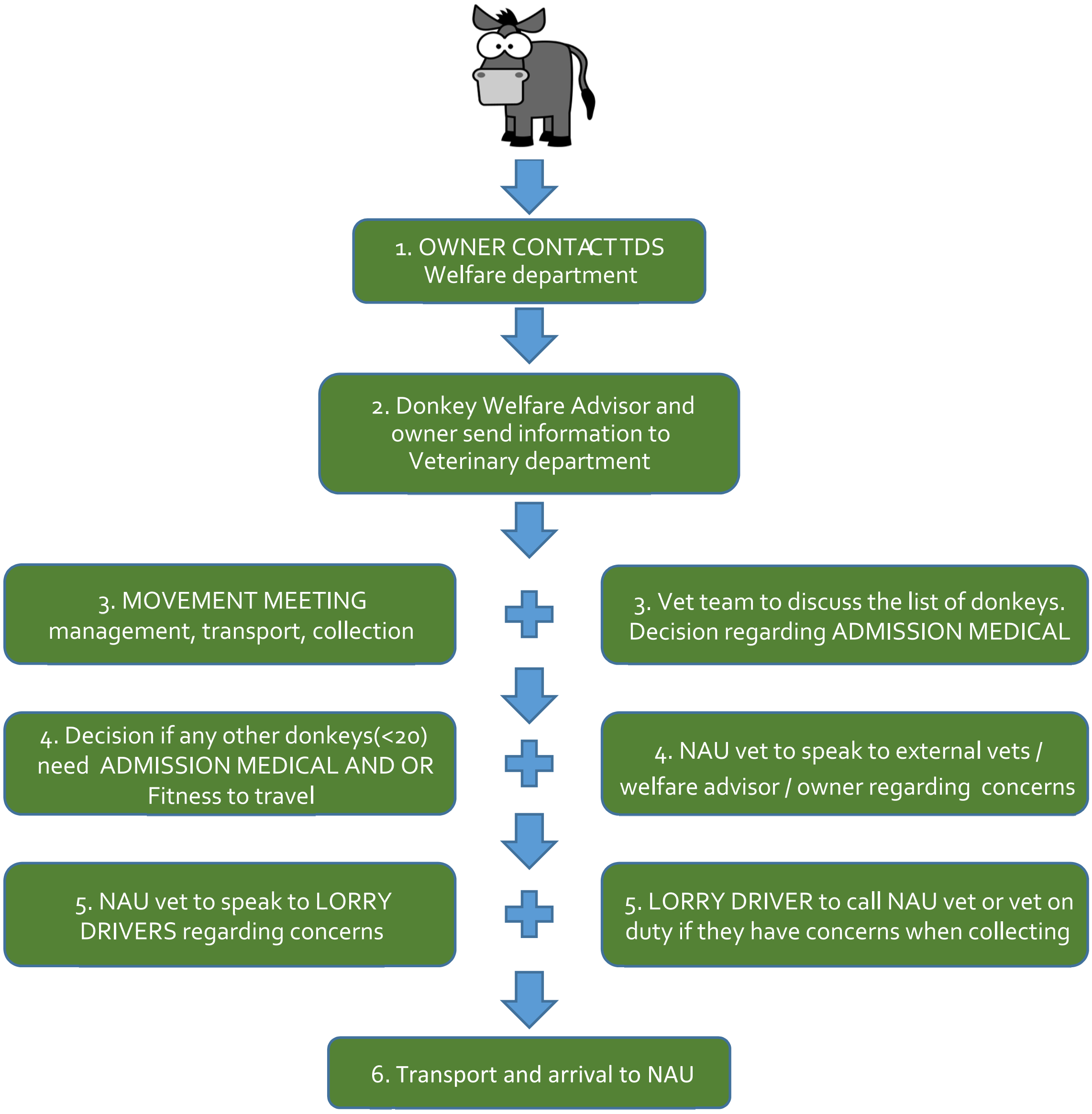
Records for donkeys arriving into the NAU during the study period were reviewed by the author. Information was selected, classified and entered into a Microsoft Access 2016 database for the purposes of the study, using name and ID number (assigned for identification on arrival at TDS).

The information included: the reason for relinquishment, region of origin (by UK postcode region; postcodes were chosen for anonymisation of data), length of ownership, vaccination status (based on medical records and passport information), presence of a microchip and passport, deworming history, diet, management, body condition score (BCS), previous medical history, date of last farrier visit and last dental check, and age (as recorded in the passport or according to the owner where no date of birth was available in the passport).

Welfare advisers discuss the relinquishment process with the owners and give them information regarding the risk of hyperlipaemia (hyperlipaemia form), laminitis (laminitis form) and complete a management and medical history form with the owner as well as the relinquishment agreement (Appendix 1).

Relinquishment process for a new admission is described in Figure 4.1.

Figure 4.1. New relinquishment process diagram



4.2.1. Donkey details

4.2.1.1. ID number

The ID number is the number assigned by TDS to the animals relinquished to the charity; numbers are given in order of entry. The number, name and surname are used to generate an entry into TDS database which holds the details and medical history of each animal; entered by office staff at TDS. The details include the previous owners' contact information and all communication and conversations between members of staff at TDS and the previous owner, guardian owner or interested party.

4.2.1.2. Sex

Donkeys, mules and ponies were classified into three different categories: mare, gelding or stallion.

The sex of the animal was given by the owner at the initial relinquishment phone call and assessed by the welfare adviser on their first visit. This information is very important for the charity in order to group animals and organise collection, as well as trying to group them at the NAU farm. Stallions were collected on their own if relinquished as single animals and were individually housed until after castration and they were considered able to mix with other donkeys safely.

4.2.1.4. Species

The following animals were recorded during the time of the study: donkey, mule, hinnie and pony. Other species can be relinquished to TDS if there is a proven bond between the donkey/mule and the other animal. A bonding test (Appendix 5) is used by welfare advisers to assess if a real bond exists. Donkey breed was not recorded and other animals were excluded from the study.

4.2.1.5. Age

The age recorded in the database was that given by the owner or checked on the passport. Age was estimated using the incisor teeth at the time of the NAU exam or within the first two weeks of arrival. If there was a discrepancy both ages were recorded in the database and were used in the study.

Dental ageing has been described as useful for estimating age in donkeys (Muylle et al., 1999). The same age categories were used in this study as those used in the Equine Assessment Research and Scoping tool (EARS) developed by TDS and World Horse Welfare (Rodrigues et al., 2019) reflecting physiological category variation and providing continuity purposes for future studies.

For further analysis, and in line with other studies in donkeys, the following age distribution groups were used: foals (≤1 year), yearlings (>1 to ≤3 years), young adults (>3 to ≤5 years), adults (>5 to ≤20 years) and geriatrics (>20 years).

Furthermore, age was also divided into two different categories for some analysis: geriatric (>20 years) and non-geriatric (≤20 years).

4.2.1.6. Acquisition of animals

Owners were asked how they acquired their animals and the information was classified into the following categories: unknown, bought from private owners, born at home, local dealer, rescued, bought locally, bought from traveller, bought from breeder, imported, local farm, local market, gift, bought from beach operator, bought in Ireland, born at TDS, inherited and auction.

4.2.1.7. Type of relinquishment

Depending on their situation, donkeys and mules in the study were classified into five different categories: newly relinquished animals, donkeys returning from a Donkey

Sanctuary guardian home, those returning from a DAT center, animals coming from a Donkey Sanctuary holding base, and those coming from an equine veterinary hospital.

4.2.1.8. Post code

Addresses were recorded on the veterinary system using UK postcode regions. This allowed for analysis of the donkeys' region of origin. The address using UK postcode regions were recorded into the veterinary system and were used for the analysis of donkey's region of origin.

The following map was used to define UK postal regions. The different coloured areas correspond to those allocated to different Welfare Advisors. The Donkey Sanctuary UK areas covered by a Welfare Advisor.

Figure 4.2. UK post code areas

4.2.1.9. Time spent at a holding base

This is the total time spent at a Donkey Sanctuary holding base (privately owned livery approved and paid by TDS). There are several reasons that animals may be sent to a Donkey Sanctuary holding base instead of being transported to TDS NAU in Sidmouth, Devon, UK. The reasons for movement onto a holding base were not investigated for the study. Donkeys are moved onto holding bases in the following situations:

- NAU farm closed: this could be due to a suspected infectious disease and the relinquished animal/s must be moved from the owner’s property urgently.
- NAU farm full to capacity and the relinquished animal/s must be moved from the owner’s property urgently.
- The relinquished donkey, mule, or animal/s must be moved from the owner’s property urgently.
- The relinquished animal/s are not fit to travel a long distance to TDS in Sidmouth, Devon, UK, but are fit to be moved a short distance and can be moved to the closest holding base.

The reasons why animals were moved out of the holding base were not recorded in TDS database.

The date of entry and the leaving date from the holding bases were recorded in TDS database, as well as any internal movement between shelters at the NAU farm.

4.2.1.10. Date of arrival

The date of arrival at the NAU was recorded in TDS database and used in the study.

4.2.1.11. Passport

Passports were requested from owners before the animals were transported by TDS and were checked on arrival by the NAU veterinary nurse. For those animals with a legitimate passport no action was required apart from notifying the Passport Issuing Organisation (PIO) of the change of ownership. If the animal did not have a passport or if the passport needed modification (sex change, update microchip etc.) an application was completed and sent to the Donkey Breed Society (DBS) or to the relevant IPO. The cost was covered by TDS.

Details of the need to modify passports and make changes were not recorded in TDS database and therefore it was not possible to calculate the related costs during the study period.

Presence or absence of a passport was recorded and used for the purpose of the study.

4.2.1.12. Vaccination status

Vaccination status against influenza and tetanus was routinely checked for every relinquished animal. Donkeys, mules and ponies without up to date vaccines were identified and a vaccination course against influenza and tetanus was started during their NAU period; the vaccine used was Proteq Flu and Proteq Flu and Tet from Merial**.** Animals with no tetanus protection received tetanus antitoxin in the case of injury or surgical intervention during their time at the NAU which was prescribed, recorded and administered by the attending vet.

4.2.1.13. Microchip

The presence of a microchip was checked at the time of the admission examination; on both sides of the neck and at other possible migration sites. All animals were microchipped if a microchip was not found (microchip sites were checked three times if not found during the first examination); a microchip was inserted on the left side of the neck. The microchip number was checked against the passport and rectified if necessary. The microchip reader and microchip used was the PET-ID. Microchip number was recorded in TDS database. Presence or absence of a microchip was also recorded in the database.

4.2.1.14. Number of friends/companions

Donkeys that were relinquished in the study period were either single, coming as a pair or in a group of animals. The number of friends was the number of animals collected from the same property and was recorded in the database. The bonding between individuals was assessed carefully during the six weeks that the animals were in the NAU farm to establish true bonding and friendships before moving the animals onto a Donkey Sanctuary farm.

4.2.1.15. Splitting friends

Welfare advisers from TDS assessed the existence of bonding between the donkey, mule and any animal that cohabited with them to ensure that friends were not separated when animals were left behind at the property. A bonding test (Appendix 5) designed by a behaviourist from TDS was used by the welfare advisers. It is Donkey Sanctuary policy not to split bonded animals.

4.2.1.16. Main reasons for relinquishment

The owner was asked about their reasons for relinquishment at the time of first contact with TDS or during the welfare adviser's first visit. The reasons for relinquishment were recorded and classified by the author into: main reason, secondary reason and others.

The following twenty different categories were created: abandoned, bad behaviour, death/illness owner, donkey health, family problems, farm closed, financial, house move, RSPCA involvement, lack of a suitable environment, lack of knowledge, lack of time, loss of companion, loss of grazing, overstocked, personal circumstances and others.

4.2.1.17. Length of ownership

Length of ownership of animals was recorded. This information was provided by the owner and recorded by the welfare advisers at the time of their first visit. If the length of ownership was less than a year it was marked as "0" for the purposes of the study.

4.2.1.18. Diet

Detailed diet information was recorded as given by the owners at the time of the relinquishment. The information was gathered by the welfare advisor and sent with the relinquishment paperwork. Information was transferred into TDS database.

Access to grass, restricted grazing, hay, straw, haylage and treats was recorded.

Types of diet were classified into the following five categories for the purposes of the study: cereal grain based compound feed (CC), fibre based compound feed (FC), chopped forage feed (CF), non-equine feed (NE) and supplement / balancer (SF).

4.2.1.19. Bedding type

Types of bedding used by owners were classified into the following categories: no bedding, straw, shavings, rubber matting, dust-extracted wood fibre bedding and other.

4.2.2. Pre-admission medical details

4.2.2.1. Pre-admission exam

A clinical examination was recorded for animals receiving either a full pre-admission exam or a partial pre-admission exam. Partial pre-admission could include a specific exam of a system or previous medical issue.

The pre-admission medical form can be seen in Appendix 2.

The dental examination was detailed on pre-admission medical paperwork, and then given a dental grade by the author based on TDS dental grading system (Lilly, 2015). Dental grading was then categorised into acceptable (grades 1-2) and pathological (3-5). Grades 1 to 2 include donkeys with good dental health and those with minor pathology, whereas grades 3 to 5 include moderate to severe and very severe pathology.

4.2.2.2. Pre-admission Date/Fitness To Travel (FTT)

The date of any pre-admission medical or fitness to travel examination was recorded.

An assessment for fitness to travel was organised for some donkeys in the study. Fitness to travel examination was requested for donkeys that had pre-admission medical concerns or a pre-existing condition that could have affected their fitness to travel on the day of transport. Fitness to travel was arranged for the same day or within 24 h of travel.

4.2.2.3. Last farrier visit

The date when the animal was last trimmed or examined by a farrier was given by the owner to the welfare advisor during their first visit and recorded in TDS database.

4.2.2.4. Last dental check

The date of the animal's last dental examination or dental treatment was recorded. The date was provided by the owner and recorded in TDS database.

4.2.3. Admission medical details

The NAU veterinary nurse or a member of the veterinary nurse team inspected the animal within 24 h of arrival and completed an admission paper form (Appendix 6). The veterinary nurse measured the height of the animal and estimated BCS. Height was measured in hands (10.16 cm) and centimetres using a flexible tape measure.

Body condition score assessment was based on TDS BCS chart of five points, 1 being poor and 5 obese with the modification of using half points (Burden, 2012) (Appendix 7).

Animals that needed veterinary attention on arrival were seen by the NAU vet or a member of the veterinary team. It is TDS policy that every animal has an admission medical exam. Paper notes were then transferred onto the veterinary computer system by a member of the veterinary office team.

Dental ageing in donkeys has been determined to be a useful tool (Muylle et al., 1999). Approximate age on arrival was estimated using the incisor teeth. A more thorough examination of the teeth was completed by the vet or the BAEDT and findings were graded following TDS dental grading system previously described. Teeth were examined by the vet if there was a medical concern on arrival.

Animals were assessed on arrival and kept overnight in a reception area to monitor behaviour and food intake. The following day, donkeys were moved into a previously assigned small group, or specific shelter.

During their time in reception, management (bedding and diet) was kept the same, or as close as possible to that of their previous home, unless it was considered detrimental to their health by the NAU vet. Donkeys and mules were not separated from their companion and the main objective was to minimise stress as much as possible. It is TDS policy not to split bonded friends.

The capacity of the NAU farm is very variable depending on the gender, behaviour and special needs of the arrivals. The total capacity of the reception farm is 152 standard-sized donkeys, taking into account 4.75 m^2 of bedded area per standard donkey (9.75 m^2 per large donkey, pony, mule or horse).

4.2.3.1. Location within NAU/reception farm

The movement of the donkeys within the NAU was recorded in TDS database and was used in the study. The NAU farm has the following units/shelters listed in the Table 4.1 and aerial views are provided in Figures 4.3 and 4.4.

Table 4.1. NAU shelter names, dimensions and donkey capacity

Unit/shelter name	Dimensions (m)	Maximum donkey capacity
Unit 1	7.1 x 12.2	10
Unit 2*	3 x 9 & 9 x 2.9	3 + 3
Unit 3	7.3 x 12	10
Unit 4	7.3 x 12	10
Resident shelter*	5.5 x 3 & 5.4 x 3	3.5 + 3.5
Shelter 1	14.6 x 3.5	9
Shelter 2	14.6 x 3.5	9
Shelter 3	14.7 x 3.6	9
Shelter 4	14.7 x 3.6	9
Back box 1	4.7 x 3.7	2
Back box 2	4.8 x 3.6	2.68
Shelter 5	10.7 x 3.4	7.75
Shelter 5 (special needs)	3.4 x 3.4	3.35
Box 2	4.7 x 3	2
Stallion box 1	4.5 x 3.5	2
Stallion box 2	4.5 x 3.5	2
Clifford Smith 1	12 x 5.8	15
Clifford Smith shelter 2 (two shelters)	5.4 x 3 & 5.4 x 3	3.5 + 3.5

* It can be divided into two sections

Units 1 to 4: These units do not have constant access to grazing although they do have assigned paddocks. Donkeys and mules have to be taken to these paddocks during the day so would not have access to grass 24hrs a day.

Back box 2: is located between shelters 3 and 4 and can be used for animals with special needs, treatments, box rest and so on. The paddock is shared with shelter 3 or 4.

Shelters 5, 6, 7 and special needs 5, 6 and 7: these shelters were built as an extension of the NAU/reception farm. These shelters can be divided inside into three different areas. They all have a concrete yard and access to two different paddocks. There is also a special needs box in each of them with a front paddock.

Box 2: is situated at the entrance of the NAU farm and used for reception only as it has no paddock access.

Clifford Smith 1: this is a large barn with access to two different paddocks.

Clifford Smith shelter 2: two shelters at the back of the large barn with a concrete yard and access to two different paddocks.

New Arrival Unit plan can be found at Appendix 8.

Figure 4.3. Aerial picture of the NAU location

Figure 4.4. Aerial picture of the NAU location

4.2.4. Veterinary findings during the NAU period

Any veterinary findings during the animal's time in the NAU were recorded in TDS database. Examination notes made by the attending TDS vet were recorded on paper and then transferred to TDS database by a member of the veterinary office. This information included the date, medical findings and any medication prescribed.

4.2.4.1. Parasitology

Faecal samples were collected at pre-admission or shortly after arrival and sent to TDS laboratory for faecal worm egg count (FWEC). The Moredun FWEC method (2011) was used for *Strongylus* spp., ascarids and cestodes (Mathews and Lester, 2015), methylene blue staining sedimentation for *Fasciola hepatica* (Graham-Brown et al., 2019) and the modified Baermann method for *Dictyocaulus arnfieldii* (Nicholls et al., 1979).

Results were then sent to the NAU vet and added to the animal´s notes in TDS database by a member of the veterinary laboratory.

During the NAU period at least one more sample was taken to assess their parasitology status. In cases with a high burden of parasites (≥300 strongyle eggs per gram), or if endoparasites other than strongyles were found, animals had further faecal samples taken to assess the efficacy of the prescribed anthelmintics.

Dated parasitology results and the date of administration of anthelmintics during their time in the NAU were recorded in TDS database.

4.2.4.2. Haematology and biochemistry panels

One week after arrival at the NAU a blood sample was taken as per Donkey Sanctuary protocol. Haematology, biochemistry and endocrinology panels were run (ACTH, insulin) for every animal. Parameters and donkey ranges can be found in Appendix 9, and they are donkey and mule specific. The following equipment was used to analyse blood samples at TDS veterinary laboratory (Table 4.3).

Table 4.3. Laboratory equipment used at TDS

Laboratory blood sample tests	Equipment used
Biochemistry	Roche Integra 400+
Haematology	Sysmex XT -2000 VET
Coagulation	Sysmex CA-50
Endocrinology	TOSOH AIA-360

4.2.4.3. Weight on arrival and departure

As a minimum, animals are weighed on arrival and prior to departure from the NAU farm. Weights (kg) were recorded into TDS database by the NAU grooms. If an animal’s bodyweight changed by over 5% the NAU vet was informed and the weight loss investigated.

Precision scales were used to weigh the donkeys (Curragh model of Horseweight® scales).

4.2.4.4. Mortality records

Records of any deaths were kept at the NAU. Cause of death was confirmed at a *post-mortem* performed by a TDS pathologist and entered in TDS database.

4.2.5. NAU/reception protocol

There is an established protocol used at the reception farm, although in some cases this may be modified depending on the individual needs of the donkey or mule.

The Donkey Sanctuary policy is that donkeys, mules and ponies must spend at least six weeks in the NAU before they can be considered for movement onto a sanctuary farm. There are occasions where donkeys and mules are considered unfit to travel after six weeks in the NAU, although reasons for delays are not recorded in the database.

Reasons for a delayed departure could include:

- Heavily pregnant mares may need to stay until foaling.
- Recently castrated animals remain at the NAU farm for 6 weeks post-castration as part of TDS policy, so unless castrated during their first week, those animals will be delayed until considered fit to travel by a vet.
- Donkeys, ponies and mules that are not considered fit to travel for veterinary reasons.
- Closure of the destination farm or the NAU farm due to changes in their biosecurity status.
- Lack of space at the destination farm.

The following protocol was followed for all animals during their NAU period:

Procedures for New Arrival Donkeys at the NAU, Sidmouth, Devon 2014

Prior to Entry

Details and requirements of each individual donkey discussed at length and correct dietary and management procedures put in place prior to arrival. Owners and vets are contacted by sanctuary vets if necessary to discuss concerns.

Arrival Day

Allowed to settle in and staff monitor closely to check eating, drinking and settling okay. Donkeys receive treatment if necessary on arrival.

Day 1

Admission medical to assess medical conditions, prioritise veterinary examinations and any treatments required. Faecal sample collected. Decision made as to whether donkey should be wormed and if so, which product should be used. This decision is made after checking worming history, recent FWEC results, body condition and medical problems. If there are no obvious problems, and no recent history of worming, the chosen wormer would be moxidectin according to body weight. Lice burden is assessed and a decision made as to when and how the donkey should be treated. If appropriate the donkey or pair of donkeys will be introduced to a group of donkeys.

Day 2

FWEC results usually return, which may determine further worming requirements, i.e. if the donkey has fluke or tapeworm for instance. Constant monitoring to check that the donkey has settled and is eating and drinking normally. Pending their FWEC, donkeys are allowed out to grass - normally 48 h post-worming, although sometimes special arrangements are required, such as droppings being picked up more thoroughly from the field.

Week 1

Farriery: normally done in the NAU on Tuesdays or Wednesdays providing any necessary radiographs have been taken.

1st blood sample: normally taken on Thursdays for haematology, biochemistry, ACTH & insulin.

Weighting: all donkeys are weighed and weights recorded on the veterinary system.

Stallions are assessed and castrated as early as is convenient so that they can be socialised after recovery.

Week 2

Vaccines: previous history checked and plans made to bring them into alignment with the Donkey Sanctuary herd (the herd are vaccinated every September). It may take several years to achieve alignment without over-vaccination so a schedule is added to the donkey's record for follow up. A lot of donkeys do not have any vaccination history so start a new course of 'flu & tetanus. This is started in week two if the donkey is clinically well.

Microchip: if the donkey does not have a microchip, this is given at the same time as their 1st 'flu & tetanus vaccine

Management of each donkey is continually assessed, and any changes required are discussed with the NAU Manager and NAU Vet.

Week 3

Passport: If the animal does not have a valid passport before coming into the Sanctuary, a passport is prepared.

Once the donkey has settled, any ongoing procedures are carried out such as diagnostic ultrasound, dental treatment, sarcoid treatment etc. Obviously all treatments are prioritised and some will have been done before this time.

Week 4

On-going assessments, etc.

Week 5

Dental and other investigations are performed if still outstanding.

Vaccines: 2nd influenza and tetanus vaccines.

2nd weighing: any donkeys that have lost more than 10 kg are blood sampled along with any donkeys that had abnormal results on their first sample - all of these decisions are at the discretion of the NAU Vet.

Meeting to discuss placement of each group and the requirements of each individual donkey. This ensures that they are placed in the right groups at the right farms according to their needs. Guardian suitability is also discussed, enabling potential plans to be made for each donkey.

Week 6

If there are no problems in the group and placements have been found for the donkeys, they can be moved to a Donkey Sanctuary Farm.

Please note this is just a guide as each animal is assessed individually.

We currently have pregnant mares in the NAU who are close to foaling, so are being kept to reduce stress and complications.

If any group has a virus, we wait for 28 days after the animal is clear of clinical signs before movement to a sanctuary herd.

Please note this guide is appropriate for the NAU at TDS in Devon but it is likely that there might be different considerations in a different set up and country.

4.3. Statistical analysis

Data from the Microsoft Access 2016 database were exported for analysis in IBM SPSS 19.0 for Windows®. Categorical variables were coded and described using relative frequencies (percentages) and absolute frequencies (n). Continuous variables were described using mean, median, standard deviation and ranges depending on normality of distribution. Values in the populations were estimated using confidence intervals.

The association between two categorical variables was assessed using Pearson's Chi-square test (X^2) or Likelihood Ratio test (LR) or Fisher's exact test (F), when it will not be applied.

The test assessed if there were statistically significant differences between the expected frequencies and the observed frequencies (McHugh, 2013). In analysis when more than

20% of expected values were lower than 5, the Fisher's exact test was used for tables 2x2 and the likelihood ratio test was used in the rest of cases.

Additionally, dependence between two variables was confirmed by calculating the adjusted standardised residuals (ASR); under the null hypothesis that the two categorical variables are independent, an ASR of more than 1.96 indicated that the number of cases in that cell were significantly greater than would be expected if the null hypothesis were true. An adjusted residual that was less than -1.96 indicated that the number of cases in that cell was significantly fewer than would be expected if the null hypothesis were true, and in consequence, the category was underrepresented (Agresti, 2002).

To assess the association between a qualitative and a quantitative variable a mean comparison was carried out (depending on normality of the quantitative variable, evaluated with the Kolmogorov-Smirnov test): Student's t (normal variables) or Mann-Whitney (non-normal variables) to compare two groups and ANOVA (normal variables) or Kurskal-Wallis (non-normal variables) to compare more than two groups… Finally, the association of two quantitative variables was checked using correlation coefficients of Pearson or Spearman (depending on normality).

Other analytical techniques were used depending on previous results such as survival analysis, logistic regression or general linear models.

The alpha error was set at 0.05.

5. Results and discussion

5.1. Description of studied population

5.1.1. Distribution of animals by sex and species

A total of 644 animals arrived into the NAU located at TDS in Sidmouth, Devon, UK between the 15th of July 2013 and the 25th of September 2015.

The majority of animals admitted were donkeys (92.5%), although there were also mules (5.7%) (this group included 3 hinnies) and ponies (1.7%). It was observed (Table 5.1), that a third of the animals were female and the rest of them male. The majority of animals were geldings (53.4%), with a small number of stallions (14.9%). No significant differences were found in the distribution of sex by species, although the percentage of geldings was slightly higher in ponies.

Table 5.1. Distribution of animals by sex and species

Sex	**Donkey** (n=596)	**Mule** (n=37)	**Pony** (n=11)	**Total** (n=644)
Mare	31.5%	35.1%	27.3%	**31.7%**
Gelding	53.0%	56.8%	63.6%	**53.4%**
Stallion	15.4%	8.1%	9.1%	**14.9%**

Significance of Likelihood Ratio test, p=0.684

The typical animal admitted into TDS seems to differ from that found in small animal shelter admissions. Marston et al. (2004) found that amongst dogs and cats, the typical shelter admission was entire and a small size. Additionally, Patroneck et al. (1996) also found that shelter dogs were likely to be entire.

The percentage of donkey stallions identified in the study was 15.4%. Identifying the reasons why owners are keeping animals entire could provide vital information for the charity to evaluate strategies to ensure early castration of donkeys where possible.

Sprayson and Thiemann (2007) reported that some young male donkeys can start to demonstrate undesirable sexual behavior at 5 or 6 months of age. The authors also reported that older entire donkeys may be aggressive to companion geldings and hard to control around mares. The ideal time of castration given by the authors was between 6-18 months of age. A survey of the reasons why owners in Australia do not neuter their dogs (Australian Bureau of Statistics, 1995) showed that 27% regarded their animals as breeding stock, 18% believed their animals were too old, 15.5% cited personal ethical reservations about neutering, and 14.5% cited cost as their primary reason for not neutering their animals (Marston et al., 2004).

Intake documents did not explore the reasons for leaving donkeys entire and this could be something to include in the future. Overbreeding in relation to current demands has been considered a welfare raising concern in domestic animals (Farstad, 2018).

5.1.2. Age of the animals

The average donkey age was 9.62 years (range: 0-42 years) and greater than mules (7.68 years) (p_{MW}=0.025). Ponies were also older than mules (p_{MW}=0.012). Furthermore, the age of ponies (mean: 13.27 years) was not significantly greater than the donkeys (p_{MW}=0.098) (Table 5.2).

Table 5.2. Age (years) stratified by species

Species	n	Mean	SD	Q1	Median	Q3	min	Max
Donkey	596	9.62 [b]	7.09	4.13	8.00	13.00	0.0	42.0
Mule	37	7.68 [a]	6.59	3.00	4.00	12.50	1.0	25.0
Pony	11	13.27 [b]	7.43	6.00	17.00	20.00	3.0	23.0

Significance of Kruskal-Wallis test, p=0.018

Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test (p_{MW}<0.050)

The average age of donkeys in the UK has been estimated as over 20 years (Cox et al., 2010) and the typical Donkey Sanctuary donkey (Sidmouth, UK) has previously been described as a sedentary, non-working, elderly animal (Morrow et al., 2010).

The age of relinquished animals was given by the owners and assessed by welfare advisers using the age in the passport (if present) and by examination of incisor teeth (Muylle et al., 1999). Welfare advisers have received specific training in dental ageing, and animals are also assessed by a member of the veterinary team on arrival and an equine dental technician a few weeks after arrival at the NAU.

Dental examination has been found to be useful in the estimation of age in donkeys (Muylle et al., 2010).

In the studied population, donkey mares were found to be significantly older (mean: 11.23 years) than geldings (p_{MW}=0.047) and stallions (p_{MW}<0.001). Geldings were also found to be older (mean: 9.84 years) than stallions (mean: 5.52 years) (p_{MW}<0.001). The oldest gelding was 42 years old (Table 5.3).

There were no significant age differences by sex in mules, with the oldest mule being a 25 year old gelding.

There was only one pony stallion arriving into the NAU within the study period and castrated ponies were significantly older (mean: 17.7 years) than female ponies (mean: 5.6 years) (p_{MW}=0.030).

Table 5.3. Age (years) stratified by species and sex

Species	Sex	n	Mean	SD	Q1	Median	Q3	min	Max	p_{KW}
Donkey	Mare	188	11.23 [a]	7.52	5.00	10.00	15.00	0.1	37.0	<0.001
	Gelding	316	9.84 [b]	6.98	5.00	8.00	12.75	1.0	42.0	
	Stallion	92	5.52 [c]	4.58	2.00	4.00	8.00	0.0	21.0	
Mule	Mare	13	9.38 [d]	6.72	3.00	8.00	15.50	1.0	20.0	0.265
	Gelding	21	7.28 [d]	6.75	3.00	4.00	10.50	1.0	25.0	
	Stallion	3	3.00 [d]	0.00	3.00	3.00	3.00	3.0	3.0	
Pony	Mare	3	5.66 [e]	2.51	3.00	6.00	-	3.0	8.0	0.047
	Gelding	7	17.71 [f]	5.15	17.00	18.00	2.00	7.0	23.0	
	Stallion	1	5.00 [ef]	-	5.00	5.00	5.00	5.0	5.0	

KW: Significance of Kruskal-Wallis test. Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test (p_{MW}<0.050)

A "geriatric" donkey is defined as one that has reached the age of 20 years or more (Sprayson et al., 2008). Burden et al. (2013) stated that donkeys frequently live until at least 30 years of age in the UK. In contrast, life expectancy in working donkeys in other countries is likely to be shorter (Pritchard et al., 2005). This study found that 9.4% of the relinquishments were over 20 years old with a maximum age of 42.0 years (Table 5.3).

Statistically significant positive association was found between sex and geriatric donkeys (p_{X2}=0.004). It was observed (Table 5.4) that amongst the geriatric population there was a significantly higher proportion of mares (13.3%) than geldings or stallions. Geriatric stallions are usually considered high risk animals at TDS, as stallions need to be castrated soon after arrival as part of the charity´s non breeding policy and for management reasons. It was observed that the number of geriatric stallions was lower than expected (1.1%). Normally, discussions are held with the owners of geriatric donkeys especially if they are stallions, to explain the concerns around bringing these types of animals into the charity.

Table 5.4. Geriatric donkeys (≥ 20 years old) stratified by sex

Sex	n	**Geriatrics** (≥ 20 years)
Mare	188	13.30% [H]
Gelding	316	9.50%
Stallion	92	1.10% [L]
Total	**596**	**9.40%**

Significance of Pearson's Chi-square test, p=0.004

[H]: Observed proportion significantly higher than expected (p<0.050)

[L]: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between the age of donkeys and their sex (p_{X2}<0.001). As seen in Table 5.5 that there were more stallions than expected in the category of donkeys ≤1 year old (50.0%), while there were fewer geldings in the same age category (25.0%). Moreover, there were more stallions than expected in the 1-3 years category (40.6%) while fewer geldings were found in this age category (30.4%).

More donkeys than expected were found to be geldings in the age category of 5-20 years (58.6%) while fewer donkeys were found to be stallions (9.6%).

Finally, it was observed that there were more female donkeys than expected in the greater than 20 years category (44.6%), with fewer donkey stallions than expected in the same category (1.8%).

This finding suggests that donkeys are more commonly being castrated before reaching the age of 3; from this age onwards the number of stallions decreases progressively. Ideally, castration of male donkeys should be carried out between the ages of 6-18 months (Sprayson and Thiemann, 2007).

Table 5.5. Age (categorised) of donkeys stratified by sex

Age	n	Mare	Gelding	Stallion
≤ 1 y	28	25.0%	25.0%^{L}	50.0%^{H}
(1 y, 3 y]	69	29.0%	30.4%^{L}	40.6%^{H}
(3 y, 5 y]	110	27.3%	57.3%	15.5%
(5 y, 20 y]	333	31.8%	58.6%^{H}	9.6%^{L}
> 20 y	56	44.6%^{H}	53.6%	1.8%^{L}
Total	**596**	**31.5%**	**53.0%**	**15.4%**

Significance of Pearson's Chi-square test, $p<0.001$

^{H}: Observed proportion significantly higher than expected ($p<0.050$)

^{L}: Observed proportion significantly lower than expected ($p<0.050$)

5.1.3. Origin of animals by UK region

There were no statistically significant differences found between the origin of animals by UK region and species (p_{LR}=0.469) (Table 5.6). A large percentage of donkeys came from the South West (27.3%) which is the closest region to TDS whilst smaller percentages of donkeys came from Greater London (0.5%) and then further regions such as Northern Ireland (3.7%) and Scotland (4.8%). Interestingly, only 0.6% of donkeys were considered to be of unknown origin (donkeys with lack of information of ownership or origin during the preceding 2 years or with a suspicion that may have entered the UK from abroad in the last 2 years) (Figure 5.1).

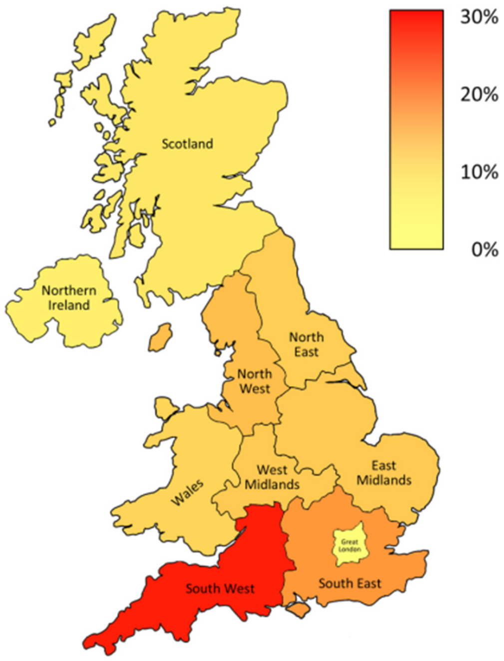
It could be interesting for the charity to survey donkey owners on the reasons why they are keeping donkeys. Proximity to the charity could influence people's perception of donkeys, and access to engage with donkeys at TDS could influence their decision to keep them as pets.

Table 5.6. Origin of animals by UK region stratified by species

Origin region	Donkey (n=579)	Mule (n=37)	Pony (n=11)	Total (n=627)
South West	28.2%	13.5%	27.3%	**27.3%**
South East	15.9%	13.5%	18.2%	**15.8%**
North West	11.2%	8.1%	18.2%	**11.2%**
East Midlands	9.3%	18.9%	0.0%	**9.7%**
West Midlands	9.2%	16.2%	18.2%	**9.7%**
North East	9.0%	10.8%	0.0%	**8.9%**
Wales	7.4%	13.5%	9.1%	**7.8%**
Scotland	4.7%	5.4%	9.1%	**4.8%**
Northern Ireland	4.0%	0.0%	0.0%	**3.7%**
Unknown origin	0.7%	0.0%	0.0%	**0.6%**
Greater London	0.5%	0.0%	0.0%	**0.5%**

Significance of Likelihood Ratio test, p=0.469

Figure 5.1. Distribution of origin of animals by UK region



Statistically significant differences were found between the origin of animals by UK region and sex ($p_{LR}<0.001$). Table 5.7 shows that statistically more mares than expected were arriving from the South West (43.3%) and Wales (44.9%) while less mares than expected were relinquished from the East Midlands (18.0%) and West Midlands (19.7%).

With regards to the relinquished geldings, statistically more geldings than expected were relinquished from the West Midlands (73.8%) while less than expected were arriving from the South West (41.5%).

Table 5.7. Origin of animals by UK region stratified by sex

Origin region	n	Mare	Gelding	Stallion
South West	171	43.3%[H]	41.5%[L]	15.2%
South East	99	30.3%	52.5%	17.2%
North West	70	32.9%	50.0%	17.1%
East Midlands	61	18.0%[L]	59.0%	23.0%
West Midlands	61	19.7%[L]	73.8%[H]	6.6%
North East	56	21.4%	64.3%	14.3%
Wales	49	44.9%[H]	40.8%	14.3%
Scotland	30	23.3%	63.3%	13.3%
Northern Ireland	23	30.4%	65.2%	4.3%
Unknown origin	4	0.0%	50.0%	50.0%
Greater London	3	66.7%	0.0%	33.3%
Total	**627**	**31.9%**	**52.8%**	**15.3%**

Significance of Likelihood Ratio test, p<0.001

[H]: Observed proportion significantly higher than expected (p<0.050)

[L]: Observed proportion significantly than expected (p<0.050)

There were statistically significant differences found between the age of donkeys and their region of origin (p_{KW}=0.001).

Interestingly, donkeys were significantly younger (younger than 10 years old) when coming from Northern regions (Table 5.8). Older donkeys kept in homes further away from TDS would have been moved to the closest holding base if considered unfit to be transported long distances.

Table 5.8. Estimated age (years) of donkeys at arrival stratified by region of origin

Origin region	n	Mean	SD	Q1	Median	Q3	min	Max
Unknown origin	4	3.75 [a]	2.75	1.3	3.5	6.5	1.0	7.0
Scotland	27	7.72 [ab]	4.49	4.0	7.0	9.0	0.5	18.0
Northern Ireland	23	6.83 [a]	5.13	3.0	6.0	8.0	2.0	25.0
North East	52	8.77 [ab]	6.37	4.0	7.0	13.3	1.0	29.0
North West	65	7.92 [ab]	5.70	4.0	7.0	10.0	0.1	30.0
East Midlands	54	7.94 [a]	6.50	3.0	5.5	10.0	0.3	24.0
West Midlands	53	11.25 [b]	7.06	6.0	8.0	14.5	4.0	30.0
Wales	43	11.70 [b]	7.44	5.0	10.0	19.0	0.3	27.0
South West	163	10.05 [b]	7.33	5.0	8.0	14.0	0.0	42.0
South East	92	11.17 [b]	8.60	5.0	9.0	14.8	0.7	37.0
Greater London	3	12.33 [b]	5.03	7.0	13.0	-	7.0	17.0
Total	**579**	**9.62**	**7.09**	**4.1**	**8.0**	**13.0**	**0.0**	**42.0**

Significance of Kruskal-Wallis test, p=0.001. Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test (p_{MW}<0.050).

Statistically significant differences were found between the donkey's region of origin and their age (p_{LR}=0.003). Table 5.9 shows that more donkeys over the age of 20 were coming from the South East than expected (17.4%).

Secondly, it was observed that for donkeys aged 1-3 years, fewer than expected came from the West Midlands (0.0%). Moreover, fewer donkeys in that same age category came from Wales (2.3%).

Thirdly, more donkeys than expected aged ≤1 year came from the East Midlands (11.1%), whilst amongst donkeys aged 5-20 years fewer came from the East Midlands (40.7%).

Finally, it was found that for donkeys aged 1-3 years, more than expected were coming from Northern Ireland (26.1%).

Table 5.9. Age (categorised) stratified by origin of donkeys by UK region

Origin region	n	≤ 1 y	(1 y, 3 y]	(3 y, 5 y]	(5 y, 20 y]	> 20 y
South West	163	4.3%	13.5%	14.1%	57.7%	10.4%
South East	92	5.4%	10.9%	15.2%	51.1%	17.4%^{H}
West Midlands	53	0.0%	0.0%^{L}	20.8%	67.9%	11.3%
Wales	43	2.3%	2.3%^{L}	25.6%	55.8%	14.0%
East Midlands	54	11.1%^{H}	18.5%	20.4%	40.7%^{L}	9.3%
North East	52	5.8%	13.5%	19.2%	57.7%	3.8%
North West	65	6.2%	12.3%	23.1%	55.4%	3.1%
Northern Ireland	23	0.0%	26.1%^{H}	17.4%	52.2%	4.3%
Scotland	27	3.7%	14.8%	18.5%	63.0%	0.0%
Greater London	3	0.0%	0.0%	0.0%	100.0%	0.0%
Unknown origin	4	25.0%	25.0%	25.0%	25.0%	0.0%
Total	**579**	**4.8%**	**11.9%**	**18.1%**	**55.6%**	**9.5%**

Significance of Likelihood Ratio test, p=0.003

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between geriatric animals and their origin by UK region (p_{LR}=0.021). During the study period the South East generated a significantly higher proportion of geriatric animals (17.4%) (Table 5.10 and Figure 5.2).

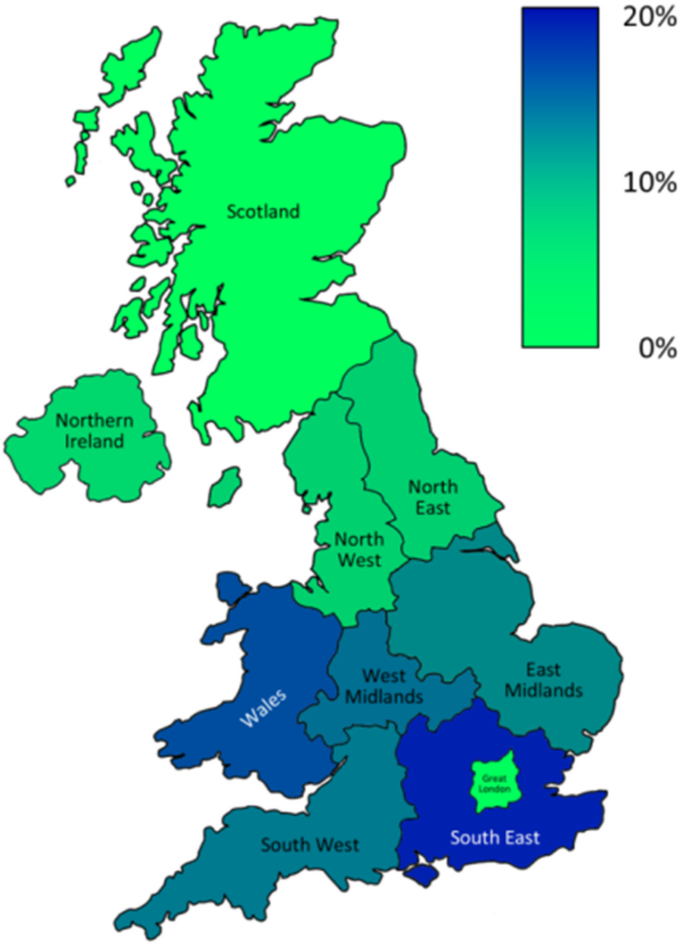
Table 5.10. Frequency of geriatric animals stratified by UK region of origin

Origin region	n	Geriatric
South West	163	10.4%
South East	92	17.4%[H]
West Midlands	53	11.3%
Wales	43	14.0%
East Midlands	54	9.3%
North East	52	3.8%
North West	65	3.6%
Northern Ireland	23	3.1%
Scotland	27	0.0%
Greater London	3	0.0%
Unknown origin	4	0.0%
Total	**579**	**9.5%**

Significance of Likelihood Ratio test, p=0.021

[H]: Observed proportion significantly higher than expected (p<0.050)

Figure 5.2. Frequency of geriatric animals by UK region



5.1.4. Acquisition of the animals

Despite the large donkey population reported in the UK, there is limited published information regarding demographic characteristics, management and health in the UK (Cox et al., 2010). To date, no reports with regards to the acquisition of UK donkeys have been published.

First of all, it was found that the majority of donkeys arriving into the NAU at TDS were from unknown acquisition/no answer given (28.4%) (not to be confused with animals from unknown origin (donkeys with lack of information of ownership or origin during the preceding 2 years or with a suspicion that may have entered the UK from abroad in the last 2 years) and privately bought origin (26.0%) (Table 5.11). More than a quarter of animals in total were said to have been bought from a private owner (26.7%). Information regarding acquisition and origin was collected by welfare advisers on their first visit to the owners and/or the first phone contact by a member of the welfare department at TDS.

Table 5.11. Distribution of animals of each species by acquisition origin

Type of acquisition	**Donkey** (n=596)	**Mule** (n=37)	**Pony** (n=11)	**Total** (n=644)
Unknown acquisition	28.4% ^{H}	8.1% ^{L}	36.4%	**27.3%**
Bought private owner	26.0%	35.1%	36.4%	**26.7%**
Born at home	11.2%	8.1%	9.1%	**11.0%**
Local dealer	10.9%	5.4%	0.0%	**10.4%**
Rescued	3.7% ^{L}	13.5% ^{H}	0.0%	**4.2%**
Bought locally	4.0%	0.0%	0.0%	**3.7%**
Bought from Traveller	2.5%	8.1% ^{H}	0.0%	**2.8%**
Bought from breeder	2.7%	2.7%	0.0%	**2.6%**
Imported	2.0%	2.7%	0.0%	**2.0%**
Local farm	1.5% ^{L}	5.4%	9.1%	**1.9%**
Local market	1.5% ^{L}	8.1% ^{H}	0.0%	**1.9%**
Gift	1.5%	0.0%	9.1% ^{H}	**1.6%**
Bought from beach op.	1.5%	0.0%	0.0%	**1.4%**
Bought in Ireland	1.2%	0.0%	0.0%	**1.1%**
Born at DS	1.0%	0.0%	0.0%	**0.9%**
Inherited	0.3%	0.0%	0.0%	**0.3%**
Auction	0.0% ^{L}	2.7% ^{H}	0.0%	**0.2%**

Significance of Likelihood Ratio test, p=0.034

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

It was also found that fewer donkeys than expected were described as rescued (3.7%), acquired from a local farm (1.5%), from a local market (1.5%) or from auction (0.0%).

Secondly, it was observed in Table 5.11 that the majority of mules were said to have been bought privately (35.1%). Moreover, a statistically significant greater number of mules than expected were said to be rescued (13.5%), bought from a Traveller (8.1%), acquire from a local market (8.1%) and by auction (2.7%) while fewer mules than expected were from an unknown/no answer acquisition origin.

Finally, it was found in Table 5.11 that significantly higher numbers of ponies were acquired as gifts (9.1%) than expected.

Statistically significant differences were found between the origin/region of animals and their type of acquisition ($p_{LR}<0.001$) (Table 5.12). We did not obtain information about region of origin of some animals (n=17).

It was found that there were more animals than expected from Scotland (43.3%), Northern Ireland (47.8%) and the South West (33.9%) where the type of acquisition was unknown. It also was found that there were statistically less animals than expected from the North West (14.3%) and the East Midlands (11.5%) with an unknown type of acquisition.

It was identified that more animals than expected from the South East were acquired at auction (1.0%) (Table 5.12); It was also seen that more animals than expected from the North East were bought from breeders (10.7%) and more than expected from West Midlands were bought from Ireland (6.6%). With regards to Greater London, more animals than expected were reported to be bought from Travellers (66.7%), and more animals than expected were said to be rescued (33.3%) from the same region.

Additionally, it was also identified that statistically more animals from Scotland were acquired as a gift (6.7%) while less animals were bought from a private owner in the same region (6.7%). It was also found that more animals from Northern Ireland were bought locally (13.0%) and with regards to the West Midlands, more animals than expected were bought from a private owner (49.2%).

Table 5.12 shows that less animals than expected from the South West were bought privately (19.9%) while more animals than expected from the same region were inherited (1.2%). It was also seen that more animals than expected from the South West were said to be acquired from local farms (4.1%) and more than expected were rescued (8.2%) while less animals than expected were bought from Travellers (0.6%).

Table 5.12. Type of acquisition stratified by origin of animals by UK region

Origin region	n	Bought private owner	Unknown acquisition	Born at home	Local dealer	Rescued
South West	171	19.9%^{L}	33.9%^{H}	13.5%	6.4%	8.2%^{H}
South East	99	32.3%	26.3%	8.1%	12.1%	3.0%
North West	70	27.1%	14.3%^{L}	14.3%	15.7%	2.9%
East Midlands	61	34.4%	11.5%^{L}	13.1%	11.5%	6.6%
West Midlands	61	49.2%^{H}	19.7%	4.9%	3.3%	1.6%
North East	56	23.2%	17.9%	8.9%	10.7%	1.8%
Wales	49	30.6%	30.6%	14.3%	10.2%	2.0%
Scotland	30	6.7%^{L}	43.3%^{H}	10.0%	30.0%^{H}	0.0%
Northern Ireland	23	13.0%	47.8%^{H}	17.4%	4.3%	0.0%
Unknown origin	4	0.0%	100%^{H}	0.0%	0.0%	0.0%
Greater London	3	0.0%	0.0%	0.0%	0.0%	33.3%^{H}
Total	**627**	**27.0%**	**26.5%**	**11.3%**	**10.2%**	**4.3%**

Significance of Likelihood Ratio test, p<0.001

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

Table 5.12. (cont.) Type of acquisition stratified by origin of animals by UK region

Origin region	n	Bought locally	Bought from Travellers	Bought from breeder	Imported	Local farm	Local market
South West	171	1.8%	0.6%^{L}	2.3%	3.5%	4.1%^{H}	1.2%
South East	99	4.0%	2.0%	3.0%	3.0%	0.0%	0.0%
North West	70	7.1%	4.3%	1.4%	0.0%	2.9%	1.4%
East Midlands	61	3.3%	11.5%^{H}	1.6%	0.0%	0.0%	4.9%
West Midlands	61	6.6%	1.6%	1.6%	0.0%	1.6%	1.6%
North East	56	3.6%	0.0%	10.7%^{H}	5.4%	1.8%	8.9%^{H}
Wales	49	0.0%	2.0%	2.0%	2.0%	0.0%	0.0%
Scotland	30	3.3%	0.0%	0.0%	0.0%	0.0%	0.0%
Northern Ireland	23	13.0%^{H}	0.0%	0.0%	0.0%	4.3%	0.0%
Unknown origin	4	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Greater London	3	0.0%	66.7%^{H}	0.0%	0.0%	0.0%	0.0%
Total	**627**	**3.8%**	**2.7%**	**2.7%**	**2.1%**	**1.9%**	**1.9%**

Significance of Likelihood Ratio test, p<0.001

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

Table 5.12. (cont.) Type of acquisition stratified by origin of animals by UK region

Origin region	n	Gift	Bought from beach op	Bought in Ireland	Born at DS	Inherited	Auction
South West	171	0.6%	1.8%	0.0%	1.2%	1.2%[H]	0.0%
South East	99	3.0%	0.0%	0.0%	2.0%	0.0%	1.0%[H]
North West	70	1.4%	1.4%	4.3%	1.4%	0.0%	0.0%
East Midlands	61	0.0%	0.0%	0.0%	1.6%	0.0%	0.0%
West Midlands	61	0.0%	1.6%	6.6%[H]	0.0%	0.0%	0.0%
North East	56	3.6%	3.6%	0.0%	0.0%	0.0%	0.0%
Wales	49	2.0%	4.1%	0.0%	0.0%	0.0%	0.0%
Scotland	30	6.7%[H]	0.0%	0.0%	0.0%	0.0%	0.0%
Northern Ireland	23	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Unknown origin	4	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Greater London	3	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	**627**	**1.6%**	**1.4%**	**1.1%**	**1.0%**	**0.3%**	**0.2%**

Significance of Likelihood Ratio test, p<0.001

[H]: Observed proportion significantly higher than expected (p<0.050)

[L]: Observed proportion significantly lower than expected (p<0.050)

There was a statistically significant association between the type of acquisition and geriatric donkeys (p_{LR}=0.011) (Table 5.13). It was found that more geriatric donkeys than expected were acquired by inheritance (50.0%), and additionally more than expected were rescued by their owners (27.3%). On the other hand, significantly fewer geriatric donkeys than expected were born at home (1.5%).

Table 5.13. Frequency of geriatric donkeys stratified by type of acquisition

Type of acquisition	n	Geriatric
Inherited	2	50.0% [H]
Rescued	22	27.3% [H]
Bought from beach op.	9	22.2%
Gift	9	22.2%
Unknown acquisition	169	12.4%
Local farm	9	11.1%
Bought private owner	155	10.3%
Imported	12	8.3%
Bought from breeder	16	6.3%
Local dealer	65	4.6%
Bought locally	24	4.2%
Born at home	67	1.5% [L]
Born at DS	6	0.0%
Bought from Travellers	15	0.0%
Bought in Ireland	7	0.0%
Local market	9	0.0%
Total	**596**	**9.4%**

Significance of Likelihood Ratio test, p=0.011

[H]: Observed proportion significantly higher than expected (p<0.050)

[L]: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between the month of arrival of donkeys and their origin region ($p_{LR}<0.001$; Table 5.14). The studied period did not comprise of three full years therefore interpretation of results might be difficult.

Taking the previous comment into account, it was observed that there appeared to be more donkeys than expected arriving in January from Scotland (14.8%), more donkeys than expected arrived in February from the South West (13.5%), whilst fewer came from the North West in the same month (0.0%). More donkeys than expected that arrived in March were from the East Midlands (14.8%) and Greater London (33.3%), and there were more donkeys than expected arriving from the East Midlands in April (14.8%) and June (22.2%). The number of donkeys arriving from Wales in June (20.9%) and July (23.3%) was also higher than expected.

When looking at the month of August, it was observed that there were more donkeys than expected arriving from an unknown origin (100.0%), Northern Ireland (100.0%) and Greater London (66.7%) while fewer than expected came in the same month from the East Midlands (1.9%), Wales (4.7%), North East (5.8%) and the South West (6.1%). These findings could be explained as long transport movements, especially those coming from Northern Ireland might be planned carefully to coincide with better weather/sea conditions for the ferry transport of donkeys.

Table 5.14. Arrival month of donkeys stratified by region of origin

		Arrival month					
Origin region	**n**	**January**	**February**	**March**	**April**	**May**	**June**
Unknown origin	4	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Scotland	27	14.8%^{H}	11.1%	0.0%	0.0%	0.0%	11.1%
Northern Ireland	23	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
North East	52	1.9%	1.9%	9.6%	1.9%	7.7%	11.5%
North West	65	6.2%	0.0%^{L}	3.1%	9.2%	10.8%	10.8%
East Midlands	54	1.9%	11.1%	14.8%^{H}	14.8%^{H}	7.4%	22.2%^{H}
West Midlands	53	5.7%	5.7%	3.8%	1.9%	1.9%	0.0%^{L}
Wales	43	4.7%	70.0%	4.7%	4.7%	4.7%	20.9%^{H}
South West	163	7.4%	13.5%^{H}	4.3%	4.9%	7.4%	6.1%
South East	92	7.6%	6.5%	5.4%	2.2%	8.7%	8.7%
Greater London	3	0.0%	0.0%	33.3%^{H}	0.0%	0.0%	0.0%
Total	**579**	**5.9%**	**7.6%**	**5.5%**	**4.8%**	**6.6%**	**9.5%**

Significance of Likelihood Ratio test, p<0.001

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

Table 5.14. (cont.) Arrival month of donkeys stratified by region of origin

Origin region	n	Arrival month July	August	September	October	November	December
Unknown origin	4	0.0%	100.0%^{H}	0.0%	0.0%	0.0%	0.0%
Scotland	27	14.8%	18.5%	22.2%^{H}	7.4%	0.0%	0.0%
Northern Ireland	23	0.0%	100.0%^{H}	0.0%	0.0%	0.0%	0.0%
North East	52	3.8%	5.8%^{L}	17.3%	17.3%^{H}	15.4%	5.8%
North West	65	9.2%	16.9%	12.3%	7.7%	7.7%	6.2%
East Midlands	54	0.0%^{L}	1.9%^{L}	1.9%^{L}	14.8%	1.9%^{L}	7.4%
West Midlands	53	5.7%	20.8%	5.7%	3.8%	41.5%^{H}	3.8%
Wales	43	23.3%^{H}	4.7%^{L}	0.0%^{L}	14.0%	7.0%	4.7%
South West	163	11.7%	6.1%^{L}	11.0%	9.2%	5.5%^{L}	12.9%^{H}
South East	92	10.9%	13.0%	19.6%^{H}	8.7%	5.4%	3.3%
Greater London	3	0.0%	66.7%^{H}	0.0%	0.0%	0.0%	0.0%
Total	**579**	**9.3%**	**14.5%**	**10.9%**	**9.5%**	**9.2%**	**6.7%**

Significance of Likelihood Ratio test, p<0.001

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

It was also observed that there were more donkeys than expected arriving in September from Scotland (22.2%) and the South East (19.6%) while there were fewer coming from the East Midlands (1.9%) and Wales (0.0%).

When looking at October, it was found that there were more donkeys than expected arriving from the North East (17.3%).

There were also more donkeys than expected coming in November from the West Midlands (41.5%) while fewer than expected arrived in the same month from the South West (5.5%) and East Midlands (1.9%).

It was observed that there were more donkeys than expected arriving in December from the South West (12.9%). Movements into The Donkey Sanctuary during the winter period are affected by weather conditions which could explain local transport rather than long distance.

Statistically significant differences were found between the donkey's year of arrival and their region of origin (p_{X2}<0.001; Table 5.15). Despite finding statistically significant differences, results might be difficult to interpret as the study period was from July 2013 to September 2015 so they were not all full years.

Taking into account previous considerations, it was observed that there were more donkeys than expected from an unknown origin arriving in 2013 (100.0%), more than expected were coming from Northern Ireland in the same year (95.7%) whilst fewer arrived from the West Midlands (15.1%), and the South West (17.8%).

It was also observed that in 2014 there were more donkeys than expected arriving from the West Midlands (64.2%) and Wales (65.1%) whilst fewer than expected were from Scotland (22.2%) and Northern Ireland (0.0%).

On the other hand, in 2015 it was seen that there were more donkeys than expected arriving from the East Midlands (44.4%) and fewer arrived from Northern Ireland (4.3%) and Wales (11.6%).

Table 5.15. Arrival year of donkeys stratified by region of origin

Origin region		Arrival year		
	n	**2013**	**2014**	**2015**
Unknown origin	4	100.0%^{H}	0.0%	0.0%
Scotland	27	37.0%	22.2%^{L}	40.7%
Northern Ireland	23	95.7%^{H}	0.0%^{L}	4.3%^{L}
North East	52	34.6%	36.5%	28.8%
North West	65	27.7%	35.4%	36.9%
East Midlands	54	16.7%	38.9%	44.4%^{H}
West Midlands	53	15.1%^{L}	64.2%^{H}	20.8%
Wales	43	23.3%	65.1%^{H}	11.6%^{L}
South West	163	17.8%^{L}	58.9%	23.3%
South East	92	25.0%	41.3%	33.7%
Greater London	3	66.7%	0.0%	33.3%
Total	**579**	**26.4%**	**45.8%**	**27.8%**

Significance of Pearson's Chi-square test, p<0.001

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

5.2. Characterisation of the arriving animals

5.2.1. Type of origin of donkeys

In this first section we will concentrate solely on donkeys.

The majority of donkeys in the study arrived into TDS NAU from private properties and as such, each was classified as a "New arrival" (69.1%) (Table 5.16). It was noted that there were a small number of donkeys returning directly from guardian homes (10.1%). Additionally, 1.7% of donkeys came via TDS-owned holding bases having been previously located in a guardian home. The remaining donkeys arriving during the study period came from TDS holding bases.

Firstly, it was observed that there were statistically significant differences between the type of origin of donkeys and sex (p_{LR}<0.001) (Table 5.16). The number of stallions and mares was higher than expected in the "New arrival" group of donkeys (75.5% and 85.4%), while there were fewer geldings than expected in the same group (60.8%) (Table 5.16). Secondly, it was seen that a significantly higher number of geldings than expected arrived from guardian homes (15.7%). Finally, a significantly greater number of geldings than expected came from DAT centres.

Table 5.16. Type of origin of donkeys stratified by sex

Type of origin	Mare (n=188)	Gelding (n=316)	Stallion (n=92)	Total (n=596)
New arrival	75.5%^{H}	60.8%^{L}	85.4%^{H}	**69.1%**
DS HB (NA)	18.1%	16.6%	14.6%	**16.8%**
Return Guardian	5.4%^{L}	15.7%^{H}	0.0%^{L}	**10.1%**
DS HB (RG)	1.0%	2.6%	0.0%	**1.7%**
DAT	0.0%^{L}	4.4%^{H}	0.0%^{L}	**2.3%**

Significance of Likelihood Ratio test, p<0.001

^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

There was a statistically significant association between the age of donkeys and type of origin (Table 5.17) (p_{KW}<0.001). Firstly, we found a group of younger animals (DS HB (NA)coming via TDS holding bases and classed as New arrivals with a mean of 6.78 years old. A second subgroup was formed by donkeys coming from DAT (mean age 8.0 years) and "New arrival" (mean age 9.47 years). The mean age of donkeys coming back from DS HB (RG) (11.18 years) was significantly higher from DS HB (NA), and finally the animals that were returning from guardian homes were significantly older than the rest of the groups (mean age 15.15 years).

Table 5.17. Age (years) of donkeys stratified by type of origin

Type of origin	n	Mean	SD	Q1	Median	Q3	min	Max
New arrival	410	9.47^{ab}	6.71	4.00	8.00	13.00	0.0	37.0
DS HB (NA)	98	6.78^{a}	5.08	3.00	5.00	9.00	0.1	25.0
Return Guardian	62	15.15^{c}	9.40	6.00	14.00	22.00	4.0	42.0
DS HB (RG)	11	11.18^{b}	8.36	5.00	7.00	18.00	5.0	30.0
DAT	15	8.00^{ab}	2.80	7.00	8.00	9.00	3.0	16.0
Total	**596**	**9.62**	**7.09**	**4.13**	**8.00**	**13.00**	**0.0**	**42.0**

Significance of Kruskal-Wallis test, p<0.001

Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test (p_{MW}<0.050).

DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

Statistically significant differences were found between the age of donkeys and their origin (p_{LR}<0.001) (Table 5.18). It was observed that there were more donkeys than expected in the younger category (younger than 1-year-old) coming from DS HB (NA) (12.2%), while fewer geriatric donkeys (older than 20 years old) were coming from the same origin (2.0%).

On the other hand, there were fewer donkeys than expected in the age category of older than 1 to 3 years old returning from guardian homes, while more donkeys than expected that returned from guardian homes were geriatric (older than 20 years old) (25.8%). This is important as geriatric donkeys are considered to be high risk movements, and it would be interesting to identify in advance those animals that are high risk and living in guardian homes, to identify the best plan of action for each donkey, in case the guardian home became unable to provide the care needed. It could improve welfare to identify hospice homes close to these animals and discuss quality of life issues and decide end points with guardian homes in advance if needed.

Finally, there were more donkeys than expected coming from DAT centres in the greater than 5 to 20 years old category (86.7%). This could be related to working donkeys requiring retirement in this age range.

Table 5.18. Age (categorised) of donkeys stratified by type of origin

Type of origin	n	Age category				
		≤ 1 y	(1 y, 3 y]	(3 y, 5 y]	(5 y, 20 y]	> 20 y
New Arrival	410	3.9%	12.9%	17.8%	56.6%	8.8%
DS HB (NA)	98	12.2%[H]	15.3%	23.5%	46.9%	2.0%[L]
Return guardian	62	0.0%	0.0%[L]	16.1%	58.1%	25.8%[H]
DS HB (RG)	11	0.0%	0.0%	27.3%	54.5%	18.2%
DAT	15	0.0%	6.7%	6.7%	86.7%[H]	0.0%
Total	**596**	**4.7%**	**11.6%**	**18.5%**	**55.9%**	**9.4%**

Significance of Likelihood Ratio test, p<0.001
[H]: Observed proportion significantly higher than expected (p<0.050).
[L]: Observed proportion significantly lower than expected (p<0.050).

There was a statistically significant association between the type of origin and geriatric donkeys (p_{LR}<0.001) (Table 5.19). It was found that more geriatric donkeys than expected returned from guardian homes (25.8%) (Table 5.19). The number of geriatric animals arriving from DS HB (NA) was significantly lower than expected (2.0%).

Table 5.19. Frequency of geriatric donkeys stratified by type of origin

Type of origin	n	Geriatrics
New Arrival	410	8.8%
DS HB (NA)	98	2.0%^{L}
Return guardian	62	25.8%^{H}
DS HB (RG)	11	18.2%
DAT	15	0.0%
Total	**596**	**9.4%**

Significance of Likelihood Ratio test, p<0.001
H: Observed proportion significantly higher than expected (p<0.050).
L: Observed proportion significantly lower than expected (p<0.050).
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

Statistically significant differences were found between the origin of animals by UK region and the type of origin (p_{LR}<0.001) (Table 5.20). It was found that more animals than expected, classed as unknown origin, were coming from DS HB (NA) (75.0%) while less than expected were New arrivals (25.0%). As part of TDS policy, unknown origin animals will need to be isolated and have specific blood tests before transportation to TDS "new arrivals" premises if possible.

Table 5.20. Type of origin of animals stratified by UK region

Origin region	n	New arrival	DS HB (NA)	Return guardian	DS HB (RG)	DAT
Unknown origin	4	25.0%^{L}	75.0%^{H}	0.0%	0.0%	0.0%
Scotland	30	26.7%^{L}	63.3%	3.3%	6.7%^{H}	0.0%
Northern Ireland	23	8.7%^{L}	87.0%^{H}	0.0%	4.3%	0.0%
North East	56	82.1%^{H}	12.5%	3.6%	0.0%	1.8%
North West	70	67.1%	24.3%	7.1%	0.0%	1.4%
East Midlands	61	73.8%	19.7%	4.9%	1.6%	0.0%
West Midlands	61	80.3%	8.2%	4.9%	3.3%	3.3%
Wales	49	71.4%	6.1%^{L}	20.4%^{H}	2.0%	0.0%
South West	171	78.4%	3.5%	15.2%	1.2%	1.8%
South East	99	68.7%	14.1%	14.1%	2.0%	1.0%
Greater London	3	100.0%	0.0%	0.0%	0.0%	0.0%
Total	**627**	**69.9%**	**16.9%**	**10.2%**	**1.8%**	**1.3%**

Significance of Likelihood Ratio test, p<0.001
^{H}: Observed proportion significantly higher than expected (p<0.050).
^{L}: Observed proportion significantly lower than expected (p<0.050).
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

More animals than expected arriving from DS HB (RG) were from Scotland (6.7%). Less animals than expected from Scotland were "New arrivals" (26.7%). Scotland is the furthest region from TDS NAU, therefore many of these animals may need to travel to nearby holding bases before being considered for the longer journey to TDS NAU.

The majority of animals from Northern Ireland arrived from DS HB (NA) (87.0%) while fewer from the same region were in the "New arrival" category (8.7%). Direct transport from Northern Ireland to TDS NAU would be an extremely long journey.

It was found that more animals than expected from the North East were in the "New arrival" category (82.1%).

Interestingly, there were statistically more "Return guardian" animals than expected arriving from Wales (20.4%), while less animals from the same region were arriving from DS HB (NA) (6.1%).

5.2.2. Time spent at holding bases

Statistically significant differences were found between the type of origin and the time spent at the holding base (p_{MW}=0.023). The mean time spent for "New arrival" donkeys was 196.61 days while "Return guardian" donkeys spent 260.36 days at holding bases (Table 5.21).

There were no statistically significant differences found in the time spent at the holding bases between mules and ponies and their type of origin (p_{KW}=0.559).

Table 5.21. Time spent in holding bases (days) stratified by origin and species

Species	Type of origin	n	Mean	SD	Q1	Median	Q3	min	Max
Donkey	DS HB (NA)	96	196.61	269.34	61	116	193.5	1	1434
	DS HB (RG)	11	260.36	487.07	32	47	63	11	1258
Mule	DS HB (NA)	7	207.43	216.9	53	194	254	12	657
Pony	DS HB (NA)	3	165.33	30.02	148	148	-	148	200

Significance of Mann-Whitney test in donkeys, p=0.023
Significance of Kruskal-Wallis test among species for New arrivals, p=0.559
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian).

The mean time spent at holding bases by non-geriatric "New arrival" animals was 198.03 days and 130 days for geriatric animals. No significant interaction was found between the two variables (p_{MW}=0.681) (Table 5.22). On the other hand, the mean time spent in holding bases by "Return guardian" donkeys was 313.44 days for non-geriatric donkeys and 21.5 days for geriatric animals. Statistically there were no significant differences when comparing these two groups (p_{MW}=0.058) (Table 5.22).

Table 5.22. Time into DS HB stratified by type of origin and geriatric and non-geriatric donkeys

Type of origin	Age	n	Mean	SD	p
DS HB (NA)	<20 years	94	198.03	272.05	0.681^{MW}
	≥ 20 years	2	130.00	4.24	
DS HB (RG)	<20 years	9	313.44	528.28	0.058^{MW}
	> 20 years	2	21.50	14.85	

MW: Significance of Mann-Whitney test
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian)

5.2.3. Identification of the animals

5.2.3.1. Possession of a passport

More donkeys than expected arrived without a valid passport (32.3%) despite regulations in the UK. When we compared this result to other species (Table 5.23), statistically significant differences were observed between species and the possession of a passport (p_{LR}=0.005). In mules the proportion of animals without a valid passport was half that of donkeys (16.2%), and was pending in 5.4%. These findings are very similar to those reported by Cox et al. (2010) who found that 41.0% of animals relinquished to TDS, Sidmouth, Devon between February 2006 and March 2007 did not have a passport.

Table 5.23. Distribution of animals by species and possession of a passport

Species	n	Passport		
		No	Pending	Yes
Donkey	596	$32.2\%^{H}$	$0.2\%^{L}$	$67.7\%^{L}$
Mule	37	$16.2\%^{L}$	$5.4\%^{H}$	78.4%
Pony	11	9.1%	0.0%	90.9%
Total	**644**	**30.9%**	**0.5%**	**68.6%**

Significance of Likelihood Ratio test, p=0.005
^{H}: Observed proportion significantly higher than expected (p<0.050).
^{L}: Observed proportion significantly lower than expected (p<0.050).

In the UK, owners of equines (horses, ponies and donkeys) are required to obtain a passport for every equine they own as per the Horse Passports (England) Regulations 2004. The passport issuing offices were legally obliged to supply data to the National Equine Database Ltd (NED) each month; but since DEFRA´s contract with the NED finished at the end of September 2012, NED services are no longer available.

The British Equestrian Federation stated in 2014 that with more than 75 passport issuing organisations and no central database, finding an equine owner and enforcing the regulations was effectively impossible.

It is the author´s experience that mules in the UK generally need special management and can be unpredictable in their behaviour, even more so during their "New arrivals" period. This can make it harder to comply with TDS "New arrivals" protocols such as: producing a passport, inserting a microchip or starting vaccinations which can result in the delay of these protocols until they settle in or are moved to a specialised farm. While waiting for these, animals are categorised as pending.

Significant differences were found between the type of origin of donkeys and their possession of a valid passport (p_{LR}<0.001). Greater numbers of donkeys than expected (37.3%) were arriving without a valid passport when coming as part of the "New arrival" group. Significantly lower frequencies than expected arrived with a valid passport (62.4%). Significantly higher frequencies of animals arrived with passports from guardian homes ("Return guardian") (100.0%), DS HB (RG) (100.0%) and DAT centres (100.0%). It is TDS policy that every equine at the charity is in possession of a valid passport in order to comply with the Horse Passports (England) Regulations 2004, therefore these numbers should be anticipated for those animals. There were no significant differences found between these two variables in mules and ponies (Table 5.24).

Table 5.24. Distribution of animals by type of origin and possession of a passport

Species	Type of origin	n	Passport			p_{LR}
			No	Pending	Yes	
Donkey	New arrival	410	37.3%^{H}	0.2%	62.4%^{L}	<0.001
	DS HB (NA)	98	39.8%	0.0%	60.2%	
	Return guardian	62	0.0%^{L}	0.0%	100.0%^{H}	
	DS HB (RG)	11	0.0%^{L}	0.0%	100.0%^{H}	
	DAT	15	0.0%^{L}	0.0%	100.0%^{H}	
Mule	New arrival	28	14.3%	7.1%	78.6%	0.641
	DS HB (NA)	7	28.6%	0.0%	71.4%	
	Return guardian	2	0.0%	0.0%	100.0%	
Pony	New Arrival	7	14.3%	0.0%	85.7%	0.619
	DS HB (NA)	3	0.0%	0.0%	100.0%	
	Return guardian	1	0.0%	0.0%	100.0%	
Total		**644**	**9.1%**	**7.3%**	**90.9%**	

LR: Significance of Likelihood Ratio test
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

Statistically significant differences were found between animals in possession of a passport and their age category (p_{LR}<0.001) (Table 5.25).

First of all, there were more donkeys than expected without a valid passport in the younger category (under 1 year old) (57.1%), while fewer in the same age category had valid passports (42.9%).

Similar results were found in the age category of older than 1 to 3 years old, where more donkeys than expected did not have a valid passport (49.3%), and fewer were in possession of a passport (49.3%).

On the other hand, there were more donkeys than expected in possession of a passport in the adult category of older than 5 to 20 years old (73.6%), while fewer donkeys in the same category did not have a valid passport (26.4%).

Table 5.25. Animals in possession of a valid passport stratified by age category

Age category	n	Passport		
		No	Pending	Yes
≤ 1 y	28	57.1%^{H}	0.0%	42.9%^{L}
(1 y, 3 y]	69	49.3%^{H}	1.4%	49.3%^{L}
(3 y, 5 y]	110	38.2%	0.0%	61.8%
(5 y, 20 y]	333	26.4%^{L}	0.0%	73.6%^{H}
> 20 y	56	21.4%	0.0%	78.6%
Total	**596**	**32.2%**	**0.2%**	**67.6%**

Significance of Likelihood Ratio test, p< 0.001

^{H}: Observed proportion significantly higher than expected (p<0.050).

^{L}: Observed proportion significantly lower than expected (p<0.050).

There were statistically significant differences between animals in possession of a valid passport and their UK region (p_{LR}<0.008) (Table 5.26). More animals than expected from an unknown origin did not have a valid passport (100.0%).

The majority of animals from Scotland arrived at TDS "New arrivals" unit with a valid passport (90.0%) while fewer than expected from the same area did not have one (10.0%).

More animals than expected from Northern Ireland were without a valid passport (52.2%) while fewer than expected had one (47.8%).

It was also identified that more animals from the South East had a valid passport (78.8%) while fewer than expected from the same region did not have one (20.2%).

Table 5.26. Animals in possession of a valid passport stratified by UK origin region

Origin region	n	Passport		
		No	Pending	Yes
Unknown origin	4	100.0%^{H}	0.0%	0.0%^{L}
Scotland	30	10.0%^{L}	0.0%	90.0%^{H}
Northern Ireland	23	52.2%^{H}	0.0%	47.8%^{L}
North East	56	30.4%	0.0%	69.6%
North West	70	37.1%	0.0%	62.9%
East Midlands	61	34.4%	0.0%	65.6%
West Midlands	61	32.8%	3.3%^{H}	63.9%
Wales	49	32.7%	0.0%	67.7%
South West	171	33.3%	0.0%	66.7%
South East	99	20.2%^{L}	1.0%	78.8%^{H}
Greater London	3	33.3%	0.0%	66.7%
Total	**627**	**9.1%**	**7.3%**	**90.9%**

Significance of Likelihood Ratio test, p<0.008

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

5.2.3.2. Presence of a microchip

There were no statistically significant differences found between species and presence of a microchip (p_{LR}=0.061), although it was observed that a greater number of donkeys than expected arrived at TDS premises without a microchip (49.2%) while a greater number of mules were in the pending group (5.4%) (Table 5.27).

In spite of EU regulations being enforced since 2004, only a total of 51.2% of the arriving animals had a valid working microchip.

Table 5.27. Presence of a microchip in animals stratified by species

Species	n	Microchip		
		No	Pending	Yes
Donkey	596	49.2%^{H}	0.5%^{L}	50.3%
Mule	37	32.4%	5.4%^{H}	62.2%
Pony	11	36.4%	0.0%	63.3%
Total	**644**	**48.0%**	**80.0%**	**51.2%**

Significance of Likelihood Ratio test. p=0.061

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between the type of origin of donkeys and presence of a microchip (p_{LR}<0.001). Statistically greater numbers of "New arrival" donkeys than expected came without a microchip (62.0%) while fewer than expected arrived with one (37.6%) (Table 5.28). A statistically significant larger number of DS HB (NA) donkeys arrived with a working microchip (61.2%). It is TDS policy to insert a microchip to every equine admitted into TDS so it could be expected that donkeys living at holding bases for a prolonged period may have had a microchip inserted. Significantly fewer donkeys from this group were arriving without a microchip (37.8%).

Table 5.28. Presence of a microchip in animals stratified by origin

Species	Type of origin	n	Microchip			p_{LR}
			No	Pending	Yes	
Donkey	New Arrival	410	62.0%^{H}	0.5%	37.6%^{L}	<0.001
	DS HB (NA)	98	37.8%^{L}	1.0%	61.2%^{H}	
	Return Guardian	62	3.2%^{L}	0.0%	96.8%^{H}	
	DS HB (RG)	11	0.0%^{L}	0.0%	100.0%^{H}	
	DAT	15	0.0%^{L}	0.0%	100.0%^{H}	
	Total	**596**	**49.2%**	**0.5%**	**50.3%**	
Mule	New Arrival	28	35.7%	7.1%	57.1%	0.536
	DS HB (NA)	7	28.6%	0.0%	71.4%	
	Return Guardian	2	0.0%	0.0%	100.0%	
	Total	**37**	**32.4%**	**5.4%**	**62.2%**	
Pony	New Arrival	7	28.6%	0.0%	71.4%	0.329
	DS HB (NA)	3	66.7%	0.0%	33.3%	
	Return Guardian	1	0.0%	0.0%	100.0%	
	Total	**11**	**36.4%**	**0.0%**	**63.6%**	

^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

Surprisingly, although it is TDS policy, 3.2% of donkeys from guardian homes arrived into the NAU without a working microchip. This could perhaps be due to microchip skin migration, failure, or human error. Lord et al. (2009) reported that in their small animal study, 21.2% of animal shelters scanned an incoming animal only once; however, 12.6% animals scanned more than one time were found to have microchips, which indicated that a microchip can be missed during the first scan. In addition, 1.6% of microchips were found implanted in a non-standard implantation site, which indicated migration of the microchip or poor application technique. The Donkey Sanctuary "New arrivals" procedures include scanning animals at various routine times before inserting a new microchip to avoid multiple microchips in one animal and thereby reduce costs for the charity. Lord et al. (2009) also stated that scanning more than one time is especially critical given that scanners do not have 100.0% sensitivity in detecting or reading microchips.

A statistically significant higher frequency of donkeys from the "Return guardian" group came with a microchip (61.2%).

A statistically significant greater number of donkeys originally from DS HB (RG) (96.8%) and Donkey Assisted Therapy centres (100.0%) arrived with microchips. These numbers should be expected as it is part of TDS policy to ensure every animal can be identified with a passport and microchip before they can be considered for the guardian scheme or a TDS assisted therapy group. These animals will be transported and it is therefore essential that they comply with the current regulations requiring them to be identified with both a passport and a microchip.

No association was found between type of origin and presence of a microchip in either mules (p_{LR}=0.536) or ponies (p_{LR}=0.329).

Statistically significant differences were not found between the presence of a microchip in donkeys and their age (p_{LR}=0.625) (Table 5.29).

Table 5.29. Presence of a microchip in animals stratified by age (categorised)

Age category	n	Microchip		
		No	Pending	Yes
≤ 1 y	28	60.7%	0.0%	39.3%
(1 y, 3 y]	69	49.3%	1.4%	49.3%
(3 y, 5 y]	110	47.3%	0.0%	52.7%
(5 y, 20 y]	333	47.4%	0.6%	52.0%
> 20 y	56	57.1%	0.0%	42.9%
Total	**596**	**49.2%**	**0.5%**	**50.3%**

Significance of Likelihood Ratio test, p=0.625

^{H}: Observed proportion significantly higher than expected (p<0.050).

^{L}: Observed proportion significantly lower than expected (p<0.050).

In Table 5.30 we can see that more animals from Northern Ireland were classified as pending with regards to microchipping (4.3%) (p_{LR}=0.015). There were also more animals than expected in the pending category coming from the West Midlands (3.3%).

More microchipped animals than expected came from the South East (63.6%) and less than expected came with no microchip from the same region (35.4%).

Table 5.30. Presence of a microchip in animals stratified by UK origin region

Origin region	n	Microchip		
		No	Pending	Yes
Unknown origin	4	100.0%^{H}	0.0%	0.0%^{L}
Scotland	30	30.0%^{L}	0.0%	70.0%^{H}
Northern Ireland	23	52.2%	4.3%^{H}	43.5%
North East	56	51.8%	0.0%	48.2%
North West	70	50.0%	1.4%	48.6%
East Midlands	61	44.3%	0.0%	55.7%
West Midlands	61	54.1%	3.3%^{H}	42.6%
Wales	49	53.1%	0.0%	46.9%
South West	171	53.2%	0.0%	46.8%
South East	99	35.4%^{L}	1.0%	63.6%^{H}
Greater London	3	100.0%	0.0%	0.0%
Total	**627**	**48.5%**	**0.8%**	**50.7%**

Significance of Likelihood Ratio test, p=0.015

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

We found a significant association between the presence of a microchip and possession of a passport ($p_{LR}<0.001$) (Table 5.31). It was observed that more animals than expected without a microchip did not have a valid passport (57.9%). Interestingly, fewer animals than expected without a microchip were in possession of passport (42.1%); this is an interesting finding, as those animals should have had a microchip inserted to allow issuing a valid passport unless their passport was issued before 2009. Horse passports Regulations 2009 (DEFRA, 2009) stated that foals born on or after 1 July 2009 must have an electronic microchip implanted by a qualified veterinary surgeon when being first identified. It also stated that adult horses that had not yet been correctly issued with a passport were also requiring a microchip when being identified.

Table 5.31. Animals with microchip stratified by possession of a passport

Microchip	n	Passport		
		No	Pending	Yes
No	309	57.9%^{H}	0.0%	42.1%^{L}
Pending	5	0.0%	60.0%^{H}	40.0%
Yes	330	6.1%^{L}	0.0%	93.9%^{H}
Total	**644**	**30.9%**	**0.5%**	**68.6%**

Significance of Likelihood Ratio test, p<0.001

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

Secondly, more animals than expected were identified as pending a microchip and they were also pending their passport being issued (60.0%).

Lastly, it was observed that more animals than expected with a microchip also had a valid passport (93.9%) while less than expected that had microchip did not have a valid passport (6.1%).

5.2.4. Friendship

It has been reported that when no other member of the same species is present, donkeys, mules and horses can form strong interspecies bonds (Budiansky, 1997; Jensen, 2006; Proops et al., 2012). It is TDS policy not to separate any bonded animals. Donkeys, especially, can develop a special bond for other animals, generally other donkeys, but they are able to bond with other types of animals.

Trawford and Crane (1995) reported that donkeys form strong bonds with one another and with other animals such as ponies and goats. They also stated that donkey "friends" should be kept together. Several publications have reported that donkeys, mules and ponies prefer to associate with members of their owned equine type (Altmann, 1951; Linklater, 2000; Bahloul et al., 2001).

The Donkey Sanctuary welfare advisers are trained to identify bonded animals and advise their owner accordingly.

There were no significant differences found between these two variables, separated and species (p_{LR}=0.349) (Table 5.32). Despite TDS policy, 4.0% of donkeys were separated from another bonded animal. Those animals are considered as having a higher risk of hyperlipaemia. Mules and ponies when separated are not considered to be at the same risk as donkeys.

Table 5.32. Animals that had been separated from another animal stratified by species

Species	n	Separated
Donkey	596	4.0%
Mule	37	8.1%
Pony	11	0.0%
Total	**644**	**4.2%**

Significance of Likelihood Ratio test, p=0.349

Table 5.33. Animals that had been separated from another animal stratified by sex

Sex	n	Separated
Mare	204	2.9%
Gelding	344	4.9%
Stallion	96	4.2%
Total	**644**	**4.2%**

Significance of Pearson's Chi-square test, p=0.528

Matthews et al. (2013) stated that donkeys are more likely to be hyperlipaemic when stressed or ill. Transportation or changes in their environment, management, or social group have been mentioned as causes of stress in donkeys (Grove et al., 2008). Burden et al. (2011) also found that donkeys commonly developed hyperlipaemia, particularly in response to stress or other illness.

There were no significant differences found between separated animals and sex (p_{X2}=0.528) (Table 5.33).

There were no significant differences found between donkeys that had suffered from a separation and their age (p_{LR}=0.359) (Table 5.34).

Table 5.34. Donkeys that had suffered from a split from another animal stratified by age (categorised)

Age category	n	Separated
≤ 1 y	28	0.0%
(1 y, 3 y]	69	4.3%
(3 y, 5 y]	110	6.4%
(5 y, 20 y]	333	3.3%
> 20 y	56	5.4%
Total	**596**	**4.0%**

Significance of Likelihood Ratio test, p=0.349

No association was found between being separated from bonded animals and type of origin (p_{LR}=0.260) although interestingly, 3.1% of "Return guardian" donkeys have been separated (split) from a type of bonded friend (Table 5.35). It is TDS policy not to separate bonded friends and guardian donkeys are owned by the charity; therefore, no separated from bonded animals should have been expected from this category. The rest of the animals, that have been separated, are from a "New arrival" origin and therefore an owner might have been involved in the final decision to split them.

Table 5.35. Animals that had suffered from a split from another animal stratified by type of origin

Type of origin	n	Separated
New arrival	445	5.2%
DS HB (NA)	108	1.9%
Return guardian	65	3.1%
DS HB (RG)	11	0.0%
DAT	15	0.0%
Total	**644**	**4.2%**

Significance of Likelihood Ratio test, p=0.260

DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

Additionally, when looking at the relationship between animals that had separated from friends and their UK origin region, no statistically significant differences were found (p_{LR}=0.067). Despite not finding statistically significant differences, taking into consideration adjusted residuals, it was observed that more donkeys that had been separated from a friend were from the North West (9.2%).

Table 5.36. Animals that had suffered from a split from another animal stratified by type of origin region

Origin region	n	Separated
Unknown origin	4	0.0%
Scotland	27	0.0%
Northern Ireland	23	0.0%
North East	52	7.7%
North West	65	9.2%[H]
East Midlands	54	3.7%
West Midlands	53	1.9%
Wales	43	0.0%
South West	163	4.3%
South East	92	2.2%
Greater London	3	33.3%
Total	**579**	**4.0%**

Significance of Likelihood Ratio test, p=0.067

In Table 5.37, no significant differences were seen between separated from bonded animals and acquisition (p_{LR}=0.761).

Table 5.37. Animals that had suffered from a split from another animal stratified by acquisition

Acquisition	n	Separated
Unknown acquisition	176	2.8%
Auction	1	0.0%
Born at DS	6	0.0%
Born at home	71	4.2%
Bought from beach op	9	0.0%
Bought from breeder	17	5.9%
Bought from traveler	18	11.1%
Bought in Ireland	7	14.3%
Bought locally	24	0.0%
Bought private owner	172	4.7%
Gift	10	0.0%
Imported	13	0.0%
Inherited	2	0.0%
Local dealer	67	6.0%
Local farm	12	0.0%
Local market	12	8.3%
Rescued	27	7.4%
Total	**644**	**4.2%**

Significance of Likelihood Ratio test, p=0.761

Of all the animals arriving into TDS "New arrivals" premises, there was a median of one companion. Although some animals arrived on their own (18.5%), the majority of animals arrived with one other companion (56.8%). The remaining donkeys arrived in larger groups up to a maximum of fourteen animals (Table 5.38). Burden et al. (2011) stated that most donkeys were unlikely to have been kept with more than one or two other equines before relinquishment into TDS. Grint et al. (2015) surveyed guardian donkey owners in the UK and found that the majority of donkeys in the study were kept with a companion (45.2%) or in a herd of three or more donkeys (45.2% of the respondents) and that the median (range) number of donkeys owned by each respondent was 3 (1-50).

On the contrary, when examining the relinquishment of other species, a study by Kass et al. (2001) of small animal shelters in the USA, found that the majority of dogs (94.0%) and cats (81.0%) were relinquished alone; with the remaining animals representing part of, or accompanied by a litter.

Table 5.38. Frequency of number of friends/companions

N. of friends/ companions	n	%
0	119	18.5%
1	366	56.8%
2	71	11.0%
3	26	4.0%
4	15	2.3%
5	5	0.8%
8	2	0.3%
11	12	1.9%
12	13	2.0%
14	15	2.3%
Total	**644**	**100.0%**

Firstly, a statistically significant association was observed (Table 5.39) between species and number of companions (p_{X2}<0.001). There were greater numbers of donkeys with more than one companion than expected (25.7%), and fewer donkeys were observed arriving with no companions (16.9%).

Secondly, with regards to mules, higher numbers than expected were seen to be arriving on their own (48.6%), while significantly fewer than expected were coming with one companion or more (40.5% and 10.8%). It is the author's experience that many of the mules in the UK are the result of misalliance; they are not bred intentionally and are therefore relinquished as unwanted animals. However, in our study, the majority of mules were described as being bought from a private owner. McLean et al. (2019) reported that it is not uncommon for mules to exhibit signs of avoidance or fearfulness when handled by an unfamiliar person for routine procedures or husbandry tasks and that their behaviour can pose challenges to providing routine care and veterinary treatment; therefore, management of mules can be more challenging for inexperienced owners and could perhaps be an underlying reason for relinquishment. Supporting mule owners with more behaviour knowledge and training could perhaps be a way to ensure fewer mule relinquishments if unwanted behaviour is proven to be an underlying reason for relinquishments.

Table 5.39. Number of friends of animals on arrival stratified by species

Species	n	With friends?		
		None	One	More than 1
Donkey	596	16.9%^{L}	57.4%	25.7%^{H}
Mule	37	48.6%^{H}	40.5%^{L}	10.8%^{L}
Pony	11	0.0%	81.8%	18.2%
Total	**644**	**18.5%**	**56.8%**	**24.7%**

Significance of Pearson's Chi-square test, p<0.001

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

It was also observed (Table 5.40) that there was a significant relationship between sex and number of companions (p_{X2}<0.001); in total, more than half of the animals that arrived into TDS premises did so with one companion (56.8%). On the other hand, significantly higher numbers of mares were arriving into "New arrivals" with more than one companion (32.4%) while fewer than expected arrived on their own (12.7%).

Table 5.40. Number of friends of animals on arrival stratified by sex

Sex	n	With friends?		
		None	One	More than 1
Mare	204	12.7%^{L}	54.9%	32.4%^{H}
Gelding	344	20.3%	61.0%^{H}	18.6%^{L}
Stallion	96	24.0%	45.8%^{L}	30.2%
Total	**644**	**18.5%**	**56.8%**	**24.7%**

Significance of Pearson's Chi-square test, p<0.001

^{H}: Observed proportion significantly higher than expected (p<0.050).

^{L}: Observed proportion significantly lower than expected (p<0.050).

Additionally, it was found that more geldings than expected were arriving with one (61.0%) companion while fewer came with more than one (18.6%).

Finally, with regards to the stallions, significantly fewer than expected arrived into "New arrivals" with one friend (45.8%). This could be due to their stallion-like behaviour which can complicate their management in groups or with other animals. Sprayson and Thiemann (2007) reported that older entire male donkeys may be aggressive to companion geldings and hard to control around mares and for that reason might be kept alone.

When looking at the number of friends arriving with donkeys, it was observed that there were statistically significant differences between the number of friends and donkey age (p_{X2}=0.001) (Table 5.41).

More donkeys than expected from the younger category (under 1 year old) arrived in a group situation (more than 1) (46.4%). Similar findings were observed in the next age category, where there were more donkeys than expected arriving with more than one other donkey (43.5%) while fewer donkeys than expected arrived with one other donkey as a pair (46.4%). There were also fewer donkeys than expected coming with more than one friend in the older category of greater than 20 years old (8.9%).

Table 5.41. Number of friends of animals on arrival stratified by age

Age category	n	With friends?		
		None	One	More than 1
≤ 1 y	28	10.7%	42.9%	46.4%^{H}
(1 y, 3 y]	69	10.1%	46.4%^{L}	43.5%^{H}
(3 y, 5 y]	110	17.3%	60.9%	21.8%
(5 y, 20 y]	333	18.0%	57.7%	24.3%
> 20 y	56	21.4%	69.6%	8.9%^{L}
Total	**596**	**16.9%**	**57.4%**	**25.7%**

Significance of Pearson's Chi-square test, p=0.001

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

A statistically significant relationship was observed between type of origin and number of friends (p_{LR}=0.001). Firstly, it was observed (Table 5.42) that more than half of the arriving animals were coming with at least one friend (56.8%).

Secondly, it was seen that fewer animals than expected were arriving from DS HB (NA) with one friend (46.3%).

On the other hand, significantly more animals than expected were coming from RG (75.4%) or DS HB (RG) (90.9%) with one friend. It is TDS policy that animals are at least paired when leaving TDS to go to a new guardian home. Members of the public can guardian a pair of donkeys after completing a training course covering basic donkey husbandry.

Lastly, fewer animals than expected were coming with more than one friend when they were coming from "Return guardian" (7.7%). In the author´s experience, although possible, it is rare for guardian homes to accept groups as part of the guardian scheme.

Table 5.42. Number of friends of animals on arrival stratified by type of origin

Type of origin	n	With friends?		
		None	One	More than 1
DS HB (NA)	108	23.1%	46.3%^{L}	30.6%
New arrival	445	17.8%	56.0%	26.3%
DAT	15	20.0%	53.3%	26.7%
Return guardian	65	16.9%	75.4%^{H}	7.7%^{L}
DS HB (RG)	11	9.1%	90.9%^{H}	0.0%
Total	**644**	**18.5%**	**56.8%**	**24.7%**

Significance of Likelihood Ratio test, p=0.001

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre

Statistically significant differences were found between the number of friends and UK region (p_{LR}=0.002) (Table 5.43) It was found that more animals than expected came from the North East with one friend (69.6%).

There were more animals than expected arriving with more than one friend from the West Midlands (47.5%) while less than expected came from the same region with one friend (32.8%). The majority of animals from Wales came with one friend (71.4%). It was also identified that more animals than expected from The South East arrived with one friend (68.7%) while less than expected from the same region arrived with more than one friend (14.1%).

Table 5.43. Number of friends of animals on arrival stratified by origin by UK region

Origin region	n	With friends?		
		None	One	More than 1
Unknown origin	4	50.0%	25.0%	25.0%
Scotland	30	16.7%	60.0%	23.3%
Northern Ireland	23	13.0%	52.2%	34.8%
North East	56	16.1%	69.6^{H}	14.3%
North West	70	21.4%	55.7%	22.9%
East Midlands	61	24.6%	50.8%	24.6%
West Midlands	61	19.7%	32.8%^{L}	47.5%^{H}
Wales	49	12.2%	71.4%^{H}	16.3%
South West	171	15.8%	55.0%	29.2%
South East	99	17.2%	68.7%^{H}	14.1%^{L}
Greater London	3	33.3%	66.7%	0.0%
Total	**627**	**18.5%**	**56.8%**	**24.7%**

Significance of Likelihood Ratio test, p=0.002

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

With regards to acquisition and number of friends, statistically significant differences (p_{LR}<0.001) were found. It was observed that higher numbers of animals than expected acquired from auction were coming on their own (100.0%); although it must be taken into consideration that there was only one animal coming from auction (n=1) (Table 5.44) in the study period. Animals that were born at a TDS location (n=6) were all arriving at the NAU with one other companion. In many of those cases, they will arrive with their mothers and foals will be weaned at TDS farms.

Table 5.44. Number of friends of animals on arrival stratified by acquisition

		With friends?		
Acquisition type	**n**	None	One	More than 1
Auction	1	100.0%^{H}	0.0%	0.0%
Bought from traveler	18	50.0%^{H}	22.2%^{L}	27.8%
Local market	12	33.3%	58.3%	8.3%
Bought from beach op	9	33.3%	55.6%	11.1%
Local farm	12	33.3%	50.0%	16.7%
Rescued	27	33.3%^{H}	48.1%	18.5%
Local dealer	67	26.9%	56.7%	16.4%
Bought locally	24	25.0%	41.7%	33.3%
Gift	10	20.0%	80.0%	0.0%
Unknown acquisition	176	17.6%	60.8%	21.6%
Bought in Ireland	7	14.3%	28.6%	57.1%^{H}
Born at home	71	12.7%	39.4%^{L}	47.9%^{H}
Bought from breeder	17	11.8%	64.7%	23.5%
Bought private owner	172	11.0%^{L}	62.8%	26.2%
Imported	13	7.7%	84.6%^{H}	7.7%
Born at TDS	6	0.0%	100.0%^{H}	0.0%
Inherited	2	0.0%	100.0%	0.0%
Total	**644**	**18.5%**	**56.8%**	**24.7%**

Significance of Likelihood Ratio test, p< 0.001
H: Observed proportion significantly higher than expected (p<0.050)
L: Observed proportion significantly lower than expected (p<0.050)

Moreover, significantly greater number of animals than expected that were born at home arrived with more than one other companion (47.9%) and fewer of those were arriving with one friend (39.4%). It was also observed that amongst animals bought from travelers, higher numbers than expected arrived on their own (50.0%), and significantly fewer arrived with one friend (22.2%).

One hundred and seventy two (172) animals were described as bought from private owners and of those, significantly lower numbers than expected were arriving on their own (11.0%). Amongst the animals described as imported, significantly higher numbers than expected arrived into TDS “New arrivals” premises in the company of another animal (84.6%). Twenty-seven (27) animals were said to have been rescued by their owners, and of those, significantly higher numbers of animals were noted arriving as singles (33.3%).

Statistically significant differences were found between animals that have been separated (split) and number of friends (p_{X2}<0.001) (Table 5.45). There were statistically higher numbers of animals arriving with one (58.7%) or more friends (25.4%) that had not been separated, whilst there were fewer numbers coming on their own from the same group (15.9%).

Of those animals that had been separated from others, it was noted that there were statistically greater numbers arriving on their own (77.8%) and fewer coming with one (14.8%) or more than one friend (7.4%).

Table 5.45. Number of friends of animals on arrival stratified by split

Split	n	With friends?		
		None	One	More than one
No	617	15.9%^{L}	58.7%^{H}	25.4%^{H}
Yes	27	77.8%^{H}	14.8%^{L}	7.4%^{L}
Total	**644**	**18.5%**	**56.8%**	**24.7%**

Significance of Pearson's Chi-square test, p<0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

5.2.5. Relinquishment reasons

The main reason given for relinquishing animals into TDS was owner´s health (21.4%) (Table 5.46). This category could also have included other reasons such as owner death and owner illness which would give a total of 24.2%. Moving house was the second most common category given as a reason for relinquishment.

These findings are similar to those of Marston et al. (2005) who showed that almost one third of the reasons given for relinquishment in dog shelters could be characterised as owner related factors. Moreover, Marston et al. (2005) found that the most common owner related reasons for relinquishment of dogs were accommodation based, followed by personal reasons, and then by dogs requiring too much effort, work or time. In rural areas, health of both owners and pets contributed to reasons for relinquishment.

The second most common reason for relinquishment at TDS was overall house move (14.0%). A study by New et al. (1999) found that moving was the most common reason given for relinquishing dogs and the third most common reason for relinquishing cats.

The third most common reason given for relinquishing animals at TDS was donkey health. Several studies report pet illnesses as a reason for relinquishment to animal shelters for euthanasia purposes (Marijana et al., 2009). At TDS, the animal's quality of life is assessed prior to movement, and for those considered to have a poor quality of life, euthanasia is suggested at their current location/home.

Table 5.46. Frequency of reasons for relinquishment

Reason	Main		Secondary		Others		Total
	n	%	n	%	n	%	%
Owner's health	130	20.2%	8	1.2%	-	-	**21.4%**
House move	66	10.2%	23	3.6%	1	0.2%	**14.0%**
Donkey health	62	9.6%	10	1.6%	2	0.3%	**11.5%**
Lack of a suitable environment	34	5.3%	32	5.0%	3	0.5%	**10.8%**
Bad behaviour	65	10.1%	4	0.6%	-	-	**10.7%**
Lack of time	49	7.6%	9	1.4%	-	-	**9.0%**
Financial	28	4.3%	18	2.8%	4	0.6%	**7.7%**
Overstocked	30	4.7%	17	2.6%	-	-	**7.3%**
Others	39	6.1%	3	0.5%	-	-	**6.6%**
Personal circumstances	23	3.6%	10	1.6%	1	0.2%	**5.4%**
Loss of grazing	29	4.5%	3	0.5%	-	-	**5.0%**
RSPCA	22	3.4%	1	0.2%	-	-	**3.6%**
Loss of companion	10	1.6%	5	0.8%	3	0.5%	**2.9%**
Owner death	17	2.6%	-	-	-	-	**2.6%**
Abandoned	14	2.2%	-	-	-	-	**2.2%**
Not specified	9	1.4%	-	-	-	-	**1.4%**
Humanitarian rescue	6	0.9%	-	-	-	-	**0.9%**
Family problems	4	0.6%	-	-	1	0.2%	**0.8%**
Lack of knowledge	4	0.6%	-	-	-	-	**0.6%**
Farm closed	2	0.3%	2	0.3%	-	-	**0.6%**
Death/Illness owner	1	0.2%	-	-	-	-	**0.2%**
Total	**644**	**100.0%**	**145**	**22.5%**	**7**	**1.1%**	

Lack of suitable environment was found to be the fourth most common reason given for relinquishment, with an overall of 10.8%. In the study by New et al. (1999) 12.7% of dog owners gave physical house limitations as reasons for relinquishment.

A study by Salman et al. (1998) of 3676 dog and cat relinquishments in the USA found that accommodation or moving, financial pressure, and lack of time were given as reasons for relinquishment.

Only 1.4% of owners did not specify their reason for relinquishment in our study, while Marston et al. (2005) found that nearly half of all dog relinquishments into suburban Australian small animal shelters gave no reason for relinquishment.

Behavioural issues have been mentioned by many authors as a risk factor for relinquishment of animals into small animal shelters, however only 10.7% of all The Donkey Sanctuary relinquishments in the study period were said to be because of behavioural problems.

Marston et al. (2005) found a similar percentage of dogs being relinquished for canine behavioural issues into shelters (10.8%). However, The National Council on Pet Population Study and Policy (NCPPSP) in the USA found that behavioural problems were the most frequently given reasons for canine relinquishment and the second most frequently given reasons for feline relinquishment (Salman et al., 2000). Similarly, Rowan and Williams (1987) and Arkow (1985) pointed out that about 20.0% of relinquishments were related to behavioural problems. Houpt et al. (1996) found a range from 25.0% to 70.0%; whilst Salman et al. (1998) reported 46.4% of relinquishments were due to undesirable behaviour. Moreover, Wells and Hepper (2000) reported that up to 89.7% of returning foster dogs were due to misbehaviour.

In the study by Marston et al. (2004) looking at reasons for relinquishment of dogs into shelters, the two primary routes were either owners no longer able or willing to take care of them, or dogs that were presented as strays by members of the public. Only a small number of dogs were relinquished due to behavioural issues. The author reported that a limitation of the study was limited recording on relinquishment paperwork, so it was felt that the complexity of reasons for relinquishment had been underestimated.

On the other hand, a study by DiGiacomo et al. (1998) based on 38 interviews, found that the most common reasons for relinquishment in small animal shelters were canine behaviour problems, followed by medical and accommodation reasons. Behavioural issues were given as frequent reasons for relinquishment in several publications (Miller et al., 1996; Salman et al., 1998). Behavioural problems were also thought to be substantially underreported (Miller et al., 1996; Coren, 1999). Other factors associated with risk of small animal shelter relinquishment included unintentional pet acquisition (DiGiacomo et al., 1998), lifestyle changes (Houpt et al., 1996) and age of dog acquisition (Miller et al., 1996; Patroneck et al., 1996), with the greatest risk of relinquishment reported amongst dogs acquired at ages one or two.

Other reasons for relinquishment of companion animals given by authors such as Scarlett et al. (1999) were allergies to dogs and cats and personal problems. Personal problems included low income or unemployment. Although the author stated that this last reason could be an excuse for other reasons for relinquishment. Owners relinquishing to The Donkey Sanctuary gave personal circumstances as a reason in 5.4% of the cases.

Interestingly, although some animals relinquished to TDS had been previously acquired by inheritance or as a gift, reasons for relinquishment did not specify or include unwanted gift or inherited as a main reason. Marston et al. (2005) found that approximately 3.0% of the small animal owners in their study gave those reasons as the main reason for relinquishment. However, the study by Patroneck et al. (1996) did not have similar findings, with dogs given as gifts found to be at a reduced risk of relinquishment, and those dogs acquired at low cost found to be at increased risk of relinquishment.

Lack of time was given as a reason in 9.0% of the relinquishments into TDS. Scarlett et al. (1999) reported that almost 70.0% of owners in their study gave lack of time as a reason for relinquishment of dogs into shelters in the USA.

In our study, 0.4% of the owners reported lack of knowledge as a reason for relinquishment, however there was no questionnaire given to assess donkey or equine knowledge which might be an appropriate action to take in future to target owner education. However, the New et al. (2000) study looking at small animal shelter relinquishments found that people relinquishing cats and dogs exhibited knowledge deficits with regards to behaviour and training and this might contribute to unrealistic expectations and inappropriate actions.

The reasons given by owners for relinquishment to TDS should be assessed to try and reduce unnecessary relinquishments. Donkey health should not necessarily be a reason for relinquishment, as owners should be responsible for the lifetime care and welfare of their donkeys unless donkey health includes a financial aspect which can be an underlying reason for relinquishment. Miller (2007) stated that in order to reduce animal relinquishments to shelters, it is necessary to know why people relinquish them; the author also concluded that the public are still irresponsible regarding pet ownership.

There were no significant differences found between the main reason for relinquishment and species (p_{LR}=0.211) (Table 5.47).

Statistically significant differences were found between main relinquishment reasons and sex (p_{LR}<0.001). It was observed that more mares than expected were relinquished due to owner's health while fewer geldings were relinquished for the same reason (Table 5.48).

Fewer mares than expected were found to be relinquished for financial (1.5%) or abandonment (0.5%) reasons when compared with the other two groups.

Significantly, more geldings (13.4%) were relinquished due to bad behaviour while fewer mares (5.4%) were relinquished for that reason. With regards to geldings it was also observed that greater numbers than expected were relinquished due to personal circumstances (4.9%) and financial reasons (6.7%) than in the other two groups. Interestingly, only 8.3% of stallions were reportedly relinquished due to bad behaviour.

Finally, it was also observed that more stallions were relinquished due to overstocking (11.5%), loss of grazing (9.4%) and other reasons (11.5%).

Table 5.47. Main reason for relinquishment stratified by species

Main Reason	n	Species: Donkey (n=595)	Mule (n=37)	Pony (n=11)	Total (n=643)
Owner's health	130	20.3%	13.5%	36.4%	**20.2%**
House move	66	10.2%	8.1%	18.2%	**10.2%**
Bad behaviour	65	9.7%	16.2%	9.1%	**10.1%**
Donkey health	62	10.2%	0.0%	9.1%	**9.6%**
Lack of time	49	7.6%	10.8%	0.0%	**7.6%**
Others	39	6.0%	8.1%	0.0%	**6.1%**
Lack of a suitable environment	34	5.0%	10.8%	0.0%	**5.3%**
Overstocked	30	5.0%	0.0%	0.0%	**4.7%**
Loss of grazing	29	3.9%	10.8%	18.2%	**4.5%**
Financial	28	4.5%	2.7%	0.0%	**4.3%**
Personal circumstances	23	3.9%	0.0%	0.0%	**3.6%**
RSPCA	22	3.5%	2.7%	0.0%	**3.4%**
Owner death	18	2.7%	2.7%	9.1%	**2.8%**
Abandoned	14	2.3%	0.0%	0.0%	**2.2%**
Loss of companion	10	1.5%	2.7%	0.0%	**1.6%**
No answer	9	1.3%	2.7%	0.0%	**1.4%**
Humanitarian rescue	6	0.8%	2.7%	0.0%	**0.9%**
Family problems	4	0.7%	0.0%	0.0%	**0.6%**
Lack of knowledge	4	0.5%	2.7%	0.0%	**0.6%**
Farm closed	2	0.2%	2.7%	0.0%	**0.3%**

Significance of Likelihood Ratio test, p=0.211

Table 5.48. Main reason for relinquishment stratified by sex

Main Reason	n	Sex: Mare (n=204)	Gelding (n=344)	Stallion (n=95)	Total (n=643)
Owner's health	130	$29.9\%^{H}$	$15.4\%^{L}$	16.7%	**20.2%**
House move	66	9.8%	11.9%	5.2%	**10.2%**
Bad behaviour	65	$5.4\%^{L}$	$13.4\%^{H}$	8.3%	**10.1%**
Donkey health	62	9.8%	10.2%	7.3%	**9.6%**
Lack of time	49	7.8%	8.4%	4.2%	**7.6%**
Others	39	5.9%	4.7%	$11.5\%^{H}$	**6.1%**
Lack of a SE	34	3.4%	5.2%	9.4%	**5.3%**
Overstocked	30	5.9%	$2.0\%^{L}$	$11.5\%^{H}$	**4.7%**
Loss of grazing	29	4.4%	3.2%	$9.4\%^{H}$	**4.5%**
Financial	28	$1.5\%^{L}$	$6.7\%^{H}$	2.1%	**4.3%**

Table 5.48. (cont.) Main reason for relinquishment stratified by sex

Main Reason	n	Sex			Total (n=643)
		Mare (n=204)	Gelding (n=344)	Stallion (n=95)	
Personal circumstances	23	2.9%	4.9%^{H}	0.0%^{L}	**3.6%**
RSPCA	22	4.4%	3.2%	2.1%	**3.4%**
Owner death	18	4.9%^{H}	1.7%	2.1%	**2.8%**
Abandoned	14	0.5%^{L}	2.6%	4.2%	**2.2%**
Loss of companion	10	1.5%	2.0%	0.0%	**1.6%**
No answer	9	0.5%	2.0%	1.0%	**1.4%**
Humanitarian rescue	6	0.5%	0.9%	2.1%	**0.9%**
Family problems	4	0.0%	0.9%	1.0%	**0.6%**
Lack of knowledge	4	0.5%	0.6%	1.0%	**0.6%**
Farm closed	2	0.5%	0.0%	1.0%	**0.3%**

Significance of Likelihood Ratio test, p<0.001

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

The main reasons for the relinquishment of geriatric animals were investigated and a positive correlation was found between them (p_{LR}<0.001).

Significantly more geriatric animals than expected were relinquished due to a house move (21.4%), owner´s death (7.1%) and loss of a companion (7.1%), while fewer than expected were due to bad behavior (0.0%) (Table 5.49). On the other hand, there were more non-geriatric donkeys than expected that were relinquished due to bad behaviour (10.7%) and fewer than expected were relinquished due to house move (9.1%), owner's death (2.2%) or loss of companion (0.9%).

Statistically significant differences were found between the main reason for relinquishment and type of origin of animals (p_{LR}<0.001) (Table 5.50). Greater frequencies than expected were observed of "New arrival" animals entering due to house move (12.1%), loss of grazing (6.1%), lack of suitable environment (6.5%) and financial reasons (5.8%). Lower frequencies than expected were observed arriving due to donkey health (7.6%), being abandoned (0.2%) and family problems (0.0%).

With regards to DS HB (NA), it was observed that higher numbers than expected were arriving due to abandonment (12.0%) and humanitarian rescue (3.7%), whilst 5.6% did not give a reason for relinquishment. In this group, lower frequencies than expected were seen of animals arriving because of donkey health (0.9%), house move (1.9%) or financial (0.0%) reasons.

In terms of the RG animals, more animals than expected were arriving due to donkey health problems (23.1%), family problems (3.1%) and the loss of a companion (4.6%) while lower frequencies than expected were seen arriving due to lack of a suitable environment (0.0%). Donkey health concerns, followed by owner's health and house move were given as the main reasons for relinquishment of guardian donkeys.

Table 5.49. Main reason for relinquishment stratified by geriatric and non-geriatric animals

Main Reason	n	Non-geriatric (n=539)	Geriatric (n=56)	Total (n=595)
Owner's health	121	20.0%	23.2%	**20.3%**
Donkey health	61	9.8%	14.3%	**10.2%**
House move	61	9.1%^{L}	21.4%^{H}	**10.2%**
Bad behaviour	58	10.7%^{H}	0.0%^{L}	**9.7%**
Lack of time	45	8.0%	3.6%	**7.6%**
Others	36	6.3%	3.6%	**6.0%**
Lack of a suitable environment	30	5.4%	1.8%	**5.0%**
Overstocked	30	5.4%	1.8%	**5.0%**
Financial	27	4.4%	5.4%	**4.5%**
Loss of grazing	23	3.5%	7.1%	**3.9%**
Personal circumstances	23	4.3%	0.0%	**3.9%**
RSPCA	21	3.7%	1.8%	**3.5%**
Owner death	16	2.2%^{L}	7.1%^{H}	**2.7%**
Abandoned	14	2.6%	0.0%	**2.3%**
Loss of companion	9	0.9%^{L}	7.1%^{H}	**1.5%**
No answer	8	1.3%	1.8%	**1.3%**
Humanitarian rescue	5	0.9%	0.0%	**0.8%**
Family problems	4	0.7%	0.0%	**0.7%**
Lack of knowledge	3	0.6%	0.0%	**0.5%**
Farm closed	1	0.2%	0.0%	**0.2%**

Significance of Likelihood Ratio test, $p<0.001$
^{H}: Observed proportion significantly higher than expected ($p<0.050$)
^{L}: Observed proportion significantly lower than expected ($p<0.050$)

Interestingly, guardian owners should be responsible for donkey health and welfare throughout the donkey's life. Specific health problems of "Return guardian" donkeys will need to be investigated to see if guardian donkey return could be avoidable by addressing donkey health issues at their guardian homes, or even if donkeys with the potential for similar health concerns should be precluded from the guardian scheme altogether to avoid return. Loss of companion, although not a very high percentage, should not be a reason for "Return guardian"relinquishment, as single donkeys can be provided as friends to the guardian home. It could be that in those cases there are other underlying reasons for the closure of the guardian home. Donkeys become the responsibility of the guardian carer, although ultimate ownership remains with TDS (Cox et al., 2010). Under the guardian scheme contract, guardian homes should cover the veterinary costs of the animals in their care

When looking at the main reasons for relinquishment for DS HB (RG), owner's health (27.3%) was given as the main reason, followed by bad behaviour (18.2%) and others (27.3%). Similar results were found by Marston et al. (2004) looking at three Australian small animal shelters, and Marston et al. (2010) found that 7.2% of the adopted dogs were returned. A quarter of these dogs (26.4%) were returned for owner-related factors such as moving house or inappropriate selection, and 22.3% for dog-related factors such as size and health.

Table 5.50. Distribution of animals by main reason and type of origin

Main Reason	**Type of origin**					**Total** (n=643)
	New Arrival (n=444)	T HB (NA) (n=108)	Return Guardian (n=65)	DS HB (RG) (n=11)	DAT (n=15)	
Owner's health	20.0%	22.2%	21.5%	27.3%	0.0%^{L}	**20.2%**
House move	12.1%^{H}	1.9%^{L}	15.4%	0.0%	0.0%	**10.2%**
Bad behaviour	9.9%	6.5%	12.3%	18.2%	26.7%^{H}	**10.1%**
Donkey health	7.6%^{L}	0.9%^{L}	23.1%^{H}	9.1%	73.3%^{H}	**9.6%**
Lack of time	8.3%	9.3%	1.5%	9.1%	0.0%	**7.6%**
Others	5.4%	8.3%	4.6%	27.3%	0.0%	**6.1%**
Lack of a suitable environment	6.5%^{H}	0.0%	0.0%^{L}	0.0%	0.0%	**5.3%**
Overstocked	5.8%	3.7%	0.0%	0.0%	0.0%	**4.7%**
Loss of grazing	6.1%^{H}	1.9%	0.0%	0.0%	0.0%	**4.5%**
Financial	5.8%^{H}	0.0%^{L}	3.1%	0.0%	0.0%	**4.3%**
Personal circumstances	3.4%	3.7%	6.2%	0.0%	0.0%	**3.6%**
RSPCA	2.7%	9.3%	0.0%	0.0%	0.0%	**3.4%**
Owner death	2.7%	3.7%	3.1%	0.0%	0.0%	**2.8%**
Abandoned	0.2%^{L}	12.0%^{H}	0.0%	0.0%	0.0%	**2.2%**
Loss of companion	1.3%	0.9%	4.6%^{H}	0.0%	0.0%	**1.6%**
No answer	0.2%^{L}	5.6%^{H}	1.5%	9.1%	0.0%	**1.4%**
Humanitarian rescue	0.4%	3.7%^{H}	0.0%	0.0%	0.0%	**0.9%**
Family problems	0.0%^{L}	1.9%	3.1%^{H}	0.0%	0.0%	**0.6%**
Lack of knowledge	0.9%	0.0%	0.0%	0.0%	0.0%	**0.6%**
Farm closed	0.4%	0.0%	0.0%	0.0%	0.0%	**0.3%**

Significance of Likelihood Ratio test, $p<0.001$

^{H}: Observed proportion significantly higher than expected ($p<0.050$)

^{L}: Observed proportion significantly lower than expected ($p<0.050$)

DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

Finally, the majority of DAT donkeys returning to TDS were due to donkey health (73.3%) and bad behaviour (26.7%). Marston et al. (2010) found that 22.0% of the dogs in their study were returned due to behaviour problems. Donkey behaviour is assessed during the "New arrivals" period and if selected as a guardian/DAT candidate behaviour would also be assessed by a TDS veterinary surgeon. Training animals for the guardian/DAT scheme should be reviewed in order to reduce the number of "Return guardian" animals due to behavioural issues.

In Table 5.51 statistically significant differences were found between the main reason for relinquishment given by the owners and the donkey's origin region (p_{LR}<0.001).

With regards to the most common reason for relinquishment, owner's health, it was found that there were fewer donkeys than expected being relinquished for that reason coming from the North East (3.8%) while there were more donkeys than expected from the West Midlands (35.8%), South West (26.4%) and Greater London (66.7%). It would be interesting for TDS to find out more about the typical donkey owner.

With regards to the second most common reason, house move, it was observed that there were more donkeys than expected being relinquished for that reason from Scotland (29.6%).

It was also noted that there were more donkeys that expected being relinquished for bad behaviour from the South East (16.5%) and fewer donkeys were being relinquished for the same reason from the South West (4.9%).

It was also observed (Table 5.51) that there were more owners who gave lack of time as a reason for relinquishment from the North East (21.2%) and North West (13.8%), while fewer were from the South East (0.0%).

There were more donkeys than expected from Wales and Greater London relinquished due to lack of a suitable environment (14.0% and 33.3%).

With regards to overstocking as a reason for relinquishment, there were more donkeys than expected coming from the North West (13.8%) and the South West (9.2%).

Financial reasons were given as a reason for relinquishment in more cases from the West Midlands (28.3%) and the South East (8.8%), while fewer donkeys from the South West (0.6%) had the same relinquishment reason given.

In the South West, loss of grazing was given as the main relinquishment reason in more donkeys than expected (7.4%).

Personal circumstances were cited as the main relinquishment reason in more relinquishments than expected from the North West (9.2%) and Wales (9.3%), while fewer donkeys had the same relinquishment reason from the South East (0.0%).

With regards to RSPCA relinquishments, there were more donkeys than expected from Northern Ireland (13.0%), the East Midlands (9.3%) and Wales (9.3%), and fewer donkeys than expected from the South East (0.0%).

When looking at owner's death as a reason for relinquishment, it was observed that there were statistically more donkeys than expected from the South East (11.0 %).

It was also seen that there were more donkeys than expected abandoned prior to relinquishment from an unknown origin (100.0%), Scotland (11.1%) and Northern Ireland (26.1%), while fewer donkeys than expected were relinquished for the same reason from the South West (0.0%).

Finally, there were more donkeys than expected without a reason for relinquishment coming from the South East (3.3%).

Table 5.51. Distribution of donkeys by main reason and type of origin region

Main Reason	n	Unknown origin (n=4)	Scotland (n=30)	Northern Ireland (n=23)	North East (n=56)	North West (n=70)
Owner's health	121	0.0%	7.4%	30.4%	3.8%^{L}	13.8%
House move	60	0.0%	29.6%^{H}	0.0%	15.4%	3.1%
Bad behaviour	55	0.0%	3.7%	8.7%	15.4%	15.4%
Donkey health	55	0.0%	3.7%	0.0%	15.4%	12.3%
Lack of time	42	0.0%	14.8%	0.0%	21.2%^{H}	13.8%^{H}
Others	36	0.0%	11.1%	8.7%	1.9%	4.6%
Lack of suitable environment	30	0.0%	7.4%	0.0%	5.8%	4.6%
Overstocked	30	0.0%	0.0%	13.0%	3.8%	13.8%^{H}
Financial	27	0.0%	0.0%	0.0%	1.9%	0.0%
Loss of grazing	23	0.0%	3.7%	0.0%	5.8%	4.6%
Personal circumstances	22	0.0%	7.4%	0.0%	1.9%	9.2%^{H}
RSPCA	20	0.0%	0.0%	13.0^{H}	3.8	0.0%
Owner death	16	0.0%	0.0%	0.0%	0.0%	0.0%
Abandoned	14	100.0%^{H}	11.1%^{H}	26.1%^{H}	0.0%	0.0%
Loss of companion	8	0.0%	0.0%	0.0%	1.9%	3.1%
No answer	7	0.0%	0.0%	0.0%	0.0%	0.0%
Humanitarian rescue	5	0.0%	0.0%	0.0%	0.0%	1.5%
Family problems	4	0.0%	0.0%	0.0%	0.0%	0.0%
Lack of knowledge	3	0.0%	0.0%	0.0%	0.0%	0.0%

Table 5.51. (cont.) Distribution of donkeys by main reason and type of origin region

Main Reason	**n**	**East Midlands** (n=61)	**West Midlands** (n=61)	**Wales** (n=49)	**South West** (n=171)	**South East** (n=98)	**Greater London** (n=3)
Owner's health	121	24.1%	35.8%^{H}	14.0%	26.4%^{H}	19.8%	66.7%^{H}
House move	60	11.1%	9.4%	11.6%	6.1%	17.6%	0.0%
Bad behaviour	55	7.4%	5.7%	9.3%	4.9%^{L}	16.5%^{H}	0.0%
Donkey health	55	11.1%	5.7%	5.7%	14.0%	6.6%	0.0%
Lack of time	42	3.7%	1.9%	0.0%	9.2%	0.0%^{L}	0.0%
Others	36	9.3%	3.8%	4.7%	6.1%	8.8%	0.0%
Lack of suitable environment	30	5.6%	5.7%	14%^{H}	4.3%	2.2%	33.3%^{H}
Overstocked	30	0.0%	0.0%	0.0%	9.2%^{H}	1.1%	0.0%
Financial	27	0.0%	28.3%^{H}	4.7%	0.6%^{L}	8.8%^{H}	0.0%
Loss of grazing	23	1.9%	0.0%	2.3%	7.4%^{H}	2.2%	0.0%
Personal circumstances	22	5.6%	0.0%	9.3%^{H}	3.7%	0.0%^{L}	0.0%
RSPCA	20	9.3%^{H}	0.0%	9.3%^{H}	3.7%	0.0%^{L}	0.0%
Owner death	16	3.7%	0.0%	4.7%	1.2%	11.0%^{H}	0.0%
Abandoned	14	0.0%	0.0%	0.0%	0.0% ^{L}	0.0%	0.0%
Loss of companion	8	1.9%	1.9%	2.3%	1.2%	0.0%	0.0%
No answer	7	3.7%	0.0%	0.0%	1.2%	3.3%^{H}	0.0%
Humanitarian rescue	5	0.0%	1.9%	0.0%	1.8%	0.0%	0.0%
Family problems	4	0.0%	0.0%	0.0%	1.2%	2.2%	0.0%
Lack of knowledge	3	1.9%	0.0%	0.0%	1.2%	0.0%	0.0%

Significance of Likelihood Ratio test, $p<0.001$

^{H}: Observed proportion significantly higher than expected ($p<0.050$)

^{L}: Observed proportion significantly lower than expected ($p<0.050$)

5.2.6. Ownership information

The mean duration of pet ownership before being relinquished to TDS was found to be 6 years for "New arrival" animals, 5 years for "Return guardian" animals, 4 years for DS HB (NA) and DS HB (RG) while it was only 2 years for donkeys in DAT centres (Table 5.52). It was observed that the maximum time owned was 25 years for "New arrival" animals, 21 for "Return guardian" animals, 17 years for DS HB (NA), 15 years for DS HB (RG) and a maximum of 5 years for DAT donkeys (Table 5.52).

In the study by Grint et al. (2015), donkey owners had owned their donkeys a median of 15 years (0.5-60).

The mean duration of pet ownership before being relinquished to TDS was found to be 5.7 years for “New arrival” animals. Interestingly, “Return guardian” animals, DS HB (RG) and DAT animals spent less time at the owner’s property (the mean for DAT animals was 2 years) (Table 5.52).

Also, the median duration of pet ownership in the USA was found to be significantly longer in a study done by Kass et al. (2001), where the author reported a median of 10.9 years in dogs, and 10 years among cats before relinquishment.

Table 5.52. Distribution of animals by type of origin and years of pet ownership

Type of origin	n	Mean	SD	Min	Max
New arrival	417	5.7	50.0	0	25
DS HB (NA)	81	4.0	42.4	0	17
Return guardian	63	5.0	52.0	0	21
DS HB (RG)	11	3.6	41.2	0	15
DAT	15	2.0	14.3	1	5
Total	**587**	**5.3**	**49.1**	**0**	**25**

DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

The mean number of years owned stratified by main reasons for relinquishment showed that animals have been owned a maximum of 8.9 years before relinquishment due to owner’s death. The reasons for relinquishment of animals that have been owned for more than 5 years were house move (8.5 years), loss of grazing (7.9 years), loss of companion (7.2 years) and owner’s health (6.1 years). While humanitarian rescue (1.4 years), lack of knowledge (1 year) and farm closure were given as the main reason for relinquishment of animals that were owned for less than a year (Table 5.53).

Miller (2007) concluded that one of the problems in shelter medicine is that the public are still irresponsible regarding pet ownership. Targeting educational programs towards responsible donkey/mule ownership could be something implemented by the charity to improve the length of ownership before relinquishment, by reducing lack of knowledge as a reason for relinquishment. Targeting a broader population for the guardian scheme and ownership programs could also be considered.

Table 5.53. Years owned stratified by main reason for relinquishment

Reasons for relinquishment	n	Mean	SD	Q1	Median	Q3	min	Max
Owner death	18	8.9^{g}	6.7	3.0	8.0	10.0	2	24
House move	65	8.5^{fg}	6.4	4.0	7.0	10.0	0	25
Loss of grazing	28	7.9^{efg}	5.5	3.0	8.0	12.0	0	21
Loss of companion	10	7.2^{defg}	4.8	3.5	6.5	10.3	1	17
Owner's health	122	6.1^{cdefg}	5.0	2.0	5.0	8.3	0	21
No answer	3	5.7^{bcdefg}	8.1	-	-	-	0	15
Donkey health	59	$5.3^{abcdefg}$	4.7	2.0	4.0	7.0	0	18
Financial	28	$4.8^{abcdefg}$	3.3	2.0	5.0	5.0	1	15
Lack of time	48	4.8^{abcdef}	4.2	2.0	5.0	6.0	0	16
Others	36	4.2^{abcde}	3.8	1.3	2.5	7.8	0	13
Lack of suitable environment	33	3.9^{abcd}	3.6	1.0	4.0	6.5	0	13
Bad behaviour	63	3.2^{abcd}	3.2	1.0	2.0	4.0	0	17
RSPCA	8	3.1^{abcd}	4.3	0.3	1.0	8.0	0	10
Personal circumstances	22	3.0^{abcd}	2.6	1.0	2.0	4.0	0	9
Overstocked	30	2.5^{abc}	2.2	1.8	2.0	3.0	0	10
Family problems	4	2.0^{abc}	0.0	-	-	-	2	2
Humanitary rescue	5	1.4^{ab}	2.2	-	-	-	0	5
Lack of knowledge	4	1.0^{a}	0.0	-	-	-	1	1
Total	**586**	**5.3**	**4.9**	**2.0**	**4.0**	**8.0**	**0**	**25**

Significance of Kruskal-Wallis test, $p<0.001$.

Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test ($p_{MW}<0.050$)

5.3. Health status on arrival

We are going to compare information from two sources: the PAM performed by external veterinary practitioners and the AM performed at TDS NAU on arrival.

5.3.1. Pre-admission medical exam (PAM)

Almost half of the population that arrived had a PAM done by an external veterinary practice (46.7%) whilst the other half were not examined by a vet prior to arrival at the charity (47.8%) (Table 5.54). Interestingly, although the median age of the arrival population was reasonably young, almost half of the relinquishments were considered to need a veterinary examination prior to transportation. This could indicate that there were some concerns with regards to the health of those animals raised by the relevant welfare advisor or the NAU vet.

A statistically significant association was found between PAM and species (p_{LR}<0.001). A higher frequency of donkeys than expected were found to have had a PAM done (48.7%) whilst a higher proportion of mules did not receive one (81.1%). This could be explained by the difficulties often faced when handling mules in the field. Owners may be reluctant to schedule a prior veterinary examination because of handling concerns, and as a result, some mules that would have been deemed unfit to travel by an attending vet may be transported unnecessarily. This in turn may increase the number of mules euthanased at the NAU rather than at their origin, as conditions that cause poor welfare and a reduced quality of life may be missed without a veterinary exam prior to transportation.

Table 5.54. PAM of animals stratified by species

PAM	**n**	**Species**			**Total**
		Donkey	Mule	Pony	
Yes	301	48.7%^{H}	10.8%^{L}	63.6%	**46.7%**
Partial	35	5.4%	8.1%	0.0%	**5.4%**
No	308	46.0%^{L}	81.1%^{H}	36.4%	**47.8%**

Significance of Likelihood Ratio test, p<0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between PAM and sex (p_{X2}<0.001); it was found that more mares than expected had a PAM (52.9%) while fewer did not have one (41.7%). With regards to stallions, it was observed that higher numbers than expected did not have a PAM (60.4%) (Table 5.55). This fact could be explained by the fact that we found more geriatric mares were relinquished to TDS, and as such they would receive a full PAM.

Table 5.55. PAM of animals stratified by sex

PAM	**n**	**Sex**			**Total**
		Mare	Gelding	Stallion	
Yes	301	52.9%^{H}	47.4%	31.3%^{L}	**46.7%**
Partial	35	5.4%	4.7%	8.3%	**5.4%**
No	308	41.7%^{L}	48.0%	60.4%^{H}	**47.8%**

Significance of Pearson's Chi-square test, p<0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between completion of a PAM and age (p_{X2}<0.001) (Table 5.56).

It was observed (Table 5.56) that more donkeys than expected that were older than 20 years had a PAM (96.4%), while fewer donkeys had a PAM in the younger than 1 year old category (28.6%), and the greater than 3 to 5 years old category (34.5%). These findings can be explained by current TDS protocols, as every donkey over 20 years old should receive a full PAM examination prior to entering the isolation premises. It is particularly interesting as those results should have been even higher for those in the older category, and TDS should aim for 100.0% of these older donkeys to receive a PAM. It can be extremely difficult to decide whether completion of a PAM is necessary for donkeys that are stated as younger in their passport than they appear physically.

In some cases, the perception of the owner is that if their donkeys show any abnormalities during the examination then TDS could halt the relinquishment process. Further education of owners is needed with regards to quality of life and the risks of transport and movement of geriatric animals.

On the other hand, to avoid missing geriatric cases due to the difficulties of ageing donkeys by teeth, welfare advisors are now asked to take specific pictures of animals pre-relinquishment. The NAU vet can then assess these, and in conjunction with the medical history, they can decide upon the need for a full medical examination.

Additionally, it was also found that more donkeys than expected had a partial PAM in the 1 year and younger category (14.3%).

Finally, it was observed (Table 5.56) that more donkeys than expected did not receive a PAM in the greater than 3 to 5 years old category (58.2%), whilst fewer than expected did not receive a PAM in the geriatric category (greater than 20 years old) (1.8%).

Table 5.56. PAM of donkeys stratified by age (categorised)

PAM	n	≤ 1 y	(1 y, 3 y]	(3 y, 5 y]	(5 y, 20 y]	> 20 y	Total
Yes	301	28.6%^{L}	42.0%	34.5%^{L}	48.3%	96.4%^{H}	**48.7%**
Partial	35	14.3%^{H}	4.3%	7.3%	4.8%	1.8%	**5.4%**
No	308	57.1%	53.6%	58.2%^{H}	46.8%	1.8%^{L}	**46.0%**

Significance of Pearson's Chi-square test, p<0.001

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

A statistically significant association was found between PAM and age (p_{X2}<0.001). More non-geriatric animals than expected did not receive a PAM (50.6%) while fewer had a complete PAM (43.7%). With regards to geriatric animals, it was found that higher frequencies of animals than expected had a complete PAM (96.4%) while fewer than expected did not receive one; only 1.8% did not receive a PAM (Table 5.57). Interestingly, as part of TDS policy, any geriatric animal should receive a complete PAM, therefore it is significant that 1.8% did not follow standard protocols and this could have been related to handling difficulties or ageing inaccuracies by the welfare advisor. The Donkey Sanctuary Welfare advisor training should assess their knowledge of ageing and provide adequate continuous training to ensure geriatric animals are always identified.

Table 5.57. PAM of animals stratified by age

PAM	n	Non-geriatric	Geriatric	Total
Yes	301	43.7%^{L}	96.4%^{H}	**48.7%**
Partial	35	5.7%	1.8%	**5.4%**
No	308	50.6%^{H}	1.8%^{L}	**46.0%**

Significance of Pearson's Chi-square test, p<0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between PAM and type of origin (p_{X2}<0.001). With regards to NAU animals, higher frequencies of animals than expected did not receive any PAM (56.6%), whilst fewer had a complete PAM (38.2%). Higher frequencies of animals coming from DS HB (NA) had a complete PAM prior to arrival (67.6%), while significantly fewer did not have one (23.1%). Animals in holding bases are generally seen by external vets on arrival and prior to movement. With regards to "Return guardian" animals, significantly higher numbers than expected had a complete PAM (66.2%) while significantly fewer did not have one (33.8%). This could be explained by the fact that a large number of "Return guardian" donkeys are classified as geriatrics.

Despite there being no significant differences, the majority of animals coming from DS HB (RG) had complete PAM (72.7%) and nearly half of the donkeys arriving from DAT did not receive PAM (40.0%) (Table 5.58). DAT donkeys usually receive a 6 monthly visit from a TDS vet to ensure that the health and routine care of the DAT population is in line with TDS standards, therefore PAM might not be seen as necessary when assessing the relinquishment paperwork and clinical history of these animals.

Table 5.58. PAM of animals stratified by type of origin

PAM	n	Type of origin					Total
		New Arrival	DS HB (NA)	Return Guardian	DS HB (RG)	DAT	
Yes	301	38.2%^{L}	67.6%^{H}	66.2%^{H}	72.7%	46.7%	**46.7%**
Partial	35	5.2%	9.3%	0.0%^{L}	0.0%	13.3%	**5.4%**
No	308	56.6%^{H}	23.1%^{L}	33.8%^{L}	27.3%	40.0%	**47.8%**

Significance of Pearson's Chi-square test, p<0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

Statistically significant differences were found between the origin region of arriving animals and whether a PAM had been performed (p_{LR}<0.001) (Tabla 5.59). Firstly, it was found that all animals from an unknown origin had a PAM done (100.0%). This fact can be easily explained, as these animals need a blood sample to screen for certain infectious diseases, so they will always be examined by a vet.

Additionally, most animals from Northern Ireland and more than expected, had a complete PAM done (95.7%) while less than expected from the same region did not have one (0.0%). Transport and long distances might be considered as risks when transporting animals from Scotland or Northern Ireland to Devon. Also, more animals than expected from Scotland had a complete PAM (66.7%), while less than expected from the same region did not receive one (30.0%).

Lastly, it was found that more animals than expected from the South West had received a partial PAM (8.2%). It is possible that shorter transport distances might be perceived as being lower risk movements.

Table 5.59. PAM of animals stratified by region

Region	**n**	**PAM**		
		No	Partial	Yes
Unknown origin	4	0.0%	0.0%	100.0%^{H}
Scotland	30	30.0%^{L}	3.3%	66.7%^{H}
Northern Ireland	23	0.0%^{L}	4.3%	95.7%^{H}
North East	56	53.6%	5.4%	41.1%
North West	70	57.1%	1.4%	41.4%
East Midlands	61	52.5%	6.6%	41.0%
West Midlands	61	45.9%	3.3%	50.8%
Wales	49	49.0%	2.0%	49.0%
South West	171	49.7%	8.2%^{H}	42.1%
South East	99	52.5%	6.1%	41.4%
Greater London	3	0.0%	0.0%	100.0%
Total	**627**	**47.8%**	**5.3%**	**46.90%**

Significance of Likelihood Ratio test, $p<0.001$

^{H}: Observed proportion significantly higher than expected ($p<0.050$)

^{L}: Observed proportion significantly lower than expected ($p<0.050$)

No significant differences were found between the Time since PAM to arrival and species (p_{LR}=0.146). Half of the total number of animals were given a PAM between 0 and 14 days pre-arrival (Table 5.60). Similarly, half (50.8%) of the arriving donkeys had their PAM completed 0 to 14 days pre-arrival at the NAU, while half of the arriving mules had their PAM more than 28 days pre-arrival.

TDS should ensure that the movement of animals occurs within a set period of time following the PAM, so that the veterinary examination accurately reflects the current health status of the animal. The Donkey Sanctuary should identify a set time period between PAM and transportation. Some animals that had a PAM performed a long time before transport would have been seen by an external vet for an additional fitness to travel examination if any problems were identified at the time of the initial PAM.

Table 5.60. Time since PAM to arrival (categorised) stratified by species

PA days (cat)	n	Species			Total
		Donkey	Mule	Pony	
0-14 days	**160**	50.8%	16.7%	42.9%	**50.0%**
15-28 days	**58**	18.2%	33.3%	0.0%	**18.1%**
>28 days	**102**	30.9%	50.0%	57.1%	**31.9%**

Significance of Likelihood Ratio test, p=0.146
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Significant differences were not found between the time of the PAM before arrival and sex (p_{X2}=0.082). However, when considering adjusted standardised residuals, fewer geldings than expected were found to have a PAM 15 to 28 days prior to arrival (12.9%). Half of the population that received a PAM did so 0 to 14 days before arrival (Table 5.61).

Table 5.61. Time since PAM to arrival (categorised) of all animals stratified by sex

PA days (cat)	n	Sex			Total
		Mare	Gelding	Stallion	
0-14 days	**160**	49.6%	52.6%	38.2%	**50.0%**
15-28 days	**58**	23.5%	12.9%^{L}	26.5%	**18.1%**
>28 days	**102**	27.0%	34.5%	35.3%	**31.9%**

Significance of Pearson's Chi-square test, p=0.082
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between the Time since PAM to arrival and donkey age (p_{X2}=0.012) (Table 5.62).

It was observed (Table 5.62) that more donkeys than expected had a PAM 15 to 28 days prior to arrival in the greater than 20 years old category (29.1%). On the other hand, fewer donkeys than expected had a PAM 15 to 28 days prior to arrival in the greater than 3 to 5 years old category (2.3%). The Donkey Sanctuary should decide upon an acceptable protocol with regards to pre-admission exams and time of admission, especially if donkeys are in need of treatment that could compromise their welfare if delayed. The Donkey Sanctuary NAU vet advises on fitness to travel 24 h prior to movement for those that have any concerns raised at the PAM that could potentially affect their fitness to travel.

It was also found that more donkeys than expected had a PAM over 28 days prior to arrival in the greater than 1 to 3 years old category (50.0%).

Table 5.62. Time since PAM to arrival (categorised) of all animals stratified by age (categorised)

PA days	n	≤ 1 y	(1 y, 3 y]	(3 y, 5 y]	(5 y, 20 y]	> 20 y	Total
0-14 days	156	41.7%	42.9%	58.1%	52.1%	47.3%	**50.8%**
15-28 days	56	16.7%	7.1%	2.3%^{L}	20.7%	29.1%^{H}	**18.2%**
> 28 days	95	41.7%	50.0%^{H}	39.5%	27.2%	23.6%	**30.9%**

Significance of Pearson's Chi-square test, p=0.012
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

No significant differences were found between when the PAM was performed and geriatric animals (p_{X2}=0.059). However, a higher proportion of geriatric donkeys than expected had their PAM 15 to 28 days prior to arrival (29.1%) (Table 5.63).

Table 5.63. Time since PAM to arrival (categorised) of all animals stratified by age

PA days (cat)	n	Non-geriatric	Geriatric	Total
0-14 days	156	51.6%	47.3%	**50.8%**
15-28 days	56	15.9%^{L}	29.1%^{H}	**18.2%**
>28 days	95	32.5%	23.6%	**30.9%**

Significance of Pearson's Chi-square test, p=0.059
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

A statistically significant association was found between Time since PAM and type of origin (p_{LR}<0.001). A significantly higher proportion of animals than expected (64.6%) arriving from DS HB (NA) received a PAM more than 28 days before arrival at TDS. On the other hand, more animals than expected from a New arrival origin had their PAM 15 to 28 days before arrival (26.8%) (Table 5.64).

Table 5.64. Time since PAM to arrival (categorised) of all animals stratified by type of origin

PA days (cat)	n	Type of origin					Total
		New Arrival	DS HB (NA)	Return Guardian	DS HB (RG)	DAT	
0-14 days	160	51.9%	32.9%^{L}	61.9%	62.5%	100.0%	**50.0%**
15-28 days	58	26.8%^{H}	2.5%^{L}	16.7%	0.0%	0.0%	**18.1%**
>28 days	102	21.3%^{L}	64.6%^{H}	21.4%	37.5%	0.0%	**31.9%**

Significance of Likelihood Ratio test, p<0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

Statistically significant differences were found between Time since PAM and donkeys' origin region (p_{LR}<0.001). Firstly, it was observed (Table 5.65) that more donkeys than expected arriving from an unknown origin had their PAM exam more than 28 days prior to arrival at TDS (100.0%). This finding can be explained as these donkeys are required to be tested for piroplasmosis, EIA (Equine Infectious Anaemia) and EVA (Equine Viral Arteritis); as such they are not moved until their results are received and assessed by TDS vets, thereby delaying the movement of donkeys that need to be isolated at their place of origin. It was also noted (Table 5.65) that fewer donkeys than expected from an unknown origin had a PAM 15 to 28 days prior to arrival (0.0%).

Secondly, it was observed that fewer donkeys than expected that received their PAM 15 to 28 days prior to arrival came from Scotland (0.0%); interestingly, the majority of donkeys coming from Scotland had a recent PAM (0 to 14 days) (61.1%). This finding may be because donkeys from Scotland undertake long-distance transportation, although 38.9% had been seen more than 28 days prior to transport and arrival.

TDS should consider if donkeys coming from Scotland develop more problems following long-distance transport than those undergoing shorter journeys. If a correlation is found, then donkeys originating in Scotland might need to be seen by a vet prior to transportation, to try and reduce transport-related problems.

Thirdly, all the donkeys that came from Northern Ireland had a PAM more than 28 days prior to arrival (100.0%). The Donkey Sanctuary should consider policies for donkeys travelling long distances and assess how donkeys cope with transport, to identify and try to prevent any problems related to long-distance travel (Table 5.65).

Table 5.65. Time since PAM to arrival (categorised) of all animals stratified by origin region

Region	n	PA days (categorised)		
		0-14 days	15-28 days	>28 days
Unknown origin	4	0.0%	0.0% ^{L}	100% ^{H}
Scotland	18	61.1%	0.0% ^{L}	38.9%
Northern Ireland	23	0.0% ^{L}	0.0% ^{L}	100% ^{H}
North East	23	52.2%	26.1%	21.7%
North West	27	63.0%	7.4%	29.6%
East Midlands	25	48.0%	12.0%	40.0%
West Midlands	30	46.7%	30.0%	23.3%
Wales	23	69.6% ^{H}	26.2%	4.3% ^{L}
South West	80	58.8%	26.3% ^{H}	15.0% ^{L}
South East	42	40.5%	19.0%	40.5%
Greater London	3	66.7%	33.3%	0.0%
Total	**298**	**49.7%**	**18.8%**	**31.5%**

Significance of Likelihood Ratio test, p<0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

It was also observed (Table 5.65) that more donkeys than expected that came from Wales received a recent PAM, between 0 and 14 days prior to arrival (69.6%), while fewer donkeys (4.3%) from the same region had a PA exam more than 28 days prior to arrival.

Lastly, it was found (Table 5.65) that more donkeys than expected from the South West had PAM exams 15 to 28 days prior to arrival (26.3%), while fewer donkeys from the same region had PAM exams more than 28 days prior to arrival (15.0%).

5.3.2. Fitness to travel in donkeys

A total of 27.9% of donkeys had a fitness to travel (FTT) examination 24 to 48 h prior to transportation.

Statistically significant differences were found between donkeys that had a FTT and those that had a PAM (p_{X2}<0.001). It was observed (Table 5.66) that of the donkeys that did not receive a PAM, more than expected also did not receive a FTT (100.0%). On other hand, it was also seen that more donkeys than expected that did have a PAM, also received a FTT (53.8%) (Table 5.66).

Table 5.66. Frequency of fitness to travel in donkeys (FTT) stratified by PAM

PAM	n	Fitness to travel
No	274	0.0% ^{L}
Partial	32	31.3%
Yes	290	53.8% ^{H}
Total	**596**	**27.9%**

Significance of Pearson´s Chi-square test, p<0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

5.3.3. Vaccination status

In Table 5.67, it was observed that there were no significant differences between species with regards to vaccination status (p_{X2}=0.581), and the majority of animals arrived at TDS premises with an incomplete vaccination status (77.3%).

Vaccination in these cases must be re-started against equine influenza and tetanus. Some animals may have had these vaccines administered previously, but if vaccine courses were not followed correctly, it is considered that these animals do not have enough protection. This has an impact on TDS finances, moreover, it highlights a serious risk to UK biosecurity with regards to prevention of disease in the UK population. Additionally, unvaccinated animals do not receive the annual examination that accompanies vaccination, and as such, certain conditions that may have been noted by the attending vet are not identified.

A study by Fagre et al. (2017) found that vaccination protocols reported from several small animal shelters in the USA were not consistent with The Association of Shelter Veterinarians Guidelines for Standards of Care in Animal Shelters. These state that vaccines must be used as part of a preventive healthcare plan for shelters in order to prevent deadly disease outbreaks. The Association of Shelter Veterinarians states that pregnancy and mild illness are not contraindications for the administration of core vaccines, though many respondents claimed these as reasons for postponing or forgoing vaccination. In Colorado, it was reported that 53.1% (17/32) of shelters vaccinated dogs and 24.1% (7/29) of shelters vaccinated cats for rabies. To date, no data is available regarding equine shelter vaccination or the vaccination status of relinquished equines.

Table 5.67. Complete vaccination status stratified by species

Species	n	Vaccinated
Donkey	596	23.2%
Mule	37	16.2%
Pony	11	18.2%
Total	**644**	**22.7%**

Significance of Pearson's Chi-square test, p=0.581

Statistically significant differences were found between vaccination status in donkeys and their age (p_{X2}=0.005) (Table 5.68).

It was observed (Table 5.68) that there were more geriatric donkeys (greater than 20 years old) that were vaccinated (35.7%) while there were fewer in the greater than 1 to 3 years category (8.7%).

Table 5.68. Vaccination status in donkeys stratified by age (categorised)

Age (categorised)	n	Vaccinated
≤ 1 y	28	14.3%
(1 y, 3 y]	69	8.7%^{L}
(3 y, 5 y]	110	26.4%
(5 y, 20 y]	333	23.7%
> 20 y	56	35.7%^{H}
Total	**596**	**23.2%**

Significance of Pearson's Chi-square test, p=0.005
^{H}: Observed proportion significantly higher than expected (p<0.050)
$^{L:}$ Observed proportion significantly lower than expected (p<0.050)

Interestingly, younger donkeys are those that are receiving less vaccinations and therefore efforts should be made to educate those with foals or young donkeys so that owners are aware of the risks of not vaccinating.

A statistically significant association was found between the type of origin of donkeys and their vaccination status (p_{X2}<0.001). Fewer donkeys than expected (9.0%) (Table 5.69) arrived at TDS NAU premises with a valid vaccination status.

Significantly higher numbers of donkeys than expected arrived with a valid vaccination status from “Return guardian”, DS HB (RG) and from DAT (88.7%, 90.9% and 86.7%). It is TDS policy that all animals are fully vaccinated against equine influenza and tetanus, therefore 100% of these animals should have had a valid vaccination status. As such, it is significant that 11.3% of “Return guardian” donkeys did not have a valid vaccination status and vaccination had to be re started; the same situation was observed in 9.1% from DS HB (RG) donkeys and 13.3% of donkeys from DAT.

With regards to mules, a significant association was observed between type of origin and vaccination status (p_{X2}=0.001); fewer NAU mules than expected had a completed vaccination status against equine influenza and tetanus (3.6%), whilst statistically higher numbers than expected were seen from mules arriving from DS HB (NA) and “Return guardian” (42.9% and 100.0%). Only very well trained mules are allowed to join the guardian scheme.

Statistically significant differences were seen in ponies as well (p_{LR}=0.037). Higher numbers of ponies than expected from “Return guardian” homes arrived fully vaccinated against equine influenza and tetanus (100.0%, Table 5.69), whilst fewer ponies than expected from a “New arrival” origin arrived fully vaccinated (0.0%, Table 5.69).

In the study by Cox et al. (2010), 84.0% of TDS donkeys in guardian homes were vaccinated during their study period.

Table 5.69. Vaccination status stratified by species and type of origin

Type of origin	**Vaccinated**		
	Donkey (n=596)	Mule (n=37)	Pony (n=11)
New Arrival	9.0%^{L}	3.6%^{L}	0.0%^{L}
DS HB (NA)	23.5%	42.9%^{H}	33.3%
Return Guardian	88.7%^{H}	100.0%^{H}	100.0%^{H}
DS HB (RG)	90.9%^{H}	-	-
DAT	86.7%^{H}	-	-
Total	**23.2%**	**16.2%**	**18.2%**
p	<0.001 ^{X2}	0.001 ^{LR}	0.037 ^{LR}

^{X2}: Significance of Pearson’s Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

There were no statistical differences between vaccination status in donkeys and their origin (UK region) (p_{X2}=0.519). Despite not finding differences when looking at the adjusted standardised residuals, it was observed that fewer donkeys than expected from Northern Ireland had been vaccinated (4.3%) (Table 5.70).

Table 5.70. Vaccination status in donkeys stratified by UK region

Origin region	n	Vaccination
Unknown origin	4	0.0%
Scotland	27	22.2%
Northern Ireland	23	4.3%^{L}
North East	52	23.1%
North West	65	23.1%
East Midlands	54	24.1%
West Midlands	53	28.3%
Wales	43	18.6%
South West	163	21.5%
South East	92	27.2%
Greater London	3	0.0%
Total	**579**	**22.5%**

Significance of Pearson's Chi-square test, p=0.519
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

5.3.4. Body condition score (BCS) at arrival

The mean BCS at arrival for all animals was close to the ideal (Table 5.71). Significant differences were not found between species, PAM BCS (p_{KW}=0.058), or admission BCS (p_{KW}=0.400).

Table 5.71. Pre-admission and admission body condition scores stratified by species

	Species	n	Mean	SD	Q1	Median	Q3	min	Max	p_{KW}
Pre-admission	Donkey	264	3.31	0.95	3.00	3.00	4.00	1.00	5.00	0.058
	Mule	7	2.92	0.83	2.25	3.00	3.00	2.00	4.50	
	Pony	7	3.89	0.19	3.75	4.00	4.00	3.50	4.00	
	Total	**278**	**3.31**	**0.94**	**3.00**	**3.00**	**4.00**	**1.00**	**5.00**	
Admission	Donkey	584	3.43	0.78	3.00	3.50	4.00	1.00	5.00	0.400
	Mule	36	3.35	0.54	3.00	3.00	3.50	2.75	5.00	
	Pony	11	3.61	0.79	3.00	3.50	4.00	2.00	5.00	
	Total	**631**	**3.43**	**0.77**	**3.00**	**3.50**	**4.00**	**1.00**	**5.00**	

KW: Significance of Kruskal-Wallis test

The Donkey Sanctuary has developed a 5 point scale system to assess the body condition of donkeys. Body condition score systems have reportedly relied on the operator developing a practiced eye and hand to detect small changes in the subcutaneous fat covering (Smith and Wood, 2008). In the author's opinion, body condition scoring in donkeys can be affected by the experience of the person assessing the animal, and can vary, even between individuals with similar donkey experience. Generally, although most scorers would not agree at the level of half a BCS point, they would agree in their description of underweight and overweight animals.

Body condition score was estimated at the PAM by external veterinary practices. A total of 23.4% of animals were considered to be underweight, either poor (between 1 and 1.5) or in a moderate condition (between 2 and 2.75). On the other hand, 43.9% of animals were considered in ideal body condition (3 to 3.75) whilst 32.6% were considered to be overweight (≥4) (Table 5.72).

Table 5.72. Frequency of pre-admission and admission body condition scores in donkeys

Body Condition	BCS	**Pre-admission** (n=264)				**Admission** (n=584)			
		n	%	n	%	n	%	n	%
Poor	1	12	4.5%	5	1.9%	14	2.4%	3	0.5%
	1.25			0	0.0%			0	0.0%
	1.5			7	2.7%			8	1.4%
	1.75			0	0.0%			3	0.5%
Moderate	2	50	18.9%	23	8.7%	72	12.3%	17	2.9%
	2.25			0	0.0%			7	1.2%
	2.5			25	9.5%			27	4.6%
	2.75			2	0.8%			21	3.6%
Ideal	3	116	43.9%	85	32.2%	318	54.5%	185	31.7%
	3.25			0	0.0%			11	1.9%
	3.5			29	11.0%			94	16.1%
	3.75			2	0.8%			28	4.8%
Fat	4	56	21.2%	43	16.3%	141	24.1%	85	14.6%
	4.25			1	0.4%			18	3.1%
	4.5			11	4.2%			26	4.5%
	4.75			1	0.4%			12	2.1%
Obese	5	30	11.4%	30	11.4%	39	6.7%	39	6.7%

Body condition score was estimated on arrival by a member of TDS veterinary team; usually the same person would assess the BCS of every donkey arriving to maintain consistency. Body condition score limitations have been reported in horses and all animal species, and several studies have developed alternative methods to differentiate body condition using objective criteria (Martin-Giménez et al., 2017).

Ponies and mules were also assessed using the same TDS 5-point scale. Several authors have described the need for different scales for different species, to ensure more accurate body condition scoring. The Donkey Sanctuary should use different scale systems to assess different species.

A larger percentage of donkeys were considered to have a poor BCS at PAM (4.5%), compared to only 2.4% described as having a poor BCS at admission (Table 5.72). Similar percentages were found in the other BCS categories. At least 24.1% of donkeys at admission were considered fat, and 6.7% were identified as obese.

Cox et al. (2010) reported that obesity and associated health conditions, including laminitis (Morrow et al., 2011), equine metabolic syndrome (Du Toit et al., 2010) and a predisposition for hyperlipaemia (Burden et al., 2011) are the major problems facing donkeys in the UK.

Significant differences were found between donkeys' PAM BCS and AM BCS (p_{LR}<0.001) (Table 5.73 and Figure 5.3). There appeared to be a tendency for donkey BCS to be underestimated at PAMs. For example, 8.3% of donkeys that had a poor PAM BCS of 1 to 1.5, had a BCS of 3.75 to 4.5 at AM. This could include donkeys that spent some time at a DS HB before arriving at TDS NAU.

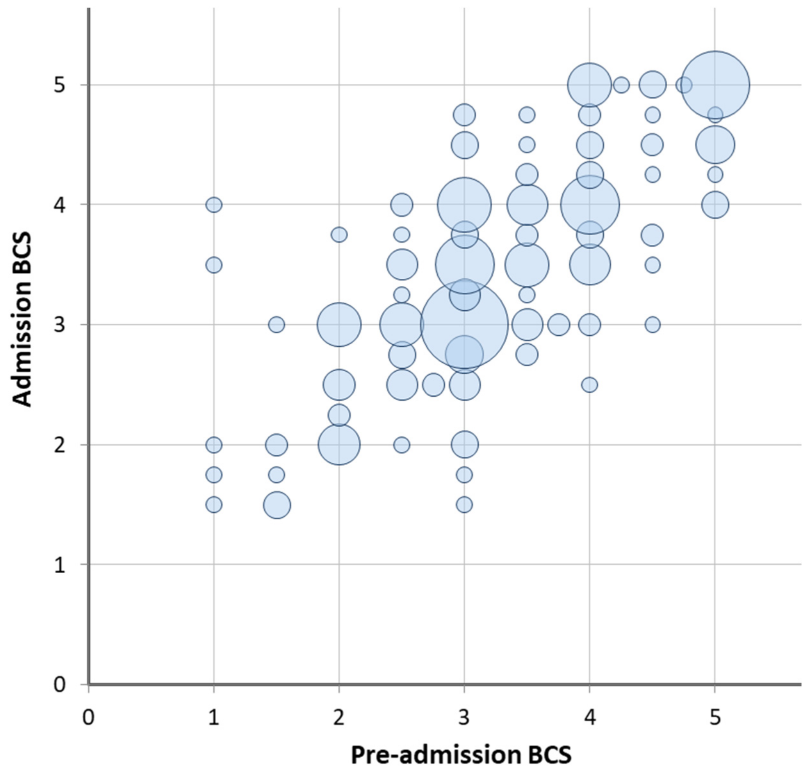
The concordance was very weak between the PAM BCS and AM BCS (k=0.359) (calculations were only used for donkeys that had a BCS at both PAM and AM). A total of 290 animals had a PAM performed by an external veterinary practice. Of those that had a full examination, 15.5% did not receive an estimation of their BCS. Of the animals that had a partial PAM, 59.4% had an estimated BCS, although this is not a requirement of partial examinations.

Table 5.73. Concordance of BCS (categorised) at pre-admission and admission in donkeys

Admission BCS	**Pre-admission BCS**						**Total**
	None	1-1.5	1.75-2.5	2.75-3.5	3.75-4.5	4.75-5	
None	2.2%	0.0%	4.2%	0.9%	0.0%	0.0%	**1.3%**
1-1.5	0.0%	33.3%	0.0%	0.9%	0.0%	0.0%	**1.6%**
1.75-2.5	6.5%	41.7%	37.5%	8.6%	1.8%	0.0%	**11.9%**
2.75-3.5	67.4%	16.7%	50.0%	61.2%	22.8%	0.0%	**45.5%**
3.75-4.5	17.4%	8.3%	8.3%	25.9%	49.1%	32.3%	**26.1%**
4.75-5	6.5%	0.0%	0.0%	2.6%	26.3%	67.7%	**13.5%**
Total	**46**	**12**	**48**	**116**	**57**	**31**	**310**

Significance of Likelihood Ratio test, p_{LR}<0.001
Cohen's Kappa coefficient = 0.359 (p<0.001)

Figure 5.3. Concordance of BCS at pre-admission and admission in donkeys



In the case of donkeys, no significant differences were found between PAM BCS and sex (p_{KW}=0.249). The mean BCS for mares, geldings and stallions was just below 3.5 (Table 5.74). However, we found statistically significant differences between BCS at admission and sex (p_{KW}<0.001). Body condition score of mares and geldings was found to be the same, while stallions had a slightly lower BCS.

Table 5.74. Pre-admission and admission body condition scores of donkeys stratified by sex

	Sex	n	Mean	SD	Q1	Median	Q3	min	Max	p_{KW}
Pre-admission	Mare	99	3.30	1.04	3.00	3.00	4.00	1.00	5.00	0.249
	Gelding	135	3.37	0.90	3.00	3.00	4.00	1.50	5.00	
	Stallion	30	3.06	0.81	2.50	3.00	3.50	2.00	5.00	
	Total	**264**	**3.31**	**0.95**	**3.00**	**3.00**	**4.00**	**1.00**	**5.00**	
Admission	Mare	183	3.49[b]	0.86	3.00	3.50	4.00	1.00	5.00	<0.001
	Gelding	310	3.49[b]	0.70	3.00	3.50	4.00	1.50	5.00	
	Stallion	91	3.10[a]	0.77	2.75	3.00	3.50	1.00	5.00	
	Total	**584**	**3.43**	**0.78**	**3.00**	**3.50**	**4.00**	**1.00**	**5.00**	

[KW]: Significance of Kruskal-Wallis test. Different superindexes in the same column indicate significant differences taking into account Mann-Whitney test by pairs.

Statistically significant differences were not found between BCS of donkeys in PAM and sex (p_{X2}=0.288), but BCS at admission and sex were significantly associated (p_{X2}=0.002)

(Table 5.75). At admission, it was observed that there was fewer gelding with BCS of 1-1.5 (0.6%) and 1.75 to 2.5 (6.6%).; significantly more stallions than expected had a BCS of 1.75 to 2.5 (15.2%), whilst fewer geldings had the same body condition score (6.6%); and it was also observed that fewer stallions had a body condition score of 3.75 to 4.5 (13.0%).

Table 5.75. Body condition scores (categorised) of donkeys at pre-admission and admission stratified by sex

BCS	Pre-admission				Admission			
	Mare	Gelding	Stallion	**Total**	Mare	Gelding	Stallion	**Total**
None	11.6%	16.7%	16.7%	**14.8%**	2.7%	1.9%	1.1%	**2.0%**
1-1.5	6.3%	3.1%	0.0%	**3.9%**	2.7%	0.6%^{L}	4.3%	**1.8%**
1.75-2.5	14.3%	13.6%	27.8%	**15.5%**	10.1%	6.6%^{L}	15.2%^{H}	**9.1%**
2.75-3.5	36.6%	37.0%	41.7%	**37.4%**	44.1%^{L}	54.4%	60.9%	**52.2%**
3.75-4.5	19.6%	19.8%	8.3%	**18.4%**	29.3%	28.5%	13.0%^{L}	**26.3%**
4.75-5	11.6%	9.9%	5.6%	**10.0%**	11.2%	7.9%	5.4%	**8.6%**
Total	**112**	**162**	**36**	**310**	**188**	**316**	**92**	**596**
p_{X2}	0.288				0.002			

^{X2}: Significance of Pearson's Chi-square test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between PAM BCS in donkeys and their age (p_{X2}<0.001) (Table 5.76). It was observed that more donkeys than expected in the greater than 1 to 3 years category did not receive a BCS at PAM (28.1%). Donkeys in this age category would rarely be seen by a vet unless there were specific concerns, so little data regarding these donkeys would be expected prior to arrival. Welfare advisors should be able to assess the BCS of every donkey relinquished.

Table 5.76. Pre-admission body condition scores of donkeys stratified by age

BCS	Pre-admission					Total
	≤ 1 y	(1 y, 3 y]	(3 y, 5 y]	(5 y, 20 y]	> 20 y	
None	0.0%	28.1%^{H}	19.0%	14.6%	7.3%	**14.8%**
1-1.5	0.0%	6.3%	2.4%	3.5%	5.5%	**3.9%**
1.75-2.5	70.0%^{H}	28.1%^{H}	21.4%	8.2%^{L}	16.4%	**15.5%**
2.75-3.5	30.0%	31.3%	45.2%	38.0%	34.5%	**37.4%**
3.75-4.5	0.0%	6.3%	7.1%^{L}	21.6%	27.3%	**18.4%**
4.75-5	0.0%	0.0%^{L}	4.8%	14.0%^{H}	9.1%	**10.0%**
n	10	32	42	171	55	**310**

Significance of Pearson's Chi-square test, p_{X2}< 0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

It was also seen that there were more donkeys than expected with a BCS of 1.75-2.5 in the younger category of less than 1 year old (70.0%), and in the greater than 1 to 3 years category (28.1%), whilst there were fewer donkeys with the same BCS in the greater than 5 to 20 years category (8.2%). Fewer donkeys than expected were given a BCS of 3.75 to 4.5 (7.1%).

Finally, it was observed that fewer donkeys than expected who were given a BCS of 4.75 to 5 were in the greater than 1 to 3 years category (0.0%), while more donkeys than expected were given the same BCS of 4.75 to 5 in the greater than 5 to 20 years category (14.0%).

Statistically significant differences were found between AM BCS in donkeys and their age (p_{LR}< 0.001) (Table 5.77).

Table 5.77. Admission body condition scores of donkeys stratified by age (categorised)

BCS	Admission					Total
	≤ 1 y	(1 y, 3 y]	(3 y, 5 y]	(5 y, 20 y]	> 20 y	
None	7.1%^{H}	1.4%	0.9%	2.4%	0.0%	**2.0%**
1-1.5	0.0%	5.8%^{H}	1.8%	1.2%	1.8%	**1.8%**
1.75-2.5	17.9%	23.2%^{H}	4.5%	6.3%	12.5%	**9.1%**
2.75-3.5	71.4%	63.8%	66.4%	46.2%^{L}	35.7%^{L}	**52.2%**
3.75-4.5	3.6%	5.8%^{L}	21.8%	32.7%^{H}	33.9%	**26.3%**
4.75-5	0.0%	0.0%^{L}	4.5%	11.1%^{H}	16.1%^{H}	**8.6%**
n	28	69	110	333	56	**596**

Significance of Likelihood ratio test, p_{LR}< 0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Firstly, it was observed that more donkeys than expected were not given a BCS in the younger than 1 year old category (7.1%). Body condition score should be assessed for every donkey independent of their age. The Donkey Sanctuary protocols have been modified since the start of this study, and foals under 1 year should be weighed and sized weekly, including BCS recording. This will allow collection of data to aid the design of a donkey foal normal growth chart.

It was also observed that there were more donkeys than expected in the greater than 1 to 3 years old category that were given a BCS of 1-1.5 (5.8%). It was also found that there were more donkeys than expected in the same age category that were given a BCS of 1.75 to 2.5 (23.2%).

Additionally, fewer donkeys than expected in the greater than 5 to 20 years category were given a BCS of 2.75 to 3.5 (46.2%) and in the greater than 20 years old category (35.7%). Moreover, it was identified that more donkeys than expected who were given a BCS of 4.75-5 at admission were from the greater than 5 to 20 years old category

(11.1%) and the greater than 20 years old category (16.1%). Obesity seems to be a problem from 5 years of age onwards. The Donkey Sanctuary should educate owners with regards to the importance of providing an adequate diet once maturity has been reached, to avoid obesity and reduce the risk of secondary related diseases.

There was no association found between BCS and age at PAM (p_{MW}=0.710). The median BCS for geriatrics and non-geriatrics animals was very similar (Table 5.78). On the other hand, statistically significant differences were found between these two variables at admission (p_{MW}=0.023). Geriatric donkeys seemed to be slightly more overweight than younger animals, with a median body condition score of 3.62 vs 3.37.

Table 5.78. Pre-admission and admission body condition scores of donkeys stratified by age

	Age	n	Mean	SD	Q1	Median	Q3	min	Max	p_{MW}
Pre-ad-mission	Non-geriatric	213	3.30	0.95	3.00	3.00	4.00	1.00	5.00	0.710
	Geriatric	51	3.33	0.98	2.75	3.50	4.00	1.00	5.00	
	Total	**264**	**3.31**	**0.95**	**3.00**	**3.00**	**4.00**	**1.00**	**5.00**	
Admission	Non-geriatric	528	3.41	0.76	3.00	3.37	4.00	1.00	5.00	0.023
	Geriatric	56	3.64	0.91	3.00	3.62	4.25	1.50	5.00	
	Total	**584**	**3.43**	**0.78**	**3.00**	**3.50**	**4.00**	**1.00**	**5.00**	

^{MW}: Significance of Mann-Whitney test

In Table 5.79 statistically significant differences were observed between the BCS of donkeys at admission and age (p_{LR}=0.047). It was found that more non-geriatric donkeys than expected had a body condition score of 2.75 to 3.5 (53.9%), whilst fewer geriatric donkeys had the same BCS (35.7%). It was also found that more geriatric donkeys than expected (16.1%) had a BCS of 4.75 to 5, while fewer non-geriatric donkeys had the same BCS (7.8%).

Overweight donkeys are considered to have a higher risk of hyperlipaemia, laminitis and associated endocrinological conditions when compared to those with an ideal or underweight BCS. As a result, overweight geriatric donkeys may experience significant health issues that could have a serious impact on their welfare and ultimately on their life expectancy.

Table 5.79. Body condition scores (categorised) of donkeys at pre-admission and admission stratified by age

BCS	Pre-admission			Admission		
	Non-geriatric (n=255)	Geriatric (n=55)	**Total** (n=310)	Non-geriatric (n=540)	Geriatric (n=56)	**Total** (n=596)
None	16.5%	7.3%	**14.8%**	2.2%	0.0%	**2.0%**
1-1.5	3.5%	5.5%	**3.9%**	1.9%	1.8%	**1.8%**
1.75-2.5	15.3%	16.4%	**15.5%**	8.7%	12.5%	**9.1%**
2.75-3.5	38.0%	34.5%	**37.4%**	53.9%[H]	35.7%[L]	**52.2%**
3.75-4.5	16.5%	27.3%	**18.4%**	25.6%	33.9%	**26.3%**
4.75-5	10.2%	9.1%	**10.0%**	7.8%[L]	16.1%[H]	**8.6%**
p	0.295 [X2]			0.047 [LR]		

[X2]: Significance of Pearson's Chi-square test; [LR]: Significance of Likelihood Ratio test
[H]: Observed proportion significantly higher than expected ($p<0.050$)
[L]: Observed proportion significantly lower than expected ($p<0.050$)

Statistically significant differences were found between PAM and admission BCS and type of origin ($p_{KW}=0.002$ and $p_{KW}=0.005$, respectively) (Table 5.80). Body condition score for "New arrival" and "Return guardian" donkeys at PAM was higher than for the rest of the donkeys (Table 5.60).

Table 5.80. Pre-admission and admission body condition scores of donkeys stratified by type of origin

	Type of origin	n	Mean	SD	Q1	Median	Q3	min	Max	p_{KW}
Pre-admission	New Arrival	154	3.48[a]	1.00	3.00	3.50	4.00	1.00	5.00	0.002
	DS HB (NA)	63	2.92[b]	0.90	2.50	3.00	3.50	1.00	5.00	
	Return Guardian	36	3.34[a,b]	0.74	3.00	3.00	4.00	1.50	5.00	
	DS HB (RG)	7	3.10[a,b]	0.49	2.50	3.00	3.5	2.50	3.75	
	DAT	4	3.00[b]	0.00	3.00	3.00	3.00	3.00	3.00	
	Total	**264**	**3.31**	**0.95**	**3.00**	**3.00**	**4.00**	**1.00**	**5.00**	
Admission	New Arrival	403	3.48[a]	0.83	3.00	3.50	4.00	1.00	5.00	0.005
	DS HB (NA)	97	3.22[b]	0.60	3.00	3.00	3.50	2.00	5.00	
	Return Guardian	61	3.49[a]	0.75	3.00	3.50	4.00	1.50	5.00	
	DS HB (RG)	9	3.47[a]	0.44	3.00	3.50	3.75	3.00	4.25	
	DAT	14	3.20[b]	0.36	3.00	3.00	3.50	2.75	4.00	
	Total	**584**	**3.43**	**0.78**	**3.00**	**3.50**	**4.00**	**1.00**	**5.00**	

[KW]: Significance of Kruskal-Wallis test. Different superindexes in the same column indicate significant differences taking into account Mann-Whitney test by pairs.

DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

Similar findings were identified at admission, where "New arrival" donkeys had similar mean body condition scores to "Return guardian" donkeys and DS HB (RG), while DAT donkeys and DS HB (NA) had more similar body condition scores. The first group had a slightly higher mean body condition score at 3.48 ("New arrival"), 3.49 ("Return guardian"), and 3.47 (DS HB (RG)).

In Table 5.80, there were two small groups (DS HB (RG) and DAT), so they were excluded from the next analysis (Table 5.81). Statistically significant differences were found at PAM and AM between BCS of donkeys and their type of origin (p_{X2}=0.004 and p_{LR}=0.003, respectively).

Firstly, it was observed at PAM (Table 5.81) that more donkeys from DS HB (NA) than expected had a BCS of 1.75-2.5 (26.7%). More "Return guardian" donkeys than expected had a BCS of 3.75-4.5 (30.2%). It was also found that more "New arrival" donkeys than expected had a BCS of 4.75-5 (15.8%).

With regards to the AM, there were more donkeys of BCS 2.75 to 3.5 coming from DS HB (NA) (64.3%), while fewer than expected of the same BCS came in as "New arrival" (46.6%).

It was also observed (Table 5.81) that more donkeys than expected were coming as "New arrival" with a BCS of 3.75 to 4.5 (30.0%). With regards to the last category (4.75-5), fewer than expected came from DS HB (NA) (3.1%) and 9.7% were "Return guardian" donkeys.

Table 5.81. Body condition scores (categorised) of donkeys at pre-admission and admission stratified by type of origin

BCS	Pre-admission				Admission			
	New Arrival (n=177)	DS HB (NA) (n=75)	Return Guardian (n=43)	**Total** (n=295)	New Arrival (n=410)	DS HB (NA) (n=98)	Return Guardian (n=62)	**Total** (n=596)
None	13.0%	16.0%	16.3%	**14.2%**	1.7%	1.0%	1.6%	**2.0%**
1-1.5	4.0%	5.3%	2.3%	**4.1%**	2.4%	0.0%	1.6%	**1.8%**
1.75-2.5	12.4%	26.7%^{H}	9.3%	**15.6%**	9.0%	14.3%	4.8%	**9.1%**
2.75-3.5	35.6%	37.3%	39.5%	**36.6%**	46.6%^{L}	64.3%^{H}	61.3%	**52.2%**
3.75-4.5	19.2%	12.0%	30.2%^{H}	**19.0%**	30.0%^{H}	17.3%^{L}	21.0%	**26.3%**
4.75-5	15.8%^{H}	2.7%^{L}	2.3%	**10.5%**	10.2%	3.1%^{L}	9.7%	**8.6%**
p	0.004 ^{X2}				0.003 ^{LR}			

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

A study by Grint et al. (2015) of TDS guardian donkeys found that 33.8% of the donkeys were described as overweight or obese by their guardian owners. The proportion of donkeys that were overweight in the study by Grint et al. (2015) was comparable to that recorded at TDS (Cox et al., 2010) where 78.0% of randomly selected animals were of average body condition, and being overweight (18%) was more common than being underweight (4.0%).

Statistically significant differences were found between PAM BCS and donkeys' UK origin region (p_{LR}=0.001). It can be seen in Table 5.82 that there were statistically more donkeys than expected from an unknown origin that had a poor BCS when examined at PAM (25.0%).

More donkeys than expected from the East Midlands were considered to have an ideal BCS (64.0%), while fewer donkeys from the same region were considered fat by external veterinary surgeons (4.0%). There were more donkeys classed as obese at PAM than expected coming from the North East (30.0%) and the West Midlands (25.9%).

Lastly, more donkeys than expected arrived with a poor BCS from the South East (11.1%), while fewer donkeys from the same region were given an ideal BCS by external vets at PAM (27.8%).

Table 5.82. Pre-admission body condition score stratified by UK origin region

Origin region	n	Poor	Moderate	Ideal	Fat	Obese
Unknown origin	4	25.0%^{H}	25.0%	50.0%	0.0%	0.0%
Scotland	16	0.0%	31.3%	37.5%	31.3%	0.0%
Northern Ireland	21	0.0%	28.6%	52.4%	19.0%	0.0%
North East	20	0.0%	25.0%	40.0%	5.0%	30.0%^{H}
North West	21	4.8%	9.5%	52.4%	33.3%	0.0%
East Midlands	25	0.0%	28.0%	64.0%^{H}	4.0%^{L}	4.0%
West Midlands	27	3.7%	18.5%	37.0%	14.8%	25.9%^{H}
Wales	21	9.5%	4.8%	42.9%	28.6%	14.3%
South West	66	4.5%	15.2%	43.9%	21.2%	15.2%
South East	36	11.1%^{H}	22.2%	27.8%^{L}	33.3%	5.6%
Greater London	3	0.0%	0.0%	33.3%	66.7%	0.0%
Total	**260**	**4.6%**	**19.2%**	**43.5%**	**21.5%**	**11.2%**

Significance of Likelihood Ratio test, p=0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between donkeys BCS at arrival and their origin region (p_{LR}=0.002).

Firstly, it was found that there were more donkeys than expected from an unknown origin with a very poor BCS of 1 to 1.5 at admission (25.0%).

Secondly, it was found that there were more donkeys than expected from Scotland that did not get a BCS at admission (11.1%). It is TDS policy that donkeys receive a first admission exam by a veterinary nurse or vet, during which they should be given a BCS, to better monitor health and changes in weight and BCS.

It was observed (Table 5.83) that there were more donkeys than expected from Northern Ireland that were underweight and had a BCS at admission of 1.75-2.5 (21.7%). There were also more donkeys from the same region that had a BCS close to ideal (2.75-3.5) (78.3%) while fewer donkeys than expected from the same region were overweight (3.75-4.5%) (0.0%).

It was also found (Table 5.83) that fewer donkeys than expected from the West Midlands were underweight (1.75-2.5) (1.9%). Interestingly, there were more donkeys than expected that were slightly underweight at admission from the South West (14.1%).

Table 5.83. Admission body condition score stratified by donkeys' origin region

Origin region	n	None	1-1.5	1.75-2.5	2.75-3.5	3.75-4.5	4.75-5
Unknown origin	4	0.0%	25.0%^{H}	25.0%	50.0%	0.0%	0.0%
Scotland	27	11.1%^{H}	0.0%	7.4%	44.4%	29.6%	7.40%
Northern Ireland	23	0.0%	0.0%	21.7%^{H}	78.3%^{H}	0.0%^{L}	0.0%
North East	52	1.9%	0.0%	7.7%	55.8%	23.1%	11.5%
North West	65	0.0%	3.1%	4.6%	55.4%	29.2%	7.7%
East Midlands	54	0.0%	1.9%	9.3%	57.4%	31.5%	0.0%
West Midlands	53	1.9%	1.9%	1.9%^{L}	58.5%	28.3%	7.5%
Wales	43	4.7%	2.3%	7.0%	46.5%	25.6%	14.0%
South West	163	3.1%	3.1%	14.1%^{H}	44.2%	26.4%	9.2%
South East	92	0.0%	0.0%	7.6%	52.2%	29.3%	10.9%
Greater London	3	0.0%	0.0%	0.0%	33.3%	33.3%	33.3%
Total	**579**	**2.1%**	**1.9%**	**9.3%**	**51.8%**	**26.4%**	**8.5%**

Significance of Likelihood Ratio test, p=0.002
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

5.3.5. Dental status at arrival in donkeys

Dental examination with an equine dental speculum was requested in all of the 290 PAM; however, in 54.8% of those, the attending veterinary practice failed to provide a dental examination report or dental chart. On partial PAM examination only one of 32 cases received a dental examination.

It was reported at PAM (Table 5.84) that a large percentage of donkeys reportedly had no major dental abnormalities (66.7%), while 21.2% had more serious dental issues with grades of 3, 4 and 5.

Based on the NAU AM, the majority of donkeys arriving within the study period received a dental grade of 1 (55.7%). On the other hand, it is significant that a quarter of the donkeys admitted (25.1%) had dental grades of 3, 4 and 5.

Dental disorders were noted to be one of the four most prevalent conditions in a study by Morrow et al. (2011) looking at the post-mortem examination of 1,444 aged UK donkeys.

Table 5.84. Frequency of dental grades of donkeys at admission

Dental grade	Pre-admission (n=132)	Admission (n=574)
1	66.7%	55.7%
2	12.1%	19.2%
3	14.4%	14.3%
4	4.5%	5.4%
5	2.3%	5.4%

Statistically significant differences were found between dental grades at PAM and AM ($p_{LR}<0.001$) (Table 5.85 and Figure 5.4). Fewer donkeys than expected that had a dental grade of 1 at PAM had dental grades of 4 or 5 at AM (7.0% and 5.8%). Despite this, donkeys that were given a dental grade of 1 at PAM should not be expected to develop a grade of 4 or 5. There was a lower percentage of donkeys that had a dental grade of 1 at admission who were considered to have slightly higher dental grades at PAM (2, 6.7% and 3, 5.3%).

Finally, the concordance of PAM dental grades and admission dental grades was found to be weak (k=0.270).

Statistically significant differences were found between PAM and AM dental grades and sex ($p_{LR}=0.009$ and $p_{X2}=0.005$, respectively) (Table 5.86). Significantly more mares than expected were found with a dental grade of 3 (21.7%) at PAM while fewer mares than expected were found to have a dental grade of 1 (50.0%). Interestingly, more mares than expected were found at admission to have dental grades of 4 (8.3%) and 5 (9.9%), while less than expected had dental grades of 1 at admission (48.6%).

Table 5.85. Concordance of dental grades at pre-admission and admission in donkeys

Admission dental grade	Pre-admission dental grade						Total (n=309)
	None (n=181)	1 (n=86)	2 (n=15)	3 (n=19)	4 (n=5)	5 (n=3)	
1	*65.2%*	48.8%^{H}	6.7%^{L}	5.3%^{L}	0.0%	0.0%	**52.4%**
2	*14.9%*	18.6%	26.7%	5.3%	0.0%	0.0%	**15.5%**
3	*10.5%*	19.8%	33.3%	42.1%^{H}	0.0%	0.0%	**15.9%**
4	*3.9%*	7.0%^{L}	13.3%	26.3%	100.0%^{H}	0.0%	**8.1%**
5	*5.5%*	5.8%^{L}	20.0%	21.1%	0.0%	100.0%^{H}	**8.1%**

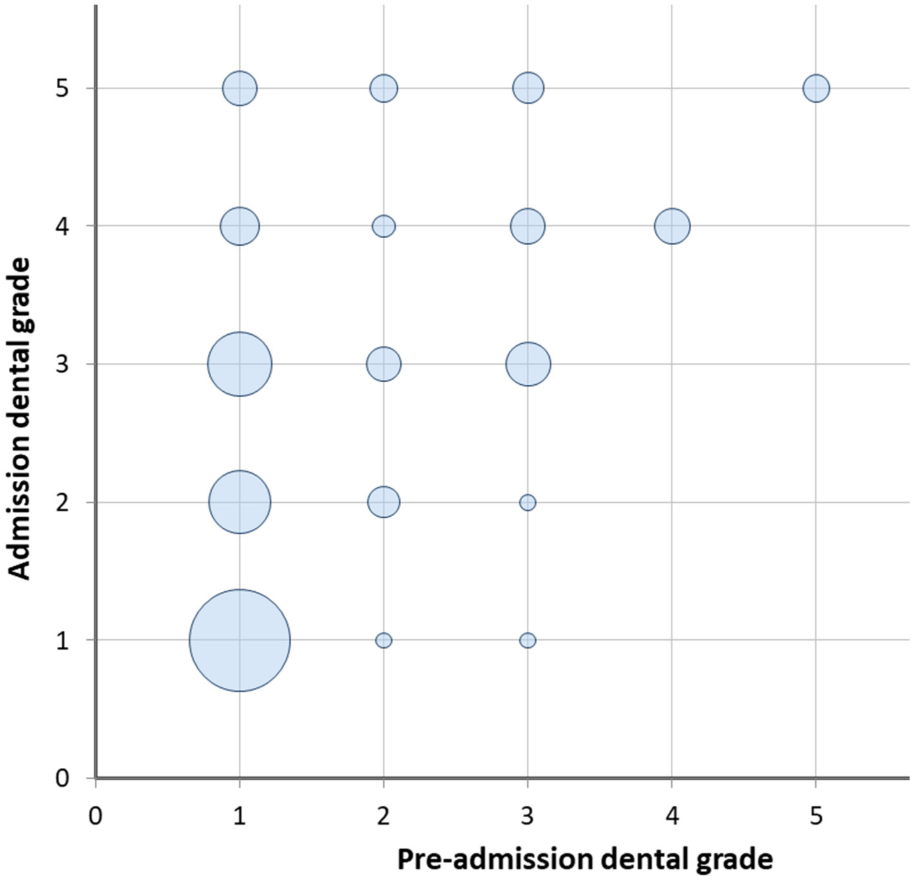
Significance of Likelihood Ratio test, $p_{LR}<0.001$

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

Cohen's Kappa coefficient = 0.270 (p<0.001)

Figure 5.4. Concordance of dental grades at pre-admission and admission in donkeys



With regards to geldings, more than expected were found with a dental grade of 1 (81.3%) at PAM, while fewer than expected had a dental grade of 2 (6.3%) (Table 5.86). It was also found that less geldings than expected were identified as having a dental grade of 5 at admission (3.3%).

Table 5.86. Dental grades of donkeys at pre-admission and admission stratified by sex

Dental grade	Pre-admission				Admission			
	Mare (n=60)	Gelding (n=64)	Stallion (n=8)	**Total (n=132)**	Mare (n=181)	Gelding (n=307)	Stallion (n=86)	**Total (n=574)**
1	50.0%[L]	81.3%[H]	75.0%	**66.7%**	48.6%[L]	58.0%	62.8%	**55.7%**
2	16.7%	6.3%[L]	25.0%	**12.1%**	16.6%	19.5%	23.3%	**19.2%**
3	21.7%[H]	9.4%	0.0%	**14.4%**	16.6%	14.7%	8.1%	**14.3%**
4	6.7%	3.1%	0.0%	**4.5%**	8.3%[H]	4.6%	2.3%	**5.4%**
5	5.0%	0.0%	0.0%	**2.3%**	9.9%[H]	3.3%[L]	3.5%	**5.4%**
p	0.009 [LR]				0.005 [X2]			

[X2]: Significance of Pearson's Chi-square test; [LR]: Significance of Likelihood Ratio test
[H]: Observed proportion significantly higher than expected (p<0.050)
[L]: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between sex and dental grade in donkeys at admission (p_{X2}<0.001). It was observed (Table 5.87) that more mares than expected had a pathological dental grade of 3 to 5 (34.8%), while fewer had dental grades of 1 and 2 (65.2%). It was also noted (Table 5.87) that more stallions than expected had acceptable dental grades of 1 and 2 (86.0%), and fewer pathological grades (14.0%).

Table 5.87. Admission dental grades (categorised) stratified by sex

Sex	n	Dental grades categories Acceptable (1-2)	Pathological (3-5)
Mare	181	65.2%^{L}	34.8%^{H}
Gelding	307	77.5%	22.5%
Stallion	86	86.0%^{H}	14.0%^{L}
Total	**574**	**74.9%**	**25.1%**

Significance of Pearson´s Chi-square test, p<0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between dental grade in donkeys at PAM and their age category (p_{LR}<0.001) (Table 5.88).

Firstly, there were more donkeys than expected in the greater than 1 to 3 years and greater than 3 to 5 years categories that did not receive a pre-admission dental grade (78.1% and 84.8%). Generally, dental examination with an equine dental speculum would not been done in the below one-year age category therefore dental grading would not be done until admission unless the donkey was showing clinical signs suggestive of dental disease.

Table 5.88. Dental grades of donkeys at pre-admission stratified by age (categorised)

PAM dental grade	Age category ≤ 1 y (n=12)	(1 y, 3 y] (n=32)	(3 y, 5 y] (n=46)	(5 y, 20 y] (n=177)	> 20 y (n=55)	Total (n=322)
None	75.0%	78.1%^{H}	84.8%^{H}	57.1%	29.1%^{L}	**59.0%**
1	25.0%	18.8%	15.2%^{L}	30.5%	32.7%	**27.3%**
2	0.0%	3.1%	0.0%	5.1%	10.9%^{H}	**5.0%**
3	0.0%	0.0%	0.0%	5.1%	18.2%^{H}	**5.9%**
4	0.0%	0.0%	0.0%	1.1%	7.3%^{H}	**1.9%**
5	0.0%	0.0%	0.0%	1.1%	1.8%	**0.9%**

Significance of Likelihood Ratio test, p_{LR}<0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

It was also noted that fewer donkeys than expected that were given a dental grade of 1 at PAM were in the greater than 3 to 5 years old category (15.2%).

In addition, more donkeys than expected in the greater than 20 years old category were given a dental grade of 2 (10.9%). It was also found that within the same age category more donkeys than expected were given dental grades of 3 and 4 (18.2% and 7.3%). It appears that the highest risk category for dental disease at PAM is the older category (5-20 years) which showed the worst dental grades.

Statistically significant differences were found between admission dental grade in donkeys and their age ($p_{LR}<0.001$) (Table 5.89).

Interestingly, more donkeys than expected in the geriatric category (greater than 20 years old) did not receive a dental grade (10.7%).

On the other hand, it was found that more donkeys than expected were given a dental grade of 1 at admission from the younger than 1 year, the greater than 1 to 3 years and the greater than 3 to 5 years of age categories (96.4%, 76.8% and 65.5%). It was also noted that fewer donkeys were given the same dental grade in the older categories of greater than 5 to 20 years old and greater than 20 years old (48.9% and 8.9%).

Fewer donkeys than expected were given a dental grade of 2 or 3 when they were in the younger than 1 year of age category (0.0%). Additionally, fewer donkeys were given a dental grade of 3 at admission in the greater than 1 to 3 years of age category (2.9%), whilst more donkeys than expected were given the same dental grade in the greater than 5 to 20 years of age category (17.7%).

Interestingly, fewer donkeys were given a dental grade of 4 at admission in the greater than 3 to 5 years of age category (0.0%), whilst more donkeys than expected where given a dental grade of 4 in the geriatric category of greater than 20 years of age (19.6%).

Moreover, fewer donkeys from the greater than 3 to 5 years of age category were given a dental grade of 5 at admission (0.9%), whilst more donkeys than expected were given a dental grade of 5 when they were older than 20 years (26.8%).

These results support the requirement for donkeys over 20 years of age to have a PAM examination that includes dental examination with an equine dental speculum. In many cases, donkeys with dental grades of 3, 4 and 5 may require urgent dental treatment. The Donkey Sanctuary should act promptly with these cases, and if they cannot be admitted to the NAU quickly then these animals should receive dental treatment prior to movement.

Quality of life should be discussed with owners prior to movement, as some donkeys with severe dental disease are unable to chew and even if receiving an adequate diet may lose weight and have a reduced quality of life. For cases where dental disease is severe and welfare is affected the animal's quality of life must be evaluated and euthanasia may be advised. These animals should be highlighted at the owner's property before movement and the need for treatment or euthanasia should be discussed prior to arrival at TDS to avoid prolonged suffering and better manage the expectations of owners. The Donkey Sanctuary should aim to further educate vets and deliver welfare advice with regards to donkeys with severe dental disease and the concerns regarding their quality of life and welfare.

Table 5.89. Dental grades of donkeys at admission stratified by age

Admission dental grade	Age category ≤ 1 y (n=28)	(1 y, 3 y] (n=69)	(3 y, 5 y] (n=110)	(5 y, 20 y] (n=333)	> 20 y (n=56)	Total (n=596)
None	3.6%	2.9%	2.7%	3.0%	10.7%^{H}	**3.7%**
1	96.4%^{H}	76.8%^{H}	65.5%^{H}	48.9%^{L}	8.9%^{L}	**53.7%**
2	0.0%^{L}	13.0%	20.9%	20.7%	16.1%	**18.5%**
3	0.0%^{L}	2.9%^{L}	10.0%	17.7%^{H}	17.9%	**13.8%**
4	0.0%	2.9%	0.0%^{L}	5.4%	19.6%^{H}	**5.2%**
5	0.0%	1.4%	0.9%^{L}	4.2%	26.8%^{H}	**5.2%**

Significance of Likelihood Ratio test, p_{LR}<0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between dental grade and age in donkeys at PAM (p_{LR}=0.016) and admission (p_{X2}<0.001) (Table 5.90). It was observed that more geriatric animals than expected were found to have dental grades of 3 (25.6%), 4 (10.3%) and 5 (2.6%) at PAM. While significantly fewer geriatric animals had a dental grade of 1 (46.2%).

At admission it was observed that more geriatric donkeys than expected had grades of 4 (22.0%) and 5 (30.0%), while less geriatric donkeys than expected had a grade of 1 (10.0%). With regards to non-geriatric donkeys at admission, more than expected were found to have a dental grade of 1 (60.1%), while less than expected were categorised as 4 (3.8%) and 5 (3.1%). It is very significant that more than half of the geriatric donkeys (52.0%) had moderate to severe dental disease at admission.

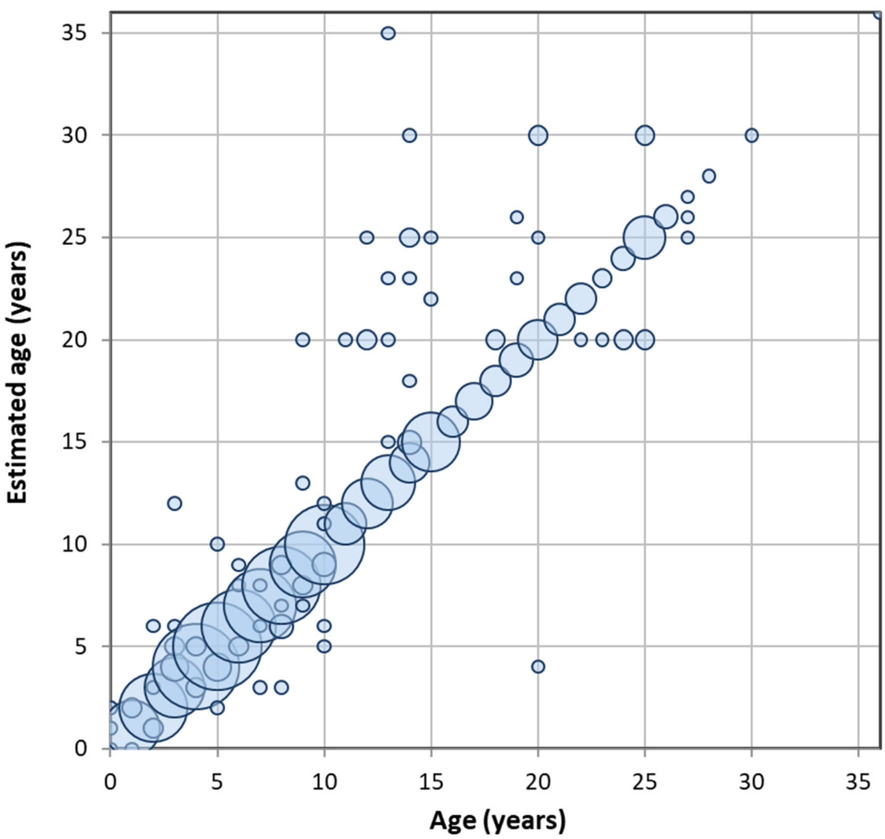
Table 5.90. Dental grades of donkeys at pre-admission and admission stratified by age

Dental grade	Pre-admission			Admission		
	Non-geriatric (n=93)	Geriatric (n=39)	**Total** (n=132)	Non-geriatric (n=524)	Geriatric (n=50)	**Total** (n=574)
1	75.3%^{H}	46.2%^{L}	**66.7%**	60.1%^{H}	10.0%^{L}	**55.7%**
2	10.8%	15.4%	**12.1%**	19.3%	18.0%	**19.2%**
3	9.7%^{L}	25.6%^{H}	**14.4%**	13.7%	20.0%	**14.3%**
4	2.2%^{L}	10.3%^{H}	**4.5%**	3.8%^{L}	22.0%^{H}	**5.4%**
5	2.2%	2.6%^{H}	**2.3%**	3.1%^{L}	30.0%^{H}	**5.4%**
p	0.016 ^{LR}			<0.001 ^{X2}		

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Equine dental technicians assessed age in 80.7% of the donkeys. There was a good correlation between the age as stated in the passport 9.60 ± 6.61 years and the age estimated by the EDTs 9.96 ± 7.15 years (Figure 5.5). However, passport age was found to be significantly lower than estimated age (p_W=0.004).

Figure 5.5. Correlation between age in passport and age estimated by dental examination



Spearman's correlation coefficient, rho=0.968 (p<0.001)

Statistically significant differences were found between the dental grades of donkeys at admission and their age (p_{KW}<0.001) (Table 5.91). Four subgroups were found, where dental grade 1 donkeys were the youngest with a mean age of 7.34 years. The second subgroup included dental grades of 2 and 3, with a similar mean age of 11.16 and 12.77 years respectively. The third subgroup comprised donkeys with a dental grade of 4 and a mean age of 16.82 years and the last subgroup was the dental grade 5 donkeys with an older mean age of 21.2 years old.

Despite not finding any statistically significant differences between PAM dental grades and UK origin region (p_{LR}=0.059) (Table 5.92), when looking at the adjusted standardised residuals there were more donkeys than expected with no dental grade coming from the North West region (79.3%).

Table 5.91. Age (years) of donkeys stratified by dental grade

Dental grade	n	Mean	SD	Q1	Median	Q3	min	Max
1	320	6.84[a]	4.83	3.3	6.0	9.0	0.1	28.0
2	110	9.78[b]	5.99	5.0	8.0	13.0	2.0	30.0
3	82	12.34[c]	6.30	7.0	11.0	16.0	2.0	27.0
4	31	17.32[d]	8.27	12.0	16.0	25.0	2.0	30.0
5	31	19.74[d]	7.63	13.0	20.0	25.0	2.0	33.0

Significance of Kruskal-Wallis test, p<0.001. Different superindexes in the same column indicate significant differences taking into account Mann-Whitney test by pairs

It was observed in the adjusted standardised residuals that more donkeys than expected that had been given a dental grade of 3 were coming from the West Midlands (19.4%). Finally, it was also observed that there were more donkeys than expected from the South West with dental grades of 2 (9.5%) and 5 (3.6%) at PAM.

Table 5.92. Pre-admission dental grades stratified by UK origin region

Origin region	n	None	1	2	3	4	5
Unknown origin	4	50.0%	50.0%	0.0%	0.0%	0.0%	0.0%
Scotland	18	72.2%	22.2%	0.0%	0.0%	5.6%	0.0%
Northern Ireland	23	60.9%	34.8%	4.3%	0.0%	0.0%	0.0%
North East	25	60.0%	36.0%	0.0%	0.0%	4.0%	0.0%
North West	29	79.3%[H]	17.2%	0.0%	3.4%	0.0%	0.0%
East Midlands	28	71.4%	10.7%	10.7%	7.1%	0.0%	0.0%
West Midlands	31	45.2%	35.5%	0.0%	19.4%[H]	0.0%	0.0%
Wales	24	45.8%	37.5%	12.5%	0.0%	4.2%	0.0%
South West	84	53.6%	23.8%	9.5%[H]	7.1%	2.4%	3.6%[H]
South East	44	50.0%	36.4%	2.3%	9.1%	2.3%	0.0%
Greater London	3	66.7%	33.3%	0.0%	0.0%	0.0%	0.0%
Total	**313**	**57.8%**	**28.1%**	**5.1%**	**6.1%**	**1.9%**	**1.0%**

Significance of Likelihood Ratio test, p=0.059
[H]: Observed proportion significantly higher than expected (p<0.050)
[L]: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between categorised dental grades in donkeys at admission and their age (p_{X2}<0.001) (Table 5.93). It was found that there were more donkeys than expected that had acceptable grades in the younger categories of less than 1 year old (100.0%), greater than 1 to 3 years old (92.5%), and the greater than 3 to 5 years old category (88.8%).

Interestingly, it was observed that there were more donkeys than expected with pathological dental grades at admission from the geriatric category of donkeys older than 20 years old (72.0%).

Table 5.93. Admission dental grades (categorised) stratified by age

Age (cat)	n	Dental grades categories	
		Acceptable (1-2)	Pathological (3-5)
≤ 1 y	27	100.0%^{H}	0.0%^{L}
(1 y, 3 y]	67	92.5%^{H}	7.5%^{L}
(3 y, 5 y]	107	88.8%^{H}	11.2%^{L}
(5 y, 20 y]	323	71.8%	28.2%
> 20	50	28.0%^{L}	72.0%^{H}
Total	**574**	**74.9%**	**25.1%**

Significance of Pearson´s Chi-square test, p<0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between the age of donkeys and their dental grade at admission (p_{X2}<0.001). It was observed (Table 5.94) that more donkeys than expected below the age of 20 had acceptable dental grades of 1 and 2 at admission (79.4%), while fewer had pathological dental grades of 3 to 5 (20.6%). On the other hand, more geriatric (over 20 years old) donkeys than expected had pathological dental grades of 3 to 5 (72.0%) while fewer had acceptable grades of 1 and 2 (28.0%).

Table 5.94. Admission dental grades (categorised) stratified by age

Age	n	Dental grades categories	
		Acceptable (1-2)	Pathological (3-5)
Non-geriatric	524	79.4%^{H}	20.6%^{L}
Geriatric	50	28.0%^{L}	72.0%^{H}
Total	**574**	**74.9%**	**25.1%**

Significance of Pearson´s Chi-square test, p<0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

There were no significant differences found between PAM dental grade and type of origin (p_{LR}=0.161) (Table 5.95), although significantly higher numbers of "New arrival" donkeys were found with dental grades of 2 (16.3%). Moreover, significantly higher numbers of "Return guardian" donkeys were found with dental grades of 5 (10.0%).

Statistically significant differences were found between the dental grade of donkeys at admission and their type of origin (p_{LR}=0.001). It was observed (Table 5.95) that fewer donkeys than expected with a dental grade of 1 were from a "New arrival" origin (52.3%).

Secondly, more donkeys than expected with a dental grade of 1 were from a DS HB (NA) origin. This can be explained, as the majority of these donkeys are seen by the DS HB vet and their teeth would be examined and rasped as necessary during their time at the holding base. Fewer donkeys from the same category had dental grades of 2 (9.4%) or 5 (1.0%).

Finally, it was observed (Table 5.95) that more DS HB (RG) donkeys than expected arrived with a dental grade of 3. Interestingly, 8.6% of “Return guardian” donkeys had a dental grade at admission of 4 and the same percentage of these had a dental grade of 5.

Table 5.95. Distribution of pre-admission dental grade of donkeys by type of origin

Type of origin	n	Pre-admission Dental				
		1	2	3	4	5
New arrival	86	62.8%	16.3%^{H}	17.4%	2.3%	1.2%
DS HB (NA)	23	82.6%	4.3%	8.7%	4.3%	0.0%
Return guardian	20	65.0%	5.0%	10.0%	10.0%	10.0%^{H}
DS HB (RG)	3	66.7%	0.0%	0.0%	33.3%	0.0%
Total	**132**	**66.7%**	**12.1%**	**14.4%**	**4.5%**	**2.3%**

Significance of Likelihood Ratio test, p=0.161
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

Statistically significant differences were not found between PAM and admission dental grades, and the type of origin (p_{LR}=0.161) (Table 5.96). Interestingly, despite this, it was reported at PAM that more “Return guardian” donkeys than expected had a dental grade of 5 (10.0%) and more donkeys than expected from a “New arrival” origin had a dental grade of 2 (16.3%).

Table 5.96. Dental grades of donkeys at pre-admission and admission stratified by type of origin

Dental grade	Pre-admission					Admission					
	New Arrival (n=86)	DS HB (NA) (n=23)	Return Guardian (n=20)	DS HB (RG) (n=3)	Total (n=132)	New Arrival (n=394)	DS HB (NA) (n=96)	Return Guardian (n=58)	DS HB (RG) (n=11)	DAT (n=15)	Total (n=574)
1	62.8%	82.6%	65.0%	66.7%	**66.7%**	52.3%^{L}	76.0%^{H}	46.6%	27.3%	73.3%	**55.7%**
2	16.3%^{H}	4.3%	5.0%	0.0%	**12.1%**	21.3%	9.4%^{L}	20.7%	18.2%	20.0%	**19.2%**
3	17.4%	8.7%	10.0%	0.0%	**14.4%**	15.2%	8.3%	15.5%	36.4%^{H}	6.7%	**14.3%**
4	2.3%	4.3%	10.0%	33.3%	**4.5%**	4.8%	5.2%	8.6%	18.2%	0.0%	**5.4%**
5	1.2%	0.0%	10.0%^{H}	0.0%	**2.3%**	6.3%	1.0%^{L}	8.6%	0.0%	0.0%	**5.4%**
p_{LR}	0.161					0.161					

^{X2}: Significance of Pearson’s Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

At admission, it was identified that more donkeys than expected from DS HB (NA) had a dental grade of 1 (76.0%), while less than expected from the same type of origin had dental grades of 2 (9.4%) and 5 (1.0%). It was also observed (Table 5.96) that less “New arrival” donkeys than expected had a dental grade of 1 (52.3%). Lastly, it was found that more DS HB (RG) donkeys than expected had a dental grade of 3 (36.4%).

Statistically significant differences were found between the origin and categorized dental grade of donkeys at admission (p_{X2}=0.004) (Table 5.97). It was found that more donkeys than expected of DS HB (NA) origin had acceptable grades of 1 and 2 (85.4%), whilst fewer from the same origin had pathological grades of 3 to 5 (14.6%).

It was also noted that more donkeys from a DS HB (RG) origin than expected had pathological dental grades of 3 to 5 (54.5%), whilst fewer from the same category had acceptable grades of 1 and 2 (45.5%).

Table 5.97. Admission dental grades (categorised) stratified by origin

Type of origin	n	Dental grades categories	
		Acceptable (1-2)	Pathological (3-5)
New Arrival	394	73.6%	26.4%
DS HB (NA)	96	85.4%^{H}	14.6%^{L}
Return Guardian	58	67.2%	32.8%
DS HB (RG)	11	45.5%^{L}	54.5%^{H}
DAT	15	93.3%	6.7%
Total	**574**	**74.9%**	**25.1%**

Significance of Pearson´s Chi-square test, p=0.004
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

Statistically significant differences were found between admission dental grade and origin region (p_{LR}=0.025). It was found (Table 5.98) that there were more donkeys than expected with a dental grade of 1 from Scotland (74.1%), Northern Ireland (73.9%) and the North East (67.3%). It was also noted (Table 5.98) that there were more donkeys than expected with a dental grade at admission of 2 from the East Midlands (29.6%).

On the other hand, it was also found that fewer donkeys than expected from the West Midlands had a dental grade of 1 at admission (37.7%). Interestingly, there were more donkeys than expected arriving from Wales with a dental grade of 3 at admission (27.9%).

Statistically significant differences were found between categorised dental grades and origin region (p_{X2}=0.034). It was observed (Table 5.99) that more donkeys than expected that had pathological dental grades (3-5) were from the West Midlands (37.3%) and Wales (46.3%). The Donkey Sanctuary should ensure that donkey owners in those regions have access to qualified equine dental technicians and equine veterinary surgeons. Additionally, TDS could provide training, more dentistry continuing professional development (CPD) and talks in those regions to increase dental care awareness.

Table 5.98. Admission dental grades stratified by origin region

Origin region	n	Dental grades					
		None	1	2	3	4	5
Unknown origin	4	0.0%	75.0%	0.0%	0.0%	25.0%	0.0%
Scotland	27	0.0%	74.1%^{H}	7.4%	11.1%	7.4%	0.0%
Northern Ireland	23	0.0%	73.9%^{H}	4.3%	13.0%	8.7%	0.0%
North East	52	0.0%	67.3%^{H}	15.4%	7.7%	5.8%	3.8%
North West	65	3.1%	50.8%	20.0%	20.0%	4.6%	1.5%
East Midlands	54	1.9%	53.7%	29.6%^{H}	5.6%	5.6%	3.7%
West Midlands	53	3.8%	37.7%^{L}	22.6%	22.6%	7.5%	5.7%
Wales	43	4.7%	39.5%	11.6%	27.9%^{H}	7.0%	9.3%
South West	163	5.5%	47.9%	21.5%	14.1%	3.1%	8.0%
South East	92	5.4%	55.4%	18.5%	9.8%	5.4%	5.4%
Greater London	3	0.0%	33.3%	33.3%	0.0%	0.0%	33.3%
Total	**579**	**3.6%**	**52.5%**	**19.0%**	**14.2%**	**5.4%**	**5.4%**

Significance of Likelihood Ratio test, p=0.025
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Table 5.99. Admission dental grades (categorised) stratified by origin region

Origin region	n	Dental grades categories	
		Acceptable (1-2)	Pathological (3-5)
Unknown origin	4	75.0%	25.0%
Scotland	27	81.5%	18.5%
Northern Ireland	23	78.3%	21.7%
North East	52	82.7%	17.3%
North West	63	73.0%	27.0%
East Midlands	53	84.9%	15.1%
West Midlands	51	62.7%^{L}	37.3%^{H}
Wales	41	53.7%^{L}	46.3%^{H}
South West	154	73.4%	26.6%
South East	87	78.2%	21.8%
Greater London	3	66.7%	33.3%
Total	**558**	**74.2%**	**25.8%**

Significance of Pearson´s Chi-square test, p=0.034
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

There were statistically significant differences between admission BCS and dental grade at admission (p_{LR}=0.004) (Table 5.100).

Firstly, it was found that more donkeys than expected with a poor BCS (1-1.5) had a dental grade at admission of 4 (18.2%). In the next group of underweight donkeys (BCS 1.75-2.5), it was also found that more than expected had a dental grade at admission of 5 (15.7%), whilst fewer than expected in the same BCS category had a dental grade of 2 (7.8%).

It was observed that fewer donkeys than expected with a close to ideal BCS of 2.75 to 3.5 had dental grades of 4 (3.3%) and 5 (3.0%). Interestingly, there were more overweight donkeys with a BCS of 4.75 to 5 than expected with a dental grade of 3 (26.5%).

Therefore, donkeys with poorer BCS at admission were identified as having more severe dental disease with grades of 4 and 5. Interestingly, dental disease was found to be not only linked to donkeys with a poor BCS, but also to overweight donkeys, some of whom were found to have signs of moderate dental disease identified at admission (grade 3).

Table 5.100. Relationship of dental grade and body condition scores (categorised) at admission

BCS	n	Dental grades				
		1	2	3	4	5
1-1.5	11	36.4%	18.2%	9.1%	18.2%^{H}	18.2%
1.75-2.5	51	60.8%	7.8%^{L}	7.8%	7.8%	15.7%^{H}
2.75-3.5	300	57.3%	21.3%	15.0%	3.3%^{L}	3.0%^{L}
3.75-4.5	153	56.9%	20.3%	11.8%	5.2%	5.9%
4.75-5	49	42.9%	14.3%	26.5%^{H}	10.2%	6.1%
Total	**564**	**55.9%**	**19.1%**	**14.4%**	**5.1%**	**5.5%**

Significance of Likelihood Ratio test, p_{LR}=0.004
^{H}: Observed proportion significant higher than expected (p<0.050)
^{L}: Observed proportion significant lower than expected (p<0.050)

Statistically significant differences were found between admission BCS and categorized dental grades at admission (p_{X2}=0.004) (Table 5.101). It was observed that more donkeys than expected with a BCS of 2.75 to 3.5 had acceptable dental grades of 1 and 2 (78.7%), whilst fewer donkeys than expected from the same category had pathological grades of 3 to 5 (21.3%).

On the other hand, it was found that there were significantly more pathological dental grades than expected in donkeys with a BCS of 4.75 to 5 (42.9%), while fewer with the same BCS had acceptable dental grades of 1 and 2 (57.1%). This highlights that donkeys need at least one dental examination per year independent of their BCS.

Firstly, it was observed that dental grades progressively worsen as they depart from an ideal BCS. Therefore, it would be logical to think that donkeys in poor body condition may have pathological dental grades affecting their ability to eat and subsequently causing weight loss or failure to gain weight. What is more difficult to explain is that overweight donkeys may also have moderate to severe dental disease. This could be related to the type of diet being provided, as they may be receiving shortly chopped and processed fibres or a high energy diet despite being overweight. Providing dietary fibre in a short length format can help ensure that a donkey with dental disease maintains their body weight or even increases it.

Table 5.101. Admission dental grades (categorised) stratified by admission body condition score in donkeys

BCS	n	Dental grades categories	
		Acceptable (1-2)	Pathological (3-5)
None	10	70.0%	30.0%
1-1.5	11	54.5%	45.5%
1.75-2.5	51	68.6%	31.4%
2.75-3.5	300	78.7%[H]	21.3%[L]
3.75-4.5	153	77.1%	22.9%
4.75-5	49	57.1%[L]	42.9%[H]
Total	**574**	**74.9%**	**25.1%**

Significance of Pearson´s Chi-square test, p=0.004
[H]: Observed proportion significantly higher than expected (p<0.050)
[L]: Observed proportion significantly lower than expected (p<0.050)

Morrow et al. (2011) stated that the types and range of health issues experienced by aged non-working donkeys have not been well studied; their study found that the most prevalent condition in 1,444 aged donkeys at post-mortem examination was dental disorders (78.7%). Morrow et al. (2011) also mentioned a previous study in donkeys which focused solely on the prevalence of dental disorders (Du Toit et al., 2008) and found a prevalence of 93.0%.

5.3.6. Time since last dental examination

There were no significant differences found between sex and last dental examination, either as time (p_{KW}=0.300) (Table 5.102) or as periods (p_{X2}=0.265) (Table 5.103). At TDS, a dental examination would be done at a minimum of once a year.

Table 5.102. Time since last dental examination (days) stratified by sex

Sex	n	Mean	SD	Q1	Median	Q3	min	Max
Mare	66	469.89	510.00	126	270.50	592.00	13	2108
Gelding	100	515.05	688.45	149	365.0	683.50	8	5497
Stallion	21	357.38	440.77	78	272.0	425.50	15	2006
Total	**187**	**481.41**	**605.35**	**126**	**303.00**	**592.00**	**8**	**5497**

Significance of Kruskal-Wallis test by sex for last dental examination, p=0.300

Although no significant differences were found between sex and last dental examination categorised at three different periods (Table 5.103), more stallions than expected had had a dental regularly (within a year) (76.2%). On the other hand, it is interesting that 16.6% of animals had not received regular dental care or a visit in a period longer than 2 years. It was observed (Table 5.102) that there was a large variability in timings of dental examinations, with some of them having as many as 5,497 days since their Last dental examination.

Table 5.103. Last dental examination (categorised) stratified by sex

Sex	n	Last dental examination		
		< 1 year	1-2 years	>2 years
Mare	66	56.1%	24.2%	19.7%
Gelding	100	52.0%	31.0%	17.0%
Stallion	21	76.2%[H]	19.0%	4.8%
Total	**187**	**56.1%**	**27.3%**	**16.6%**

Significance of Pearson's Chi-square test, p=0.265
[H]: Observed proportion significantly higher than expected (p<0.050)
[L]: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were not found between the time since their last dental examination and their age (p_{LR}=0.127) (Table 5.104). Significant differences should perhaps be seen in this case, as older and geriatric donkeys should receive more frequent dental examinations than younger donkeys, especially because they are showing worse dental grades on arrival.

Table 5.104. Time since last dental examination (categorised) in donkeys by age

Age (cat)	n	Last dental examination		
		< 1 year	1-2 years	>2 years
≤ 1 y	1	100.0%	0.0%	0.0%
(1 y, 3 y]	10	80.0%	20.0%	0.0%
(3 y, 5 y]	28	75.0%[H]	17.9%	7.1%
(5 y, 20 y]	118	49.2%[L]	30.5%	20.3%
> 20	30	56.7%	26.7%	16.7%
Total	**187**	**56.1%**	**27.3%**	**16.6%**

Significance of Likelihood Ratio test, p=0.127
H: Observed proportion significantly higher than expected (p<0.050)
L: Observed proportion significantly lower than expected (p<0.050)

No correlation was found between time since last dental examination and age (p_{MW}=0.750) (Table 5.89) or last dental examination categorised and age (p_{X2}=0.997) (Table 5.105). Interestingly, it was observed (Table 5.106) that geriatric donkeys had a higher mean of 604.33 days since their last dental examination, versus 457.92 days since their Last dental examination in younger donkeys. It was Du Toit et al. (2008) who reported a high prevalence (93.4%) of significant dental disease when looking at the post-mortem examinations of 349 mainly aged donkeys (median estimated age of 31 years). Therefore, geriatric donkeys should have more frequent dental examinations especially when dental disease occurs.

Table 5.105. Time since Last dental examination (days) stratified by age

Age	n	Mean	SD	Q1	Median	Q3	min	Max
Non-geriatric	157	457.92	493.15	126	315	539	8	2785
Geriatric	30	604.33	1011.65	124.5	275	742.25	15	5497
Total	**187**	**481.41**	**605.35**	**126**	**303**	**592**	**8**	**5497**

Significance of Mann-Whitney test for time since last dental examination (days), p=0.750

Table 5.106. Time since Last dental examination (categorised) by age

Age	n	Last dental examination		
		< 1 year	1-2 years	>2 years
Non-geriatric	157	56.1%	27.4%	16.6%
Geriatric	30	56.7%	26.7%	16.7%
Total	**187**	**56.1%**	**27.3%**	**16.6%**

Significance of Pearson's Chi-square test, p=0.997

Statistically significant differences were found between when the last dental examination occurred and type of origin (p_{KW}=0.001) (Table 5.107). A subgroup of donkeys was identified from the categories of "New arrival" and DS HB (NA). This group had no significant differences with regards to the timing of their last dental examination, where "New arrival" donkeys had a mean of 579.67 days from their Last dental examination, and DS HB (NA) donkeys had a mean of 348.46 days from their Last dental examination. A second subgroup with significantly lower means since their last dental examination was comprised of DS HB (NA) (348.46 days), "Return Guardian" (216.03 days), and DS HB (RG) (193.50 days).

Table 5.107. Time since last dental examination (days) stratified by type of origin

Type of origin	n	Mean	SD	Q1	Median	Q3	min	Max
New Arrival	132	579.67 ^{a}	673.93	137.25	378	744.75	8	5497
DS HB (NA)	13	348.46 ^{ab}	529.29	53	150	445.50	15	2006
Return Guardian	35	216.03 ^{b}	143.73	117	190	296	13	686
DS HB (RG)	6	193.50 ^{b}	125.25	95	167.5	264.5	95	425
DAT	1	254	-	-	-	-	-	-
Total	**187**	**481.41**	**605.35**	**126**	**303**	**592**	**8**	**5497**

Significance of Kruskal-Wallis test by origin for last dental days, p=0.001. Different superindexes in the same column indicate significant differences taking into account Mann-Whitney test by pairs.
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

The survey by Cox et al. (2010) reported that 86% of guardian donkeys had a dental examination at least once every 12 months; in this case although "Return guardian" had a mean of 216.03 days from their last dental examination, there was great variability with a maximum of 686 days between dental examinations.

Statistically significant differences were found between the number of days since the last dental categorised and type of origin (p_{LR}<0.001) (Table 5.108). Higher numbers of "New arrival" donkeys than expected were described as having been seen by the dentist more than 2 years prior to their arrival into TDS NAU (22.7%). Fewer from the same "New arrival" category had been seen by a dentist less than a year prior to arrival (46.2%). Higher numbers of "Return guardian" donkeys were described as having been seen by the dentist less than a year prior to arrival (85.7%), while none (0.0%) were said to have been seen by the dentist more than 2 years prior to arrival. Donkeys from DAT were all last seen by a dentist less than 1 year before arrival.

Table 5.108. Time since last dental examination (categorised) stratified by type of origin

Type of origin	n	Last dental examination		
		< 1 year	1-2 years	>2 years
New Arrival	132	46.2%^{L}	31.1%	22.7%^{H}
DS HB (NA)	13	61.5%	30.8%	7.7%
Return Guardian	35	85.7%^{H}	14.3%	0.0%^{L}
DS HB (RG)	6	83.3%	16.7%	0.0%
DAT	1	100.0%	0.0%	0.0%
Total	**187**	**56.1%**	**27.3%**	**16.6%**

Significance of Likelihood Ratio test, p<0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

No statistically significant differences were found between the time since the last dental examination and donkeys' origin region (Table 5.109), however if taking into account adjusted residuals, it was identified that more donkeys than expected from the North East had their Last dental examination more than 2 years before arrival (38.9%).

Additionally, it was found that more donkeys than expected from the North West had their last dental examination within 1 to 2 years prior to arrival (63.6%).

There were no significant differences found between the time since the last dental examination and the dental grade (p_{KW}=0.208) (Table 5.110). This is a very interesting finding and highlights the need for further training for UK veterinary practices and EDTs with regards to donkey dentistry. This could help avoid donkeys arriving with severe dental disease that could have been prevented or treated before arrival at TDS. It would also ensure that donkeys in the UK receive quality dental examinations and treatments.

Table 5.109. Time since last dental examination (categorised) stratified by origin region

Origin region	n	Last dental examination		
		< 1 year	1-2 years	>2 years
Scotland	4	75.0%	25.0%	0.0%
Northern Ireland	1	0.0%	100.0%	0.0%
North East	18	50.0%	11.1%	38.9%^{H}
North West	11	36.4%	63.6%^{H}	0.0%
East Midlands	21	71.4%	9.5%	19.0%
West Midlands	10	70.0%	20.0%	10.0%
Wales	12	41.7%	41.7%	16.7%
South West	62	58.1%	25.8%	16.1%
South East	43	55.8%	30.2%	14.0%
Total	**182**	**56.6%**	**26.9%**	**16.5%**

Significance of Likelihood Ratio test, p=0.062
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Table 5.110. Time since last dental examination (days) stratified by dental grade

Dental grade	n	Mean	SD	Q1	Median	Q3	min	Max
None	7	326.86	667.99	71	83	120	13	1840
1	87	409.40	389.08	124	315	525	8	2006
2	41	492.29	439.35	140.5	337	734	15	1811
3	25	636.64	750.67	152.5	365	741.5	8	2785
4	12	732.67	1510.8	213.5	276.5	505.25	13	5497
5	15	481.67	542.92	127	272	746	73	2108
Total	**187**	**481.41**	**605.35**	**126**	**303**	**592**	**8**	**5497**

Significance of Kruskal-Wallis test by dental grades for last dental days, p=0.208

No correlation was found between the number of days since the last dental examination categorised and the dental grade at admission (p_{LR}=0.750) (Table 5.111). Interestingly, approximately 6 out of 10 donkeys with dental grades 4 or 5 were said to have been seen by a dentist less than a year prior to arrival into TDS NAU; these numbers again highlight the need for further education and training of EDTs and vets with regards to donkey dentistry.

Table 5.111. Time since last dental (categorised) stratified by dental grade

Dental grade	n	Last dental examination		
		< 1 year	1-2 years	>2 years
None	7	85.7%	0.0%	14.3%
1	87	56.3%	27.6%	16.1%
2	41	51.2%	31.7%	17.1%
3	25	52.0%	28.0%	20.0%
4	12	58.3%	33.3%	8.3%
5	15	60.0%	20.0%	20.0%
Total	**187**	**56.1%**	**27.3%**	**16.6%**

Significance of Likelihood Ratio test, p=0.750

From a different point of view (and excluding donkeys with no information concerning their dental grade), there was no correlation found between the time since the last dental examination and dental grade at admission (p_{LR}=0.986) (Table 5.112). A small percentage of donkeys were found with dental grades of 4 and 5 that had reportedly been seen by a vet or an EDT in a period of less than a year. Donkeys with severe dental disease can be very difficult to treat and it is possible that those donkeys were not referred to a specialist for treatment. In addition, information was provided by owners, so reliability might be an issue.

Table 5.112. Admission dental grades stratified by last dental examination (categorised)

Last dental examination	n	Dental grade				
		1	2	3	4	5
< 1 year	99	49.5%	21.2%	13.1%	7.1%	9.1%
1-2 years	51	47.1%	25.5%	13.7%	7.8%	5.9%
>2 years	30	46.7%	23.3%	16.7%	3.3%	10.0%
Total	**180**	**48.3%**	**22.8%**	**13.9%**	**6.7%**	**8.3%**

Significance of Likelihood Ratio test, p=0.986

Table 5.113. Admission dental grades (categorised) stratified by last dental examination (categorised)

Last dental examination	n	Dental grade categories	
		Acceptable (1-2)	Pathological (3-5)
< 1 year	99	70.7%	29.3%
1-2 years	51	72.5%	27.5%
> 2 years	30	70.0%	30.0%
Total	**180**	**71.1%**	**28.9%**

Significance of Pearson´s Chi-square test, p=0.962

There was also no correlation found between the time of the last dental examination and dental grade of donkeys at admission when we categorised the dental grades (p_{X2}=0.962) (Table 5.113).

5.3.7. Last farrier visit for donkeys

There were no significant differences found between sex and time since the farrier last visited (p_{KW}=0.489) (Table 5.114). At TDS, donkeys are routinely trimmed every 4 to 6 weeks.

Table 5.114. Time since last farrier visit (days) stratified by sex

Sex	n	Mean	SD	Q1	Median	Q3	min	Max
Mare	118	134.38	174.69	42.00	84.00	145.75	7	1278
Gelding	196	101.29	111.76	48.25	66.00	104.75	2	805
Stallion	44	99.68	92.21	28.75	63.00	141.25	12	365
Total	**358**	**112.00**	**134.52**	**44.00**	**69.00**	**122.00**	**2**	**1278**

Significance of Kruskal-Wallis test by sex for last farrier visit (days), p=0.489

Statistically significant differences were found between the time since the last farrier visit (categorised) and sex (p_{X2}=0.034) (Table 5.115). Fewer mares than expected were found to have been trimmed between 6 and 12 weeks prior to arrival (24.6%). A large percentage of donkeys were seemingly trimmed by the farrier more than 24 weeks prior to arrival into TDS NAU (17.0%).

Table 5.115. Time since last farrier visit (categorised) stratified by sex

Sex	n	Last farrier visit			
		≤ 6 wk	6-12 wk	12-24 wk	≥ 24 wk
Mare	118	25.4%	24.6%^{L}	29.7%	20.3%
Gelding	196	21.4%	42.3%	21.9%	14.3%
Stallion	44	31.8%	31.8%	15.9%	20.5%
Total	**358**	**24.0%**	**35.2%**	**23.7%**	**17.0%**

Significance of Pearson's Chi-square test, p=0.034

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

There were no statistically significant differences found between the time since the last farrier visit and their age (p_{X2}=0.270) (Table 5.116).

No significant differences were found between geriatric and non-geriatric donkeys and the time since the last farrier visit, either when comparing days (p_{MW}=0.849) (Table 5.117) or periods (p_{X2}=0.798) (Table 5.118).

Table 5.116. Time since last farrier visit (categorised) stratified by age

Age	n	Last farrier visit			
		<6 wk	6-12 wk	12-24 wk	>24 wk
≤ 1 y	7	28.6%	42.9%	0.0%	28.6%
(1 y, 3 y]	32	31.3%	18.8%	25.0%	25.0%
(3 y, 5 y]	76	14.5%[L]	35.5%	27.6%	22.4%
(5 y, 20 y]	206	26.2%	37.9%	21.8%	14.1%
> 20	37	24.3%	32.4%	29.7%	13.5%
Total	**358**	**24.0%**	**35.2%**	**23.7%**	**17.0%**

Significance of Pearson's Chi-square test, p=0.270
[L]: Observed proportion significantly lower than expected (p<0.050)

Table 5.117. Time since last farrier visit (days) stratified by age

Age	n	Mean	SD	Q1	Median	Q3	min	Max
Non-geriatric	321	111.20	132.98	44	69	121.50	2	1278
Geriatric	37	118.95	149.02	40	70	125	13	805
Total	**358**	**112.00**	**134.52**	**44**	**69**	**122**	**2**	**1278**

Significance of Mann-Whitney test for last farrier days, p=0.849

Table 5.118. Time since last farrier visit (categorised) stratified by age

Age	n	Last farrier visit			
		<6 wk	6-12 wk	12-24 wk	>24 wk
Non-geriatric	321	24.0%	35.5%	23.1%	17.4%
Geriatric	37	24.3%	32.4%	29.7%	13.5%
Total	**358**	**24.0%**	**35.2%**	**23.7%**	**17.0%**

Significance of Pearson's Chi-square test, p=0.798

Statistically significant differences were found between the time since the last farrier visit (days) and the type of origin (p_{KW}<0.001) (Table 5.119). There were two subgroups found. Mean time was similar for the "New arrival", "Return Guardian", DS HB (RG) and DAT (96.76, 87.26, 127. 33 and 70.33 days) with significantly higher mean (days) in donkeys coming from DS HB (NA) with a mean of 279.81 days since their last trim.

In the study by Grint et al. (2015), all of the guardian donkeys had reportedly received preventive healthcare. Most commonly treatments were for endoparasites, farriery and vaccinations. These common procedures occur at similar frequencies in horses (Brosnahan and Paradis, 2003). Grint et al. (2015) found that only 60.0% of the donkeys were reported to have had a hoof examination or treatment during the study. The authors considered this to be underestimated, since a number of the respondents were thought to have not included routine farriery in this category.

Statistically significant differences were found between the date of the last farrier visit (categorised) and origin (p_{LR}<0.001) (Table 5.120). Higher numbers of donkeys coming as "New arrival" were said to have been seen by the farrier 6 to 12 weeks prior to arrival (39.8%), while fewer were reportedly seen by the farrier more than 24 weeks prior to arriving into TDS.

Table 5.119. Time since last farrier visit (days) stratified by type of origin

Type of origin	n	Mean	SD	Q1	Median	Q3	min	Max
New Arrival	284	96.76[a]	116.01	44	64	112.75	2	1278
DS HB (NA)	31	279.81[b]	202.90	172	233	365	7	966
Return Guardian	34	87.26[a]	106.72	31	68.5	97.50	13	553
DS HB (RG)	6	127.33[a]	118.76	55	91	171	55	366
DAT	3	70.33[a]	24.13	-	64	-	50	97
Total	**358**	**112.00**	**134.52**	**44**	**69**	**122**	**2**	**1278**

Significance of Kruskal-Wallis test by origin for last farrier days, p<0.001. Different superindexes in the same column indicate significant differences taking into account Mann-Whitney test by pairs.
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

Higher numbers of donkeys than expected arriving from DS HB (NA) were said to have been trimmed more than 24 weeks prior to arrival at NAU (77.4%). Holding bases follow 6 to 10 weeks farriery visits as part of TDS protocol; therefore it is likely that those visits were not recorded in the system although were performed. The Donkey Sanctuary needs to ensure that all of the information is recorded into each donkey's clinical history irrespectively of their origin. Also, higher numbers than expected of "Return guardian" donkeys were reportedly seen by the farrier less than 6 weeks prior to coming back to TDS NAU (41.2%).

Table 5.120. Time since last farrier visit (categorised) stratified by type of origin

Type of origin	n	Last farrier visit			
		<6 wk	6-12 wk	12-24 wk	>24 wk
New Arrival	284	24.3%	39.8%[H]	23.9%	12.0%[L]
DS HB (NA)	31	9.7%[L]	0.0%[L]	12.9%	77.4%[H]
Return Guardian	34	41.2%[H]	26.5%	26.5%	5.9%
DS HB (RG)	6	0.0%	33.3%	50.0%	16.7%
DAT	3	0.0%	66.7%	33.3%	0.0%
Total	**358**	**24.0%**	**35.2%**	**23.7%**	**17.0%**

Significance of Likelihood Ratio test, p<0.001
[H]: Observed proportion significantly higher than expected (p<0.050)
[L]: Observed proportion significantly lower than expected (p<0.050)
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre.

Statistically significant differences were found between the time since the last farrier visit and origin region (p_{LR}<0.001). In Table 5.121, it can be observed that there were more donkeys than expected from Scotland (54.5%) and Northern Ireland (80.0%) that had been trimmed over 24 weeks prior to arrival. The Donkey Sanctuary should ensure that donkey owners and holding bases have access to farriers with donkey experience and should invest in further training for owners and professionals with regards to the importance of regular hoof care in donkeys.

Moreover, it was noted that more donkeys than expected from the North West (48.5%) and the South West (31.6%) had been attended by a farrier 12 to 24 weeks prior to arrival. The Donkey Sanctuary could investigate reasons as to why this is occurring in these areas and should invest in further training for owners and professionals regarding hoof care in donkeys across the UK. On the other hand, it was found that there were fewer donkeys than expected from the South West that had been trimmed more than 24 weeks prior to arrival (8.2%).

It was also observed that there were more donkeys than expected from the West Midlands that had been trimmed 6 weeks to 12 weeks prior to arrival (59.5%), whilst fewer donkeys from the same region had been trimmed within 6 weeks prior to arrival (10.8%).

Finally, it was observed that all of the donkeys coming from Greater London had been trimmed in the 6 weeks prior to arrival at TDS NAU (100.0%).

Table 5.121. Time since last farrier visit (categorised) stratified by origin region

Origin region	**n**	**Last farrier visit**			
		<6 wk	6-12 wk	12-24 wk	>24 wk
Scotland	11	9.1%	36.4%	0.0%	54.5%^{H}
Northern Ireland	5	0.0%	0.0%	20.0%	80.0%^{H}
North East	38	21.1%	44.7%	7.9%^{L}	26.3%
North West	33	12.1%	24.2%	48.5%^{H}	15.2%
East Midlands	35	31.4%	28.6%	25.7%	14.3%
West Midlands	37	10.8%^{L}	59.5%^{H}	16.2%	13.5%
Wales	23	34.8%	34.8%	13.0%	17.4%
South West	98	30.6%	29.6%	31.6%^{H}	8.2%^{L}
South East	68	25.0%	38.2%	20.6%	16.2%
Greater London	3	100.0%^{H}	0.0%	0.0%	0.0%
Total	**351**	**24.5%**	**35.3%**	**23.6%**	**16.5%**

Significance of Likelihood Ratio test, $p<0.001$
^{H}: Observed proportion significantly higher than expected ($p<0.050$)
^{L}: Observed proportion significantly lower than expected ($p<0.050$)

5.3.8. Health conditions of donkeys

Any health conditions reported by external veterinary practices at the PAM examination were divided into the following categories: dermatological, ophthalmic, cardiac, respiratory, musculoskeletal (limb), musculoskeletal (hoof), behaviour, digestive and other findings.

It is worth noting that in the following tables more than one condition may be observed in the same animal. It is also important to take into account that not all body systems were examined by all of the external veterinary practices. They may have been unable to perform a full PAM despite having been requested (n=290), or it may be that only a partial PAM was requested (n=32). For this reason, the total number of donkeys examined varies by health condition.

5.3.8.1. Dermatological conditions

With regards to dermatological conditions, 23.6% of animals suffered one or more skin condition at the PAM, compared with a prevalence of 33.2% registered at admission. The concordance of absence or presence of a dermatological condition at both examinations was low (k=0.290) (Table 5.122).

The most frequent conditions noted at admission were alopecia, sarcoid, fly bites, scar tissue, skin nodules and lice infestation (between 3.2 and 4.5%). However, at PAM the frequency of fly bites, scar tissue and skin nodules were under reported, whilst lice infestation, history of sarcoids and rain scald were over-reported.

If lice were found at the PAM, it is likely that those animals received treatment prior to arrival. Lice have been described as common in donkeys in the UK and their prevalence is higher in late winter and early spring (Knottenbelt, 2005). Both biting lice (*Damalinia* spp.) and sucking lice (*Haematopinus* spp.) occur in donkeys. In both types of infestation, pruritus can be observed, although it can be mild, and affected donkeys may develop a moth-eaten appearance without marked pruritus (Knottenbelt, 2005).

Information regarding a donkey's clinical sarcoid history should appear on the AM form. The new computer system at TDS should allow a link between both exams to ensure that a complete history is available at the time of admission.

Table 5.122. Frequency of dermatological conditions in donkeys

Dermatological conditions	Pre-admission		Admission	
	Prev. (n=322 donkeys)	Case freq. (n=76 cases)	Prev. (n=596 donkeys)	Case freq. (n=198 cases)
NAD	76.4%	-	66.8%	-
Alopecia	3.1%	13.2%	4.5%	13.6%
Sarcoid	2.5%	10.5%	4.4%	13.1%
Fly bites	0.9%	3.9%	4.0%	12.1%
Scar tissue	0.9%	3.9%	3.9%	11.6%
Skin nodule	1.2%	5.3%	3.7%	11.1%
Lice infestation	5.6%	23.7%	3.2%	9.6%
History of sweet itch	1.6%	6.6%	2.9%	8.6%
Wound	1.6%	6.6%	2.9%	8.6%

Table 5.122 (cont). Frequency of dermatological conditions in donkeys

Dermatological conditions	Pre-admission		Admission	
	Prev. (n=322 donkeys)	Case freq. (n=76 cases)	Prev. (n=596 donkeys)	Case freq. (n=198 cases)
History of sarcoids	4.3%	18.4%	2.7%	8.1%
Tail rub	0.9%	3.9%	2.2%	6.6%
History of sarcoid treated	-	-	2.2%	6.6%
Rain scald	3.1%	13.2%	1.8%	5.6%
Dermatitis	1.9%	7.9%	1.8%	5.6%
Sunburn	0.3%	1.3%	1.5%	4.5%
Sweet itch	0.6%	2.6%	1.2%	3.5%
Mud fever/pastern dermatitis	0.3%	1.3%	1.0%	3.0%
Dermatophytosis	-	-	0.7%	2.0%
Trauma	-	-	0.5%	1.5%
History of dermatitis	0.3%	1.3%	0.3%	1.0%
Bent right ear	0.3%	1.3%	0.2%	0.5%
Sheath infection	0.3%	1.3%	0.2%	0.5%
Head rub	-	-	0.2%	0.5%
Wart type lesion	-	-	0.2%	0.5%

Cohen's Kappa coefficient between pre-admission and admission, k=0.290±0.055 (p<0.001)
NAD: No abnormalities detected

No statistically significant differences were found between dermatological conditions at PAM and origin region (p_{LR}=0.919) (Table 5.123), however when looking at the adjusted standardised residuals it was found that more donkeys than expected that had been diagnosed with rain scald were coming from an unknown origin (25.0%), and there were also more donkeys with the same condition coming from Northern Ireland (17.4%). These results could be affected by regional average rainfall but also lack of appropriate shelter. Further investigation should be need it to assess risk factors.

Other interesting results were found. It was observed that more donkeys than expected from the South West (2.4%) had tail rubs noted at their PAM. On the other hand, more donkeys than expected from the East Midlands (7.1%) had wounds when assessed at PAM. It was also found that more donkeys than expected from Scotland had a history of sweet itch (11.1%). There were also more donkeys than expected from the South East with signs of sun burn noted at their PAM (2.3%). With regards to alopecia, more donkeys than expected from the North East (12.0%) had alopecia at the time of the PAM. More donkeys from Northern Ireland (4.3%) than expected had scar tissue found at the time of the PAM. Finally, it was found that more donkeys than expected from Northern Ireland had a bent ear (cartilage disorder of the ear) (4.3%).

Table 5.123. Pre-admission dermatological conditions in donkeys stratified by origin region

PAM dermatological condition	Unknown origin (n=4)	Scotland (n=18)	Northern Ireland (n=23)	North East (n=25)	North West (n=29)	East Midlands (n=28)
NAD	75.0%	61.1%	69.6%	80.0%	82.8%	67.9%
Lice infestation	0.0%	16.7%H	0.0%	4.0%	6.9%	14.3%H
Sarcoid	0.0%	0.0%	0.0%	0.0%	3.4%	7.1%
Rain scald	25.%H	5.6%	17.4%H	0.0%	0.0%	0.0%
Dermatitis	0.0%	0.0%	0.0%	0.0%	3.4%	0.0%
History of sarcoids	0.0%	5.6%	0.0%	0.0%	3.4%	0.0%
Wound	0.0%	0.0%	0.0%	0.0%	0.0%	7.1%H
Skin nodule	0.0%	0.0%	0.0%	4.0%	0.0%	0.0%
History of sweet itch	0.0%	11.1%H	0.0%	0.0%	0.0%	0.0%
Sweet itch	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Fly bites	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Tail rub	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sheath infection	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sunburn	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 5.123 (cont.) Pre-admission dermatological conditions in donkeys stratified by origin region

PA dermatological condition	West Midlands (n=31)	Wales (n=24)	South West (n=84)	South East (n=44)	Greater London (n=3)	Total (n=313)
NAD	87.1%	79.2%	76.2%	75.0%	66.7%	**76.0%**
Lice infestation	0.0%	0.0%	4.8%	4.5%	0.0%	**5.1%**
Sarcoid	0.0%	4.2%	2.4%	2.3%	0.0%	**2.2%**
Rain scald	0.0%	0.0%	1.2%	0.0%	0.0%	**2.2%**
Dermatitis	3.2%	0.0%	3.6%	2.3%	0.0%	**1.9%**
History of sarcoids	3.2%	8.3%H	1.2%	0.0%	0.0%	**1.9%**
Wound	3.2%	0.0%	0.0%	2.3%	0.0%	**1.3%**
Skin nodule	0.0%	0.0%	2.4%	2.3%	0.0%	**1.3%**
History of sweet itch	0.0%	0.0%	1.2%	2.3%	0.0%	**1.3%**
Sweet itch	0.0%	0.0%	2.4%H	0.0%	0.0%	**0.6%**
Fly bites	0.0%	0.0%	1.2%	2.3%	0.0%	**0.6%**
Tail rub	0.0%	0.0%	2.4%H	0.0%	0.0%	**0.6%**
Sheath infection	0.0%	0.0%	0.0%	2.3%H	0.0%	**0.3%**
Sunburn	0.0%	0.0%	0.0%	2.3%H	0.0%	**0.3%**

Significance of Likelihood Ratio test, p=0.919
H: Observed proportion significantly higher than expected (p<0.050)
L: Observed proportion significantly lower than expected (p<0.050)

Knottenbelt (2005) reported that donkeys are prone to several cutaneous tumours including (in order of prevalence): sarcoid, squamous cell carcinoma, fibroma, fibrosarcoma and melanoma. Sarcoids are reported to be by far the commonest skin mass and they have been the subject of considerable research at Glasgow University in conjunction with TDS. Sarcoid predilection sites in donkeys include the face (around the mouth and eyes) and the groin region. Occult sarcoids are not reported as common in donkeys, with fibroblastic sarcoids being the most frequently reported type in donkeys.

Knottenbelt (2005) also reported that the major skin conditions of donkeys encountered by veterinary practices were: pruritus, nodular skin disease, alopecia, moist/exudative dermatoses and dry dermatosis (flaking and scaling).

Statistically significant differences were found between dermatological cases at admission and origin region (p_{LR}=0.001) (Table 5. 124). It was found that fewer donkeys than expected arrived from Northern Ireland with no dermatological abnormalities noted at admission (30.4%).

Table 5.124. Admission dermatological conditions in donkeys stratified by origin region

Dermatological condition at admission	**Unknown origin** (n=4)	**Scotland** (n=27)	**Northern Ireland** (n=23)	**North East** (n=52)	**North West** (n=65)	**East Midlands** (n=54)
NAD	25.0%	66.7%	30.4%^{L}	73.1%	66.2%	68.5%
Sunburn	0.0%	0.0%	0.0%	0.0%	1.5%	0.0%
Sarcoid	0.0%	3.7%	0.0%	5.8%	9.2%^{H}	5.6%
Fly bites	0.0%	7.4%	0.0%	3.8%	0.0%	1.9%
Lice infestation	0.0%	0.0%	0.0%	0.0%	4.6%	7.4%
Alopecia	0.0%	0.0%	0.0%	0.0%	3.1%	3.7%
History of sarcoids	0.0%	7.4%	0.0%	1.9%	0.0%	0.0%
Wound	0.0%	0.0%	8.7%^{H}	0.0%	3.1%	3.7%
Tail rub	0.0%	0.0%	43.5%^{H}	1.9%	1.5%	0.0%
Skin nodule	0.0%	3.7%	0.0%	1.9%	4.6%	1.9%
Scar tissue	25.0%^{H}	0.0%	13.0%^{H}	3.8%	1.5%	3.7%
Dermatitis	50.0%^{H}	0.0%	4.3%	3.8%	1.5%	1.9%
History of sweet itch	0.0%	7.4%^{H}	0.0%	1.9%	1.5%	0.0%
Rain scald	0.0%	0.0%	0.0%	0.0%	0.0%	1.9%
Sweet itch	0.0%	0.0%	0.0%	1.9%	0.0%	0.0%
Dermatophytosis	0.0%	0.0%	0.0%	0.0%	1.5%	0.0%
Trauma	0.0%	3.7%^{H}	0.0%	0.0%	0.0%	0.0%
History of dermatitis	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Sheath infection	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Wart type lesion	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 5.124. (cont.) Admission dermatological conditions in donkeys stratified by origin region

Dermatological condition at admission	**West Midlands** (n=53)	**Wales** (n=43)	**South West** (n=163)	**South East** (n=92)	**Greater London** (n=3)	**Total** (n=579)
NAD	73.6%	69.8%	63.8%	69.6%	66.7%	**66.1%**
Sunburn	1.9%	4.7%^{H}	0.6%	1.1%	0.0%	**10.0%**
Sarcoid	1.9%	2.3%	3.7%	5.4%	0.0%	**4.5%**
Fly bites	7.5%	4.7%	5.5%	1.1%	0.0%	**3.6%**
Lice infestation	3.8%	2.3%	3.1%	3.3%	0.0%	**3.1%**
Alopecia	1.9%	0.0%	7.4%^{H}	2.2%	0.0%	**3.3%**
History of sarcoids	5.7%	9.3%^{H}	1.2%	3.3%	0.0%	**2.6%**
Wound	1.9%	0.0%	1.2%	4.3%	0.0%	**2.2%**
Tail rub	0.0%	0.0%	0.0%^{L}	0.0%	0.0%	**2.1%**
Skin nodule	0.0%	2.3%	0.6%	4.3%	0.0%	**2.1%**
Scar tissue	0.0%	0.0%	0.6%	0.0%	33.3%^{H}	**1.9%**
Dermatitis	0.0%	0.0%	1.2%	1.1%	0.0%	**1.7%**
History of sweet itch	0.0%	2.3%	3.1%	0.0%	0.0%	**1.7%**
Rain scald	0.0%	2.3%	3.7%^{H}	1.1%	0.0%	**1.6%**
Sweet itch	0.0%	0.0%	1.8%^{H}	0.0%	0.0%	**0.7%**
Dermatophytosis	0.0%	0.0%	1.2%	1.1%	0.0%	**0.7%**
Trauma	0.0%	0.0%	0.6%	1.1%	0.0%	**0.5%**
History of dermatitis	0.0%	0.0%	0.6%	0.0%	0.0%	**0.2%**
Sheath infection	0.0%	0.0%	0.0%	1.1%^{H}	0.0%	**0.2%**
Wart type lesion	1.9%^{H}	0.0%	0.0%	0.0%	0.0%	**0.2%**

Significance of Likelihood Ratio test, p= 0.001
^{H}: Observed proportion significantly higher than expected ($p<0.050$)
^{L}: Observed proportion significantly lower than expected ($p<0.050$)

It was observed that more donkeys than expected from Scotland had signs of trauma at admission (3.7%).

It was also noted that more donkeys than expected from the South East were diagnosed with a sheath infection at admission (1.1%).

With regards to having a history of sarcoids, it was found that there were more donkeys than expected from Wales with a clinical history of sarcoids (9.3%).

It was noted that more donkeys than expected from the South West were diagnosed with sweet itch at admission (1.8%).

More donkeys than expected from an unknown origin displayed clinical signs of dermatitis on admission (50.0%).

Interestingly, more donkeys than expected from Northern Ireland had tail rubs (43.5%) and wounds (8.7%) on admission. Additionally, it was observed that fewer donkeys than expected from the South West (0.0%) had tail rubs. These findings would suggest that long distance transport could be associated to presence of tail rub injuries and should be taken into consideration.

It was also observed that more donkeys than expected from the South West had signs of rain scald at admission (3.7%). Further investigations should be need it to assess association of rain scald and rainfall and lack of appropriate shelter.

There were more donkeys than expected from Wales with signs of sunburn on admission (4.7%).

It was also found that more donkeys than expected arriving from Scotland had a history of sweet itch (7.4%). Further investigation could be done to asses if there is a link with higher culicoides levels.

Interestingly, when we categorised all of the dermatological conditions in healthy donkeys and donkeys with any dermatological skin condition; it was observed (Table 5.125) that there were statistically significant differences between skin conditions and origin region (p_{X2}=0.001); it was seen that there were more donkeys than expected with dermatological diseases from Northern Ireland (69.6%) while fewer donkeys than expected from the same region had been categorised as healthy (30.4%).

Table 5.125. Dermatological conditions in donkeys at admission stratified by origin region

Origin region	n	Any dermatological condition at admission
Unknown origin	4	75.0%
Scotland	27	33.3%
Northern Ireland	23	69.6%^{H}
North East	52	26.9%
North West	65	33.8%
East Midlands	54	31.5%
West Midlands	53	26.4%
Wales	43	30.2%
South West	163	36.2%
South East	92	30.4%
Greater London	3	33.3%
Total	**579**	**33.9%**

Significance of Pearson's Chi-square test, p=0.031

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

5.3.8.2. Ophthalmic conditions

The prevalence of ophthalmic conditions was low at PAM (13.7%) and it was even lower at admission (5.2%) (Table 5.126). The concordance of absence or presence of ophthalmic conditions showed a moderate agreement (k=0.523). Eye conditions reported by external veterinary surgeons will be re-examined on arrival but will not necessarily appear on the admission information form. Admission and PAM forms should be linked to ensure continuity of clinical cases and for data analysis.

The most frequent conditions described at PAM and admission were cataracts and epiphora (including increased lacrimation) (40.9% and 15.9% at PA and 29.0% and 32.3% at admission respectively). There were other frequently reported conditions at PAM such as lens opacity (11.4%) and the presence of floaters in the anterior chamber (11.4%).

Table 5.126. Frequency of ophthalmic conditions in donkeys

Ophthalmic conditions	Pre-admission		Admission	
	Prev. (n=322 donkeys)	Case freq. (n=44 cases)	Prev. (n=596 donkeys)	Case freq. (n=31 cases)
NAD	86.3%	-	94.8%	-
Epiphora	2.2%	15.9%	1.7%	32.3%
Cataracts	5.6%	40.9%	1.5%	29.0%
Nuclear degeneration	0.9%	6.8%	0.5%	9.7%
Cloudy	0.6%	4.5%	0.5%	9.7%
Opacity of lenses	1.6%	11.4%	0.3%	6.5%
De-pigmented area ventral to optic disc	1.2%	9.1%	0.3%	6.5%
Vision affected	1.2%	9.1%	0.3%	6.5%
Floaters	1.6%	11.4%	0.2%	3.2%
Entropion	0.3%	2.3%	0.2%	3.2%
Recurrent uveitis	0.3%	2.3%	0.2%	3.2%
Eyelid defect/trauma	-	-	0.2%	3.2%
History of recurrent epiphora	-	-	0.2%	3.2%
Eye missing	0.3%	2.3%	-	-
History of recurrent conjunctivitis	0.3%	2.3%	-	-
Retinopathy	0.3%	2.3%	-	-
No ophthalmoscope	0.3%	2.3%	-	-

Cohen's Kappa coefficient between pre-admission and admission, k=0.523±0.075 ($p<0.001$)
NAD: No abnormalities detected

There were no statistically significant differences found between ophthalmic conditions at PAM and origin region (p_{LR}=0.914) (Table 5.127). However, when looking at the adjusted standardised residuals, it was observed that there were more donkeys than expected with a de-pigmented ventral optic disc (8.3%). It was also noted that more donkeys than expected from Greater London had floaters detected at PAM (50.0%). Vets reported epiphora at the time of the PAM in more donkeys than expected from the East Midlands (10.5%) and Wales (10.0%). It is interesting that there were more vets in the South West that reportedly did not have an ophthalmoscope at the time of the PAM (2.9%). Finally, there were more donkeys than expected that had an eye missing in the North West (4.2%).

Table 5.127. Frequency of pre-admission ophthalmic conditions stratified by origin region

PA ophthalmological condition	**Unknown origin** (n=3)	**Scotland** (n=11)	**Northern Ireland** (n=16)	**North East** (n=20)	**North West** (n=24)	**East Midlands** (n=19)
NAD	100.0%	100.0%	100.0%	90.0%	87.5%	68.4%
Cataracts	0.0%	0.0%	0.0%	5.0%	0.0%	10.5%
Epiphora	0.0%	0.0%	0.0%	0.0%	0.0%	10.5%^{H}
Floaters	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Opacity of lenses	0.0%	0.0%	0.0%	0.0%	0.0%	10.5%^{H}
De-pigmented area ventral to optic disc	0.0%	0.0%	0.0%	5.0%	8.3%^{H}	0.0%
Nuclear degeneration	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Cloudy	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
No ophthalmoscope	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Eye missing	0.0%	0.0%	0.0%	0.0%	4.2%^{H}	0.0%

Table 5.127 (cont). Frequency of ophthalmic conditions in donkeys stratified by origin region

PA ophthalmological conditions	**West Midlands** (n=27)	**Wales** (n=20)	**South West** (n=67)	**South East** (n=35)	**Greater London** (n=2)	**Total** (n=244)
NAD	81.5%	75.0%	82.1%	77.1%	50.0%	**82.8%**
Cataracts	14.8%	5.0%	9.0%	5.7%	0.0%	**6.6%**
Epiphora	0.0%	10.0%^{H}	3.0%	2.9%	0.0%	**2.9%**
Floaters	0.0%	5.0%	1.5%	5.7%	50.0%^{H}	**2.0%**
Opacity of lenses	0.0%	5.0%	1.5%	0.0%	0.0%	**1.6%**
De-pigmented area ventral to optic disc	3.7%	0.0%	0.0%	0.0%	0.0%	**1.6%**
Nuclear degeneration	0.0%	0.0%	1.5%	5.7%^{H}	0.0%	**1.2%**
Cloudy	0.0%	0.0%	1.5%	0.0%	0.0%	**0.4%**
No ophthalmoscope	0.0%	0.0%	0.0%	2.9%^{H}	0.0%	**0.4%**
Eye missing	0.0%	0.0%	0.0%	0.0%	0.0%	**0.4%**

Significance of Likelihood Ratio test, p= 0.914
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

It was observed (Table 5.128) that there were no statistical differences found between ophthalmic conditions observed at admission and origin region (p_{LR}=0.998). However, if taking residuals into account it can be noted that there were more donkeys than expected arriving from the North West with no ophthalmic conditions (100.0%), whilst there were fewer with no ophthalmic conditions from Greater London (66.7%). It was also observed that more donkeys than expected from the East Midlands had a lens opacity observed at admission (1.9%).

More donkeys than expected from the West Midlands had cloudy eyes at admission (1.9%), and more donkeys than expected from Scotland had depigmented areas ventral to the optic disc (3.7%). There might be other causes for this depigmentation but equine herpes virus (EHV-1) could be responsible and this lesion may indicate possible EHV-1 exposure.

There were also more donkeys than expected from Greater London with anterior chamber floaters observed at admission (33.3%).

More donkeys than expected from the West Midlands had an eyelid defect or trauma (1.9%), and more donkeys than expected from the East Midlands had a history of recurrent epiphora (1.9%).

Table.5.128. Frequency of ophthalmic conditions at admission stratified by origin region

Ophthalmological condition at admission	**Unknown origin** (n=4)	**Scotland** (n=27)	**Northern Ireland** (n=23)	**North East** (n=52)	**North West** (n=65)	**East Midlands** (n=54)
NAD	100.0%	96.3%	95.7%	94.2%	100.0%^{H}	90.7%
Epiphora	3.7%	1.9%	2.3%	0.6%	1.1%	0.0%
Cataracts	0.0%	0.0%	0.0%	1.9%	0.0%	1.9%
Nuclear degeneration	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Opacity of lenses	0.0%	0.0%	0.0%	0.0%	0.0%	1.9%^{H}
Cloudy	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
De-pigmented area ventral to optic disc	0.0%	0.0%	0.0%	0.0%	1.1%	0.0%
Floaters	0.0%	0.0%	0.0%	0.0%	0.0%	33.3%^{H}
Eyelid defect/trauma	0.0%	0.0%	0.0%	0.0%	1.1%^{H}	0.0%
History of recurrent epiphora	1.9%^{H}	0.0%	0.0%	0.0%	0.0%	0.0%

Significance of Likelihood Ratio test, p= 0.998
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Table.5.128 (cont.) Frequency of ophthalmic conditions at admission stratified by origin region

Ophthalmological condition at admission	**West Midlands** (n=53)	**Wales** (n=43)	**South West** (n=163)	**South East** (n=92)	**Greater London** (n=3)	**Total** (n=579)
NAD	94.3%	97.7%	95.1%	93.5%	66.7%[L]	**95.0%**
Epiphora	1.9%	2.3%	0.6%	1.1%	0.0%	**1.6%**
Cataracts	1.9%	0.0%	2.5%	1.1%	0.0%	**1.4%**
Nuclear degeneration	0.0%	0.0%	0.6%	2.2%[H]	0.0%	**0.5%**
Opacity of lenses	0.0%	0.0%	0.6%	0.0%	0.0%	**0.3%**
Cloudy	1.9%[H]	0.0%	0.6%	0.0%	0.0%	**0.3%**
De-pigmented area ventral to optic disc	0.0%	0.0%	0.0%	1.1%	0.0%	**0.3%**
Floaters	0.0%	0.0%	0.0%	0.0%	33.3%[H]	**0.2%**
Eyelid defect/trauma	0.0%	0.0%	0.0%	1.1%[H]	0.0%	**0.2%**
History of recurrent epiphora	0.0%	0.0%	0.0%	0.0%	0.0%	**0.2%**

Significance of Likelihood Ratio test, p= 0.998
[H]: Observed proportion significantly higher than expected (p<0.050)
[L]: Observed proportion significantly lower than expected (p<0.050)

5.3.8.3. Cardiac conditions

Cardiac conditions were infrequently detected during the PAM by external veterinary practices (2.2%) and at admission (0.8%). The most frequently reported cardiac conditions at PAM were murmurs (42.9% of cardiac cases), arrhythmias (28.6%), and atrioventricular (AV) block (28.6%) (Table 5.129). Interestingly, at AM, only murmurs (80.0%) and arrhythmias (20.0%) were noted.

The concordance of absence or presence of cardiac conditions showed a good agreement (k=0.661). For cardiac conditions the same comments should have been noted at both PAM and AM. AV blocks would not necessarily be recorded as an abnormal condition at the AM even though they may have been previously reported by an external veterinary surgeon as abnormal.

Table 5.129. Frequency of cardiac conditions in donkeys

Cardiac conditions	**Pre-admission**		**Admission**	
	Prev. (n=322 donkeys)	Case freq. (n=7 cases)	Prev. (n=596 donkeys)	Case freq. (n=5 cases)
NAD	97.8%		99.2%	
Murmurs	0.9%	42.9%	0.7%	80.0%
Arrhythmia	0.6%	28.6%	0.2%	20.0%
AV Block	0.6%	28.6%	-	-

Cohen's Kappa coefficient between pre-admission and admission, k=0.661±0.159 (p<0.001)
NAD: No abnormalities detected

There were no statistical differences found between pre-admission cardiac conditions and donkeys' origin region (p_{LR}=0.912) (Table 5.130); however, when looking at the adjusted standardised residuals, it was identified that there were fewer donkeys than expected from the South East with no abnormalities found (89.3%), whilst more donkeys than expected from the same region were reported to have heart murmurs (7.1%).

Additionally, more donkeys than expected from Wales were reported to have arrhythmias (6.3%). Finally, there were more donkeys than expected reported as having AV blocks from Northern Ireland (6.3%).

Table 5.130. Frequency of cardiac conditions in donkeys at pre-admission stratified by origin region

Origin region	n	Pre-admission cardiac conditions			
		None	Irregularity	AV Block	Murmurs
Unknown origin	3	100.0%	0.0%	0.0%	0.0%
Scotland	11	100.0%	0.0%	0.0%	0.0%
Northern Ireland	16	93.8%	0.0%	6.3%^{H}	0.0%
North East	18	100.0%	0.0%	4.8%^{H}	0.0%
North West	21	95.2%	0.0%	0.0%	0.0%
East Midlands	13	100.0%	0.0%	0.0%	0.0%
West Midlands	22	100.0%	0.0%	0.0%	0.0%
Wales	16	93.8%	6.3%^{H}	0.0%	0.0%
South West	55	98.2%	0.0%	0.0%	1.8%
South East	28	89.3%^{L}	3.6%	0.0%	7.1%^{H}
Greater London	1	100.0%	0.0%	0.0%	0.0%
Total	**204**	**96.6%**	**10.0%**	**10.0%**	**1.5%**

Significance of Likelihood Ratio test, p=0.912
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were not found between the frequency of cardiac conditions and donkeys' origin region (p_{LR}=0.911) (Table 5.131). However, residuals demonstrate that more donkeys than expected from Wales had arrhythmias auscultated at admission (2.3%).

A lower frequency of heart conditions was observed at admission; this finding can be explained as not all donkeys will be examined by a veterinary surgeon at admission. Veterinary nurses conduct some admission examinations and some nurses might not be able to detect minor irregularities at auscultation. Having said that, any cardiac conditions noted at the PAM would usually have been reported to the NAU vet who would subsequently examine them at their AM. The Donkey Sanctuary vets should ensure that complete notes from examinations are transferred onto TDS vet system, and minor abnormalities such as AV block should also be recorded.

Table 5.131. Frequency of cardiac conditions at admission stratified by origin region

Origin region	n	Admission cardiac conditions		
		None	Murmurs	Irregularity
Unknown origin	4	100.0%	0.0%	0.0%
Scotland	27	100.0%	0.0%	0.0%
Northern Ireland	23	100.0%	0.0%	0.0%
North East	52	100.0%	0.0%	0.0%
North West	65	100.0%	0.0%	0.0%
East Midlands	54	100.0%	0.0%	0.0%
West Midlands	53	100.0%	0.0%	0.0%
Wales	43	97.7%	0.0%	2.3%^{H}
South West	163	98.8%	1.2%	0.0%
South East	92	97.8%	2.2%	0.0%
Greater London	3	100.0%	0.0%	0.0%
Total	**579**	**99.1%**	**0.7%**	**0.2%**

Significance of Likelihood Ratio test, p=0.911
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

5.3.8.4. Respiratory conditions

Prevalence of respiratory conditions was low, and there were only nine cases reported by the external veterinary practices (2.8%), whilst at admission, prevalence although still low, was slightly higher at 3.2%. The most frequent respiratory cases at PAM were recurrent airway obstruction (RAO) in 55.6% of the cases, harsh noises (22.2%) and a history of nasal discharge (22.2%) (Table 5.132). The most frequent conditions reported at AM were bilateral nasal discharge (57.9%), RAO (21.1%) and harsh lung noises on auscultation (21.1%).

Table 5.132. Frequency of respiratory conditions in donkeys

Respiratory conditions	Pre-admission		Admission	
	Prev. (n=322 donkeys)	Case freq. (n=9 cases)	Prev. (n=596 donkeys)	Case freq. (n=19 cases)
NAD	97.2%	-	96.8%	-
Bilateral nasal discharge	0.3%	11.1%	1.8%	57.9%
Harsh noises on lung auscultation	0.6%	22.2%	0.7%	21.1%
RAO	1.6%	55.6%	0.7%	21.1%
Coughing	-	-	0.3%	10.5%
History of nasal discharge	0.6%	22.2%	0.2%	5.3%
History of coughing	0.3%	11.1%	0.2%	5.3%
Endoscopy-contact with *S. equi*	0.3%	11.1%	-	-
On clenbuterol	0.3%	11.1%	-	-

Cohen's Kappa coefficient between pre-admission and admission, k=0.295±0.123 (p<0.001)
NAD: No abnormalities detected

Thiemann (2005) reported a higher incidence of chronic fibrosing lung disease, dental sinus empyema and neoplasia in geriatric donkeys, whilst infectious respiratory disease is seen more commonly in younger donkeys. Clinical signs described at PAM and AM, such as bilateral nasal discharge and harsh lung noises on auscultation could be clinical signs of a variety of conditions in the donkey.

Respiratory clinical signs have been described as quite subtle in the donkey, and usually, as donkeys are non-athletic animals, indicate a much more advanced condition.

The concordance of absence or presence of respiratory conditions at both examinations was low (k=0.295). This can be explained as some of the respiratory conditions may have a sudden onset. With regards to RAO cases, if confirmed at admission, they should be recorded on the admission form as well as on PAM paperwork.

No statistical differences were found between respiratory conditions in donkeys and their region of origin (p_{LR}=0.965) (Table 5.133); however, when looking at the typified corrected residuals, fewer donkeys than expected from the West Midlands were reported as having no abnormalities (87.0%), whilst there were more donkeys than expected from the same region with a history of coughing.

Table 5.133. Frequency of respiratory conditions at pre-admission stratified by origin region

Origin region	n	Pre-admission respiratory conditions				
		None	RAO	Harsh noises on lung auscultation	History of nasal discharge	History of coughing
Unknown origin	3	100.0%	0.0%	0.0%	0.0%	0.0%
Scotland	11	100.0%	0.0%	0.0%	0.0%	0.0%
Northern Ireland	15	100.0%	0.0%	0.0%	0.0%	0.0%
North East	18	100.0%	0.0%	0.0%	0.0%	0.0%
North West	20	100.0%	0.0%	0.0%	0.0%	0.0%
East Midlands	13	100.0%	0.0%	0.0%	0.0%	0.0%
West Midlands	23	87.0%^{L}	4.3%	4.3%	0.0%	4.3%^{H}
Wales	15	93.3%	0.0%	0.0%	6.7%^{H}	0.0%
South West	54	96.3%	0.0%	1.9%	1.9%	0.0%
South East	26	96.2%	3.8%	0.0%	0.0%	0.0%
Greater London	2	50.0%^{L}	50.0%^{H}	0.0%	0.0%	0.0%
Total	**200**	**96.0%**	**1.5%**	**1.0%**	**1.0%**	**0.5%**

Significance of Likelihood Ratio test, p=0.965
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

There were also fewer donkeys than expected from greater London with no respiratory conditions reported at PAM (50.0%), and more donkeys than expected from the same region with RAO reported at their PAM (50.0%; n=1).

Finally, it was observed that there were more donkeys than expected from Wales with a history of nasal discharge (6.7%).

When looking at respiratory conditions at admission, no significant differences were found between the frequency of conditions and donkeys' origin region (p_{LR}=0.400) (Table 5.134). However, residuals showed that fewer donkeys than expected arrived from an unknown origin (75.0%), Northern Ireland (82.6%) and Greater London (66.7%) with no respiratory abnormalities at admission. The Donkey Sanctuary should investigate risk factors for those regions to avoid introducing higher risk animals into the NAU.

Interestingly, it was found that more donkeys than expected that presented with a bilateral nasal discharge at admission were coming from an unknown origin (25.0%) and Northern Ireland (17.4%), whilst fewer than expected were coming from the South West (0.0%). This finding supports the notion that long-distance transport carries greater risks. Donkeys from an unknown origin are now considered by TDS as high-risk animals and are tested on arrival for *Streptococcus equi* and *Streptococcus zooepidemicus* by endoscopic guttural pouch lavage which is sent externally for PCR testing.

Lastly, it was seen that more donkeys than expected arrived from Wales with a history of coughing (2.3%).

Table 5.134. Frequency of respiratory conditions at admission stratified by origin region

Origin region	n	Respiratory conditions at admission					
		None	Bilateral nasal discharge	Harsh noises on lung auscultation	RAO	History of coughing	History of nasal discharge
Unknown origin	4	75.0%^{L}	25.0%^{H}	0.0%	0.0%	0.0%	0.0%
Scotland	27	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Northern Ireland	23	82.6%^{L}	17.4%^{H}	0.0%	0.0%	0.0%	0.0%
North East	52	98.1%	1.9%	0.0%	0.0%	0.0%	0.0%
North West	65	98.5%	1.5%	0.0%	0.0%	0.0%	0.0%
East Midlands	54	96.3%	3.7%	0.0%	0.0%	0.0%	0.0%
West Midlands	53	96.2%	0.0%	1.9%	1.9%^{H}	0.0%	0.0%
Wales	43	93.0%	2.3%	2.3%	0.0%	2.3%^{H}	0.0%
South West	163	98.8%	0.0%^{L}	0.6%	0.0%	0.0%	0.6%
South East	92	98.9%	1.1%	0.0%	0.0%	0.0%	0.0%
Greater London	3	66.7%^{L}	0.0%	0.0%	33.3%^{H}	0.0%	0.0%
Total	**579**	**96.9%**	**1.9%**	**0.5%**	**0.3%**	**0.2%**	**0.2%**

Significance of Likelihood Ratio test, p=0.400
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Interestingly, statistically significant differences were found when respiratory conditions were categorised as “healthy” or “any respiratory conditions” (p_{LR}=0.015) (Table 5.135). It was observed that fewer donkeys than expected were categorised as healthy on arrival from an unknown origin (75.0%) and Northern Ireland (82.6%). It was also noted that more donkeys than expected from these regions were categorised as diseased on admission (unknown origin 25.0%, Northern Ireland 17.4%). These findings support the idea that animals from these regions should be considered as high risk and undergo isolation within the NAU facility and further testing including guttural pouch endoscopy. The Donkey Sanctuary has introduced guttural pouch endoscopy for high risk animals prior to admission to increase biosecurity measures. Region of origin should be added to the list of risk factors.

Table 5.135. Admission respiratory conditions (categorised) stratified by origin region

Origin region	n	Any respiratory condition at admission
Unknown origin	4	25.0%^{H}
Scotland	27	0.0%
Northern Ireland	23	17.4%^{H}
North East	52	1.9%
North West	65	1.5%
East Midlands	54	3.7%
West Midlands	53	3.8%
Wales	43	7.0%
South West	163	1.2%
South East	92	1.1%
Greater London	3	33.3%^{H}
Total	**579**	**3.1%**

Significance of Likelihood Ratio test, p=0.015
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

5.3.8.5. Musculoskeletal and hoof conditions

Prevalence of limb problems was reported as low (2.5%) during PAM and slightly higher at admission (4.7%). The most frequent musculoskeletal conditions reported by external veterinary practices were chronic tendinitis (37.5%), stiffness (25.0%) and locking stifle (25.0%) (Table 5.94). On the other hand, the most frequent cases reported at admission were chronic tendinitis (10.7%), lameness (10.7%) and a history of lameness (10.7%).

The concordance of absence or presence of musculoskeletal conditions at both examinations was found to be in fair agreement (k=0.364).

Table 5.136. Frequency of musculoskeletal conditions in donkeys

Musculoskeletal conditions	Pre-admission		Admission	
	Prev. (n=322 donkeys)	Case freq. (n=8 cases)	Prev. (n=596 donkeys)	Case freq. (n=28 cases)
NAD	97.5%	-	95.3%	-
Chronic tendinitis	0.9%	37.5%	0.5%	10.7%
Lameness	-	-	0.5%	10.7%
History of lameness	0.3%	12.5%	0.5%	10.7%
Stiffness	0.6%	25.0%	0.3%	7.1%
Locking stifle	0.6%	25.0%	0.3%	7.1%
Osteoarthritis	0.3%	12.5%	0.2%	3.6%
Back pain	0.3%	12.5%	0.2%	3.6%
Receiving NSAID for chronic musculoskeletal	0.3%	12.5%	-	-

Cohen's Kappa coefficient between pre-admission and admission. k=0.364±0.111 ($p<0.001$)
NAD: No abnormalities detected

A high prevalence of hoof problems was observed at PAM (30.1%) and AM (46.6%). The concordance of absence or presence of hoof conditions at both examinations was found to be in fair agreement (k=0.260).

The most frequent hoof conditions observed by external veterinary practices at PAM were long feet (39.2%), followed by seedy toe or white line disease (30.9%) and laminitic rings (18.6%). In 43.3% of cases the external examination of the feet was abnormal and either the external vet or TDS vet decided that radiographs were advisable. In addition, 19.6% of cases were reported to have had inappropriate trimming (Table 5.137). On the other hand, the most frequently reported hoof condition at arrival was long feet (62.2% of cases). Overgrown feet with or without twisting has also been reported as a common problem in donkeys (Evans and Crane 2018). Other frequently noted conditions were seedy toe or white line disease (53.6%), inappropriate trimming (15.8%) and poor medio-lateral (ML) balance (14.4%).

Hoof and oral conditions have been identified as the most common problems in older donkeys by various studies in the UK (Cox et al., 2010), USA (Brosnahan and Paradis, 2003), Australia (McGowan et al., 2006) and France (Codron and Benamou-Smith, 2006).

Conditions of the musculoskeletal system are reportedly one of the main reasons for euthanasia in donkeys, and a lack of regular foot care frequently contributes to musculoskeletal disorders in this species (Evans and Crane, 2018a).

Laminitis is one of the commonest causes of lameness in donkeys. Unfortunately, it can be easily overlooked and may go undiagnosed for a considerable time (Evans and Crane, 2018a).

Donkeys in some environments have been described as prone to white line disease. Dirty, wet conditions, genetic factors, mechanical stress and poor farriery are cited as causes of white line disease in the donkey (Evans and Crane, 2018b).

Table 5.137. Frequency of hoof cases in donkeys

Hoof conditions	Pre-admission		Admission	
	Prev. (n=322 donkeys)	Case freq. (n=97 cases)	Prev. (n=596 donkeys)	Case freq. (n=278 cases)
NAD	69.9%	-	53.4%	-
Long feet	11.8%	39.2%	29.0%	62.2%
Seedy toe	9.3%	30.9%	25.0%	53.6%
Inappropriate trimming	5.9%	19.6%	7.4%	15.8%
Poor M-L balance	3.4%	11.3%	6.7%	14.4%
Poorly balanced feet	0.9%	3.1%	6.5%	14.0%
Laminitic hoof rings	5.6%	18.6%	5.2%	11.2%
Thrush	0.9%	3.1%	5.0%	10.8%
Flat soles	0.3%	1.0%	2.3%	5.0%
History of laminitis	3.4%	11.3%	2.3%	5.0%
Laminitis	1.9%	6.2%	1.5%	3.2%
Upright feet	-	-	1.3%	2.9%
Chronic laminitis	2.8%	9.3%	1.2%	2.5%
Coronary band dystrophy	-	-	1.0%	2.2%
Poor conformation	-	-	0.8%	1.8%
Travelling on NSAID	3.4%	11.3%	0.8%	1.8%
History of lameness	0.9%	3.1%	0.5%	1.1%
P3 rotation	-	-	0.5%	1.1%
Acute laminitis	1.2%	4.1%	0.2%	0.4%
White line abscess (WLA)	1.2%	4.1%	0.2%	0.4%
Ballerina syndrome	0.6%	2.1%	0.2%	0.4%
History of recurrent WLA	0.3%	1.0%	0.2%	0.4%
Very poor foot balance	0.3%	1.0%	0.2%	0.4%
Arriving with a type of shoe	-	-	0.2%	0.4%
Travelling with bandages	-	-	0.2%	0.4%
X rays front feet	13.0%	43.3%	-	-
Never been trimmed	0.9%	3.1%	-	-
Lameness	0.9%	3.1%	-	-
Digital pulse present	0.3%	1.0%	-	-
Suspected keratoma	0.3%	1.0%	-	-

Cohen's Kappa coefficient between pre-admission and admission, k=0.260±0.048 (p<0.001)
NAD: No abnormalities detected

Statistically significant differences were found between hoof conditions at PAM and donkeys' origin region (p_{LR}=0.001). Firstly, it was observed that there were fewer donkeys than expected from Northern Ireland with no abnormalities reported at PAM (40.0%), whilst more donkeys than expected from the same region were reported to have inappropriate trimming (60.0%).

Secondly, it was found that there were more donkeys than expected from the North West with no hoof abnormalities reported (90.5%). It was also noted that more donkeys than expected from the North East had seedy toe reported at the time of PAM (23.8%). It is interesting that more donkeys than expected from an unknown origin (50.0%) were reported to have inappropriate trimming, and fewer than expected from the South West (1.5%) were reported to have had inappropriate trimming. It was also found that more donkeys than expected from the South West had laminitic hoof rings noted at PAM (13.8%).

Interestingly, more donkeys than expected from Scotland reportedly had thrush at their PAM (16.7%). More donkeys than expected from the North East were reported to have pedal bone rotation (4.8%).

However, when looking at the relationship between categorised hoof conditions at PAM, statistically significant differences were found when compared with UK origin regions (p_{X2}=0.014).

Interestingly, it was observed that more donkeys than expected from Northern Ireland (52.2%) had hoof abnormalities and were considered diseased at PAM, whilst fewer from the same region were considered healthy (47.8%).

Fewer donkeys than expected from the North West (6.9%) were considered to have hoof abnormalities, whilst most donkeys from the same region were considered to have healthy hooves at PAM (93.1%).

No statistically significant differences were found between the frequency of hoof cases at admission and donkeys' origin region (p_{LR}=0.664) (Table 5. 139). Despite finding no significant differences, when taking residuals into account, it was observed that there were fewer donkeys than expected from Wales (37.2%) with no hoof abnormalities, whilst more donkeys than expected from the same region were diagnosed with seedy toe (32.6%), and laminitic hoof rings (9.3%) at admission.

Secondly, it was observed that there were more donkeys than expected from the North West with thrush on arrival (7.7%).

Table 5.138. Frequency of pre-admission hoof conditions stratified by origin region

PA Hoof conditions	**Unknown origin** (n=4)	**Scotland** (n=12)	**Northern Ireland** (n=16)	**North East** (n=21)	**North West** (n=21)	**East Midlands** (n=23)
None	50.0%	58.3%	40.0%^{L}	52.4%	90.5%^{H}	52.2%
Seedy toe	0.0%	0.0%	0.0%	23.8%^{H}	9.5%	21.7%
Inappropriate trimming	50.0%^{H}	8.3%	60.0%^{H}	0.0%	0.0%	13.0%
Laminitic hoof rings	0.0%	0.0%	0.0%	14.3%	0.0%	0.0%
Poor M-L balance	0.0%	8.3%	0.0%	0.0%	0.0%	4.3%
History of laminitis	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
WLA	0.0%	0.0%	0.0%	0.0%	0.0%	4.3%
Laminitis	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Thrush	0.0%	16.7%^{H}	0.0%	0.0%	0.0%	0.0%
Chronic laminitis	0.0%	0.0%	0.0%	4.8%	0.0%	0.0%
History of lameness	0.0%	8.3%	0.0%	0.0%	0.0%	0.0%
P3 rotation	0.0%	0.0%	0.0%	4.8%^{H}	0.0%	0.0%
Suspected keratoma	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
History of recurrent WLA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ballerina syndrome	0.0%	0.0%	0.0%	0.0%	0.0%	4.3%^{H}

Table 5.138 (cont.) Frequency of pre-admission hoof conditions stratified by origin region

PA Hoof conditions	**West Midlands** (n=26)	**Wales** (n=17)	**South West** (n=65)	**South East** (n=27)	**Greater London** (n=1)	**Total** (n=237)
None	65.4%	76.5%	56.9%	66.7%	0.0%	**60.8%**
Seedy toe	0.0%	0.0%	12.3%	14.8%	0.0%	**10.1%**
Inappropriate trimming	0.0%	0.0%	1.5%^{L}	0.0%	0.0%	**8.0%**
Laminitic hoof rings	5.9%	11.5%	13.8%^{H}	3.7%	0.0%	**7.2%**
Poor M-L balance (twisted)	0.0%	0.0%	9.2%^{H}	0.0%	0.0%	**3.4%**
History of laminitis	15.4%^{H}	0.0%	1.5%	3.7%	0.0%	**2.5%**
WLA	3.8%	5.9%	0.0%	3.7%	0.0%	**1.7%**
Laminitis	0.0%	0.0%	3.1%	3.7%	0.0%	**1.3%**
Thrush	0.0%	0.0%	1.5%	0.0%	0.0%	**1.3%**
Chronic laminitis	0.0%	5.9%	0.0%	3.7%	0.0%	**1.3%**
History of lameness	0.0%	0.0%	0.0%	0.0%	100.0%^{H}	**0.8%**
P3 rotation	0.0%	0.0%	0.0%	0.0%	0.0%	**0.4%**
Suspected keratoma	0.0%	5.9%^{H}	0.0%	0.0%	0.0%	**0.4%**
History of recurrent WLA	3.8%^{H}	0.0%	0.0%	0.0%	0.0%	**0.4%**
Ballerina syndrome	0.0%	0.0%	0.0%	0.0%	0.0%	**0.4%**

Significance of Likelihood Ratio test, p= 0.001

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

Interestingly, different hoof findings were identified at admission; despite finding no statistically significant differences (p_{X2}=0.063) (Table 5.140), when taking into account residuals, it was observed that more donkeys than expected from an unknown origin were categorised as having healthy hooves (100.0%), whilst none from the same origin were categorised as diseased (0.0%).

One of the interesting findings is that there were more donkeys than expected with hooves categorised as diseased coming from Wales (62.8%), whilst fewer from the same region were considered as healthy (37.2%).

Table 5.139. Frequency of admission hoof conditions stratified by origin region

Hoof conditions at admission	**Unknown origin** (n=4)	**Scotland** (n=27)	**Northern Ireland** (n=23)	**North East** (n=52)	**North West** (n=65)	**East Midlands** (n=54)
None	100.0%	66.7%	65.2%	59.6%	50.8%	64.8%
Seedy toe	0.0%	25.9%	8.7%	23.1%	20.0%	16.7%
Inappropriate trimming	0.0%	3.7%	8.7%	5.8%	6.2%	7.4%
Poor M-L balance	0.0%	0.0%	0.0%	0.0%	6.2%	0.0%
Thrush	0.0%	3.7%	0.0%	0.0%	7.7%^{H}	1.9%
Laminitic hoof rings	0.0%	0.0%	0.0%	1.9%	0.0%	1.9%
Poorly balanced feet	0.0%	0.0%	8.7%^{H}	1.9%	6.2%^{H}	0.0%
Flat soles	0.0%	0.0%	0.0%	3.8%	0.0%	0.0%
Laminitis	0.0%	0.0%	4.3%	0.0%	0.0%	0.0%
History of laminitis	0.0%	0.0%	0.0%	0.0%	0.0%	1.9%
Coronary band dystrophy	0.0%	0.0%	0.0%	1.9%	3.1%^{H}	0.0%
Upright feet	0.0%	0.0%	4.3%^{H}	0.0%	0.0%	0.0%
Chronic laminitis	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
In poor condition	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
History of lameness	0.0%	0.0%	0.0%	0.0%	0.0%	1.9%^{H}
P3 rotation	0.0%	0.0%	0.0%	1.9%^{H}	0.0%	0.0%
WLA	0.0%	0.0%	0.0%	0.0%	0.0%	1.9%^{H}
History of recurrent WLA	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Ballerina syndrome	0.0%	0.0%	0.0%	0.0%	0.0%	1.9%^{H}

Significance of Likelihood Ratio test, p= 0.664
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Table 5.139 (cont.) Frequency of admission hoof conditions stratified by origin region

Hoof conditions at admission	West Midlands (n=53)	Wales (n=43)	South West (n=163)	South East (n=92)	Greater London (n=3)	Total (n=579)
None	52.8%	37.2%L	47.9%	54.3%	33.3%	**53.4%**
Seedy toe	15.1%	32.6%H	18.4%	26.1%	66.7%H	**20.9%**
Inappropriate trimming	1.9%	9.3%	7.4%	3.3%	0.0%	**5.9%**
Poor M-L balance	5.7%	7.0%	5.5%	2.2%	0.0%	**3.6%**
Thrush	0.0%	0.0%	7.4%H	1.1%	0.0%	**3.5%**
Laminitic hoof rings	3.8%	9.3%H	3.1%	6.5%	0.0%	**3.3%**
Poorly balanced feet	1.9%	0.0%	2.5%	2.2%	0.0%	**2.4%**
Flat soles	5.7%H	2.3%	3.1%	0.0%	0.0%	**1.9%**
Laminitis	1.9%	0.0%	1.8%	1.1%	0.0%	**1.0%**
History of laminitis	3.8%H	0.0%	1.2%	1.1%	0.0%	**1.0%**
Coronary band dystrophy	1.9%	0.0%	0.6%	0.0%	0.0%	**0.9%**
Upright feet	3.8%H	0.0%	0.0%	0.0%	0.0%	**0.5%**
Chronic laminitis	0.0%	2.3%	0.6%	1.1%	0.0%	**0.5%**
In poor condition	0.0%	0.0%	0.6%	1.1%	0.0%	**0.3%**
History of lameness	0.0%	0.0%	0.0%	0.0%	0.0%	**0.2%**
P3 rotation	0.0%	0.0%	0.0%	0.0%	0.0%	**0.2%**
WLA	0.0%	0.0%	0.0%	0.0%	0.0%	**0.2%**
History of recurrent WLA	1.9%H	0.0%	0.0%	0.0%	0.0%	**0.2%**
Ballerina syndrome	0.0%	0.0%	0.0%	0.0%	0.0%	**0.2%**

Significance of Likelihood Ratio test, p= 0.664

H: Observed proportion significantly higher than expected (p<0.050)

L: Observed proportion significantly lower than expected (p<0.050)

Table 5.140. Admission hoof conditions (categorised) stratified by origin region

Origin region	n	Any hoof condition at admission
Unknown origin	4	0.0%L
Scotland	27	33.3%
Northern Ireland	23	34.8%
North East	52	40.4%
North West	65	49.2%
East Midlands	54	35.2%
West Midlands	53	47.2%
Wales	43	62.8%H
South West	163	52.1%
South East	92	45.7%
Greater London	3	66.7%
Total	**579**	**46.6%**

Significance of Pearson's Chi-square test, p=0.063

H: Observed proportion significantly higher than expected (p<0.050)

L: Observed proportion significantly lower than expected (p<0.050)

There were no statistical differences found between the time of the last farrier visit and pre-admission musculoskeletal conditions (p_{LR}=0.217) and hoof conditions (p_{X2}=0.144) (Table 5.141).

No correlation was found between the time of the last farrier visit and AM conditions (p_{LR}=0.725). Nevertheless, statistically significant differences were noted between the last farrier visit and AM hoof conditions. It was observed (Table 5.141) that more donkeys than expected who had their last farrier visit 12-24 weeks prior to admission, had hoof conditions reported on arrival (60.0%). Interestingly, it was found that less donkeys than expected, who had their last farrier visit more than 24 weeks before arrival, had hoof conditions noted at arrival (36.1%). This can be explained, as donkeys with really neglected feet might not have been deemed fit to be travel. Such cases may have needed to be examined and trimmed by a farrier before transportation; whilst donkeys that had their last farrier visit 12-24 weeks before arrival, although having neglected and overgrown feet, could have travelled under veterinary supervision to receive corrective trimming and treatment.

Table 5.141. Prevalence of musculoskeletal and hoof conditions stratified by last farrier visit (categorised)

Last farrier visit	Pre-admission		Admission	
	Musculoskeletal condition	Hoof condition	Musculoskeletal condition	Hoof condition
<6 wk	6.7%	22.2%	7.0%	50.0%
6-12 wk	2.1%	31.3%	4.0%	46.0%
12-24 wk	0.0%	44.4%	3.5%	60.0%^{H}
>24 wk	2.9%	38.2%	4.9%	36.1%^{L}
Total	**2.9%**	**33.7%**	**4.7%**	**48.6%**
p	0.217^{LR}	0.144^{X2}	0.725^{LR}	0.034^{X2}

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

5.3.8.6. Behaviour

There was no specific field for behavioural problems on the PAM form and external veterinary practices were mainly reporting unwanted behavioural issues while positive behaviour, if any, was frequently mentioned at admission. In future, forms should consider an area for the inclusion of behavioural observations, both good and bad, to encourage external practices to document exhibited behaviour, which may help identify potential guardian animals before admission in favour of direct rehoming.

The prevalence of behavioural problems was 28.6% at PAM and 71.3% at AM. The most frequently reported behavioural issue at PAM was that donkeys were difficult to handle with a case frequency of 34.8%, whilst the second most frequently reported issue was cases of positive behaviour, and donkeys were reported as being good to handle in 22.8% of cases (Table 5.142).

Table 5.142. Frequency of behaviour cases in donkeys

Behaviour conditions	Pre-admission		Admission	
	Prevalence (n=322 donkeys)	Case freq. (n=92 cases)	Prevalence (n=596 donkeys)	Case freq. (n=425 cases)
NAD	71.4%	-	28.7%	-
Good to handle	6.5%	22.8%	40.4%	56.7%
Good to catch	-	-	18.0%	25.2%
Nervous to catch	2.2%	7.6%	16.6%	23.3%
Needs further handling	2.8%	9.8%	13.4%	18.8%
Naughty with feet	1.9%	6.5%	7.6%	10.6%
Difficult to handle	9.9%	34.8%	3.4%	4.7%
Kicks	2.2%	7.6%	3.4%	4.7%
Very friendly	1.2%	4.3%	3.2%	4.5%
Sedation required for farrier	0.9%	3.3%	2.9%	4.0%
Apprehensive	-	-	2.3%	3.3%
Difficult to catch	0.3%	1.1%	2.2%	3.1%
Unable to pick up feet	0.6%	2.2%	1.7%	2.4%
Head shy	-	-	0.7%	0.9%
Sedation required for dental	4.3%	15.2%	0.5%	0.7%
Dislikes other animals	0.9%	3.3%	0.5%	0.7%
Rears	0.6%	2.2%	0.5%	0.7%
Dull	0.3%	1.1%	0.5%	0.7%
History of bad behaviour	-	-	0.5%	0.7%
Very stressed during exam	0.9%	3.3%	0.3%	0.5%
Dislikes children	0.3%	1.1%	0.2%	0.2%
Pacing when stressed	0.3%	1.1%	0.2%	0.2%
Bites	-	-	0.2%	0.2%
Dangerous for dental exam	2.2%	7.6%	-	-
Twitched for blood sample (B/S)	0.6%	2.2%	-	-
Unable to take B/S -behaviour	0.6%	2.2%	-	-
B/S taken under sedation	0.3%	1.1%	-	-
Difficult to blood sample	0.3%	1.1%	-	-
Ear shy	0.3%	1.1%	-	-
Requires sedation for treatments	0.3%	1.1%	-	-
Sedation required for exam	0.3%	1.1%	-	-
Sedation required for transport	0.3%	1.1%	-	-

Cohen's Kappa coefficient between pre-admission and admission, k=0.039±0.041 (p=0.350)
NAD: No abnormalities detected

On the other hand, the most frequent behaviour described at admission was that donkeys were good to handle (56.7% of cases), and the second most described behavioural trait was also positive, with donkeys being described as good to catch in 25.2% of cases.

Taylor and Matthews (1997) stated that there are behavioural differences between donkeys and horses. Donkeys are reportedly not driven by the same "fight or flight" instincts as in horses. Matthews et al. (2005) stated that donkeys are much more inclined to stop and face frightening objects, accept restraint (e.g. head ties or manual restraint) and not panic in unknown conditions.

Donkey behaviour has been reported as different to that of horses and ponies, and it is crucial that this is considered when examining or attempting to carry out procedures on donkeys. Their stoic nature can lead to missing or misdiagnosing the severity of painful conditions. Their behaviour is often incorrectly labelled as stubborn, but a more accurate explanation for their behaviour is likely to be due to their sense of self-preservation (Evans and Crane, 2018c).

It is significant that 15.2% of external vets explained at PAM that donkeys might require sedation for a full dental examination and dental treatment. This may contribute to misdiagnosis of dental disease and dental grading discrepancies at PAM.

The concordance of absence or presence of behavioural conditions at both examinations was found to be in poor agreement (k=0.039). This can be explained as there is no behavioural field to be completed at the PAM and not every vet would feel the need to comment.

5.3.8.7. Digestive conditions

The prevalence of digestive problems during the PAM was reported to be 37.9%, while it was inferior at admission with a prevalence of 27.9%. It is very relevant that the most frequent digestive cases reported at PAM and admission are donkeys that have never received a dental examination or treatment by a vet or equine dental technician (70.5% at PA and 72.9% at admission). Interestingly, many donkeys did not follow a worming programme either (29.5%, Table 5.143).

Cox et al. (2010) found that 86.0% of guardian donkeys included in the study had a dental examination at least once every 12 months. Of these, 56% were conducted by a vet and 25% by an equine dental technician and 19% by another person ("other"). Moreover, all the donkeys in that study received some form of preventive healthcare during the study, most frequently in the form of treatment for internal parasites and/or vaccinations.

The third most frequent type of digestive case reported at admission was donkeys in poor body condition (3.9% of digestive cases, Table 5.143).

Although noted at a low frequency (4.9%), some external veterinary surgeons reported not having a dental speculum at the time of the PAM exam. This should have been prevented as PA forms are sent in advance to veterinary practices to ensure full medical examination of the requested animals. Considering that TDS is funding the PAM and the requirements of the PAM are given in advance, lack of a dental examination for whatever reason should not be occurring.

The concordance of presence or absence of digestive conditions at both examinations was found to be in poor agreement (k=0.041). Some of the digestive conditions included in this category are part of the clinical history and as such may be omitted by either the vet at PA or at admission. Interestingly, the two most frequently reported conditions were the same at both PAM and admission.

Table 5.143. Frequency of digestive cases in donkeys

Digestive conditions	Pre-admission		Admission	
	Prevalence (n=322 donkeys)	Case freq. (n=8 cases)	Prevalence (n=596 donkeys)	Case freq. (n=28 cases)
NAD	62.1%	-	72.1%	-
Never dental	26.7%	70.5%	20.3%	72.9%
No worming programme followed	11.2%	29.5%	4.2%	15.1%
Poor body condition	-	-	3.9%	13.9%
Quidding	0.9%	2.5%	0.8%	3.0%
History of recurrent colic	0.9%	2.5%	0.7%	2.4%
History of recurrent choke	0.3%	0.8%	0.5%	1.8%
Choke	0.3%	0.8%	0.3%	1.2%
Ventral oedema	0.3%	0.8%	0.3%	1.2%
Diastemata	0.6%	1.6%	0.2%	0.6%
Umbilical hernia	0.3%	0.8%	0.2%	0.6%
Weight loss	0.3%	0.8%	0.2%	0.6%
Loose faeces	-	-	0.2%	0.6%
Loose teeth	-	-	0.2%	0.6%
Suspected Cyathostomiasis	-	-	0.2%	0.6%
No dental speculum	1.9%	4.9%	-	-

Cohen's Kappa coefficient between pre-admission and admission. k=0.041±0.041 (p=0.298)
NAD: No abnormalities detected.

When looking at categorised digestive conditions at admission, it was observed that there were no statistically significant differences between those and the region of origin. Despite that, if taking residuals into consideration, it was noted that there were more donkeys than expected who were classified as healthy coming from Scotland (100.0%) and Northern Ireland (91.3%).

On the other hand, it was observed that more donkeys than expected from the North West were classified as any digestive condition on admission (38.5%). This finding is difficult to explain and requires further investigation. Special care could be taken with animals from this region, paying particular attention to known risk factors such as parasitological status, dental grading and so on.

Table 5.144. Digestive conditions at admission (categorised) stratified by origin region

Origin region	n	Any digestive condition at admission
Unknown origin	4	25.0%
Scotland	27	0.0%[L]
Northern Ireland	27	8.7%[L]
North East	23	23.1%
North West	65	38.5%[H]
East Midlands	54	20.4%
West Midlands	53	32.1%
Wales	43	32.6%
South West	163	30.1%
South East	92	34.8%
Greater London	3	0.0%
Total	**579**	**28.2%**

Significance of Pearson's Chi-square test, p=0.798
[H]: Observed proportion significantly higher than expected (p<0.050)
[L]: Observed proportion significantly lower than expected (p<0.050)

5.3.8.8. Other conditions

There was a low prevalence of liver conditions at PAM (4.7%) and admission (4.5%) (Table 5.145). A study on the causes of dullness in a herd of donkeys found lameness, liver disease and respiratory disorders were the most prevalent causes identified (Thiemann, 2013). High levels of gamma glutamyl transferase (GGT) have frequently been reported at both PAM (53.3%) and admission (71.0%). Ambrojo et al. (2013) reported that although mild to moderate levels of GGT are of limited diagnostic and prognostic value; it is very unusual to find a horse with significant hepatopathy in the absence of increased GGT.

Table 5.145. Frequency of liver conditions in donkeys

Liver conditions	Pre-admission		Admission	
	Prevalence (n=322 donkeys)	Case freq. (n=15 cases)	Prevalence (n=596 donkeys)	Case freq. (n=31 cases)
NAD	95.3%	-	95.5%	-
High GGT	2.5%	53.3%	3.7%	71.0%
High GLDH	0.3%	6.7%	0.7%	12.9%
High liver parameters	0.3%	6.7%	0.5%	9.7%
Mild hepatitis/good prognosis	0.6%	13.3%	0.2%	3.2%
High GGT/GLDH	0.0%	0.0%	0.2%	3.2%
Liver ultrasound and biopsy	0.6%	13.3%	-	-
High bile acids	0.3%	6.7%	-	-

There was a very low prevalence of endocrine conditions reported at both PAM and AM (Table 5.146). This could be related to a lack of testing for these conditions in donkeys. The most frequently reported cases were donkeys on medication for pituitary pars intermedia dysfunction (PPID) (pergolide; Prascend®) in 28.6% of the cases at PAM and 60.0% at admission. Equine metabolic syndrome (EMS) was also reported in 14.3% of the cases at PAM and 40.0% at admission. Donkeys with either EMS or PPID should be noted in the same numbers at both PAM and admission but could have been omitted on either form.

Although PPID is recognised in donkeys, hirsutism and curliness are less frequently seen. Interestingly, donkeys have been reported as potentially more insulin resistant than horses and ponies, therefore EMS should be considered as a diagnosis by clinicians. Recurrent laminitis in overweight donkeys may be indicative of EMS (Evans and Crane, 2018d).

Table 5.146. Frequency of endocrine conditions in donkeys

Endocrine conditions	Pre-admission		Admission	
	Prevalence (n=322 donkeys)	Case freq. (n=7 cases)	Prevalence (n=596 donkeys)	Case freq. (n=5 cases)
NAD	97.8%	-	99.2%	-
On Prascend®	0.6%	28.6%	0.5%	60.0%
EMS	0.3%	14.3%	0.3%	40.0%
PPID	1.2%	57.1%	-	-

There was a low prevalence of pregnancy related conditions although it is significant that the most frequent problem was that it was not known if a donkey mare was pregnant. This status was reported in 36.4% of the PAM cases and 46.2% at admission (Table 5.147). Diagnosis of pregnancy can be performed similarly to horses with some differences. Gestation period is very variable and can vary from 11 to 14.5 months, therefore if pregnancy is suspected, extra care should be taken when deciding about transport; Transport of female donkeys in the last trimester may cause unnecessary stress and increase the risk of hyperlipaemia (Evans and Crane, 2018e).

Table 5.148. Frequency of pregnancy conditions in donkeys

Pregnancy conditions	Pre-admission		Admission	
	Prevalence (n=322 donkeys)	Case freq. (n=11 cases)	Prevalence (n=596 donkeys)	Case freq. (n=13 cases)
NAD	96.6%	-	97.8%	-
Unknown if pregnant	1.2%	36.4%	1.0%	46.2%
Foal at foot	-	-	0.7%	30.8%
Pregnant 10 months	-	-	0.3%	15.4%
History of recent abortion	0.3%	9.1%	0.2%	7.7%
Pregnant 7 months	0.6%	18.2%	-	-
Foal check OK	0.6%	18.2%	-	-
Oestrone sulphate negative	0.3%	9.1%	-	-
Oestrone sulphate positive/pregnant	0.3%	9.1%	-	-

Table 5.149 displays the prevalence of medical and fitness to travel (FTT) conditions at PAM (20.5%) and at AM (35.9%). The most frequently reported cases were donkeys of unknown origin at PAM, who needed an extra blood sample to ensure the absence of exotic infectious diseases. The most frequently reported condition at admission was the fact that donkeys had guardian and DAT potential in 93.9% of the cases. This high frequency was related to behaviour in the majority of cases, without assessing the relevant clinical history and first blood sample results. It would be interesting to assign someone to assess their potential in tandem with their history and blood results to achieve more specific and realistic suggestions.

There was a low but relevant report of equine viral arteritis (EVA) (4.5%) at PAM, which is a notifiable disease that would affect their transport. Stallions would be moved following DEFRA's instructions and castrated as soon as possible. Female donkeys would have caused less concerned due to TDS non-breeding policy. *Babesia* was also reported in 0.5% of the cases; clinical signs of disease were no present and donkeys were monitored. Historically equine piroplasmosis has not been a cause of concern in the UK due to lack of competent tick vectors; however, increase presence of vector species has been recently reported (Coultous et al., 2018), therefore identifying and monitoring carriers would be essential as well as introducing further biosecurity measures.

Table 5.149. Frequency of medical/Fitness to travel conditions in donkeys

Medical/FTT conditions	**Pre-admission**		**Admission**	
	Prevalence (n=322 donkeys)	Case freq. (n=66 cases)	Prevalence (n=596 donkeys)	Case freq. (n=214 cases)
NAD	79.5%	-	64.1%	-
Guardian/DAT potential	0.9%	4.5%	33.7%	93.9%
Unknown origin	15.8%	77.3%	1.3%	3.7%
EVA positive	0.9%	4.5%	0.7%	1.9%
Unsuitable for guardian scheme due to dental disease	-	-	0.5%	1.4%
Babesia positive	-	-	0.2%	0.5%
Failed direct rehoming medical	0.6%	3.0%	0.2%	0.5%
Guardian medical failed	0.3%	1.5%	0.2%	0.5%
Vaccinated at HB	0.9%	4.5%	-	-
Microchipped at HB	0.6%	3.0%	-	-
Passport issued at HB	0.6%	3.0%	-	-
No FTT	0.3%	1.5%	-	-

Other conditions were reported in donkeys with a very low prevalence at PAM (1.8%) and admission (0.5%) (Table 5.150). Some donkeys were identified as high-risk individuals for hyperlipemia, where 25.0% of the cases were identified by external vets and 70.0% of the cases were identified at admission.

Hyperlipemia is a life-threatening condition in the donkey and some of the risk factors include transportation and stress, which are sometimes inevitable factors when relinquishing donkeys. Minimising stress on arrival is essential to keep the prevalence of hyperlipaemia low.

Table 5.150. Frequency of other conditions in donkeys

Other conditions	**Pre-admission**		**Admission**	
	Preva. (n=322 donkeys)	Case freq. (n=4 cases)	Preva. (n=596 donkeys)	Case freq. (n=30 cases)
NAD	98.8%	-	95.0%	-
High risk of hyperlipaemia	0.3%	25.0%	3.5%	70.0%
Triglycerides borderline high	-	-	0.5%	10.0%
Muscle wastage	-	-	0.3%	6.7%
High WBC	0.3%	25.0%	0.2%	3.3%
Castration complications	-	-	0.2%	3.3%
High CPK	-	-	0.2%	3.3%
History of vaccine reaction	-	-	0.2%	3.3%
Dribbling urine	0.3%	25.0%	-	-
Trauma	0.3%	25.0%	-	-

5.4. Diet and dentistry

Information regarding each donkey's diet and husbandry in their home was collected by the welfare advisers and recorded onto the vet system. There was a limitation to the study as information was not gathered and recorded in a formal or structured manner.

Dietary management of donkeys is essential to avoid health issues and should be seen as the foundation of a healthy animal (Evans and Crane, 2018f).

Several studies have shown that the energy and daily intake requirements are significantly lower in the donkey than the horse. Donkeys reportedly have different nutrient requirements, with significantly lower energy and protein needs than horses and ponies. Donkeys fed fibrous forages require 80 to 95 KJ of digestible energy per Kg of body weight per day. The dry matter intake of donkeys has been reported as 1.3-1.7% of their body weight, which is significantly lower than that of horses and ponies (2 to 2.5%) (Carretero-Roque et al., 2005; Wood et al., 2005). Example diets can be found in Appendix 10.

Donkeys have evolved to browse and graze highly fibrous plants of poor nutritional quality (Pearson et al., 2001). Diets should therefore be fibre-based, and feedstuffs high in starches and sugars should be strictly avoided (Burden et al., 2013). A diet based on fibrous forages with controlled access to grass (especially in places such as the UK where grass is abundant) is reportedly sufficient for most donkeys (Burden, 2012).

One of the challenges with donkeys living in the UK is to ensure that they are receiving enough bulk to satisfy their daily appetite, whilst not oversupplying energy which will lead to considerable weight gain (Burden et al., 2013).

In the author´s experience, diet and bedding should be planned and changed according to the specific needs of each donkey. As donkeys age, dental disease can affect mastication and increase the risk of colic and discomfort. Diet and bedding type may need to be altered as a result. Some musculoskeletal conditions should also affect the choice of bedding and older donkeys might be better on a shavings bed rather than straw so that they can move around freely inside their stable or barn. Donkeys should have access to dry bedding at all times in order to lie down.

5.4.1. Pre-arrival diet information

Table 5.151 shows the frequency of use of different diets before arrival at TDS. The most common dietary components are grass (79.4% plus 11.7% with restricted grazing), hay (75.7%) and straw (44.0%). The inclusion of chopped forage feed (30.9%), fibre compound feed (27.6%) and cereal grain compound feed (16.9%) is relatively frequent. Interestingly, cereal grain course mixes are not recommended for donkeys as these products have high levels of sugar and starches that are not needed and may even predispose them to conditions such as gastric ulceration, laminitis and obesity. These types of products can be difficult for donkeys with poor teeth or dental disease to chew, thereby increasing the risk of choke.

Other feeds included at a low frequency are haylage (8.4%), supplement balancer (4.1%) and non-equine feed diet (0.4%). Special attention should be paid to treats, as offering treats is a very common practice amongst donkey owners (42.4%). Using treats on a regular basis as part of their daily feed can increase the risk of obesity and should be used with caution especially in overweight donkeys. Some balancers could be used as a treat which would be a healthier option, adding only vitamins and minerals to their daily energy intake.

In the study by Cox et al. (2010) looking at the management of TDS guardian donkeys in the UK, it was found that almost all donkeys (99.0%) were fed forage some of the time, most commonly dry hay or straw, and 50.0% were fed other types of feed (chaff, coarse mix, high fibre cubes or pellets, whole cereal or sugar beet).

Nearly half of the donkeys (44.0%) in the study had access to straw, this percentage should have perhaps been even bigger. Burden et al. (2013) specified that one of the golden rules of donkey feeding is that barley or wheat straw should be available at all times if dentition allows.

Smith and Wood (2008) stated that TDS advises the provision of an additional source of high-fibre roughage, such as straw for donkeys. Healthy donkeys with good dentition require a maintenance diet of good quality barley or wheat straw along with restricted grazing or hay (Burden et al., 2013). Evans and Crane (2018f), stated that a diet based on fibrous forages and limited grazing is usually sufficient for the majority of sedentary donkeys kept as companion animals.

Cox et al. (2010) stated that the nutritional requirements of donkeys should take into account age-associated anatomical (for example, dental) and physiological (changes that influence feeding (Brosnahan and Paradis, 2003). Dental disease and feeding management have been implicated as risk factors for impaction colic in donkeys (Cox et al., 2007, 2009) as well as in other equids (Tinker et al., 1997; White, 1997; Cohen et al., 1999; Hudson et al., 2001; Hillyer et al., 2002).

In Table 5.151 we compare the use of each diet component stratified by age. Statistically significant differences were found between donkeys having access to grass and their age (p_{LR}<0.001). It was observed that there were fewer donkeys than expected with access to grass in the younger age category (younger than 1 year old, 55.5%); while fewer than expected from the greater than 1 to 3 years old category had access to restricted grazing (0.0%). Additionally, more donkeys than expected had access to restricted grazing from the geriatric category of older than 20 years old (22.0%).

Statistically significant differences were also found between the use of chopped forage feed in donkeys and their age (p_{X2}=0.001). It was observed that more donkeys than expected had this type of diet in the greater than 1 to 3 years of age category (54.0%), whilst fewer donkeys had access to this diet in the greater than 5 to 20 years old category (25.3%).

In addition, statistically significant differences were found between donkeys receiving fibre compound feed and their age (p_{X2}=0.004), where more donkeys than expected that were greater than 3 to 5 years old had access to this type of diet (40.4%), and fewer donkeys from the greater than 5 to 20 years old category had access to this diet (22.4%).

Finally, statistically significant differences were also found between the use of haylage in donkeys and their age (p_{LR}=0.007). It was noted that more donkeys than expected from the greater than 1 to 3 years old category had access to haylage (24.0%).

Table 5.151. Diets fed stratified by age (categorised)

Diet	Age category					Total (n=486)	p
	≤ 1 y (n=20)	**(1 y, 3 y]** (n=50)	**(3 y, 5 y]** (n=89)	**(5 y, 20 y]** (n=277)	**> 20 y** (n=50)		
Grass	55.0%^{L}	84.0%	80.9%	80.9%	74.0%	**79.4%**	<0.001^{LR}
Restricted grazing	5.0%	0.0%^{L}	11.2%	12.6%	22.0%^{H}	**11.7%**	
Hay	70.0%	68.0%	75.3%	78.0%	74.0%	**75.7%**	0.58 ^{X2}
Straw	35.0%	32.0%	38.2%	49.8%^{H}	38.0%	**44.0%**	0.053^{X2}
Treats	50.0%	52.0%	40.4%	39.7%	48.0%	**42.4%**	0.411^{X2}
Chopped forage feed	40.0%	54.0%^{H}	31.5%	25.3%^{L}	34.0%	**30.9%**	0.001 ^{X2}
Fibre compound feed	45.0%	22.0%	40.4%^{H}	22.4%^{L}	32.0%	**27.6%**	0.004^{X2}
Cereal grain compound feed	15.0%	18.0%	16.9%	18.4%	8.0%	**16.9%**	0.498^{X2}
Haylage	5.0%	24.0%^{H}	4.5%	7.6%	6.0%	**8.4%**	0.007^{LR}
Supplement balancer	20.0%^{H}	2.0%	4.5%	3.2%	4.0%	**4.1%**	0.086^{LR}
Non-equine feed	0.0%	0.0%	1.1%	0.4%	0.0%	**0.4%**	0.781^{LR}

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between donkeys having access to grass and age (p_{X2}=0.035) (Table 5.152). Geriatric donkeys had significantly more restricted grazing access than expected (22.0%). Cox et al. (2010) reported that while forage, in particular grass, is a natural feedstuff for donkeys, lush pasture is not ideal. The use of restricted grazing can help to prevent overfeeding and therefore control obesity in donkeys.

Restricted grazing by limiting time at grass is not recommended (Burden et al., 2013). More appropriate ways of restricting pasture include strip grazing, rotational grazing in small paddocks, track grazing and using sheep to pre-graze before donkeys. With this in mind, TDS could record the methods of grazing restriction being used before relinquishment, which may yield information that could in turn help improve pasture management for donkeys in the UK.

It has been reported that donkeys adapt their behaviour so that consumption of grass is the same in 8 h as it is if they are allowed 24 h access to the same area (Wood, 2010); so physical restriction of grazing is necessary instead of just time restriction.

Almost one third of the different types of diet included chopped forage feed (30.9%), but there were no significant differences found between donkeys on chopped forage feed as part of their diet and age (p_{X2}=0.612). Chopped forage feeds are generally suitable for geriatric donkeys with dental disease, therefore significant differences should have been expected from these two groups. Nutritional requirements of donkeys should consider age-associated changes that influence feeding, for example, dental disease (Cox et al., 2010). Feeding management with dental disease has been implicated as risk factors for impaction colic in donkeys (Cox et al., 2007, 2009).

Table 5.152. Diet feeds stratified by age

Diet	Non-geriatric (n=436)	Geriatric (n=50)	Total (n=486)	p
Grass	80.0%	74.0%	**79.4%**	0.035 ^{X2}
Restricted grazing	10.6%^{L}	22.0%^{H}	**11.7%**	
Hay	75.9%	74.0%	**75.7%**	0.765 ^{X2}
Straw	44.7%	38.0%	**44.0%**	0.364 ^{X2}
Treats	41.7%	48.0%	**42.4%**	0.396 ^{X2}
Chopped forage feed	30.5%	34.0%	**30.9%**	0.612 ^{X2}
Fibre compound feed	27.1%	32.0%	**27.6%**	0.459 ^{X2}
Cereal grain compound feed	17.9%	8.0%	**16.9%**	0.077 ^{X2}
Haylage	8.7%	6.0%	**8.4%**	0.787 ^{F}
Supplement balancer	4.1%	4.0%	**4.1%**	>0.999 ^{F}
Non-equine feed	0.5%	0.0%	**0.4%**	>0.999 ^{F}

^{X2}: Significance of Pearson's Chi-square test; ^{F}: Significance of Fisher's exact test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Table 5.153 shows the relationship between type of diet and type of origin; no statistically significant association was found between type of diet and type of origin, except in the case of access to grass (p_{LR}<0.001) and straw diet (p_{X2}<0.001).

More "New arrival" donkeys than expected had access to grass (82.6%), while less "Return guardian" donkeys than expected had unregulated access to grass (55.3%). Furthermore, it was found that more "Return guardian" donkeys than expected had restricted grazing as part of their management (34.2%). This is interesting and reflects the work that TDS welfare advisers do with guardian owners, advising on the use of restricted grazing as best practice to control and avoid obesity in donkeys.

Moreover, it was observed that there were more “Return guardian” donkeys than expected on a straw diet (71.1%), while less DS HB (NA) donkeys than expected had straw as part of their diet (16.9%).

Table 5.153. Diet feeds stratified by type of origin

Diet	**New Arrival** (n=380)	**DS HB (NA)** (n=65)	**Return Guardian** (n=38)	**Total** (n=483)	**p**
Grass	82.6%^{H}	75.4%	55.3%^{L}	**79.5%**	<0.001 ^{LR}
Restricted grazing	10.5%	4.6%	34.2%^{H}	**11.6 %**	
Hay	77.4%	73.8%	63.2%	**75.8%**	0.139 ^{X2}
Straw	46.1%	16.9%^{L}	71.1%^{H}	**44.1%**	<0.001 ^{X2}
Treats	43.4%	36.9%	36.8%	**42.0%**	0.492 ^{X2}
Chopped forage feed	31.8%	23.1%	36.8%	**31.1%**	0.268 ^{X2}
Fibre compound feed	27.9%	30.8%	21.1%	**27.7%**	0.563 ^{X2}
Cereal grain compound feed	16.3%	24.6%	10.5%	**17.0%**	0.140 ^{X2}
Haylage	8.4%	12.3%	2.6%	**8.5%**	0.234 ^{X2}
Supplement balancer	3.4%	3.1%	10.5%	**3.9%**	0.178 ^{LR}
Non-equine feed	0.5%	0.0%	0.0%	**0.4%**	0.618 ^{LR}

^{X2}: Significance of Pearson’s Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
DS HB (NA): Donkey Sanctuary Holding Base (New arrival)

Statistically significant differences were found between origin region and straw diet (p_{X2}<0.001). It was observed (Table 5.154) that there were more donkeys than expected coming from the West Midlands with straw as part of their diet (67.3%), whilst there were fewer than expected from Scotland (19.0%), Northern Ireland (0.0%) and the North West (25.5%) with a straw component. This is an interesting finding, as straw should be always given as part of a donkey’s healthy diet, unless there are concerns with regards to giving long fibre to donkeys with dental disease.

With regards to having hay as part of their diet, statistically significant differences were also found between the type of origin and whether they received hay as part of their diet (p_{X2}=0.018). It was seen (Table 5.154) that more donkeys than expected from the West Midlands received hay (93.9%), whilst fewer than expected from the South West had hay (68.0%).

There were also statistically significant differences between having full access to grass and restricted grazing and their origin (p_{LR}=0.009). It was observed that there were more donkeys than expected from Greater London with restricted access to grazing (100.0%), whilst there were no donkeys from that area with unrestricted access to grazing (0.0%).

Table 5.154. Diet feeds stratified by origin region

Origin Region	n	Type of diet					
		Straw	Hay	Grass	Restricted grazing	Haylage	FCF
Scotland	21	19.0%[L]	71.4%	76.2%	9.5%	14.3%	14.3%
Northern Ireland	9	0.0%[L]	77.8%	100.0%	0.0%	0.0%	11.1%
North East	46	41.3%	73.9%	76.1%	8.7%	2.2%	45.7%[H]
North West	55	25.5%[L]	81.8%	70.9%	10.9%	20.0%[H]	18.2%
East Midlands	53	32.1%	73.6%	81.1%	5.7%	7.5%	45.3%[H]
West Midlands	49	67.3%[H]	93.9%[H]	81.6%	12.2%	2.0%	46.9%[H]
Wales	33	51.5%	87.9%	75.8%	21.2%	0.0%	21.2%
South West	128	48.4%	68.0%[L]	81.3%	13.3%	8.6%	10.9%[L]
South East	81	53.1%	69.1%	82.7%	11.1%	12.3%	30.9%
Greater London	3	100.0%	100.0%	0.0%[L]	100.0%[H]	0.0%	66.7%
Total	**478**	**44.4%**	**75.5%**	**79.1%**	**11.9%**	**8.6%**	**27.2%**
p		<0.001[X2]	0.018 [X2]	0.009[LR]		0.004[LR]	<0.001[X2]

FCF: Forage compound feed

Table 5.154 (cont.) Diet feeds stratified by origin region

Origin Region	n	Type of diet				
		CGCF	**CFF**	**Non-equine feed**	**Supplement balancer**	**Treats**
Scotland	21	28.6%	14.3%	0.0%	4.8%	23.8%
Northern Ireland	9	44.4%[H]	11.1%	0.0%	0.0%	11.1%
North East	46	19.6%	37.0%	0.0%	2.2%	32.6%
North West	55	21.8%	29.1%	1.8%	0.0%	58.2%[H]
East Midlands	53	15.1%	45.3%[H]	0.0%	1.9%	52.8%
West Midlands	49	6.1%[L]	14.3%[L]	0.0%	10.2%[H]	24.5%[L]
Wales	33	24.2%	15.2%[L]	0.0%	6.1%	39.4%
South West	128	19.5%	38.3%[H]	0.8%	6.3%	42.2%
South East	81	8.6%[L]	28.4%	0.0%	2.5%	50.6%
Greater London	3	0.0%	66.7%	0.0%	0.0%	33.3%
Total	**478**	**17.2%**	**30.8%**	**0.4%**	**4.2%**	**42.3%**
p		0.030 [X2]	0.002[X2]	0.897[LR]	0.186[LR]	0.003[X2]

CGCF: cereal grain compound feed

CFF: chopped forage feed

There were statistically significant differences between donkeys that received haylage as part of their diet and origin region (p_{LR}=0.004). It was found that there were more donkeys than expected from the North West that received haylage as part of their diet (20.0%).

Statistically significant differences were also found between donkeys having fibre based compound feed (FCF) as part of their diet and their origin region (p_{X2}<0.001). It was observed that there were more donkeys than expected that had FCF as part of their diet from the North East (45.7%), East Midlands (45.3%) and West Midlands (46.9%), whilst fewer donkeys than expected from the South West received FCF (10.9%).

When looking at donkeys receiving cereal grain compound feed (CGCF) as part of their diet, statistically significant differences were also found between this type of diet and origin region (p_{X2}=0.030). It was observed that there were more donkeys than expected from Northern Ireland with CGCF as part of their diet (44.4%), whilst fewer than expected from the West Midlands (6.1%) and the South East (8.6%) received the same diet.

There were also statistically significant differences found between donkeys receiving chopped forage feed (CFF) as part of their diet and origin region (p_{X2}=0.002). More donkeys than expected were given CFF as part of their diet from the East Midlands (45.3%) and the South West (38.3%), whilst fewer than expected from the West Midlands (14.3%) and Wales (15.2%) received CFF.

On the other hand, statistically significant differences were not found between donkeys given non-equine feed as part of their diet and origin (p_{LR}=0.897), and donkeys having supplementary balancer and origin (p_{LR}=0.186).

Lastly, statistically significant differences were found between donkeys that were given treats as part of their diet and origin (p_{X2}=0.003). It was observed that more donkeys than expected from the North West were given treats (52.8%), whilst fewer than expected from the West Midlands received treats (24.5%).

With regards to volume diet feeds (straw, hay, haylage, grass or fibre compound feed), 11.7% included only one component, 39.1% included two components, 38.1% comprised three components and 10.9% included four components. Only 0.2% did not include any of these.

When we analysed the relationships between different diet compounds (Table 5.155), we found some significant associations. Some combinations of diets were significantly more frequent, such as: hay and grass (70.3%), straw and grass (with restricted grass, 41.3%), straw and hay (36.0%), and hay plus fibre compound feed diet (22.6%). Furthermore, two combinations were seen significantly less frequently, both related to haylage: straw and haylage (2.5%), and hay plus haylage (1.6%). This may be as haylage could be a substitute for straw or hay depending on the circumstances.

Interestingly, combinations such as grass plus hay should generally be avoided if donkeys have access to good quality grass, and the use of hay should be restricted for the winter months when grass is poor. The Donkey Sanctuary Pre admission medical (PAM) should include differences in diet at different times of the year, so appropriate use of combinations can be accurately analysed. Donkey owners should be gradually changing diet throughout the year depending on the needs of each donkey, differences in the environment and paddock quality.

Table 5.155. Combinations of main volume diet compounds (n=486)

	Hay	Haylage	Grass	Fibre compound feed
Straw	36.0% (0.006)	2.5% (0.047)	41.3% (0.001)	10.9% (0.220)
Hay	-	1.6% (<0.001)	70.3% (0.013)	22.6% (0.043)
Haylage	-	-	7.0% (0.052)	1.2% (0.053)
Grass	-	-	-	25.7% (0.764)

Between brackets, significance of Pearson's Chi-square test

With regards to treats (Table 5.156), statistically significant differences were found between the use of treats and access to grass (p_{X2}=0.005). Most donkeys that were not given treats had access to grass (free or restricted; 79.3% and 14.6%).

Similarly, there were significant differences between receiving treats and fibre compound feed (p_{X2}=0.005). Statistically more donkeys on this type of diet were not given treats by their owners (32.5%), versus 20.8% of donkeys on fibre compound feed that were given treats. The use of extra feeds might be perceived by owners as a treat rather than a feed.

Table 5.156. Use of treats in donkeys stratified by type of diet

Diet type	No Treats (n=280)	Treats (n=206)	Total (n=486)	p
Grass	79.3%	79.6%	**79.4%**	0.005^{X2}
Restricted grazing	$14.6\%^{H}$	$7.7\%^{L}$	**11.7%**	
Hay	74.6%	77.2%	**75.7%**	0.518^{X2}
Straw	45.7%	41.7%	**44.0%**	0.384^{X2}
Chopped forage feed	30.7%	31.0%	**30.9%**	0.934^{X2}
Fibre compound feed	$32.5\%^{H}$	$20.8\%^{L}$	**27.6%**	0.005^{X2}
Cereal grain compound feed	$20.3\%^{H}$	$12.1\%^{L}$	**16.9%**	0.017^{X2}
Haylage	8.9%	7.7%	**8.4%**	0.649^{X2}
Supplement balancer	5.0%	2.9%	**4.1%**	0.252^{LR}
Non-equine feed	0.7%	0.0%	**0.4%**	0.137^{LR}

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Also, statistically significant differences were found between receiving treats and cereal grain compound feed (p_{X2}=0.017). Significantly more donkeys weren't given treats when they received cereal grain compound feed as part of their diet (20.3%), whilst only 12.1% of the donkeys in the same category were offered treats. This could be because owners might perceive the use of cereals as a treat. In addition, the use of cereal grain compound feeds is not recommended in donkeys due to their high sugar and starch content and should not be included in their diet at all.

It was found that donkeys that had treats given by their owners were those that had less access to grass or did not get any extra feed such as cereal compound feed (or fibre compound feed). Other possible reason could be that donkeys that are out in the fields might spend less time with their owners, so it would be interesting to find out the average time spend by the owners and the use of treats.

Statistically significant differences were found between donkeys having access to grass and supplement balancers (p_{LR}=0.014). Donkeys that received supplement balancer were those that had no access to grass (14.0%). On the other hand, only 2.8% of donkeys that had grazing access also received balancers, and 5.3% of those with restricted grazing also had supplement balancers as part of their diet. In cases with unrestricted grazing, the use of supplement balancers would be unnecessary.

Vitamin and mineral supplementation has been described as one of the requirements when donkeys have little access to grazing (Burden et al., 2013). Vitamins are described as the most important element in the diet and have been described as often lacking in dried forages. Donkeys with restricted grazing access for much of the year might require vitamins E and A towards the end of winter. Therefore, the use of equine-specific supplement or balancer might be useful for the very young, very old or sick donkeys (Burden et al., 2013).

The majority of donkeys have access to grass in the UK, restricting grazing correctly might be needed to control donkey weight and prevent health concerns in UK donkeys. Donkeys that have less access to grass were the ones receiving supplement balancers, which would help deliver the correct intake of vitamins and minerals.

Diets do not seem to be designed for the specific needs of donkeys, especially for those considered to be in higher risk categories, such as geriatric donkeys with dental disease or obese donkeys. Long-fibre diets seem to be randomly given to geriatric and non-geriatric donkeys and donkeys with moderate to severe dental disease (dental grades of 3 to 5). Specifically targeted diet education should be provided by TDS for owners. More information with regards to the risks of overfeeding donkeys and associated health concerns could be made available to owners. Reaching donkey owners might be difficult and therefore delivering dietary education through veterinary practices might be necessary.

For future training and education, TDS should ideally be asking donkey owners at the time of relinquishment how they decided upon the diet they are using, and if this was designed in conjunction with advice from TDS or their veterinary practice.

5.4.2. Pre-arrival bedding information

The association between type of bedding used and donkey age was assessed (Table 5.157). Statistically significant differences were only found between the use of straw and age (p_{X2}=0.039), and the use of shavings and age (p_{X2}=0.011).

Firstly, with regards to the use of straw as a bedding, it was observed that there were more donkeys than expected in the younger group of under 1 year old (85.0%).

With regards to the use of shavings, it was observed that there were more donkeys than expected in the adult group of 5 to 20 years old (21.0%), whilst fewer donkeys than expected had shavings as a bedding in the age category of 3 to 5 years old (9.0%).

Table 5.157. Types of bedding in donkeys stratified by age category

Type of bedding	≤ 1 y (n=20)	(1 y, 3 y] (n=50)	(3 y, 5 y] (n=89)	(5 y, 20 y] (n=267)	> 20 y (n=42)	Total (n=468)	p
Straw	85.0%^{H}	68.0%	62.9%	56.2%	50.0%	**59.4%**	0.039^{X2}
Shavings	5.0%	10.0%	9.0%^{L}	21.0%^{H}	26.2%	**17.3%**	0.011^{X2}
No bedding	0.0%	8.0%	13.5%	8.2%	11.9%	**9.2%**	0.176^{LR}
Other	10.0%	10.0%	6.7%	10.5%	4.8%	**9.2%**	0.654^{LR}
Rubber matting	5.0%	4.0%	7.9%	6.4%	7.1%	**6.4%**	0.916^{LR}
Dust-extracted wood fibre	0.0%	0.0%	2.2%	1.1%	0.0%	**1.1%**	0.509^{LR}

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

There were no significant differences found between the type of bedding in donkeys and their age (Table 5.158). These findings are similar to those found by Cox et al. (2010) who looked at the management of guardian TDS donkeys in the UK. Cox et al. (2010) found that most donkeys were bedded on straw (75.0%), wood shavings (33.2%) or less commonly, rubber matting (14.8%), and 5.0% reportedly had no bedding. The study by Cox et al. (2009) found that paper bedding was a risk factor for impaction colic and therefore should not be recommended as bedding in donkeys.

Table 5.158. Types of bedding in donkeys stratified by age

Type of bedding	Non-geriatric (n=426)	Geriatric (n=42)	Total (n=468)	p
Straw	60.3%	50.0%	**59.4%**	0.193^{X2}
Shavings	16.4%	26.2%	**17.3%**	0.111^{X2}
No bedding	8.9%	11.9%	**9.2%**	0.572^{F}
Other	9.6%	4.8%	**9.2%**	0.408^{F}
Rubber matting	6.3%	7.1%	**6.4%**	0.743^{F}
Dust-extracted wood fibre	1.2%	0.0%	**1.1%**	>0.999^{F}

^{X2}: Significance of Pearson's Chi-square test; ^{F}: Significance of Fisher's exact test

In Table 5.159 DAT and DS HB (RG) categories were excluded, as they were very small categories. Statistically significant differences were only found between donkeys on a shavings bed and their origin (p_{X2}=0.006). Significantly more donkeys than expected from a "Return guardian" origin were on a shavings bed (36.4%), whilst it was noted (Table 5.159) that fewer donkeys than expected from a "New arrival" origin were on shavings (14.8%). These findings can be explained as there were more geriatric donkeys coming from a guardian origin, and shavings are usually recommended for donkeys with dental disease or musculoskeletal problems.

Table 5.159. Types of bedding in donkeys stratified by origin

Type of bedding	**New Arrival** (n=365)	**DS HB (NA)** (n=65)	**Return Guardian** (n=33)	**Total** (n=463)	**p**
Straw	61.6%	52.3%	51.5%	**59.6%**	0.227^{X2}
Shavings	$14.8\%^{L}$	18.5%	$36.4\%^{H}$	**16.8%**	0.006^{X2}
No bedding	8.8%	15.4%	3.0%	**9.3%**	0.104^{X2}
Other	8.8%	12.3%	9.1%	**9.3%**	0.663^{X2}
Rubber matting	7.7%	1.5%	3.0%	**6.5%**	0.070^{LR}
Dust-extracted wood fibre	1.4%	0.0%	0.0%	**1.1%**	0.302^{LR}

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
DS HB (NA): Donkey Sanctuary Holding Base (New arrival)

When looking at types of bedding and their relationship to origin region (Table 5.160), it was found that there were statistically significant differences between the use of straw bedding and origin (p_{X2}=0.003); the use of shavings and origin (p_{X2}=0.010); the use of other types of bedding and origin (p_{LR}<0.001), and the use of dust-extracted wood fibre (Easibed®) and origin (p_{LR}=0.006).

With regards to straw bedding, it was seen (Table 5.160) that there were more donkeys than expected on straw bedding in the East Midlands (76.0%), whilst there were fewer donkeys from the South East on straw bedding (40.0%).

It was found that there were more donkeys than expected from the South East that had shavings as bedding (30.7%), whilst there were fewer donkeys from Wales kept on a shavings bed (3.0%).

With regards to the use of less common types of bedding (other), there were more donkeys than expected using other types of bedding in Scotland (23.8%), the North West (18.2%) and Greater London (66.7%).

Lastly, with regards to the use of dust-extracted wood fibre, it was found (Table 5.160) that there were more donkeys than expected that had dust-extracted wood fibre as a bedding from the West Midlands (10.4%).

Table 5.160. Type of bedding in donkeys stratified by origin region

Origin region	n	Type of bedding					
		Straw	Shavings	No bedding	Other	Rubber matting	Dust-extracted wood fibre
Scotland	21	42.9%	9.5%	14.3%	23.8%^{H}	9.5%	0.0%
Northern Ireland	8	50.0%	37.5%	12.5%	0.0%	0.0%	0.0%
North East	47	63.8%	12.8%	12.8%	2.1%	12.8%	0.0%
North West	55	56.4%	20.0%	3.6%	18.2%^{H}	1.8%	0.0%
East Midlands	50	76.0%^{H}	10.0%	8.0%	4.0%	4.0%	0.0%
West Midlands	48	64.6%	12.5%	2.1%	12.5%	8.3%	10.4%^{H}
Wales	33	69.7%	3.0%^{L}	12.1%	3.0%	12.1%	0.0%
South West	120	64.2%	18.3%	10.0%	4.2%^{L}	5.0%	0.0%
South East	75	40.0%^{L}	30.7%^{H}	13.3%	14.7%	2.7%	0.0%
Greater London	3	33.3%	0.0%	0.0%	66.7%^{H}	33.3%	0.0%
Total	**460**	**59.6%**	**17.2%**	**9.3%**	**9.3%**	**6.1%**	**1.1%**
p		0.003^{X2}	0.010^{X2}	0.316^{LR}	<0.001^{LR}	0.150^{LR}	0.006^{LR}

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

5.4.3. Association between type of bedding and diet

In Table 5.161 we analysed the relationship between the type of bedding and different diet components. Statistically significant differences were found between the use of straw in the diet and the type of bedding (p_{X2}<0.001). It was found that significantly more donkeys than expected that had bedding were on a straw diet (46.4%), whilst only 16.7% of donkeys without bedding received straw as part of their diet. The use of bedding is necessary for donkeys to lie down; owners should always provide a type of bedding, and TDS should ensure that daily donkey care is included as part of the donkey owner essential information package.

Moreover, statistically significant differences were also found between the use of bedding and the use of hay as part of their diet (p_{X2}=0.030). There were significantly more donkeys that had bedding that also received hay as part of their diet (78.9%). Similarly, it was found that there were statistically significant differences between type of bedding and receiving haylage as part of their diet (p_{LR}=0.005). It was found that of the donkeys with no bedding, none were given haylage as part of their diet (0.0%).

Finally, it was observed that more donkeys than expected with no bedding had access to unrestricted grazing (92.9%), while less donkeys than expected that had bedding had access to grass (78.0%). On the other hand, there were more donkeys than expected that had bedding and restricted grazing (12.4%), while there were less donkeys that expected without bedding that had access to restricted grazing (2.4%). This is an interesting finding, and it would be interesting to find out if this could be linked to the presence of a shelter or not. Owners that have donkeys in the field might not be providing adequate shelter and therefore would not be providing any bedding. Future new UK welfare guidelines will include the need for donkeys to have a solid shelter. The Donkey Sanctuary should ensure that donkey owners are aware of the requirement to provide an adequate shelter.

Table 5.161. Use of diet feeds stratified by presence of bedding in donkeys

Diet	**With bedding** (n=418)	**Without bedding** (n=42)	p
Grass	78.0%^{L}	92.9%^{H}	0.030^{LR}
Restricted grazing	12.4%^{H}	2.4%^{L}	
Hay	78.9%	64.3%	0.030^{X2}
Straw	46.4%	16.7%	<0.001^{X2}
Treats	41.6%	42.8%	0.878^{X2}
Chopped forage feed	30.4%	38.0%	0.303^{X2}
Fibre compound feed	28.4%	16.6%	0.102^{X2}
Chopped forage feed	17.2%	21.4%	0.495^{X2}
Haylage	9.6%	0.0%	0.005^{LR}
Supplement balancer	4.5%	0.0%	0.054^{LR}
Non-equine feed	0.2%	0.0%	0.661^{LR}

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were only found between the use of rubber matting for donkeys and fibre compound feed diet (p_{X2}=0.043) (Table 5.162). The use of rubber matting should not necessarily be linked to the use of any type of diet. However, rubber matting could be helpful for older donkeys as it reduces musculoskeletal impact when walking or lying down, so it could perhaps be associated with the use of a short chop diet in older animals.

It was found (Table 5.163) that statistically significant differences were only found between the use of straw bedding in donkeys and having straw as part of their diet (p_{X2}<0.001). There were statistically more donkeys than expected on straw bedding that also received straw as part of their diet (54.9%). This would be considered a normal finding, as it is considered as the standard management for a healthy donkey. It would be interesting to identify the reasons as to why owners are selecting one type of bedding over another. Reasons for choosing diet and bedding should be included as part of the TDS management form for owners to complete at the time of relinquishment.

Table 5.162. Use of diet feeds stratified by use of bedding in donkeys

Diet	**Rubber matting** (n=30)	**Without rubber matting** (n=430)	p
Grass	70.0%	80.0%	0.358^{LR}
Restricted grazing	20.0%	10.9%	
Hay	80.0%	77.4%	0.745^{X2}
Straw	36.7%	44.2%	0.422^{X2}
Treats	36.7%	42.1%	0.560^{X2}
Chopped forage feed	33.3%	30.9%	0.783^{X2}
Fibre compound feed	$43.3\%^{H}$	$26.3\%^{L}$	0.043^{X2}
Cereal grain compound feed	6.7%	18.4%	0.104^{X2}
Haylage	6.7%	8.8%	0.672^{LR}
Supplement balancer	3.3%	4.2%	0.815^{LR}
Non-equine feed	0.0%	0.2%	0.713^{LR}

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Table 5.163. Use of diet compounds stratified by use of straw as a bedding in donkeys

Diet	**Straw bedding** (n=275)	**Non-straw bedding** (n=185)	p
Grass	81.8%	75.7%	0.280^{X2}
Restricted grazing	10.2%	13.5%	
Hay	78.9%	75.7%	0.415^{X2}
Straw	$54.9\%^{H}$	$27.0\%^{L}$	$<0.001^{X2}$
Treats	41.8%	41.6%	0.967^{X2}
Chopped forage feed	30.9%	31.4%	0.920^{X2}
Fibre compound feed	28.0%	26.5%	0.721^{X2}
Cereal grain compound feed	18.5%	16.2%	0.520^{X2}
Haylage	9.50%	7.60%	0.481^{X2}
Supplement balancer	4.5%	0.00%	0.516^{X2}
Non-equine feed	0.4%	0.00%	0.310^{LR}

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were only found between the use of a shavings bed and having straw as part of their diet (p_{X2}<0.001) (Table 5.164). There were statistically more donkeys than expected on non-shavings bedding that had access to straw as part of their diet (47.5%); this again would be an expected normal finding. Ideally, shavings beds should be used in donkeys with moderate to severe dental disease to prevent them from eating long fibre. Shavings beds should also be considered for donkeys with musculoskeletal conditions who may find it difficult to move around the stable with other types of bedding. It therefore it could be assumed that donkeys that do not have shavings could have straw as a diet. Interestingly, 24.7% of donkeys on a shavings bed had straw in their diet.

Table 5.164. Use of diet compounds stratified by use of shavings as bedding in donkeys

Diet	**Shavings bedding** (n=77)	**Non-shavings bedding** (n=383)	p
Grass	77.9%	79.6%	0.664^{X2}
Restricted grazing	14.3%	11.0%	
Hay	77.3%	79.2%	0.710^{X2}
Straw	$24.7\%^{L}$	$47.5\%^{H}$	$<0.001^{X2}$
Treats	44.2%	41.3%	0.110^{X2}
Chopped forage feed	32.5%	30.8%	0.774^{X2}
Fibre compound feed	26.0%	27.7%	0.760^{X2}
Cereal grain compound feed	18.2%	17.5%	0.885^{X2}
Haylage	6.5%	9.1%	0.452^{X2}
Supplement balancer	4.2%	3.9%	0.909^{LR}
Non-equine feed	0.3%	0.0%	0.545^{LR}

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

It was found (Table 5.165) that there were statistically significant differences between donkeys on dust-extracted wood fibre bedding and access to straw as part of their diet (p_{LR}=0.016). There were statistically more donkeys on non-dust-extracted wood fibre that received straw as part of their diet (44.2%), whilst fewer donkeys that were on dust-extracted wood fibre bedding had straw as part of their diet. Generally, dust-extracted wood fibre bedding is recommended for geriatric donkeys with dental disease , donkeys with respiratory disease or musculoskeletal conditions where long fibre would not be recommended as part of their diet.

An association was also noted between donkeys on dust-extracted wood fibre bedding and fibre compound feed as part of their diet (p_{X2}<0.001). In addition, there were statistically significant differences found between donkeys on dust-extracted wood fibre bedding and the use of supplement balancer (p_{X2}<0.001), and there was also an association between the use of dust-extracted wood fibre and the administration of treats (p_{LR}=0.020). These findings might be difficult to explain as there is not a clear association between this type of bedding and the use of balancers or treats.

Table 5.165. Use of diet compounds stratified by use of dust-extracted wood fibre bedding

Diet	**Dust-extracted wood fibre bedding** (n=5)	**Non-dust-extracted wood fibre bedding** (n=455)	p
Grass	80.0%	79.3%	0.439^{LR}
Restricted grazing	0.0%	11.6%	
Hay	100.0%	77.4%	0.110^{LR}
Straw	$0.0\%^{L}$	$44.2\%^{H}$	0.016^{LR}
Treats	0.0%	42.2%	0.020^{LR}
Chopped forage feed	0.0%	31.4%	0.053^{LR}
Fibre compound feed	$100.0\%^{H}$	$26.6\%^{L}$	$<0.001^{X2}$
Cereal grain compound feed	0.0%	17.8%	0.163^{LR}
Haylage	0.0%	8.8%	0.339^{LR}
Supplement balancer	$80.0\%^{H}$	$3.3\%^{L}$	$<0.001^{X2}$
Non-equine feed	0.0%	0.2%	0.882^{LR}

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

There were statistically significant differences found between donkeys on "other" types of bedding and access to grass (p_{LR}=0.001). It was found (Table 5.166) that more donkeys than expected on other types of bedding had some form of access to grass (55.8% and 20.9%).

Table 5.166. Use of diet compounds stratified by use of other types of bedding in donkeys

Diet	**Other bedding** (n=43)	**Without other bedding** (n=417)	p
Grass	$55.8\%^{H}$	$55.8\%^{L}$	0.001^{LR}
Restricted grazing	$20.9\%^{H}$	$10.6\%^{L}$	
Hay	79.1%	77.5%	0.809^{X2}
Straw	44.2%	43.6%	0.946^{X2}
Treats	37.2%	42.2%	0.527^{X2}
Chopped forage feed	23.3%	31.9%	0.244^{X2}
Fibre compound feed	23.3%	27.8%	0.523^{X2}
Cereal grain compound feed	17.5%	18.6%	0.857^{X2}
Haylage	16.3%	7.9%	0.090^{LR}
Supplement balancer	11.6%	3.4%	0.028^{LR}
Non-equine feed	0.0%	0.2%	0.658^{LR}

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Finally, it was found that there were statistically significant differences between donkeys on other types of bedding and the use of supplement balancers (p_{LR}=0.028). In any case, the use of other types of bedding was less common finding.

5.4.4. Pre-arrival body condition score and diet

There were statistically significant differences found between BCS and cereal grain compound feed (p_{X2}=0.022). It was observed (Table 5.167) that more donkeys with poor body condition (BCS=1-1.5) than expected were given cereal grain compound feed (66.7%). Cereal based diets have been identified as inappropriate for donkeys. Cereal based diets are not recommended in donkeys and have been reported to be linked to gastric ulceration (Burden et al., 2009). Owners could be considering cereal grain-based diets as a high energy diet for donkeys with a poor body condition score, which may paradoxically have the opposite effect, and even be detrimental to their health. Appropriate feeding regimes for donkeys with various health conditions can be found on the TDS website (The Donkey Sanctuary, 2020i). Some donkey owners may not be aware of this resource or may have access issues and other ways to reach them should be explored.

Statistically significant differences were demonstrated between the BCS of donkeys at admission and the use of chopped forage feed (p_{X2}=0.047, Table 5.167). It was observed that more donkeys than expected with a BCS of 2.75-3.5 had received chopped forage feed (35.9%). It was also noted that there were no donkeys with a very poor body condition score (1-1.5) that had received chopped forage feed as part of their diet (0.0%). This study has found a link between donkeys in poor body condition and dental disease (Tables 5.100 and 5.101). This finding would suggest that donkey owners are not selecting dietary products adequately. Specifically, there is not enough consideration of dental status and body condition score when selecting diets, and owners do not appear to be following TDS website feeding guidelines and advice (The Donkey Sanctuary, 2020j).

Statistically significant differences were found between the BCS of donkeys at admission and use of treats (p_{X2}=0.045) (Table 5.167). Donkeys that were given significantly more treats were either those with a poor BCS (below 2.5) or those that were overweight (BCS over 3.75). Owners of underweight donkeys may consider treats as a source of energy to help increase body weight, although on the other hand, overweight donkeys may struggle to lose weight if owners continue to feed treats.

There were no other significant differences found; although interestingly, the use of long fibres, such as straw and hay, is very common in donkeys of all BCS, including those with a very poor BCS. This study has found a link between moderate to severe dental disease in donkeys and poor BCS (Tables 5.100 and 5.101), therefore significant differences should have been expected in those categories. Long fibres should be limited to donkeys with good dentition. Basic donkey nutrition concepts need explaining to donkey owners to ensure appropriate nutrition in donkeys.

Table 5.167. Use of different types of diet stratified by body condition score at arrival

Diet	Body Condition Score 1-1.5 (n=6)	1.75-2.5 (n=35)	2.75-3.5 (n=245)	3.75-4.5 (n=144)	4.75-5 (n=49)	Total (n=479)	p
Grass	83.3%	71.4%	78.8%	81.9%	77.6%	**79.1%**	0.232^{LR}
Restricted grazing	16.7%	8.6%	11.0%	11.8%	18.4%	**11.9%**	
Hay	83.3%	71.4%	76.7%	72.9%	79.6%	**75.6%**	0.794^{X2}
Straw	66.7%	45.7%	46.9%	38.9%	36.7%	**43.6%**	0.318^{X2}
Treats	50.0%	54.3%	$35.5\%^{L}$	$49.3\%^{H}$	40.8%	**41.8%**	0.045^{X2}
Chopped forage feed	0.0%	25.7%	$35.9\%^{H}$	29.9%	$18.4\%^{L}$	**31.1%**	0.047^{X2}
Fibre compound feed	33.3%	14.3%	31.0%	27.1%	20.4%	**27.6%**	0.204^{X2}
Cereal grain compound feed	$66.7\%^{H}$	11.4%	17.1%	16.0%	16.3%	**16.9%**	0.022^{X2}
Haylage	0.0%	14.3%	9.0%	7.6%	6.1%	**8.6%**	0.568^{LR}
Supplement balancer	0.0%	2.9%	4.9%	4.2%	2.0%	**4.2%**	0.796^{LR}
Non-equine feed	0.0%	0.0%	8.0%	0.0%	0.0%	**0.4%**	0.611^{LR}

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

5.4.5. Association between dental grade, diet and bedding

Firstly, no statistically significant differences were found between any of the types of diet and dental grade (Table 5.168). Dental disease has been identified as a risk factor for impaction colic in donkeys (Cox et al., 2007), therefore significant differences should be expected when looking at different types of diet and dental grade.

Significant differences were not found between dental grade at admission and donkeys receiving hay as part of their diet (p_{X2}=0.258). Hay would not be recommended for a donkey with a dental grade of 4 or 5, and possibly even donkeys with a dental grade of 3 depending on EDT and vet recommendations.

Similarly, there was no association found between admission dental grade and donkeys receiving straw (p_{X2}=0.411) or fibre compound feed (p_{X2}=0.081) as part of their diet.

Donkeys with severe dental disease (grades 4 and 5) find managing long fibre diets very difficult. Dental disease should be taken into account when deciding on feeding and diet, to reduce the risk of impaction colic.

It was observed (Table 5.168) that no association was found between dental grade at admission and access to grass as part of their diet (p_{LR}=0.340), nor with donkeys having haylage in their diet (p_{X2}=0.611).

No significant differences were found between dental grade and cereal grain compound feed as part of their diet (p_{X2}=0.131). However, if looking at the standard residuals, it was observed (Table 5.168) that fewer donkeys than expected that were on cereal grain compound feed had a dental grade of 5 (0.0%). Cereal based diet has been identified as inappropriate for feeding donkeys and increase their risk of gastric ulceration (Burden et al., 2009).

Statistically significant differences were not found between donkeys on chopped forage feed and dental grade (p_{X2}=0.052), although if attending to standard residuals more donkeys than expected on this type of feed had a dental grade of 1 (60.3%), whilst fewer than expected had a dental grade of 4 (2.1%). Ideally donkeys with dental disease should be fed chopped feeds especially those with dental grades of 3, 4 and 5.

Table 5.168. Admission dental grade stratified by diet

Diet	n	Dental grade					p
		1	2	3	4	5	
Grass	374	52.9%	21.7%	15.0%	4.5%	5.9%	0.340^{LR}
Restricted grazing	57	45.6%	15.8%	21.1%	10.5%	7.0%	
Hay	356	51.4%	20.2%	15.7%	6.7%	5.9%	0.258^{X2}
Straw	206	49.0%	21.8%	18.0%	6.3%	4.9%	0.411^{X2}
Treats	201	48.8%	23.4%	15.9%	6.0%	6.0%	0.686^{X2}
Chopped forage feed	146	$60.3\%^{H}$	20.5%	11.0%	$2.1\%^{L}$	6.2%	0.052^{X2}
Fibre compound feed	129	62.0%	16.3%	10.9%	3.9%	7.0%	0.081^{X2}
Cereal grain compound feed	82	59.8%	18.3%	15.9%	6.1%	$0.0\%^{L}$	0.131^{X2}
Haylage	41	56.1%	26.8%	12.2%	2.4%	2.4%	0.611^{X2}
Supplement balancer	20	65.0%	20.0%	5.0%	0.0%	10.0%	0.262^{LR}
Non-equine feed	2	50.0%	50.0%	0.0%	0.0%	0.0%	0.802^{LR}
Total	**456**	**53.9%**	**20.8%**	**14.7%**	**5.3%**	**5.3%**	

^{X2}: Significance of Pearson´s Chi-square test; ^{LR}: Significance of Likelihood ratio
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

We assessed if there was a causal relationship between diet and categorised dental grade (Table 5.169). Classifying dental grades into two categories helped identify interesting associations between diet and dental pathology.

Statistically significant differences were found between donkeys eating grass as part of their diet and dental grade at admission (p_{X2}=0.045). It was observed that donkeys with pathological dental grades had more restricted grazing (17.7%).

We also observed that categorised dental grades at admission were related to donkeys having chopped forage feeds (p_{X2}=0.018). Interestingly, it was found that more donkeys than expected that were on chopped forage feeds had acceptable dental grades of 1 and 2 (34.0%), whilst fewer on the same feeds had pathological dental grades of 3 to 5 (22.6%).

Chopped forage feeds are recommended for donkeys with poor dentition. Diet choice does not seem to be influenced by dental disease and this finding would indicate that owners are not taking into consideration dental disease when choosing a specific diet for their donkey/s. This finding could also have an impact on donkey BCS, as short chop diets in donkeys with good dentition can increase their body weight and the risk of obesity.

Table 5.169. Type of diet and admission dental grades (categorised) in donkeys

Diet	n	Dental grades categories		p
		Acceptable (1-2)	Pathological (3-5)	
Grass	374	80.4%	76.6%	0.045^{X2}
Restricted grazing	57	$10.1\%^{L}$	$17.7\%^{H}$	
Hay	356	73.5%	81.5%	0.076^{X2}
Straw	206	42.1%	48.4%	0.224_{X2}
Treats	201	41.8%	45.2%	0.514^{X2}
Chopped forage feed	146	$34.0\%^{H}$	$22.6\%^{L}$	0.018^{X2}
Fibre compound feed	129	29.1%	22.6%	0.162^{X2}
Cereal grain compound feed	82	18.4%	14.5%	0.322^{X2}
Haylage	41	9.8%	5.6%	0.159^{X2}
Supplement balancer	20	4.9%	2.4%	0.240^{X2}
Non-equine feed	2	0.6%	0.0%	$>0.999^{FS}$

^{X2}: Significance of Pearson´s Chi-square test; ^{FS}: Significance of Fisher's exact test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p>0.050)

No statistically significant differences were found between the type of bedding and dental grade of donkeys at admission (p_{LR}=0.978) (Table 5.170).

No differences were found between categorised dental grades of donkeys at admission and the type of bedding they were kept on in their home (p_{LR}=0.291). A similar distribution was found between types of bedding and dental grade categories (Table 5.171). This finding would indicate that owners are not taking dental status into consideration when selecting bedding type. Type of bedding has been linked to certain conditions such as hyperlipemia (Burden et al., 2011) and impaction colic (Cox et al., 2009).

Firstly, it was identified that there was a positive association between age and the severity of dental disease, and dental grade increases with age (Table 5.172 and Figure 5.6) (p_{KW}<0.001).

Table 5.170. Admission dental grades stratified by bedding

Bedding	n	Dental grade				
		1	2	3	4	5
Straw	265	53.6%	21.9%	14.0%	4.5%	6.0%
Shavings	77	49.4%	19.5%	18.2%	6.5%	6.5%
No bedding	40	42.5%	25.0%	20.0%	7.5%	5.0%
Other	38	63.2%	15.8%	13.2%	5.3%	2.6%
Rubber matting	25	64.0%	16.0%	12.0%	8.0%	0.0%
Dust-extracted wood fibre	5	80.0%	20.0%	0.0%	0.0%	0.0%
Rubber matting + Straw	4	75.0%	25.0%	0.0%	0.0%	0.0%
Rubber matting + Shavings	1	100.0%	0.0%	0.0%	0.0%	0.0%
Straw + Shavings	1	100.0%	0.0%	0.0%	0.0%	0.0%
Total	**456**	**53.9%**	**20.8%**	**14.7%**	**5.3%**	**5.3%**

Significance of Likelihood ratio, p_{LR}=0.978

Table 5.171. Types of bedding stratified by dental grade (categorised)

Bedding	Dental grade categories	
	Acceptable (1-2) (n=341)	Pathological (3-5) (n=115)
Straw	58.7%	56.5%
Shavings	15.5%	20.9%
No bedding	7.9%	11.3%
Other	8.8%	7.0%
Rubber matting	5.9%	4.3%
Dust-extracted wood fibre	1.5%	0.0%
Rubber matting + Straw	1.2%	0.0%
Rubber matting + Shavings	0.3%	0.0%
Straw + Shavings	0.3%	0.0%

Significance of Likelihood ratio, p_{LR}=0.291

It was found that donkeys that had a dental grade of 1 were significantly younger than the rest of the groups with a mean age of 7.34 years, while donkeys that had dental grades of 2 and 3 had a similar age, with means of 11.16 and 12.77 years respectively. It was also found that donkeys with more severe dental disease (grade 4) were significantly older than donkeys with better dental grades of 3 and below.

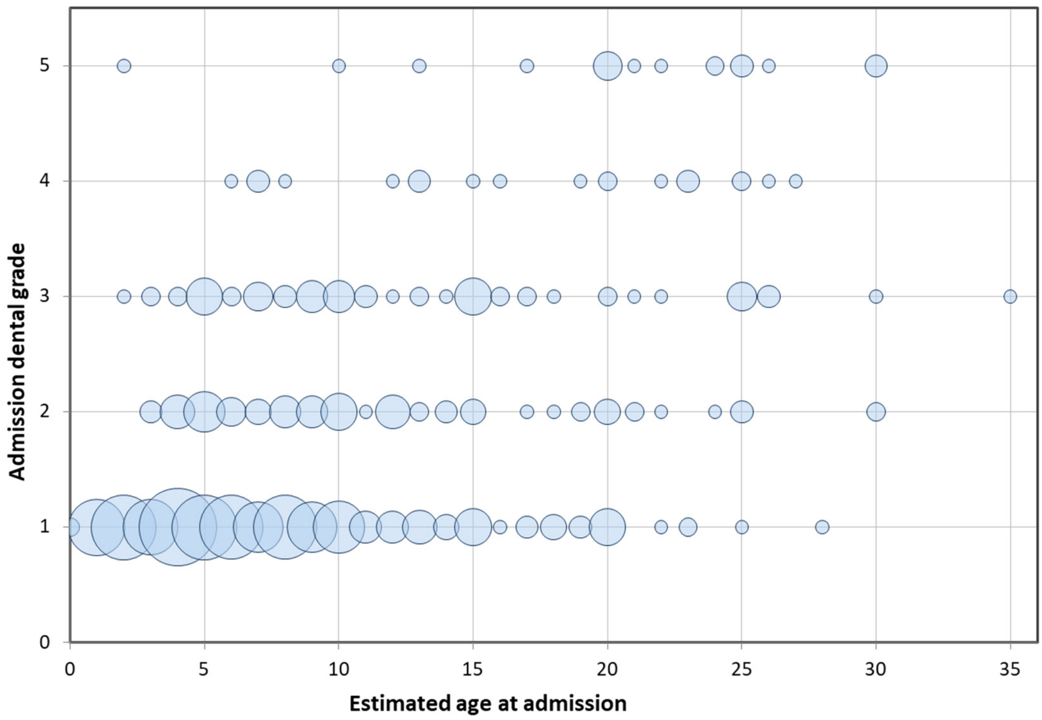
Moreover, donkeys that had severe dental disease and were classified as a dental grade of 5 were significantly older than the rest of the groups with a mean age of 21.2 years, and most of them were in the geriatric category. This finding would justify donkeys over 20 years old receiving a thorough dental examination prior to admission, in order to identify if dental disease is affecting their quality of life.

Table 5.172. Age of donkeys (years) stratified by dental grade

Dental grade	n	Mean	SD	Q1	Median	Q3	min	Max
None	13	13.92[bc]	9.58	6.0	10.0	21.5	5	36
1	274	7.34[a]	5.31	4.0	6.0	10.0	0	28
2	83	11.16[b]	6.63	6.0	10.0	15.0	3	30
3	69	12.77[b]	7.53	7.0	10.0	16.5	2	35
4	22	16.82[c]	7.04	11.0	17.5	23.0	6	27
5	20	21.2[d]	6.88	20.0	21.5	25.0	2	30
Total	**481**	**9.96**	**7.14**	**5.0**	**8.0**	**14.0**	**0**	**36**

Significance of Kruskal-Wallis test, $p<0.001$
Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test ($p_{MW}<0.050$)

Figure 5.6. Correlation between dental grade at admission and estimated age of donkeys



5.5. Weight and height of donkeys

5.5.1. Weight and height of donkeys at arrival

The majority of donkeys in the UK have been reported as having a height between 9.5 and 11 hands (96.5 and 111.8 cm) (Camac, 1997). However, donkey weight and height can vary between different donkey breeds: for example, miniature Mediterranean donkeys are under 91.44 cm at the withers, Sardinian donkeys stand at between 8.4 hands (85 cm) and 11.1 hands (115 cm) at the withers and weigh 90 to 130 kg, whilst some of the biggest breeds in Europe such as the Zamorano Leonés can weigh 350 kg and grow to 15.2 hands (157 cm) (Squance, 1997). Crane (1997) states that adult donkeys of 10 to 11 hands should ideally weigh no more than 180 kg.

In this study, the average weight of donkeys on arrival was 187.38 ± 44.90 kg, with a range of 21 to 334 kg and interquartile range (IQR) equal to 0.298, which indicates a moderate heterogeneity (Table 5.173).

Statistically significant differences were found between arrival weight and sex ($p_{KW}<0.001$) (Table 5.173). The weight of geldings was found to be significantly greater than that of mares and stallions, with stallions being the lightest of the three other subgroups. This fact can be explained as stallions were found to be the youngest (Table 5.3), with a high percentage of colts amongst the stallions.

Table 5.173. Weight (kg) of donkeys on arrival stratified by sex

Sex	n	Mean	SD	Q1	Median	Q3	min	Max
Mare	184	182.42^{b}	41.89	156.25	183.00	213.00	34.0	295.0
Gelding	314	199.02^{c}	39.54	173.75	195.00	224.00	99.0	334.0
Stallion	91	157.53^{a}	52.95	120.00	156.00	193.00	21.0	319.0
Total	**589**	**187.42**	**45.01**	**161.00**	**188.00**	**217.00**	**21.0**	**334.0**

Significance of Kruskal-Wallis test, p<0.001
Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test by pairs (p<0.050)

Statistically significant differences were found between the age of donkeys and their weight ($p_{KW}<0.001$). It was found that the mean weight of donkeys increased with age although, geriatric donkeys (older than 20 years) had a similar mean weight to those in the younger adult category (3 to 5 years category) (Table 5.174). This suggests that the mean weight of donkeys reduces significantly between the adult and geriatric age groups.

Table 5.174. Weight (kg) of donkeys on arrival stratified by age

Age	n	Mean	SD	Q1	Median	Q3	min	Max
≤ 1 y	28	107.89^{a}	39.50	75.75	112.50	129.00	21.0	192.0
(1 y, 3 y]	69	156.59^{b}	39.96	126.50	152.00	179.50	84.0	257.0
(3 y, 5 y]	109	187.72^{c}	35.46	161.00	187.00	207.50	107.0	314.0
(5 y, 20 y]	330	201.06^{d}	39.79	174.00	196.00	225.25	74.0	334.0
> 20 y	53	184.02^{c}	38.92	158.50	179.00	206.00	106.0	319.0

Significance of Kruskal-Wallis test, p<0.001
Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test by pairs (p<0.050)

Statistically significant differences were not found between the weight of donkeys and their type of origin ($p_{KW}=0.096$) (Table 5.175).

Table 5.175. Weight (kg) of donkeys on arrival stratified by type of origin

Type of origin	n	Mean	SD	Q1	Median	Q3	min	Max
New arrival	404	188.10	46.94	162.00	189.00	218.00	21.0	324.0
DS HB (NA)	98	179.76	45.12	142.75	180.50	213.00	99.0	334.0
Return Guardian	61	192.25	31.79	170.50	193.00	214.50	125.0	280.0
DS HB (RG)	11	183.00	35.75	160.00	166.00	230.00	145.0	250.0
DAT	15	202.93	38.92	181.00	212.00	227.00	128.0	274.0

Significance of Kruskal-Wallis test, p=0.096
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre

We found statistically significant differences between the weight of donkeys and their BCS (p_{KW}<0.001). Donkeys with a BCS below 2.5 were found to be significantly lighter than donkeys with a BCS above 3.5 (Table 5.176).

Table 5.176. Weight (kg) of donkeys on arrival stratified by body condition score at admission

BCS	n	Mean	SD	Q1	Median	Q3	min	Max
None	11	164.82[a]	75.70	131.00	190.00	223.00	21.0	250.0
1-1.5	11	157.64[a]	52.60	117.00	138.00	216.00	106.0	252.0
1.75-2.5	51	163.47[a]	43.98	133.00	159.00	188.00	84.0	282.0
2.75-3.5	310	181.15[ab]	45.27	157.00	181.00	204.50	60.0	334.0
3.75-4.5	156	203.93[b]	36.58	177.25	202.00	225.75	103.0	319.0
4.75-5	50	210.72[b]	29.34	187.75	206.50	226.50	157.0	290.0

Significance of Kruskal-Wallis test, p<0.001
Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test by pairs (p<0.050)

Height was measured in hands and 1 hand is equal to 10.16 cm. The average height of donkeys on arrival was 10.56 ± 0.85 hands, with a range of 8.0 to 13.3 hands, and IQR was equal to 0.097, so this measurement was more homogeneous than weight (Table 5.177). A significant association was found between between height of donkeys and their sex (p_{KW}<0.001). Two subgroups were identified, mares and stallions had similar heights, whilst geldings were significantly taller (Table 5.177).

Statistically significant differences were found between the height of donkeys on arrival and their age (p_{KW}<0.001) (Table 5.178). It was observed that younger donkeys (under 1 year old) were significantly smaller in size with a mean height of 9.64 hands. The next age category of donkeys (1 to 3 years old) was significantly taller than this first category with a mean of 10.39 hands, making this category a similar mean height to the geriatric group (over 20 years old) whose mean height was 10.28 hands. The other subgroups with similar mean heights were the young adults (3-5 years) and adult donkeys (5 to 20 years old) with a mean height of 10.67 and 10.68 hands respectively.

Table 5.177. Height (hands) of donkeys on arrival stratified by sex

Sex	n	Mean	SD	Q1	Median	Q3	min	Max
Mare	172	10.42[a]	0.84	10.10	10.30	11.00	8.1	13.0
Gelding	305	10.74[b]	0.77	10.20	11.00	11.10	8.3	13.3
Stallion	82	10.21[a]	0.98	10.00	10.20	11.00	8.0	13.1
Total	**559**	**10.56**	**0.85**	**10.10**	**10.30**	**11.10**	**8.0**	**13.3**

Significance of Kruskal-Wallis test, p<0.001
Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test by pairs (p<0.050)

Table 5.178. Height (hands) of donkeys on arrival stratified by age

Age (cat)	n	Mean	SD	Q1	Median	Q3	min	Max
≤ 1 y	24	9.64[a]	0.86	9.10	10.00	10.10	8.1	11.1
(1 y, 3 y]	62	10.39[b]	0.94	10.00	10.20	11.00	8.3	13.0
(3 y, 5 y]	101	10.67[c]	0.75	10.20	10.30	11.10	8.3	13.3
(5 y, 20 y]	318	10.68[c]	0.82	10.20	10.30	11.10	8.0	13.2
> 20 y	54	10.28[b]	0.76	10.07	10.20	11.00	8.1	13.1

Significance of Kruskal-Wallis test, p<0.001
Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test by pairs (p<0.050)

Statistically significant differences were not found between the height of donkeys and their type of origin (p_{KW}=0.284) (Table 5.179).

Table 5.179. Height (hands) of donkeys on arrival stratified by type of origin

Type of origin	n	Mean	SD	Q1	Median	Q3	min	Max
New arrival	379	10.57	0.88	10.10	10.30	11.10	8.0	13.0
DS HB (NA)	94	10.51	0.81	10.10	10.30	11.00	8.3	13.2
Return Guardian	61	10.56	0.69	10.10	10.30	11.10	9.1	12.2
DS HB (RG)	10	10.78	0.90	10.17	10.30	11.20	10.1	13.0
DAT	15	10.74	0.95	10.20	11.10	11.20	8.3	12.1

Significance of Kruskal-Wallis test, p=0.284
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre

There was no significant association found between height of donkeys and their body condition score (p_{KW}=0.409) (Table 5.180).

Table 5.180. Height (hands) of donkeys on arrival stratified by body condition score at admission

BCS	n	Mean	SD	Q1	Median	Q3	min	Max
None	9	11.09	0.83	10.60	11.00	11.20	10.1	13.0
1-1.5	7	10.77	1.44	9.30	11.00	12.20	9.3	12.2
1.75-2.5	45	10.61	0.91	10.00	10.30	11.10	9.1	13.3
2.75-3.5	298	10.53	0.88	10.10	10.30	11.10	8.0	13.2
3.75-4.5	141	10.59	0.80	10.20	10.30	11.10	8.2	13.1
4.75-5	49	10.51	0.59	10.10	10.30	11.00	9.3	12.1

Significance of Kruskal-Wallis test, p=0.409

There were statistically significant differences between the weight/height (WH) ratio in donkeys and sex (p_{KW}<0.001). The mean WH ratio was similar in mares and geldings, whilst stallions had a significantly lower WH ratio. Stallion weight was significantly lower than the rest of the groups. This finding can be explained as colts were included in the stallion category.

Table 5.181. Weight/height ratio (kg/hands) on arrival stratified by sex

Sex	n	Mean	SD	Q1	Median	Q3	min	Max
Mare	169	17.61[b]	2.93	15.65	17.66	19.73	7.41	24.51
Gelding	304	18.45[b]	2.93	16.59	18.45	20.36	10.79	27.38
Stallion	81	15.53[a]	3.86	12.29	15.60	18.93	8.02	25.04
Total	**554**	**17.77**	**3.14**	**15.91**	**18.03**	**19.90**	**7.41**	**27.38**

Significance of Kruskal-Wallis test, p<0.001
Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test by pairs (p<0.050)

When looking at the WH ratio in donkeys and their age category, statistically significant differences were found (p_{KW}<0.001). It was observed (Table 5.182) that there were three subgroups.

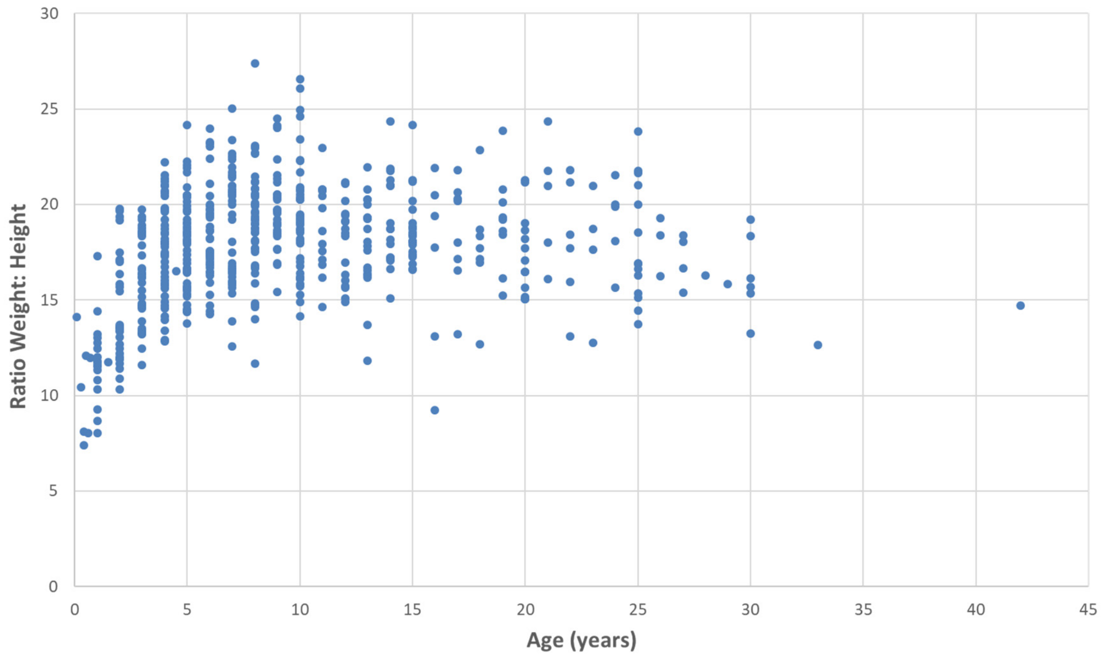
Table 5.182. Weight/height ratio (kg/hands) on arrival stratified by age

Age (cat)	n	Mean	SD	Q1	Median	Q3	min	Max
≤ 1 y	24	11.35[a]	2.34	9.53	11.67	12.68	7.4	17.3
(1 y, 3 y]	62	15.23[b]	2.66	13.23	14.99	17.39	10.3	19.8
(3 y, 5 y]	100	17.77[c]	2.39	15.77	17.98	19.51	12.8	24.2
(5 y, 20 y]	317	18.75[c]	2.66	16.88	18.73	20.49	9.3	27.4
> 20 y	51	17.78[c]	2.86	15.70	17.73	20.00	12.6	24.4

Significance of Kruskal-Wallis test, p<0.001
Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test by pairs (p<0.050)

The lower ratio comprised donkeys from the younger category, under 1 year old with a mean of 11.35, second subgroup was the one with donkeys older than 1 to 3 years old with a mean WH of 15.23. The last subgroup was made up of young adults, adults and the geriatric group (older than 20 years old) with WH means of 17.77, 18.75 and 17.78 respectively. Furthermore, the donkey age at admission was significantly correlated with the weight/height ratio on arrival (Figure 5.7).

Figure 5.7. Correlation between donkey age at admission and weight/height ratio on arrival



Spearman's correlation coefficient, rho=0.287 (p<0.001)

Statistically significant differences were not found between WH ratio and type of origin (p_{KW}=0.063) (Table 5.183).

Table 5.183. Weight/height ratio (kg/hands) on arrival stratified by type of origin

Type of origin	n	Mean	SD	Q1	Median	Q3	min	Max
New arrival	375	17.86	3.26	16.04	18.16	20.00	7.41	26.56
DS HB (NA)	94	17.08	3.28	14.40	17.36	19.11	10.79	27.38
Return Guardian	60	18.17	2.24	16.64	18.33	19.43	12.65	22.95
DS HB (RG)	10	17.23	2.06	15.67	16.03	19.56	15.53	20.53
DAT	15	18.73	2.31	16.86	18.76	20.27	14.61	22.64

Significance of Kruskal-Wallis test, p=0.063

DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre

Statistically significant differences were not found between the weight/height ratio in donkeys and their origin region (p_{KW}=0.395) (Table 5.184).

Table 5.184. Weight/height ratio (kg/hands) on arrival stratified by origin region

Origin region	n	Mean	SD	Q1	Median	Q3	min	Max
Unknown origin	4	19.61	1.79	17.77	19.84	21.20	17.3	21.43
Scotland	26	18.36	2.84	17.12	18.43	19.90	12.1	24.11
Northern Ireland	23	17.43	3.18	15.64	17.53	19.37	11.93	27.38
North East	52	17.61	3.47	15.25	17.60	20.54	10.32	26.56
North West	62	17.95	3.11	16.07	18.52	20.38	9.26	24.51
East Midlands	50	17.10	3.35	15.94	17.66	19.33	8.02	24.60
West Midlands	52	18.56	2.43	16.81	18.17	19.87	13.70	24.15
Wales	40	17.90	3.31	15.09	18.05	20.20	11.83	24.96
South West	141	17.73	3.29	15.93	18.06	20.00	7.41	26.07
South East	84	17.29	3.00	15.55	17.61	19.28	9.25	23.97
Greater London	3	18.83	4.31	13.90	20.64	-	13.90	21.94

Significance of Kruskal-Wallis test, p=0.395

Statistically significant differences were found between the WH ratio and BCS (p_{KW}<0.001) (Table 5.185). Several subgroups were identified, donkeys with a BCS 1-1.5, 1.75-2 and 2.75 to 3.5 had similar WH ratios, whilst a second subgroup with significantly higher WH ratios were donkeys with a BCS of 2.75-3.5 and 3.75-4.5. The third subgroup with significantly higher WH ratios were donkeys with the highest BCS of 4.75-5. These findings are as expected and indicate that subjective body condition scoring is a good measuring tool, coinciding with objective calculations of WH ratio.

Body condition scoring only takes into consideration subcutaneous fat deposits, however, intra-abdominal fat can also contribute to body weight and might affect weight without altering BCS. This can be seen in Table 5.185, where there are high WH ratios (even greater than 20) in donkeys with a low BCS.

Table 5.185. Weight/height ratio (kg/hands) on arrival stratified by body condition score at admission

BCS	n	Mean	SD	Q1	Median	Q3	min	Max
None	9	17.51^{abc}	2.47	15.71	17.59	19.66	12.84	20.54
1-1.5	7	15.95^{a}	3.53	11.83	15.38	19.18	11.40	20.66
1.75-2.5	43	15.50^{a}	2.87	13.24	15.27	17.30	10.32	22.95
2.75-3.5	297	17.05^{ab}	3.19	15.28	17.13	18.92	7.41	27.38
3.75-4.5	150	19.22^{bc}	2.32	17.36	19.22	20.98	12.56	26.07
4.75-5	48	20.06^{c}	2.14	18.45	19.46	21.53	15.70	24.51

Significance of Kruskal-Wallis test, p<0.001

Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test by pairs (p<0.050)

It is interesting that the lowest WH ratio (7.41) corresponded to a 0.4 month old foal in the BCS category of 2.75-3.5. In fact, the majority of WH ratios below 12 corresponded to donkeys below 1 year of age.

Finally, when taking into account the results of adult donkeys with an adequate BCS, normal WH ratios fall between 15 and 19.

5.5.2. Weight of donkeys at departure

Donkeys were weighed again during their NAU period at the time of departure. Mean donkey weight was 186.99 kg, although it was very variable; weight ranged from only 32 kg to 338 kg. These variations can be explained by taking into consideration foals, and there is great variability with regards to donkey breeds (Table 5.166). Statistically significant differences were found between donkey weight at departure and sex (p_{KW}<0.001). It was found that stallions were significantly lighter than mares and geldings. Mares were also significantly heavier than stallions but significantly lighter than geldings. Geldings were the heaviest of the three with a mean departure weight of 196.93 kg (Table 5.186). The stallion category also included colts, which are obviously much lighter.

Table 5.186. Weight (kg) of donkeys at departure stratified by sex

Sex	n	Mean	SD	Q1	Median	Q3	min	Max
Mare	179	182.94[b]	39.07	157.0	186.0	207.0	48.0	293.0
Gelding	311	197.46[c]	38.00	173.0	195.0	219.0	99.0	338.0
Stallion	89	158.53[a]	50.42	125.0	155.0	188.0	32.0	327.0
Total	**579**	**186.99**	**42.67**	**161.0**	**188.0**	**210.0**	**32.0**	**338.0**

Significance of Kruskal-Wallis test, p<0.001
Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test by pairs (p<0.050)

When looking at donkey weight on departure and age categories, statistically significant differences were found (p_{KW}<0.001) (Table 5.187). It was observed that adult donkeys were significantly heavier than both geriatric donkeys and the other age categories with a mean of 199.17 kg. It was noted that a subgroup of young adults and geriatric donkeys had similar mean weights, at 187.48 kg and 182.45 kg respectively. Younger donkeys were significantly lighter than those in other categories and donkeys under one were the lightest with a mean of 115.18 kg.

Statistically significant differences were found between the weight of donkeys at departure and their origin (p_{KW}=0.063) (Table 5.188). It was identified that DS HB (NA) donkeys were significantly lighter than the rest of the groups (179.71 kg) although their weight was not significantly different to New arrivals and DS HB (RG). On the other hand, DAT donkeys were found to be significantly heavier at departure than the rest of the origin groups with a mean weight of 206.20 kg.

Table 5.187. Weight (kg) of donkeys at departure stratified by age

Age (cat)	n	Mean	SD	Q1	Median	Q3	min	Max
≤ 1 y	28	115.18[a]	37.72	89.00	116.00	136.75	32.0	197.0
(1 y, 3 y]	69	160.70[b]	38.77	129.50	152.00	185.50	99.0	272.0
(3 y, 5 y]	108	187.48[c]	34.88	163.25	186.00	204.25	111.0	298.0
(5 y, 20 y]	327	199.17[d]	38.24	173.00	195.00	221.00	75.0	338.0
> 20 y	47	182.45[c]	37.08	157.00	178.00	200.00	109.0	327.0

Significance of Kruskal-Wallis test, p<0.001
Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test by pairs (p<0.050)

Table 5.188. Weight (kg) of donkeys at departure stratified by type of origin

Type of origin	n	Mean	SD	Q1	Median	Q3	min	Max
New arrival	399	186.78	43.66	161.0	188.0	210.0	32.0	327.0
DS HB (NA)	98	179.71	43.56	143.5	182.0	207.2	99.0	338.0
Return Guardian	57	195.42	32.80	174.0	194.0	218.0	127.0	302.0
DS HB (RG)	10	189.60	39.55	162.7	172.5	234.0	149.0	257.0
DAT	15	206.20	38.16	173.0	210.0	232.0	139.0	268.0

Significance of Kruskal-Wallis test, p=0.063
DS HB (NA): Donkey Sanctuary Holding Base (New arrival); DS HB (RG): Donkey Sanctuary Holding Base (Return Guardian); DAT: Donkey Assisted Therapy centre

5.5.3. Evolution of weight of donkeys

During the NAU period, donkeys are weighed at least twice, on arrival and departure. If they spend longer than 6 weeks in the NAU then they are weighed monthly to assess any weight changes. Weight gain or loss of 5% or more of body weight is considered high during this short period of time, and loss in particular can indicate signs of disease and be a cause for concern. Weight loss in overweight donkeys is reportedly difficult to achieve; the aim for weight loss should be a gradual reduction of 2 to 5 kg/month (Burden et al., 2013). Crane (1997) also reported that a loss of 2-4 kg per month was advisable. Weekly weighing or weight estimation and condition scoring for these donkeys is recommended (Burden et al., 2013).

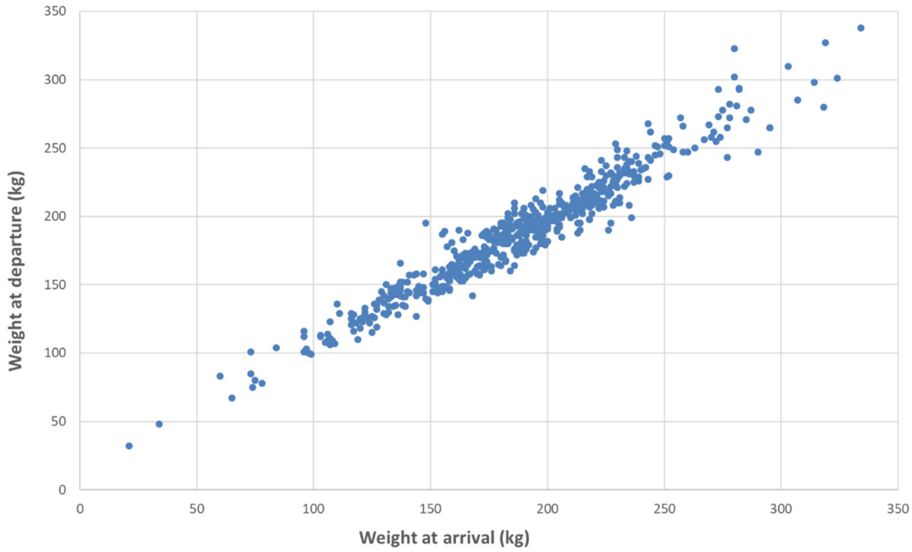
When comparing weight at arrival and departure across all of the sexes, statistically significant differences were not found (p_W=0.228), and there was a good correlation between both weights (rho=0.962; p<0.001) (Table 5.189 and Figure 5.8).

Table 5.189. Correlation between weight (kg) of donkeys at arrival and departure

Weight	n	Mean	SD	p_{rho}	rho	p_W
Arrival	579	187.54	45.16	<0.001	0.962	0.228
Departure		186.99	42.67			

[W:] Significance of Wilcoxon test; [rho]: Correlation coefficient of Spearman

Figure 5.8. Correlation between weight (kg) of donkeys at arrival and departure



Spearman's correlation coefficient, rho=0.962 (p<0.001)

Despite this, statistically significant differences were found between the weight of geldings on arrival and at departure (p_W=0.002); there was significant weight loss in geldings during their time in the NAU (Table 5.190). Statistically significant differences were also found between the weight of stallions on arrival and at departure (p_W=0.023). There was a significant increase in weight amongst stallions during their time in the NAU. We observed that the average daily gain (Table 5.191) was significantly greater in stallions.

Table 5.190. Correlation between weight (kg) of donkeys at arrival and departure stratified by sex

Sex	Weight at	n	Mean	SD	p_{rho}	rho	p_W
Mare	Arrival	179	182.28	42.25	<0.001	0.946	0.710
	Departure		182.94	39.07			
Gelding	Arrival	311	199.51	39.38	<0.001	0.959	0.002
	Departure		197.46	38.00			
Stallion	Arrival	89	156.29	52.64	<0.001	0.976	0.023
	Departure		158.53	50.41			

$^{W:}$ Significance of Wilcoxon test; ^{rho}: Correlation coefficient of Spearman

Table 5.191. Average daily gain (kg/day) in donkeys stratified by sex

Sex	n	Mean	SD	Q1	Median	Q3	min	Max
Mare	179	-0.001^a	0.149	-0.095	-0.014	0.098	-0.545	0.351
Gelding	311	-0.029^a	0.142	-0.120	-0.017	0.060	-0.573	0.449
Stallion	89	0.022^b	0.123	-0.040	0.032	0.087	-0.455	0.508
Total	**579**	**-0.012**	**0.142**	**-0.100**	**-0.009**	**0.071**	**-0.573**	**0.508**

Significance of Kruskal-Wallis test, p=0.002
Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test by pairs (p<0.050)

When looking at the average daily gain in donkeys and their age, it was found that there were statistically significant differences ($p_{KW}<0.001$). Three subgroups were identified (Table 5.192), and younger donkeys (under 1 year of age) were found to have significantly greater gain than the other subgroups, with a mean of 0.09 kg/day. Interestingly, the second subgroup were young donkeys under 3 years old with a mean of 0.03 kg day.

In contrast, the remaining age categories including young adults, adults and geriatric donkeys experienced weight loss and their mean was significantly lower, with means of -0.01 kg/day, -0.03 kg/day and -0.03 kg/day respectively (Table 5.192).

Table 5.192. Average daily gain (kg/day) in donkeys stratified by age category

Age (cat)	n	Mean	SD	Q1	Median	Q3	min	Max
≤ 1 y	28	0.09^{a}	0.07	0.04	0.08	0.14	0.0	0.2
(1 y, 3 y]	69	0.03^{b}	0.13	-0.02	0.04	0.11	-0.5	0.4
(3 y, 5 y]	108	-0.01^{c}	0.14	-0.12	-0.01	0.08	-0.3	0.5
(5 y, 20 y]	327	-0.03^{c}	0.15	-0.11	-0.02	0.06	-0.6	0.4
> 20 y	47	-0.03^{c}	0.14	-0.13	-0.07	0.06	-0.3	0.3

Significance of Kruskal-Wallis test, p<0.001
Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test by pairs (p<0.050)

Statistically significant differences were found (Table 5.193) in some of the age groups between weight (kg) on arrival and at departure.

Firstly, statistically significant differences were found between weight on arrival and at departure in younger donkeys (less than 1 year old) ($p_w<0.001$), these donkeys were significantly lighter on arrival with a mean weight of 107.89 kg, whilst their mean weight at departure was 115.18 kg (Table 5.193).

Secondly, statistically significant differences were found between weight on arrival and at departure in young donkeys, from 1 to 3 years old ($p_w=0.001$). These donkeys were significantly lighter on arrival with a mean weight of 156.59 kg, and a mean weight at departure of 160.70 kg (Table 5.193).

Thirdly, statistically significant differences were found between the weight of adult donkeys (5 to 20 years old) at arrival and departure. Weight on departure was significantly lower than at arrival with a mean weight of 201.02 kg at arrival and a mean weight on departure of 199.17kg (Table 5. 193).

Finally, statistically significant differences were found between arrival and departure weights in geriatric donkeys (over 20 years old) ($p_w=0.049$). This group of donkeys had a significantly lower weight at departure compared to arrival, with mean weights of 185.81 kg at arrival and 182.45 kg at departure ($p_w=0.049$) (Table 5.193).

Table 5.193. Correlation between weight (kg) of donkeys at arrival and departure stratified by age

Age (cat)	Weight at	n	Mean	SD	p_{rho}	rho	p_W
≤ 1 y	Arrival	28	107.89	39.50	<0.001	0.984	<0.001
	Departure		115.18	37.72			
(1 y, 3 y]	Arrival	69	156.59	39.97	<0.001	0.963	0.001
	Departure		160.70	38.77			
(3 y, 5 y]	Arrival	108	187.93	35.56	<0.001	0.956	0.661
	Departure		187.48	34.88			
(5 y, 20 y]	Arrival	327	201.02	39.88	<0.001	0.953	0.002
	Departure		199.17	38.24			
> 20 y	Arrival	47	185.81	39.33	<0.001	0.948	0.049
	Departure		182.45	37.08			

$^{W:}$ Significance of Wilcoxon test; ^{rho}: Correlation coefficient of Spearman

Statistically significant differences were found between average daily gain in donkeys and age (p_{KW}<0.001). It was observed (Table 5.194) that there were three subgroups of donkeys with similar average daily gains. Foals and donkeys younger than 1 year old had the highest average daily gain with a mean of 0.085 kg/day followed by young donkeys (1 to 3 years old) with a mean average daily gain of 0.033 kg/day.

On the other hand, the remaining age groups had a daily loss with a similar average of -0.014 kg/day in young adults (3 years old to 5), -0.027 kg/day in adults (5 years old to 20 years old) and -0.030 kg/day in geriatric donkeys (older than 20 years old) (Table 5.194).

Table 5.194. Average daily gain (kg/day) in donkeys stratified by age

Age	n	Mean	SD	Q1	Median	Q3	min	Max
≤ 1 y	28	0.085^a	0.069	0.035	0.078	0.142	-0.03	0.23
(1 y, 3 y]	69	0.033^b	0.130	-0.024	0.038	0.111	-0.45	0.35
(3 y, 5 y]	108	-0.014^c	0.138	-0.119	-0.013	0.080	-0.34	0.51
(5 y, 20 y]	327	-0.027^c	0.146	-0.109	-0.019	0.059	-0.57	0.45
> 20 y	47	-0.030^c	0.142	-0.134	-0.065	0.062	-0.33	0.29

Significance of Kruskal-Wallis test, p<0.001
Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test by pairs (p<0.050)

Statistically significant differences were found between the weight of donkeys on arrival and at departure in every BCS category with the exception of the None category (where there was no information with regards to BCS) (Table 5.195). Donkeys that had a poor BCS of 1-1.5 experienced a significant increase in body weight (4.51%) whilst in the NAU, with a mean body weight increase of 7.5 kg. Similarly, donkeys that had a BCS of

1.75-2.5 also experienced a significant increase of 5.7% of their body weight during their time in the NAU, with a 9.33 kg mean increase in their body weight at departure.

There were also statistically significant differences between body weight on arrival and at departure for donkeys with a BCS of 2.75 to 3.5. This group increased their mean body weight during their NAU period by only 1.59 kg (a 0.88% increase in body weight), maintaining a similar body weight overall.

On the other hand, overweight donkeys, with a BCS of 3.75-4.5 experienced a significant decrease in their body weight. Their mean body weight decreased by 5.5 kg (a 2.67% decrease in body weight). Lastly, obese donkeys, with a BCS of 4.75-5 also decreased their body weight whilst in the NAU. Mean body weight decreased by 11.82 kg (a 5.61% decrease in body weight).

These findings support the current NAU management system with regards to feeding, showing that underweight donkeys gain weight, and overweight and obese donkeys progressively reduce their body weight. The amount of time spent in the NAU varies from one individual to another, but they each have a minimum period of six weeks. Any sudden variation in weight, or weight gain or loss of over 5% of their body weight is assessed during their NAU period, and these donkeys are examined by a vet to ensure their health and welfare.

Table 5.195. Correlation between weight (kg) of donkeys at arrival and departure stratified by body condition score at arrival

BCS	Weight at	n	Mean	SD	p_{rho}	rho	p_W
None	Arrival	11	164.82	75.79	<0.001	0.982	0.062
	Departure		170.82	73.10			
1-1.5	Arrival	10	159.10	55.21	0.002	0.842	0.041
	Departure		166.60	55.33			
1.75-2.5	Arrival	51	163.47	43.98	<0.001	0.979	<0.001
	Departure		172.80	46.35			
2.75-3.5	Arrival	304	181.47	45.59	<0.001	0.969	0.004
	Departure		183.06	44.20			
3.75-4.5	Arrival	155	203.66	36.54	<0.001	0.948	<0.001
	Departure		198.15	34.96			
4.75-5	Arrival	48	210.65	29.71	<0.001	0.936	<0.001
	Departure		198.83	27.49			

$^{W:}$ Significance of Wilcoxon test; ^{rho}: Correlation coefficient of Spearman

When examining the average daily weight gain (Table 5.196), there are statistically significant differences between overweight donkeys with a BCS above 3.5 and those at an ideal BCS or underweight (p_{KW}<0.001). Overweight donkeys with a BCS of 4.75-5 had a mean average daily loss of 150 g/day, which was similar to those with a BCS of 3.75-4.5. There was a second subgroup of donkeys with a BCS between 2.75 and 4.5; whose average daily gain was 8 and -81 g/day respectively. The third subgroup included donkeys with a BCS 1 to 3.5, with a similar average daily gain of around 100 g/day.

In summary, diet management was found to be adequate whilst donkeys were in the NAU, with those that were underweight gaining weight, and those that were overweight and obese losing weight.

Table 5.196. Average daily gain (kg/day) in donkeys stratified by body condition score at arrival

BCS	n	Mean	SD	Q1	Median	Q3	min	Max
None	11	0.091^{c}	0.137	-0.033	0.078	0.173	-0.102	0.367
1-1.5	10	0.087^{c}	0.110	0.023	0.069	0.124	-0.049	0.339
1.75-2.5	51	0.116^{c}	0.103	0.043	0.098	0.154	-0.037	0.417
2.75-3.5	304	0.013^{bc}	0.117	-0.047	0.019	0.083	-0.339	0.449
3.75-4.5	155	-0.076^{ab}	0.144	-0.167	-0.084	-0.011	-0.545	0.508
4.75-5	48	-0.149^{a}	0.125	-0.229	-0.134	-0.051	-0.573	0.023

Significance of Kruskal-Wallis test, p<0.001
Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test by pairs (p<0.050)

5.6. Endoparasite status of donkeys

Donkeys have been reported as a unique and challenging endoparasitic host, moreover, donkeys under stress due to malnourishment, infectious disease, overwork and neglect are at a higher risk of disease-related parasite infection and careful consideration must be given to targeted treatments (Burden and Getachew, 2016). The isolation period after movement of donkeys into the NAU at TDS should therefore be considered a high-risk period for endoparasitic related disease.

It has been observed that donkeys kept in temperate climates can become overweight if they are allowed free access to grazing without restrictions. On the other hand, restricting grazing can influence their normal behavior. When restricted, donkeys might graze close to dung piles and their commonly grazed area averages 0.1-0.2 ha/animal; such stock densities mean that larval contamination can become high on land that is not effectively managed (Matthews and Burden, 2013).

Studies at the Donkey Sanctuary (UK) have shown substantially reduced strongyle FWEC in donkeys grazing pastures where dung was lifted mechanically or manually twice a week, when compared to pastures with no dung removal (Matthews and Burden, 2013).

Cox et al. (2010) looked at the health status of TDS guardian donkeys and found that the majority of guardian donkeys in the UK followed some type of internal parasite treatment (91%). However, no other data is available with regards to privately owned donkeys with regards to frequency of treatments, choice of anthelmintics and management of land.

Moreover, Morrow et al. (2011) determined that of 1,444 donkeys that presented at post mortem, 16.0% harboured helmintic infections that were classed as moderate to high cyathostomin or mixed species burdens.

5.6.1. Last anthelmintic treatment information

Parasitology information was recorded generally by welfare advisers on their first visit and it was reported by vets at the time of the PAM in those animals that received a clinical examination.

The information was classified for the purpose of the study into five different categories:

- *Date-Product:* Donkeys included in this category had a complete record of their last anthelmintic treatment, including date and type of anthelmintic (active ingredient).
- *Date-No product:* This category included all the donkeys that had a date of last anthelmintic treatment, but the owner did not specify type of anthelmintic given.
- *Unknown date-Product:* This category included all the donkeys where the owner had specified the type of anthelmintic last used, but did not record the date of administration.
- *Unknown date-No product:* Donkeys in this category comprised those where the owner specified that they had treated their donkey, but did not provide information regarding when or product used.
- *No date-No product:* In this category, no information was provided by the owner with regards to worming; in these cases, it is possible that these donkeys did not receive any anthelmintic treatment from their owners.

Interestingly, in 21.0% of the donkeys admitted, the owner gave no history of any previous worming (Table 5.197). TDS should ask owners at the time of admission the reasons as to why donkeys have not been wormed. For example, were decisions made in conjunction with their vet and based on FWEC, or was it due to other reasons such as financial, lack of awareness or neglect. TDS should aim to advise donkey owners on methods of parasite control, and thereby improve overall welfare, to serve both donkeys and the other grazing species that might be affected (Burden and Getachew, 2016).

This finding does not coincide with those of Cox et al. (2010) in their study of a guardian donkey population. In their study, all of the donkeys received some form of preventative healthcare during the study, most frequently treatment for internal parasites (91.0%) and/or vaccinations (84.0%). The Cox et al. (2010) study also found that pasture management to reduce the presence of parasites was common amongst donkey owners. The most frequent action being removal of droppings (80.0%), and/or species or pasture rotation (34.0%). It would have been interesting to assess what type of pasture management owners had been following, and it might be beneficial to request that information before admission in the future.

Table 5.197. Information about anthelmintic use in donkeys

Treatment information	n	%
Date - Product	388	65.1%
No date - No product	125	21.0%
Date - No product	58	9.7%
Unknown date - No product	21	3.5%
Unknown date - Product	4	0.7%
Total	**596**	**100.0%**

Statistically significant differences were found between the last anthelmintic treatment information for donkeys and their type of origin (p_{LR}=0.010). In Table 5.198 it can be observed that there were fewer donkeys than expected from a "New arrival" origin that had information recorded regarding the date of their last anthelmintic treatment and the product used (62.2%). It was also noted that there were more donkeys than expected from a DS HB (New arrival) origin that had the date of their last anthelmintic treatment and the product used recorded (77.6%). This finding can easily be explained as the majority of donkeys are wormed on arrival into a DS HB and therefore the date and worming are done under TDS supervision. It was also found that there were fewer donkeys than expected from the same origin that were categorised as "Unknown date-No product" (0.0%).

More donkeys than expected arriving from a "Return guardian" origin had information on their last anthelmintic treatment without a specific date and without the name of the product used ("Unknown date-No product") (8.1%). This is an interesting finding as these donkeys are still TDS property and their worming should be recorded properly by the guardian home. The welfare department should ensure that guardian homes are recording and updating each donkey's record to ensure that routine treatments are recorded.

Lastly, it was observed (Table 5.198) that there were no donkeys from DAT that had no information regarding anthelmintic administration date and product ("No date-No product") (0.0%). This finding could be expected as DAT centres are asked to update each donkey's record regularly with regards to any routine treatment. Interestingly, it was also found that there were more donkeys than expected from DAT centres that were categorised as "Unknown date-No product". This finding suggests that DAT centres should be improving their recording of routine worming to ensure complete records.

When looking at last anthelmintic treatment information in donkeys and their origin region, statistically significant differences were found (p_{LR}=0.007) (Table 5.199).

Table 5.198. Last anthelmintic treatment information in donkeys stratified by type of origin

Type of origin	Last anthelmintic treatment information				
	Date - Product (n=388)	**No date - No product** (n=125)	**Date - No product** (n=58)	**Unknown date - No product** (n=21)	**Unknown date - Product** (n=4)
New Arrival	62.2%^{L}	22.9%	10.7%	3.2%	1.0%
DS HB (NA)	77.6%^{H}	16.3%	6.1%	0.0%^{L}	0.0%
Return Guardian	59.7%	22.6%	9.7%	8.1%^{H}	0.0%
DS HB (RG)	81.8%	9.1%	0.0%	9.1%	0.0%
DAT	73.3%	0.0%^{L}	13.3%	13.3%^{H}	0.0%
Total	**65.1%**	**21.0%**	**9.7%**	**3.5%**	**0.7%**

Significance of Likelihood Ratio test, p_{LR}=0.010
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Firstly, it was observed (Table 5.199) that there were more donkeys than expected arriving from Wales with no worming date or product information (37.2%). Secondly, it was observed that there were more donkeys than expected from Greater London that had a date for their last anthelmintic treatment, but no product details (66.7%). Thirdly, it was seen that there were fewer donkeys from the South West with the date and name of their last anthelmintic treatment provided by their owners (55.8%).

Table 5.199. Last anthelmintic treatment information in donkeys stratified by origin region

Origin region	n	Last anthelmintic treatment information				
		No date - No product	**Date - No product**	**Date - Product**	**Date unknown - product unknown**	**Date unknown - Product named**
Unknown origin	4	0.0%	0.0%	100.0%	0.0%	0.0%
Scotland	27	18.5%	3.7%	77.8%	0.0%	0.0%
Northern Ireland	23	13.0%	8.7%	78.3%	0.0%	0.0%
North East	52	21.2%	9.6%	69.2%	0.0%	0.0%
North West	65	23.1%	12.3%	64.6%	0.0%	0.0%
East Midlands	54	20.4%	13.0%	66.7%	0.0%	0.0%
West Midlands	53	15.1%	7.5%	69.8%	7.5%	0.0%
Wales	43	37.2%^{H}	70.0%	55.8%	0.0%	0.0%
South West	163	23.3%	9.8%	55.8%^{L}	8.6%^{H}	2.5%^{H}
South East	92	19.6%	5.4%	71.7%	3.3%	0.0%
Greater London	3	0.0%	66.7%^{H}	33.3%	0.0%	0.0%
Total	**579**	**21.6%**	**9.2%**	**64.9%**	**3.6%**	**0.7%**

Significance of Likelihood Ratio test, p_{LR}=0.007
^{H}: Observed proportion significantlv higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Furthermore, there were more donkeys than expected from the South West where owners said that their donkeys were wormed at some point but did not provide the name of the most recent worming product used (8.6%).

Lastly, more donkeys than expected from the South West had owners who described worming their donkeys at some point and gave the name of the product used but did not specify the date of administration (2.5%).

All these findings are very interesting, as TDS should encourage owners and veterinary practices to record anthelmintic use wherever possible to facilitate TDS worming protocols on arrival. This could help reduce drug resistance and facilitate decision making with regards to which products can be safely used.

It was found that there was complete information for only 65.1% of the donkeys arriving at TDS. Interestingly, we did not have any worming information regarding donkeys in 18.3% of cases; who we suspect did not receive any routine treatment, whilst in 2.7% of cases the owner reported that they did not worm the donkeys at all (Table 5.200).

Table 5.200. Last anthelmintic treatment information in donkeys

Last anthelmintic treatment information	n	%
No worming	16	2.7%
No information	109	18.3%
Partial information	83	13.9%
Complete information	388	65.1%
Total	**596**	**100.0%**

Statistically significant differences were found between the information regarding their last anthelmintic treatment and type of origin (p_{LR}=0.010). It was found (Table 5.201) that there were more donkeys than expected from a new arrival origin that did not receive any anthelmintic (3.7%), whilst there were fewer donkeys than expected from the same origin that had complete information regarding their last anthelmintic treatment (62.2%).

It can be seen (Table 5.201) that there were fewer donkeys than expected from DS HB (NA) that had partial information regarding their last anthelmintic treatment (6.1%). This is interesting as they should always have complete information especially if their last anthelmintic treatment was at TDS premises; although this is generally the rule, 6.1% of these donkeys arrived with partial information only. DS HB record keeping should be reviewed and TDS should ensure that holding bases are recording information correctly. It was also observed that more donkeys than expected from the same origin had complete information regarding the details of their last anthelmintic treatment (77.6%).

Table 5.201. Last anthelmintic treatment information in donkeys stratified by type of origin

Type of origin	Last anthelmintic treatment information			
	No information (n=109)	**No worming** (n=16)	**Partial information** (n=83)	**Complete information** (n=388)
New Arrival	19.3%	3.7%^{H}	14.9%	62.2%^{L}
DS HB (NA)	15.3%	1.0%	6.1%^{L}	77.6%^{H}
Return Guardian	22.6%	0.0%	17.7%	59.7%
DS HB (RG)	9.1%	0.0%	9.1%	81.8%
DAT	0.0%	0.0%	26.7%	73.3%
Total	**18.3%**	**2.7%**	**13.9%**	**65.1%**

Significance of Likelihood Ratio test, p_{LR}=0.010
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

When looking at the information provided regarding worming and origin regions; it was found that there were statistically significant differences (p_{LR}=0.012) (Table 5.202).

In Table 5.202 it can be observed that there were more donkeys from Wales that had no information regarding their last anthelmintic treatment (34.9%). In the majority of these cases, it is reasonable to assume that donkeys are not following a worming program and have not been regularly treated or FWEC tested.

Table 5.202. Last anthelmintic treatment information in donkeys stratified by origin region

Origin region	n	Last anthelmintic treatment information			
		No info	**No worming**	**Partial info**	**Complete info**
Unknown origin	4	0.0%	0.0%	0.0%	100.0%
Scotland	27	18.5%	0.0%	3.7%	77.8%
Northern Ireland	23	13.0%	0.0%	8.7%	78.3%
North East	52	21.2%	0.0%	9.6%	69.2%
North West	65	15.4%	7.7%^{H}	12.3%	64.6%
East Midlands	54	20.4%	0.0%	13.0%	66.7%
West Midlands	53	15.1%	0.0%	15.1%	69.8%
Wales	43	34.9%^{H}	2.3%	7.0%	55.8%
South West	163	19.6%	3.7%	20.9%^{H}	55.8%^{L}
South East	92	15.2%	4.3%	8.7%	71.7%
Greater London	3	0.0%	0.0%	66.7%^{H}	33.3%
Total	**579**	**18.8%**	**2.8%**	**13.5%**	**64.9%**

Significance of Likelihood Ratio test, p_{LR}=0.012
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Secondly, it was found that there were more donkeys than expected from the North West (7.7%) whose owners said that their donkeys had not been wormed. It was also seen (Table 5.202) that there were more donkeys than expected from the South West (20.9%) and Greater London (66.7%) that had partial information regarding their last anthelmintic treatment; either date or name of product used was given.

Lastly, it was observed that there were fewer donkeys from the South West with complete information regarding their last anthelmintic treatment (date and product used) (55.8%).

The Donkey Sanctuary could launch specific worming and information campaigns aimed at owners and veterinary practices around Wales and the South West to encourage regular FWECs and anthelmintic treatment when necessary to improve the welfare of donkeys in those regions.

Statistically significant differences were found between the date of last anthelmintic administration with partial information and those with complete information (p_{MW}=0.024). Donkeys with complete information regarding their last anthelmintic treatment also had their last anthelmintic treatment much more recently than those with only partial information, in those the mean was 169.09 days versus 136.19 days for those with complete information (Table 5.203).

Table 5.203. Days since last anthelmintic treatment in donkeys stratified by information

Last anthelmintic treatment	n	Mean	SD	Q1	Median	Q3	min	Max
Partial info	58	169.09	131.80	76.75	124.50	200.00	11	551
Complete info	388	136.19	121.95	54.75	108.00	165.00	1	762
Total	**446**	**140.47**	**123.61**	**57.00**	**109.00**	**175.25**	**1**	**762**

Significance of Mann-Whitney test, p=0.024

There were no statistically significant differences found between the number of days since their last anthelmintic administration in donkeys with complete worming information and their sex (p_{KW}=0.463) (Table 5.204).

Table 5.204. Days from last anthelmintic treatment in donkeys with complete worming information stratified by sex

Sex	n	Mean	SD	Q1	Median	Q3	min	Max
Mare	114	128.32	104.97	66.75	111.50	143.75	2	581
Gelding	226	143.75	132.53	52.50	108.50	171.00	1	762
Stallion	48	119.31	105.66	48.25	79.00	151.00	7	458
Total	**388**	**136.19**	**121.95**	**54.75**	**108.00**	**165.00**	**1**	**762**

Significance of Kruskal-Wallis test, p=0.463

Statistically significant differences were not found between the number of days since their last anthelmintic administration and age category (p_{KW}=0.321) (Table 5.205).

Table 5.205. Days since last anthelmintic treatment in donkeys with complete worming information stratified by age (categorised)

Age (cat)	n	Mean	SD	Q1	Median	Q3	min	Max
≤ 1 y	16	101.50	78.60	34.50	93.00	180.00	2.0	277.0
(1 y, 3 y]	46	115.93	102.07	49.25	79.50	171.00	11.0	403.0
(3 y, 5 y]	81	149.21	131.19	57.00	99.00	185.00	2.0	506.0
(5 y, 20 y]	260	144.86	127.97	57.75	115.00	178.00	2.0	762.0
> 20 y	43	138.21	115.16	57.00	108.00	170.00	1.0	551.0

Significance of Kruskal-Wallis test, p=0.321

Statistically significant differences were found between the number of days since their last anthelmintic administration in donkeys with complete information and their type of origin (p_{KW}=0.009) (Table 5.206). Interestingly, three groups were identified, and of those, DS HB (RG) had the most recent worming treatment. This finding can be explained as these animals would have been wormed on arrival at the HB and sometimes before transport to TDS New arrivals unit, with a mean of 50.56 days. The mean was similar for those coming from DS HB (NA) and “New arrival” with means of 128.86 and 130.04 days respectively. These two groups had similar means to the “Return guardian” donkeys whose mean was 172.46 days.

Table 5.206. Days from last anthelmintic treatment in donkeys with complete worming information stratified by type of origin

Type of origin	n	Mean	SD	Q1	Median	Q3	min	Max
New Arrival	410	130.04[ab]	103.07	63.00	109.00	165.00	1	581
DS HB (NA)	98	128.86[ab]	124.61	45.75	86.50	151.00	2	600
Return Guardian	62	172.46[b]	159.77	43.00	135.00	233.50	12	608
DS HB (RG)	11	50.56[a]	29.16	26.00	46.00	81.50	24	97
DAT	15	277.55[c]	248.64	38.00	248.00	512.00	11	762

Significance of Kruskal-Wallis test, p=0.009
Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test by pairs (p<0.050).

Lastly, donkeys with the longest number of days since their last anthelmintic administration were those coming from DAT centres with a mean of 277.55 days since their last anthelmintic treatment. DAT donkeys are regularly screened and are wormed if necessary based on their FWEC.

In summary, these findings show that donkeys from a “New arrival” origin are wormed much more frequently, whilst donkeys under TDS care are only wormed when necessary. These findings support concerns regarding parasite resistance and the need to preserve anthelmintics. TDS advises worming according to faecal worm egg count results. Advice and protocols are different for donkeys at TDS premises and those that are privately owned. It would have been interesting as part of this study to identify where owners obtain worming information from: vets, TDS welfare advisers, internet, pharmacist, SQP (Suitably Qualified Person). This information could help shape future educational programs.

5.6.2. Last anthelmintic treatment used

Table 5.207 shows the use of different worming products before arrival at TDS, depending on the type of origin of the donkeys. The most frequently used products were ivermectin (Eqvalan™, Vectin™, Furexel™, Panomec™) (42.0%) and moxidectin (Equest™) (39.2%), while praziquantel (Equitape™), fenbendazole (Panacur™, Zerofen™, Panacur Guard™), pyrantel (Strongid P™, Pyratape P™, Exodus™) and closantel (Flukiver™) were used with low frequency, and finally mebendazole (Telmin™) and triclabendazole (Fasinex™, Tribex™) were hardly used.

Donkeys can be treated with the same anthelmintics as horses, although very few anthelmintics have evidence based dosing data specifically for donkeys (Grosenbaugh et al., 2011). However, control is threatened by anthelmintic resistance: resistance to all three available anthelmintic classes has been recorded in donkeys in the UK (Matthews and Burden, 2013).

Notable differences in parasite dynamics and treatment regimens between horses and donkeys have been reported, the most important being the lack of anthelmintic products licensed for use in donkeys (Evans and Crane, 2018g). As a result, anthelmintic treatment can be challenging in donkeys.

An association was found between the use of ivermectin and type of origin (p_{X2}=0.043) (Table 5.207), where more donkeys than expected that received ivermectin were from a “New arrivals” origin (47.1%); on the other hand, there were fewer donkeys than expected from a DS HB (NA) origin that had ivermectin as their last anthelmintic treatment (30.3%).

With regards to the use of moxidectin, statistically significant differences were found between the use of this wormer as their last anthelmintic treatment and origin (p_{X2}=0.043). More donkeys than expected from a DAT origin used moxidectin as their last anthelmintic treatment (72.7%), whilst fewer than expected from a “New arrival” origin received moxidectin at their last anthelmintic treatment.

It was found that there were statistically significant differences between the use of pyrantel as their last anthelmintic treatment and origin (p_{LR}=0.003). More donkeys than expected from a "Return guardian" origin received pyrantel as their last treatment when compared to the other origins (27%). It was also noted that fewer donkeys than expected from a "New arrivals" origin had pyrantel as their last anthelmintic treatment.

Moreover, it was found (Table 5.207) that there was a significant association between the use of closantel and type of origin (p_{LR}<0.001). More donkeys than expected that had closantel as their last anthelmintic treatment came from DS HB (NA) (17.1%), and fewer donkeys than expected arriving as "New arrivals" received closantel at their last treatment (1.6%). Lastly, statistically significant differences were found between the use of triclabendazole and type of origin (p_{LR}=0.043), where more donkeys than expected were from a DS HB (NA) origin (3.9%) and there were no donkeys coming from a "New arrival" origin (0.0%) (Table 5.207).

Table 5.207. Use of different worming products in donkeys with complete last anthelmintic treatment information stratified by type of origin

Last anthelmintic products	**New Arrival** (n=255)	**DS HB (NA)** (n=76)	**Return Guardian** (n=37)	**DS HB (RG)** (n=9)	**DAT** (n=11)	**Total** (n=388)	**p**
Ivermectin	47.1%^{H}	30.3%^{L}	40.5%	33.3%	18.2%	**42.0%**	0.043^{X2}
Moxidectin	34.1%^{L}	48.7%	37.8%	66.7%	72.7%^{H}	**39.2%**	0.008^{X2}
Praziquantel	11.0%	7.9%	13.5%	0.0%	0.0%	**10.1%**	0.254^{LR}
Fenbendazole	9.4%	9.2%	10.8%	11.1%	0.0%	**9.3%**	0.684^{LR}
Pyrantel	5.5%^{L}	3.9%	27.0%^{H}	11.1%	9.1%	**7.5%**	0.003^{LR}
Closantel	1.6%^{L}	17.1%^{H}	0.0%	0.0%	0.0%	**4.4%**	<0.001^{LR}
Mebendazole	2.7%	0.0%	0.0%	0.0%	0.0%	**1.8%**	0.203^{LR}
Triclabendazole	0.0%^{L}	3.9%^{H}	0.0%	0.0%	0.0%	**0.8%**	0.043^{LR}

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Firstly, statistically significant differences were found between the use of ivermectin and origin region (p_{LR}=0.008). It was found (Table 5.208) that there were fewer donkeys from the North West (26.2%) and the East Midlands (25.0%), that received ivermectin as a last anthelmintic product prior to arrival, whilst more donkeys than expected from the West Midlands received this medication at their last anthelmintic treatment (62.2%). When looking at the use of moxidectin and origin regions, statistically significant differences were not found (p_{X2}=0.800).

Statistically significant differences were also not found with regards to the use of praziquantel as a last anthelmintic product and origin region (p_{LR}=0.113). Despite not finding statistical differences, if residuals are taken into consideration there were more donkeys than expected from Scotland (23.8%) and the West Midlands (21.6%) that received praziquantel.

Table 5.208. Use of different worming products in donkeys with complete last anthelmintic treatment information stratified by origin region

Origin region	n	Last anthelmintic product			
		Ivermectin	Moxidectin	Praziquantel	Fenbendazole
Unknown origin	4	75.0%	25.0%	0.0%	0.0%
Scotland	21	42.9%	23.8%	23.8%[H]	0.0%
Northern Ireland	18	38.9%	44.4%	0.0%	0.0%
North East	36	52.8%	41.7%	13.9%	2.8%
North West	42	26.2%[L]	38.1%	4.8%	16.7%
East Midlands	36	25.0%[L]	38.9%	11.1%	16.7%
West Midlands	37	62.2%[H]	32.4%	21.6%[H]	2.7%
Wales	24	58.3%	33.3%	8.3%	0.0%
South West	95	41.1%	45.3%	7.4%	11.6%
South East	66	36.4%	42.4%	9.1%	15.2%
Greater London	1	100.0%	0.0%	0.0%	0.0%
Total	**380**	**41.8%**	**39.5%**	**10.3%**	**9.5%**
p		0.008 [LR]	0.800 [X2]	0.113 [LR]	0.005 [LR]

[X2]: Significance of Pearson's Chi-square test; [LR]: Significance of Likelihood Ratio test
[H]: Observed proportion significantly higher than expected (p<0.050)
[L]: Observed proportion significantly lower than expected (p<0.050)

Table 5.208 (cont.) Use of different worming products in donkeys with complete last anthelmintic treatment information stratified by origin region

Origin region	n	Last anthelmintic product			
		Pyrantel	Closantel	Mebendazole	Triclabendazole
Unknown origin	4	0.0%	50.0%[H]	0.0%	25.0%
Scotland	21	23.8%[H]	0.0%	0.0%	0.0%
Northern Ireland	18	0.0%	55.6%[H]	0.0%	11.1%[H]
North East	36	0.0%	0.0%	2.8%	0.0%
North West	42	7.1%	5.6%	7.1%[H]	0.0%
East Midlands	36	11.1%	0.0%	5.6%	0.0%
West Midlands	37	2.7%	0.0%	0.0%	0.0%
Wales	24	8.3%	0.0%	0.0%	0.0%
South West	95	8.4%	1.1%[L]	1.1%	0.0%
South East	66	6.1%	0.0%[L]	0.0%	0.0%
Greater London	1	0.0%	0.0%	0.0%	0.0%
Total	**380**	**7.1%**	**4.5%**	**1.8%**	**0.8%**
p		0.074 [LR]	0.001 [LR]	0.254 [LR]	0.055 [LR]

[LR]: Significance of Likelihood Ratio test
[H]: Observed proportion significantly higher than expected (p<0.050)
[L]: Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between the use of fenbendazole and origin region (p_{LR}=0.005).

With regards to the use of pyrantel as the last anthelmintic treatment, there were no significant differences (p_{LR}=0.074). However, if taking residuals into consideration, there were more donkeys than expected from Scotland that received pyrantel as a last anthelmintic treatment (23.8%).

When looking at the use of closantel as a last anthelmintic treatment, it was found that there were statistically significant differences between its use and origin region ($p_{LR=}$0.001). More donkeys than expected from an unknown origin (50.0%) and Northern Ireland (55.6%) received closantel as their last anthelmintic treatment, whilst fewer than expected from the South West (1.1%) had closantel at their last treatment.

Statistically significant differences were not found between the use of mebendazole as a last anthelmintic treatment and origin region (p_{LR}=0.254). However, if taking residuals into consideration, there were more donkeys than expected from the North West receiving this product as their last anthelmintic treatment (7.1%).

Finally, it was observed that there were no statistically significant differences between the use of triclabendazole as a last anthelmintic treatment and origin region (p_{LR}=0.055). Despite this finding, if taking residuals into consideration, it was observed that there were more donkeys than expected from Northern Ireland that were given triclabendazole as their last anthelmintic treatment (11.1%). This finding is suggestive of a higher liver fluke incidence. Closantel is the first drug of choice against this parasite and so increased use of triclabendazole may have occurred under the cascade system if closantel was found to be ineffective. Further investigation might be needed for donkeys that emanate from Northern Ireland.

Several commercial combination wormers are available, include the following combinations: ivermectin + praziquantel (Equimax™, Equimax Tabs™, Eqvalan Duo™ and Noropraz™) and moxidectin + praziquantel (Equest Pramox™).

The association between different wormers was assessed and the following combinations were noted in order of prevalence: ivermectin and praziquantel (5.9%), moxidectin and praziquantel (3.6%), fenbendazole and moxidectin (1.3%), closantel and ivermectin (1.0%), closantel and moxidectin (0.8%), fenbendazole and pyrantel (0.8%), moxidectin and pyrantel (0.8%), ivermectin and moxidectin (0.5%), triclabendazole and moxidectin (0.5%), triclabendazole and ivermectin (0.3%), and fenbendazole and ivermectin (0.3%).

5.6.3. Prevalence of parasites on arrival

The most frequently allocated NAU location for donkeys on arrival and departure was Clifford Smith shelter (12.0% and 13.7%, respectively). This finding can be easily explained as Clifford Smith is a large shelter suitable for larger groups of young donkeys; and this study identified that during the 30 months study period the majority of donkeys arriving at TDS were younger. The second most populated shelter for donkeys on arrival was SH3 (12.0%) followed by SH6 (8.4%). Interestingly, Clifford Smith and SH3 are not the best shelters with regards to biosecurity and should perhaps have been used less frequently than others.

Interestingly, it was observed (Table 5.209) that there were units and shelters where there was a tendency for donkeys to be moved again, such as units 1, 2 and 4, SH3, stallion boxes (1, 2, 3 and 4), special needs shelter 5, 6 and 7. These locations are generally used for smaller groups and stallions (until they're castrated), therefore once donkeys are considered settled they might move to a bigger group in a different location within the NAU for the rest of their isolation period. Movements between shelters are very limited and generally avoided to ensure biosecurity and keep time in the NAU at a minimum.

Table 5.209. Frequency of location of animals during their time in the NAU

Location in the NAU	At arrival		At departure		Variation
	n	%	n	%	
Clifford Smith	77	12.0%	88	13.7%	11
SH3	77	12.0%	65	10.1%	-12
SH6	54	8.4%	58	9.0%	4
Unit 1	50	7.8%	30	4.7%	-20
SH7	49	7.6%	56	8.7%	7
SH4	48	7.5%	73	11.3%	25
SH2	42	6.5%	51	7.9%	9
Unit 4	40	6.2%	16	2.5%	-24
SH1	38	5.9%	67	10.4%	29
SH5	33	5.1%	40	6.2%	7
Unit 2	22	3.4%	12	1.9%	-10
Unit 3	21	3.3%	31	4.8%	10
Resident Group	21	3.3%	21	3.3%	0
Stallion box 3	15	2.3%	8	1.2%	-7
Stallion box 4	15	2.3%	5	0.8%	-10
SH6 special needs	14	2.2%	2	0.3%	-12
SH7 special needs	7	1.1%	6	0.9%	-1
SH5 special needs	7	1.1%	4	0.6%	-3
Stallion box 1	6	0.9%	0	0.0%	-6
Clifford Smith back	3	0.5%	9	1.4%	6
Stallion box 2	3	0.5%	0	0.0%	-3
Box 2	2	0.3%	2	0.3%	0

There was a tendency towards no movement in locations such as: resident group and box 2. These shelters are frequently used for donkeys with special requirements, such as heavily pregnant mares or donkeys in need of box rest.

The remaining locations within the NAU (SH1, 2, 4, 5, 6, 7; unit 3 and Clifford Smith and back) tend to admit more donkeys in the NAU, which would usually be those donkeys moving from smaller groups that are considered settled and would benefit from moving to a bigger group. Movements would be normally done in the first two weeks of their NAU period and other unnecessary movements would be avoided as part of TDS "New arrivals" protocol.

In future, TDS admissions should aim to reduce the number of donkeys per group, taking pasture management into consideration.

It was found that the mean time for parasite control after arrival was 1.48 ± 4.53 days, with a median of 1 day and a range from -28 to 66 days. This finding would be expected as part of TDS standard protocols. Faecal samples are collected on arrival or the following day if possible and sent to TDS lab for FWEC results. Results are normally available by the next working day or in 2-3 days if samples are collected on a Friday. Arrival of donkeys should be limited to days earlier in the week to ensure early parasite control whenever possible.

It was found that 18.7% of the donkeys had FWEC results on the day of arrival (day 0), whilst the majority of donkeys had their first FWEC results on day 1 (61.6%), and a few had their results on day 2 (5.0%) and day 3 (2.4%). Delay in producing FWEC results has an impact on donkeys' access to grazing and increases the risk of them suffering from stress and subsequently developing life- threatening conditions such as colitis and hyperlipemia. In 3.3% of cases the FWEC value was negative because anthelmintic control had been carried out in DS HB.

It was found that 80.1% of the donkeys were parasitised by *Strongylus* spp. (Table 5.210); interestingly, 34.9% of donkeys had a burden higher than 300 eggs per gram. Matthews and Burden (2013) reported that in donkey populations where animals are administered anthelmintics on a regular basis, most harbour low burdens of parasitic nematode infections; therefore, the results found in this study suggest that the majority of donkeys have not received regular treatments and their endoparasite management has been inadequate.

The second most prevalent parasite found was liver fluke (9.4%). Matthews and Burden (2013) reported that liver fluke (*Fasciola hepatica)* affects mainly cattle and sheep, but can infect all grazing animals. A coprological survey (n=735) of new relinquishments into the Donkey sanctuary (UK) indicated an infection prevalence of 4% which is much lower than that found in this study. Anthelmintic resistance has reportedly been increasing in fluke populations in the UK (Matthews and Burden, 2013).

Interestingly, in previously unpublished data, Burden (2013) reported a higher prevalence (4.0%) of lungworm (positive on coprological examination) in "New arrival donkeys" than the prevalence found in this study (3.1%).

Table 5.210. Parasite prevalence in donkeys at arrival (n=584)

Parasite prevalence	n	%
Strongylus spp.	468	80.1%
Strongylus spp. >300 e.p.g.	204	34.9%
Liver fluke (*Fasciola hepatica*)	55	9.4%
Lungworm (*Dictyocaulus arnfieldi*) *	18	3.1%
Tapeworm (*Anoplocephala magna* and *A. perfoliata*)	7	1.2%
Ascarids (*Parascaris equorum*)	4	0.7%

* For lungworm n=583

Statistically significant differences were not found when looking at the association between different parasites (Table 5.211). Apart from the presence of lungworm and stronglyles at arrival (p_{LR}=0.004), all of the donkeys that had lungworm detected on faecal sample also had *Strongylus* spp. (3.1%).

Three out of the six donkeys that had three different parasites at the time of their FWEC had a combination of lungworm, *Strongylus* spp. and liver fluke.

Table 5.211. Frequency of different parasites in faecal samples of donkeys on arrival (n=596)

Number of different parasites	n	%
0 (no infestation)	107	18.4%
1 (simple infestation)	407	69.8%
2 (co-infestation)	63	10.8%
3 (multiple co-infestation)	6	1.0%

Firstly, statistically significant differences were found between the presence of *Strongylus* spp. and sex (p_{X2}=0.015). It was found that more stallions than expected had *Strongylus* spp. on arrival (91.2%) (Table 5.212). Moreover, statistically significant differences were also found between donkeys that had a high *Strongylus* spp. burden of more than 300 eggs per gram (e.p.g.) and sex (p_{X2}=0.007); it was observed that more stallions than expected had 300 e.p.g. of *Strongylus* spp. (49.5%).

Additionally, statistically significant differences were found between the presence of ascarids and sex (p_{LR}=0.011). It was found that geldings did not have any ascarids present (0.0%) (Table 5.212).

Table 5.212. Prevalence of parasites in donkeys at arrival stratified by sex

Parasites	Mare (n=184*)	Gelding (n=309)	Stallion (n=91)	Total (n=584*)	p
Strongylus spp.	78.8%	77.7%	91.2%^{H}	**80.1%**	0.015^{X2}
Strongylus spp. >300 e.p.g.	31.5%	32.7%	49.5%^{H}	**34.9%**	0.007^{X2}
Liver fluke	11.4%	8.7%	7.7%	**9.4%**	0.511^{X2}
Lungworm	3.3%	1.9%	6.6%	**3.1%**	0.077^{X2}
Tapeworm	0.5%	1.0%	3.3%	**1.2%**	0.195^{LR}
Ascarids	0.5%	0.0%^{L}	3.3%	**1.0%**	0.011^{LR}

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
*: number of mares for lungworm was n=183

When looking at the prevalence of parasites and the association with age category; an association was found between the prevalence of *Strongylus* spp. and age of donkeys (p_{X2}=0.004) (Table 5.213).; it was found that fewer donkeys than expected from the youngest category (under 1-year-old) had *Strongylus* spp. on arrival (60.7%) whilst it was observed that there were more donkeys than expected in the 1 to 3 years old category (92.6%). Moreover, statistically significant differences were found between donkeys with >300 e.p.g. of *Strongylus* spp. and age category (p_{X2}=0.019), where it was observed that there were fewer donkeys than expected from the youngest category shedding more than 300 e.p.g. of *Strongylus* spp. These findings concur with those of Matthews and Burden (2013) who demonstrated that young (< 3 years) and old (age ≥ 26 years) donkeys may not be the highest strongyle egg shedders and, in fact, mature donkeys contribute substantially to pasture contamination.

Statistically significant differences were only found between ascarid prevalence and donkey age category (p_{LR}=0.004). It was observed that there were more donkeys than expected with ascarids in the younger category of under 1 year old (10.7%). This finding coincides with those found in horse and pony foals where patent infections (detected by FWEC) are usually seen in young animals. Despite this, Getachew et al. (2010) reported that mature donkeys harbour patent infection, therefore healthy, mature donkeys are considered an important source of pasture contamination and may be at risk of disease when compromised through over work, ill health or poor nutrition. Moreover, Burden and Getachew (2016) stated that *Parascaris* spp. infections in donkeys are common, although infection did not seem to be limited to young immuno-compromised animals as seen in horses, as infection was a frequent finding in all age groups of donkeys. This was not the case in our study, where there was no prevalence of this parasite in the older donkeys apart from a very low prevalence of 0.3% in the adult category.

These findings are similar to those of Matthews and Burden (2013) who found that young (< 3 years) and old (≥ 26 years) donkeys may not always be the highest shedders of strongyles and mature donkeys can also contribute to pasture contamination.

Table 5.213. Prevalence of parasites in donkeys at arrival stratified by age category

Parasites	≤ 1 y (n=28)	(1 y, 3 y] (n=68)	(3 y, 5 y] (n=108)	(5 y, 20 y] (n=326*)	> 20 y (n=54)	Total (n=584*)	p
Strongylus spp.	60.7%^{L}	92.6%^{H}	79.6%	80.7%	72.2%	**80.1%**	0.004^{X2}
Strongylus spp. >300 e.p.g.	17.9%^{L}	44.1%	38.9%	34.0%	29.6%	**34.9%**	0.019^{X2}
Liver fluke	7.1%	16.2%	10.2%	8.0%	9.3%	**9.4%**	0.321^{X2}
Lungworm	3.6%	4.4%	1.9%	3.7%	0.0%	**3.1%**	0.311^{LR}
Tapeworm	0.0%	4.4%^{H}	0.0%	0.9%	1.9%	**1.2%**	0.126^{LR}
Ascarids	10.7%^{H}	0.0%	0.0%	0.3%	0.0%	**0.7%**	0.004^{LR}

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
*: the number of donkeys for lungworm was n=325 for 5-20 year, and n=583 for total

Firstly, statistically significant differences were not found between arrival month and the prevalence of *Strongylus* spp. (p_{X2}=0.152), >300 e.p.g. of *Strongylus* spp. (p_{X2}=0.640), lungworm (p_{LR}=0.067), tapeworm (p_{LR}=0.193) or ascarids (p_{LR}=0.405) (Table 5.214 and Figure 5.9).

However, statistically significant differences were found between the prevalence of liver fluke and the arrival month (p_{LR}=0.006). There were more donkeys than expected testing positive for liver fluke during December (27.5%), whilst fewer donkeys than expected tested positive for liver fluke during June (1.9%).

TDS produces a "de-worming diary" to encourage owners to test donkeys at different times of the year, especially during the grazing season.

Firstly, winter is the time of the year where encysted *Cyathostomin* are a concern, especially as FWECs do not evaluate encysted *Cyathostomin* larvae. Treatment against cyathostomins is advised to reduce pasture contamination and guard against gastrointestinal damage associated with encysted larvae. Treatment options for encysted *Cyathostomin* include: moxidectin or Fenbendazole (5-day course). Moxidectin is not licensed for use in donkeys so the advice given is to prescribe under the "cascade"; on the other hand, the use of fenbendazole is licensed in donkeys although levels of resistance have been reported that make its use for encysted cyathostomins questionable. Its use has been suggested for youngsters, underweight and heavily pregnant animals.

For the grazing season (May to September), TDS advises FWECs are performed for *Strongylus* spp. only.

At the end of the grazing season (September), TDS advises FWECs for a full faecal screen for parasites. TDS advises that if donkeys are very young, old or in poor health it is worth considering some of the less common parasites such as liver fluke. If donkeys are fit and healthy then a standard *Strongylus* spp. FWEC has been considered sufficient in the past. Interestingly, this study has not found BCS or age to be associated with the presence of liver fluke, therefore it might be worth considering testing for liver fluke independent of body condition or age (Tables 5.219 and 5.213).

Finally, TDS advises donkeys are treated for tapeworm in winter (November), especially if donkeys are living in an area where tapeworm is prevalent. Options for treatment are: prazinquantel (treats tapeworm only) or pyrantel which treats *Strongylus* spp. and tapeworm. The prevalence of tapeworm was very low in new arrival donkeys, and statistically significant differences were not found with regards to arrival month.

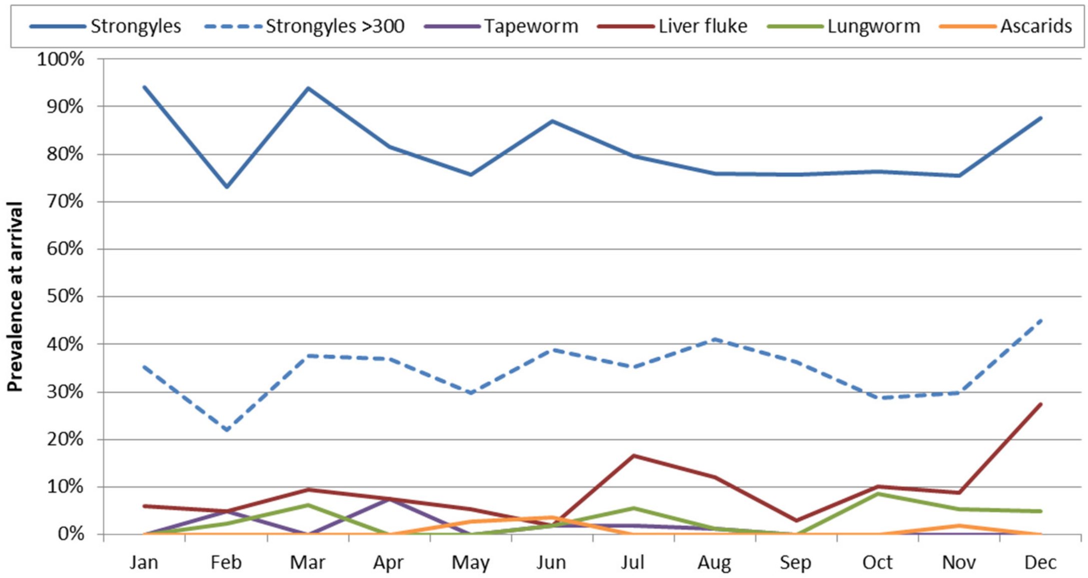
Interestingly, Clayton and Trawford (1981) advised faecal examination and, if necessary, treatment for lungworm to be repeated each spring before the temperatures become warm enough for excreted larvae to develop on pasture, therefore some association with season should have been expected.

Table 5.214. Prevalence of parasites in donkeys on arrival stratified by arrival month

Arrival month	n	*Strongylus* spp.	*Strongylus* spp. >300 e.p.g.	Liver fluke	Lungworm	Tapeworm	Ascarids
January	34	94.1%	35.3%	5.9%	0.0%	0.0%	0.0%
February	41	73.2%	22.0%	4.9%	2.4%	4.9%	0.0%
March	32	93.8%	37.5%	9.4%	6.3%	0.0%	0.0%
April	27	81.5%	37.0%	7.4%	0.0%	7.4%	0.0%
May	37	75.7%	29.7%	5.4%	0.0%	0.0%	2.7%
June	54	87.0%	38.9%	1.9%^{L}	1.9%	1.9%	3.7%
July	54	79.6%	35.2%	16.7%	5.6%	1.9%	0.0%
August	83	75.9%	41.0%	12.0%	1.2%	1.2%	0.0%
September*	66	75.8%	36.4%	3.0%	0.0%	0.0%	0.0%
October	59	76.3%	28.8%	10.2%	8.5%	0.0%	0.0%
November	57	75.4%	29.8%	8.8%	5.3%	0.0%	1.8%
December	40	87.5%	45.0%	27.5%^{H}	5.0%	0.0%	0.0%
Total*	**584**	**80.1%**	**34.9%**	**9.4%**	**3.1%**	**1.2%**	**0.7%**
p		0.152^{X2}	0.640^{X2}	0.006^{LR}	0.067^{LR}	0.189^{LR}	0.405^{LR}

^{X2}: Significance of Pearson's Chi-square test; $^{LR:}$ Significance of Likelihood Ratio test
*: number of arrivals for lungworm was n=65 for September, and n=583 for total

Figure 5.9. Prevalence of parasites in donkeys on arrival stratified by arrival month



Firstly, a significant association was found (Table 5.215) between the presence of liver fluke and type of origin (p_{LR}=0.004). There were no donkeys with liver fluke returning from a guardian origin (0.0%). This finding could relate to routine care advice given to guardian homes, advocating routine FWECs.

On the other hand, statistically significant differences were not found between the other types of parasites and type of origin (Table 5.215); although if we take into consideration standard residuals there were more donkeys than expected with *Strongylus* spp. from a new arrival origin, and fewer than expected with the same type of parasite coming from a DS HB (NA) origin. This finding is consistent with recent worming and testing at the DS HB as part of routine care.

Table 5.215. Prevalence of parasites in donkeys at arrival stratified by type of origin

Parasites	New arrival (n=400)	DS HB (NA) (n=98*)	Return Guardian (n=60)	DS HB (RG) (n=11)	DAT (n=15)	Total (n=584*)	p
Strongylus spp.	82.5%^{H}	72.4%^{L}	78.3%	72.7%	80.0%	**80.1%**	0.261^{LR}
Strongylus spp. >300 e.p.g.	37.0%	33.7%	28.3%	9.1%	33.3%	**34.9%**	0.266^{X2}
Liver fluke	10.8%	11.2%	0.0%^{L}	0.0%	6.7%	**9.4%**	0.004^{LR}
Lungworm	4.0%	2.1%	0.0%	0.0%	0.0%	**3.1%**	0.147^{LR}
Tapeworm	1.5%	0.0%	1.7%	0.0%	0.0%	**1.2%**	0.497^{LR}
Ascarids	0.8%	1.0%	0.0%	0.0%	0.0%	**0.7%**	0.853^{LR}

^{X2}: Significance of Pearson's Chi-square test; $^{LR:}$ Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
*: number of donkeys with lungworm was n=97 from DS HB (NA), and n=583 for total

When looking at the association between other routine treatments such as vaccination (against 'flu' and tetanus) and prevalence of parasites (Table 5.216), it is interesting to note that there were statistically significant differences found between the prevalence of *Strongylus* spp. and vaccination status (p_{X2}=0.014). There were more donkeys than expected with *Strongylus* spp. on arrival that were also unvaccinated (82.4%), whilst there were fewer with *Strongylus* spp. in the vaccinated category (72.8%). Moreover, statistically significant differences were also found when looking at the association between a high *Strongylus* spp. burden (>300 e.p.g.) and vaccination status. It was observed that there were more unvaccinated donkeys than expected with a high *Strongylus* spp. burden of >300 e.p.g. (38.6%).

Additionally, statistically significant differences were also found between the presence of liver fluke and vaccination status. There were more unvaccinated donkeys than expected that had liver fluke at arrival (10.9%).

Finally, a significant association was also found between the presence of lungworm and vaccination status (p_{LR}=0.038). Unvaccinated donkeys had lungworm in 3.8% of cases versus 0.7% of vaccinated donkeys.

Table 5.216. Prevalence of parasites in donkeys at arrival stratified by vaccination status

Parasites	Unvaccinated (n=448*)	Vaccinated (n=136)	Total (n=584*)	p
Strongylus spp.	82.4%^{H}	72.8%^{L}	**80.1%**	0.014^{X2}
Strongylus spp. >300 e.p.g.	38.6%^{H}	22.8%^{L}	**34.9%**	0.001^{X2}
Liver fluke	10.9%^{H}	4.4%^{L}	**9.4%**	0.022^{X2}
Lungworm	3.8%	0.7%	**3.1%**	0.038^{LR}
Tapeworm	0.9%	2.2%	**1.2%**	0.250^{LR}
Ascarids	0.9%	0.0%	**0.7%**	0.145^{LR}

^{X2}: Significance of Pearson's Chi-square test; $^{LR:}$ Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
*: number of donkeys with lungworm was n=447 for unvaccinated, and n=583 for total

When looking at the association between presence of parasites and origin region (Table 5.217 and Figure 5.10), statistically significant differences were only found in the case of presence of liver fluke and origin region (p_{LR}=0.001). It was observed that there were more donkeys than expected from Wales (20.5%) and Northern Ireland (30.4%) that had liver fluke.

Interestingly, these findings coincide with previous findings from a survey of new arrivals where the majority of positive animals also originated from Wales and Ireland (Burden, unpublished data 2013) (Matthews and Burden, 2013). The Donkey Sanctuary should consider these regions as high-risk areas for the prevalence of liver fluke, and advice could be given to donkey owners in those areas to test more frequently. On the contrary, there were no donkeys with liver fluke coming from the East Midlands (0.0%).

Despite not finding statistically significant differences between the presence of lungworm and origin region, it was observed (Table 5.196) that when taking standard residuals into consideration there were more donkeys with lungworm coming from an unknown origin (25.0%) and the East Midlands (9.3%).

Table 5.217. Prevalence of parasites in donkeys at arrival stratified by origin region

Origin region	n	*Strongylus* spp.	*Strongylus* spp. >300 e.p.g.	Liver fluke	Lungworm	Tapeworm	Ascarids
Unknown origin	4	100.0%	100.0%	0.0%	$25.0\%^{H}$	0.0%	0.0%
Scotland	27	74.1%	25.9%	14.8%	0.0%	0.0%	0.0%
Northern Ireland	23	91.3%	34.8%	$30.4\%^{H}$	0.0%	0.0%	0.0%
North East	52	84.6%	34.6%	11.5%	1.9%	1.9%	0.0%
North West	65	78.5%	33.8%	10.8%	4.6%	0.0%	3.1%
East Midlands	54	81.5%	42.6%	$0.0\%^{L}$	$9.3\%^{H}$	3.7%	0.0%
West Midlands	52	80.8%	46.2%	11.5%	3.8%	1.9%	0.0%
Wales	39	71.8%	38.5%	$20.5\%^{H}$	2.6%	0.0%	0.0%
South West	158	84.8%	31.6%	7.0%	2.5%	1.9%	0.0%
South East	90*	74.4%	31.1%	5.6%	1.1%	0.0%	2.2%
Greater London	3	66.7%	33.3%	0.0%	0.0%	0.0%	0.0%
Total	**567***	**80.6%**	**35.3%**	**9.5%**	**3.2%**	**1.2%**	**0.7%**
p		0.340^{LR}	0.165^{X2}	0.001^{LR}	0.223^{LR}	0.548^{LR}	0.393^{LR}

^{X2}: Significance of Pearson's Chi-square test; ^{LR}: Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected ($p<0.050$)
^{L}: Observed proportion significantly lower t0020han expected ($p<0.050$)
*: number of donkeys with lungworm was n=89 for the South East, and n=566 for total

Figure 5.10. Prevalence of parasites in donkeys at arrival according to origin region

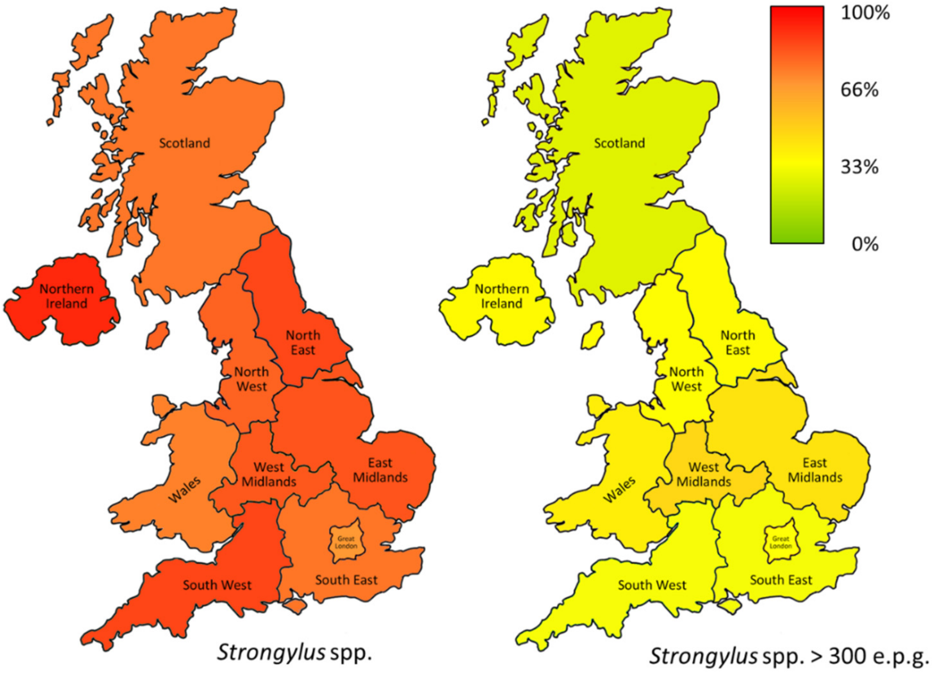
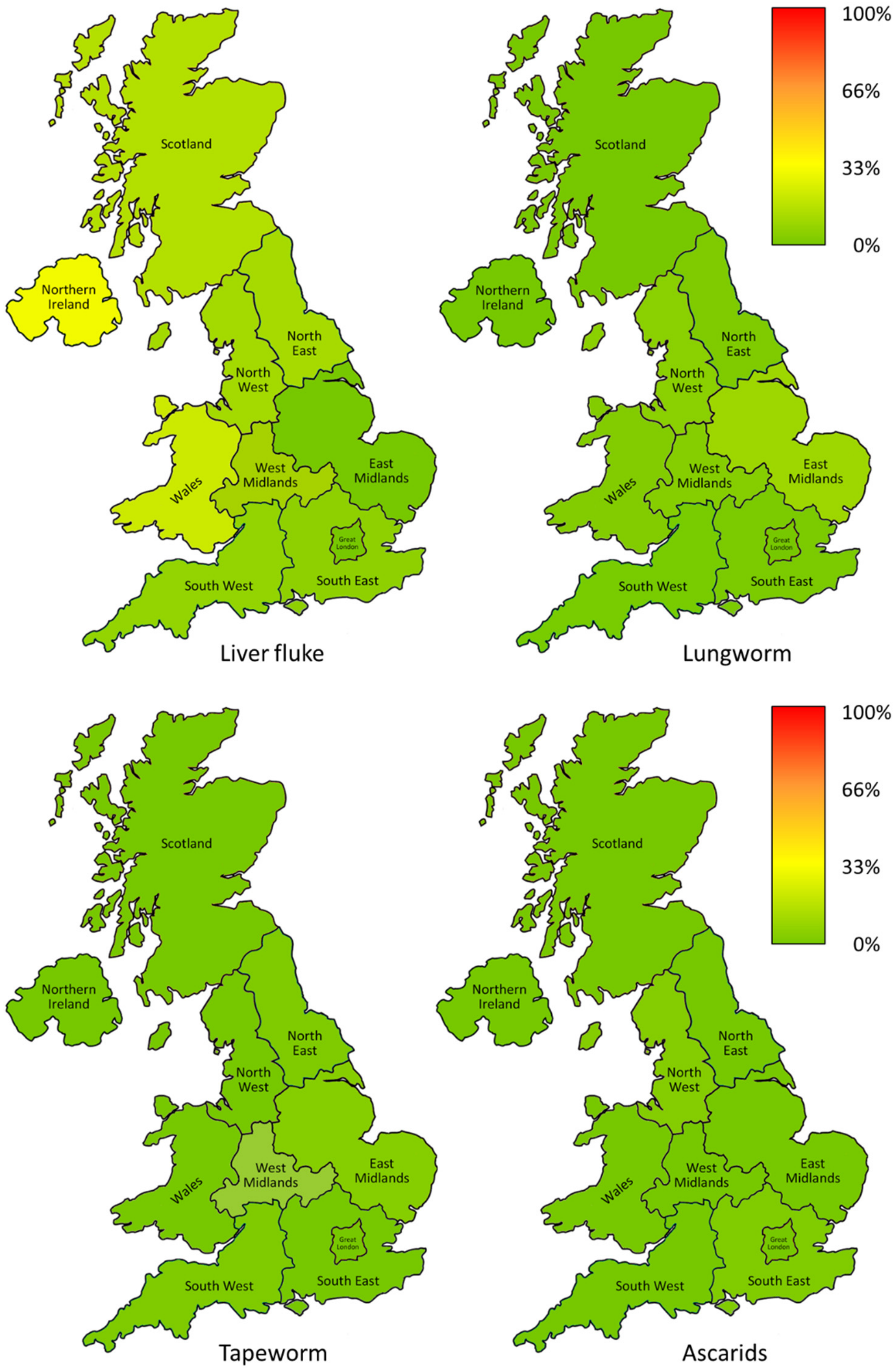


Figure 5.10 (cont.) Prevalence of parasites in donkeys at arrival according to origin region



The association between the presence of parasites and access to grazing was assessed (Table 5.218). A positive association was found between the presence of ascarids and access to grass (p_{LR}=0.040). Of the donkeys arriving with an ascarid burden, more than expected were reported as having had no access to grass (4.8%), whilst fewer than expected reportedly had unrestricted grazing access (0.3%). Infective ascarid eggs can reportedly be found on pasture, in contaminated water and feed.

Donkeys with restricted access to grass appeared to have the lowest prevalence of parasites apart from tapeworm. Appropriate donkey management should include restricting grazing, so it would be interesting to assess if donkey owner knowledge has an impact on parasite prevalence; more experienced owners that restrict grazing may also follow TDS advice with regards to routine FWEC and anthelmintic use.

Table 5.218. Prevalence of parasites in donkeys at arrival stratified by access to grass

Parasites	Grass (n=380*)	Restricted grazing (n=55)	No access (n=42)	Total (n=477*)	p
Strongylus spp.	80.5%	74.5%	78.6%	**79.7%**	0.578^{X2}
Strongylus spp. >300 e.p.g.	36.3%	23.8%	34.5%	**35.0%**	0.272^{X2}
Liver fluke	10.0%	1.8%	7.1%	**8.8%**	0.060^{LR}
Lungworm	4.2%	0.0%	2.4%	**3.6%**	0.098^{LR}
Tapeworm	1.1%	1.8%	0.0%	**1.0%**	0.565^{LR}
Ascarids	$0.3\%^{L}$	0.0%	$4.8\%^{H}$	**0.6%**	0.040^{LR}

^{X2}: Significance of Pearson's Chi-square test; $^{LR:}$ Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
*: number of donkeys with lungworm was n=379 for with access to grass, and n=583 for total

Evans and Crane (2018h) reported that the impact of small strongyle infections on working donkeys was unclear and that some studies indicated they have a negative effect on BCS and are associated with the presence of anaemia, although other studies showed no correlation between FWEC and BCS. Further research was deemed necessary, particularly in light of the significant expenditure required to maintain the mass deworming programs common in equine charities (Matthews and Burden, 2013).

As a result, the association between BCS at admission and the prevalence of parasites was assessed (Table 5.219).

Table 5.219. Prevalence of parasites in donkeys at arrival stratified by BCS at admission

BCS	n	*Strongylus* spp.	*Strongylus* spp. >300 e.p.g.	Liver fluke	Lungworm	Tapeworm	Ascarids
None	11	63.6%	$0.0\%^{L}$	9.1%	0.0%	0.0%	0.0%
1-1.5	11	81.8%	36.4%	9.1%	$27.3\%^{H}$	9.1%	0.0%
1.75-2.5	53	$94.3\%^{H}$	$56.6\%^{H}$	11.3%	3.8%	0.0%	0.0%
2.75-3.5	305	80.0%	32.5%	11.5%	3.3%	1.0%	1.0%
3.75-4.5	154*	77.9%	33.1%	6.5%	2.0%	1.3%	0.6%
4.75-5	50	76.0%	40.0%	4.0%	0.0%	2.0%	0.0%
Total	**584***	**80.1%**	**34.9%**	**9.4%**	**3.1%**	**1.2%**	**0.7%**
p		0.086^{X2}	0.002^{X2}	0.357^{LR}	0.022^{LR}	0.508^{LR}	0.839^{LR}

^{X2}: Significance of Pearson's Chi-square test; $^{LR:}$ Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
*: number of donkeys with lungworm was n=153 for with BCS 3.75-4.5, and n=583 for total

A significant association was found between the presence of lungworm and BCS at admission (p_{LR}=0.022). Interestingly, more donkeys than expected that had lungworm also had a very poor BCS on arrival (1-1.5) (27.3%).

Although there were no statistically significant associations between the presence of other parasites and BCS at admission, it was found (Table 5.219) that more donkeys with *Strongylus* spp. on arrival had a lower BCS and were underweight (BCS 1.75-2.5; 94.3%). Moreover, statistically significant differences were found between donkeys with a high burden of *Strongylus* spp. (>300 e.p.g.) and BCS (p_{X2}=0.002). It was observed that were more donkeys than expected with a BCS of 1.75-2.5 that had a high burden (56.6%).

5.6.4. Effect of last anthelmintic treatment on prevalence at arrival

Association between the presence of parasites at arrival and their last anthelmintic treatment status was also assessed (Table 5.220). It was found that there were statistically significant differences with regards to the presence of *Strongylus* spp. and the last anthelmintic treatment status (p_{LR}=0.004). It was found that more donkeys than expected arriving with *Strongylus* spp. had reportedly been wormed but at an unknown date, and with an unknown product (Unknown-No product; 100.0%). There were fewer donkeys than expected with *Strongylus* spp. on arrival and information on both date of worming and product used (76.9%). Moreover, statistically significant differences were also found between donkeys with a high *Strongylus* spp. burden (>300 e.p.g.) and their last anthelmintic treatment status (p_{X2}=0.007). There were more donkeys than expected with a high *Strongylus* spp. burden in the no date-no product category (43.8%), and fewer donkeys than expected with a high *Strongylus* spp. burden with a known date and product (76.9%).

Secondly, statistically significant differences were also found between the presence of liver fluke on arrival and their last anthelmintic treatment status information (p_{LR}=0.004). More donkeys than expected had liver fluke on arrival when their owners described the last treatment as unknown date-unknown product (25.0%) or an unknown date-product named (75.0%).

Finally, there were statistically significant differences found between the presence of lungworm and last anthelmintic treatment status information (p_{LR}=0.004) (Table 5.220). It was found that there were more donkeys than expected with lungworm on arrival that did not have any date of worming or product recorded and may not have been wormed for a long time (9.1%). It was also identified that there were fewer donkeys than expected with lungworm on arrival that did have a date of last anthelmintic treatment and product recorded (1.6%). Therefore, it can be deduced that recent worming was effective at controlling lungworm.

Finally, there were no significant association found between the presence of tapeworm or ascarids and the last anthelmintic treatment status in donkeys (p_{LR}=0.552 and p_{LR}=0.649) (Table 5.220).

Table 5.220. Prevalence of parasites in donkeys at arrival stratified by last anthelmintic treatment status

Parasites	No date - No product (n=121)	Date - No product (n=58)	Date - Product (n=381*)	Unknown - No product (n=20)	Unknown - Product (n=4)	Total (n=584*)	p
Strongylus spp.	85.1%	82.8%	76.9%^{L}	100.0%^{H}	100.0%	**80.1%**	0.004^{LR}
Strongylus spp. >300 e.p.g.	43.8%^{H}	36.2%	30.4%^{L}	55.0%	75.0%	**34.9%**	0.007^{X2}
Fluke	9.9%	6.9%	8.1%	25.0%^{H}	75.0%^{H}	**9.4%**	0.004^{LR}
Lungworm	9.1%^{H}	1.7%	1.6%^{L}	0.0%	0.0%	**3.1%**	0.004^{LR}
Tapeworm	1.7%	3.4%	0.8%	0.0%	0.0%	**1.2%**	0.552^{LR}
Ascarids	1.7%	0.0%	0.5%	0.0%	0.0%	**0.7%**	0.649^{LR}

^{X2}: Significance of Pearson's Chi-square test; $^{LR:}$ Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
*: number of donkeys with lungworm was n=380 with date and product, and n=583 for total

With regards to the association between the presence of parasites and their location in the NAU, it was found that there was a statistically significant association between the presence of *Strongylus* spp. and location (p_{LR}<0.001). It was found (Table 5.221) that more donkeys than expected with *Strongylus* spp. on arrival were located at Clifford Smith (93.3%), whilst fewer than expected were located at SH4 (68.8%) and SH7 special needs (33.3%). Moreover, statistically significant differences were also found between donkeys with a high burden of *Strongylus* spp. (>300 e.p.g.) (p_{LR}=0.032). It was observed that there were also more donkeys than expected with a high *Strongylus* spp. burden at Clifford Smith (46.7%) and stallion box 3 (66.7%), while fewer donkeys had a high *Strongylus* spp. burden when located at Unit 1 (18.2%).

Statistically significant differences were not found in the case of *Strongylus* spp. prevalence and location within the stallion boxes, but the prevalence in Stallion boxes 1, 2 and 4 was 100.0% which would coincide with findings from stallion burden at arrival (Table 5.221).

With regards to the presence of liver fluke, a significant association was found with the locations (p_{LR}=0.033) where more donkeys with liver fluke were located in SH3 (18.8%) and SH6 special needs (28.6%).

Moreover, statistically significant differences were found between the presence of lungworm at arrival and location within the NAU (p_{LR}=0.001). It was found that more donkeys than expected who arrived with lungworm were located at Resident group

(25.0%), SH7 (13.3%) and Unit 2 (11.8%). These findings should help to identify potentially heavily contaminated paddocks to reduce exposure of incoming donkeys. Parasitology status should be considered when allocating donkeys to groups and pasture in future.

Table 5.221. Parasite prevalence in donkeys at arrival stratified by location within the NAU

Location in the NAU	n	*Strongylus* spp.	*Strongylus* spp. >300 e.p.g.	Liver fluke	Lungworm	Tapeworm	Ascarids
Box 2	1	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Clifford Smith	75	93.3%^{H}	46.7%^{H}	13.3%	1.3%	1.3%	0.0%
Clifford Smith back	3	100.0%	33.3%	33.3%	0.0%	0.0%	0.0%
Resident Group	20	65.0%	20.0%	10.0%	25.0%^{H}	0.0%	5.0%^{H}
SH1	31	77.4%	25.8%	6.5%	0.0%	0.0%	0.0%
SH2	35	94.3%^{H}	31.4%	5.7%	2.9%	0.0%	0.0%
SH3	69	87.0%	29.0%	18.8%^{H}	1.4%	0.0%	1.4%
SH4	48	68.8%^{L}	37.5%	10.0%	0.0%	0.0%	2.1%
SH5	30*	83.3%	40.0%	0.0%	0.0%	3.3%	0.0%
SH5 special needs	6	66.7%	16.7%	0.0%	0.0%	0.0%	0.0%
SH6	52	75.0%	26.9%	3.8%	0.0%	3.8%	0.0%
SH6 special needs	14	71.4%	35.7%	28.6%^{H}	7.1%	0.0%	0.0%
SH7	45	75.6%	35.6%	2.2%	13.3%^{H}	2.2%	0.0%
SH7 special needs	6	33.3%^{L}	16.7%	0.0%	0.0%	0.0%	0.0%
Stallion box 1	6	100.0%	66.7%	16.7%	0.0%	0.0%	0.0%
Stallion box 2	3	100.0%	33.3%	0.0%	0.0%	0.0%	0.0%
Stallion box 3	15	93.3%	66.7%^{H}	6.7%	6.7%	6.7%	0.0%
Stallion box 4	14	100.0%	64.3%^{H}	0.0%	0.0%	0.0%	0.0%
Unit 1	44	72.7%	18.2%^{L}	6.8%	0.0%	0.0%	0.0%
Unit 2	17	76.5%	35.3%	17.6%	11.8%^{H}	5.9%	0.0%
Unit 3	20	70.0%	45.0%	15.0%	0.0%	0.0%	5.0%
Unit 4	30	70.0%	36.7%	6.7%	0.0%	0.0%	0.0%
Total	**584***	**80.1%**	**34.9%**	**9.4%**	**3.1%**	**1.2%**	**0.7%**
p_{LR}		<0.001	0.032	0.033	0.001	0.825	0.945

$^{LR:}$ Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
*: number of donkeys with date and product for lungworm was n=29 for SH5, and n=583 for total

The association between the presence of *Strongylus* spp. on arrival and the recent worming history was assessed (Table 5.222). Interestingly, there were no statistically significant differences found between the use of a recent anthelmintic and the prevalence of *Strongylus* spp. It would have been interesting to assess if correct dosages (according to weight) were given at the time of worming. In future, dose and estimated weight could perhaps be recorded by owners to assess levels of efficacy and parasite resistance. Weight estimation in donkeys might be difficult for vets and owners and it would be interesting to find out if donkey owners and vets are estimating weights correctly.

Statistically significant differences were found between the use of praziquantel and the prevalence of *Strongylus* spp. (p_{X2}=0.001); interestingly, there were fewer donkeys than expected with *Strongylus* spp. after recent treatment with praziquantel. It has been extensively reported that praziquantel is only effective against tapeworm; however, in a lot of cases it has been used in combination with ivermectin.

Table 5.222. Prevalence of *Strongylus* spp. in donkeys at arrival stratified by last anthelmintic treatment

Last anthelmintic treatment	***Strongylus* spp.**				p
	Without worming		**With recent worming**		
	n	%	n	%	
Fenbendazole	349	75.9%	36	88.9%	0.078 ^{X2}
Mebendazole	378	76.7%	7	100.0%	0.359 ^{F}
Ivermectin	227	76.7%	158	77.8%	0.783 ^{X2}
Moxidectin	231	80.5%	154	72.1%	0.053 ^{X2}
Praziquantel	347	79.5%	38	55.3%^{L}	0.001 ^{X2}
Pyrantel	356	76.4%	29	86.2%	0.227 ^{X2}

^{X2}: Significance of Pearson's Chi-square test; $^{F:}$ Significance of Fisher's exact test
$^{F:}$ Significance of Fisher's exact test
^{L}: Observed proportion significantly lower than expected (p<0.050)

When looking at donkeys with a high *Strongylus* spp. burden (> 300 e.p.g.) and the association with their last anthelmintic treatment, it was found (Table 5.223) that there were statistically significant differences in the case of recent treatment with mebendazole (p_F<0.001). It was found that there were fewer donkeys than expected with a high burden of *Strongylus* spp. (29.6%) that did not receive mebendazole as their last anthelmintic treatment. On the other hand, there were more donkeys than expected with a high burden of *Strongylus* spp. (100.0%) that did receive mebendazole as their last treatment. These results could suggest drug resistance and further investigation is required.

Association between the use of triclabendazole and closantel and the presence of liver fluke on arrival was assessed (Table 5.224). Statistically significant differences were found between the presence of liver fluke and the use of closantel (p_F=0.011). It was found that there were more donkeys than expected that had recently received closantel and had liver fluke on arrival (29.4%). This finding is suggestive of a potential resistance in liver fluke that would be interesting to investigate further.

On the other hand, although no significant differences were found, donkeys that received triclabendazole as a recent treatment did not have liver fluke on arrival (0.0%).

This suggests that triclabendazole is the preferable anthelmintic for use in cases of liver fluke in donkeys, although further research is required.

Table 5.223. Prevalence of *Strongylus* spp. in donkeys at arrival stratified by last anthelmintic treatment

Last anthelmintic treatment	***Strongylus* spp. >300 e.p.g.**				p
	Without worming		**With recent worming**		
	n	%	n	%	
Fenbendazole	349	31.5	36	25.0	0.420 X2
Mebendazole	378	29.6 L	7	100.0 H	<0.001 F
Ivermectin	277	31.7	158	29.7	0.681 X2
Moxidectin	231	32.0	154	29.2	0.575 F
Praziquantel	347	32.0	38	21.1	0.166 X2
Pyrantel	356	30.9	29	31.0	>0.999 F

X2: Significance of Pearson's Chi-square test; F: Significance of Fisher's exact test
F: Significance of Fisher's exact test
L: Observed proportion significantly lower than expected (p<0.050)

Table 5.224. Prevalence of liver fluke in donkeys on arrival stratified by last anthelmintic treatment

Last anthelmintic treatment	**Liver fluke**				p_F
	Without worming		**With recent worming**		
	n	%	n	%	
Triclabendazole	382	8.9%	3	0.0%	>0.999
Closantel	368	7.9% L	17	29.4% H	0.011

F: Significance of Fisher's exact test
H: Observed proportion significantly higher than expected (p<0.050)
L: Observed proportion significantly lower than expected (p<0.050)

The association between the use of mebendazole, ivermectin, moxidectin and praziquantel, and the presence of lungworm on arrival was assessed (Table 5.225). Interestingly, although no significant differences were found between the use of these four wormers and the presence of lungworm, donkeys that had mebendazole and praziquantel as a recent treatment did not have any lungworm on arrival (0.0%).

Table 5.225. Prevalence of lungworm in donkeys on arrival stratified by last anthelmintic treatment

Last anthelmintic treatment	**Lungworm**				p_F
	Without worming		**With recent worming**		
	n	%	n	%	
Mebendazole	377	1.6%	7	0.0%	>0.999
Ivermectin	226	2.2%	158	0.6%	0.407
Moxidectin	231	1.7%	153	1.3%	>0.999
Praziquantel	346	1.7%	38	0.0%	>0.999

F: Significance of Fisher's exact test

The association between the use of praziquantel and pyrantel and tapeworm prevalence was assessed (Table 5.226). Although statistically significant differences were not found, it was seen (Table 5.226) that tapeworm was not present in donkeys that had received recent treatment with either praziquantel or pyrantel or both.

Table 5.226. Prevalence of tapeworm in donkeys on arrival stratified by last anthelmintic treatment

Last anthelmintic treatment	Tapeworm				p_F
	Without worming		With recent worming		
	n	%	n	%	
Praziquantel	347	0.9%	38	0.0%	>0.999
Pyrantel	356	0.8%	29	0.0%	>0.999

F: Significance of Fisher's exact test

Association between the use of different wormers with efficacy against ascarids and their presence was assessed (Table 5.227). Statistically significant differences were only found in the case of fenbendazole (p_F=0.009). Interestingly, those donkeys that did not receive a recent treatment had no ascarids present, whilst donkeys that had received a recent fenbendazole treatment had a prevalence of 5.6%. This could have been explained as donkeys receiving recent treatment for ascarids might have had other concurrent endoparasites.

On the other hand, although there were no statistically significant associations found between the use of the other wormers and the presence of ascarids, donkeys that had recently received one of the other wormers other than fenbendazole (Table 5.227) did not have any ascarids on arrival.

Pyrantel has been reported as effective against adults ascarids but not larvae.

Table 5.227. Prevalence of ascarids in donkeys at arrival stratified by last anthelmintic treatment

Last anthelmintic treatment	Ascarids				p_F
	Without worming		With recent worming		
	n	%	n	%	
Fenbendazole	349	0.0%	36	5.6%	0.009
Mebendazole	378	0.5%	7	0.0%	>0.999
Ivermectin	227	0.9%	158	0.0%	0.515
Moxidectin	231	0.9%	154	0.0%	0.519
Pyrantel	356	0.6%	29	0.0%	>0.999

F: Significance of Fisher's exact test

Firstly, when looking at the association between the last anthelmintic treatment date and prevalence of parasites (Table 5.228), statistically significant differences were only found between the last anthelmintic treatment date and the prevalence of

Strongylus spp. (p_{MW}<0.001). Donkeys with *Strongylus* spp. on arrival had spent significantly more time since their last anthelmintic treatment than donkeys with no infestation. The median time for donkeys with *Strongylus* spp. was 116 days since their last anthelmintic treatment, whilst donkeys without the infestation had a median of 63 days since their last anthelmintic treatment.

Moreover, statistically significant differences were also found between the last anthelmintic treatment date and donkeys with a high burden of *Strongylus* spp. (> 300 e.p.g.). It was observed that donkeys with a significantly higher burden of *Strongylus* spp. had significantly more days (median=136.0 days) since their last anthelmintic treatment, compared to donkeys without a high burden who had a median of 88.5 days since their last anthelmintic treatment.

Table 5.228. Last anthelmintic treatment (days) of donkeys at arrival stratified by parasite infestation

Parasite		n	Mean	SD	Median	min	Max	p_{MW}
Strongylus spp.	No	98	96.00	98.82	63.0	2.0	506.0	<0.001
	Yes	341	153.59	128.15	116.0	1.0	762.0	
Strongylus spp. >300 e.p.g.	No	302	130.49	125.47	88.5	1.0	762.0	<0.001
	Yes	137	163.31	119.53	136.0	15.0	608.0	
Liver fluke	No	404	143.82	126.70	110.0	2.0	762.0	0.059
	Yes	35	105.14	88.46	73.0	1.0	388.0	
Lungworm	No	431	140.05	123.26	109.0	1.0	762.0	0.833
	Yes	7	190.86	195.57	67.0	47.0	530.0	
Tapeworm	No	434	141.17	124.87	108.5	1.0	762.0	0.567
	Yes	5	102.60	78.25	73.0	23.0	191.0	
Ascarids	No	437	141.11	124.60	109.0	1.0	762.0	0.235
	Yes	2	58.50	31.82	58.5	36.0	81.0	

^{MW}: Significance of Mann-Whitney test

Statistically significant differences were only found between the prevalence of ascarids on arrival and age (p_{MW}=0.015) (Table 5.229). Ascarids are mainly found in foals; immunity to infection is reportedly developed in horses by around 18 months of age (Fort-Dodge, 2008).

Association between the weight: height ratio WH ratio and the presence of parasites was assessed (Table 5.230). It has been reported that donkeys with high burdens might have a worse body weight and therefore WH ratio would be predictably lower in those animals.

Statistically significant differences were only found in the case of ascarids (p_{MW}=0.005). Donkeys with ascarids had a lower WH ratio than donkeys without ascarids on arrival. This finding could perhaps be related to the younger age of donkeys with ascarid infection rather than poor body weight because of ascarids; younger donkeys are usually the most affected by ascarids, and those animals would have lower WH ratio. In fact, this study found that there were statistically significant differences between the presence of ascarids and the age of donkeys (Table 5.230).

Table 5.229. Age of donkeys at arrival stratified by parasitic infestation

Parasite		n	Mean	SD	Median	min	Max	p_{MW}
Strongylus spp.	No	116	9.89	7.57	7.0	0.3	30.0	0.852
	Yes	468	9.49	6.95	8.0	0.0	42.0	
Strongylus spp. >300 e.p.g.	No	380	9.64	7.23	8.0	0.0	42.0	0.844
	Yes	204	9.34	6.80	8.0	0.5	36.0	
Liver fluke	No	529	9.67	7.08	8.0	0.0	42.0	0.174
	Yes	55	8.61	7.02	6.0	0.3	30.0	
Lungworm	No	565	9.62	7.15	8.0	0.0	42.0	0.542
	Yes	18	7.59	4.12	8.5	0.6	15.0	
Tapeworm	No	577	9.58	7.07	8.0	0.0	42.0	0.506
	Yes	7	8.57	8.30	7.0	2.0	26.0	
Ascarids	No	580	9.61	7.07	8.0	0.0	42.0	0.015
	Yes	4	2.67	3.55	1.0	0.7	8.0	

^{MW}: Significance of Mann-Whitney test

Table 5.230. Weight:height ratio in donkeys at arrival stratified by parasitic infestation

Parasite		n	Mean	SD	Median	min	Max	p_{MW}
Strongylus spp.	No	113	18.05	3.19	18.33	8.03	24.35	0.097
	Yes	433	17.67	3.13	17.94	7.41	27.38	
Strongylus spp. >300 e.p.g.	No	353	17.79	3.19	18.00	7.41	27.38	0.531
	Yes	193	17.68	3.06	18.04	8.02	26.56	
Liver fluke	No	492	17.77	3.12	18.04	7.41	26.56	0.465
	Yes	54	17.54	3.39	17.85	8.11	27.38	
Lungworm	No	528	17.78	3.08	18.03	7.41	27.34	0.439
	Yes	17	17.01	4.84	17.47	8.02	26.07	
Tapeworm	No	541	17.75	3.15	17.79	7.41	27.38	0.578
	Yes	5	18.5	1.6	18.54	16	20.35	
Ascarids	No	543	17.78	3.12	18.04	7.41	27.38	0.005
	Yes	3	11.66	0.11	11.69	11.32	11.98	

^{MW}: Significance of Mann-Whitney test

5.6.5. Parasitic burden on arrival

No association was found between *Strongylus* spp. FWEC (parasite burden) and sex of donkeys (p_{KW}=0.116) (Table 5.231). The mean *Strongylus* spp. burden was slightly higher in stallions without being significant.

Table.5.231. *Strongylus* spp. burden (e.p.g.) in donkeys at arrival stratified by sex

Sex	n	Mean	SD	Q1	Median	Q3	min	Max
Mare	145	418.42	602.57	46.5	214.0	578.5	1	4491
Gelding	240	382.09	467.96	54.5	229.0	516.0	1	2889
Stallion	83	492.52	498.48	81.0	342.0	738.0	1	2094
Total	**468**	**412.93**	**518.93**	**54.3**	**242.5**	**569.7**	**1**	**4491**

Significance of Kruskal-Wallis test, p=0.116

Statistically significant differences were not found between *Strongylus* spp. burden and age category (p_{KW}=0.208) (Table 5.232). Furthermore, when we analysed the correlation between *Strongylus* spp. burden and age, we did not find a significant correlation (Spearman's rho=0.006; p=0.888), so age was not a relevant factor associated with *Strongylus* spp. burden.

Table 5.232. *Strongylus* spp. burden (e.p.g.) in donkeys at arrival stratified by age category

Age (cat)	n	Mean	SD	Q1	Median	Q3	min	Max
≤ 1 y	17	203.71	247.87	26.50	109.00	320.00	1.0	954.0
(1 y, 3 y]	63	390.43	393.29	55.00	288.00	600.00	1.0	1638.0
(3 y, 5 y]	86	494.09	551.16	74.50	290.00	680.25	1.0	2094.0
(5 y, 20 y]	263	370.84	413.52	50.00	244.00	540.00	1.0	2673.0
> 20 y	39	645.36	1034.21	32.00	140.00	1053.00	1.0	4491.0

Significance of Kruskal-Wallis test, p=0.208

Statistically significant differences were not found between *Stronglylus* spp. burden and the origin region of donkeys (p_{KW}=0.344) (Table 5.233).

Association between admission BCS and *Strongylus* spp. burden was assessed (Table 5.234). Statistically significant differences were found (p_{KW}=0.050). Three subgroups were identified; interestingly, donkeys that were the most infested were those with a higher BCS (4.75-5). This is an interesting finding and highlights the importance of regular FWECs even if there is no history of weight loss or poor BCS. Furthermore, correlation analysis found a significant, but low, correlation (Spearman's rho=0.177; p=0.001).

Table 5.233. *Strongylus* spp. burden (e.p.g.) in donkeys on arrival stratified by origin region

Origin region	n	Mean	SD	Q1	Median	Q3	min	Max
Unknown origin	4	854.75	551.53	347.2	877.0	1340.0	315	1350
Scotland	20	288.2	247.87	59.2	265.5	459.0	1	855
Northern Ireland	21	428.38	727.92	20.0	107.0	783.0	1	3240
North East	44	458.43	573.52	48.7	214.0	600.0	1	1971
North West	51	362.27	371.34	68.0	209.0	558.0	1	1566
East Midlands	44	485.57	548.65	54.5	341.5	609.0	1	2556
West Midlands	42	476.14	713.6	169.5	329.5	544.5	1	4491
Wales	28	478.57	444.3	158.5	364.5	705.7	1	1645
South West	134	348.16	405.74	44.2	182.0	519.2	1	1869
South East	67	464.37	646.01	36.0	153.0	672.0	1	2889
Greater London	2	423.00	483.66	81.0	423.0	-	81	765

Significance of Kruskal-Wallis test, p=0.344

Table 5.234. *Strongylus* spp. burden (e.p.g.) in donkeys at arrival stratified by admission BCS

Admission BCS	n	Mean	SD	Q1	Median	Q3	min	Max
None	7	107.71[a]	115.78	27.00	68.0	252.0	4	293
1-1.5	9	537.00[ab]	490.32	194.00	262.0	1022.5	100	1350
1.75-2.5	50	520.48[ab]	556.82	95.75	393.5	690.7	1	2889
2.75-3.5	244	361.25[ab]	432.06	47.3	220.5	510.0	1	3240
3.75-4.5	120	414.36[ab]	522.89	46.50	219.0	605.3	1	2673
4.75-5	38	625.63[c]	853.03	44.00	460.0	807.7	1	4491
Total	**468**	**412.93**	**518.93**	**54.3**	**242.5**	**569.7**	**1**	**4491**

Significance of Kruskal-Wallis test, p=0.050

The second parasite burden analysed was liver fluke. Statistically significant differences were not found between fluke burden and sex (p_{KW}=0.113) (Table 5.235).

Table 5.235. Liver fluke burden (e.p.g.) in donkeys on arrival stratified by sex

Sex	n	Mean	SD	Q1	Median	Q3	min	Max
Mare	21	49.14	72.80	2.0	7.0	78.0	1	257
Gelding	27	16.19	48.58	1.0	2.0	17.0	1	256
Stallion	7	45.71	69.64	2.0	5.0	136.0	1	158
Total	**55**	**32.53**	**62.46**	**1.0**	**5.0**	**21.0**	**1**	**257**

Significance of Kruskal-Wallis test, p=0.113

Statistically significant differences were not found between liver fluke burden and age category (p_{KW}=0.142) (Table 5.236). Furthermore, correlation was assessed and not found to be significant (Spearman's rho=0.148; p=0.281).

Table 5.236. Liver fluke burden (e.p.g.) in donkeys at arrival stratified by age category

Age (cat)	n	Mean	SD	Q1	Median	Q3	min	Max
≤ 1 y	-	-	-	-	-	-	-	-
(1 y, 3 y]	11	43.45	58.93	2.00	7.00	92.00	1.0	158.0
(3 y, 5 y]	11	5.82	7.57	1.00	2.00	11.00	1.0	21.0
(5 y, 20 y]	26	46.50	78.95	1.75	6.50	56.50	1.0	257.0
> 20 y	5	7.20	5.93	3.00	6.00	12.00	1.0	17.0

Significance of Kruskal-Wallis test, p=0.142

Statistically significant differences were not found between liver fluke burden and region of origin (p_{KW}=0.287) (Table 5.237).

Table 5.237. Liver fluke burden (e.p.g.) in donkeys on arrival stratified by origin region

Origin region	n	Mean	SD	Q1	Median	Q3	min	Max
Scotland	4	6.25	9.18	1.25	2.0	15.50	1	20
Northern Ireland	7	7.29	9.32	1.00	2.0	15.00	1	25
North East	6	31.17	62.49	1.75	3.5	53.75	1	158
North West	7	44.86	93.54	1.00	11.0	22.00	1	256
West Midlands	6	3.67	2.66	1.00	3.5	6.25	1	7
Wales	8	49.25	70.26	3.50	7.5	115.50	1	180
South West	11	65.45	83.83	5.00	17.0	114.00	1	257
South East	5	15.00	27.50	1.00	2.0	35.50	1	64

Significance of Kruskal-Wallis test, p=0.287

There was no association between admission BCS and fluke burden (p_{KW}=0.623) (Table 5.238). Despite not finding any statistically significant differences, donkeys with higher mean fluke burdens had lower admission BCS (1.75-2.5). As in previous cases, the correlation was not significant (Spearman's rho=0.056; p=0.750).

Table 5.238. Liver fluke burden (e.p.g.) in donkeys on arrival stratified by admission BCS

Admission BCS	n	Mean	SD	Q1	Median	Q3	min	Max
None	1	1.00	-	-	1.0	-	-	-
1-1.5	1	8.00	-	-	8.0	-	-	-
1.75-2.5	6	60.33	77.52	1.0	22.0	147.0	1	180
2.75-3.5	35	26.89	54.32	1.0	5.0	21.0	1	257
3.75-4.5	10	46.90	87.73	2.0	5.5	54.5	1	256
4.75-5	2	4.00	4.24	1.0	4.0	-	1	7
Total	**55**	**32.53**	**62.46**	**1.0**	**5.0**	**21.0**	**1**	**257**

Significance of Kruskal-Wallis test, p=0.623

Statistically significant differences were not found between lungworm burden in donkeys and their age category (p_{KW}=0.378) (Table 5.239).

Table 5.239. Lungworm burden in donkeys stratified by age category

Age	n	Mean	SD	Q1	Median	Q3	min	Max
≤ 1 y	1	-	-	-	-	-	-	-
(1 y, 3 y]	3	322.67	277.71	2.00	482.00	-	2.0	484.0
(3 y, 5 y]	2	3.00	1.41	2.00	3.00	-	2.0	4.0
(5 y, 20 y]	12	15.17	14.94	3.75	11.00	22.25	1.0	51.0
> 20 y	-	-	-	-	-	-	-	-

Significance of Kruskal-Wallis test, p=0.378

5.6.6. Parasitic prevalence on departure from the NAU

Prevalence and burden of parasites at departure were assessed (Tables 5.240 and 5.241). The most prevalent parasites were *Strongylus* spp. and more than 75% had a burden < 300 e.p.g. that it is the limit used as a reference by TDS. Interestingly, there were no ascarids present which would indicate that control of ascarids during the NAU period was efficient. Prevalence of lungworm and tapeworm was very low but present, and control of these parasites might need further investigation as there is zero tolerance for both in the organisation.

Table 5.240. Parasite prevalence at departure

Parasite prevalence	n	%
Strongylus spp.	389 / 560	69.3%
Strongylus spp. >300 e.p.g.	83 / 560	14.8%
Liver fluke	9 / 561	1.6%
Lungworm	2 / 550	0.4%
Tapeworm	1 / 560	0.2%
Ascarids	0 / 560	0.0%

Table 5.241. Parasite burden at departure

Parasite burden at departure	n	Mean	SD	Q1	Median	Q3	min	Max
Strongylus spp.	559	205.93	336.29	10	64.5	255	1	2889
Liver fluke	9	4.78	7.23	1	1	6.5	1	23
Lungworm	2	3	2.83	1	3	5	1	5

Parasite prevalence associated with NAU location was assessed; it was found (Table 5.242) that there were statistically significant differences between *Strongylus* spp. prevalence and location within the NAU (p_{LR}=0.047). More donkeys than expected that had *Strongylus* spp. infestation were located at Clifford Smith (78.8%), whilst fewer than expected with *Strongylus* spp. infestation were housed at SH3 (55.6%) and SH6 special needs (0.0%). Moreover, statistical significant differences were found between a high burden of *Strongylus* spp. and their NAU location (p_{LR}=0.033) and more donkeys than expected with a high burden were located at Clifford Smith (46.7%) and Stallion box 3(66.7%) while less than expected were located at Unit 1 (17.8%).

No statistically significant differences were found between NAU location and the prevalence of liver fluke (p_{LR}=0.526). Despite this, when looking at the standard residuals more donkeys than expected that were infested with liver fluke were housed at the Resident group (11.1%) and Unit 2 (11.1%). In addition, statistically significant differences were not found when looking at lungworm prevalence and the different locations within the NAU. It was however noted at standard residuals that more donkeys than expected had lungworm when located at the Resident group (5.6%) and SH6 (2.0%). Furthermore, no statistically significant differences were found between the prevalence of tapeworm and NAU location, although more donkeys than expected at standard residuals had tapeworm when they were located at SH1 (1.90%).

Table 5.242. Parasite prevalence in donkeys at departure stratified by location within the NAU on arrival

Location in the NAU	n	*Strongylus* spp.	*Strongylus* spp. > 300 e.p.g.	Liver fluke	Lung-worm	Tape-worm
Clifford Smith	85	78.8%^{H}	46.7%^{H}	1.2%	0.0%	0.0%
Clifford Smith back	8	87.5%	33.3%	0.0%	0.0%	0.0%
Resident Group	18	55.6%	20.0%	11.1%^{H}	5.6%^{H}	0.0%
SH1	52	65.4%	25.8%	0.0%	0.0%	1.9%^{H}
SH2	37	75.7%	31.4%	0.0%	0.0%	0.0%
SH3	54	55.6%^{L}	29.0%	0.0%	0.0%	0.0%
SH4	70	61.4%	37.5%	3.0%	0.0%	0.0%
SH5	36	83.3%	40.0%	2.8%	0.0%	0.0%
SH5 Special needs	4	50.0%	16.7%	0.0%	0.0%	0.0%
SH6	54	68.5%	26.9%	1.9%	2.0%^{H}	0.0%
SH6 Special needs	2	0.0%^{L}	35.7%	0.0%	0.0%	0.0%
SH7	52	65.4%	35.6%	0.0%	0.0%	0.0%
SH7 Special needs	3	100.0%	16.7%	0.0%	0.0%	0.0%
Stallion box 3	8	62.5%	66.7%^{H}	0.0%	0.0%	0.0%
Stallion box 4	5	80.0%	64.3%	0.0%	0.0%	0.0%
Unit 1	24	70.8%	17.8%^{L}	4.2%	0.0%	0.0%
Unit 2	8	62.5%	35.3%	11.1%^{H}	0.0%	0.0%
Unit 3	30	80.0%	45.0%	0.0%	0.0%	0.0%
Unit 4	10	80.0%	36.7%	0.0%	0.0%	0.0%
Total	**560**	**69.3%**	**34.9%**	**1.6%**	**0.4%**	**0.2%**
p_{LR}		0.047	0.033	0.526	0.961	0.999

$^{LR:}$ Significance of Likelihood Ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

5.6.7. Evolution of prevalence of parasites: incidence and treatment efficacy

Association between the prevalence of parasites in donkeys at arrival and departure was assessed (Table 5.243). Statistically significant differences were found between *Strongylus* at arrival and departure (p_{X2}=0.029). It was found that there were fewer donkeys than expected that arrived without *Strongylus* spp. infestation and were then found to have *Strongylus* spp. on departure (60.9%); however, this figure highlights an important degree of pasture contamination at the NAU. Interestingly, it was also found that fewer donkeys than expected with *Strongylus* spp. on arrival were not infested at departure (28.6%), showing low efficacy of the worming treatment.

When looking at high burdens of *Strongylus* spp. on arrival and departure, no statistical differences were found (p_{X2}=0.776). There was a similar prevalence of donkeys with a high *Strongylus* spp. burden on departure to those that came in with a high initial burden (14.4%) and those that came in without (15.3%). Interestingly, 14.4% of donkeys that did not have a high burden of parasites at entry to the NAU had high burdens on departure which suggests a degree of pasture contamination and failure of treatment protocols that will require further investigation.

On the other hand, statistically significant differences were found between the presence of liver fluke on arrival and departure (p_F<0.001); it was found that there was a small incidence of liver fluke and fewer donkeys than expected had fluke at departure (0.6%), therefore, donkeys that did not test positive for liver fluke on arrival later tested positive at departure. This finding suggests that the sensitivity of the test is not 100.0% (and there were false negatives) or that there is a degree of pasture contamination or both. On the other hand, it was noted that there were fewer donkeys than expected that had a fluke infestation on arrival but not at departure (89.1%). This percentage would indicate a possible degree of drug resistance with the products used against liver fluke. TDS should re-test donkeys for liver fluke post-treatment to assess drug efficacy, and treatment protocols and drug efficacy should be monitored carefully.

Thirdly, statistically significant differences were not found between the presence of lungworm on arrival and departure (p_F=0.065). Despite this, it was found looking at standard residuals (Table 5.243) that there were fewer donkeys than expected (0.2%) that tested negative on arrival but were positive at departure. This would also suggest a test sensitivity problem or a degree of pasture contamination or both, necessitating further investigation.

Furthermore, it was found that there were fewer donkeys than expected that tested positive for lungworm on arrival then tested negative at departure (94.4%), supporting the previous comments regarding sensitivity of testing and pasture contamination.

Finally, there were no statistically significant differences found between tapeworm presence at departure and on arrival (p_F>0.999) (Table 5.243).

Table 5.243. Evolution of prevalence of parasites (on arrival vs at departure)

Presence at arrival		Presence at departure			p
		n	No	Yes	
Strongylus spp.	No	115	39.1%^{H}	60.9%^{L}	0.029^{X2}
	Yes	444	28.6%^{L}	71.4%^{H}	
Strongylus spp. <300 e.p.g.	No	369	85.6%	14.4%	0.776^{X2}
	Yes	190	84.7%	15.3%	
Liver fluke	No	505	99.4%^{H}	0.6%^{L}	<0.001^F
	Yes	55	89.1%^{L}	10.9%^{H}	
Lungworm	No	530	99.8%^{H}	0.2%^{L}	0.065^F
	Yes	18	94.4%^{L}	5.6%^{H}	
Tapeworm	No	553	99.8%	0.2%	>0.999^F
	Yes	6	100.0%	0.0%	
Ascarids	No	555	100.0%	0.0%	nc
	Yes	4	100.0%	0.0%	

^{X2}: Significance of Pearson's Chi-square test; $^{F:}$ Significance of Fisher's exact test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)
nc: non calculable

Statistically significant differences were not found between *Strongylus* spp. burden on arrival and at departure (p_{X2}=0.087). Despite this, it was noted looking at standard residuals (Table 5.244) that there were more donkeys than expected with no parasites on arrival and at departure (39.7%). It was also found that there were fewer donkeys than expected with no parasites on arrival that had more than 300 e.p.g. at departure (8.6%). Again, this indicates a degree of pasture contamination.

Table 5.244. *Strongylus* spp. burden in donkeys at arrival and departure

***Strongylus* spp. burden at arrival**	***Strongylus* spp. burden at departure**			**Total**
	No parasites	1-300 e.p.g.	>300 e.p.g.	
No parasites	39.7%^{H}	51.7%	8.6%^{L}	116
1-300 e.p.g.	29.5%	53.5%	16.9%	254
>300 e.p.g.	27.4%	57.4%	15.3%	190
Total	**30.9%**	**54.5%**	**14.6%**	**560**

Significance of Pearson's Chi-square test, p=0.087
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

When looking at the *Strongylus* spp. variation with regards to location on arrival (p_{LR}<0.001) there were statistically significant differences. It was found (Table 5.245) that more donkeys than expected acquire parasites whilst in the Resident group location (31.6%). Additionally, it was observed that more donkeys than expected at Clifford Smith remained infected (74.0%), whilst fewer donkeys than expected remained infected at SH3 (40.9%), SH4 (41.3%) and SH7 special needs (0.0%). Finally, it was observed that there were more donkeys than expected at SH4, SH6 special needs and SH7 special needs that remained free of parasites (17.4%, 23.1% and 100.0%, respectively).

Table 5.245. *Strongylus* spp. variation stratified by arrival location within the NAU

NAU location on arrival	n	Remained free	Dewormed	Remained infected	Parasitised
Clifford Smith	73	2.7%	19.2%	74.0%^{H}	4.1%^{L}
Clifford Smith back	2	0.0%	0.0%	100.0%	0.0%
Resident Group	19	5.3%	26.3%	36.8%	31.6%^{H}
SH1	28	17.9%	17.9%	57.1%	7.1%
SH2	35	2.9%	22.9%	71.4%	2.9%
SH3	66	6.1%	45.5%	40.9%^{L}	7.6%
SH4	46	17.4%^{H}	26.1%	41.3%^{L}	15.2%
SH5	28	3.6%	17.9%	64.3%	14.3%
SH5 special needs	6	0.0%	16.7%	50.0%	33.3%
SH6	51	7.8%	15.7%	58.8%	17.6%
SH6 special needs	13	23.1%^{H}	23.1%	46.2%	7.7%
SH7	44	6.8%	22.7%	52.3%	18.2%
SH7 special needs	3	100.0%^{H}	0.0%	0.0%^{L}	0.0%
Stallion box 1	6	0.0%	16.7%	83.3%	0.0%
Stallion box 2	3	0.0%	0.0%	100.0%	0.0%
Stallion box 3	15	0.0%	33.3%	60.0%	6.7%
Stallion box 4	13	0.0%	30.8%	69.2%	0.0%
Unit 1	44	13.6%	25.0%	47.7%	13.6%
Unit 2	14	0.0%	7.1%	64.3%	28.6%
Unit 3	20	5.0%	15.0%	55.0%	25.0%
Unit 4	30	10.0%	3.3%^{L}	66.7%	20.0%
Total	**559**	**8.1%**	**22.7%**	**56.7%**	**12.5%**

Significance of Likelihood Ratio test, $p_{LR}<0.001$
^{H}: Observed proportion significantly higher than expected ($p<0.050$)
^{L}: Observed proportion significantly lower than expected ($p<0.050$)

Donkeys are often moved to different groups whilst in the NAU facility, therefore the previous analysis was repeated stratified by location at departure. When looking at *Strongylus* spp. status in donkeys at departure stratified by location, it was found (Table 5.246) that more donkeys than expected remained infected at Clifford Smith (73.8%). On the other hand, fewer than expected from the same location had parasite infection on departure (4.8%) which suggests that there was a low degree of pasture contamination, and a possible problem with drug efficacy, although it would be necessary to examine if parasite burden was lower than 300 e.p.g.

Interestingly, more donkeys than expected showed signs of having acquired infection whilst at the Resident group (27.8%). This paddock is one of the smallest and oldest on the site and is generally populated by special needs donkeys, such as geriatric animals or pregnant mares. Pasture management should be looked at carefully, and the possibility of a higher pasture contamination at this location considered. On the other hand, there were fewer donkeys than expected at the same location that remained infected, suggesting good control of *Strongylus* spp. at this location for those with pre-existing infestations (27.8%).

Moreover, it was seen (Table 5.246) that more donkeys than expected remained infected at shelter SH2 (73.0%), suggesting that pasture management should be carefully examined as well as drug efficacy.

Table 5.246. *Strongylus* spp. variation stratified by departure location within the NAU

NAU location on departure	n	Remain free	Dewormed	Remain infected	Parasitised
Clifford Smith	84	3.6%	17.9%	73.8%^{H}	4.8%^{L}
Clifford Smith back	8	0.0%	12.5%	87.5%	0.0%
Resident Group	18	5.6%	38.9%	27.8%^{L}	27.8%^{H}
SH1	52	13.5%	21.2%	55.8%	9.6%
SH2	37	8.1%	16.2%	73.0%^{H}	2.7%
SH3	54	11.1%	33.3%^{H}	46.3%	9.3%
SH4	70	8.6%	30.0%	47.1%	14.3%
SH5	36	2.8%	13.9%	66.7%	16.7%
SH5 special needs	4	0.0%	50.0%	25.0%	25.0%
SH6	54	11.1%	20.4%	48.1%	20.4%
SH6 special needs	2	100.0%^{H}	0.0%	0.0%	0.0%
SH7	52	11.5%	23.1%	48.1%	17.3%
SH7 special needs	3	0.0%	0.0%	33.3%	66.7%^{H}
Stallion box 3	8	12.5%	25.0%	37.5%	25.0%
Stallion box 4	5	0.0%	20.0%	80.0%	0.0%
Unit 1	24	8.3%	20.8%	50.0%	20.8%
Unit 2	8	0.0%	37.5%	50.0%	12.5%
Unit 3	30	3.3%	16.7%	73.3%	6.7%
Unit 4	10	0.0%	20.0%	70.0%	10.0%
Total	**559**	**8.1%**	**22.7%**	**56.7%**	**12.5%**

Significance of Likelihood Ratio test, p_{LR}=0.006
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

When looking at the rest of the shelters within the NAU, it was observed that more donkeys than expected were dewormed whilst at SH3 (33.3%); while all the donkeys that lived at SH6 special needs remained free of parasites on FWEC (100.0%). On the other hand, more donkeys than expected that were housed at SH7 special needs became infested while being in the NAU (66.7%).

In Table 5.247 we identified if the donkeys moved to another NAU location during their time in the NAU, and if this movement had an effect on the efficacy of deworming.

As noted in previous tables, two important parameters exist that determine prevalence: the incidence (proportion of the non-parasitised donkeys at arrival that were parasitised at departure) and the drug efficacy (proportion of parasitised donkeys at arrival that were FWEC clear at departure). As a result, we analysed these two parameters for each parasite according to sex and age.

Table 5.247. Parasite variation stratified by location change within the NAU

Parasite	During NAU period	n	Remain free	De-wormed	Remain parasitised	Parasi-tised	p
Strongylus spp.	Same location	319	9.1%	24.8%	55.8%	10.3%	0.152^{X2}
	Changed location	240	6.7%	20.0%	57.9%	15.4%	
	Total	**559**	**8.1%**	**22.7%**	**56.7%**	**12.5%**	
Strongylus spp. > 300 e.p.g.	Same location	319	60.2%	27.3%	5.0%	7.5%	0.144^{X2}
	Changed location	240	51.7%	30.8%	5.4%	12.1%	
	Total	**559**	**56.5%**	**28.8%**	**5.2%**	**9.5%**	
Fluke	Same location	319	92.2%	6.3%	0.9%	0.6%	0.116^{LR}
	Changed location	241	86.3%	12.0%	1.2%	0.4%	
	Total	**560**	**89.6%**	**8.8%**	**1.1%**	**0.5%**	
Lungworm	Same location	312	96.2%	3.5%	0.3%	0.0%	0.355^{LR}
	Changed location	236	97.0%	2.5%	0.0%	0.4%	
	Total	**548**	**96.5%**	**3.1%**	**0.2%**	**0.2%**	
Tapeworm	Same location	319	99.1%	0.9%	-	0.0%	0.403^{LR}
	Changed location	240	98.3%	1.3%	-	0.4%	
	Total	**559**	**98.7%**	**1.1%**	**-**	**0.2%**	
Ascarids	Same location	319	99.1%	0.90%	-	-	0.826^{LR}
	Changed location	240	99.6%	0.4%	-	-	
	Total	**559**	**99.3%**	**0.7%**	**-**	**-**	

^{X2}: Significance of Pearson's Chi-square test
$^{LR:}$ Significance of Likelihood Ratio test

The incidence of *Strongylus* spp. was not different amongst sexes (Table 5.248), but statistically significant differences were found when looking at the efficacy of treating *Strongylus* spp. when stratified by sex (p_{X2}=0.016). It was observed (Table 5.248) that there was greatest efficacy when treating *Strongylus* spp. in donkey geldings (33.0%), followed by mares (28.2%). There was notably less *Strongylus* spp. treatment efficacy in stallions (16.3%), which coincides with the higher incidence seen in stallions (75.0%).

Table 5.248. *Strongylus* spp. incidence in donkeys and efficacy of treatment stratified by sex

Sex	***Strongylus* spp.**			
	n	Incidence	n	Efficacy
Mare	38	60.5%	131	28.2%
Gelding	69	59.4%	233	33.0%^{H}
Stallion	8	75.0%	80	16.3%^{L}
Total	**115**	**60.9%**	**444**	**28.6%**
p_{X2}	0.693		0.016	

^{X2}: Significance of Pearson's Chi-square test
$^{H:}$ Observed proportion significantly higher than expected (p<0.050)
$^{L:}$ Observed proportion significantly lower than expected (p<0.050)

However, in the case of a high burden of *Strongylus* spp. (> 300 e.p.g.), it was found that there were statistically significant differences with regards to *Strongylus* spp. incidence when stratified by sex (p_{X2}<0.001); it was observed (Table 5.249) that there were more stallions than expected with a greater incidence of a high *Strongylus* spp. burden (35.6%). On the other hand, it was found that there were statistically significant differences with regards to efficacy and sex (p_{X2}=0.027). A lower anthelmintic efficacy was found (Table 5.249) when treating stallions (72.1%), compared to mares and geldings.

Table 5.249. High burden of *Strongylus* spp. in donkeys and efficacy of treatment stratified by sex

Sex	***Strongylus* spp. > 300 e.p.g.**			
	n	Incidence	n	Efficacy
Mare	119	10.9%	50	86.0%
Gelding	205	11.7%	97	89.7%
Stallion	45	35.6%^{H}	43	72.1%^{L}
Total	**369**	**14.4%**	**190**	**84.7%**
p_{X2}	<0.001		0.027	

^{X2}: Significance of Pearson's Chi-square test
$^{H:}$ Observed proportion significantly higher than expected (p<0.050)
$^{L:}$ Observed proportion significantly lower than expected (p<0.050)

Statistically significant differences were found between the efficacy of treatment for *Strongylus* spp. in donkeys and their age category (p_{X2}=0.006) (Table 5.250). There was significant lower efficacy against *Strongylus* spp. when treating donkeys from the young category of 1 to 3 years old (11.1%).

Table 5.250. *Strongylus* spp. incidence and efficacy of anthelmintic treatment in donkeys stratified by age category

Age (cat)	***Strongylus* spp.**			
	n	Incidence	n	Efficacy
≤ 1 y	11	54.5%	17	41.2%
(1 y, 3 y]	5	60.0%	63	11.1%[L]
(3 y, 5 y]	22	77.3%	83	36.1%
(5 y, 20 y]	63	60.3%	253	28.5%
> 20 y	14	42.9%	28	39.3%
Total	**115**	**60.9%**	**444**	**28.6%**
p	0.317 [LR]		0.006 [X2]	

[X2]: Significance of Pearson's Chi-square test
[LR]: Significance pf Likelihood ratio test

Statistically significant differences were also found between efficacy of treatment against high burdens of *Strongylus* spp. and age category (p_{LR}=0.018) (Table 5.251). There was a significant lower treatment efficacy when treating young donkeys from 1 to 3 years old (63.3%) (Table 5.251).

Table 5.251. High *Strongylus* spp. burden incidence in donkeys and efficacy of treatment stratified by age category

Age (cat)	***Strongylus spp.* > 300 e.p.g.**			
	n	Incidence	n	Efficacy
≤ 1 y	23	17.4%	5	100.0%
(1 y, 3 y]	38	23.7%	30	63.3%[L]
(3 y, 5 y]	66	12.1%	39	89.7%
(5 y, 20 y]	212	13.7%	104	88.5%
> 20 y	30	10.0%	12	83.3%
Total	**369**	**14.4%**	**190**	**84.7%**
p	0.452[X2]		0.018[LR]	

Incidence of liver fluke was not associated with sex (p_{X2}=0.352). Statistically significant differences were not found between fluke treatment efficacy in donkeys and sex (p_{X2}=0.052). It was observed (Table 5.252) that there was significantly lower efficacy when treating donkey mares (76.2%) compared to geldings (96.3%) or stallions (100.0%).

There were no statistically significant differences found between incidence of liver fluke and age (p_{LR}=0.401), or treatment efficacy and age (p_{LR}=0.191) (Table 5.253).

Similarly, no statistically significant differences were found for lungworm incidence (p_{LR}=0.654) and efficacy (p_{LR}=0.347), when stratified by sex (Tables 5.254).

Table 5.252. Liver fluke incidence and treatment efficacy in donkeys stratified by sex

Sex	Liver fluke			
	n	Incidence	n	Efficacy
Mare	149	1.3%	21	76.2%[L]
Gelding	275	0.4%	27	96.3%
Stallion	81	0.0%	7	100.0%
Total	**505**	**0.6%**	**55**	**89.1%**
p_{X2}	0.352		0.052	

X2: Significance of Pearson's Chi-square test
L: Observed proportion significantly lower than expected (p<0.050)

Table 5.253. Fluke incidence and treatment efficacy in donkeys stratified by age category

Age (cat)	Liver fluke			
	n	Incidence	n	Efficacy
≤ 1 y	26	0.0%	2	50.0%
(1 y, 3 y]	57	0.0%	11	90.9%
(3 y, 5 y]	94	2.1%[H]	11	100.0%
(5 y, 20 y]	291	0.3%	26	84.6%
> 20 y	37	0.0%	5	100.0%
Total	**505**	**0.6%**	**55**	**89.1%**
P^{LR}	0.401		0.191	

LR: Significance of Likelihood ratio test
H: Observed proportion significantly higher than expected (p<0.050)

Table 5.254. Lungworm incidence and treatment efficacy in donkeys stratified by sex

Sex	Lungworm			
	n	Incidence	n	Efficacy
Mare	164	0.0%	6	83.3%
Gelding	287	0.3%	6	100.0%
Stallion	79	0.0%	6	100.0%
Total	**530**	**0.2%**	**18**	**94.4%**
p_{X2}	0.654		0.347	

X2: Significance of Pearson's Chi-square test

Statistically significant differences were not found between lungworm incidence and treatment efficacy and age (p_{LR}=0.884) ($p_{LR=}$0.840) (Table 5.255).

No statistically significant differences were found for tapeworm incidence (p_{X2}=0.063) and treatment efficacy when we analysed the effect of sex (Table 5.256).

Table 5.255. Lungworm incidence and treatment efficacy in donkeys stratified by age category

Age (cat)	Lungworm			
	n	Incidence	n	Efficacy
≤ 1 y	27	0.0%	1	100.0%
(1 y, 3 y]	64	0.0%	3	100.0%
(3 y, 5 y]	101	0.0%	2	100.0%
(5 y, 20 y]	296	0.3%	12	91.7%
> 20 y	42	0.0%	-	-
Total	**530**	**0.2%**	**18**	**94.4%**
$\mathbf{P^{LR}}$	0.884		0.840	

^{LR}: Significance of likelihood ratio test

Table 5.256. Tapeworm incidence and treatment efficacy in donkeys stratified by sex

Sex	Tapeworm			
	n	Incidence	n	Efficacy
Mare	169	0.0%	-	-
Gelding	299	0.0%	3	100.0%
Stallion	85	1.2%	3	100.0%
Total	**553**	**0.2%**	**6**	**100.0%**
$\mathbf{p_{X2}}$	0.063		-	

^{X2}: Significance of Pearson's Chi-square test

Statistically significant differences were not found between tapeworm incidence and treatment efficacy and age (Table 5.257).

Table 5.257. Tapeworm incidence and treatment efficacy in donkeys stratified by age category

Age (cat)	*Tapeworm*			
	n	Incidence	n	Efficacy
≤ 1 y	28	0.0%	-	-
(1 y, 3 y]	65	0.0%	3	100.0%
(3 y, 5 y]	105	0.0%	-	-
(5 y, 20 y]	313	0.3%	3	100.0%
> 20 y	42	0.0%	-	-
Total	**553**	**0.2%**	**6**	**100.0%**
P^{LR}	0.888		-	

^{LR}: Significance of Likelihood ratio test

5.6.8. Efficacy of specific worming treatments

Ideally anthelmintic efficacy should have been calculated following FWEC reduction test. Matthews and Burden (2013) reported that the FWEC reduction test compares FWEC before (day 0) and 10-14 days after anthelmintic treatment. This can be applied to all classes of anthelmintic and is a widely used screening test for anthelmintic resistance. Efficacy is calculated using the formula:

Reduction (%) = (Day 0 mean FWEC - 14 days post treatment mean FWEC) x 100/Day 0 FWEC

Unfortunately, a limitation of the study was that although most donkeys should have been tested at these times as part of TDS policy, records were incomplete, therefore in this study efficacy was calculated using pre-treatment FWEC results and post treatment FWEC at departure.

The majority of donkeys received two worming treatments whilst in the NAU (52.7%). Interestingly, despite TDS NAU worming protocols, 4.5% received no treatment whilst in the NAU. In contrast, a small percentage of donkeys had 4 (2.7%) and even 5 treatments (0.5%) (Table 5.258) whilst in the NAU.

Table 5.258. Frequency of anthelmintic treatments in donkeys during their time in the NAU

Number of treatments	n	%
0	27	4.5%
1	174	29.2%
2	314	52.7%
3	62	10.4%
4	16	2.7%
5	3	0.5%
Total	**596**	**100.0%**

In accordance with the data, 1,067 anthelmintic treatments were prescribed using between 1 and 3 anthelmintics. The majority of donkeys had one anthelmintic product per treatment (53.9%), whilst a large percentage of donkeys had two different anthelmintic products per treatment (45.8%), and only 0.3% received three anthelmintic products (Table 5.259).

When looking at the first anthelmintic treatment, most donkeys received only one anthelmintic product (78.6%), which coincides with the NAU protocol, where the anthelmintic product of choice was moxidectin.

On the other hand, the majority of donkeys had two wormers at the time of the second treatment; this coincides with their last anthelmintic treatment in the NAU; as a last treatment donkeys receive a dose of ivermectin plus fenbendazole at a double dose as part of TDS protocol. Interestingly, treatment failure has been reported against lungworm using higher doses and repeated treatments in donkeys (Urch and Allen, 1980), therefore protocols for departure include the use of ivermectin too.

Table 5.259. Number of anthelmintic products used at each treatment in donkeys during their NAU period

Order of treatment	n	Number of anthelmintic products 1	2	3
First	569	78.6%	21.4%	-
Second	395	23.3%	75.9%	0.8%
Third	81	27.2%	72.8%	-
Fourth	19	57.9%	42.1%	-
Fifth	3	100.0%	-	-
Total	**1 067**	**53.9%**	**45.8%**	**0.3%**

Interestingly, most donkeys that had a third treatment also received two anthelmintic products (72.8%), whilst those receiving a fourth treatment either received one (57.9%) or two wormers (42.1%). Finally, of donkeys that had five treatments, 100% received only one type of anthelmintic product at the fifth treatment.

Donkeys that received three, four and five treatments were those that had abnormal results; these findings suggest a degree of false negative results, pasture contamination or lack of drug efficacy. TDS protocols should be reviewed carefully and monitoring closely.

Table 5.260 shows the frequency of use of each worming treatment. The most frequent treatment used was fenbendazole, with 80.9% of donkeys receiving fenbendazole once, whilst only 2.0% of donkeys received it twice whilst in the NAU.

Table 5.260. Frequency of anthelmintic type and use in donkeys during their time in the NAU

Wormer	Number of anthelmintic treatments 0		1		2	
	n	%	n	%	n	%
Fenbendazole	102	17.1%	482	80.9%	12	2.0%
Moxidectin	119	20.0%	474	79.5%	3	0.5%
Ivermectin	185	31.0%	394	66.1%	17	2.9%
Triclabendazole	507	85.1%	88	14.8%	1	0.2%
Closantel	572	96.0%	15	2.5%	9	1.5%
Pyrantel	575	96.5%	21	3.5%	-	-
Praziquantel	594	99.7%	2	0.3%	-	-
Mebendazole	595	99.8%	1	0.2%	-	-

The second most frequent product used was moxidectin (80.0%), and ivermectin was the third most common treatment. (69.0%).

When looking at the frequency of treatments against liver fluke, it was identified that 14.8% of donkeys were treated with triclabendazole once, and a very small percentage (0.2%) received a second treatment. On the other hand, only 2.5% of donkeys received closantel once, and only 1.5% had this treatment twice while at the NAU (Table 5.260).

Finally, the lesser used wormers were pyrantel (3.5%), praziquantel (0.3%) and mebendazole (0.2%) (Table 5.241). Interestingly, pyrantel resistance in donkeys has been reported in the UK, and Lawson et al. (2015) stated that this finding illustrates the continuing development of resistance through different classes of chemotherapeutics.

When a combination of two different wormers was used in donkeys (Table 5.261), it was found that the most common combination was fenbendazole and ivermectin (35.3%). This combination forms part of TDS anthelmintic protocol, as part of the final anthelmintic treatment before leaving the NAU to move to a TDS farm. The second most prevalent combination was fenbendazole and moxidectin (9.4%). This combination was used in donkeys that had either received ivermectin on arrival or had a recent ivermectin treatment before arrival, necessitating a different combination to TDS standard protocol.

Table 5.262. Combinations of treatments used in donkeys during their NAU period

	Order of treatment								**Total** (n=1067)	
	First (n=569)		**Second** (n=395)		**Third** (n=81)		**Fourth** (n=19)			
Drug combination	n	%	n	%	n	%	n	%	n	%
Fenbendazole + Ivermectin	48	8.4%	264	66.8%	58	71.6%	7	36.8%	377	**35.3%**
Fenbendazole + Moxidectin	61	10.7%	36	9.1%	2	2.5%	1	5.3%	100	**9.4%**
Moxidectin + Triclabendazole	6	1.1%	-	-	-	-	-	-	6	**0.6%**
Moxidectin + Closantel	6	1.1%	-	-	-	-	-	-	6	**0.6%**
Fenbendazole + Ivermectin + Praziquantel	-	-	2	0.5%	-	-	-	-	2	**0.2%**
Fenbendazole + Mebendazole	1	0.2%	-	-	-	-	-	-	1	**0.1%**
Fenbendazole + Ivermectin + Pyrantel	-	-	1	0.3%	-	-	-	-	1	**0.1%**

Other combinations with a low prevalence (0.6%) were moxidectin combined with triclabendazole or closantel. These combinations were probably used on arrival when liver fluke was diagnosed at the first FWEC.

For the first anthelmintic treatment the most common combination was fenbendazole with moxidectin (10.7%); moxidectin is added as fenbendazole has no known effect against lungworm.

The most common combination for the second anthelmintic treatment was fenbendazole and ivermectin (66.8%, Table 5.262) which coincides with the last treatment before departure from the NAU as part of TDS protocol.

In cases where there was a fourth and fifth anthelmintic treatment, the most common combination was fenbendazole and ivermectin (71.6%, 36.8%, Table 5.262).

The use of wormers was also assessed in between two coprological exams. There are some limitations to this study with regards to the interpretation of these results as they have been achieved by assessing clinical notes and findings.

5.6.8.1. Strongylus spp.

In Table 5.263 statistically significant differences can be seen between *Strongylus* spp. incidence and the use of fenbendazole (p_{LR}=0.005). The incidence was significantly lower when using one fenbendazole treatment (0.0%), whilst it was 63.1% without a fenbendazole treatment.

Interestingly, no statistical differences could be seen between efficacy of treatment against *Strongylus* spp. and the use of fenbendazole, despite the fact that efficacy was greater with fenbendazole treatments (Table 5.263).

Table 5.263. *Strongylus* spp. incidence and efficacy of fenbendazole treatments

Number of worming with fenbendazole	***Strongylus* spp.**			
	n	Incidence	n	Efficacy
0	111	63.1%^{H}	419	27.7%
1	4	0.0%^{L}	24	41.7%
2	-	-	1	100.0%
Total	**115**	**60.9%**	**444**	**28.6%**
P	0.005 ^{LR}		0.103 ^{LR}	

$^{LR:}$ Significance of Likelihood Ratio test
$^{H:}$ Observed proportion significantly higher than expected (p<0.050)
$^{L:}$ Observed proportion significantly lower than expected (p<0.050)

On the other hand, when looking at the incidence of *Strongylus* spp. and the efficacy of moxidectin, statistical differences were found (Table 5.264).

Table 5.264. *Strongylus* spp. incidence and efficacy in donkeys given moxidectin

Number of wormings with moxidectin	*Strongylus* spp.			
	n	Incidence	n	Efficacy
0	87	70.1%^{H}	150	18.7%^{L}
1	28	32.1%^{L}	294	33.7%^{H}
Total	**115**	**60.9%**	**444**	**28.6%**
p	<0.001 ^{X2}		0.001 ^{X2}	

$^{X2:}$ Significance of Pearson's Chi-square test
$^{H:}$ Observed proportion significantly higher than expected (p<0.050)
$^{L:}$ Observed proportion significantly lower than expected (p<0.050)

In fact, it was observed that there was a significantly lower incidence of *Strongylus* spp. after one moxidectin treatment (32.10%), whilst those with no treatment had a significantly higher incidence of 70.1%.

Secondly, with regards to the efficacy of moxidectin, statistical differences were also found (p_{X2}=0.001). Although efficacy was low at 33.7%, it was significantly higher than in donkeys receiving no treatment (18.7%).

On the other hand, there were no statistical differences found between the incidence of *Strongylus* spp. and the use of ivermectin (p_{LR}=0.547) (Table 5.265). Treatment efficacy was very low (37.5%) for those treated with ivermectin; this result is supportive of concerns regarding possible drug resistance.

Matthews and Burden (2013) reported that availability of macrocyclic lactones (ML), ivermectin and, later, moxidectin, led to substantial reductions in the prevalence of large strongyle infections in managed equine populations as these anthelmintics are highly effective against the pathogenic larval stages.

Table 5.265. Strongylus spp. incidence and efficacy in donkeys receiving ivermectin

Number of wormings with ivermectin	*Strongylus* spp.			
	n	Incidence	n	Efficacy
0	108	60.2%	404	27.7%
1	7	71.4%	40	37.5%
Total	**115**	**60.9%**	**444**	**28.6%**
p	0.547^{LR}		0.192 ^{X2}	

$^{X2:}$ Significance of Pearson's Chi-square test; $^{LR:}$ Significance of Likelihood Ratio test

When looking at the relationship between the incidence of *Strongylus* spp. and treatment efficacy with ivermectin or moxidectin or a combination of both, it was found that there were statistical differences between the incidence of *Strongylus* spp. and the use of ivermectin or moxidectin (p_{LR}=0.002). Interestingly, the incidence of *Strongylus* spp. was similar with the use of ivermectin and with no treatment (71.4%

vs 70.0%), while it was significantly lower with moxidectin (32.1%). These results suggest the possibility of ivermectin resistance, making moxidectin the drug of choice when treating *Strongylus* spp. in donkeys.

Additionally, it was observed that there were statistical differences when looking at the efficacy of treatment between the use of ivermectin, moxidectin or a combination of both (p_{X2}=0.001). Ivermectin efficacy alone was significantly lower (27.6%) than moxidectin (32.5%), whilst higher in combination (63.6%) (Table 5.266).

The incidence and efficacy of different worming treatments was assessed despite the knowledge that triclabendazole has no known efficacy against *Strongylus* spp. Interestingly, statistically significant differences were found between the number of treatments with triclabendazole and efficacy against *Strongylus* spp. (p_{LR}=0.027). These findings may perhaps be explained by the possible combined use of triclabendazole with another drug effective against *Strongylus* spp. When triclabendazole was used once as a treatment there was a 40.0% efficacy against *Strongylus* spp., whilst efficacy increased if used twice although there was only one individual wormed (n=1, Table 5.267).

Table 5.266. *Strongylus* spp. incidence and treatment efficacy in donkeys receiving moxidectin and ivermectin

Worming	***Strongylus* spp.**			
	n	Incidence	n	Efficacy
No worming	80	70.0%^{H}	121	16.5%^{L}
Moxidectin	28	32.1%^{L}	283	32.5%^{H}
Ivermectin	7	71.4%	29	27.6%
Ivermectin + Moxidectin	-	-	11	63.6%^{H}
Total	**115**	**60.9%**	**444**	**28.6%**
p	0.002 ^{LR}		0.001 ^{X2}	

$^{X2:}$ Significance of Pearson's Chi-square test; $^{LR:}$ Significance of Likelihood Ratio test
$^{H:}$ Observed proportion significantly higher than expected (p<0.050)
$^{L:}$ Observed proportion significantly lower than expected (p<0.050)

Table 5.267. *Strongylus* spp. incidence and efficacy with triclabendazole treatment

Number of wormings with triclabendazole	***Strongylus* spp.**			
	n	Incidence	n	Efficacy
0	102	62.7%	378	26.5%^{L}
1	13	46.2%	65	40.0%^{H}
2	-	-	1	100.0%
Total	**115**	**60.9%**	**444**	**28.6%**
p	0.248 ^{X2}		0.027 ^{LR}	

$^{X2:}$ Significance of Pearson's Chi-square test; $^{LR:}$ Significance of Likelihood Ratio test
$^{H:}$ Observed proportion significantly higher than expected (p<0.050)
$^{L:}$ Observed proportion significantly lower than expected (p<0.050)

As expected, no statistical differences were found between the number of closantel treatments and the incidence and efficacy against *Strongylus* spp. (p_{LR}=0.366 and p_{LR}=0.540) (Table 5.268).

Table 5.268. *Strongylus* spp. incidence and efficacy with closantel treatment

Number of wormings with closantel	*Strongylus* spp.			
	n	Incidence	n	Efficacy
0	113	60.2%	427	29.0%
1	1	100.0%	10	20.0%
2	1	100.0%	4	14.3%
Total	**115**	**60.9%**	**444**	**28.6%**
p	0.366 ^{LR}		0.540 ^{LR}	

$^{LR:}$ Significance of Likelihood Ratio test

No statistical differences were found between the incidence of *Strongylus* spp. and treatment efficacy with pyrantel (p_{LR}=0.196) (Table 5.269). Pyrantel resistance has previously been reported in donkeys in the UK (Lawson et al., 2015).

Table 5.269. *Strongylus* spp. incidence and efficacy in donkeys with pyrantel treatment

Number of wormings with pyrantel	*Strongylus* spp.			
	n	Incidence	n	Efficacy
0	115	60.9%	427	29.3%
1	-		17	11.8%
Total	**115**	**60.9%**	**444**	**28.6%**
p	-		0.196 ^{LR}	

$^{LR:}$ Significance of Likelihood Ratio test

The following considerations have been recommended when treating *S. equinus, S. vulgari*s and *S. edentates* (Evans and Crane, 2018h). Once yearly administration of moxidectin for encysted small strongyles should be sufficient to control large strongyles in most populations; secondly, there is no indication of resistance to anthelmintics in the large strongyles at present. Lastly, where administration of anthelmintics is unknown, erratic or absent, treatments should be undertaken as a precaution.

5.6.8.2. Liver fluke

Despite the known effect of triclabendazole against liver fluke, there were no statistically significant differences found when looking at the incidence and efficacy of triclabendazole against liver fluke in donkeys (p_{LR}=0.976 and p_{LR}=0.129) (Table 5.270). This would suggest the possibility of liver fluke resistance to triclabendazole, necessitating further investigation. Matthews and Burden (2013) reported increasing anthelmintic resistance amongst fluke populations in the UK.

Table 5.270. Liver fluke incidence and efficacy in donkeys receiving triclabendazole

Number of worming with triclabendazole	Liver fluke			
	n	Incidence	n	Efficacy
0	470	0.4%	10	100.0%
1	35	2.9%	44	86.4%
2	-	-	1	100.0%
Total	**505**	**0.6%**	**55**	**89.1%**
p	0.177 LR		0.240 LR	

LR: Significance of Likelihood Ratio test

Despite not finding any statistical differences between the incidence of liver fluke and the use of closantel and the efficacy of treatment and the use of closantel (p_{LR}=0.976 and p_{LR}=0.129); it can be observed (Table 5.271) that there was no presence of liver fluke after one or two treatments, and there was a 100.0% efficacy when using closantel rather than the 86.4% efficacy found with the use of triclabendazole (Table 5.270).

Table 5.271. Liver fluke incidence and treatment efficacy in donkeys with closantel

Number of worming with closantel	Liver fluke			
	n	Incidence	n	Efficacy
0	501	0.6%	40	85.0%
1	3	0.0%	8	100.0%
2	1	0.0%	7	100.0%
Total	**505**	**0.6%**	**55**	**89.1%**
p	0.976 LR		0.129 LR	

LR: Significance of Likelihood Ratio test

There were no statistical differences found when looking at the incidence of liver fluke and the efficacy of triclabendazole or closantel (p_{LR}=0.408 and p_{LR}=0.220) (Table 5.272); however, it can be observed that there is a 100% efficacy with the use of two treatments, whilst treatment efficacy is lower after only one treatment (84.6%).

Evans and Crane (2018) reported that the following considerations should be followed when treating liver fluke. Firstly, there are no flukicidal products licensed for use in donkeys so treatment must be prescribed according to relevant local regulations. Secondly, triclabendazole has been used extensively at TDS at an increased dose rate of 18 mg/kg.

Thirdly, there have been numerous reports of lack of efficacy of triclabendazole, and this has been observed in donkey infestations (Evans and Crane, 2018). It has been recommended that faecal samples are analysed 14 and 28 days post-treatment to ensure efficacy.

Table 5.272. Liver fluke incidence and treatment efficacy in donkeys with triclabendazole or closantel

Number of wormings with triclabendazole or closantel	Liver fluke			
	n	Incidence	n	Efficacy
0	467	0.4%	2	100.0%
1	36	2.8%	39	84.6%
2	2	0.0%	13	100.0%
3	-	-	1	100.0%
Total	**505**	**0.6%**	**55**	**89.1%**
p	0.408 ^{LR}		0.220 ^{LR}	

$^{LR:}$ Significance of Likelihood Ratio test

Lastly, where triclabendazole is known to be ineffective, closantel (20 mg/kg) may be considered. This product is only effective against adult flukes, so the recommendation is to re-dose 8 to 10 weeks later. Reported symptoms of overdose although rare, include blindness, anorexia and ataxia, although no symptoms of overdose have been observed at TDS.

5.6.8.3. Lungworm

Despite not finding statistically significant differences between lungworm incidence and the efficacy of moxidectin (p_{LR}=0.289 and p_{LR}=0.471) (Table 5.273), it was interesting to note that efficacy after one treatment with moxidectin was higher than with ivermectin (Table 5.274).

Table 5.273. Lungworm incidence and moxidectin efficacy in donkeys

Number of wormings with moxidectin	Lungworm			
	n	Incidence	n	Efficacy
0	228	0.0%	4	100.0%
1	302	0.3%	14	92.9%
Total	**530**	**0.2%**	**18**	**94.4%**
p	0.289 ^{LR}		0.471^{LR}	

$^{LR:}$ Significance of Likelihood Ratio test

In Table 5.274 it can be observed that there were statistically significant differences between efficacy against lungworm and ivermectin treatment (p_{LR}=0.048); interestingly, there was a lower efficacy after the use of one ivermectin treatment (66.7%) which would also suggest a lack of drug efficacy and resistance issues in this parasite.

There were no statistically significant differences found between the efficacy against lungworm with ivermectin and moxidectin and their combination (p_{LR}=0.175) (Table 5.275).

Table 5.274. Lungworm incidence and efficacy with ivermectin treatment in donkeys

Number of worming with ivermectin	Lungworm			
	n	Incidence	n	Efficacy
0	488	0.2%	15	100.0%[H]
1	42	0.0%	3	66.7%[L]
Total	**530**	**0.2%**	**18**	**94.4%**
p	0.684 [LR]		0.048 [LR]	

[LR:] Significance of Likelihood Ratio test

[H:] Observed proportion significantly higher than expected (p<0.050)

[L:] Observed proportion significantly lower than expected (p<0.050)

Table 5.275. Lungworm incidence and efficacy with moxidectin and ivermectin treatment in donkeys

Number of wormings with ivermectin or moxidectin	Lungworm	
	n	Efficacy
No worming	3	100.0%
Moxidectin	12	100.0%
Ivermectin	1	100.0%
Ivermectin + Moxidectin	2	50.0%
Total	**18**	**94.4%**
p	0.175 [LR]	

[LR:] Significance of Likelihood Ratio test

Evans and Crane (2018h) recommended the following considerations when choosing anthelmintics against lungworm. Firstly, that macrocyclic lactones can treat lungworm successfully. Secondly, there is currently no indication of resistance to anthelmintics. Thirdly, de-worming schedules that include a once yearly larvicidal macrocyclic lactone treatment should control lungworm in a closed population. The last recommendation being that newly introduced donkeys or mules should always be treated with a macrocyclic lactone and have restricted grazing for 48 h.

5.6.8.4. Tapeworm

Statistically significant differences were found between ivermectin efficacy against tapeworm and number of treatments (p_{LR}=0.048). Interestingly, it was observed (Table 5.276) that there was a lower efficacy than expected when using ivermectin against tapeworm (66.7%). Ivermectin on its own has not reportedly been effective against tapeworm and is normally used in combination with praziquantel against this parasite.

Evans and Crane (2018h) recommended the following when choosing a treatment against tapeworm. Firstly, treatment should be undertaken in late autumn or winter in temperate climates or as indicated in other climates.

Table 5.276. Tapeworm incidence and ivermectin efficacy in donkeys

Number of wormings with ivermectin	Tapeworm			
	n	Incidence	n	Efficacy
0	508	0.2%	15	100.0% [H]
1	45	0.0%	3	66.7% [L]
Total	**553**	**0.2%**	**18**	**94.4%**
p	0.680[LR]		0.048[LR]	

[LR:] Significance of Likelihood Ratio test

[H:] Observed proportion significantly higher than expected (p<0.050)

[L:] Observed proportion significantly lower than expected (p<0.050)

Secondly, products specifically licenced for tapeworm should be used; such as pyrantel embonate at an increased dose ("double dose"). Praziquantel is not licensed for use in donkeys, therefore should be used where appropriate and according to relevant local regulations when pyrantel embonate unavailable.

Lastly, Evans and Crane (2018h) reported that there is no data available concerning the use of combination de-wormers in donkeys and TDS does not recommend their use.

5.7. Veterinary findings during the NAU period

Donkeys were observed by experienced grooms, and examined by a vet if any health abnormality was seen during their time in the NAU.

From a total of 596 donkeys, 403 animals had veterinary findings (67.6%), with a total of 923 veterinary findings during the time in the NAU (Table 5.277).

Table 5.277. Frequency of veterinary findings in donkeys (n=596) during the NAU period

Number of veterinary findings	n	%
0	193	32.4%
1	143	24.0%
2	120	20.1%
3	73	12.2%
4	29	4.9%
5	22	3.7%
6	16	2.7%

5.7.1. Veterinary findings during NAU period stratified by systems

There were numerous dermatological veterinary findings recorded during the study period. Skin conditions in donkeys are often at an advanced stage before they are reported (Evans and Crane, 2018i). Their thick coat and lack of regular thorough examinations may have contributed to skin conditions being overlooked by their owners in their origin home.

The commonest dermatological condition noted at admission was the presence of suspected sarcoids; specifically, nodular type B1 (n=20) and fibroblastic (n=10). Sarcoids were classified using Knottenbelt's classification (Knottenbelt, 2016).

The second most reported finding was the presence of lice (2.0%). Lice infestation can be common in donkeys and can cause discomfort and pruritus and donkeys should be treated. Lice are easily missed in donkeys due to their long coat (Evans and Crane, 2018i). These findings might suggest a lack of detection, such as thorough examination at the time of grooming.

Table 5.278. Dermatological veterinary findings in donkeys (n=596) during the NAU period

Dermatological veterinary findings	n	%
Nodular sarcoid type B1	20	3.4%
Lice infestation	12	2.0%
Fibroblastic sarcoid	10	1.7%
Sarcoid treatment with AW4	10	1.7%
Wounds	10	1.7%
Sweet itch	8	1.3%
Sarcoid elastrated under sedation	7	1.2%
Skin nodule	7	1.2%
Hypersensitivity to ectoparasites	5	0.8%
Dermatitis	5	0.8%
Nodular sarcoid type B2	5	0.8%
Verrucose sarcoid	5	0.8%
Mud fever-pastern dermatitis	4	0.7%
Sarcoid laser surgery-GA	2	0.3%
Skin abscess	2	0.3%
Skin cyst	2	0.3%
Dermatophytosis-treatment	1	0.2%
Eosinophilic granuloma	1	0.2%
Skin trauma	1	0.2%
Suspected dermatophytosis	1	0.2%
Thrombophlebitis	1	0.2%

If conditions occurred in the NAU and were unreported at both admission and PAM, this would suggest that some conditions such as the development of sarcoids can occur suddenly and recording should include if a nodule has developed since admission; the same would apply for the presence of lice. Mixing donkeys from different origins might increase the risk of infestation during their time in the NAU if the presence of lice was missed at admission.

The commonest ophthalmological finding during the NAU period was conjunctivitis (1.2%), whilst uveitis was the second most reported finding (0.5%) (Table 5.279).

Table 5.279. Ophthalmological veterinary findings in donkeys (n=596) during the NAU period

Ophthalmological veterinary findings	n	%
Conjunctivitis	7	1.2%
Uveitis	3	0.5%
Entropion	2	0.3%
Bilateral immature cataracts	1	0.2%
Chronic pannus	1	0.2%
Corneal ulceration	1	0.2%
Corneal scarring	1	0.2%
Eye trauma	1	0.2%

Cardiological findings were rarely reported, which might indicate a low frequency of cardiological problems. *Post-mortem* surveys suggest a high prevalence of cardiovascular disease in donkeys and Roberts and Duke (2016) stated that there was sparse clinical information about cardiovascular findings at TDS. Roberts and Duke (2016) looked at 202 donkeys and detected a heart murmur in four donkeys. An additional 43 donkeys were also diagnosed with aortic insufficiency at echocardiography whilst another three showed degenerative aortic valve changes at post-mortem. These findings would suggest that some donkeys have undiagnosed cardiovascular disease and a thorough examination including heart auscultation at admission should perhaps be performed by a vet to detect more cases. The study by Morrow et al. (2010) found that vascular disease was the second most common post-mortem finding. Their findings suggested that degenerative changes were affecting blood vessels more commonly in elderly animals rather than being associated with any donkey specific pathology; therefore, TDS should consider a much more thorough first clinical examination in the case of geriatric animals to detect early signs of disease. The majority of first admission exams responsible for identifying minor findings are currently performed by a veterinary nurse. These donkeys may not be examined by a vet unless they are displaying clinical signs that would necessitate examination or they require sedating.

Table 5.280. Cardiological veterinary findings in donkeys (n=596) during the NAU period

Cardiology veterinary findings	n	%
Heart murmur	3	0.5%
Tachycardia + tachypnoea	3	0.5%

With regards to respiratory findings in donkeys whilst in the NAU, the most reported finding was a bilateral nasal discharge (2.7%) followed by a cough (1.2%); these are clinical signs rather than diagnostic findings. It would be interesting to assess the incidence of respiratory diseases in donkeys in the future. The new veterinary system should assist diagnostic findings being taken into consideration rather than just initial clinical signs.

Recurrent airway obstruction (RAO) was reported in 0.7% of cases (Table 5.281). Interestingly, Morrow et al. (2010) found that pulmonary fibrosis was frequently noted at post-mortem in donkeys in the UK with an undetermined aetiology. Previous studies have suggested an association between cases of interstitial pneumonia and pulmonary fibrosis in donkeys infected with asinine herpes virus (Kleiboeker et al., 2002). As part of TDS health screening in the NAU it could be helpful to ultrasound the lungs of those animals with a history of respiratory disease to identify prevalence of disease.

Table 5.281. Respiratory findings in donkeys (n=596) during the NAU period

Respiratory veterinary findings	n	%
Bilateral nasal discharge	16	2.7%
Cough	7	1.2%
RAO	4	0.7%
Dyspnoea	4	0.7%

With regards to musculoskeletal findings, the most frequently reported conditions in donkeys during their NAU period was lameness of unknown origin (1.2%) and osteoarthritis (1.2%) (Table 5.282).

The third most reported finding was back pain (0.8%). Morrow et al. (2010) found that arthritis was the third commonest post-mortem finding in aged donkeys within the UK; it has been associated with ageing in many species and it is possible that it is underdiagnosed in donkeys on arrival at the NAU. With this in mind, careful assessment of mobility should be performed as well as further diagnostics in order to assess the severity of arthritic changes, to ensure quality of life especially in geriatric donkeys. In this study, 0.2% of donkeys showed enough clinical signs of osteoarthritis that a decision was made to monitor their quality of life closely for signs of deterioration with regards to their mobility and pain scale scores.

Table 5.282. Musculoskeletal findings in donkeys (n=596) during the NAU period

Musculoskeletal findings	n	%
Lameness of unknown origin	7	1.2%
Osteoarthritis	7	1.2%
Back pain	5	0.8%
Cast	3	0.5%
Lameness Trauma	3	0.5%
Locking stifle	3	0.5%
Tendonitis	3	0.5%
Hind limb lameness	1	0.2%
Lameness tendonitis	1	0.2%
Muscle wastage	1	0.2%
Poor conformation	1	0.2%
Quality of life concerns due to osteoarthritis	1	0.2%

The commonest hoof-related conditions in donkeys were laminitis (4.2%) and acute laminitis (3.0%), followed by white line abscesses (2.2%) (Table 5.283). Donkeys that were diagnosed with severe osteoarthritis had their quality of life closely monitored (Quality of life osteoarthritis) and end points decided for them. In contrast, 1.2% of donkeys were diagnosed with osteoarthritis and displayed clinical signs that were felt to be manageable with analgesia. As a result, the attending clinician did not have concerns regarding the donkey's quality of life.

Table 5.283. Hoof-related findings in donkeys (n=596) during the NAU time

Hoof-related findings	n	%
Laminitis	25	4.2%
Acute bout of laminitis	18	3.0%
Lameness White Line Abscess	13	2.2%
Lameness after farrier	9	1.5%
Chronic laminitis	8	1.3%
Lameness soft soles	8	1.3%
Extensive seedy toe	7	1.2%
Lameness seedy toe	5	0.8%
White Line Abscess	4	0.7%
P3 severe remodelling	3	0.5%
Very poor foot balance	3	0.5%
Permanent solar support	2	0.3%

Donkeys that showed signs of laminitis at PAM had radiographs taken of their front feet to assess their fitness to travel. If there is a history of mild laminitis then donkeys are traveled with analgesic medication, bandages and deep bedding in the lorry. The study by Morrow et al. (2010) in an aged donkey population found that foot disorders were the fourth most common finding at post-mortem.

It would have been interested to identify if there was an association between donkeys with foot disorders and Pituitary Pars Intermedia Dysfunction (PPID). Morrow et al. (2010) identified that donkeys with foot disorders were over 30 times more likely to have PPID compared to those without a foot disorder. As part of TDS NAU protocol, donkeys have basal insulin, glucose, triglycerides and adrenocorticotropic hormone (ACTH) measured to screen for equine metabolic syndrome (EMS) and PPID.

Table 5.284 shows the behavioural veterinary findings during the NAU. The commonest clinical behavioural finding was "dullness" (n=20). Dullness and depression are generally considered as an indicator of pain in donkeys (Thiemann, 2013). Identification of subtle signs and changes in behaviour can be difficult in donkeys as they do not usually show clear clinical signs like horses. Moreover, donkeys that have been recently admitted and whose normal patterns and behaviours are unknown to carers might not have their behavioural changes noticed as promptly. TDS provides training for NAU grooms to identify the early signs of disease and has staff on site for monitoring purposes from 07:00 to 21:00.

Table 5.284. Behavioural veterinary findings in donkeys (n=596) during the NAU period

Behaviour veterinary findings	n	%
Dullness	20	3.4%
Sedation required for dental	19	3.2%
Anorexia	12	2.0%
Sedation required for treatment	8	1.3%
Sedation for lice treatment-clipping	7	1.2%
Sedation required for farrier	6	1.0%
Microchipped under sedation	2	0.3%
Oral sedation to examine	1	0.2%
Stallion-like behaviour	1	0.2%

In contrast to TDS farms, there were many reported cases of sedation needed in the NAU for routine procedures such as dentals, clipping, the farrier and microchipping. Sedation for routine procedures is usually rare on TDS farms and could indicate a degree of stress and lack of handling in the previous home.

Interestingly, the second most reported finding was “anorexia” (2.0%) which is commonly noted alongside dullness in donkeys and guarantees an emergency visit by a veterinarian.

When looking at digestive findings, the most commonly reported finding was weight loss (9.9%) (Table 5.285). Donkeys are weighed as a minimum on arrival and departure and once monthly if they have a prolonged stay in the NAU. An increase or loss of 5% or more bodyweight is reported to the NAU vet. As a result, donkeys are examined and blood samples are usually taken.

The second most reported finding was colic (2.8%) although the type of colic was not recorded on every occasion.

Table 5.285. Digestive veterinary findings in donkeys (n=596) during the NAU period

Digestive veterinary findings	n	%
Weight loss	59	9.9%
Colic	12	2.0%
Poor body condition	7	1.2%
Diastema treatment	6	1.0%
Choke	4	0.7%
Dental extraction under sedation	3	0.5%
Ileus	2	0.3%
Ptyalism- dental	2	0.3%
Quality of life dental	2	0.3%
Suspected cyathostominosis	2	0.3%
Colitis	1	0.2%
GA- complicated choke	1	0.2%
Intra abdominal mass	1	0.2%
Quidding	1	0.2%
Referred for colic	1	0.2%
Spasmodic colic	1	0.2%
Suspected colitis	1	0.2%
Strongyloides westeri	1	0.2%

There was a small incidence of liver disease reported in donkeys whilst residing in the NAU (0.2%) (Table 5.286). All donkeys had a full biochemistry profile including liver parameters such as GGT, GLDH and bile acids. Donkeys with consistently elevated liver enzymes underwent ultrasonography of the liver and biopsy where indicated.

Table 5.286. Hepatic findings in donkeys (n=596) during the NAU period

Hepatic findings	n	%
Inappetence-liver related	2	0.3%
Liver disease	1	0.2%

The initial blood sample taken from each donkey in the NAU measures basal ACTH, insulin, glucose and triglycerides. Results were examined by the NAU vet and a small percentage of donkeys were diagnosed with PPID (6.5%) and EMS (0.8%) (Table 5.287). Despite this comprehensive screening, the majority of donkeys are rarely diagnosed or medicated during their stay in the NAU. It is in the author's experience that these endocrine parameters can be out of range initially due to stress. Consequently, these endocrine parameters often normalise when samples are repeated after allowing donkeys to settle and become accustomed to any diet changes and weight loss. It is possible that cases were under reported and many of them were re-scheduled for repeat blood sampling.

Table 5.287. Endocrine veterinary findings in donkeys (n=596) during the NAU period

Endocrine veterinary findings	n	%
Pituitary Pars Intermedia Dysfunction (PPID)	39	6.5%
Equine Metabolic Syndrome (EMS)	5	0.8%
Inappetence-pergolide related	1	0.2%
Slightly high ACTH-repeat blood sample	1	0.2%

The most common reproductive finding reported in donkeys during their NAU period was castration complications (8.4%) (4.2% required surgical intervention and the remaining cases resolved without the need for further intervention) (Table 5.288).

Table 5.288. Reproductive veterinary findings in donkeys (n=596) during the NAU period

Reproductive veterinary findings	n	%
Castration complication requiring surgery	25	4.2%
Castration complications	25	4.2%
Pregnant: 3 months	5	0.8%
Clitoris prolapse	1	0.2%
Pregnant: 10 months	1	0.2%
Pregnant: 5 months	1	0.2%
Pregnant: last trimester	1	0.2%
Urine scalding	1	0.2%

In the majority of cases pyrexia indicates a possibly infectious disease (bacterial or viral etiology) and was therefore included in this category.

The most common finding in donkeys in terms of infectious diseases was Equine Herpesvirus- 1 (EHV-1) (1.3%). This is diagnosed by Polymerase Chain Reaction (PCR) on a nasopharyngeal swab (Table 5.289). A number of donkeys had suspected EHV-3 scar-type lesions around the external genital skin. Interestingly, there were no reports of *S. equi* subs. *equi* (strangles) or *S. equi* subs. *zooepidemicus* or influenza or any other infectious disease although tests were only performed if donkeys were showing clinical signs of disease.

Despite a null incidence of *S. equi subs. equi*, new protocols have been initiated to increase the testing of high-risk animals (Appendix 11). High-risk animals are defined as those that have had possible exposure to *S. equi* subs*. equi* or are from an unknown origin. It would be interesting to record if the incidence of the disease increases and if the stress of screening precipitates conditions such as hyperlipaemia.

Table 5.289. Infectious diseases in donkeys (n=596) during the NAU period

Infectious diseases	n	%
Pyrexia of unknown origin	10	1.7%
EHV-1 PCR positive	8	1.3%
EHV-3 skin scar lesions	4	0.7%
EHV1-4 positive in group	3	0.5%
EHV-5 PCR positive	3	0.5%
EHV-5 positive in group	2	0.3%
Suspected EHV-1, EHV-4	2	0.3%
EHV-1 isolated	1	0.2%
EHV-1-4 evidence of infection, serology	1	0.2%

5.7.2. Veterinary procedures during the NAU period

Donkeys have a blood sample taken for haematology and biochemistry during week 1 in the NAU. Despite the current NAU protocol of drawing a blood sample from every donkey, a small number of donkeys did not have an initial blood sample (1.0%). The majority of donkeys had one blood sample whilst in the NAU (72.8%), whilst 20.0% had a second sample taken in order to assess any abnormal parameters found in the first sample. Interestingly, a few donkeys had 4, 5, 6 and even 8 blood samples taken (Table 5.290).

The most commonly reported finding was hypoproteinemia, a common finding in cases of parasitic colitis, and can also be related to nutrition and gastrointestinal disease (Table 5.291). Donkeys with hypoproteinemia diagnosed from their first bloods undergo further investigations.

Table 5.290. Number of blood samples taken from donkeys (n=596) during the NAU period

Number of blood samples	n	%
0	6	1.0%
1	434	72.8%
2	119	20.0%
3	22	3.7%
4	9	1.5%
5	2	0.3%
6	3	0.5%
8	1	0.2%

Table 5.291. Blood abnormalities in donkeys (n=596) during the NAU period

Blood abnormalities	n	%
Hypoproteinemia	42	7.0%
High GGT	22	3.7%
Hyperlipaemia	14	2.3%
High WBC	13	2.2%
High GGT-GLDH	10	1.7%
High bile acids	9	1.5%
Hypoglobulinemia	9	1.5%
TRIG borderline high	8	1.3%
High GLDH	7	1.2%
High liver parameters	6	1.0%
Hypoalbuminemia	5	0.8%
High CPK	4	0.7%
High Amylase and Lipase	3	0.5%
High Urea	3	0.5%
Low WBC	3	0.5%
High Insulin levels	2	0.3%
High Lipase	2	0.3%
Lymphocytosis	2	0.3%
Anaemia	1	0.2%
Hyperalbuminemia	1	0.2%
High AST	1	0.2%
High Create	1	0.2%
High SAA	1	0.2%
Thrombocytopenia	1	0.2%

High levels of GGT were recorded as the second most common finding (3.7%). In the author's experience many young clinically normal donkeys have elevated GGT on their first bloods. Further blood samples usually show a decreased level to within the normal range.

Interestingly, the third most common finding was hyperlipaemia (2.3%). Over the past 15 years, cases of primary hyperlipaemia have decreased in the NAU; stress has been minimised by keeping donkeys in smaller groups, whilst diets are maintained as similar to those received previously and changed as gradually as possible. Procedures are minimised and TDS protocols have been designed and planned to minimise the risk of hyperlipaemia. High risk animals are identified before arrival and appetite monitoring is performed twice daily by feeding these donkeys a small amount of a vitamin and mineral balancer (forage balancer from Top Spec) to help identify early cases of inappetence.

The commonest diagnostic procedures during the NAU period were radiography of front feet (3.7%), followed by pregnancy diagnostics such as ultrasonography (1.2%) (Table 5.292).

Table 5.292. Diagnostic procedures in donkeys (n=596) during the NAU period

Diagnostic procedures	n	%
Radiographs of front feet	22	3.7%
Ultrasound Pregnancy positive	7	1.2%
Ultrasound Pregnancy negative	6	1.0%
Rig test negative	6	1.0%
Pregnancy diagnosis- Oestrone negative	4	0.7%
Skin samples taken	2	0.3%
Ultrasound heart NAD	1	0.2%
Ultrasound abdominal NAD	1	0.2%
Ultrasound liver	1	0.2%
Ultrasound liver-biopsy	1	0.2%
Endoscopy – choke	1	0.2%
Referred for abdominal ultrasound	1	0.2%
Endoscopy - contact with *S. equi*	1	0.2%
Endoscopy - history of nasal discharge	1	0.2%
Referred for joint investigation	1	0.2%
Ultrasound Pregnancy positive: 6 months	1	0.2%
Ultrasound vaginal discharge	1	0.2%

Interestingly, endoscopy of the guttural pouches was very infrequent (0.2%), and TDS has started a new protocol of *S. equi* screening. This increases the number of endoscopies and reduces the risk of disease in individuals as well as reducing the risk of introducing *S. equi* to TDS farms.

In total, ultrasound was used in 3.6% of donkeys.

Few surgical treatments were carried out at TDS (Table 5.293), and the most frequent treatment recorded in the veterinary system was castration (23.6%). It is very likely that some castrations were not recorded in veterinary examinations and were on a separate page on the system and were not added into the study and therefore they are under reported. Surgical procedures are now recorded and appear on clinical examinations and would be easier to statistically analyse in future.

Table 5.293. Surgical treatments in donkeys (n=596) during the NAU period

Treatments	n	%
Castration	141	23.6%
Special dental treatment	3	0.5%
Surgical procedure GA skin	2	0.3%
Surgical excision of mass	1	0.2%
Surgical procedure GA joint	1	0.2%
Surgical procedure standing trauma	1	0.2%

Statistically significant differences were found between the castration method in donkeys and the location where the castration was performed (p_{X2}<0.001). It was observed (Table 5.294) that more donkeys than expected were castrated before arrival with an unknown method of castration recorded (86.0%). It would be interesting to request the type of castration technique used in order to survey the various techniques used in donkeys by external practices.

More donkeys than expected from TDS had a closed castration performed (61.5%) whilst similar percentages had an inguinal approach (19.8%) or scrotal ablation (16.5%) (Table 5.294)

Table 5.294. Castration method in donkeys stratified by location

Castration methods	Total (n=141)	Location		Total
		Before arrival (n=50)	At TDS (n=91)	
Unknown	44	86.0%^{H}	1.1%^{L}	**31.2%**
Closed	61	10.0%^{L}	61.5%^{H}	**43.3%**
Inguinal	18	0.0%^{L}	19.8%^{H}	**12.85**
Scrotal ablation	15	0.0%^{L}	16.5%^{H}	**10.6%**
Semi-closed	3	4.0%	1.1%	**2.1%**

Significance of Pearson´s Chi-square test, p<0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

Scrotal ablation although a valid technique was not found to be superior to the other techniques in reducing complications and is no longer used at TDS.

The most frequent technique used in donkeys under 2 years old is the closed technique (Table 5.295). Adult donkeys and those with very well developed testicles and spermatic cords would usually have an inguinal approach performed in theatre. Statistically significant differences were found between donkey age and type of castration technique used (p_{KW}=0.001). The age of donkeys was significantly lower when a closed castration technique was used, with a mean of 4.45 years old; whilst means were significantly older for the other two techniques, inguinal approach (8.06 years old) and scrotal ablation (6.6 years old).

Table 5.295. Age (years) of donkeys at castration stratified by method

Castration method	n	Mean	SD	Q1	Median	Q3	min	Max
Unknown	44	4.96^{ab}	3.53	2.0	4.0	6.0	1.0	15.0
Closed	61	4.45^{a}	4.30	2.0	3.0	5.5	0.3	20.0
Inguinal	18	8.06^{c}	4.83	4.0	7.0	10.0	3.0	21.0
Scrotal ablation	15	6.60^{abc}	3.74	3.0	5.0	10.0	2.0	15.0
Semi closed	3	6.00^{abc}	3.46	4.0	4.0	-	4.0	10.0
Total	**141**	**5.33**	**4.21**	**2.0**	**4.0**	**7.0**	**0.3**	**21.0**

Significance of Kruskal-Wallis test by age, p=0.001. Different superindexes in the same column indicate significant differences taking into account the Mann-Whitney test by pairs

Statistically significant differences were found between castration method and age in the case of stallions (p_{LR}=0.020) (Table 5.296). It was observed that there were more donkeys than expected in the younger category of under 1 year old that had a closed castration technique (100.0%), whilst fewer donkeys underwent this type of technique in the adult category (40.6%). Additionally, more donkeys than expected in the adult and geriatric age categories had an inguinal approach castration method (34.4% and 100.0%).

Table 5.296. Castration methods in donkeys stratified by age category

Sex	Castration methods	≤ 1 y	(1 y, 3 y]	(3 y, 5 y]	(5 y, 20 y]	> 20 y	Total
Gelding	Unknown	85.7%	90.9%	78.6%	88.9%	-	**86.0%**
	Closed	14.3%	9.1%	7.1%	11.1%	-	**10.0%**
	Inguinal	-	-	-	-	-	**-**
	Scrotal ablation	-	-	-	-	-	**-**
	Semi-closed	0.0%	0.0%	$14.3\%^{H}$	0.0%	-	**4.0%**
	n	7	11	14	18	**-**	**50**
	$\mathbf{p_{LR}}$			0.481			

Table 5.296 (cont.) Castration methods in donkeys stratified by age category

Sex	Castration methods	≤ 1 y	(1 y, 3 y]	(3 y, 5 y]	(5 y, 20 y]	> 20 y	Total
Stallions	Unknown	0.0%	0.0%	5.9%^{H}	0.0%	0.0%	**1.1%**
	Closed	100.0%^{H}	75.0%	52.9%	40.6%^{L}	0.0%	**61.5%**
	Inguinal	0.0%	10.7%	17.6%	34.4%^{H}	100.0%^{H}	**19.8%**
	Scrotal ablation	0.0%	14.3%	23.5%	21.9%	0.0%	**16.5%**
	Semi-closed	0.0%	0.0%	0.0%	3.1%	0.0%	**1.1%**
	n	13	28	17	32	1	**91**
	p_{LR}	0.020					
Total	Unknown	30.0%	25.6%	38.7%	32.0%	0.0%	**31.2%**
	Closed	70.0%^{H}	56.4%	32.3%	30.0%^{L}	0.0%	**43.3%**
	Inguinal	0.0%	7.7%	9.7%	22.0%^{H}	100.0%^{H}	**12.8%**
	Scrotal ablation	0.0%	10.3%	12.9%	14.0%	0.0%	**10.6%**
	Semi-closed	0.0%	0.0%	6.5%	2.0%	0.0%	**2.1%**
	n	20	39	31	50	1	**141**
	p_{LR}	0.015					

^{LR}: Significance of Likelihood ratio test
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

There was a low frequency of medication used in donkeys during their time in the NAU (24.5%), although it is worth noting that worming products were not classified as medication (Table 5.297).

Table 5.297. Medication used in donkeys (n=596) during the NAU period

Number of medications used per donkey	n	%
0	450	75.5%
1	102	17.1%
2	21	3.5%
3	11	1.8%
4	11	1.8%
5	1	0.2%

And finally in Table 5.298 is recorded the medication used grouped by type of product, indicating the period of use of each one.

Table 5.298. Medication used (and days of use) in medicated donkeys (n=146) during the NAU period

Type	Medication	n	%	Period of use (days)				
				n	Mean	s	min	Max
Antibiotics	Ceftiofur	2	1.4%	2	6.0	1.4	5	7
	Procaine benzylpenicillin	1	0.7%	1	5.0	-	5	5
	Trimethoprim + sulfonamide	11	7.5%	9	12.8	12.7	5	45
Corticosteroids	Prednisolone	3	2.1%	2	49.0	11.3	41	57
Dermatology	Nicotinamide	1	0.7%	-	-	-	-	-
Digestive	Omeprazole	10	6.8%	3	41.0	14.1	28	56
Endocrine	Metformin	1	0.7%	-	-	-	-	-
	Pergolide	12	8.2%	2	27.0	5.7	23	31
	Pergolide (Prascend®)	5	3.4%	-	-	-	-	-
Fluid therapy	Fluid therapy IV	3	2.1%	1	1.0	-	1	1
NSAIDs	Carprofen	3	2.1%	1	6.0	-	6	6
	Phenylbutazone	69	47.3%	26	25.6	27.2	1	105
	Flunixin meglumine	19	13.0%	18	3.7	2.0	1	11
	Paracetamol	8	5.5%	5	23.0	11.7	7	39
Respiratory	Steroid inhaler	6	4.1%	4	15.5	9.9	5	28
	Dembrexine hydrochloride	10	6.8%	9	16.7	17.1	4	56
	Clenbuterol	12	8.2%	9	16.1	16.6	4	56
Sedative	Acepromazine	7	4.8%	4	32.5	7.9	21	39
Supplement	Comprehensive balancer®	24	16.4%	1	97.0	-	97	97
	Forage balancer®	18	12.3%	1	30.0	-	30	30
	Probiotic	1	0.7%	-	-	-	-	-

5.7.3. Mortality records

There was a low frequency of natural death in donkeys after arrival (0.3%, n=2), whilst 9.6% (n=57) were humanely euthanised (PTS) using secobarbital sodium and cinchocaine hydrochloride (Somulose®), so the overall mortality was 9.9%.

The commonest reasons for euthanasia in donkeys were colitis (17.5%) and laminitis (14.8%), followed by liver failure (12.3%) (Table 5.299).

Of all of the donkeys that were euthanised or died at the TDS during the study period, 64.4% occurred outside of the NAU, versus a lower percentage that were euthanised in the NAU (35.6%). There were no donkeys in the NAU that died instead of being euthanised, whereas two donkeys died outside of the NAU.

Table 5.299. Reasons for euthanasia (n=57) in donkeys

Death causes	n	%
Laminitis	10	17.5%
Colitis	9	15.8%
Liver failure	7	12.3%
Sarcoid	6	10.5%
Impaction colic	6	10.5%
Colic	5	8.8%
Lower respiratory tract	2	3.5%
P3 sepsis	2	3.5%
Quality of life	2	3.5%
Colic- tapeworm	1	1.8%
Hepatopathy	1	1.8%
Intra-abdominal mass	1	1.8%
Pancreatitis	1	1.8%
Thrombus	1	1.8%
Trauma/fracture	1	1.8%
Choke	1	1.8%

It can be observed (Table 5.300) that the average time of euthanasia in the NAU was at 32.52 days.

Table 5.300. Time of euthanasia (in days) post arrival at the NAU

Death moment	n	Mean	SD	Q1	Median	Q3	min	Max
At the NAU	21	32.52	36.21	6.5	15.0	50.0	0	138
Not in the NAU	38	172.66	161.61	32.75	11.5	292.25	1	583

Statistically significant differences were not found between death location and age (p_{LR}=0.117) (Table 5.301).

Table 5.301. Death location stratified by age

Death location	Cause	n	Age	
			Non-geriatric	Geriatric
At the NAU	Died	-	-	-
	Euthanasia	21	52.4%	47.6%
	Total	**21**	**52.4%**	**47.6%**
Not in the NAU	Died	2	100.0%	0.0%
	Euthanasia	36	52.8%	47.2%
	Total	**38**	**55.3%**	**44.7%**

Significance of Likelihood ratio test (out of NAU), p=0.117

In addition, statistically significant differences were not found between death location and age category of donkeys (p_{LR}=0.588) (Table 5.302).

Table 5.302. Death location in donkeys stratified by age category

Death location	n	Age					Total
		≤ 1 y	(1 y, 3 y]	(3 y, 5 y]	(5 y, 20 y]	> 20 y	
At the NAU	21	-	0.0%	22.2%	40.9%	37.0%	35.60%
Out of the NAU	38	-	100.0%	77.8%	59.1%	63.0%	64.40%

Significance of Likelihood ratio test, p=0.588

Statistically significant differences were found between the frequency of death in donkeys and their age (p_{LR}<0.001). More geriatric donkeys than expected died during their time in the NAU (17.9%) (Table 5.303).

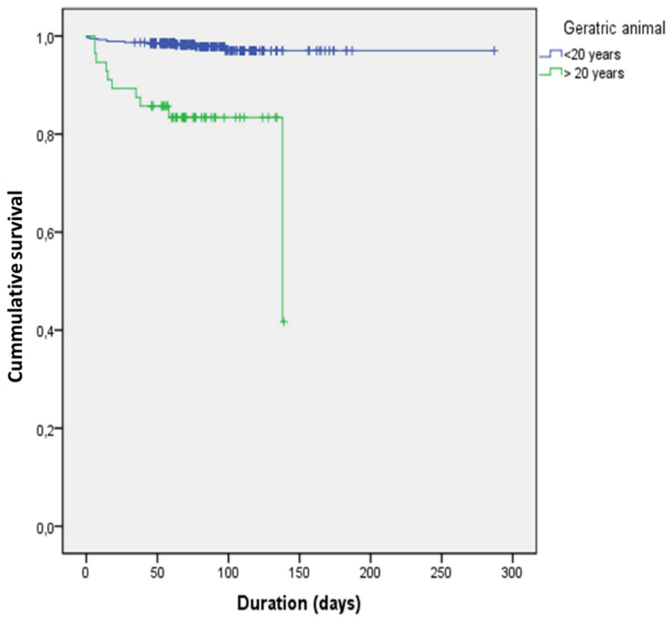
Table 5.303. Frequency of death in the NAU stratified by age

Age	n	Death at the NAU
Non-geriatric	540	2.0%^{L}
Geriatric	56	17.9%^{H}
Total	**596**	**3.5%**

Significance of Likelihood Ratio test, p<0.001
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

A total of 17.9% of geriatric donkeys died versus 2.0% in the case of non-geriatric donkeys. It was found that the mean time for non-geriatric donkeys to die was 279.95 ± 2.34 days, versus a mean time of 119.33 ± 5.89 days for geriatric donkeys (Figure 5.11).

Figure 5.11. Survival time in donkeys after arrival



Significance of log rank test, p<0.001

5.7.4. Donkeys going to the guardian scheme

A small number of donkeys were selected to join TDS guardian scheme during the study period (2.3%, Table 5.304). A suitability assessment is performed prior to relinquishment of donkeys, and some donkeys are sent directly to guardian homes. The number of donkeys joining the scheme from the NAU should therefore be very limited. TDS should aim to identify donkeys with potential for the guardian scheme prior to movement to avoid unnecessary transport and movement stress.

Table 5.304. Frequency of donkeys going to the guardian scheme from the NAU

Going to guardian scheme	n	%
No	531	92.3%
Yes, indirectly	31	5.4%
Yes, from the NAU	13	2.3%
Total	**575**	

Statistically significant differences were found between the age of donkeys and whether they went out as part of the guardian scheme (p_{LR}=0.022). It was observed that there were no geriatric donkeys joining the guardian scheme (100.0%). This is part of TDS policy, which limits the age of donkeys joining the scheme (Table 5.305).

Table 5.305. Frequency of donkeys going to guardian homes stratified by age

Age	n	No	Yes, indirectly	Yes, from the NAU
Non-geriatric	529	91.7% ^{L}	5.9%	2.5%
Geriatric	46	100.0% ^{H}	0.0%	0.0%
Total	**575**	**92.3%**	**5.4%**	**2.3%**

Significance of Likelihood Ratio test, p=0.022
^{H}: Observed proportion significantly higher than expected (p<0.050)
^{L}: Observed proportion significantly lower than expected (p<0.050)

No association was found between the frequency of donkeys leaving as part of the guardian scheme and sex (p_{X2}=0.137, Table 5.306).

Table 5.306. Frequency of donkeys going to guardian homes stratified by sex

Sex	n	No	Yes, indirectly	Yes, from the NAU
Mare	178	94.9%	4.5%	0.6%
Gelding	309	91.9%	4.9%	3.2%
Stallion	88	88.6%	9.1%	2.3%
Total	**575**	**92.3%**	**5.4%**	**2.3%**

Significance of Pearson´s Chi-square test, p=0.137

Statistically significant differences were not found between the type of origin and the percentage of donkeys leaving as part of the guardian scheme (p_{LR}=0.182). Interestingly, a percentage of returning guardian donkeys (8.9%) went straight out again from the NAU (Table 5.307). Those animals could perhaps have been sent directly to a new guardian as a direct rehoming. New protocols have been put in place to ensure that donkeys that can be directly rehomed are not sent to the NAU. The number of donkeys leaving the NAU to go to a guardian home should therefore be extremely small, as donkeys should have gone directly to their new home.

Table 5.307. Frequency of donkeys going to guardian homes stratified by type of origin

Type of origin	n	No	Yes, indirectly	Yes, from the NAU
New arrival	396	92.9%	5.3%	1.8%
DS HB (NA)	98	87.8%	10.2% ^{H}	2.0%
Return guardian	56	92.9%	0.0%	7.1% ^{H}
DS HB (RG)	10	100.0%	0.0%	0.0%
DAT	15	100.0%	0.0%	0.0%
Total	**575**	**92.3%**	**5.4%**	**2.3%**

Significance of Likelihood Ratio test, p=0.023

^{H}: Observed proportion significantly higher than expected (p<0.050)

^{L}: Observed proportion significantly lower than expected (p<0.050)

6. Conclusions/Conclusiones

6.1. Conclusions

Based on the data and results obtained, the following conclusions have been drawn:

FIRST. The typical animal admitted into The Donkey Sanctuary was an adult donkey gelding. Stallions represent a greater cost to the charity and therefore data regarding the number of stallions entering other equine charities would be helpful to assess if animals being left entire is particularly prevalent amongst donkeys. Identifying the reasons why owners are keeping animals entire could provide vital information for charities, allowing them to evaluate strategies, reduce overbreeding and the numbers of unwanted equids. Whilst the study looked at the proportion of entire relinquished donkeys, it was not designed to look into the reasons why privately owned donkeys may be left entire.

SECOND. The lack of identification (microchip and passport) identified in donkeys has a clear impact on traceability with regards to welfare law enforcement and the ability to locate equids. Awareness of the lack of identification in donkeys could improve compliance with legislation in the UK and aid preparation for potential disease outbreaks.

THIRD. There is a clear need for improving preventative healthcare in donkeys to ensure good equine welfare and biosecurity within the general UK equine population.

FOURTH. Relinquishment reasons, and reasons for owning donkeys should be assessed regularly to prevent unnecessary relinquishment. New strategies should include direct rehoming as the first and preferable option.

FIFTH. Identification of high-risk animals in guardian homes would enable forward planning. This could potentially avoid high-risk donkeys becoming emergency relinquishments, by identifying hospice homes nearby and/or discussing quality of life and agreeing on humane end points if needed.

SIXTH. The preventative healthcare of donkeys was found to be a generalised problem in all areas of the UK. Specific areas within the UK were identified as targets for educational campaigns, aimed at owners, veterinary practices, professionals and paraprofessionals: deworming, dentistry, obesity, foot care, diet and bedding selection.

SEVENTH. Geriatric donkeys have a higher risk of moderate to severe dental disease. The veterinary profession should be encouraged to ensure that geriatric donkeys in particular receive more frequent dental assessments, thereby identifying the need for advanced dental treatments, changes in dietary management and bedding type, and ensuring that their quality of life is not compromised by painful dental disease.

EIGHTH. In future, admission paperwork generated by The Donkey Sanctuary should include a description of the donkey's behaviour during the clinical exam to help with the process of rehoming. Practitioners should be encouraged to report positive as well as undesirable behavior and to make a thorough behavioural assessment.

NINTH. The study suggests that weight management at the NAU was adequate for donkeys. The Donkey Sanctuary dietary advice and weight changes should continue to be monitored to ensure correct practices are followed.

TENTH. This study highlights the risks of moving a geriatric donkey into a new environment despite providing good care. The Donkey Sanctuary should continue their efforts to avoid movement of geriatric animals. Statistical data may be helpful when discussing the risks of movement with owners. The first 50 days were a critical period for geriatric donkey survival.

These evidence- based conclusions could help support current practice at The Donkey Sanctuary, enable necessary change and also highlight areas for targeted education.

6.2. Conclusiones

En base a los datos y resultados obtenidos, se han extraído las siguientes conclusiones:

PRIMERA. El animal típico admitido en The Donkey Sanctuary era un burro macho adulto castrado. Los sementales representan un costo mayor para la organización benéfica y, por lo tanto, los datos sobre el número de burros sementales que ingresan a otras organizaciones benéficas equinas serían útiles para evaluar si dejar animales enteros es particularmente prevalente entre los burros. Identificar las razones por las que los propietarios mantienen a los animales enteros podría proporcionar información vital para las organizaciones benéficas, permitiéndoles evaluar estrategias, reducir la sobrecría y la cantidad de équidos no deseados. Si bien el estudio analizó la proporción de burros abandonados enteros, no fue diseñado para investigar las razones por las cuales los burros de propiedad privada pueden quedar enteros.

SEGUNDA. La falta de identificación (microchip y pasaporte) encontrada en los burros tiene un claro impacto en la trazabilidad en lo que respecta a la aplicación de la ley de bienestar y la capacidad de localizar équidos. El conocimiento de la falta de identificación en los burros podría mejorar el cumplimiento de la legislación en el Reino Unido y ayudar en la preparación para enfrentarse a posibles brotes de enfermedades.

TERCERA. Existe una clara necesidad de mejorar la atención médica preventiva en burros para garantizar un buen bienestar y una buena bioseguridad dentro de la población equina general del Reino Unido.

CUARTA. Los motivos de abandono y las razones por las cuales se poseen burros deben evaluarse periódicamente para evitar un abandono innecesario. Las nuevas estrategias deben incluir el realojamiento directo como la opción más preferible.

QUINTA. La identificación de animales de alto riesgo en los hogares de casas de acogida permitiría una planificación anticipada. Esto podría evitar potencialmente que los burros de alto riesgo se conviertan en abandonos de emergencia, al identificar hogares de cuidados paliativos cercanos y / o discutir la calidad de vida y acordar puntos finales humanitarios si es necesario.

SEXTA. Se descubrió que la atención médica preventiva de los burros es un problema generalizado en todas las áreas del Reino Unido. Se identificaron áreas específicas dentro del Reino Unido como objetivos para campañas educativas, dirigidas a propietarios, clínicas u hospitales veterinarios, profesionales y para profesionales: desparasitación, odontología, obesidad, cuidado de cascos, dieta y selección del tipo de cama.

SÉPTIMA. Los burros geriátricos tienen un mayor riesgo de enfermedad dental de moderada a grave. Se debe alentar a la profesión veterinaria a garantizar que los burros geriátricos, en particular, reciban evaluaciones dentales más frecuentes, identificando así la necesidad de tratamientos dentales avanzados, cambios en el manejo dietético y el tipo de cama, y asegurándose de que su calidad de vida no se vea comprometida por una enfermedad dental dolorosa.

OCTAVA. En el futuro, la documentación de admisión generada por The Donkey Sanctuary debería incluir una descripción del comportamiento del burro durante el examen clínico para ayudar con el proceso de realojamiento. Se debe alentar a los profesionales a informar sobre comportamientos tanto positivos como indeseables y a realizar una evaluación del comportamiento exhaustiva.

NOVENA. El estudio sugiere que el control de peso en NAU fue adecuado para los burros. Se debería seguir monitorizando los consejos dietéticos y los cambios de peso en el Donkey Sanctuary para garantizar que se sigan usando prácticas correctas.

DÉCIMA. Este estudio destaca los riesgos de trasladar un burro geriátrico a un nuevo entorno a pesar de brindar una buena atención. The Donkey Sanctuary debe continuar sus esfuerzos para evitar el movimiento de animales geriátricos. Los datos estadísticos pueden ser útiles al discutir los riesgos de movimiento con los propietarios. Los primeros 50 días fueron un período crítico para la supervivencia de los burros geriátricos.

Estas conclusiones basadas en evidencia podrían ayudar a respaldar la práctica actual en The Donkey Sanctuary, permitir cambios necesarios y también resaltar áreas para la educación específica.

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Appendixes

Appendix 1. Relinquishment paperwork

Appendix 1.1. Hyperlipaemia form

HYPERLIPAEMIA FORM

PLEASE READ BEFORE SIGNING THE RELINQUISHMENT FORMS

THE DONKEY SANCTUARY

Some donkeys can develop a potentially serious condition known as **"hyperlipaemia"**. This disease is a known problem in donkeys and it can be fatal. It is more likely to affect those who are **overweight** or whose appetite is depressed due to other problems, and in particular **older donkeys**. The majority of donkeys do cope with the transition to life in Devon, in the company of many potential new friends, without any obvious stress. However, it is almost inevitable that transport from their old home and adapting to the new surroundings of The Donkey Sanctuary can be a stressful experience. In many cases, particularly with older individuals, the first six weeks here can be the time when they first start to show evidence of any pre-existing illness or disability.

Since its founding in 1969 The Donkey Sanctuary has taken into its care many thousands of donkeys and mules; these have included animals from a wide range of differing backgrounds; each has been fed and managed in a particular way. On caring for new arrivals, close attention is given to all of the information provided in the relinquishment paperwork; and other than in exceptional circumstances, companions are never separated.

The Donkey Sanctuary provides donkey owners and carers with this information so that they are fully aware of the risk involved and understand that all efforts will be taken to minimise that risk. Please do not hesitate to ask for further information should any issue relating to relinquishing a donkey be required. It is the policy of The Donkey Sanctuary to ensure that previous owners and carers are kept informed of any significant problem or change during the donkey's life whilst at the Sanctuary.

Please help us to care for your donkey by filling out the paperwork and passing on as much information as you can.

Signed: (Owner)... Date: …………………

Name of Donkey: ....

Please return this with your signed relinquishment forms.

COPY TO BE LEFT WITH OWNER

THE DONKEY SANCTUARY
Slade House Farm,
Sidmouth, Devon EX10 0NU

T 01395 578222 F 01395 579266
E enquiries@thedonkeysanctuary.org.uk
www.thedonkeysanctuary.org.uk

The Donkey Sanctuary (registered charity number 264818) and its sole corporate trustee, The Donkey Sanctuary Trustee Limited (Company number 07328588) both have their registered office at Slade House Farm, Sidmouth, EX10 0NU
Incorporating: The Elisabeth Svendsen Trust for Children and Donkeys (EST); The International Donkey Protection Trust (IDPT).

WORKING WORLDWIDE

Appendix 1.2. Laminitis form

LAMINITIS FORM

PLEASE READ BEFORE SIGNING THE RELINQUISHMENT FORMS

Laminitis is a painful condition of the tissues (laminae) that bond the hoof wall to the pedal bone within the hoof. It can affect any horse, pony or donkey irrespective of age or sex, and can occur at any time of the year. Although it is traditionally considered a disease of fat donkeys, laminitis can be triggered by a variety of causes in any donkey. If laminitis is not treated promptly the pedal bone can rotate downwards and drop within the hoof. Unfortunately it is seen very commonly in donkeys, and can result in severe pain which may necessitate euthanasia.

Many donkeys with laminitis do **not** show the classical signs that ponies do, such as leaning back on their heels. Many show **subtle** signs such as **lying down a lot**, looking **stiff** when they walk (taking small steps with their front legs) and **weight shifting** slowly from one front leg to the other. These subtle clinical signs mean that unfortunately some donkeys can have severe changes within the hoof that may not have been recognised as laminitis before their arrival at the Sanctuary.

If we find that your donkey has evidence of previous or current laminitis we will endeavor to diagnose the extent of the hoof changes and trim their hooves as sympathetically as possible to minimise any discomfort. Unfortunately we sometimes find the changes that have occurred within the donkey's hooves are so severe, and the donkey is in such considerable pain, that the only option we have left is euthanasia to relieve suffering.

The information that you provide about any previous laminitis, stiffness, lying down or reluctance to move prior to the donkey's arrival can enable us to identify any potential problem and allow us to treat your donkey as promptly and effectively as possible.

The Donkey Sanctuary provides owners and carers with this information so that they are fully aware of the condition and understand that all efforts will be taken to treat existing laminitics and reduce the risk of any further bouts of laminitis.

Appendix 1.3. Management form

Management Form for Donkeys or Mules

THE DONKEY SANCTUARY

This form must be completed by the Welfare Officer with the Owner

History about how your animals have been managed is very important. Please complete this form as accurately as you can. If you are unsure about any of the questions then please leave blank.
Please tick the appropriate box or boxes and provide extra information on the lines provided as required.

DONKEY'S/MULE'S NAME: ....

Feeding questions

What do you feed your donkey/mule? Grass ☐ Hay ☐ Haylage ☐ Straw ☐

What is your pasture management throughout the year?

....

Do you feed your donkey/mule any other type of feed? Yes ☐ No ☐
(If yes please state what type and how much)

....

Do you feed your donkey/mule any treats? (If yes please explain) Yes ☐ No ☐

....

Management Questions

What is your donkey/mule bedded on? Straw ☐ Shavings ☐ Other ☐ (please state)

....

Does your donkey/mule have any obvious dislikes that may cause him/her to become stressed?
Yes ☐ No ☐ (If yes please explain)
....
....

Is the Welfare Officer able to catch, put on head collar and lead the donkey/mule? Yes ☐ No ☐
If not, is there a confined loading area? Please give details.

....
....

Is the Welfare Officer able to pick out feet? Yes ☐ No ☐

What other animals has the donkey/mule been kept with? ....
Are they bonded / close? Yes ☐ No ☐

Does your donkey/mule wear a rug during the winter season? Yes ☐ No ☐
Any other comments:

Oct 07

Admissions Dept., The Donkey Sanctuary, Sidmouth, Devon EX10 0NU
Tel: 01395 578222 Email: welfare@thedonkeysanctuary.org.uk

Appendix 1.4. Medical history

MEDICAL HISTORY

THE DONKEY SANCTUARY

This questionnaire must be completed by the Welfare Officer with the owner

It must be made clear to owners that the information given here will not affect animals being accepted. It helps the veterinary department in planning for any special needs of donkeys or mules prior to travel and arrival in Isolation.

DONKEY'S/MULE'S NAME: ……………………………Condition Score……………………

1. Eye Problems?	Yes		No		Not sure	
Comments:						
2. Breathing problems?	Yes		No		Not sure	
Comments:						
3. Dental Problems?	Yes		No		Not sure	
Date of last dental: Comments:						
4. How long have you owned your donkey?						
Has your donkey lost weight in the time that you have owned it?	Yes		No		Not Sure	
Comments:						
5. Has your donkey ever suffered from colic?	Yes		No		Not sure	
Comments:						
6. Has your donkey ever suffered from skin problems?	Yes		No		Not sure	
Comments:						

Page 1 of 2

Nov.10

Admissions Dept., The Donkey Sanctuary, Sidmouth, Devon EX10 0NU
Tel: 01395 578222 Email: welfare@thedonkeysanctuary.org.uk

MEDICAL HISTORY

7. Has your donkey ever had any sarcoids (skin tumours) or growths?	Yes		No		Not sure	
Comments:						
8. Has your donkey ever suffered from foot/joint problems?	Yes		No		Not sure	
Date farriered: Comments:						
9. Do you follow a worming programme for your donkey?	Yes		No		Not sure	
If Yes please give date of worming and product used: Comments:						
10. Has your donkey been vaccinated?	Yes		No		Not sure	
If Yes please give date of vaccination and whether it was for flu only or flu and tetanus. Comments:						
11. Does your donkey suffer from any other medical conditions, please give details?	Yes		No		Not sure	
Comments:						

Vets Name:	Practice:
Tel:	Mob:

IMPORTANT

In the interest of the welfare of the donkey our driver is instructed not to load any donkey that in his opinion:

- Is **lame**
- Has **overgrown hooves**
- Or is in any other way **not fit to travel**;

Unless that donkey is accompanied by a valid "**CERTIFICATE OF FITNESS TO TRAVEL**" issued by a veterinary surgeon **within the last 48 hours**.

Admissions Dept., The Donkey Sanctuary, Sidmouth, Devon EX10 0NU
Tel: 01395 578222 Email: welfare@thedonkeysanctuary.org.uk

Appendix 1.5. Relinquishment agreement

RELINQUISHMENT AGREEMENT

TO BE COMPLETED BY THE WELFARE OFFICER
PLEASE USE BLOCK LETTERS THROUGHOUT – ONE DONKEY PER FORM

THE DONKEY SANCTUARY

I wish my donkey/mule named ………………………………… to be admitted to The Donkey Sanctuary. I confirm that I am the legal owner and agree that having signed this form I relinquish all rights to the animal from the time of collection. **I fully understand that The Donkey Sanctuary will place my donkey in the best-suited location, this may be on our foster scheme, working for one of our DAT centres or as a resident on one of our farms**. At all times the decision taken will be made entirely in the best interest of the donkey's well being.

Name:

Address:

Tel home/work:

Postcode:

Email:

Mobile:

Signed (owner): ………………………………………………………………… **Date**: …………………

We regret that visiting your donkey during its isolation period is not permitted.

Name of Donkey/Mule: …………………………………………

Age: ……………………………………………

Colour and Description: ………………………………………

Mare/Gelding/Stallion (delete where applicable)

Passport No: …………………………………………

Microchip No: ………………………………

How long have you owned this donkey/mule? …………………………………………………………………

Where did you buy him/her? ……………………………………………………………………………………

What is your reason for sending him/her to us? ………………………………………………………………

Would you like to be kept in touch with your donkey/mule's whereabouts in future? ……………………………

If you are moving please give your new address, postcode and telephone no.:

In consideration of this relinquishment, The Donkey Sanctuary agrees to provide care and protection for this donkey.

Signature (on behalf of The Donkey Sanctuary): …………………………………………… **Date**: ……………

Data Protection Statement
The Donkey Sanctuary (incorporating The Elisabeth Svendsen Trust for Children and Donkeys), Donkey World Limited and all their branches and subsidiaries will process your personal data for the purposes of achieving their charitable objectives and conducting fundraising activities. It is our policy not to transfer your data to any other organisation other than our duly appointed agents, who have undertaken not to disclose such personal data, and all information is kept confidential. If you would prefer that we cease to send you further information about any of the above organisations please write to The Data Compliance Officer, The Donkey Sanctuary, Sidmouth, Devon, EX10 0NU.

Collected and into The Donkey Sanctuary on ……………………………………………… (to be filled in by Admissions):

May 13

Admissions Dept., The Donkey Sanctuary, Sidmouth, Devon EX10 0NU
Tel: 01395 578222 Email: welfare@thedonkeysanctuary.com

Appendix 2. Pre admission medical (PAM) form

THE DONKEY SANCTUARY

Dear Colleague

The Donkey Sanctuary would like you to examine this/these donkey/s on our behalf, attached is a Certificate of Veterinary Examination for your completion. The purpose of this examination is to ensure that the most appropriate decisions are made with regard to management and transport. We would appreciate your assessment of this/these animal/s and the Donkey Sanctuary will cover the cost of the visit and examination.

We are particularly keen to identify elderly, obese or terminally ill donkeys and those with chronic conditions at the earliest opportunity so that appropriate decisions can be made about their future. It has been of great benefit to us when we have been able to discuss such cases with the attending vet so if you feel that the welfare of the donkey you examine may be compromised by travel please could you phone the Donkey Sanctuary Veterinary department: 01395-579162. In such cases we will attempt to find alternative options for the donkeys which may involve further diagnostic tests, treatment or travel to a veterinary hospital facility locally.

Unfortunately we do still get cases where donkeys are travelled to the Donkey Sanctuary and the severity of their condition and its associated pain has been underestimated. As a Sanctuary we attempt to provide quality care to many animals with chronic conditions but recognise that in some circumstances the kindest option may be euthanasia at the donkey's home. The following conditions in particular can compromise a donkey's welfare so we would appreciate it if you would phone the veterinary department before considering moving the donkey if you identify any of them at your examination:

Severe weight loss
Severe dental disease
Chronic foot disease
Sudden onset visual loss

Chronic foot disease is a major welfare issue for donkeys in the UK, if you feel radiographs would help in your decision making please phone us to discuss.

THE DONKEY SANCTUARY
Slade House Farm,
Sidmouth, Devon EX10 0NU

T 01395 578222 **F** 01395 579266
E enquiries@thedonkeysanctuary.org.uk
www.thedonkeysanctuary.org.uk

WORKING WORLDWIDE

Please forward the examination form, dung and blood samples packed in accordance with the current Royal Mail postal regulations/IATA packing instruction 602, clearly marked to The Veterinary Department, The Donkey Sanctuary, Sidmouth, Devon, EX10 0NU, to arrive (whenever possible) between Monday and Thursday inclusive.

A full biochemistry and haematology profile in our laboratory can be best obtained if the following samples are submitted:-

1 x 10 ml plain (red top) vacutainer tube (clotted sample)
1 EDTA (purple top) tube (preferable to Heparin)

If facilities are available please centrifuge the clotted sample (once fully clotted and separated) and send the serum only.
If a glucose test is required, then a tube with fluoride anti-coagulant is needed.
For the faecal worm egg count, lungworm and fluke tests please send at least 70g of faeces (a large handful).

NB. Please advise us of your fax number which will enable us to send results and comment on the day of receipt.
Your help is greatly appreciated and if you have any queries please telephone the Veterinary Department at the Donkey Sanctuary on 01395 579162.

Thank you.

Yours sincerely

K Rickards PhD BVSc MRCVS
Principal Veterinary Surgeon

Certificate of Veterinary Examination of a Donkey on behalf of the Donkey Sanctuary

Present owner or keepers name:……………………………………..

Address:……………………………………………………………………..

……………………………………………………………………………..

Tel. No:………..

…………………………………………….Post Code:……………..

Reason for relinquishment (if known):………………………………………………….....................

…….

Name of Donkey	***Approximate*** **Age by teeth**	**Sex**	**Companion/s name/s**

Condition Score: ………………..   1 (thin) – 5 (obese)

Heart:	**Respiratory System:**
Skin:	**Limbs:**
Eyes: ***Is vision affected?***	**Feet:** ***Laminitic rings present?*** ***Are radiographs required?***
Dental Exam (with gag) / **Rasping Req'd Yes/No** ***Please comment on any abnormalities found:***	**Temperament:**
Vaccination Status:	**Passport: Yes/No** / **Micro-chip: Yes/No No. if known**

THE DONKEY SANCTUARY

Recent/Current Clinical History:

Recent/Current Medication:

De-Worming History:

Faeces sample taken…………………..

Blood sample taken…………………..
(please attach results if not analysed by Sanctuary laboratory)

Report on relevant clinical findings and /or history in relation to future management and prognosis

Fitness to travel:
(Please include any concerns which you may wish to discuss with our veterinary department – obesity, current medication, foot problems-radiographs etc. prior to travel to the Sanctuary in Devon)

Opinion of examining veterinary surgeon

In my opinion the Donkey is:

Fit to Travel:

NO ☐

YES ☐

Short distance only ☐ (please call vet dept on 01395 579162 to discuss options)

or to the Donkey Sanctuary, Devon, UK ☐

☐ *Future possibility - Requirements before travel (eg radiographs, NSAIDs, discussion with DS vet)*

Veterinary Surgeon:	**Practice Name:**
Address……………………………………………………………………………………………………..	
…………………………………………………………………………………. **Post Code:**………………	
Tel:………………………….. **Fax:**……………………………..	
Signed:…………………….. **Date:**……………	

Thank you for your care and attention in completing this form.

Please return to: The Veterinary Department, Slade House Farm, Sidmouth, Devon. EX10 0NU

Appendix 3. Donkeys of unknown origin policy

Donkeys of Unknown Origin Policy

Author (s)	Faith Burden (Head of Policy and Development), Andrew Trawford (Director Veterinary Policy and Development)
Names & Roles of Contributors	Karen Rickards (Principal Veterinary Surgeon)
Relevant to:	Veterinary Department (Europe), Welfare Department (Europe), Policy & Development, Veterinary Laboratory
Review date:	01/02/2014
Links to other Policies & Procedures	
Distribution	Vet Dept (Europe), Welfare (Europe), Policy & Development, Veterinary Laboratory – Email
Date of Issue:	
Date of Review:	

Introduction

Equids of unknown origin[1] or those known to have originated abroad[2] must undergo testing for specific infectious diseases before being relinquished to The Donkey Sanctuary (DS) as outlined below. In emergency situations where equids are relinquished to the DS immediately they will be isolated from other equids pending testing results before being allowed to mix with equids other than those in their companion group. Equid companions may be tested as outlined below.

Definitions

1. *Equids of Unknown Origin (EUO)*

Equids of unknown origin are those for which there is a lack of information of ownership or origin during the preceding 2 years or where there is a suspicion that the equid may have entered the UK from abroad in the last 2 years. In the case of disputed origin the decision of the Principal Veterinary Surgeon to consider an equid as having 'unknown origin' is final.

2. *Equids Originating from Abroad (EOA)*

Equids originating abroad are those which were bred, lived or have visited any country except the United Kingdom within the preceding two years. In the case of a dispute the decision of the Principal Veterinary Surgeon to consider an equid as originating from abroad is final.

3. *Equid Companions*

Companions of equids classed as EUO or EOA will not undergo testing if they themselves do not fit the criteria for said categories. Testing will be required if companions classed as EUO or EOA test positive for any disease specified below; in such cases the companions will be tested only for the disease which the EUO / EOA tested positive.

Testing & Results

Equine Infectious Anaemia (EIA)

All equids of unknown origin or originating from abroad will be tested for EIA. Testing will be carried out using the AGDIT (Coggins) Test.

EIA is a notifiable disease, if EIA is confirmed or suspected the duty vet at the local Animal Health Veterinary Laboratories Agency must be contacted immediately. The AHVLA may advise destruction of equids testing positive for EIA and will advise upon movement restrictions and testing for 'in contact' animals.

Piroplasmosis

All equids of unknown origin or originating abroad will be tested for Piroplasmosis. Testing will be carried out using the IFAT test.

If equids test positive for piroplasmosis the following shall be instigated:

(i) Equids to be treated for ticks before being transported to the Donkey Sanctuary with fipronil at a dose rate of 6ml / kg bodyweight

(ii) A blood sample shall be taken for Piroplasmosis PCR testing
   a. If PCR negative – a note will be made on the clinical history of the animal advising future PCR testing if there are related clinical concerns
   b. If PCR positive – the equid concerned will be kept in a location as advised by the Principal Veterinary Surgeon and will be treated throughout the tick season with a suitable product at a dose and frequency according to the data sheet. Notes will be made on the clinical history of the equid to ensure carers and veterinary staff are aware of the possibility of iatrogenic transmission.

Equine Viral Arteritis (EVA)

Primary screening for EVA will be limited to uncastrated males of unknown origin or who have originated abroad. Testing with be carried out using the EVA serum neutralisation test (SNT).

If uncastrated males test positive for EVA the following will be instigated:

(i) Uncastrated males positive for EVA will be castrated prior to relinquishment to the DS. Emergency relinquishments that test positive for EVA will remain in isolation until castrated. 6 weeks must elapse before the castrated male can be mixed with others.

(ii) All 'in contact' females must be tested.
   a. Females positive for EVA will be re-tested 2 weeks later to ensure declining antibodies. Further tests will be carried out at 2 weekly intervals until antibody titres are stable or declining.

(iii) All equids that have been on the premises for less than 28 days will be closely monitored for relevant clinical signs. Bloods should be sent for EVA SNT testing if clinically indicated.

Appendix 4. Record of assessment for quality of life

FACTSHEET: ANIMAL HEALTH PROFESSIONALS

RECORD OF ASSESSMENT FOR QUALITY OF LIFE

THE DONKEY SANCTUARY

Name of animal:

Name of owner:

Age/year of birth:

Discussion with owner:

Major condition:

QOL end points:

- ☐ Loss of condition despite increased feed
- ☐ Recurrence of laminitis
- ☐ Lameness on maintenance dose NSAID
- ☐ Anorexia, dullness or colic
- ☐ Blindness causing distress

Minor condition(s):

Any further comments:

Date	Weight kg	Condition Score	Feed	Appetite	Blood Results	Demeanour	Medicines and doses	Dental Condition	Skin condition	Use of rug	Movement and Feet	Progress of condition

Appendix 5. Bonding assessment test

Guidance notes for bonding tests

The purpose of the test is to assess the strength of bonds between donkeys and their equine companions in an objective measureable and consistent way.

To complete the tasks you will need two head collars of the correct size and lead ropes, a small quality of familiar feed, or hi fibre nuts, chopped carrot or apple for the animals. Access to stable with door, hard standing, field and gate or safe fence, safe improvisation may be needed if the venue does not have all the requirements. At least one other person to handle donkeys, ideally two people other than yourself to allow you to direct, observe and record findings.

The progression of the tests should insure that you do not need to test the animal at a level where their behaviour becomes dangerous. Once the animal begins to show fear or more agitated behaviour at any level that you feel indicates pairs are strongly bonded, stop the tests at that level and consider the suitability of using different tests or of stopping altogether, safety of those involved and minimising stress to the animals are essential. Consider the use of correct level of PPE such as gloves and safety shoes. A risk assessment has been done for the test and training should have been given to those undertaking the test. Read the task guidance notes on page 2 before commencing the test.

Bond assessment task recording sheet.

Use the first letter of the animal's name, (or other recognisable letter if both names start with the same letter) and enter the animals initial in the relevant box if the behaviour described in the header column is during task. You only need to record the initial once for each behaviour during a task. The additional notes below can be used for more detail.

Additional comments

If you wish to record unusual, frequencies of behaviour, the severity or intensity of behaviour during a task or any other facts you think may be relevant then use the additional comments boxes to do this.

Task guidance notes

Task	description
A)Briefly separated across open space by at least 10 meters	Both animals on lead rope and head collar with separate handlers. One to remain in place other to be walked 10 meters away, remaining insight of each other. Loose lead rope. Pause for 30 seconds before returning animals together
B) Separated by gate but can see each other	If safe fenced facilities are available this test can be done without head collars. Animals separated by gate and observed. If safe facilities not available both animals on lead rope and head collar with separate handlers. Lead one through gate and close gain turn to face each other 1 meter or so from gate. Wait for a minute and reunite.
C) Separated one in stable, one outside stable	Place one animal unrestrained inside stable or shelter with door. Other animal outside on head collar and lead rope. External donkey pause for 30 seconds outside the door, then lead away 10 meters pause again for 30 seconds and the reunite
D) Separated across yard or paddock for 2 minutes	Both animals on lead rope and head collar with separate handlers. One to remain in place other to be walked as far as possible but remaining insight of each other. Loose lead rope. Pause for 2 minutes before returning animals together. If the animals show clear measurable signs of distress reunite before 2 minutes elapsed
E) Separated out of sight for 10 seconds	Both animals on lead rope and head collar with separate handlers. One to remain in place other to be walked away, moving out of sight of each other around side of stable, barn, hedge etc. Loose lead rope. Pause for 10 seconds before reuniting animals. Repeat test if required reversing roles of animals
F) Separated out of sight for 60 seconds Separate 2 minutes out of sight if safe at 60 seconds	Both animals on lead rope and head collar with separate handlers. One to remain in place other to be walked away, moving out of sight of each other around side of stable, barn hedge etc. Loose lead rope. Pause for 60 seconds before reuniting animals. Repeat test if required reversing roles of animals. Repeat with two minutes of observation.
G) Separated across open yard or paddock space with food available, on and off head collar	Both animals on lead rope and head collar with separate handlers. One to remain in place other to be walked at least 10 meters away, remaining insight of each other. Loose lead rope. Two buckets (or piles if buckets not available) with small quantity of high fibre feed or haylage or fresh grass, one for each animal. Allow to feed for two minutes before returning animals together. If safe to do so remove head collar or unclip rope and move away from animal.
H) Separated out of sight of friend but with food	Both animals on lead rope and head collar with separate handlers. One to remain in place other to be walked at least 10 meters away, remaining insight of each other. Loose lead rope. Two buckets (or piles if buckets not available) with small quantity of high fibre feed or haylage or fresh grass, one for each animal enough for 60 seconds of eating. Allow to feed for two minutes before returning animals together
I)Separated in view of friend but with other animals or human interaction and without human interaction	Separated either on or off head collars if facilities and safety allows, over at least 10 metres more if available for at least five minutes. With other animals or while being groomed, feet picked out and interacting with by human handler and when handler leaves

Bond assessment task recording sheet. Enter each animal's initial into the relevant box if they display the behaviour described during the task. (see note 1)

See guidance details for information on tasks and recording	Reluctant to leave friend	No change in behaviour shows no interest in friend	Looks toward friend but does not move but looks worried	Squeak or attempt to bray	short bray	Full bray/ whinny	Repeated braying/ whinny	Moves to look for friend or Paws ground	Paces around, increased speed of movement runs around	Pushes against barriers, handler Paces along fence	Rears, repeated attempts to jump barriers	Attempts to escape from handler, rears or kicks or barges	Starts or continues to eat	Dull depressed low head carriage
A) Briefly separated across open space by at least 10 meters														
B) Separated by gate but can see each other														
C) Separated one in stable, one outside stable														
D) Separated across yard or paddock for 2 minutes														
E) Separated out of sight for 10 seconds														
F) Separated out of sight for 60 seconds														
Separate 2 minutes out of sight if safe at 60 seconds														
G) Separated across open yard or paddock space with food available, on and off head collar														
H) Separated out of sight of friend but with food														
I) Separated in view of friend with other animals or human without human interaction														

Additional comments on behaviour of animals during bonding assessment tasks, such as usual behaviours, frequency or severity of behaviour (see note2)

Task	Additional comments
A) Briefly separated across open space by at least 10 meters	
B) Separated by gate but can see each other	
C) Separated one in stable, one outside stable	
D) Separated across yard or paddock for 2 minutes	
E) Separated out of sight for 10 seconds	
F) Separated out of sight for 60 seconds Separate 2 minutes out of sight if safe at 60 seconds	
G) Separated across open yard or paddock space with food available, on and off head collar	
H) Separated out of sight of friend but with food	
Separated in view of friend but with other animals or human interaction and without human interaction	

Appendix 6. Admission medical form

ADMISSION MEDICAL – ISOLATION / STRETE- / HOLDING BASE

THE DONKEY SANCTUARY

Name:		**No:**		**Sex:**
Date of Medical: Examiner	Donkey:	**Mule:**	**Pony:**	**Hinny :**

Passport Checked: Yes / No Reminder Required ☐
PIO/Passport No :
Queries:
Passport sent to SL ☐

Microchip: Yes / No
No:
Reminder Required ☐

Colour & Description (full details if no passport) Height:

Age :

Medical Hx:

Preadmission Medical : Yes / No
FTT : Yes / No
X-Rays : No
B/S taken : Yes/ No
Unknown Origin : Yes/ No

Body Condition Score: 0.5, 1 , 1.5, 2 , 2.5, 3 , 3.5, 4 , 4.5, 5
Details :

Height:	Eyes:	**Responding to Movement:**

Teeth:

Heart:	Lungs:

Skin/Lice check:

Mare : Udder checked ☐ Pregnancy: Yes / No / Possible / Not Known
Comments:

Entire/Gelded: N/A Date of Castration: Comments:

Limbs:

Feet:

Anthelmintic Hx : Not wormed. If fit should be okay to worm but would be good to see results.
Anthelminitic Tx at Medical : Yes/No Product : Entered ☐
Pinworm slide to be taken only if symptoms – Date done: ☐

Vaccinations : Previous Hx : Entered ☐

Temperament:

Rehoming/DAT Prospect

Animal Prep Comments (JM) Entered ☐

Summary of Problems ☐

Appendix 7. Condition scoring and weight estimation of the donkey

FACTSHEET: Owners

THE DONKEY SANCTUARY

CONDITION SCORING AND WEIGHT ESTIMATION OF THE DONKEY

Keeping a regular record of your donkey's condition scores and estimated weight measurements can be very useful for monitoring their health and management.

For donkeys over 2 years of age their weight can be estimated using The Donkey Sanctuary's weight estimator. For donkeys less than 2 years of age, height cannot be used to help estimate the donkey's weight but the table at the bottom of the following page can be used instead. Please note that the estimator is not accurate for miniature or mammoth donkeys. In order to estimate your donkey's weight you will need to know their height and heart girth measurements (in centimetres).

MEASURING YOUR DONKEY

To measure your donkey's height, stand him/her on a hard level surface and measure from the ground up to the highest point of their withers. Once a donkey is over four years of age this measurement will only be required once and the same measurement can be used in future weight estimations. A height measuring stick is ideal but a broom handle marked at the height of the donkey's withers can be measured to give an accurate reading.

The heart girth measurement can be taken using an ordinary tailor's tape measure. The tape measure should pass around the bottom of the donkey's chest as far forward as possible and as close to the front legs as possible. The tape measure should cross the top of the donkeys back approximately 10 centimetres (a hands width) back from the withers. The front of the cross can be quite a good guide to the position of the withers. The tape should be pulled firmly but carefully around the donkey and the reading taken in centimetres.

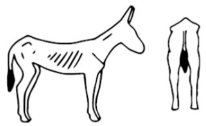
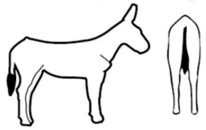
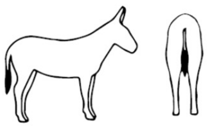
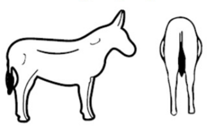
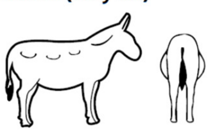
The heart girth measurement should always be taken in the same location preferably by the same person to ensure a continuity of the measurements taken. Both height and heart girth measurements can then be marked on the weight estimation chart and the donkey's weight read off the centre scale by drawing a line between the two measurements.

Measuring height (cm)

Measuring girth (cm)

DONKEY BODY CONDITION SCORE CHART

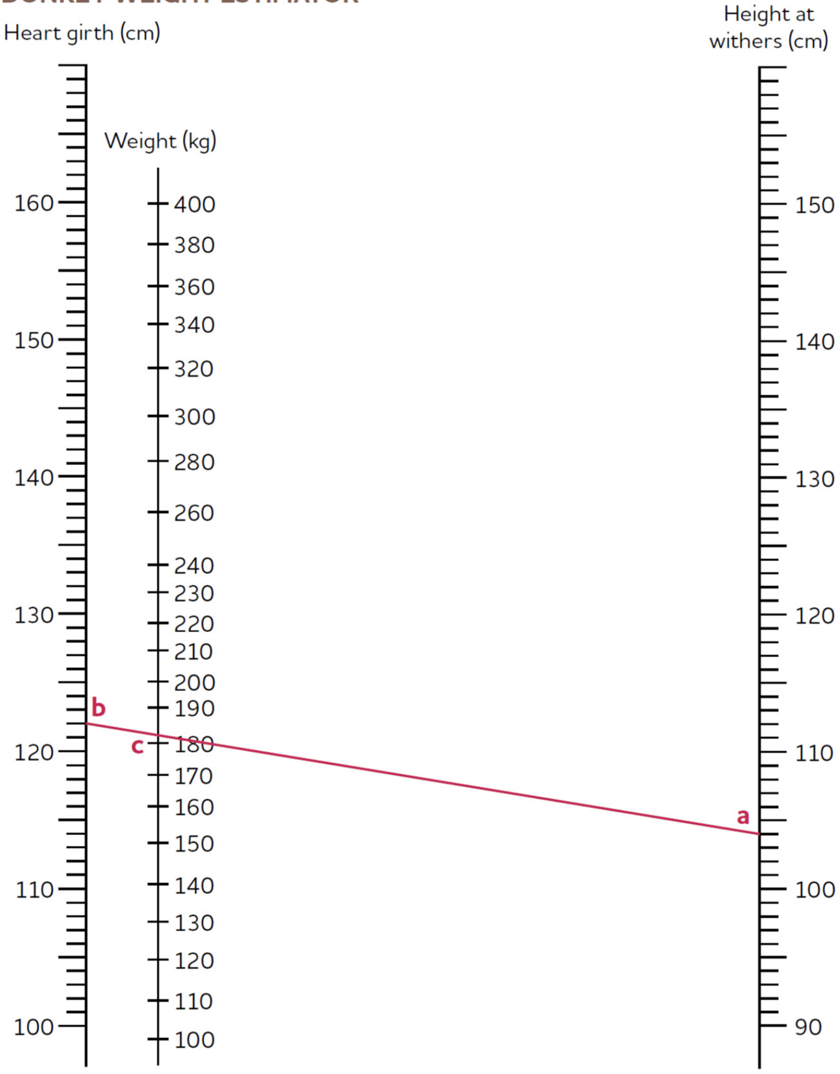
Accurate Body condition scoring is a hands-on process for feeling the amount of muscle and fat that are covering the donkey's bones. Using this chart as a guide, feel the coverage over the bones in five specific areas listed below. Fat deposits may be unevenly distributed especially over the neck and hindquarters. Some resistant fat deposits may be retained in the event of weight loss or may calcify (harden). Careful assessment of all areas should be made and combined, to give an overall score. When deciding on the correct course of action following condition scoring, you might have to take into consideration the age of the donkey and any veterinary conditions they have. Aged donkeys can be hard to condition score due to lack of muscle bulk and tone giving thin appearance dorsally with dropped belly ventrally, while overall condition may be reasonable. If in doubt, get advice from your vet.

Condition score	Neck and shoulders	Withers	Ribs and belly	Back and loins	Hindquarters
1. Poor (very thin) 	Neck thin, all bones easily felt. Neck meets shoulder abruptly, shoulder bones felt easily, angular.	Dorsal spine and withers prominent and easily felt.	Ribs can be seen from a distance and felt with ease. Belly tucked up.	Backbone prominent, can feel dorsal and transverse processes easily.	Hip bones visible and felt easily (dock and pin bones). Little muscle cover. May be cavity under tail.
2. Moderate (underweight) 	Some muscle development overlying bones. Slight step where neck meets shoulders.	Some cover over dorsal withers, spinous processes felt but not prominent.	Ribs not visible but can be felt with ease.	Dorsal and transverse processes felt with light pressure. Poor muscle development either side of midline.	Poor muscle cover on hindquarters, hip bones felt with ease.
3. Ideal 	Good muscle development, bones felt under light cover of muscle/fat. Neck flows smoothly into shoulder, which is rounded.	Good cover of muscle/ fat over dorsal spinous processes, withers flow smoothly into back.	Ribs just covered by light layer of fat/muscle, ribs can be felt with light pressure. Belly firm with good muscle tone and flattish outline.	Can feel individual spinous or transverse processes with pressure. Muscle development either side of midline is good.	Good muscle cover over hindquarters, hip bones rounded in appearance, can be felt with light pressure.
4. Overweight (fat) 	Neck thick, crest hard, shoulder covered in even fat layer.	Withers broad, bones felt with pressure.	Ribs dorsally only felt with firm pressure, ventral ribs may be felt more easily. Belly over developed.	Can only feel dorsal and transverse processes with firm pressure. May have slight crease along midline.	Hindquarters rounded, bones felt only with pressure. Fat deposits evenly placed.
5. Obese (very fat) 	Neck thick, crest bulging with fat and may fall to one side. Shoulder rounded and bulging with fat.	Withers broad, bones felt with firm pressure.	Large, often uneven fat deposits covering dorsal and possibly ventral aspect of ribs. Ribs not palpable dorsally. Belly pendulous in depth and width.	Back broad, difficult to feel individual spinous or transverse processes. More prominent crease along mid line fat pads on either side.Crease along midline bulging fat either side.	Cannot feel hip bones, fat may overhang either side of tail head, fat often uneven and bulging.

DONKEY WEIGHT ESTIMATOR

To estimate a donkey's weight using the diagram below mark the height and heart girth measurements on the correct axis. Then draw a line between the two. The donkey's weight is indicated by where the line crosses the weight axis. For example, a donkey 104cm tall (a) and with a heart girth 122cm (b) should weigh 181kg (c).

DONKEY WEIGHT ESTIMATOR

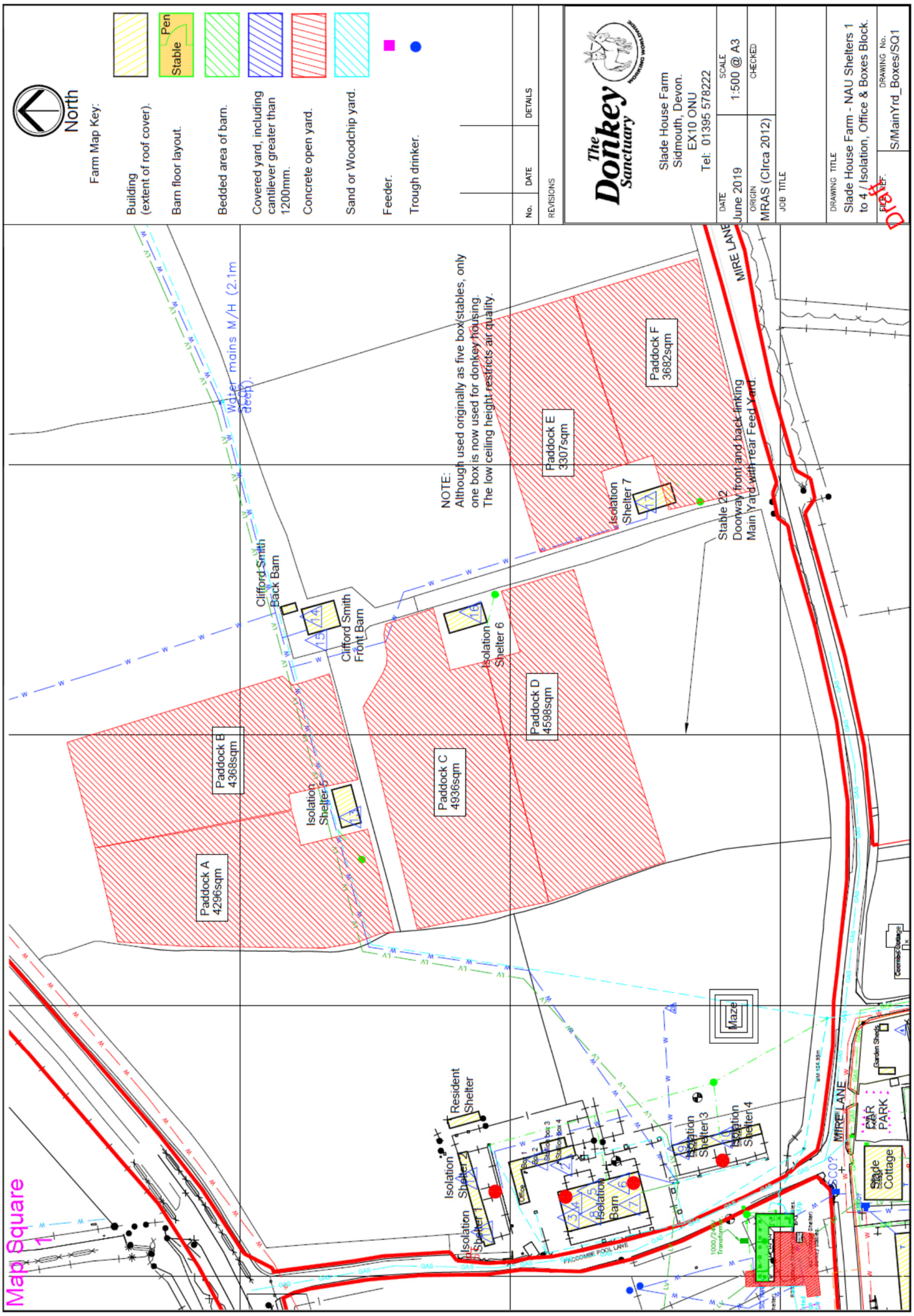


Whilst the weight estimator is an effective tool to estimate weight it's accuracy cannot be guaranteed.

Weight estimation table for donkeys under 2 years

Heart Girth (cm)	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Weight (kg)	46	47	49	51	53	55	57	59	61	63	65	67	69	71	74	76	78	81	83	86	88	91	94	96	99	102

Appendix 8. NAU plan



Appendix 9. Parameters for adult donkey: biochemistry and haematology

FACTSHEET: Vets

THE DONKEY SANCTUARY

PARAMETERS: BIOCHEMISTRY AND HAEMATOLOGY

Parameters for an adult donkey.

Haematology	Units	Ave	Range
RBC	10^{12}/l	5.5	(4.4 – 7.1)
PCV	%	33	(27 – 42)
Hb	g/dl	11.0	(8.9 – 14.7)
MCH	pg	20.6	(17.6 – 23.1)
MCHC	g/dl	34	(31 – 37)
MCV	fl	60	(53 – 67)
WBC	10^9/l	10	(6.2 – 15)
NEU%	%	38.3	(23 – 59)
NEU T	10^9/l	3.7	(2.4 – 6.3)
EOS%	%	4.0	(0.9 - 9.1)
EOS T	10^9/l	0.4	(0.1 – 0.9)
BAS%	%	0.05	(0 – 0.5)
BAS T	10^9/l	0	(0 – 0.07)
LYM%	%	54	(34 – 69)
LYM T	10^9/l	5.5	(2.2 – 9.6)
MON%	%	3.0	(0.5 – 7.5)
MON T	10^9/l	0.3	(0 – 0.75)
Platelets	10^9/l	201	(95 – 384)
RDW	%	18.3	(16.1 – 22)

Biochemistry	Units	Ave	Range
Trig	mmol/l	1.4	(0.6 – 2.8)
CPK	u/l	208	(128 – 525)
AST	u/l	362	(238 – 536)
GGT	u/l	24	(14 – 69)
GLDH	u/l	2 .5	(1.2 – 8.2)
ALP	u/l	152	(98 – 252)
Bile acids	μmol/l	10	(2.6 – 18.6)
Tbil	μmol/l	1.6	(0.1 – 3.7)
TP	g/l	65	(58 – 76)
Alb	g/l	26	(22 - 32)
Glob	g/l	38	(32 – 48)
Creat	μmol/l	87	(53 – 118)
Urea	mmol/l	3.2	(1.5 – 5.2)
Amylase	u/l	4	(1 – 10.6)
Lipase	u/l	12.9	(7.8 – 27.3)
Glucose	mmol/l	4.43	(3.9 - 4.7)
Calcium	mmol/l	3	(2.2 – 3.4)
Na	mmol/l	133	(128 – 138)
K	mmol/l	4.3	(3.2 – 5.1)
Cl	mmol/l	102	(96 – 106)
Chol	mmol/l	2.0	(1.4 – 2.9)

Clotting Factors	Units	Range
Fibrinogen	g/l	(0.6 – 2.6)
Prothromb	seconds	(8.9 – 14.5)

If you need further advice or information please do not hesitate to contact us on **01395 578222** or by email **vets@thedonkeysanctuary.org.uk**

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Appendix 10. Example diets

FACTSHEET: Animal Health Professionals and Owners

THE DONKEY SANCTUARY

EXAMPLE DIETS: FOR THE MATURE, PREGNANT AND LACTATING DONKEY

Mature donkeys fed on fibrous forages:

Donkey weight	MJ, DE/day	Daily DMI requirement	Suggested diet
180 kg donkey maintenance (summer)	14.4	2.4 kg	2.1 kg barley straw (5 MJ DE/kg DM) + limited grazing or + 0.5 kg moderate hay (8 MJ DE/kg DM)
180 kg donkey maintenance (winter)	17.1	3.1 kg	3 kg barley straw (5 MJ DE/kg DM) + 0.4 kg moderate hay (8 MJ DE/kg DM)
Dieting donkey goal weight 180 kg (summer)	13	2.4 kg	2.2 kg barley straw (5 MJ DE/kg DM) + very limited grazing or + 0.2 kg moderate hay (8 MJ DE/kg DM) + forage balancer
Dieting donkey goal weight 180 kg (winter)	15.5	3.1 kg	3.1 kg barley straw (5 MJ DE/kg DM) + very limited grazing or + forage balancer
180 kg donkey (aged) with dental disease (summer)	14.4–15	2.4 kg	2.4 kg short chop hay replacer (7.3 MJ DE/kg DM assuming 85% DM) e.g. forage balancer
180 kg donkey (aged) with dental disease (winter)	17.1–18	3.1 kg	2.9 kg short chop hay replacer (7.3 MJ DE/kg DM assuming 85% DM) e.g. forage balancer

Pregnant donkeys in the final 3 months of pregnancy:

Donkey weight	MJ, DE/day	Daily DMI requirement	Suggested diet
180 kg - 9 months gestation (summer)	16.7	2–2.4 kg	1.1 kg barley straw (5 MJ DE/kg DM) + grazing and high protein balancer or + 1.3 kg moderate hay (8.5 MJ DE/kg DM) and high protein balancer
180 kg - 10 months gestation (summer)	17.4	2–2.4 kg	0.4 kg barley straw (5 MJ DE/kg DM) + 1.8 kg moderate hay (8.5 MJ DE/kg DM) + high protein balancer
180 kg - 11 months gestation (summer)	18.6	2–2.4 kg	2.2 kg moderate hay (8.5 MJ DE/kg DM) + high protein balancer + grazing If hay is not managed supplement with high fibre cubes, alfalfa chop or unmolassed sugar beet
180 kg - 9 months gestation (winter)	19.8	2.5–3.1 kg	1 kg barley straw (5 MJ DE/kg DM) 1.7 kg moderate hay (8.5 MJ DE/kg DM) + high protein balancer
180 kg - 10 months gestation (winter)	20.7	2.5–3.1 kg	2.2 kg moderate hay (8.5 MJ DE/kg DM) 0.4 kg barley straw (5 MJ DE/kg DM) + high protein balancer
180 kg - 11 months gestation (winter)	22.1	2.5–3 kg	2.5 kg moderate hay (8.5 MJ DE/kg DM) + 200 g alfalfa chop (9 MJ DE/kg DM) + high protein balancer

Lactating donkeys:

Donkey weight	MJ, DE/day	Daily DMI requirement	Suggested diet
180 kg lactation 1st month (summer)	27.5	2.4–3 kg	2.4 kg good hay (9 MJ DE/kg DM) + grazing and high protein balancer or 0.3 kg alfalfa oil chop (11.2 MJ DE/kg DM) and high protein balancer
180 kg lactation 2nd month (summer)	27.3	2.4–3 kg	2.6 kg good hay (9 MJ DE/kg DM) + grazing and high protein balancer or 0.2 kg alfalfa oil chop (11.2 MJ DE/kg DM) and high protein balancer
180 kg lactation 3rd month (summer)	26.5	2.4–3 kg	2.6 kg good hay (9 MJ DE/kg DM) + grazing and high protein balancer or 0.15 kg alfalfa oil chop (11.2 MJ DE/kg DM) and high protein balancer
180 kg lactation 4th month (summer)	25.5	2.4–3 kg	2.6 kg good hay (9 MJ DE/kg DM) + grazing and high protein balancer or 0.1 kg alfalfa oil chop (11.2 MJ DE/kg DM) and high protein balancer
180 kg lactation 5th month (summer)	24.5	2.4–3 kg	2.5 kg good hay (9 MJ DE/kg DM) + grazing and high protein balancer or 0.1 kg alfalfa oil chop (11.2 MJ DE/kg DM) and high protein balancer
180 kg lactation 6th month (summer)	23.6	2.4–3 kg	2.4 kg good hay (9 MJ DE/kg DM) + grazing and high protein balancer
180 kg lactation 1st month (winter)	30.2	2.7–3.1 kg	3 kg good hay (9 MJ DE/kg DM) + grazing and high protein balancer or 0.3 kg alfalfa oil chop (11.2 MJ DE/kg DM) and high protein balancer
180 kg lactation 2nd month (winter)	30	2.7–3.1 kg	3 kg good hay (9 MJ DE/kg DM) + grazing and high protein balancer or 0.2 kg alfalfa oil chop (11.2 MJ DE/kg DM) and high protein balancer
180 kg lactation 3rd month (winter)	29.2	2.7–3.1 kg	3 kg good hay (9 MJ DE/kg DM) + grazing and high protein balancer or 0.15 kg alfalfa oil chop (11.2 MJ DE/kg DM) and high protein balancer
180 kg lactation 4th month (winter)	28.2	2.7–3.1 kg	3 kg good hay (9 MJ DE/kg DM) + grazing and high protein balancer or 0.1 kg alfalfa oil chop (11.2 MJ DE/kg DM) and high protein balancer
180 kg lactation 5th month (winter)	27.2	2.7–3.1 kg	2.8 kg good hay (9 MJ DE/kg DM) + grazing and high protein balancer or 0.1 kg alfalfa oil chop (11.2 MJ DE/kg DM) and high protein balancer
180 kg lactation 6th month (winter)	26.3	2.4–3 kg	2.6 kg good hay (9 MJ DE/kg DM) grazing + high protein balancer

The table includes estimated dry matter intakes and practical dietary recommendations. DE values assume a dry matter content of 90% unless otherwise stated, foodstuffs such as haylage should be evaluated for DE levels per kg as fed and if unsure forage analysis is recommended.

Forage balancer refers to a concentrated pellet vitamin, mineral and protein supplement which does not act as a significant source of energy and which is designed to balance a forage only diet.

High protein balancer – as above but with a higher protein specification which is more suited to pregnant/lactating/growing donkeys.

Appendix 11. High risk strangles screening protocol

High risk strangles screening protocol

High risk animals will be those that after assessing their relinquishment paperwork appeared to have unknown history, respiratory disease history and or possible contact with unknown equines and or direct or closed contact with affected animals.

High risk animals would be identified by the New arrivals vet/s and or a member of the veterinary team who would advise the welfare team and new arrivals team with regards to the risk. High risk animals would require to be transported on their own or with those animals that have been in direct contact.

Identifying high risk animals prior movement would be vital and the welfare team should advice the veterinary team as soon as possible if more information becomes available at any point during or after the relinquishment.

Owners should be fully informed that those animals would require testing during their isolation as part of Donkey Sanctuary protocol and should also be informed of the risks of the procedure.

High risk animals will require the following:

- Isolation from other animals and shelters (within New arrivals) for a minimum period of approximately 10- 12 days to allow endoscopy, testing and results. Isolation could be for a prolonged period if animals were positively diagnosed and period would be subject to the New arrivals vet in charge of the case.
- Shelter 7 would be considered the best unit for isolation purposes; if SH7 is unavailable other preferable option would be SH5 and 6 which would require discussion with the New arrivals vet.
- Biosecurity in designated shelter should include full protection guia: white overalls, foot covers, gloves and foot disinfected dips.
- Access to the shelter should be limited and minimising number of grooms working in shelter would be preferable.
- Testing (endoscopy and sample of guttural pouches) would be done at the same time as first bloods to minimise stress (one week post arrival); Donkey would require to be sedated for the procedure so will require closely monitoring after the procedure.