Pair-bonding and companion recognition in domestic donkeys, *Equus asinus*

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ABSTRACT

Pair and social bonding has been documented in various taxa, where pair formations are often described as being driven by kinship or sexual motivation. However, pair-bonding between unrelated individuals where sexual motivation is not a factor is not well documented. Many social relationships and pair-bonds between members of a dyad are facilitated by each individual's ability to recognise their partner using cues which are characteristic of that particular individual. The aims of this study were i) to investigate the existence of pair-bonding in domestic donkeys and ii) to determine whether members of a dyad could recognise their companion during a Y-maze recognition test. Subjects were 55 unrelated donkeys (38 gelded males, 15 females) in seven groups of mixed or same sex, comprising 4–14 individuals. Spatial proximity (nearest-neighbour) was observed three times a day over a 22-day period. Using a simulation approach based on observed data to generate randomised nearest-neighbour matrices, the statistical significance of social relationships was estimated. Of these, 42 (79.2%) were involved in significantly ($p < 0.05$) non-random nearest-neighbour relationships, most of which were reciprocal pair relationships. Based on the spatial data, 24 of the donkeys which had shown significant reciprocal nearest-neighbour preferences for one individual (companion) were then used in a Y-maze recognition test in which they were presented with a choice of their companion and either a familiar donkey from the same group or an unfamiliar donkey from a different group. Donkeys' spatial location in the Y-maze demonstrated a preference for their companion versus familiar (one sample Wilcoxon signed rank test, $W = 239$, $p = 0.002$) or unfamiliar donkeys ($W = 222$, $p = 0.041$). These results verify anecdotal evidence from donkey handlers that donkeys often form pair-bonds, and show that reciprocal social preference and recognition are the basis of these. Pair-bond formation and companionship among donkeys have potential implications for their management, husbandry and welfare.

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1. Introduction

Social pair-bonding, whereby long-lasting preferential partner bonds and affiliative behaviour are observed between individuals, has primarily been documented in primates (Berghänel et al., 2011; Mitani, 2009; Moscovice et al., 2010), but has also been studied in some ungulates (Cameron et al., 2009; Wasilewski, 2003); horses (Heitor et al., 2006; Proops et al., 2012; VanDierendonck and Spruijt, 2012;) birds (Emery et al., 2007; Massen, 2010; Svec et al., 2009) and rodents (Wang and Aragona, 2004; Williams et al., 1992; Young et al., 2011). However the majority of research in this area focuses on kinship and sexual motivation as the drivers of pair formation.

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Research investigating non-kin bonding among animals however, is less well documented. The maintenance of 'friendships' and close bonds among dyads, facilitated by each individual's ability to identify the distinct characteristics of its preferential partner via individual recognition cues, may provide psychosocial benefits to each of the individuals involved. The evolutionary function of unrelated and non-sexually motivated pair-bonds however, still remains unclear (Clutton-Brock, 2009; Silk, 2002; Wasilewski, 2003).

There has been little research into pair-bonding in domestic donkeys *Equus asinus*. Based on nearest-neighbour observations in different contexts, Wasilewski (2003) reported that donkeys had small numbers of strong 'friendships' which were long-lasting, but also those social preferences were situation-specific. The social dynamics of domestic donkey groups are usually characterised by close proximity of individuals, implying high mutual tolerance and affiliative behaviour (Whitehead et al., 1991). Anecdotal evidence from donkey handlers suggests that it is 'common knowledge' that donkeys form strong pair-bonds with other donkeys, which become their companion, or there may be individuals for whom they have a particular preference (Svendsen, 2008; Whitehead et al., 1991). Although the strength of the bond may vary, it has been noted that the separation of bonded donkeys can cause extreme distress to either individual, resulting in 'pining' and inappetence which can potentially lead to hyperlipaemia (Svendsen, 2008; Whitehead et al., 1991). Pair-bonds have not been observed in wild or feral populations (Klingel, 1998; Moehlman, 1998; Rudman, 1998). This may not be surprising given that domestic donkeys are descended from two independent domestication events each from a separate subspecies (Kimura et al., 2011). One ancestor was the Nubian wild ass, *Equus africanus africanus*, while the other was a population from an area in modern Eritrea (probably corresponding with the Eritrean wild ass *Equus africanus dianae* (Clutton-Brock, 1999)). As both of these subspecies are now presumed extinct in the wild (Kimura et al., 2011), there is no way of ascertaining the natural behaviour of either. Furthermore, donkey populations are composed of a mixture of descendants of both ancestors (Beja-Pereira et al., 2004), which raises the possibility of derived social behaviour based on a whole range of interactions between two originally genetically distinct groups. The only point of reference is the Somali wild ass, *Equus africanus somaliensis*, for which limited observations have been made in the natural habitat and which indicate that social bonds exist primarily between females and their offspring. Other social groups have been observed, including all female groups and some mixed male–female groups, but these are rarer and group numbers are small (Moehlman et al., 2012). The suggested reason for this structure is the ecology of desert environments in which resources are limited and defended, however the possibility that there may have been differences among subspecies because of ancestry cannot be ruled out.

This study aimed to investigate social preferences and to determine whether there are pair-bonds and pair-associations among domestic donkeys. We define pair-bonds as reciprocal preferences between both

Table 1
The number and size of enclosure, number of males including age range and number of females including age range in each field.

Paddock	Size (ha)	Males	Females	Age-Range
1	2.02	8	0	2–10 yrs
2	2.02	8	0	6–13 yrs
3	1.42	4	0	5–8 yrs
4	1.50	5	0	5–12 yrs
5	2.10	4	4	4–7 yrs
6	2.12	6	2	9–26 yrs
7	2.27	3	11	8–30 yrs

members of a dyad, whereas pair-associations are defined as reciprocal and non-reciprocal preferences for more than one individual. The study comprised two components: 1) the observation of nearest-neighbour (NN) preferences between individuals and thus identification of bonds based on the frequency of spatial proximity within dyads. 2) A subset of donkeys showing a clear preference for one other donkey (companion pairs) was identified and the ability of each member of a pair to recognise its companion was then investigated using a Y-maze social discrimination test, where the companion was presented alongside a familiar or unfamiliar donkey.

2. Material and methods

2.1. Animals

The subjects of this study were 55 donkeys (38 gelded males, 17 females) at the Scottish Borders Donkey Sanctuary, registered charity no. SC 034 634. Many of the donkeys had been family pets that could no longer be cared for. Some of these were established pairs that were kept together in the same group. Other individuals were rescued, arrived without a companion and were placed in a group of similar individuals. Details of group structure and location are shown in Table 1.

2.2. Behavioural observations to identify nearest-neighbour preferences

Behavioural observations of donkeys were carried out in situ in their home enclosures to establish each individual's nearest-neighbour preferences (observer L.M.AM.). Of the 67 donkeys at the sanctuary, 55 were observed (donkeys kept only in pairs were excluded). Each donkey was distinguished based on its own distinct features, such as coat colour and length, height, markings and body shape. Instantaneous scan sampling of donkeys in seven enclosures was conducted at two-hourly intervals, three times per day for 22 days (on one observation day, only two scan samples were done). The total number of observations per donkey was 65. Each individual donkey's nearest-neighbour (identity) was recorded, unless no other donkeys were within two body lengths (approx 3.6 m) in which case the donkey was scored as 'on own'.

During the course of observations, two donkeys were introduced to each of enclosures 1 and 7. These four donkeys had been living in pairs, so had not been previously observed. From the point of introduction, they were