RUAKURA STUDIES ON THE GRAZING BEHAVIOUR OF DAIRY CATTLE

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At the outset it must be made clear that this paper is largely based on John Hancock's extensive grazing behaviour studies at Ruakura. More recently I have had the opportunity of carrying out further observations on grazing cattle. A brief review of these, of Hancock's earlier work, and a number of related overseas reports form the basis of this paper.

A characteristic feature of the New Zealand pastoral farming system is that within a herd all cattle have the same opportunity of eating to capacity irrespective of their productive level or actual nutritional requirements, even though these may differ markedly. Further common features include the rapid manner in which pasture quality and quantity may vary from season to season, and the extent to which these changes may be modified by pasture management practices. -Under such conditions it is of considerable interest, not only to record changes in the environmental conditions imposed on cattle and their consequent production, but also to indicate their reaction to these varying conditions.

An animal behaviour pattern of any nature is intelligible only when considered in relation to a "normal" pattern for the expression of a character under study, thus to interpret the grazing pattern of New Zealand dairy cattle some knowledge must first be obtained of the "normal" pattern and the common causes of deviations from it. The determination of this basic pattern was the first task that Hancock tackled. Thereafter, successive grazing behaviour projects aimed at clarifying the role of particular environmental and animal factors.

The recording system used at Ruakura is such that various activities arerecorded approximately once every minute during daylight and once or twice in every five minutes during darkness, depending on the

number of 'cows, size of paddock and type of night. Observations are made continuously for 24 hours on pre-determined days, irrespective of weather conditions. The behaviour of each animal is recorded separately, whilst identical twin cattle are used in the majority of projects. Of the activities recorded to date, grazing and rumination times and rates are the most important and only these will be considered. in this paper:

THE "NORMAL" GRAZING PATTERN

New Zealand dairy cattle tend to exhibit a cyclic pattern of behaviour. There are normally some four major periods of grazing occupying a total of some seven to eight hours, a similar period of rumination ; the remainder of the day being spent idling or resting.

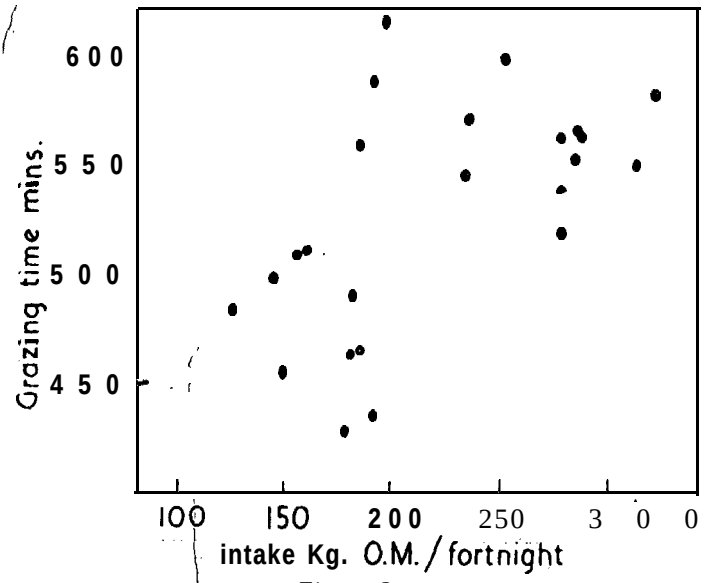

Figure 2.

The distributioh of these periods largely depends upon the time of milking and the time of sunrise and sunset. Usually the ratio of day to night grazing time is of the order of 60:40, whereas the actual time available for grazing is of the order of 40:60. A period of maximum grazing activity follows each milking, while the rate of grazing, i.e. bites per minute, declines as grazing time proceeds. In the course of 24 hours, each cow will take some 24,000 bites at an average rate of about 50 per minute. About 350 cuds will be regurgitated and each chewed for approximately 48 bites, thus total-

ling some 17,000 rumination bites. Each cow will defaecate some. 12 times, urinate ten times and drink water three. or four" times as well 'as' walking some 3,000' yards plus: the distance to and from-the shed. All in all, the cow will-work for 13 to 14 hours a day. Little wonder then that an animal deriving its total diet from pasture has a high maintenance requirement. Attempts to calculate this grazing cost have been made in the past but, because of the complexity of the problem involved, direct experimentation appears to, offer the only reasonable approach. Experiments aimed at this problem are being carried out at Ruakura at the moment for it is obviously a problem of the greatest importance and one where grazing behaviour studies may .yet contribute appreciably.

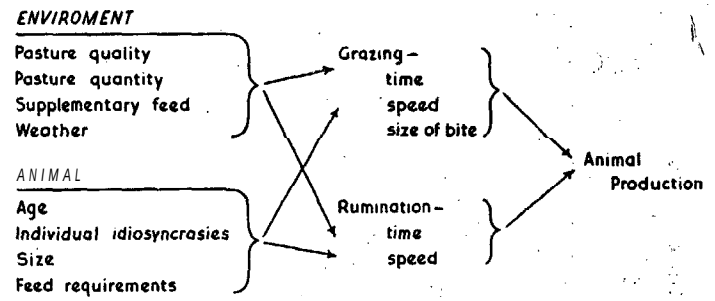

Figure 1.

Though the pattern outlined above may be considered typical of the behaviour 'of New Zealand dairy cattle, it may be markedly modified, by changing environmental and animal factors. In Fig. 1 causal relationships between animal production, grazing pattern and major environmental and animal variables are depicted.

ENVIRONMENTAL FACTORS AND THE GRAZING PATTERN

The role of pasture quality and quantity in causing variations in grazing behaviour was recently reviewed by Hancock, and the position summarised as shown in Table 1.

TABLE 1

Quantity	Quality	Grazing time	Rumination time
High	Good....	Intermediate	Short
	Mixed	Long	Long
	Poor	Short	Long
Low	Good	Long	Short
	Mixed	Long	Intermediate
	Poor	Long	Intermediate

Good pasture refers to uniform. herbage of low fibre content ; mixed:. pasture to. herbage of varying fibre content ; and- poor pasture. to herbage of evenly high fibre content.

Supplementary feeding. is capable of 'modifying the. grazing and rumination pattern to an- appreciable degree. Thus, in one particular trial, the feeding of concentrates at the rate of, one lb. to each five lb. of milk produced lowered the grazing times by approximately 10 per cent. in comparison with cows fed on pasture alone, whilst a recent report from Scotland indicates that the foraging capacity of hill country sheep was appreciably reduced by offering them supplementary fodder. 'As a result of observations 'such as these the poor. response frequently resulting> from supplementary feeding may be better understood.

--Variations in pasture. and animal management are capable of eliciting a measurable response. In. this field it is important to distinguish between the usual influence of the management system upon pasture quality and quantity and the direct influence upon the animal's behaviour. Of interest in this regard is the observation that the strip-grazing of dairy cattle may appreciably delay the morning grazing, the animals waiting for a fresh strip of grass to be provided. A similar- situation. has been found to apply with steers as well. A year or two back, in an attempt to control bloat,' Hancock divided the daily pasture allowance of a group of lactating twins into five separately given portions. The ensuing grazing cycles were more intensive but of shorter duration than in the control group, which received the daily allocation in one piece. Bloat was not appreciably controlled, however.

In temperate climates the influence of weather does not appear to be marked. Temperatures usually encountered in such areas have little effect on the time spent in grazing. On the hottest days, however, grazing begins earlier, and is reduced during the heat of the day ; loafing time and distance walked tends to increase somewhat. Cold windy weather, with frequent heavy showers, tends to shorten grazing times, as the cattle usually shelter while heavy rains fall. However, they may generally make up such lost grazing time by expanding grazing time in the subsequent day or days.

ANIMAL FACTORS VARYING THE GRAZING PATTERN

Major variables contributed by the grazing animal may be summarised under the headings of age, individuality, size and feed requirement.

Calves reared on grass from birth commence nibbling within the first week and start ruminating in about three weeks. They soon establish a cyclic pattern of behaviour and react to changes in pasture quantity and quality in a manner similar to that of mature animals. As growing animals their grazing behaviour pattern resembles that of the adult animal and is 'subject to similar modifying forces.

The ***use*** of identical twin animals in grazing' behaviour studies has enabled an estimate to be made of the extent to which grazing and ruminating times are influenced by the individuality of an animal. Data -from a number of uniformity and split twin trials indicates that inherent specific idiosyncracies are most important in determining an animal's grazing pattern. Rumination times are likewise subject to control by the animal's inherent individuality. Unfortunately the physiological mechanism underlying these individual patterns is not clear, though, in the case of grazing time, the size of bite and the frequency of biting, i.e. selectivity, undoubtedly play a part. There appears to be no obvious factor determining inherent rumination time, although this is. modified by the level of intake and the quality of the feed consumed. Recently the grazing behaviour of Jersey and Friesian cows running together in the same herd was observed and the

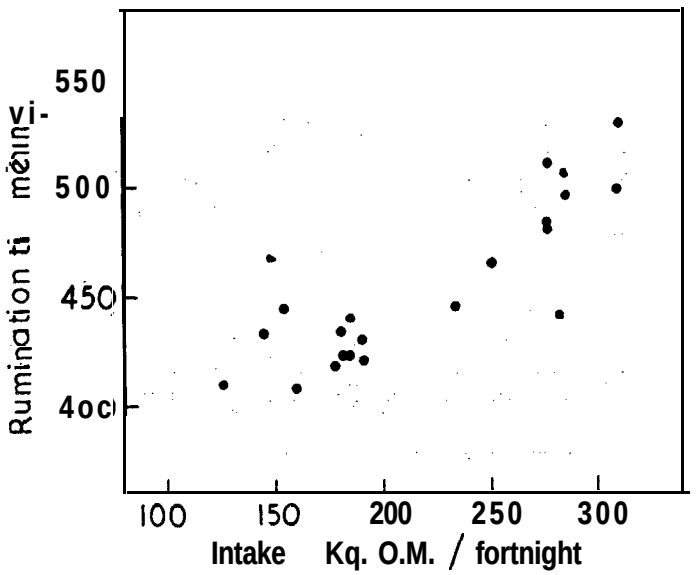

Figure 3.

results obtained have helped to clarify the way in which the breed and size of an animal is related to its grazing pattern. A summary of this situation is depicted in Table 2.

TABLE 2

JERSEY-FRIESIAN COMPARISON

	Fat Corrected Milk (lb.)	Grazing Time (Mins.)	Rumination Time (Mins.	Liveweight (lb.)	Intake Kg. Organic Matter Per Fortnight
Period 1: October					
Jersey	462	485	339	860	174
Friesian.	485	482	385	1,100	194
Periud 2: December:					
Jersey	355	544	448	937	205
Friesian	352	543	468	1,109	245
Period 3: February					
Jersey	277	512	480	888	184
Friesian	283	519	459	1,064	193
Period 4: April					
Jersey	165	493	197	883	136
Friesian	161	499	227	1,202	172

The figures presented in Table 2 reflect the mean performance of five animals observed at four different stages of lactation; the actual animals involved varying from one period to the next. From this data it 'is apparent that animals of equal milk-producing ability, but different in size and breed, graze and ruminate for similar periods of time.

By observing a number of cattle whose intakes were being measured it has been possible to assess the relationsh-ip between grazing.behaviour and actual feed intake. This has now been. done on a number of occasions. Figs. 2 and 3 show typical results. Though it is apparent that there is a relationship betwsen grazing-time and cudding time, the marked variability present makes it very doubtful if the relationship is of any value as a means of estimating intake.

The role of individual selectivity in regard to an animal's grazing pattern is a difficult problem to sort

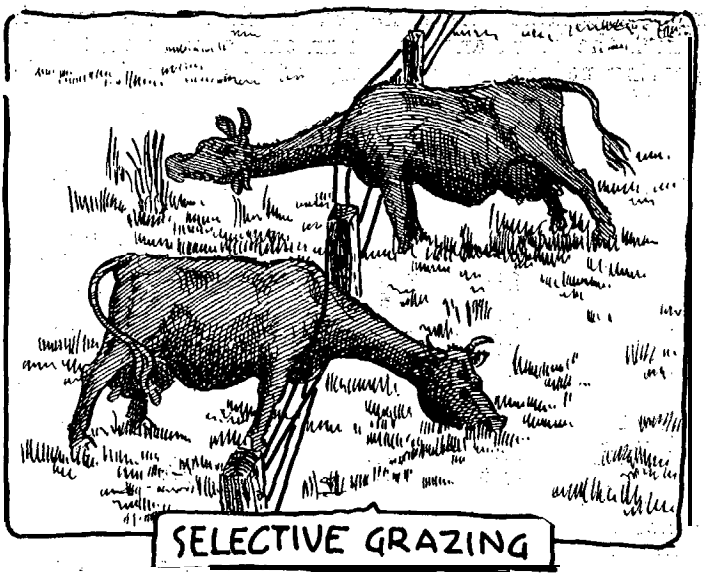

Figure 4.

out. Fig. 4 depicts a situation that is all too commonly encountered.

However, in spite of the expression of this universal failing, certain measurements of the importance of selectivity have been made.' From the summary of data that was presented in Table 1 it is apparent that within defined limits grazing time lengthens as pasture quality, but not quantity,; deteriorates ; a reasonable, conclusion of this observation being that the degree of selection practised by the grazing animal has increased.

A comparison of the grazing and rumination rates in twins leads to the conclusion that individuality is a most important 'factor in the problem of selectivity. From such data, it is also interesting to note that the slowest grazing animals have the highest ruminating rate, indeed. it would appear that. the slower grazers select rather- less fibrous feed and, in. consequence, rumination 'is somewhat easier. and.- thus faster. The fact that -grazing calves,. though very slow and selective grazers, ruminate at-a fast rate ,reinforces such an idea.

The problem of selective grazing in a normal mixed pasture is very real when attempts are made to assess the digestibility and nutrient contents of a sward of grass, for the. error introduced by estimating digesti-

bility and chemical composition of plucked or mown pasture. samples.-may be very real. The role of. selective grazing in problems of this: nature may be measured by comparing the feed digestibility and chemical composition of the faeces of animals grazing a pasture to the composition of the faeces of animals. fed mown or plucked grass from the same sward. By the use of such a comparison recent results indicate that the diet selected by grazing steers was actually higher in protein and lower in crude fibre than the whole herbage available for consumption, but that selectivity tended to be reduced by restriction of the grazing areas.

Though there is little knowledge of the relationship between animal food preferences and the chemical composition of the herbage grazed nevertheless this is a problem about which many strong opinions are held. Thus, it is commonly stated- that the nutritional wisdom of the grazing animal alters its. grazing pattern and, in consequence, a study of this grazing pattern is a measure of the nutritive status of the herbage available. If animals are observed eating weeds, bark or earth, it follows that these should be provided as part of the regular diet. However, as such' a system of management obviously reduces the dry matter output of pasture land, reasonable 'justification is required before general acceptance of such a system is forthcoming.

The crux of the problem centres about the idea that grazing animals select their diet in accordance with their nutritional needs.

The. only reasonable evidence I am aware' of on this question and relating to cattle and sheep is a recent paper from Scotland in which the authors describe how pregnant ewes fed indoors were offered a selection of carbohydrate, protein, hay, minerals' and water. Throughout pregnancy the voluntary intake of all animals fell whilst the diet selected was such that lambing. was spectacularly unsuccessful. The problem is probably best summed up by classifying appetite into three categories :

1. True hunger;
2. Trivial preference; and
3. Learned hunger.

Through. trial and error some animals 'undoubtedly learn what is good for them, and what 'is bad for

them. However, as behaviour is certainly not infallible in regard to indicating nutritive status, it would be most unwise to base 'a management system solely on apparent animal preferences.

GRAZING OBSERVATIONS AND THEIR INTERPRETATION

At this stage it is reasonable to ask "Of. what value, in terms of gaining greater understanding of the pasture animal complex, have been the observations briefly summarised in this paper?"

As far as the actual technique of accurately observing grazing behaviour is concerned, we may now plan trials such that the number of animals required and the frequency of observation, may be predicted with reasonable hope of detecting a difference of any given size. As with production -trials the appreciable superiority of twin animals for this purpose is now established.

Of the results it may be stated: "The concept that the grazing behaviour of a cow reflects both her comfort and well being as well as her ability to produce to maximum capacity, and thus provides a measure of the success of different. management practices, is no longer tenable. Rather, it is clear that the grazing behaviour of a cow is most flexible and may vary markedly in accordance with her requirements and with the. amount and quality of pasture available.

Because of this marked adaptability, grazing behaviour studies alone are rarely sufficient to enable the relative efficiency of various management practices to be accurately evaluated. Output of animal production per unit of input provides the only true criterion of the value of any management system. Hence, feed intake data are frequently essential to a sound interpretation of results whilst grazing behaviour studies may be most valuable in explaining variations in feed intake that might otherwise appear mysterious."

DISCUSSION

Q. (Homersham) : Could the speaker elaborate on the drinking behaviour of cows. How often do they drink and how much ? The knowledge of this could affect water reticulation. Is it enough to offer them water twice a day in the milking shed or is it necessary to provide water in the paddock?

A. Cows may drink from 3 times to up to 12 times a day. There is marked variation. In summer they drink more frequently than in spring and winter. Cattle are flexible in requirements. The fact that a cow drinks 6 times a day does not mean that. she needs it more than twice a day.

Prof. Campbell: At Massey College the water consumption of 32 cows was measured. The, cows were reasonably well

fed and on high producing pastures. A.M. and P.M. intake varied. They drank from 3 gallons to 11 gallons a day. There is little information on how often a cow needs a drink. On certain occasions, when pastures are lush and wet from rain cows produce equally well whether they can obtain water ad lib or whether they are restricted to milking time.

J. Pollock: I should like to protest against such terms as "pasture-grazing animal complex." Why not say the relationship between the pasture and the grazing animal ?

Q. (Homersham) : Could an animal be restricted so much in selection by electric fencing that it affects its production?

A. (Dr. Filmer): Yes. selectivity could reduce production. In one case hoggets in Poverty Ray found kale so unpalatable that they kept to twitch grasses and lost weight, although kale was known to be capable of producing &lb. per day weight gain.

Q. Has any work been done on quality of drinking water? Could quality affect production?

A. I have no knowledge on this point.

Q. Can one spoil cows by providing regularly palatable feed, and once spoilt would they be difficult about accepting less palatable feed ?

A. Yes, the regular provision of supplementary feed may inhibit forage capacity. When supplementary feed is withdrawn the animals may not be prepared to forage as well as their needs demand. Animals will again become accustomed to work for their feed but the degree and speed of adjustment varies markedly with the individual.

Q. (Dr. Melville) : Has Ruakura shown preference by cattle for different pasture species ?

A. There is not much information about this at Ruakura. While doing work on bloat it was found that some animals seek out clover much more than other animals.