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## The degree of visual cover and location of birth fluids affect dairy cows' choice of calving site

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### ABSTRACT

Under natural conditions, cows seek isolation and visual cover when calving becomes imminent, but the degree of visual cover necessary to provide an attractive calving site is not known. When calving indoors, preparturient cows are attracted to other cows' birth fluids, and this may influence their isolation seeking. Therefore, we aimed to investigate the effect of degree of visual cover of secluded areas and the location of birth fluids on dairy cows' calving site selection. One hundred twenty-four Danish Holstein cows were moved in groups of 8 to 12 to a group pen with access to 6 areas secluded by a barrier of either 3 m (wide barrier) or 1.5 m (narrow barrier). Sixty cows calved within 14 d of having been moved to the group pen and were included in the study. From 3 h before partition and until the cow and calf were removed from the pen within 3 h after parturition, the location and posture of cows were recorded, along with the location of where their birth fluids were discharged. In addition, location and posture of calves were recorded during and up to 3 h after calving. All data were collected from continuous video recordings. Continuous data for location and behavior were analyzed by mixed models, binary data were analyzed by chi-squared analysis, and location of calving relative to where the cow's own or alien birth fluids were discharged was analyzed using logistic regression models. Ten percent of the cows calved in a secluded area, with no effect of barrier width. However, before calving, cows with access to secluded areas with a wide barrier spent more time in a secluded area (22 vs. 7 min/3 h), and more cows were observed lying there (58 vs. 28%) than cows with access to secluded areas with a narrow barrier. Secluded areas with a wide barrier were used by more cows and calves during

the first hour after calving (36 vs. 10%). Among the cows that entered a secluded area after calving, the latency to enter correlated with their calf's latency to enter, suggesting that the 2 sought seclusion together. Seventy-nine percent of the cows calved in proximity (within a 1.25-m radius) to their own or an alien cow's birth fluids. There was no effect of barrier width on the probability of calving in proximity to their own or alien birth fluids. However, the probability of calving in proximity to their own or alien birth fluids was higher than the probability of not doing so. The greater use of secluded areas with a 3-m-wide barrier before and after parturition suggests that these are preferred over areas with a 1.5-m-wide barrier. Only a few cows calved in a secluded area, and more research is needed to explore the environmental and social factors affecting parturient cows' use of designated calving areas. The majority of cows calved close to where their own or alien birth fluids were discharged, suggesting that cows are attracted to these before calving. This may have affected the use of secluded areas as calving sites.

**Key words:** housing, maternal behavior, transition, parturition

### INTRODUCTION

Use of individual maternity pens protects cows from social disturbances during calving and reduces the risk of mis-mothering (Edwards, 1983; Illmanm and Špinka, 1993) and thus failure of passive transfer of immunoglobulins. One of the challenges of managing individual maternity pens, however, is to move cows into the pens well in time before calving. It is difficult to predict the time of calving based on physical signs (Lange et al., 2017) or automatically monitored changes in behavior (Ouellet et al., 2016). This means that cows are likely to be moved late relative to calving, which in turn increases the risk of prolonged labor (Proudfoot et al., 2013) and thus calving complications. A key question is whether this problem can be solved by attracting the cow to a designated calving area before parturition.

When kept under near-natural conditions, cattle search for an appropriate place to calve isolated from

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the herd and potential predators (reviewed by Rørvang et al., 2018b), and motivation to search for a secluded place to calve is also suggested in dairy cows housed indoors. Dairy cows offered an opportunity to hide behind a 1.5-m-wide barrier in an individual maternity pen predominantly calved behind such a barrier rather than in visual contact with cows in an adjacent group pen, whereas the cows' calving site in similarly sized pens without a barrier was random (Proudfoot et al., 2014b). In the aforementioned study, cows were individually housed and thus separated from the group, but they spent the majority of time visually isolated behind the barrier beginning approximately 1 h before calving. Cows kept outdoors (Lidfors et al., 1994) and cows kept in pairs indoors in a large pen with access to a secluded area (Proudfoot et al., 2014a) were reported to isolate several hours before calving. In the study by Proudfoot et al. (2014b), the cows may have had problems staying behind the 1.5-m-wide barrier during the restless phase before parturition, which is characterized by frequent postural changes (Miedema et al., 2011; Jensen, 2012). A subsequent study, also with cows housed in individual maternity pens adjacent to a group pen housing pregnant cows, found that a 2.5-m-wide barrier was preferred over a 1.5-m-wide barrier, but only by cows with a prolonged calving (Rørvang et al. 2017a), which provides partial support for this suggestion. Thus, a secluded area with a wider barrier may be a more attractive calving site and may better enable cows to hide with their calf than a secluded area with a narrow barrier. The first research question of the present study thus was whether the width of a barrier of a secluded area affects cows' use of it around the time of calving.

Dominant cows were more likely to calve in a secluded area than subordinate cows (Rørvang et al., 2018a), and the presence of a newborn calf in either the group pen or any of the secluded areas reduced the likelihood of a cow calving in a secluded area. Birth fluids cover the newborn, and these fluids are thought to contain important chemosensory cues for establishing the maternal bond in many mammalian species (Lévy et al., 1983). In cattle, Edwards (1983) showed that calving cows, as well as newborn calves, have an attracting effect on preparturient cows, and Pinheiro Machado et al. (1997) reported that cows are attracted to amniotic fluid in their feed starting as early as 12 h before parturition. In support of this, a small-scale study suggested that cows favor a birth site close to where a previous calving has taken place (Rørvang et al. 2017b). Likewise, George and Barger (1974) noted in their field observations that cows remained in approximately the same spot as their own amniotic fluid was discharged until the calving was completed. Birth fluids may thus interfere with isolation seeking before

calving, and the second research question of the present study is whether calving site selection of group-housed dairy cows is influenced by discharge locations of a cow's own or alien birth fluids.

## MATERIALS AND METHODS

### *Animals, Housing, and Design*

The experiment was conducted on a commercial organic dairy farm in Jutland, Denmark. One hundred twenty-four Danish Holstein cows (59 were going to calve for the first time, and 65 had already calved once or more) were enrolled in the experiment. Cows were moved from the same group of dry cows to the experimental barn during the period from February 14 to May 10, 2017 (wk 7 to 19). Every week on a fixed weekday (Monday), a group of 8 to 12 cows (at least 7 d from expected calving) were moved to 1 of 2 group pens (16 m × 27 m). Except for a 4-m-wide slatted concrete floor area in front of a feed table on the 27-m side, the pens had a compost-bedded pack (a mixture of wood chips and sawdust) including an open area (9 m × 27 m) and 6 secluded areas (each 3 m × 4.5 m). The secluded areas were custom-made by using metal frames fitted with plywood and placed along the partially curtained sidewall of the building. Each secluded area had two 3 m × 1.8 m (width × height) sides and a side facing the open area with an entrance, which allowed the cows free entrance to each of the secluded areas. In 1 of the 2 group pens (group pen 1), this side (hereafter termed "barrier") was 1.8 m high and 1.5 m wide, leaving a 3-m-wide entrance; in the other (group pen 2), this barrier was 1.8 m high and 3.0 m wide, leaving a 1.5-m-wide entrance (Figure 1). For an illustration of the pen with secluded areas with a wide barrier, see Figure 2. The 2 experimental pens were separated by an opaque curtain, and a curtain also separated group pen 2 from the neighboring nonexperimental pen, whereas group pen 1 had an outer wall on one side. Water was available ad libitum from water troughs located in the slatted floor area. All animals had ad libitum access to a TMR, which was provided twice daily.

In uneven-numbered weeks, cows were moved into group pen 1, whereas in even-numbered weeks cows were moved into group pen 2. Within 5 h after parturition, cow and calf were moved to an individual maternity pen in a separate building. Cows that had not calved within 14 d after having been moved to the experimental group pens (groups 1 to 12) or had not calved within 7 d after having been moved to the experimental group pen (group 13) were moved to a maternity pen in a separate building. Seventy-five of the 124 cows calved in one of the experimental pens [10,

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