BEHAVIOUR OF LOT-FED CATTLE

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SUMMARY

Behavioural observations we have made on cattle in Australian feedlots are presented here in the context of a literature review of the main features of animal behaviour in lot-fed animals.

Despite the lack of detailed ethograms of lot-fed cattle in Australia, there is enough information on their maintenance behaviours to draw some conclusions. Feedlot cattle exhibit the normal range of ingestion and resting behaviours, but their pattern of expression is different from that seen in range cattle. More research is needed, particularly into social behaviour. Some of this is planned within the Health and Welfare research program of the Cattle and Beef Industry Cooperative Research Centre.

Climatic conditions in Australia differ in some respects from other feedlotting countries, being hotter and more humid in some areas. Preliminary findings are reported here of the relationship between cattle behaviour and meteorological indicators of heat load and also some effects of providing shade.

INTRODUCTION

Wild cattle live in herds which roam over large areas of grassland, but the domesticated breeds are subject to varying degrees of confinement. This ranges from extensive fenced grazing lands, with occasional close handling, to intensive feedlot production in pens with regular human contact, and even to total confinement in crates. Naturally, the behaviour of cattle is affected by the degree of handling and confinement. One reason is that handling leads to habituation and taming of the animals so they become less reactive and vigilant. Presumably this is at least partly because they have adapted to a situation in which they perceive fewer threats. They spend more time standing still, or idling, than less tame animals would. There could also be a direct effect of confinement on their reactivity or walking behaviour. The fact that feedlot cattle are fed differently and are usually heavier than grazing cattle would also be likely to affect behaviour. The process of selecting animals for intensive environments has obviously produced an evolutionary adaptation as well.

Australia has a tradition of extensive grazing beef production and the rapid expansion of a sustainable feedlot industry is a recent development. It is of interest to determine to what extent the basic pattern of maintenance behaviour in feedlot cattle differs from that of free-ranging animals. In this paper we attempt to answer this question by a strategic review of the literature supplemented with some of our own observations in various Australian feedlots.

Maintenance Behaviour

An ethogram, or detailed systematic inventory of the elementary units of behaviour, does not appear to have been recorded for feedlot cattle in Australia, but our observations suggest that other published information is readily applicable in many situations. The principles of "behaviours of maintenance" in relation to extensive and intensive

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husbandry of farm animals were elaborated by Fraser (1983; 1989). He identified eight primary classes with cattle having 44 specific behaviours distributed amongst these classes. A selection of these is listed below:

1. Reactivity - startle reflex, orientation toward stimuli, vocalisation, agonistic actions (butting etc);
2. Ingestion - eating, drinking and rumination patterns;
3. Exploration - sensory stimulation (novelty), exploratory drives;
4. Kinesis - perambulation (different gaits), stretching, head-neck movements, tail movements;
5. Association - social exchanges, group formation, social organisation, followership;
6. Body Care - scratching, rubbing, shaking, licking, nosing, seeking shade;
7. Territorialism - home range, individual space;
8. Rest - lying, standing (idling), drowsing, sleep.

The literature on the question of whether these behaviours are inherent "needs", i.e. internally motivated, or not (Friend 1989) and the related concepts of ethological homeostasis (Fraser 1984) and ethological deficit (Dawkins 1988) will not be discussed in detail here. A number of authors have considered that there is a degree of behavioural deprivation in feedlot cattle, but that it is clearly less than in tethered or stalled animals (Fox 1983). Fraser (1983) considered that 25% of the natural ethogram was lacking in feedlot cattle compared to a 56% deficit in enstalled calves. He suggested that a deficit of 25% or more could be critical, judging by the occurrence of a behavioural anomaly which is known as the buller-steer syndrome. Other investigators of stress in farm animals have argued that this conclusion is too simplistic and a more detailed knowledge of neuroendocrine and other psychobiological adaptation processes is required to assess the situation in intensively managed livestock (Dantzer and Mormède 1983). We believe that further work is needed on the adaptation of cattle in Australian beef feedlots. One of the research objectives of the Cattle and Beef Industries Cooperative Research Centre is to establish acceptable indices of animal welfare in lot-fed cattle.

Behavioural Anomalies

It is generally agreed that anomalous (i.e. atypical) behaviour may be associated with particular intensive husbandry systems. Tongue-rolling has been reported in closely confined cattle, but we have not heard of this in Australian feedlots. The buller-steer syndrome (in which certain steers are continually being mounted by other steers) is an anomaly which is widely associated with feedlots. The incidence was estimated to be about 4% in US feedlots (Craig 1981) and was found to be influenced by stocking density, stormy weather and the use of hormonal growth promotants in one study (Brower and Kiracofe 1978), but only by cattle numbers in the pen in another study (Irwin et al. 1979). It has been attributed to "stressful social circumstances" (Fraser 1983) or “boredom due to the absence of diverting stimuli” (Fox 1983), but its cause is not known. It is probably the most common cause of removal of animals from feedlot pens in Australia, but we estimate, from anecdotal evidence, that its incidence is <2%.

Australian Beef Cattle Feedlots

Of the 25 million cattle in Australia, about 350,000 are in feedlots, producing an annual turnoff of 750,000 head (worth $500 million dollars) and the number of feedlots is increasing (Anon 1992). There is an enormous variation in the size of feedlots - from a few hundred head to approximately 30,000, but this is still much smaller than the largest U.S. feedlots which have up to 200,000 head. The number of animals per pen ranges from about 50 to 300 whereas in the U.S. this range was reported to be from 20 to 2,000 head per pen (Elam 1971). Stocking densities in the U.S. were said to vary from 9 to 46 m^2 per head - typically 9-18 m^2 per head. In Australia 10-15 m^2 per head is quite common. The Australian Lot Feeders' Association Code of Practice for Cattle Welfare in Feedlots recommends 15 m^2/hd (minimum 9 m^2/hd). The National Consultative Committee on Animal Welfare has suggested a minimum of 15-20 m^2/hd. Studies in the U.S. have shown adverse effects on production when space was <7 m^2/hd, but no difference between 9 and 19 m^2/hd (Fox 1983).

Climatic conditions in Australian feedlots could be hotter and more humid than in many overseas feedlot localities and may also have less air movement at times - although similar problems have been extensively researched in Southern California and Arizona. The advent of automated meteorological recording close to the feeding pens in some Australian feedlots is now beginning to provide good information about this. Availability of the more heat-tolerant *Bos indicus* breeds in the northern regions of Australia provides an opportunity for matching feedlot management systems to the local environment - although market specifications are the main determinant of the breed used.

The observations reported here are mainly concerned with variation in feed and water intake, resting behaviour and the use of shade in certain Australian feedlots. The results also show some of the effects of climate on these behaviours.

METHODS

Study 1

Feed intake per pen, recumbency and the use of shade by Brahman cross cattle in shaded and unshaded feedlot pens at the QDPI Brigalow Research Station in central Queensland were recorded from January to May, 1992. Production and meat quality parameters were also recorded (See Clarke et al. 1992 for a preliminary report). The shade was knitted shadecloth (rated 70%) at 12 m^2 per head in each pen.

Study 2

Feed intake per pen by Charolais cross cattle in shaded and unshaded pens at a commercial feedlot in Southern Queensland was recorded from November, 1991, to May, 1992 by Clarke (unpublished). Other production data were also recorded. The shade consisted of knitted shadecloth (rated 70%) at 2.5 m^2 per head in each pen.

Study 3

Feed and water intake per pen, recumbency and the use of shade by British breed cattle were recorded in two commercial feedlots - one in northern NSW, from November, 1992, to January, 1993, and one in southern Queensland, from January to March, 1992. In these feedlots the proportions of cattle feeding, drinking, standing and lying were recorded once daily at about **1400** h by the stockperson using logbooks designed for this purpose by Fell. Meteorological data were recorded immediately outside the pens by a fully-automated weather station. The shade structures consisted of either knitted shadecloth (rated 70%) or iron (to cover 90%) and varied from 1.5 m^2 to 2.5 m^2 per head in different pens. This was part of a larger study (to be published) on the effects of shade in commercial feedlots which was initiated by the Australian Lot Feeders' Association and is financially supported by the Meat Research Corporation.

The occurrence of other behaviours was noted during visits to these and other feedlots by Fell or Clarke.

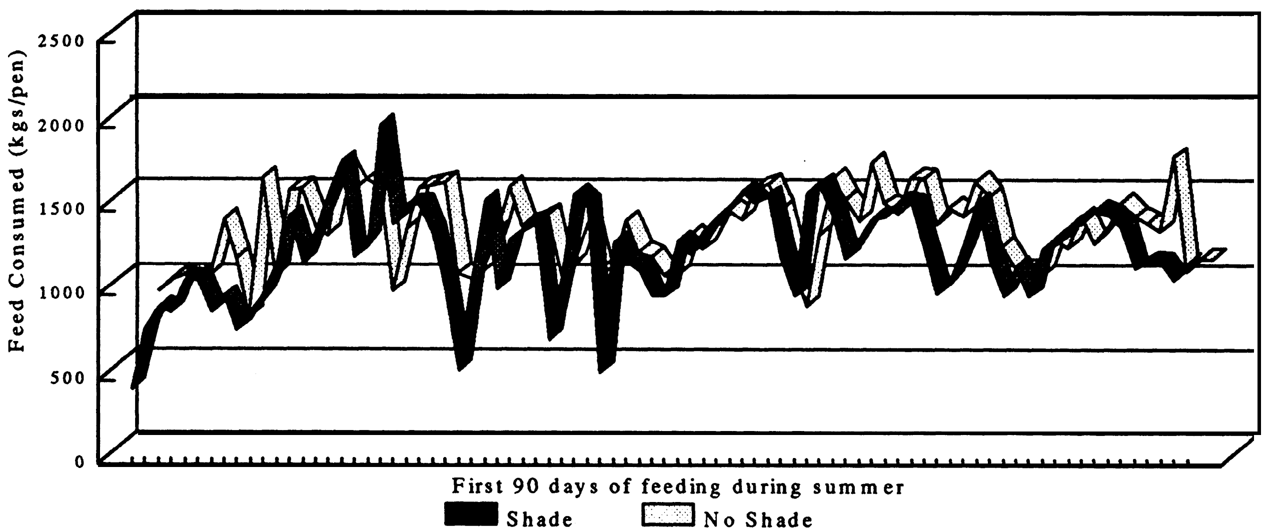

FIGURE 1 Daily variation in feed intake (kg/pen) over the first 90 days of feeding during summer in Study 2. Figures are from one shaded and one unshaded pen.

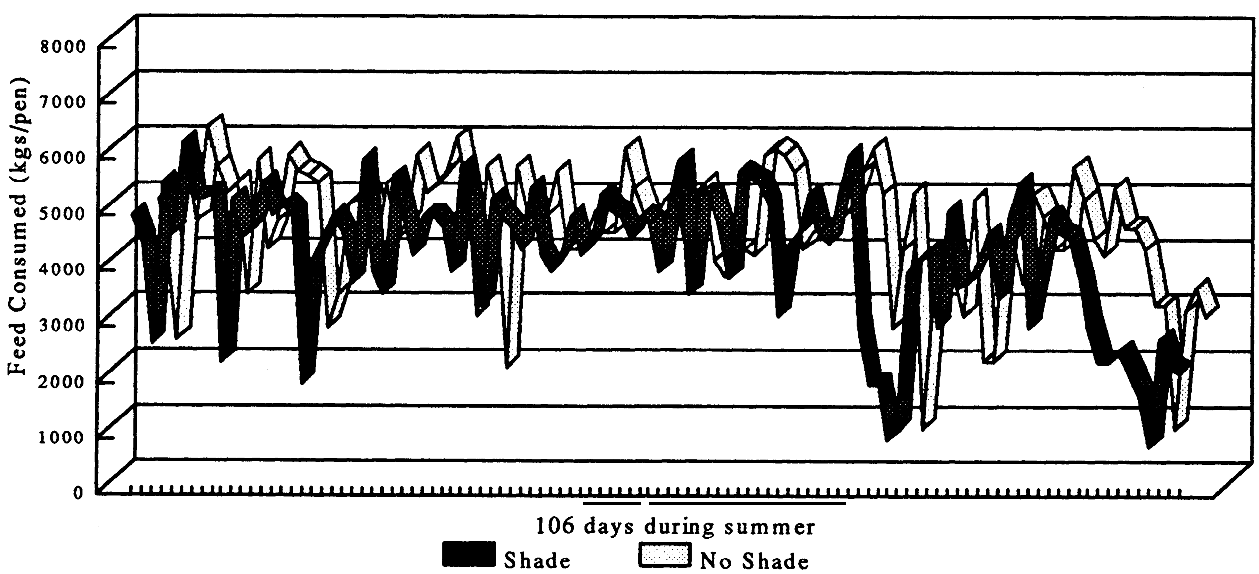

FIGURE 2 Daily variation in feed intake (kg/pen) over 106 days during summer in Study 3. Figures are from one shaded and one unshaded pen in the more southern feedlot.

RESULTS AND DISCUSSION

Feeding and Drinking

Voluntary feed intake is obviously an important behavioural variable in any production equation. Despite the fact that a consistent ration is supplied regularly to the pens, ‘two, three or more times a day, there is considerable variation in the time which cattle spend eating and the amount of feed consumed from day to day.

The daily variation in feed intake per pen in two of these studies is illustrated in Figures 1 and 2. There was no significant difference in the amount of feed consumed between shaded and unshaded pens in these studies. Whatever variations in feeding behaviour might have occurred due to the presence of shade, it appears that these have cancelled one another out so that overall feed intake was not affected. However, there was a greater daily variation in feed consumption in shaded pens than in unshaded pens in each study. The coefficients of variation, between days, for feed intake per pen - for shaded and unshaded pens, respectively - were 20.5% and 18.3% in Study 1, 22.5% and 17.7% for Study 2, and 27.8% and 24.4% in Study 3. This finding is consistent with the observation, reported to us by feedlot personnel, that cattle tend to seek shade in preference to feed during the day in hot weather, i.e. they change their pattern of feeding.

This does not indicate individual animal variation in feed intake, of course. It may be compared with unpublished data from the NSW Agriculture Trangie Research Station (Diana Perry, personal communication) which showed that the within-animal (between-day) coefficient of variation for feed intake in British steers in a feedlot was 34%, 36% and 43% in three experiments conducted during summer.

In study 3 some effects of climate on behaviour are indicated in a preliminary way in terms of the significant trends in a simple correlation matrix (note that multiple regression analyses have not yet been performed as this is a subset of what will be the complete shade project data.). These trends are summarised in Table 2. There were some significant negative correlations between feed intake and indicators of hot weather, but daily maximum temperature, for example, accounted for only about 15-25% of the variation in feed intake. Much more significant was the effect of ambient temperature on the number of animals feeding at 1400 h - which accounted for about 50% of the variation observed. This suggests that, although hot weather strongly affected the afternoon feeding behaviour, the cattle made at least partial compensation for this by feeding at other times.

Daily water intake had a strong positive correlation with hot weather and a negative correlation with relative humidity. In shaded pens, the number of animals at the water trough was not positively correlated with hot weather as it was in unshaded pens. It seems that these animals chose to drink at other times and showed less inclination to gather around the water trough as a means of keeping cool.

Recumbency

Sternal recumbency is the normal alternative to standing in feedlot cattle. Cattle often ruminate in this position and it is regarded as an important aspect of their resting behaviour. We have formed the impression from our observations that lateral recumbency, while relatively uncommon, may be more prevalent in feedlot cattle than in animals at pasture.

The proportion of animals which were lying at 0730 h and 1500 h during February in Study 1 averaged 40% and 53% respectively, but there was considerable variation as shown in Figure 3.

TABLE 2 CLIMATE-BEHAVIOUR CORRELATIONS
Trends in Significant Correlations Between Meteorological Data and Cattle Behaviour Parameters in Pens with Shade (S) and Pens without Shade (US) in Study 3

WEATHER	Daily Feed Consumption		Daily Water Consumption		% Feeding (1400 h)		% At Water (1400 h)		% Standing (1400 h)		% Lying (1400 h)	
	S	US	S	US	S	US	S	US	S	US	S	US
Daily Max. Ambient Temp.	-	-	++	++	-	- -	NS	++	++	NS	- -	NS
Daily Min. Ambient Temp.	-	-	+	+	NS	-	NS	++	+	+	NS	NS
Daily Rainfall	NS	NS	-	-	NS	+	NS	NS	+	NS	NS	NS
Current Ambient Temp.	-	-	++	++	-	- -	NS	++	++	+	- -	NS
Current Black Globe Temp.	-	-	++	++	-	- -	NS	++	++	+	- -	NS
Current Relative Humidity	NS	NS	- -	- -	NS	NS	NS	-	++	NS	- -	NS
Overnight Cooling[1]	NS	NS	++	++	NS	NS	NS	NS	+	NS	-	NS

[1] Average hourly rate of temperature decline between 1800 and 0600 h.

\+ or - indicates r = 0.3-0.5 in most pens. ++ or - - indicates r = 0.5-0.8 in most pens.

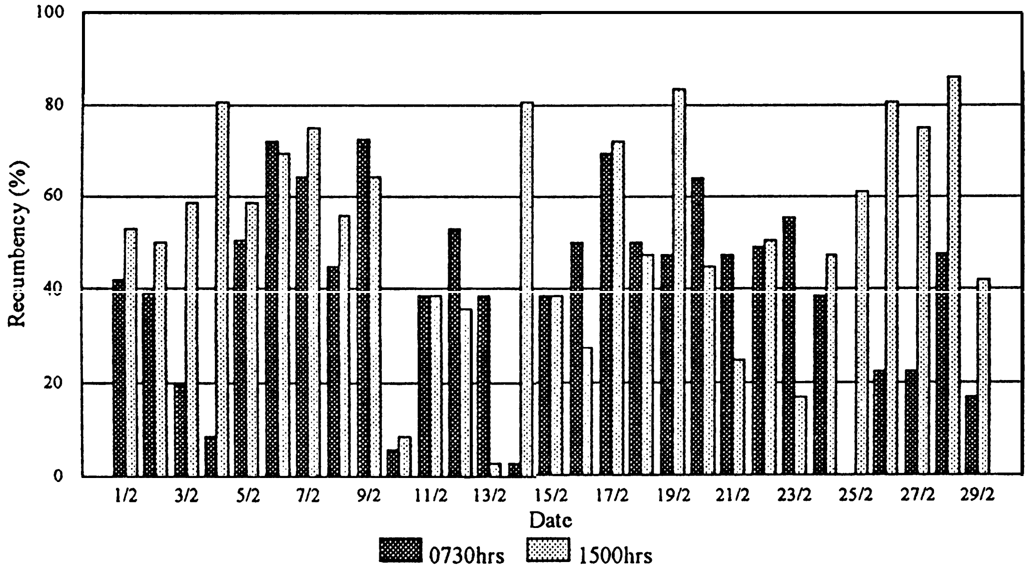

FIGURE 3 The percentage of Brahman cross steers recumbent in a central Queensland feedlot during February at 0730 h and 1500 h (Study 1).

The percentage of animals lying in Study 3 (at 1400 h) varied from 0 to 90% in unshaded pens (with a mean of 34%) and from 0 to 82% in shaded pens (mean 30%). In shaded pens there were about equal numbers lying in the shade and in the open.

The correlation trends in Study 3 (Table 2) show that the proportion of animals standing (rather than lying) increased with all indicators of heat load, but it should be noted that this association was much stronger in shaded pens and the standing occurred mostly in the shaded area. Similarly, the negative correlation between lying and hot weather occurred only in shaded pens, i.e. under the shade, animals were mostly standing. Reluctance to lie down is regarded as an early sign of heat load, although it has also been reported that Brahman cattle grazing on treeless plains tend to lie down more on hot days (Blackshaw 1992).

From practical observation it is obvious that prolonged wet weather can reduce the lying behaviour of cattle if the pen surface, through inadequate drainage or slope, becomes muddy. Such conditions did not apply during our studies.

Shade-Seeking

It is well known that cattle will seek shade wherever it is available during the hotter parts of the day and will also use it at other times. British breeds show shade-seeking behaviour more strongly than Brahman types (Bennett et al. 1984; Blackshaw 1992). Cattle also have a strong tendency to stand close to (or in) water during the hottest parts of the day, particularly if shade is absent. The importance of these behaviours in coping with thermal stress is discussed by Blackshaw and Blackshaw (1991).

The proportion of animals (Brahman cross) using the shade at 0730 h and 1500 h during February in Study 1 was 41% and 70% respectively. The day-to-day variation is shown in Figure 4. The corresponding usage rate for April was 47% and 54%. In this study the use of shade was significantly influenced by cloud cover and ambient temperature as well as by time of the day and month of the year.

In Study 3, with British breeds of cattle, the proportion of cattle using the shade at 1400 h during summer varied from 9% to 97% with an overall mean of 63% (SD=25%). Shade use was strongly correlated with all indicators of heat load - least so with relative humidity. Black globe temperature or ambient temperature appeared to account for over 60% of the variation in shade use.

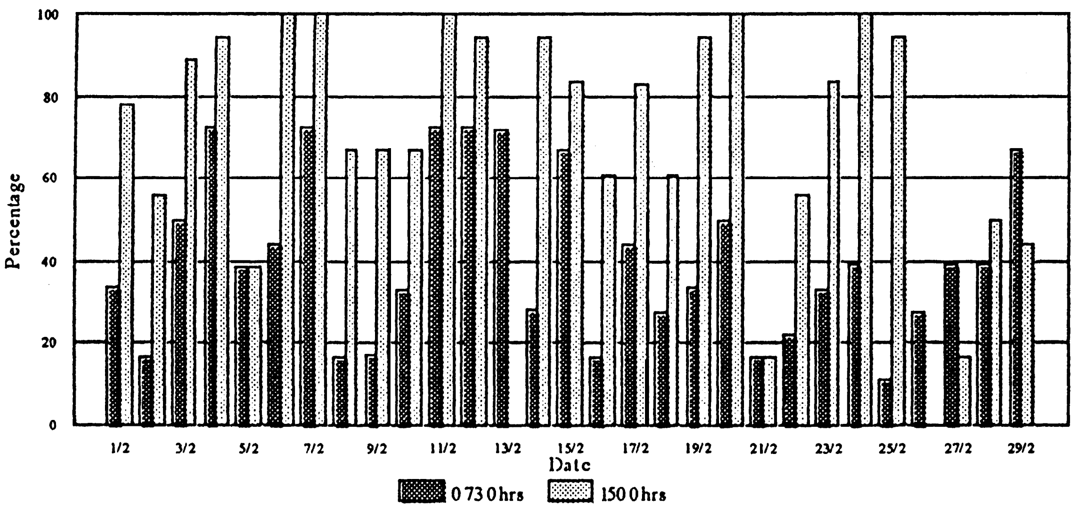

FIGURE 4 The percentage of Brahman cross steers using the shade in a central Queensland feedlot during February at 0730 h and 1500 h (Study 1).

CONCLUSIONS

Further work is obviously needed before commenting on all the maintenance behaviours of Australian feedlot cattle, but a few points can be made at this stage regarding the behaviours associated with ingestion and resting.

Cattle at pasture commonly spend 7-10 hours grazing per day in order to satisfy their appetite, with peak eating periods soon after sunrise and around sunset and a smaller peak around midnight. In preference testing they will substitute concentrates for pasture thus satisfying appetite more quickly (Kilgour and Dalton 1984). In feedlots this photoperiod effect is still evident (Stricklin 1988), but the arrival of feed in the trough is the biggest stimulus to feeding. Feedlot steers in Oklahoma (Hicks et al. 1989) were found to spend 7% of their time (1.5-2 h/day) feeding, with peaks at 0650 h (47% of steers eating) and 1700 h (37% eating) - corresponding with morning and afternoon feed delivery time - and a smaller peak at 2100 h (18% eating). Time spent eating was positively correlated with growth rate. In a Japanese feedlot, steers were observed to consume an average of 11 meals per day of about 11-14 min duration, but the growth of individuals was significantly correlated with the amount of feed eaten in the 30 min period after arrival of the feed (Hidari et al. 1987). Steers whose average daily gain was >0.8 kg ate about 30% of daily intake within 30 min of feed arriving, while steers with an average daily gain <0.7 kg ate only 18% of daily intake at that time.

Even though feeding is spread throughout the day to a certain extent, the ability to satisfy appetite from troughs in a total time of <2 h (instead of 7-10 h) obviously affects the amount of walking and the time spent idling. Grazing cattle may walk 3-6 km/day (Lynch and Alexander 1980), but the distance walked in feedlot pens is not known, nor is there any information about the importance of walkingto the animal. There are other effects on the behaviours of kinesis, with some apparent restriction to movement due to the body size and shape of fat feedlot cattle, but these have not been studied either. It has been suggested that greater idling time induces boredom and increases the likelihood of anomalous behaviour (Fox 1983; Blackshaw 1992). We think this also requires further investigation.

Climate affects eating behaviour, but again the picture is sketchy, for Australian conditions. Provision of shade was shown to affect the pattern of feeding in this study, but did not affect overall consumption. Further results on this will be available soon.

The time spent lying is regarded as an expression of the maintenance behaviour of resting - although it is not the only form of this behaviour. Feedlot steers in Oklahoma (Hicks et al. 1989) spent 54% of their time lying, and lying time, eating time and growth rate were positively correlated. Our cattle also spend a considerable time lying and it appeared that the provision of shade could affect this behaviour during hot weather.

The biggest deficiency in our knowledge of cattle behaviour in feedlots seems to be in the area of social interaction. This affects reactivity, body care and territorial behaviours and all kinds of associative behaviour. We have observed a range of normal social exchanges and body care activities (although the latter can be restricted by the size of the animal), but a proper study has not been undertaken. We do not know about personal space requirements under these conditions, so statements about possible crowding are not very meaningful at this stage. As Blackshaw (1992) has pointed out, an important consideration in intensive systems is the phenomenon of social facilitation, i.e. the way animals copy the behaviour of others. The early adaptation phase when cattle enter the feedlot is recognised by feedlot managers and ethologists alike as a critical period for animal behaviour. It is worth noting that the surveillance of animal behaviour and the managerial responsiveness to changes in behaviour is much greater in a feedlot than in extensive management situations. Idiosyncratic behaviour, such as a favourite location for a particular animal, is commonly noticed by pen riders on daily inspections. Cattle are removed from pens for health treatments (in a hospital pen), re-location or culling, on the basis of behavioural observation.

The importance of social behaviour to production, health and welfare should not be underestimated. Cattle are normally put into closely matching groups, which Stricklin (1983) thought could increase social stress, but it is apparent that stable, quiet patterns of social behaviour are quickly established in most cases. Mixing of cattle from different locations is a significant psychosocial stressor, but the dominance hierarchy of cattle groups serves to minimise social friction in the longer term. The role of olfactory communication in this is shown by the finding of Klemm et al. (1984) that obstruction of the vomeronasal organ in feedlot steers altered the dominance ranking. Previously high-ranking steers lost rank and low-ranking steers moved up. As suggested by Stricklin (1983), a lackof correlation between dominance rank and production of individual steers is a good sign - being an indication that competition between animals is not affecting access to feed, water or shelter.

Further studies of behaviour, such as those planned in the Health and Welfare research program of the Cattle and Beef Industries Cooperative Research Centre, should assist in the profitable management of feedlot cattle and also in public perceptions of the animal welfare situation. It could also influence the design of future feedlots. A point worth remembering in designing cattle handling facilities is that the visual acuity of cattle is relatively poor. Measurements made recently (in Japanese Black heifers) show that humans have approximately 20 times the visual discriminating power of cattle (Entsu et al. 1992).

Our general conclusion is that the ethogram of maintenance behaviours of feedlot cattle is different, but not greatly different, from that of grazing cattle. Clearly, the behaviour of cattle is altered in the feedlot situation, but not to the extent that some public statements suggest, e.g. that they are “force-fed” or “unable to move around.” A difference between feedlot behaviour and rangeland behaviour does not necessarily indicate that there is a problem, but it provides one means of analysing the effects on animals of intensive management and therefore one avenue for learning more about the factors which affect their welfare, health and production.

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