RELATIONSHIPS BETWEEN CLIMATIC CONDITIONS AND THE BEHAVIOUR OF FEEDLOT CATTLE

C.A. CASTAÑEDA, J.B. GAUGHAN and Y. SAKAGUCHI

School of Animal Studies, The University of Queensland, Gatton, Qld 4343

SUMMARY

Five pens in 2 south east Queensland commercial feedlots (A and B) were used to determine relationships between climatic conditions and behavioural patterns of cattle. Standing or lying at the feed bunk or at the water trough were recorded from the 8th January to the 27th March. In Feedlot A, more cattle were standing when morning observations were used than in Feedlot B, while in Feedlot B there were more animals in standing behaviour during afternoon observation. Behavioural patterns such as standing at the feed bunk or standing at the water trough in Feedlot B were related to weather conditions. However, in Feedlot A, standing at the feed bunk did not show any relationship to weather conditions and the relationship between weather conditions and standing at the water trough was not as strong as in Feedlot B. Evaluation of behavioural patterns in a feedlot can be used as an aid to assess heat stress in feedlot cattle. However, this should be done on an individual feedlot basis.

Keywords: behaviour, feedlot cattle, heat load index, heat stress

INTRODUCTION

Feedlot personnel need to recognise the response of cattle to high heat loads. Early diagnosis of high heat load conditions can increase efficiency of heat load relieving strategies used, thereby improving animal welfare during periods of hot weather. High heat load can disrupt behaviour in feedlot cattle (Hahn and Morrow-Tesch 1993; Gaughan and Goopy 2002). However, relationships between behavioural changes and different heat load levels under commercial feedlot conditions have not been determined, making any use of behavioural patterns difficult. Ansell (1981) found that cattle under heat stress refuse to lie down. Ansell (1981) explained this phenomenum as the need of the animals to expose as much of the body surface as possible to the atmosphere. However, in a study undertaken in Texas USA using 16 pens of 18 m^2 and using 2 animals per pen, Mitlöhner *et al*, (2001) did not find excessive standing in un-shaded pens compared with shaded pens.

Following McFarland's tri-dimensional model for motivational priorities (McFarland 1989), cattle will eat to satisfy their hunger up to a point where cooling becomes a priority due to high heat load. Among the cooling strategies that animals can use are increasing standing behaviour, reducing feed intake, seeking shade (Bennett *et al.* 1985), bunching or huddling (Ansell 1981), and seeking water to drink or splash themselves with (Ansell 1981), although Mitlöhner *et al.* (2001) point out that it is very difficult to measure body splashing since it gets confounded with drinking behaviour. The purpose of this study was to determine relationships between climatic conditions and behavioural patterns of feedlot cattle.

MATERIALS AND METHODS

The study was conducted at 2 commercial feedlots (A and B) in south east Queensland, from the 8th January until the 27th March 2003 at Feedlot A, and from the 9th January to the 24th March in Feedlot B. Two pens in Feedlot A, and 3 pens in Feedlot B, all of them without shade, were used for the trial. Stocking rates for Feedlot A were 21.9 and 15.0 m^2/head, and for Feedlot B were 15.4, 17.2 and 20.1 m^2/head.

Pen sizes, stocking rates, bunk space and water trough space were not standardised between the feedlots, and there were differences in the type of diet fed and breed composition in each pen. In Feedlot A, there were 136 and 198 head per pen, and in Feedlot B, there were 194, 174 and 149 head per pen. Weather data were recorded in each feedlot by automatic weather stations, and average hour and average daily heat load index (HLI) was calculated using the following equation (Gaughan and Castañeda 2003):

$$HLI = 34.1 + (0.26 \times RH) + (1.33 \times BGT) - (0.82 \times Ws)^{0.1} - Log(0.4 \times (0.0001 + Ws^2))$$

where RH is relative humidity divided by 100, BGT is black globe temperature (ºC), and Ws is wind speed (m/s). Day or hour very hot conditions (VHT) were determined when the HLI was higher than 78, hot conditions (HOT) when HLI was between 74 and 78 and cool (COOL) was lower than 74.

Standing and lying, at the water trough (WT) or at the feed bunk (FB), were recorded twice each day, in the morning between 0550 h and 0700 h (MORN) and in the afternoon between 1450 and 1600 h (AFTR). Additional readings were occasionally taken every 2 h between 0600 and 1800 h in both feedlots. Standing was defined as upright posture, while lying was defined as any body contact with the ground. Cattle were determined to be at the WT or FB when their head was over or in close proximity (2 metres for WT and 1 metre for FB) or they were moving towards it within the 2 metre perimeter. Behavioural differences for each feedlot were determined using the Mixed procedure in SAS (1996). The model included effects of hour HLI level nested into day HLI level. The percentages of cattle recorded for each behaviour were transformed to a normalised distribution using squared root-arcsine transformation. The transformed data were then analysed using all observations (All Times), observations MORN and observations AFTR. Data in tables are presented as percentage of animals rather than as transformed values.

RESULTS

Cattle showed different behaviour in each feedlot. Total standing behaviour was significantly higher (P<0.05) at MORN in Feedlot A than in Feedlot B. However, at AFTR hours, it was higher (P<0.05) in Feedlot B than in Feedlot A (Table 1). Standing at the FB behaviour at All times, and AFTR observations, was higher in Feedlot B than in Feedlot A animals.

Table 1. Least square means (LSM) and standard error (s.e.) of the percentage of cattle in some behaviours that were different (P<0.05) in both feedlots (A and B) during summer 2002-2003 (see text for details).

Behaviour	Time	Feedlot A		Feedlot B	
		Observations	LSM ± s.e.	Observations	LSM ± s.e.
Total standing	MORN	168	86.19 ± 0.49	304	62.33 ± 0.36
	AFTR	186	59.40 ± 0.25	304	77.78 ± 0.16
Standing at FB	All times	639	4.76 ± 0.16	722	9.31 ± 0.16
	AFTR	186	1.95 ± 0.36	304	15.16 ± 0.25
Lying at wt	AFTR	186	0.01 ± 0.00	304	0.000 ± 0.000

At Feedlot A or B, there were no significant differences (P<0.05) on total standing behaviour at different day-hour interactions at All times, AFTR or MORN observations. At Feedlot A, there were no differences (P<0.05) in standing at the FB behaviour at different day-hour interactions. However, standing at the WT was higher on VHT hours of COOL days than at COOL hours of Hot days at All times (Table 2) but no differences were found at MORN or AFTR observations with this behaviour. At Feedlot B, at All times, more animals were observed at the FB on VHT hours of COOL days than any other day-hour interaction. However, on VHT hours of VHT days, no significant differences (P<0.05) were found (Table 3).

Table 2. Least square means (LSM) and stand error (s.e.) of some behaviours that were related to weather in Feedlot A in summer 2002-2003 (see the text for details of weather conditions).

Behaviour	Time	Weather condition DAY – HOUR	Number of observations	LSM ± s.e. (% of animals)
Standing at WT	All times	COOL – VHT	134	3.21 ± 0.01[a]
		HOT – VHT	53	3.21 ± 0.01[ab]
		HOT – HOT	10	3.21 ± 0.09[ab]
		COOL – HOT	103	2.86 ± 0.01[ab]
		COOL – COOL	297	2.23 ± 0.01[b]
		HOT – COOL	42	1.95 ± 0.01[ab]

Means with different superscripts are significantly different (P<0.05)

At Feedlot B, standing at the WT behaviour was greater on VHT hours of VHT days than in other day-hour interaction at all times, but this difference was not significant for HOT hours of VHT days. During HOT hours of VHT days, standing at the WT was higher than at COOL hours of HOT days and Cool hours of COOL days at All times. In this feedlot, at AFTR observations, it was found a higher proportion of animals at the WT during VHT hours of VHT days than at VHT or HOT hours of

COOL days. It was also found a higher proportion of animals at the WT during VHT hours of HOT days than during VHT hours of COOL days (Table 3).

Table 3. Least square means (LSM) and stand error (s.e.) of some behaviours that were related to weather in Feedlot B in summer 2002-2003 (see the text for details of weather conditions).

Behaviour	Time	Weather condition DAY – HOUR	Number of Observations	LSM ± s.e. (% of animals)
Standing at FB	All times	COOL - VHT	56	29.12 ± 0.25 [b]
		VHT - VHT	57	13.08 ± 0.25 [ab]
		HOT - VHT	234	12.41 ± 0.09[a]
		HOT – HOT	63	7.11 ± 0.16[a]
		COOL-COOL	80	7.11 ± 0.16[a]
		VHT - HOT	20	6.12 ± 0.36[a]
		COOL - HOT	56	6.12 ± 0.64[a]
		HOT – COOL	140	5.65 ± 0.09[a]
		VHT - COOL	16	3.21 ± 0.49[a]
	AFTR	COOL – VHT	56	29.12 ± 0.36[a]
		VHT – VHT	36	13.76 ± 0.49[ab]
		HOT – VHT	184	11.76 ± 0.25[b]
		HOT – HOT	4	8.18 ± 3.21[ab]
		COOL – HOT	24	5.65 ± 1.00[ab]
Standing at WT	All times	VHT – VHT	57	9.90 ± 0.04[a]
		VHT – HOT	20	5.65 ± 0.09[ab]
		HOT – VHT	234	4.76 ± 0.04[b]
		VHT - COOL	16	3.95 ± 0.09[b]
		HOT – HOT	63	3.57 ± 0.04[b]
		COOL – VHT	56	2.54 ± 0.04[b]
		HOT – COOL	140	2.23 ± 0.04[bc]
		COOL – COOL	80	2.23 ± 0.04[bc]
		COOL – HOT	56	1.95 ± 0.09[b]
	AFTR	VHT – VHT	36	6.12 ± 0.04[a]
		HOT – VHT	184	4.35 ± 0.01[b]
		HOT – HOT	4	2.54 ± 0.16[abc]
		COOL – VHT	56	2.54 ± 0.04[c]
		COOL - HOT	24	1.95 ± 0.09[bc]

Means with different superscripts are significantly different (P<0.05)

DISCUSSION

The present study found that cattle behave differently under different environments or management practices, even if their environmental conditions are similar. Therefore, it is difficult to draw general conclusions to be applied across feedlots. Total standing behaviour was not related to weather conditions at either feedlot. This result suggests that under the observed conditions, feedlot cattle do not increase standing behaviour as a response to high heat loads. However, it is possible than under different circumstances, such as with high wind speed, cattle may increase standing behaviour to reduce temperature as described by Ansell (1981).

Standing at the water trough was related to high heat load conditions at Feedlot B, but was not so strongly related to high heat load conditions at Feedlot A. Cattle placed under 2 different environments take advantage of whatever is available to cope with the heat. In Feedlot A, they may seek water to reduce their body heat, but they may have other cooling options such as shade from the FB, WT or fellow animals. Higher wind speed may allow them to cool down by properly positioning their bodies. In Feedlot B, cattle used the WT to reduce body heat by drinking, splashing, breathing over the cooler surface of the water, or getting some shade over their heads. It is possible that other options were not available or were not as efficient as the WT to relieve heat stress. It is also possible that animals in Feedlot A were not as heat stressed as cattle in Feedlot B due to weather characteristics of each feedlot not taken into account by the HLI.

Standing at the feed bunk was related to high stress hour conditions on cool days in 1 feedlot, but not in the other. This result could be due to an interaction of eating behaviour and cattle seeking shade at the feed bunk during very hot hours of cool days. It was impossible to distinguish in this study if animals were eating or seeking shade at the feed bunk. This result is in agreement with Mitlöhner *et al*. (2001) who found that cattle use the shadow of the feed bunk to hide their heads from direct solar radiation.

Following McFarland's (1989) tri-dimensional model, cattle may be seeking food, driven by hunger until the need for cooling due to high heat load becomes a priority. However, in different environments, animals may find 1 strategy to be better than another, and may learn from previous experience which strategies help them to cope with the high heat load best. Feedlot cattle change their behaviour in response to climatic conditions, but this response is influenced by other factors such as feedlot location, feedlot aspect, management and social interactions. Behavioural responses to weather conditions need to be evaluated at each individual feedlot, if behaviour is to be used as a tool to assess heat load.

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Email: c.castaneda@uq.edu.au j.gaughan@uq.edu.au yoichi65@hotmail.com