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Research Paper

Behavioural assessment of the habituation of feral rangeland goats to an intensive farming system

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ABSTRACT

There is increasing interest in methods for the habituation of feral rangeland goats to intensive farming conditions. We tested whether there were production performance and behavioural differences between groups of rangeland goats in an intensive farming system that were either exposed to a high degree of human interaction (HI, n = 60) or low degree of human interaction (LI, n = 60) over 3 weeks. In the HI group, a stockperson entered the pens twice daily and calmly walked amongst the goats for 20 mins. In the LI group, a stockperson only briefly entered the pens to check water/feed (daily/weekly). At the end of each week the goats were weighed and drafted into 12 subgroups of 10 animals (i.e. 6 sub-groups per treatment). Each sub-group was then tested for agonistic behaviour, avoidance of humans, and flight response. During the flight response test video footage was collected and later used for analysis using Qualitative Behavioural Assessment (QBA). For QBA analysis, the videos of each group, taken each week, were shown in random order to 16 observers who used their own descriptive terms to score the groups' behavioural expression. There was a significant interaction between treatment and time on body mass ($F_{3,174} = 5.0$; $P < 0.01$), agonistic behaviour ($F_{3,12} = 4.3$; $P < 0.05$) and flight speed ($F_{3,12} = 3.9$; $P < 0.05$), with the HI group having significantly higher average body mass ($P < 0.05$), fewer agonistic events ($P < 0.05$), and a slower flight speed ($P < 0.05$) than the LI group after the three weeks. Two main QBA dimensions of behavioural expression were identified by Generalised Procrustes Analysis. QBA dimension 1 scores differed between treatments ($P < 0.05$); HI goats scored higher on QBA dimension 1 (more 'calm/content') compared to LI goats (more 'agitated/scared'). QBA dimension 1 scores were significantly negatively correlated with the number of agonistic contacts ($R_s = -0.62$, $P < 0.01$), and flight speed ($R_s = -0.79$, $P < 0.001$), and significantly positively correlated with body mass ($R_s = 0.68$, $P < 0.001$) of the goats over the 3 weeks of the experiment. QBA dimension 2 scores were not significantly different between treatments or over time.

Findings from this study support the hypothesis that production performance and behavioural measures can distinguish behavioural changes in rangeland goats that were likely a result of habituation to human interaction in an intensive feedlot.

1. Introduction

Domestic goats (*Capra aegagrus hircus*) of various breeds were first introduced to Australia in 1788 from England with British colonisation (Rolls, 1969). Many descendants of these goats now roam freely over rangeland (arid and semi-arid) regions of Australia (Parkes et al., 1996), and have effectively adjusted to the environment to the extent that they no longer bear any strong resemblance to the original breeds. These feral animals can pose a significant environmental problem if not managed appropriately, but also represent a valuable livestock resource, accounting for approximately 90% of total goat meat production in Australia (GICA, 2016). The rangeland goat industry in Australia is starting to capture and rear these animals under semi-intensive or intensive conditions to allow more efficient production and predictable supply. Consequently, best practice management and welfare assessment protocols for the transition from rangeland to intensive conditions are needed.

As part of the transition from rangeland to intensive rearing conditions, goats will experience changes in the availability or accessibility of food, water, shelter, space, and social grouping (Price 1999). Agonistic behaviour and stress-related production losses associated with confinement and mixing are significant challenges to intensive rearing

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of rangeland goats (Addison and Baker, 1982; Cowley and Grace, 1988; MLA, 2015). In general, goats are more reactive than sheep to a threat or perceived challenge, and they exhibit more exploratory behaviours (Kilgour and Dalton, 1984).

Behaviour is one of the most important early indicators of the welfare of an individual and its adaptation to its environment and reflects the immediate response to the interaction between the animal and its environment (Metz and Wierenga, 1997). Strategies for improving livestock animal welfare require objective measures of behaviour that will enable comparison and contrast of welfare implications. Such measures need to be versatile, relevant, reliable, relatively economic to apply, and they need to have broad acceptance and understanding by all stakeholders (Fleming et al., 2016). Qualitative Behavioural Assessment (QBA) is a methodological approach for capturing the body language of animals in numbers that can then be analysed statistically. An animal's body language can reveal important aspects of its physical and mental health, and therefore welfare. Boissy et al. (2007) suggested that Qualitative Behavioural Assessment represented one of the most immediately applicable methodologies for assessing behaviour related to welfare, both positive and negative, in animals. Previous QBA studies have shown that observers can quickly, reliably and repeatedly assess the behavioural expression of sheep (Wickham et al., 2012, 2015; Stockman et al., 2014), pigs (Wemelsfelder et al., 2000; Morgan et al., 2014; Clarke et al., 2016), cattle (Rousing and Wemelsfelder, 2006; Stockman et al., 2011, 2012), horses (Napolitano et al., 2008; Minero et al., 2009; Fleming et al., 2013), and dairy goats (Muri et al., 2013; Grosso et al., 2016). To date there have been no QBA studies conducted on feral goats.

One of the greatest challenges for livestock under domestication conditions is how they cope with the presence of people (Tennessen, 1989). This issue is particularly important when wild animals are held under confined conditions. Research on cattle, lambs, pigs, and dairy goats suggests that when animals have more interactions with a stockperson, they become less fearful and stressed, more productive, and healthier overall (Le Neindre et al., 1996; Jago et al., 1999; Hemsworth et al., 2000). In the present study we tested whether habituation to human interaction in an intensive farming system (feedlot) would improve the welfare of rangeland goats using production performance and behavioural measures, including QBA. We compared the production and behavioural responses of confined rangeland goats that were exposed to either a high degree of human interaction (a stockperson entered their pens twice daily and calmly walked amongst the goats for 20 min) or a low degree of human interaction (the stockperson only briefly entered the pens daily/weekly to check water/feed). We further predicted that when challenged by the presence of a different person, goats in the high interaction group would show calmer behaviour that was more fitting with the domestication environment.

2. Materials and methods

These experiments were approved by the Animal Ethics Committees at Murdoch University (R2411/11; R2541/12; R2617/13) to ensure compliance with the guidelines of the Australian Code of Practice for the Care and Use of Animals for Scientific Purposes. All experiments were conducted at a private rangeland goat feedlot, Chapman Valley, WA, Australia (latitude: 28.4° S; longitude: 114.9° E). The feedlot comprised six individual pens on either side of a central laneway that was 3 m wide. The pens were approximately 10 × 15 m in area, providing 7.5 m^2 per animal for the 20 goats housed in each. There was one feed trough and one water trough, both of 4 m length, providing 0.2 m of trough space per animal. In the laneway that ran between the pens, a small test pen (3 × 3 m; approximately 0.9 m^2 per goat) was created at the end to hold animals during the behavioural tests. The sides of the laneway and test pen were covered with shade cloth so that the animals could not see out, and distance markers were painted on the ground. Two video cameras (GoPro Hero 3; GoPro Inc., Woodman Labs, San Mateo, CA, USA) were placed to capture continuous video footage of the goats in the holding pen and in the laneway during behavioural tests. The video footage was later analysed for each of the behavioural measures.

2.1. Animals

In late February (late summer), 120 Australian rangeland goats (*Capra hircus*), weighing 33 ± 5.9 kg (± SD, range: 22.5–49.5 kg), were selected from about 400 goats trapped at a water source over a period of 2 d, using a swinging one-way gate trap, on a sheep and cattle extensive rangeland grazing property, North Wooramel station, located 78 km east of Denham and 113 km south east of Carnarvon in the Gascoyne region of Western Australia (latitude: 25.6° S; longitude: 114.5° E). The estimated age of the goats, based on dentition, was between 9 and 15 months. The goats were then immediately transported to an intensive goat feedlot in Chapman Valley situated 20 km east of Geraldton, Western Australia, an 8 h journey.

On arrival at the feedlot, goats were given three days to recover from travel and acclimatise to new conditions, with gates open between the six pens to allow freedom of movement between pens prior to treatment allocation. They were fed good quality roughage in the form of hay and *ad libitum* feed pellets, with free access to *ad libitum* water. The pellets contained 92.3% dry matter, 11.9% crude protein and 10 MJ/kg DM of metabolisable energy. The roughage was provided in the form of a round bale (approximately 400 kg) of oaten hay in each pen at the start of the experiment to provide roughage and allow acclimatisation to the pelleted feed. The hay contained 90.1% dry matter, 6.4% crude protein, 8.6 MJ/kg DM of metabolisable energy, 33.6% acid detergent fibre and 63.0% neutral detergent fibre. After acclimatisation they were given individual identification ear tags and received a 1 ml Glanvac 3 in 1 vaccine (Zoetis Australia, Rhodes, NSW, Australia) subcutaneously providing protection against *Clostridium tetani, Clostridium perfringens* type D and *Corynebacterium pseudotuberculosis*, a 15 ml Baycox® (Toltrazuril; Bayer AG, Leverkusen, Germany) drench for coccidia, administered orally, a 16 ml Cydectin® (Moxidectin; Virbac, Milperra, NSW, Australia) for internal parasites, administered orally, and a Clout S® (Deltamethrin; Coopers, Sydney, NSW, Australia) backline for lice.

2.2. Housing and human interaction treatments

The 120 individuals were allocated to two experimental treatment groups, split equally amongst 6 pens. The 20 goats within each pen were further subdivided into two sub-groups each of 10 goats (with two differing ear-tag colours that were individually numbered). Their allocation into the sub-groups were based on their presentation order when moved into the drafting raceway (an indication of dominance ranking; Houpt 2011), body condition score (BCS) and body mass, aiming to produce similar body mass, BCS and social structure (dominance) between sub-groups. Goats from three of the pens were assigned to the 'high' human interaction treatment (HI; 3 pens; n = 60), and the other three pens to the 'low' human interaction treatment (LI; 3 pens; n = 60). In the HI group, a stockperson entered the pen twice daily and calmly walked amongst the goats for 20 mins. In the LI group, a stockperson only entered the group pen to fill up feed bins (weekly) and clean water troughs (daily) without interacting with the goats, as was done for the HI group as well. The three HI pens and the three LI pens were located on opposite sides of the shadecloth-covered laneway so that the LI goats could not see the stockperson interacting with the goats in the HI pens.

2.3. Production measurements: body mass and body condition score (BCS)

Body condition score (BCS) and body mass were measured weekly, beginning at the start of the experiment. BCS was measured by spinal