Cattle Behavior and Implications to Performance and Health

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Bovine Hierarchy and Herd Structure

Cattle evolved as plain-grazing herbivores gathering together into herds to aid in the defense against predators. In non-domesticated species, matriarchal social groups of mothers and offspring exist separately from groups of male animals in various stages of maturity. The size of the group varies depending on the availability of basic resources such as food supply and access to mates for reproduction.

Domestication, selection and controlled breeding over many hundreds of generations has modified and suppressed many “wild type” behaviors, particularly those that are incompatible with more intensive modern farm management conditions. However, it is vital that the fundamental behavioral characteristics which modern cattle retain based on their evolutionary history, are considered if we are to maximize performance and health in herds of domestic cows.

Cattle are highly social herd animals and engage in complex interactions to communicate dominance, subordination and peer bonding within the group. Herds have a strict (predominantly) linear hierarchical structure with the most dominant animal at the top and the most subordinate animal at the bottom. Social rank is largely predicted by age and body weight / size. Older animals have more experience and are thus better placed to compete and larger animals are more capable of physically domineering their smaller herd mates.

When individuals first meet they “fight” to establish rank. Once hierarchical structure within a group is established, negative interactions become less common except when animals compete for a limited resource e.g. access to feed, preferred lying areas, access to the milking parlour etc, or when closely ranked animals seek to re-establish or alter the dominance order. For example, KetelaardeLauwere et al. (1996) demonstrated that cows of higher dominance entered an automatic milking system more often without waiting and spent less time in the waiting area. Overt aggression between animals of very different hierarchical rank within an established herd is uncommon because dominant animals assert control using small and often very subtle indicators e.g. a small toss of the head, and / or because subordinate animals identify and acknowledge the more dominant individual by seeding control of the limited resource or by moving away.

Performance of the High Yielding Dairy Cow

The modern dairy cow faces “stress” from many sources including the environment, disease and particularly the “metabolic load" created by high yields. A dairy cow, giving 30Kg of milk per day is performing at well over three times her

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maintenance requirements for energy; it is nearly five times maintenance requirements for a high yielding animal giving 50Kg per day. To contextualize these levels of “metabolic load”, cyclists competing in the Tour de France work at approximately 2.7 times their maintenance requirements during the race and polar explorers dragging sleds in arctic conditions operate at up to 3.4 times their daily requirements for energy. Thus the metabolic performance of the high yielding cow is far higher than any examples from Man.

These levels of performance place high yielding cows on a “knife edge”. If high yields are to be maintained without compromising health and welfare, management must be optimized to ensure the physical and behavioral requirements of the animals are met.

The Affects of Social Hierarchy on Food Intake

If dry matter intake and thus yield is to be maximized across the whole herd it is important that the impacts of social hierarchy are considered at the farm level. It does not matter how carefully formulated a diet is or what dry matter intake predictions have been calculated if other external factors reduce the intakes which animals actually achieve.

When individuals enter or re-enter an established group they must establish their social rank within the herd. This can only be achieved by interacting with all the animals they meet. Hence it often takes a number of days or even weeks for animals to establish themselves following introduction to the herd. Even in herds with a stable hierarchy, social rank remains important when limited and / or valued resources such as feed or access to feed are considered (e.g. cows of lower social rank were displaced from the feed bunk more often, particularly at high stocking rates (Huzzey et al., 2006) and high ranking cows spend more time at the feeder following the provision of fresh food (Val-Laillet et al., 2008). This is particularly true for low ranking, high yielding animals. In any situation, animals of higher social rank are better able to cope and perform because they are able to “out compete” their more subordinate peers. Equally, small changes which are of limited consequence to a low yielding animal can be of huge significance to animals genetically destined to produce high yields. In order to maximize herd performance as a whole, and not just the performance of higher ranking individuals it is important to manage the herd, the diet ***and*** the environment so lower ranking individuals are able to fulfill their yield potential without compromising their health and welfare.

Depression in Yield Following Introduction to a Herd

A number of studies have investigated the effects of mixing both multiparous and uniparous cows on milk yield. Phillips and Rind (2001) reviewed a number of these studies and report reductions of 19%, 8% for 10 days, 5% for 40 days, 4% for 5 days, 3% for 1 day and no reduction (two papers). In their own study Phillips and Rind (2001) report a reduction of 3% during week one and 1% over the six week study period. Whilst these reductions are relatively small they are entirely avoidable if the mixing of animals is avoided. Whilst this is of course impossible under modern management systems, this work suggests that where possible, avoidable and / or excessive movement of animals between groups should at least be limited to ensure stable social groups and maximize levels of production.

Building Design

To encourage good cow flow and to optimize access to feed, and therefore dry matter intakes, feeding passageways should be as wide as practically possible and provide adequate space per cow (see below). Feeding passageways should have entry and exit points at both ends and intermittently along their length, in large buildings, i.e. they must not be blind ended. A passage width of at least 3 to 3.5m has been suggested as it allows cows to pass each other whilst others are feeding (Bickert and Cermak, 1997). Low ranking cows are much less likely to use blind ended passageways because of the fear of becoming trapped and “bullied” by more dominant herd mates who perceive their presence as competition for a limited resource.

Feed space and bunk design

Feed and access to feed is one of the most valued resources in the environment. Additionally when one cow feeds, other are motivated to eat as well (Grant and Albright, 2001), meaning that cows tend to feed as a herd. This is particularly true in TMR fed herds when the provision of fresh feed encourages all animals to eat at the same time. As a result, animals will compete for access which often results in negative social interactions and bullying if feed space is inadequate. To minimize this and to maximize dry matter intakes, particularly in lower ranking cows, it has been suggested that animals should be provided with at least 0.6m/cow of ad lib access trough space and preferably 0.8m/cow (Blowey, 2005). Although by combing the results of a number of different studies, Grant and Albright (2001) report that there is unlikely to be a measurable reduction in DMI providing a minimum of 0.51cm of bunk space is provided. Whilst some evidence suggests that increasing bunk space above 0.5m may not have significant effects on DMI, doubling the amount of feeding space per cow from 0.5m to 1.0m resulted in a 57% reduction in aggressive interactions and allowed cows to increase their feeding activity during the period following the provision of fresh food (DeVries et al., 2004). This was particularly true for subordinate animals.

There is also evidence that feed bunk design can influence aggressive behavior; for example, cows were displaced more frequently from a post and rail feed barrier, compared to a barrier composed of headlocks (Huzzey et al., 2006). Lastly the frequency of feeding may influence behavior. Whilst the number of aggressive encounters at the feed bunk did not decrease as the frequency of feed delivery increased, subordinate cows were displaced less frequently when the herd was fed more often (DeVries et al., 2005).

Disease and discomfort

The ranging wild cattle from which domesticated animals are descended were prone to predator attack. As a consequence there was strong evolutionary pressure for them to mask signs of pain and its implied weakness (Phillips, 2002). This does not mean cattle do not experience pain; it is highly likely that they experience and perceive pain in a similar way to other less stoical mammalian species. Domesticated cattle retain this stoic nature and show few external behavioral signs of discomfort until levels of pain are high. The challenge for those of us working with cattle is to recognize the subtle signs of pain and / or lesions of disease which are likely to cause discomfort so that they can be controlled and their impacts on behavior, performance, and welfare minimized.

Many diseases are associated with a reduction in milk yield which in nearly all cases is likely to be caused by a reduction in dry matter intake i.e. sick and injured cows eat less. This paper will highlight the impacts of two contrasting conditions on performance and behavior.

Lameness

Lameness is undoubtedly one of the most serious disease problems currently facing the UK and world dairy industries in terms of its impact on welfare and decreased productivity. Recently the impact of a case of lameness on future milk yield during that lactation has been investigated. The total mean estimated reduction per 305 day lactation was calculated as 390 Kg (Green et al., 2002). Interestingly an animals that suffered a case of sole ulcer or white line disease had a reduction in yield for up to two months prior to the lesion being treated and animals that developed a sole ulcer initially produced more milk than unaffected cows (+1.5 Kg/day). The very fact that animals alter their gait in response to the discomfort caused indicates that lameness is a painful condition and this has been confirmed by previous work which demonstrated that lame cows are more sensitive to pain (Whay et al., 1997; Whay et al., 1998).

The exact changes in behavior which cause the reduction in yield have not been clearly defined; however it is likely that lameness leads to changes in feeding activity. In a recent study conducted by the author, the feeding behavior of lame cows was compared to matched control animal which were sound. Provisional results suggest that lame cows spend significantly less time eating compared to the sound controls (196 min/day vs. 307 min/day; $P = 0.03$).

Injuries to the Neck

Injuries and callusing on the dorsal aspects of the neck are common in UK dairy cows and other intensive dairy regions that the author has visited e.g. Canada and northern Europe. Most of these injuries are acquired from prolonged contact with the neck rail of the feed barrier i.e. when animals push forward to reach forage. In the UK, many feed barriers were designed and built when cows were smaller than they currently are, consequently the top rail is often far too low for the modern Holstein cow.

Whilst it cannot currently be substantiated with research evidence, it is logical to assume that a high prevalence of injuries, especially moderate to severe lesions, is likely to have an impact on dry matter intake and therefore yield. This will be especially true if animals are forced to ‘reach’ forward to eat e.g. if feed is not pushed up frequently enough and when it begins to run short. At the very least, the presence of lesions suggests that an unnecessary barrier is in place between the cows and their feed.

The required dimensions of the feed bunk will vary depending on cow size. Suggested dimensions for feed barriers suitable for the modern UK dairy cow are 64 cm from the floor to the top of the solid barrier, then 66 cm from the top of the solid barrier to the neck rail (i.e. the neck rail is 1.3 m from the floor). Ideally the top rail should be 7.5 cm forward (towards the forage) of the barrier and the floor of the food passage should be 15 cm higher than the floor on which the cows stand. The authors' current preference is for a top rail constructed from tensioned steel cable covered with alkathene piping or tensioned nylon strapping. These neck rails contain some give and have a smooth surface that does not damage the neck. It also offers the advantage of being relatively easy to adjust if the average cow size on the farm increases substantially.

Conclusions

The high levels of performance achieved by modern high yielding dairy cows places them on a "knife edge". If high yields are to be achieved and maintained their behavioral requirements should be considered and integrated into farm management protocols.

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SESSION NOTES