

Giving Calves a Good Start: Lessons from the Maternity Pen

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■ Take Home Messages

- ▶ Understanding the natural behaviour of cows and calves around calving can provide insight into their care and management
- ▶ Dairy cows separate from the herd and find a secluded place to give birth when kept indoors or outdoors
- ▶ Allowing cows the ability to separate from herd mates may result in shorter labor
- ▶ Limited research has been done to understand natural calf behaviour in the first few hours and days after birth
- ▶ In nature, calves stay hidden with their dams for the first few days of life; they are later introduced to the herd within about a week of life
- ▶ We recommend future research to investigate the natural behaviour of calves in early life

■ Introduction

Research over the last ten years has investigated maternity pen design from the cows' perspective. This research has provided insight into preferred calving environments for dairy cows that allow for the performance of natural behaviours. This information can help inform dairy producers about practical ways to adapt their maternity areas to accommodate cow behaviour. The majority of maternity pen research has focused on the cows' experience in the few days before giving birth. By comparison, much less research has focused on the calf and the interaction between the cow-calf pair.

Dairy calves experience several challenges in the first few days and months of life, including separation from their dam, novel and sometimes isolated environments, novel feed and feeding methods and exposure to environmental stressors such as poor housing and ventilation. These factors likely contribute to a high risk of disease and death in pre-weaned calves. Traditionally, the dairy industry has focused on creating housing and management strategies for newborn calves that have been thought to limit pathogen exposure (e.g., separation from the dam and individual housing). However, new research is showing that more natural environments (e.g., prolonging contact with the dam and pair housing or small group housing with other calves) may not increase the risk of disease in calves (see reviews by Costa et al., 2016; Beaver et al., 2019; Meagher et al., 2019). Instead, providing calves a more natural social environment has benefits such as improved cognition and social skills. Very little research has investigated the calves' social environment in the first few hours and days of life.

For these proceedings, we will focus on reviewing research to date exploring the impact of the maternity area on the health and welfare of dairy cows and their calves. We will start with a review of what we currently know about the natural behaviour of cows and calves during the few days before and after birth, drawing from research using dairy cattle, beef cattle and other wild ungulates. We will then review the research on cow behaviour approaching calving, and the behaviour of the dam-calf pair in the first few days of life when kept in commercial settings. We will then discuss some promising research linking the design and management of the maternity area to cow and calf outcomes and will end with recommendations for future research.

■ The Behaviour of Cattle in Natural Environments

Cow Behaviour in Preparation of Birth

For the majority of mammals, the survival of young is dependent upon the care provided by mothers. Maternal behaviours include those expressed by mothers during late gestation in preparation for giving birth and directed towards offspring until young are weaned.

One of the first signs of maternal behaviour in wild ungulates and domesticated cattle is isolation from the herd to find a secluded birth site (Lidfors et al., 1994). Dairy cattle kept on a large rangeland isolated themselves from the herd as calving approached, but the degree of isolation was dependent on the resources available in the environment. Greater separation from the herd occurred when cows had to travel further distances to find a suitable calving site (e.g., dry, soft ground and overhead cover). Similarly, Flörcke and Grandin (2014) found that beef cattle managed on extensive rangeland were observed to separate 25 to 1,250 m from the herd to find a calving site, and a majority of animals moved more than 100 m away. The beef cows in this study sought hollows with sandy soil surrounded by small bushes and avoided open spaces to give birth.

Dairy cattle managed on pasture appear to have retained calving behaviours similar to those in extensively managed, natural environments. A recent study found that cows kept on pasture with access to natural cover (e.g., tall grasses and overhead trees), open pasture (no environmental cover), and a manmade barn (deep bedded with straw and overhead cover), calved either in the area with natural cover or the barn (Edwards et al., 2020). The choice of calving site was dependent on parity; heifers giving birth for the first time were more likely to calve in the pasture area with natural cover, whereas older cows were more likely to choose the barn for their calving site. It is unclear what drove the difference in calving location, but we speculate that previous experience and social status may have contributed to the animals' choice.

It is not clear why cattle and other ungulates choose to separate from the protection of their herd to find a secluded place to give birth. These behaviours are thought to be a strategy to improve offspring survival through reducing the likelihood of predation and disturbance from other cows. Other cows in the herd, particularly those preparing to give birth, may interfere with the development of the dam-calf bond. For example, Finger et al. (2014) found that beef cows preparing to give birth separated more from pregnant animals compared to non-pregnant animals before and after giving birth. For cattle that rear their young, such as wild ungulates and beef cattle, the formation of a bond with their calf occurs within hours of birth and is critical for calf survival.

Cow and Calf Behaviour After Birth

For ungulate species, there are two general styles of rearing described in the literature: 'hider' and 'follower' (Lent, 1974). Most species use a combination of these strategies to avoid predation of their newborn. For a 'hider', the offspring stays hidden or covered in secluded habitats for the first few days after birth while the mother grazes nearby. For a 'follower', the offspring stays close to the mother and is more active than a hider during the first few days after birth.

There is no research to our knowledge that has described the strategies used by domesticated dairy cows to rear their offspring in a natural setting. However, there has been some research with beef cows and feral populations of cattle that provide insight into post-calving behaviours in cattle. For example, Maremma cow-calf pairs (free-ranging cattle in Italy) perform both hiding and following behaviour during the first week after birth (Vitale et al., 1986). During the first three to four days of life, calves stayed hidden in bushes while their dams grazed nearby. Calves then followed their dams for the next few days, and finally rejoined the herd with the mother after about one week of life. Similarly, beef cattle kept on pasture reduce the amount of time spent with other animals on the day of calving, and gradually increase social contact with the herd over the span of one week after calving before fully rejoining the group with the calf (Swain et al., 2015).

■ The Maternity Pen

Designing the Maternity Area from the Cow's Perspective

The research described so far has focused on the behaviour of cattle and other ungulates as calving approaches in natural settings. It may not be practical to allow dairy cows to calve in large outdoor areas, such as large rangeland. However, we can use insights gained from studies in natural settings to design maternity areas that allow for expression of the cows' and calves' natural behaviours.

Indoor-housed dairy cattle have retained many of the maternal behaviours seen in cattle in outdoor settings, such as seeking shelter at calving and separating themselves from herdmates (Proudfoot et al., 2014a,b; Creutzinger et al., under review). For example, Proudfoot et al. (2014a) found that 79% of dairy cows in individual maternity pens calved behind a solid wall providing separation from a larger group pen compared to calving behind a gate where other cows were visible (Figure 1).



Figure 1. Options for creating an area of seclusion in individual maternity pens for dairy cows (the image on the left was from Proudfoot et al.(2014b) and the image on the right is courtesy of Vander Made Dairy, Ohio).

Creating opportunities for cows to seclude themselves at calving in group pens may be more challenging because of competition over resources. For example, Proudfoot et al. (2014b) found that cows were more likely to calve in a large shelter area of a maternity pen when they were kept individually (62% used the shelter to calve) compared with when they were kept with a partner (34% used the shelter to calve). Thus, when creating a space for cows to seclude themselves in a group maternity pen, it is important to make sure cows are able to access the provided resources for hiding.

Most of the recent research on creating hiding spaces for dairy cows at calving have used similar 3- or 4-sided shapes made of solid material. An alternative hide design was recently used in a study by Creutzinger et al. (2020); for this study we used a single-sided 'blind' in a group pen for six to ten animals (see Figure 2). This shape allowed more than one cow to use the hiding area at the same time but provided much less cover compared with other hiding spaces. We found that about 36% of cows chose to calve directly next to the blind, which was higher than the same area of an identical pen without a blind (14%). While not as many cows used this single-sided design as other designs, we only provided space for about two cows out of six to ten. Including more linear space in a single-sided blind may increase the number of animals that use the blind to give birth.



Figure 2. Options for creating a more secluded area for cows in group maternity pens. The photo on the left shows a single-sided ‘blind’ in a group maternity pen (from Creutzinger et al., 2020), and the photo on the right shows and ‘L’ shaped hide (from Zobel et al., 2020).

Indoor-housed dairy cows also seek separation from other cows as they approach calving. For example, Proudfoot et al. (2014b) found that, when pair-housed in a maternity area, cows separate from their pen-mates starting approximately 8 hours before calving. When cows were kept in groups of six to ten in sawdust-bedded packs with either low (~ 9.3 m²/cow) or high (~ 18.6 m²/cow) lying space, cows increased their distance from pen-mates as calving approached regardless of treatment (Creutzinger et al., under review). Cows given more space (~ 18.6 m²/cow) were farther away from other cows in the pen at the moment of calving compared with those given less space, suggesting that cows will use additional space to separate from other cows if provided.

Cow and Calf Behaviour in Maternity Areas

Cow and calf behaviour in the first few hours and days after calving are impacted by the animals’ social environment in the maternity area. For example, cows kept in group maternity pens spent less time licking their calves during the 6 hours after calving compared with those kept in individual pens, likely because other cows in the group were also found to be licking their newborn (Edwards, 1983). In the same study, about 30% of calves born in group pens were nursed by a cow other than their mother. This behaviour, referred to as ‘mis-mothering’, can be reduced by providing the cow and her newborn a secluded space after calving (Jensen et al., 2019).

It is unclear how ‘mis-mothering’ behaviour impacts the cow and her calf, but it may be stressful for the new mother to have interference from other cows when she is trying to nurse and groom her newborn, and may also impact the colostrum quality of cows being nursed before giving birth. Thus, we recommend that cows either give birth in individual pens, or if cows calve in groups, the cow and her newborn should have the opportunity to seclude themselves. Alternatively, cow-calf pairs should be moved to a protected space shortly after birth to limit ‘mis-mothering’ behaviour.

There is also some evidence that newborn calves, similar to their dams, are attracted to more secluded areas in the first few hours after birth. Zobel et al. (2020) kept New Zealand dairy cows in outdoor paddocks with ‘L’ shaped hides (18:50 hides:cows; Figure 2) overnight during the few weeks before calving. Only about 20% of cows used the hides to give birth, but a majority of calves (73%) later moved themselves into the hides with their dams in the few hours after birth (~ 2.4 hours after birth).

The Impact of the Maternity Area on the Cow and Her Calf

The studies described above have focused on determining the preference and natural behaviours of cows and their calves around calving. Understanding animal preferences and behaviours can provide insight into what types of environments they like, and providing animals with choices is important for their welfare. We also acknowledge that other outcomes measurements, including health and affective states, may give us more information about how these environments affect the animals.

Our knowledge about the impacts of indoor environments that mimic more natural settings is limited; however, there has been some recent, promising work to show that maternity pens that allow greater space for separation may be beneficial for cows and their calves. For example, Creutzinger et al. (under review) found that cows provided more lying space (~18.6 m²/cow) and access to a single-sided 'blind' (Figure 2) before calving had the shortest duration of stage 2 labour compared with those kept with less space (~9.3 m²/cow) and no access to a blind. We speculate that stressors experienced by cows (e.g., an inability to isolate using environmental resources and distance to other animals) may prolong labour, as it would be beneficial for the cows to wait until they are in a more relaxed state before giving birth.

Another factor that may impact a cows' ability to progress through labour without disruption is human interaction. Cows are often moved from a group pen to an individual pen during and before labour, which may provide them with the seclusion they are looking for before giving birth. However, the interaction with farm staff may also be stressful to cows. Proudfoot et al. (2013) had farm staff move cows before labour, during early stage 1 labour (signs of suddenly tense and enlarged udder, raised tail or relaxed pelvic ligaments) and during late stage 1/early stage 2 labour (signs of viscous, bloody mucus or abdominal contractions). We found that cows moved during late stage 1/early stage 2 had longer labour (by approximately 30 minutes) and shorter lying time compared with those moved earlier. These results suggest that human interaction during labour and movement into a novel environment (the individual pen) may stall labour progress.

Another important outcome to measure in the maternity area for both the cow and calf is hygiene. Wet and dirty substrate in maternity areas potentially increases disease risk for cows and calves post-calving. For example, good hygiene in the calving area is considered critical for reducing the spread of Johne's disease between dams and calves for positive herds (Donat et al., 2016). Some research has also found associations between maternity area type (group or individual) and disease incidence in calves; however, these results may be confounded with pen hygiene (Svensson et al., 2003; Pithua et al., 2009). Calves born in individual maternity areas had lower risk of respiratory disease compared with calves born in group maternity areas (Svensson et al., 2003). In contrast, calves born in group maternity areas were not at greater risk of diarrhea, pneumonia, or morbidity compared with calves born in individual calving pens (Pithua et al., 2009). The link between maternity area type and calf disease is unclear but it may be related to frequency of pen cleaning and not maternity area type alone.

High stocking density in group maternity pens likely increases the risk of poor hygiene. Indeed, Creutzinger et al. (2020) found that cows provided less lying space (~9.3 m²/cow) had poorer hygiene compared with those provided more space (~18.6 m²/cow) when sawdust bedded packs were cleaned regularly (new sawdust added every other day and replaced every three weeks). We recommend that individual maternity pens are cleaned between calvings, and group bedded pack pens should have soiled material removed daily and fresh bedding added at least every other day to ensure calves are born into clean, comfortable areas. We also recommend that maternity pens do not double as hospital pens because this can also impact the transmission of pathogens to the calf.

■ Gaps in the Literature and Opportunities for Future Research

One of the knowledge gaps regarding maternity pen design is the calf perspective. A majority of the research in this review has focused on maternity pen design that provides cows the ability to express their normal behaviour before calving. We recommend researchers continue to explore natural behaviours in

calves during the first few days after calving. For example, following the work of Zobel et al. (2020), a future study could provide calves with their own 'hiding space' in maternity pens that they can use within the first few hours to days after birth. We do not encourage producers to socially isolate calves during this time because in nature the dam stays near the calf during this period. However, creating opportunities for calves to find seclusion in individual or group maternity pens may help them better cope with some of the challenges they face in the first few days of life.

A second area of research that we encourage is on alternative housing systems that allow for some cow-calf contact in early life (see Beaver et al., 2019; Meagher et al., 2019 for detailed reviews). For example, one of the most common patterns observed in wild ungulates and extensively managed beef cattle is the slow introduction of the calf and cow back in to the herd. Currently, cows are moved directly into fresh or high lactating pens, and calves moved into a nursery, sometimes within hours of birth. Research is encouraged to determine ways to mimic a more natural transition for both the cow and her calf into the herd by determining when the cow and calf would leave the maternity area on their own.

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