

## Special Article

# Survey of six infectious diseases of feral donkeys in the United Arab Emirates

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### Introduction

In September 1998, a team of veterinary inspectors from the European Union visited the United Arab Emirates (UAE) to carry out an assessment of the equine disease status within the country, to examine the import and export procedures and controls, and to review the ability of the veterinary services in the UAE to control outbreaks of notifiable diseases. One of the recommendations of the EU inspectors was that a survey of the disease status of the feral donkey population should be carried out.

Although not indigenous to the Emirates, the feral donkeys of the Hajar Mountains and deserts of the Northern Emirates live and breed in a wilderness of desert and barren mountains. It is likely that the donkey was imported from Africa and it is recorded that, shortly after the death of the Prophet Mohammed, the Muslim army made the difficult trek across the mountains from the east coast of the Northern Emirates by an ancient trade route across the granite peaks of the Hajar Mountains. The donkey was used for its strength and surefootedness and its ability to climb terrain that was suitable for neither horse nor camel.

For centuries, donkeys lived and worked with man in the mountains of Arabia, only to be cast aside when the 4-wheel-drive off-road vehicle was able to replace it as a beast of burden. The natural habitat of the donkeys is marginal desert land and the release from domestic use found them living in areas for which they are ideally suited (**Fig 1**). Indeed, they have adapted so well to life in the wild that conservationists consider them a potential threat to some of the indigenous species, such as the Arabian oryx, since they compete for the same food sources and manage to exist with minimal access to water.

In these areas they have adapted remarkably well wherever there is sufficient food and water for them to survive. There appears to be a degree of seasonal migration as they follow the wadis (riverbeds) towards the sea in the summer, while moving back into the mountains during the cooler weather.

The reason for the rather particular demand made by the EU inspectors to carry out a serological donkey survey is that donkeys, as zebras, can act as carriers of diseases such as African horse sickness (AHS), while not themselves showing any clinical signs of disease. Although the feral donkey population comes into contact with horses only occasionally, diseases such as AHS, which is carried by *Culicoides* midges, are capable of spreading from one population to another.

In the extensive equine serological survey carried out in 1995/1996 (Anon 1996a), the only donkeys that were sampled were those found on equine holdings, and no attempt was made to assess the status of the population of feral donkeys living in the deserts of the Northern Emirates.

**This article presents a survey of 6 infectious diseases in feral donkeys in the UAE.**

### Materials and methods

#### Donkeys

Before a representative number of donkeys could be sampled, it was necessary to carry out a survey of the appropriate areas,

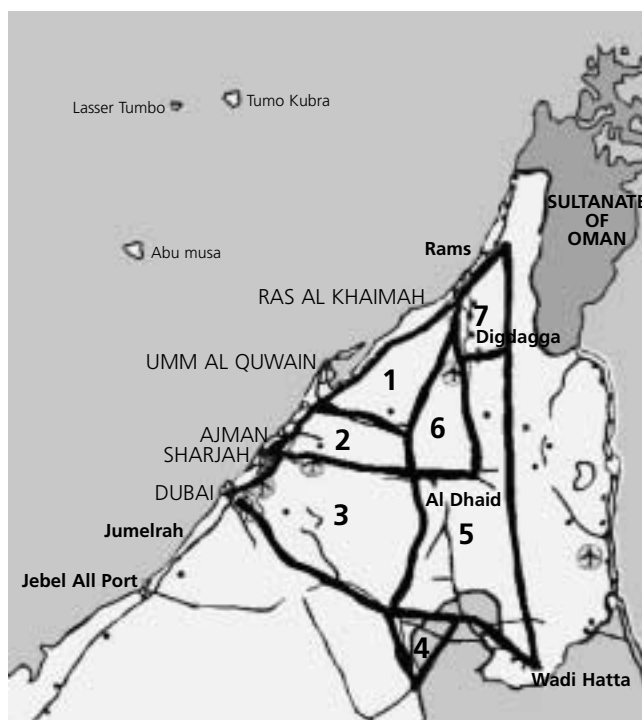


**Fig 1:** Feral donkeys in their natural habitat in the UAE.

**TABLE 1: Estimated feral donkey density and number of samples in 7 different areas**

No.	Location	Density	Area (km <sup>2</sup> )	Estimated No. donkeys	No. samples
1	Umm Al Quwain	A	920	4600	47
2	Ajman	B	629	315	4
3	Sharjah	D	-	Occasional	0
4	Mundan Plain	C	187	19	1
5	Mountain Edges	B	1388	694	7
6	Al Dhaid Plain	B/C	1950	488	2
7	Digdagga	A	350	1750	1
<b>Total</b>				<b>7172</b>	<b>62</b>

A = 5+ donkeys/km<sup>2</sup>; B = 0.5–5.0 donkeys/km<sup>2</sup>; C = 0.1–0.4 donkeys/km<sup>2</sup>; D = <0.1 donkeys/km<sup>2</sup>.

**Fig 2: Location of the different sampling areas in the UAE.**

to locate where donkeys could be found and to make an estimate of their index of relative abundance. An estimate of relative abundance is a common method of describing the number of wild or feral animals found within a given area. The methodology used in this survey in the UAE describes a direct way of measuring this index, while indirect ways, such as measuring proportions of favourable habitat by satellite, aerial photography or ground reconnaissance, have been used to make estimates of this index or assess likely changes to it (Glennon and Porter 1999).

This was initially done using 4 x 4 vehicles led by a local Bedouin and completed by using a helicopter. When using a vehicle, an estimate was first made of the distance either side of the vehicle in which donkeys were likely to be spotted given the particular terrain in each area surveyed. In a helicopter kept at a

**TABLE 2: Mean ± s.d. values of haematological and biochemical parameters of 62 feral donkeys from the UAE in comparison to domestic donkeys from England**

Test	Feral donkeys	Donkeys from UK	Units
Red blood cells (RBC)	7.62 ± 2.0	5.5 ± 1.6	x 10 <sup>12</sup> /l
Haemoglobin (Hb)	15.0 ± 2.5	11.6 ± 2.6	g/dl
Packed cell volume (Haematocrit) (PCV)	45.0 ± 5.0	33.0 ± 5	%
Mean cell volume (MCV)	59.0 ± 4.0	64.0 ± 5	fl
Mean corpuscular haemoglobin concentration (MCHC)	33.3 ± 0.7	34.8 ± 3.4	g/dl
Platelets (PLT)	140–450	NA	x 10 <sup>9</sup> /l
White blood cells (WBC)	10.2 ± 5.0	10.2 ± 5.9	x 10 <sup>9</sup> /l
Neutrophils	55–65	50.5 ± 27	%
Lymphocytes	25–50	43 ± 22	%
Monocytes	2–8	1–5	%
Eosinophils	1–6	1–10	%
Basophils	0–1	0–1	%
Iron (Fe)	18.3 ± 4.8	NA	mmol/l
Creatine-kinase (CK)	225 ± 50	15–149	iu/l
Lactate-dehydrogenase (LDH)	450 ± 80	NA	iu/l
Glutamate-oxalate-transaminase (GOT, AST)	433 ± 80	NA	iu/l
Creatinine (Crea)	88.4 ± 44.2	124.6	µmol/l
Blood urea nitrogen (BUN)	5.4 ± 2.9	5.5	µmol/l
Total protein (TP)	7.5 ± 1.0	7.0 ± 12.0	g/dl
Albumin (ALB)	4.0 ± 0.5	2.8 ± 0.6	g/dl
Calcium (Ca)	2.9 ± 0.4	NA	mmol/l
Phosphorus (P)	1.6 ± 0.5	NA	mmol/l

NA = Not available.

constant height, a similar estimate of the range of visibility was made by measuring on a map the distance at which donkeys could be spotted. By assessing the range of visibility and counting the number of donkeys seen over a given distance, it was possible to calculate the approximate index of relative abundance of donkeys in each area. This protocol provided the scientific basis to the survey and in some areas refuted public opinion or impression. The latter was often based on the number of donkeys seen along a highway whereas, away from rural housing where donkeys scavenge in competition with sheep and goats, the picture was very different.

**Table 1** and **Figure 2** show the varying index of relative abundance of donkeys and their location. Donkeys were sampled in July 1999 from the various areas based on a *pro rata* allocation determined from this index (**Table 1**).

Feral donkeys both bite and kick and it was assumed that it would be necessary to tranquilise them, in order that a blood sample could be obtained. However, with the assistance of local Bedouins, donkeys were enticed by the provision of food and water into corrals where they were trapped. Once trapped, they rapidly accepted their circumstances without a struggle.

### Sampling

Sampling was carried out from the jugular vein of the donkey within 24 h of capture. After a few strenuous attempts to

**TABLE 3: Number and percentage of serologically positive donkeys for 5 notifiable diseases**

Test	Total tested	Negative	Positive	Positive %
ELISA for AHS	62	62	0	0.00
AGID for EIA	62	62	0	0.00
CFT Dourine	62	59	3	4.84
CFT Glanders	62	53	9	14.52
SNT for EVA	62	61	1	1.61

restrain the donkeys in the standing position, the easiest method proved to be to cast the donkeys using rope hobbles. This was very quick and painless, except to the pride of a number of Jack donkeys, and provided adequate restraint for blood sampling (**Fig 3**).

From 62 donkeys, EDTA blood and serum were taken and sent for further investigation to the Central Veterinary Research Laboratory (CVRL) in Dubai. After the initial blood testing, all donkeys were marked with a paint marker and held until the results of the AHS test were known. It was not practical to keep them longer than 2 days, but when the serological test for glanders was positive, 5 of them were recaptured after 5 days.

### Testing

EDTA blood and sera of the 62 animals were tested in the Abbott Cell Dyn Autoanalyser 3500<sup>1</sup> and the Hitachi Autoanalyser 911<sup>2</sup> for haematology and blood biochemistry parameters.

All 62 serum samples were investigated for notifiable and non-notifiable diseases at CVRL using the following serological tests:

- ELISA for African horse sickness (AHS)
- AGID for equine infectious anaemia (EIA)
- CFT for dourine and glanders
- SNT for vesicular stomatitis (VS)
- SNT for equine viral arteritis (EVA)
- IFAT for *Babesia equi* and *B. caballi* (piroplasmosis)

The test procedures were conducted using Office Internationale des Epizooties (OIE) approved serological tests (Anon 1996). To reduce unspecific reactions, donkey sera were inactivated at 62°C for 30 min for the serum neutralisation (SNT) and complement fixation (CFT) tests. To confirm dourine results, 5 sera were sent to the Veterinary Laboratory Agency (VLA), Weybridge, UK, where CFT and Immunofluorescent antibody test (IFAT) for *T. equiperdum* were performed. In order to try and resolve the actual disease status of the serologically positive cases for glanders, 5 donkeys were injected with 0.25 ml mallein into the skin of the lower eyelid (intrapalpebral test) (**Fig 4**). In addition, the donkey that demonstrated the highest antibody titre was subjected to euthanasia, and a necropsy performed at CVRL. The remaining 4 donkeys were subsequently necropsied in the field.

**TABLE 4: Dourine comparison of 3 CFT-positive donkey sera achieved at CVRL with results at VLA**

Donkeys	CFT at CVRL	CFT at VLA	IFAT at VLA
11	Pos. 1:16	Negative	Negative
12	Pos. 1:8	Positive	Pos. 1:160
19	Pos. 1:64	Negative	Negative
17	Negative	Negative	Negative

**TABLE 5: Number and percentage of serologically positive donkeys for non-notifiable diseases**

Test	Total tested	Negative	Positive	Positive %
SNT for VS	62	61	1	1.61
IFAT for <i>Piroplasmosis</i>				
<i>B. equi</i>	62	56	6	9.68
<i>B. caballi</i>	62	61	1	1.61

### Results

The estimated feral donkey population of the Northern Emirates was about 7000. This estimate was derived by multiplying the index of relative abundance for each area by its size. It was not possible to sample donkeys in the Hatta and Digdagga areas, since 2 captured donkeys were released by Bedouins before samples could be taken. All donkeys sampled were in good condition and there was no clinical evidence of disease seen on examination.

Haematological and biochemical parameters of 62 feral donkeys from the UAE are presented in **Table 2**. They are compared with reference values obtained from domestic donkeys kept at the Donkey Sanctuary in Devon, UK.

**Table 3** shows the serological results of 62 feral donkeys for AHS, EIA, dourine, glanders and EVA. All samples were negative for AHS and EIA. Three donkeys were positive for dourine (4.8%), 9 for glanders (14.5%) and 1 for EVA (1.6%).

The 3 dourine-positive donkey sera and a randomly chosen negative serum were sent to the Veterinary Laboratory Agency (VLA) in Weybridge, UK for confirmation. The results are presented in **Table 4**. Only one donkey was confirmed positive by the VLA.

Nine out of 62 (14.5%) of the feral donkeys were positive for glanders. Five of the 9 serologically positive donkeys were recaptured in areas 1 and 6 (**Fig 2**). Detailed examination did not identify any clinical signs of glanders. The donkeys were subjected to the intradermal mallein test, 0.1 ml mallein being injected into the lower eyelid. The test was read at 24 and 48 h. There was no allergic reaction to this test, no localised, oedematous swellings and no purulent conjunctivitis. The donkey that demonstrated the highest antibody titre was subjected to euthanasia, but no lesions of glanders were seen at necropsy (**Fig 5**). No pathological lesions were seen in the remaining 4 serologically positive donkeys.

**Table 5** shows the serological results of 62 donkeys for vesicular stomatitis and piroplasmosis. Of 62 samples, one was



**Fig 3:** A feral donkey is restrained before a blood sample is drawn from the jugular vein.



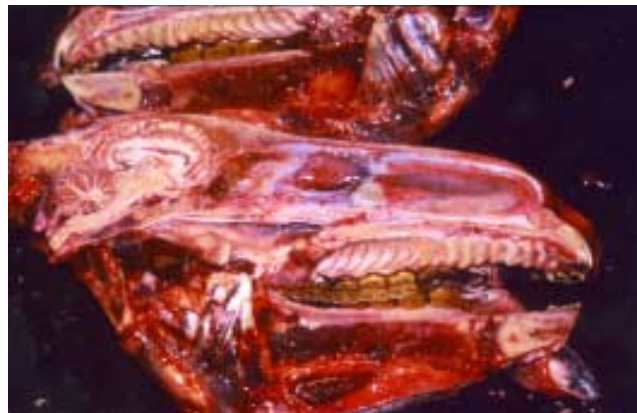
**Fig 4:** Mallein is injected into the lower eyelid of a restrained feral donkey.

positive for VS (1.6%), one for *Babesia caballi* (1.6%) and 6 for *B. equi* (9.7%).

## Discussion

This is the first time that the distribution and relative abundance of donkeys in the UAE has been investigated. It was found that approximately 7000 feral donkeys are living in the Northern Emirates, with the highest concentration in area 1 (Umm Al Quwain, **Table 1**). The level of random sampling of 62 donkeys in the population gives a 95% level of confidence of identifying a 5% prevalence of disease (Cannon and Roe 1986). This level of confidence was considered to be sufficient in a well established population of donkeys.

The comparison of haematological values between the UAE's feral donkey population and a domestic donkey population from England revealed only slight differences in RBC, Hb and PCV. Parameters were higher in the UAE donkey population, indicating a superior physique, probably caused by their feral status. Biochemical parameters were very similar. There was an increase of CK in feral donkeys which may be explained by the stress of handling while blood samples were



**Fig 5:** The split head of the donkey with the highest glanders CFT antibody titre; no glanders lesions were observed.

taken. It has to be noted that their total protein and albumin levels were higher than in the domesticated population, indicating an excellent nutritional status for these animals. It is also worth mentioning that the eosinophils were in the reference range, indicating no burden with parasites.

All 62 serum samples were negative for AHS and EIA, demonstrating freedom from these diseases. Donkeys can become infected with virulent AHS virus (e.g. serotype 4, AHS V4). They develop a viraemia with low titre which can persist for at least 12 days. They do not develop pyrexia or other observable clinical signs. It is believed that the virus replicates less efficiently in donkey tissues compared to horses. At necropsy, an increased fluid accumulation, particularly in the peritoneal cavity, may be observed, as well as ecchymotic and petechial haemorrhages on the left hepatic ligament. Experimental trials revealed that donkeys, unlike zebras (Barnard 1998), do not play an important role as reservoirs for AHS (Hamblin *et al.* 1998). However, specific antibodies against AHSV have been found in donkeys after experimental infection, confirming that the virus replicates in the host (El Hasnaoui *et al.* 1998).

Equine infectious anaemia (EIA) is an acute or chronic lentiviral infection of *Equidae*. The most common mode of transmission is through blood-sucking insects feeding on infected blood. The disease occurs mainly in low-lying, humid and swampy areas which do not exist in the UAE. EIA infections have not been reported in donkeys.

In this survey, only one donkey (1.61%) was positive to EVA. This contrasts with a survey carried out in 1994, when 207 horses and 12 donkeys were tested for EVA. All 207 horses were negative, but 2 (16.6%) donkeys were positive, 1 of which was negative when retested. In the 1995/96 survey, 444 horses and 1 donkey were tested, of which 5 horses and 1 donkey had a positive reaction. However, no clinical disease attributable to equine viral arteritis has been recorded in the UAE in the last 4 years. The disease is notifiable.

Dourine is a true venereal disease and occurs in horses, mules and donkeys. Mules and donkeys are only subclinically or mildly affected (Barrowman *et al.* 1994). In this survey, 3

donkeys were positive (4.8%) using the CFT at CVRL. When retested at VLA with the IFAT, only one donkey remained positive. The CFT is still the most commonly used serological technique. However, it gives cross-reactions with other members of the *T. brucei* complex. It is known that *T. evansi* is endemic in dromedaries in the UAE (Anon 1998). An antigen latex-agglutination test (Suratex) (Nantulya 1994) was also used for the detection of *T. evansi* antigen in all 62 donkey sera. A prevalence of 16.1% was found (not shown) underlining the possibility of cross-reactions with *T. evansi*.

In 1995/96 (Anon 1996a), the 432 horses and donkeys were tested for dourine using a complement fixation test. Five samples had nonspecific reactions but were negative when tested using the IFAT. All remaining samples were negative.

Glanders occurs primarily in domestic *Equidae* and occasionally in carnivores, rodents, cattle, sheep, goats and pigs. Human subjects are highly susceptible to the disease. Donkeys are apparently the most susceptible equids and frequently develop the acute form of the disease. Horses are more resistant and commonly contract the chronic form. Mules occupy an intermediate position (Bishop 1994). The mode of infection is probably through food or water, contaminated by nasal discharges and pus from cutaneous ulcers.

In this survey, 15% (9/62) were positive for glanders. Five of the 9 serologically positive donkeys were injected with mallein, but did not show any allergic reaction to this test. No glanders lesions were seen at necropsy of a suspicious donkey. Similar findings have subsequently been recorded for the other 4 serologically positive donkeys that were necropsied. The mallein test is considered to be both specific and reliable, and more sensitive than the CFT (P.K. Uppal, personal communication). It is, therefore, believed that all positive serological reactors are cross-reactions to other pseudomonas organisms.

In the 1995/96 survey (Anon 1996a), 4 donkeys had positive titres for glanders, 2 of which gave negative results when retested 6 weeks later. All 4 donkeys were clinically normal on each occasion. Glanders has not been recorded in the UAE since its formation in 1972 and it is probable that the results in the donkeys are due to cross-reaction. It is known that sera of *Equidae* have a tendency for nonspecific reactions in assays where complement is used. The anticomplementary action of sera may result from antigen-antibody complexes, heparin, chelating agents and aggregated immunoglobulins. To reduce the nonspecific reactions, the sera were inactivated at 62°C for 30 min.

In this serological survey, tests were also carried out for VSV and piroplasmiasis. VS is a viral disease of horses, mules, cattle and pigs, characterised by vesicular lesions in the oral mucosa and the skin of the coronary band of the feet. One positive donkey with a SNT titre of 1:16 was found. VS has not been described in donkeys.

Piroplasmiasis is endemic in the UAE (Wernery *et al.* 1999). The results from this survey contrast favourably with the results for the horse population in 1995/96. Whereas 35% of horses tested were positive for piroplasmiasis (28.9% to *Babesia equi* and 4.6% to *B. caballi*), only 11% of the donkeys

from this survey were positive for *Babesia* (9.6% to *Babesia equi* and 1.6% *B. caballi*). Although ectoparasites are commonly found on camels grazing in the same area, none were seen on the donkeys.

## Conclusion

The results of the survey were presented to the standing Veterinary Committee of the European Union, who accepted the findings that the feral donkeys of the Northern Emirates are a healthy population of free living *Equidae* which do not pose any significant risk of spreading any of the major diseases of international concern to the local horse population in the UAE (Ellis *et al.* 1999).

Despite the apparent paucity of water and fodder and bearing in mind that the survey was carried out in June/July the hottest time of year, all the donkeys seen were in good bodily condition.

## Acknowledgements

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<sup>2</sup>Boehringer Mannheim GmbH, Mannheim, Germany.

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