Is the welfare of dairy cows at risk from current farm practices?

A.L. HARGREAVES, L.R. MATTHEWS, G.A. VERKERK[1]

Animal Behaviour and Welfare Research Centre, Ruakura Agricultural Centre,
Private Bag 3123, Hamilton, New Zealand.

ABSTRACT

New Zealand dairy systems are characterised by extensively-managed outdoor herds which calve in spring. Such systems allow cattle to perform a wider range of normal behaviours than is possible in more intensive conditions. However, there are aspects of extensive management which may compromise the welfare of dairy cattle. These include practices which are intrinsic to the management system and strategic interventions. This paper will discuss some of the issues pertaining to the welfare of dairy cattle, the methods by which welfare is assessed and attitudes within the local and international community regarding the management of dairy cattle in New Zealand.

Keywords: dairy cattle, welfare, management.

INTRODUCTION

The welfare of animals affects the productivity, the efficiency and the image of the industry with which they are associated. To achieve the best production and highest returns, and to maintain the NZ dairy industry's image of quality and innovation, systems of dairy management must take into account issues of animal welfare. Of primary importance is the wellbeing of animals within the industry, and how best to evaluate their welfare in scientific and ethical terms. However, consideration should also be given to consumer perceptions about the welfare of animals within the NZ dairy industry.

ASSESSING WELFARE

In its broadest sense, welfare refers to the biological fitness of an individual (Mendl, 1991). It is difficult to measure such a comprehensive characteristic as fitness, therefore a stress response is often used to gauge whether an animal's welfare is compromised. A stress response is the neuroendocrine, autonomic or behavioural response to any stimulus which threatens an animal's homeostasis. Stress is largely adaptive. However, if the animal fails to adapt, its health, productivity or fertility may suffer. These consequences may be preceded by a "pre-pathological state" (Moberg, 1987) when the animal is predisposed to the more severe consequences of stress although they are not necessarily manifested in depressed production, health or fertility.

The response to a stressor depends on the characteristics of the animal and stimulus in question. Many management procedures have been shown to result in a stress response (Lay *et al.*, 1992) and to affect the reproductive or immune system of cattle (Nanda *et al.*, 1989; Arave *et al.*, 1974) or to decrease milk production (Varner *et al.*, 1983). The effects of stress have also been modelled by the use of exogenous ACTH (Varner and Johnson, 1983).

A particular stressor does not always elicit the same magnitude of stress response, nor does a certain response always affect production, reproduction or immunity (Henke Drenkard *et al.*, 1985; Fox *et al.*, 1981). Characteristics of the animal (age, experience and genotype) or the stressor (the type or timing) can influence the perception of, or the response to, the stimulus. Perception is central to the issue of animal welfare, and our only measure of perception is the response of the animal. To ensure that assessments of animal welfare are valid, differences in the capacity to show a stress response should not be confused with differences in perception.

MANAGEMENT PRACTICES IN NZ

Management practices can be categorized according to how they impinge on the animals and their environment and include: physical environment (climate, topography of farms, space allowance, walking distances, design of races, yards and shed); nutritional environment (quantity, quality and accessibility of feed); social environment (size, density and mix of herd, position of individuals in the social hierarchy); interaction with other species (nature of interactions, use of dogs, frequency of interactions); handling experience (predictability or novelty of stimuli).

Another way of classifying management practices in the dairy industry is according to how they are incorporated into the total management system.

(1) Long–term management factors
Factors which operate over the long term and are basic characteristics of the production system: climate, geography, grazing management (herd size, stocking rate, feeding levels), system of calf rearing, human expertise (both in herd management and in handling stock).

(2) Interventions
These operate over a shorter time and are undertaken to (a) sustain or improve production (preventative medi-

[1] Dairying Research Centre, Ruakura Agricultural Centre, Private Bag 3123, Hamilton, New Zealand.

cine, induced calving) or (b) improve the efficiency of herd management (disbudding/dehorning, branding, tail docking, castration).

(3) Off–farm procedures
Enterprises such as the trade in bobby calves which are inevitably allied to the dairy industry although may extend beyond the on-farm treatment of cows.

Our recent research evaluating animal welfare has focused on several of the practices routinely carried out in the NZ dairy industry and which represent these three categories.

(1) Social Stress

The management of a grazing herd is intricately interwoven with the social behaviour of cattle. The implications for production of factors such as herd size, composition (mix of ages and breeds, familiarity), stocking density and grazing management are all mediated by the animal's social behaviour. Within these parameters, attributes of the individual (age, size, presence of horns) are important insofar as they determine the position of the animal within the group hierarchy.

NZ's dairy herds are amongst the largest in the world and the proportion of herds with more than 300 cows has risen more than four-fold in the last 10 years. The average herd size is 170 cows. Our knowledge of the social behaviour of dairy cows is based on groups considerably smaller than this. It is unlikely that cows can remember and recognise more than about 100 others (Albright, 1978). Beyond this limit of recognition agonistic behaviour within the herd increases as violations of the social hierarchy become more frequent. Frequent agonistic interactions and the inability to maintain personal space are both potentially stressful (O'Connell *et al.*, 1989). Even in smaller herds, the frequency of agonistic encounters increases with group size (Kondo *et al.*, 1989). Subgroups, which contribute to social harmony, are known to form in large herds of rangeland cattle (Albright, 1978) but in dairy herds these may be destabilized by the twice-daily milking routine (Czakó, 1983).

Another feature of NZ dairy herds is that although they are managed extensively, the grazing systems are relatively intensive. The higher the density of the group, the greater the likelihood that a cow's personal space will be invaded, resulting in an agonistic encounter. Avoiding agonistic interactions (Stakelum *et al.*, 1987) may compromise other maintenance behaviours such as grazing, ruminating and resting.

A third source of social stress in dairy cattle arises from the mixing of animals of different origins, ages or experience. The acute effects of frequent physical interactions abate within about 48 hours of mixing (Kondo and Hurnik, 1990). However the behavioural adaptations to the new social environment, including re-apportioning grazing time, may persist. Heifers entering the herd are especially vulnerable because in addition to being unfamiliar to the rest of the herd they are smaller and younger, so likely to be lower in the hierarchy (Stakelum *et al.*, 1987) and enter as a minority group (Albright, 1978). Heifers introduced to the herd in winter may be confronted with more crowded conditions (break grazing) and a more competitive environment (supplementary feeding and a limited supply of pasture) than prevail at other times of the year.

As part of a study of social behaviour and welfare, social behaviour in two dry Friesian herds were observed at Ruakura, for four weeks beginning one week after heifers were introduced (Hargreaves and Matthews, unpublished data). The herds were run at 3.02 cows/ha and 3.98 cows/ha and under the break grazing regime this allowed each cow 30.7m^2 and 23.3m^2, respectively. At the lower stocking rate, heifers won more of their agonistic encounters with cows than did heifers in the other herd, suggesting that there was less of a disparity between the dominance ranks of heifers and cows in the smaller/less dense group. Grooming (an affiliative behaviour) was more frequent amongst heifers at the lower stocking rate, indicating more social stability in the less crowded group (Sato *et al.*, 1991). Delaying the introduction of heifers to the herd until after calving may just delay the effects of mixing until a time when heifers also have to adapt to the routine of milking (Thomson *et al.*, 1991). The high incidence of aberrant oestrous cycles in three-year-old cows and in large herds may be indicative of social stress (Macmillan and Watson, 1971). The recent tendency towards higher body weight targets in heifers may better equip them to withstand these stressors.

(2) Induced calving

Induction of parturition in dairy cows is a common management technique used by New Zealand dairy farmers. The practice is used to increase the proportion of cows calving within a six week period which will allow the production peak of the herd to coincide with the period of peak pasture growth. A small proportion of many herds fail to conceive within the six week "window" (Macmillan and Asher, 1990) and hence are induced to calve prematurely during the following spring. Inductions may be either "early" (during the first three weeks of calving, with calves being 1-3 months premature and nonviable) or "late" (at the end of calving, with calves being from 2-6 weeks premature, and a proportion capable of being reared).

Induction of parturition is done under the direct supervision of registered veterinarians. A variety of drug combinations are used, most commonly a long-acting glucocorticoid followed 8-14 days later by a parturition 'trigger' of either a prostaglandin F2α or a short-acting glucocorticoid. The decision to induce parturition is based on the age, health and condition of the cow and the availability of feed.

Welfare issues concerning both the cow and the calf may arise from the practice of inducing parturition. In cows, there is an increased incidence of retained afterbirth which can lead to uterine infection and delayed uterine involution (MacDiarmid, 1979; Macmillan *et al.*, 1987). Immune suppression due to glucocorticoid treatment may increase susceptibility to infection, eg. mastitis (MacDiarmid, 1979), and an attenuated cortisol response for approximately forty days following first injection (G. Verkerk, unpublished data.). This may result in these animals having an impaired mechanism for the normalisation of stress responses (Harbuz and Lightman, 1992). Routine veterinary examination and treatment provides protection for the health of induced cows.

Calves resulting from induced parturition may be born alive but be too premature to survive. For calves born more than three weeks premature survival is 50% or less. Farmers must be able to make a judgement regarding likelihood of survival. If the calves are judged not viable, humane euthanasia must be carried out. Calves selected for rearing have increased requirements due to their prematurity. There is an increased risk of hypothermia and consideration should be given to provision of shelter, covers and/or external heat sources. Colostrum from induced cows often contains insufficient immunoglobulin to provide adequate passive immunity (Field *et al.*, 1989). Colostrum from normally calving cows should be provided during the first 12-24 hours of life.

Bunny (1993) reports that approximately 30% of induced calves have been sent to slaughter as bobbies. There is now a minimum weight requirement for bobby calves which means that induced calves have to be kept on farms for longer periods prior to slaughter. Thus, rearing practices assume greater importance.

(3) Tail docking

Although tail docking is not central to dairy productivity it is practised in a majority of NZ dairy herds to facilitate ease of management during milking. Stafford and Mellor (1993) discuss the procedures for on-farm tissue removal in some detail. These procedures can also have long-term implications for the animal's welfare if they alter the ability or motivation of animals to perform certain behaviours.

In order to avoid insect pests cattle perform behaviours which are specific to the species and abundance of the pest. As the abundance of stable files increases, cattle flick their tails, twitch their skin, stamp their forelegs and turn their heads. In a study of dairy heifers and the stable fly *Stomoxys calcitrans*, Phipps and Matthews (unpublished data), found that over the summer months, docked heifers performed fly-avoidance behaviours more frequently than did heifers with tails. In addition, a higher proportion of the behaviours performed by docked animals were energetically costly (foot-stamps, head turns). Under some circumstances cattle are unaffected by insect pests, provided they can perform the appropriate avoidance behaviours (Schmidtman and Valla, 1982). However, there are reports of milk production being depressed and grazing behaviour disrupted when insect pests are abundant (Bruce and Decker, 1958; Dougherty *et al.*, 1993). Although in the Ruakura study the fly avoidance behaviours of heifers without tails were more pronounced, they were ineffective, as flies were more abundant on these animals. Thus, at least in their first summer after docking, the heifers had not adapted to being without a tail. The Ruakura data suggest that docking exposes cows to both the direct energetic cost of fly intensity and the indirect cost of fly avoidance behaviour (Wieman *et al.*, 1988).

(4) Transporting bobby calves

The treatment of calves reflects on the welfare image of the dairy industry because of the large numbers of calves produced and their integral role in the production cycle.

In NZ calves are transported and processed at somewhat younger ages (a minimum of 4 days) than is usual in many countries with which NZ trades. There are indications that the response of young calves to the psychological stressors of transport is no greater than that of older animals (Kent and Ewbank, 1983; 1986a; 1986b), although it is difficult to compare stress responses of animals at different stages of maturity, and much of the intensive research has involved gentler methods of transportation than prevail under commercial conditions. However, younger calves may be more vulnerable to the physical demands encountered during transport. These demands include cold (Gonzalez-Jiminez and Blaxter, 1962), fasting, and the muscular exertion needed to maintain their footing during travel (Atkinson, 1992). The high mortality of calves within several weeks of being transported to rearing facilities (Staples and Haugse, 1974) and the inverse relationship between age and mortality in calves transported before 1 week of age (Barnes *et al.*, 1975) indicate that the transportation process is taxing for calves. These deaths can perhaps be explained by the impaired immune response recorded by Kelley *et al.*, (1981) after transport. Although in NZ calves are slaughtered before such extreme effects can develop, they nevertheless incur the same stressors which can predispose calves to such ill health.

Research by Bremner *et al.* (1992) reported a high risk of physical trauma (falling) in bobby calves during unloading. As the steepness of the unloading ramp increased and the process became more physically challenging, the incidence of such trauma also increased. Young calves may cope better with the rigours of transport if the handling method and facilities take into account their behavioural and metabolic limitations. The premium paid for calves of high body weight may increase the proportion of robust animals being processed, but cannot be relied on to underpin animal welfare in the industry.

MANAGEMENT PRACTICES IN THE NZ DAIRY INDUSTRY: AN OVERVIEW

The differences between NZ farming practices and those of our trading partners is the impetus for much of the current scrutiny of the local industry. In this paper we have highlighted several practices which are peculiar to NZ and which may threaten the well being of NZ dairy animals. However, in several respects NZ animals may be better off than their overseas counterparts. For example, under NZ conditions, cows do not have the spatial restrictions and intensity of social contact incurred by housed cows, nor do they have to adapt between winter housing and summer grazing. NZ cows suffer less damage to legs and udders caused by solid flooring, restricted movement and crowding. In intensive systems, calves are often removed from their dam at birth, whereas in NZ it is usual for them to suckle. There is no white veal industry in NZ and calves are group-reared. In terms of animal welfare there are likely to be relative strengths amongst our current management practices as well as weaknesses. The keys to maintaining and improving animal welfare are (1) to understand thoroughly and objectively how our management procedures impinge on animals, (2) to maintain high standards in the execution of these procedures; (3) to consider the welfare implications of

any new procedures; (4) to be receptive to alternative, less stressful or less risky procedures.

REFERENCES

Albright, J.L. 1978: Social considerations in grouping cows. In: *Large Dairy Herd Management.* Ed. G.J. Wilcox. University Florida Press, Gainsville. pp 757-779.

Arave, C.W.; Albright, J.L.; Sinclair, C.L. 1974. Behavior, milk yield and leucocytes of dairy cows in reduced space and isolation. *Journal of Dairy Science* **57**: 1497-1501.

Atkinson, P.J. 1992: Investigation of the effects of transport and lairage on hydration state and resting behaviour of calves for export. *The Veterinary Record* **130**: 413-416.

Barnes, M.A.; Carter, R.E.; Longnecker, J.V.; Riesen, J.W.; Woody, C.O. 1975: Age at transport and calf survival. *Journal of Dairy Science* **58**: 1247.

Bremner, K.J.; Matthews, L.R.; Brears, D.J.; Painting, A.M. 1992: The behaviour and welfare of calves during unloading after transportation. *Proceedings of the New Zealand Society of Animal Production* **52**: 73-75.

Bruce, W.N.; Decker, G.C. 1958: The relationship of stable fly abundance to milk production in dairy cattle. *Journal of Economic Entomology* **51**: 269-274.

Bunny, J. (1993) Induction of premature partuirition in New Zealand dairy herds. Thesis, Massey University, Palmerston North.

Czakó J. 1983: Control of large-scale dairy units from ethological view. *Proceedings V World Congress on Animal Production Vol. I*: 192-196.

Dougherty, C.T.; Knapp, F.W.; Burrus, P.B.; Willis, D.C.; Burg, J.G.; Cornelius, P.L.; Bradley, N.W. 1993: Stable flies (*Stomoxys calcitrans* L.) and the behavior of grazing beef cattle. *Applied Animal Behaviour Science* **35**: 215-233.

Field, R.W.; Bretzlaff, K.N.; Elmore, R.G.; Rupp, G.P. 1989: Effect of induction of parturition on immunoglobulin content of colostrum and calf serum. *Theriogenology* **32**: 501-506.

Fox, L.; Butler, W.R.; Everett, R.W.; Natzke, R.P. 1981: Effect of Adrenocorticotropin on milk and plasma cortisol and prolactin concentrations. *Journal of Dairy Science* **64**: 1794-1803.

Gonzalez-Jimenez, E.; Blaxter, K.L. 1962: The metabolism and thermal regulations of calves in the first month of life. *British Journal of Nutrition* **16**: 199-212.

Harbuz, M.S.; Lightman, S.L. 1992: Stress and the hypothalamo-pituitary-adrenal axis: acute, chronic and immunological activation. *Journal of Endocrinology* **134**: 327-339.

Henke Drenkard, D.V.; Gorewit, R.C.; Scott, N.R.; Sagi, R. 1985: Milk production, health, behavior and endocrine responses of cows exposed to electrical current during milking. *Journal of Dairy Science* **68**: 2694-2702.

Kelley, K.W.; Osborne, C.A.; Evermann, J.F.; Parish, S.M.; Hinrichs, D.J. 1981: Whole blood leukocyte vs separated mononuclear cell blastogenesis in calves: time-dependent changes after shipping. *Canadian Journal of Comparative Medicine* **45**: 249-258.

Kent, J.E.; Ewbank, R. 1983: The effect of road transportation on the blood constituents and behaviour of calves. I. Six months old. *British Veterinary Journal* **139**: 228-235.

Kent, J.E.; Ewbank, R. 1986a: The effect of road transportation on the blood constituents and behaviour of calves. II. One to three weeks old. *British Veterinary Journal* **142**: 131-140.

Kent, J.E.; Ewbank, R. 1986b: The effect of road transportation on the blood constituents and behaviour of calves. III. Three months old. *British Veterinary Journal* **142**: 326-335.

Kondo, S.; Hurnik, J.F. 1990: Stabilization of social hierarchy in dairy cows. *Applied Animal Behaviour Science* **27**: 287-297.

Kondo, S.; Sekine, J.; Okubo, M.; Asahida, Y. 1989: the effect of group size and space allowance on the agonistic and spacing behaviour of cattle. *Applied Animal Behaviour Science* **24**: 127-135.

Lay, D.C.; Friend, T.H.; Grissom, K.K.; Bowers, C.L.; Mal, M.E. 1992: Effects of freeze or hot-iron branding of Angus calves on some physiological and behavioral indicators of stress. *Applied Animal Behaviour Science* **33**: 137-147.

MacDiarmid, S.C. 1979: Betamethasone alcohol suspensions for the induction of parturitionä in dairy cows: a comparison with dexamethasone trimethyl acetate. *New Zealand Veterinary Journal* **27**: 86-89.

Macmillan, K.L.; Asher, G.W. 1990: Developments in artificial insemination and controlled breeding in dairy cattle and deer in New Zealand. *Proceedings of the New Zealand Societyä of Animal Production* **50**: 123-133.

Macmillan, K.L.; Day, A.M.; Taufa, V.K.; Henderson, H.V.; Allison, P.A. 1987: Some effects of injecting a prostaglandin F2a (Lutalyse) during the post-partum period on the subsequent fertility of dairy cows. *Proceedings of the New Zealand Society of Animal Production* **47**: 65-68.

Macmillan, K.L.; Watson, J.D. 1971: Short estrous cycles in New Zealand dairy cattle. *Journal of Dairy Science* **54**: 1526-1529.

Mendl, M. 1991: Some problems with the concept of a cut-off point for determining whenä an animal's welfare is at risk. *Applied Animal Behaviour Science* **31**: 139-146.

Moberg, G.P. 1987: A model for assessing the impact of behavioural stress on domestic animals. *Journal of Animal Science* **65**: 1228-1235.

Nanda, A.S.; Ward, W.R.; Dobson, H. 1989: Effects of naloxone on the oestradiol-induced LH surge and cortisol release in transported cows. *Journal of Reproduction and Fertility* **87**: 803-807.

O'Connell, J.; Giller, P.S.; Meaney, W. 1989: A comparison of dairy behavioural patterns at pasture and during confinement. *Irish Journal of Agricultural Research* **28**: 65-72.

Sato, S.; Sako, S.; Maeda, A. 1991: Social licking patterns in cattle (*Bos taurus*): influenceä of environmental and social factors. *Applied Animal Behaviour Science* **32**: 3-12.

Schmidtmann, E.T.; Valla, M.E. 1982: Face-fly pest intensity, fly-avoidance behaviour (bunching) and grazing time in holstein heifers. *Applied Animal Ethology* **8**: 429-438.

Stakelum, G.; Lievense, P.; Gleeson, P.A. 1987: The relationship between the social dominance of cows in a grazing herd and their milk production, herbage intake and grazing behaviour. *Irish Journal of Agricultural Research* **26**: 231-235.

Stafford, K.J.; Mellor, D.J. 1993: Castration, tail docking and dehorning - What are the constraints? *New Zealand Society of Animal Production, this volume.*

Staples, G.E.; Haugse, C.N. 1974: Losses in young calves after transportation. *British Veterinary Journal* **130**: 374-379.

Thomson, N.A.; Barnes, M.L.; Prestidge, R. 1991: The effect of cow age and managementä of winter liveweight gain, liveweight at calving and subsequent effects on dairy productionä in a seasonal supply herd. *Proceedings of the New Zealand Society of Animal Production* **51**: 277-282.

Varner, M.A.; Johnson, B.H. 1983: Influence of adrenocorticotropin upon milk production, milk constituents, and endocrine measures of dairy cows. *Journal of Dairy Science* **66**: 458-465.

Varner, M.A.; Johnson, B.H.; Britt, J.H.; McDaniel, B.T.; Mochric, R.D. 1983: Influence of herd relocation upon production and endocrine traits of dairy cows. *Journal of Dairy Science* **66**: 466-474.

Wieman, G.A.; DeShazer, J.A.; Campbell, J.B. 1988: Performance and behaviour responsesä of beef cattle to stable flies in warm environments. Livestock Environment III. Proceedings of the third International Livestock Environment Symposium. Toronto. pp315-321.