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Spatial and social behavior of a beef-cattle group on grazing pasture and in dry-lot

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Abstract.

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The spatial and social behavior of a group of beef cattle were studied on a 42,000 m^2 grazing pasture in summer and a 725 m^2 dry-lot in winter. The experimental animals were 47 beef cattle consisted of Hereford heifers and steers, and Holstein steers. A lying position of each cattle in nighttime was recorded through 2 consecutive days on each grazing pasture and dry-lot, and a mean distance from individuals to others (ID) and a mean distance to the nearest neighbor (rA) were calculated. In each experimental period, their agonistic encounters were recorded during 0600h to 1800h.

Mean individual distance and mean distance to the nearest neighbor in cattle on the grazing pasture were 48.9 m and 4.5 m, while those in the dry-lot were 12.0 m and 1.0 m, respectively. The ratio of rA to the expected rA in random distribution on each density situation were 0.32 on the grazing pasture and 0.54 in the dry-lot. Total frequency of agonistic encounters throughout two experimental days were 927 times in the grazing and 3281 times in the dry-lot, respectively. The proportion of frequency of bunting to total agonistic encounters was 35.9 % in grazing, and that was 61.3 % in the dry-lot. The dominance ranks in both experimental periods had a significant coefficient of correlation ($r = +0.5$, $P < 0.01$).

Key words, Beef cattle, Spatial behavior, Social behavior, Grazing, Dry-lot feeding

Introduction

Keeping animals to a group produces various economic advances, while management of the group of animals should settle certain behavioral problems in addition to other general problems of keeping animals individually. A density of animals in groups is one of the factors of these behavioral problems. Behavioral problems of animals in a high density condition were theoretically reviewed by KILEY-WORTHINGTON (1977). For cattle, behavioral changes of dairy cows in reduced space were studied by ARAVE *et al.* (1974). KONDO (1987) conducted a series of studies in spatial and social behavior of calves comparing different density conditions. In recent beef productions, animals are moved periodically from units to units which different densities, so animals are frequently facing these density problems, though there is little behavioral study concerning those practical beef production systems.

The Livestock Farm of Faculty of Agriculture in Hokkaido University has been studying of high roughage feeding system for raising and fattening cattle. Cattle in this system were grazed in summer and were kept in dry-lot in winter. Besides changes of feeds and ambient temperature, a change of space allowance could influence on cattle, especially on their spatial and sociacl behavior.

In the present study, we carried out behavioral observations of these cattle in a grazing pasture in summer and in a dry-lot in winter, and discussed differences their spatial and social behavior between two density conditions.

Materials and methods

Experimental animals were 47 beef cattle kept in Livestock Farm of Hokkaido University, including 18 steers and 20 heifers of Hereford breed and 9 steers of Holstein breed. They were born in March to June in the previous year and were kept on grazing pastures from early May to mid November as summer season and in dry-lot from late November to the end of April as winter season.

Behavior observations were done on two consecutive days in both summer and winter periods. In summer, positions of lying animals were determined all the night through by applying a method of tringular surveying (KONDO *et al.*, 1987) in a 42,000 m^2 grazing pasture. Agonistic encounters between individuals were observed from 0600h to 1800h in each observation day. Agonistic encounters were recorded as following categories: bunting, pushing, fighting and threatening and avoiding.

In winter, positions of lying animals in two night of the experimental period in a 725 m^2 dry-lot were determined by the position of poles in fences at 1.8 m intervals, as recorded X-Y coordinates. Agonistic encounters in the group was recorded from 0600h to 1800h during two experimental days.

From the position of cattle, mean distance from individuals to others in the group (ID) and distance from individuals to the nearest neighbor (rA) were calculated. Dominance rank orders of the group in each observation period were estimated by win-loss ratio in agonistic encounters for each individual. This ratio were also used for calculation of dominance values (DV, BEILHARZ and MYLREA, 1963, COLLIS, 1967) for individuals in the group.

In summer, experimental animals only grazed without any supplementation. In winter, they were fed hay and grass silage ad lib. with 4.0 kg concentrate / day / animal in the dry-lot.

Results and discussion

Table 1 shows ID, rA and ratio of rA to the expected distance to nearest neighbor in random

Table 1. Mean distance from individuals to others (ID), mean distance to the nearest neighbor (rA) and ratio (R) of rA to the expected rA in random distribution on the grazing pasture and in the day lot.

	Pasture	Dry-lot
ID , m	48.9	12.0
rA , m	4.5	1.0
R	0.32**	0.54**

**, $P<0.01$

distribution in each density situation (R). The expected rA in random distribution was obtained by the equation of CLARK and EVANS (1954).

The distance of ID and rA were both shorter in the dry-lot than those on the grazing pasture. These seemed to be directly influenced by decreasing space allowance from 893.6 m^2 / animal on the grazing pasture to 15.4 m^2 / animal in the dry-lot. The ratio R was 0.32 on the grazing pasture, and 0.54 in the dry-lot, which suggested cattle showed relatively dispersing their spatial pattern in the dry-lot rather than on the grazing pasture, while actual distances among cattle were depressed physically in dry-lot. The same phenomena was reported in grazing cattle (SATO *et al.*, 1976) and in calves in reduced lot space (KONDO *et al*, 1984). A physical limitation of space, which depressed distances among cattle in the group, could cause psychological mutual repulsions in the group.

The distributions of each distance on the grazing pasture and the dry-lot were shown in Fig. 1. The distribution of ID on the grazing pasture was similar to that in the drt-lot but their means and variations were obviously independent of each other. In the case of distributions of rA, the variation was larger in grazing than that in the dry-lot, while the difference between means was not

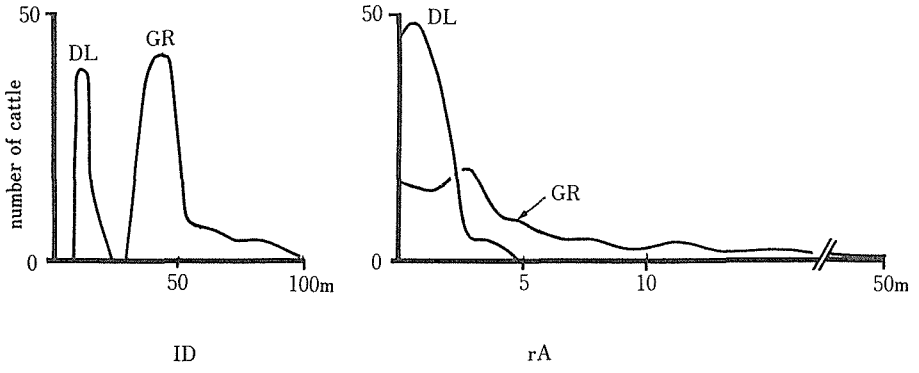

Fig. 1 Distribution of mean distances from individual to others (ID) and distances to the nearest neighbor (rA) in the grazing (GR) and dry-lot (DL).

so large as that in ID. On the grazing pasture, each cattle was able to choice their distances to the nearest neighbor by themselves according to each social relationship. In the dry-lot, their rA range was restricted physically less than 5 m, approximately. Thus, every cattle in the dry-lot would always enter within other's individual zones (HEDIGER, 1968) and also be invaded their zones. These conditions should produce an aggressive environment (MCBRIDE, 1968). These frequent physical aggressions in high density situation were observed in calves (KONDO, 1987), swine (SYME and SYME, 1979) and poultry (RINGER, 1971).

Table 2 shows frequencies of agonistic encounters during two observation days in both grazing and dry-lot. Total frequencies in dry-lot were as about three times as that on the grazing pasture. As expected in the result of their spatial patterns, social behavior in dry-lot was highly aggressive.

In proportions of their agonistic behavior, bunting in the dry-lot occupied 2/3 of odserved agonistic encounters, while that was about 1/3 on the grazing pasture. The social behavior in the dry-lot was not only more frequent than that on the grazing pasture, but also becoming to be more physical. An increasing of physical agonistic encounters in high density situation was reported in calves on experimental lot (KONDO *et al.*, 1984). The same changes in beef cattle on a practical feeding system was found in this study.

Table 2. Frequency of agonistic encounters between 0600h to 1800h during two experimental days and proportions (%) of each agonistic behavior to the total frequency.

	Pasture	Dry-lot
Total frequency	927	3,281
Bunting, %	35.9	61.3
Pushing, %	39.2	13.4
Fighting, %	9.9	11.8
Threatening and avoiding, %	15.0	13.5

A dominance rank in both grazing and dry-lot was estimated by the result of agonistic encounters in each experimental period. Those two dominance ranks on the grazing pasture and in the dry-lot seemed to be positively related to each other (Fig. 2). The obtained coefficient of correlation was $+ 0.5$ ($P < 0.01$). The dominance rank in this group was not essentially different between situations on the grazing pasture and in the dry-lot. Fig. 2 also shows that high rank animals and low rank animals did not change their ranks so much, while some middle rank animals largely changed their ranks. Social positions of the middle rank animals were changeable even in the same situation (HOOK *et al.*, 1965). The highest and lowest animals always win or

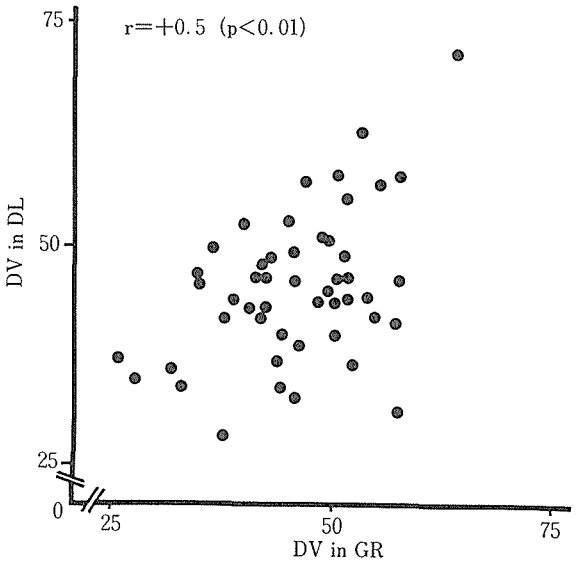

Fig. 2 Correlation between dominance values (DV) in the grazing (GR) and dry-lot (DL).
DV=arc sin($\sqrt{\text{number of encounter won/total encounters}}$)

loss in every encounters, but results of encounters of middle rank animals are depended on whether they encounter more dominant animals or subordinate.

The group in this study included different breeds and sexes. The effect of the breed and sex on spatial and social behavior in this group was reported by our previous study (KONDO, *et al.*, 1987), which showed spatial pattern was not differ to each breed and sex, and differences of body weight between breeds and between sexes influenced on the dominance rank in this group.

Daily weight gain during one week before experiment on the grazing pasture was 1.1 kg, while daily weight gain in dry-lot during 10 days from the beginning of keeping cattle in dry-lot to the experiment was 1.1 kg. An aggressive condition in the dry-lot did not inhibit their weight gains. In reduced lot space, calves changed their spatial and social behavior to adapt to high density conditions, and their weight gain were affected by the high density (KONDO *et al.*, 1984). In this study, cattle were able to adapt behaviorally to the high density condition in the dry-lot, and concentrate supplementation resulted in good weight gains.

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放牧飼養時およびDry-lot飼養時の肉用牛群の空間行動および社会行動

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粗飼料を主体として育成肥育されている肉用牛群47頭について，夏季の放牧時および冬季のdry-lot飼養時の空間行動および社会行動を比較検討した。供試牛群は前年春生まれのヘレフォード種去勢牛18頭，同雌牛20頭およびホルスタイン種去勢牛9頭であり，放牧時における観察は8月下旬に42,000㎡の放牧地で，dry-lotでの観察は11月下旬に725㎡のdry-lotでそれぞれ2日間行った。各観察期間中，夜間に牛が横臥した位置を，放牧地ではtransitにより極座標として求め，dry-lotではlot床面を1.8m四方に区画してXY座標として記録した。各個体の位置から群内の平均個体間距離（ID）および平均最近接個体間距離（rA）を算出した。また，それぞれ6時から18時に観察された敵対行動をbunting，pushing，fightingおよびthreatening and avoidingに分けて2日間記録した。

IDは放牧時の48.9mに対して，dry-lot飼養時には12.0mとなり，rAはそれぞれ4.5mおよび1.0mと約¼となった。rAとその期待値の比Rは放牧時には0.32，dry-lot飼養時には0.54でどちらも1％水準で有意な集合性の分布を示したが，dry-lot飼養時に相対的に分散傾向があることが示唆された。敵対行動の2日間の頻度は放牧時が927回であるのに対してdry-lot飼養時は3281回と著しく増大した。また，放牧時にはbuntingが敵対行動の35.9％であったものが，dry-lot飼養時には61.3％を占め，物理的敵対行動が増加した。敵対行動の勝率から算出した群内の優劣順位は放牧時とdry-lot飼養時で1％の有意な正の相関（$r=+0.5$, $P<0.01$）を示し，飼養環境が変っても順位は基本的に変化しないことを示唆した。

キーワード，肉用牛群，空間行動，社会行動，放牧，dry-lot飼養