

Annotated Bibliography

The summaries are organized by their contribution to my paper. I started off with articles that explain the behaviours origin, move into early experiments, and end off with newer experiments or unique ones.

Stěhulová, I., Valníčková, B., Šárová, R., & Špinka, M. (2017). Weaning reactions in beef cattle are adaptively adjusted to the state of the cow and the calf. *Journal of Animal Science*, 95(3), 1023–1029. <https://doi.org/10.2527/jas.2016.1207>

Summary:

The authors wanted to analyze the cow-calf bond to explain what factors increase stress behaviours at weaning time. Past literature discusses how evolutionarily heifers would remain with the herd post-weaning where the males would leave. Studies have also noted that female calves vocalize more when distressed. The authors predicted that younger, female calves, with higher body weights, would be more distressed after removal. This was predicted because calves with higher daily gain would probably spend more time suckling than calves with lower daily weight gain. Data for this study were collected over ten years from 2001-2011 for a total of 85 cow-calf pairs. Coloured collars were used to identify the pairs. At weaning time, calves were removed from mothers and placed in a different barn. They could hear each other but could not see or touch each other. Behaviours recorded included frequency of vocalization and locomotion time. Groups were separated from dams and then divided by sex. Observations were recorded for each individual, so body weight, age and sex could be compared. Vocalizations varied between

the sexes; females vocalized more than twice as often as the males. No difference was observed with time spent walking. Calves that had gained more body weight per day did vocalize more than those with lower daily weight gain. No change in time spent walking was observed between different weights. The rate of vocalization did not change with age. The results found that movement increased as age increased, which is different than predicted. These findings are significant because many past experiments have observed the act of walking as an indicator of stress. After finding these results, the authors believe walking is not a good behaviour to observe when analyzing stress in beef calves. This new finding is important for future experimental design.

Contribution:

This study dives into how complex the relationship between cows and their calves are. It also supports past literature that found females expressed greater vocalization during weaning time. This article expanded on that idea that female calves are more connected to their mothers for evolutionary reasons. They further supported the idea and provided evidence that supports the literature. I included this study in my review because it gives a great deal of background information about cow-calf relationships. It uses evidence and literature to explain the behaviours being expressed by calves during this stressful time.

Lambertz, C., Farke-Röver, A., & Gauly, M. (2015). Effects of sex and age on behavior and weight gain in beef calves after abrupt weaning: sex and age effects on weaning stress. *Animal Science Journal*, 86(3), 345–350. <https://doi.org/10.1111/asj.12285>

Summary:

This study wanted to know how weaning at either six (W6) or eight (W8) months will affect the behaviour of both male and female beef calves. They wanted to recommend an optimal weaning age to reduce stress behaviours and increase productivity. Each year 20 female calves and 20 male calves were observed. Half of each group were removed from their mothers and taken to the final facility at six months of age: the remaining were removed at eight months. Observations were done for five hours per day for the first three days after weaning. Each day, 30 observational periods of five minutes occurred; the total group vocalizations were recorded. Other behaviours observed were feeding, lying, and standing/ walking. These behaviours were also recorded 30 times per day. On all three days of observation, the W6 group had more vocalizations than the W8 group. Both groups did have a decrease in vocalizations each day. It was also observed that the W8 group saw an increase in lying on days 1-2 and, W6 saw an increase in lying behaviour between days 2-3. Results indicate that the W8 group was more comfortable in their new environment than the W6 group. When looking at differences between the sexes, females expressed more vocalization than males. Indicating the females may have a greater connection to their mother. This is interesting to consider because some past studies did not note the sex of the calves studied. There was no difference between the other stress behaviours observed between the male and female groups.

Contribution:

The information on similarities and differences between the sexes is very beneficial when planning future studies on the topic. It would be important to have equal representation of both sexes to get accurate results. The differences in ages could also be beneficial when comparing weaning methods and their impacts at different ages. The ideas support literature referenced and elaborated on the research found in those experiments. This article is included because it can help explain data variations in other studies. It also provided future direction for some of the newer literature being discussed.

Enríquez, D., Hötzel, M. J., & Ungerfeld, R. (2011). Minimising the stress of weaning of beef calves: A review. *Acta Veterinaria Scandinavica*, 53(1), 28.

<https://doi.org/10.1186/1751-0147-53-28>

Summary:

The purpose of this review was to discuss beef cattle weaning management strategies and how to reduce calf stress. To understand how to reduce stress behaviours the authors first describe the behaviours and how their frequencies can indicate stress. They also described how some of those stress behaviours, like vocalization and pacing, are the calves trying to reunite with their mothers. When weaning there are three major factors to consider, the first is the removing of suckling, the second is physical removal from their mother and the third is a change in environment. Each of the factors can bring on stress responses including increased vocalization, reduced feed intake, decreased rumination, increased standing, pacing, and reduced time laying down. Some of the responses were more frequent when certain factors occurred. Vocalization is meant to signal for care from the mother. Vocalization increased when unable to drink and removed from their mothers. Increased pacing was observed when the environment changed. The authors also discuss how cow-calf interactions like suckling can release hormones in the calf. The current methods to reduce stress during weaning are to recreate a more natural weaning process: breaking the weaning into a multistep process. One method is using nose flaps that make it so the calf cannot drink but remain at the dam's side. They were removed 7-21 days later. The second is using a fence to prevent suckling and limit physical contact while still present. It is important to understand the breakdown of the stress behaviours associated with the different aspects of weaning to minimize them and encourage good practice. A major question

stemming from this paper is how physiological actions can impact behavioural responses? What cow-calf interactions release hormones in the calves that could lead to stress behaviours when weaned?

Contribution:

This article is included because of its thorough description of behaviours associated with weaning. The authors explain the behaviour and how its frequency can indicate stress. In some cases, they also described what it means concerning their past relationship with their mother. It also mentions a lot of key research points and provides many questions that can be asked moving forward. This article is important because it breaks the stress behaviours down to the separate steps of weaning. By understanding each behaviour and at what step it is most pronounced, more direct comparisons can be made.

Ungerfeld, R., Quintans, G., & Hötzel, M. J. (2016). Minimizing cows' stress when calves were early weaned using the two-step method with nose flaps. *Animal*, *10*(11), 1871–1876. <https://doi.org/10.1017/S1751731116000793>

Summary:

The authors wanted to investigate how alternative weaning methods can reduce stress in calves weaned around 60 days of age. Past literature discussed the benefits of using a two-step weaning method in calves weaned between 6 and 8 months of age. Younger calves show more stress behaviours than older calves. Some cattle operations wean calves younger to increase production, so it is important knowledge. The goal of this study was to determine if two-step weaning is an effective method of reducing stress responses in beef calves that are weaned at approximately 60 days of age. Three groups of 12 calves (half female and half male) were studied. The first group received nose flaps on day zero of the experiment. The nose flaps were removed on day five and the calves were removed from their mothers. The second group was abruptly weaned on day five. On day six of the experiment, the group had their nose flaps were removed and moved to a different area than their mothers. The second group of 12 was abruptly weaned on day five and moved to the same place. The last group acted as a control, they were not weaned, but observations were recorded. Observations were obtained by trained professionals doing instant visual sampling 50 times per day. The data collected showed that the nose flap method did have the lowest stress response. It was the most effective at reducing stress behaviours expressed. They also determined that the first response occurred when nose flaps were placed and another after removal. This is significant because the results show that two-step weaning may be more effective when calves are younger (around 60 days old) than at the

traditional age of seven months. It also agreed with past literature that noticed an increased response at both handling times.

Contribution:

The knowledge gained from this experiment made researchers question the cow-calf bond and how different aspects of it can be stressful. It asks the questions why are they behaviours caused and how do we minimize their effects? This study agrees with past literature that discusses increased vocalization calling for the other despite receiving no reply. This article is helpful to understand the cow calf bond that causes the stress behaviour observed. This article answers the question of why it needs done and brings questions of how to minimize the bond separation between cow and calf.

Haley, D. B., Bailey, D. W., & Stookey, J. M. (2005). The effects of weaning beef calves in two stages on their behavior and growth rate. *Journal of Animal Science*, 83(9), 2205–2214. <https://doi.org/10.2527/2005.8392205x>

Summary:

This article wanted to learn more about the advantages of two-step weaning. On most ranches, beef calves are weaned in a single step resulting in a higher frequency of stress behaviours. Past studies told the authors that two-step weaning reduces the frequency of stress behaviours. Breaking the weaning process into two separate steps, milk removal, and mother removal gives the calf more time to adapt. The authors predicted that pacing and vocalization would decrease when nose flaps were used. They also predicted that longer time spent with nose flaps would reduce distress after being removed. Two trials focused on short-term stress behaviours. The first study collected data on vocalization for a control group (n= 74) and two groups with nose flaps (n=58 for each). The nose flap time was different for the two groups; 14 days and three days. The number of vocalizations was observed and tallied. The second trial focused on time spent walking. Both the control and nose flap groups consisted of 25 calves each. Data was collected by pedometers for eight consecutive days. Calves with nose flaps remained with the mother for four days after placement. The other two trials focused on long-term effects. Both trials showed that the two-step weaning method was beneficial at reducing the specific stress behaviour observed. Researchers determined that less time with nose flaps was beneficial. The authors found their pasture results were even more effective at reducing stress than past literature (feedlot experiment). These findings were significant because they showed that the greatest differences were in the two days. It gives a smaller time to focus on for future

studies. This study was in a pasture environment, unlike past literature. This setting could be even more beneficial to the farmers as it allows the cow to remain on pasture for longer.

Contribution:

The results of two-step weaning in a pasture environment is beneficial for farmers. They could leave the pairs on pasture for longer; past research shows that pasture weaning is less stressful than feedlot weaning. It provided information for future studies and the data supports a move in the correct direction. It agrees with previous findings that were done in the same environment but experimentally different and for studies where the experiment was the same but in a different environment. I included this article because it brings ideas together and provides ways to combine and test different behaviours in future experiments.

Enrriquez, D. H., Ungerfeld, R., Quintans, G., Guidoni, A. L., & Hötzel, M. J. (2010). The effects of alternative weaning methods on behaviour in beef calves. *Livestock Science*, *128*(1–3), 20–27. <https://doi.org/10.1016/j.livsci.2009.10.007>

Summary:

The authors wanted to compare weaning methods with a broader scope, to consider side effects associated with the different methods. Many changes occur at weaning time, including a new diet, change in the social environment, and loss of maternal contact. Increased vocalization is one of the most prominent stress behaviours observed in the past. The purpose of the study was to compare behavioural responses of beef calves using three weaning practices. The methods they used were abrupt weaning, nose flaps and fenceline separation. Age, sex and weight were all considered when the three groups of 16 were separated for observation. The control group (CON) consisted of calves who were removed from their mother on day zero of the experiment. The nose-flap group (NF) received their nose flaps 17 days before day zero. The nose flaps were removed on day zero and the calves were separated from their mothers. The fenceline separation group (FEN) was placed on the opposite side of the fence from their mother 17 days before day zero. Scan sampling occurred 36 times per day from day -17 to -13 and from -3 to 5. The behaviours recorded included walking, grazing, vocalizing, ruminating, seeking, and pacing. The results show there was no benefit to either of the two-step weaning methods. Abrupt, two-step and fenceline weaning all showed similar stress responses. The authors did note that the calves with nose flaps had an increase of stress responses twice. Calves that underwent abrupt weaning returned to normal levels more quickly. This is a significant finding because it could indicate that

the stress response is redistributed over an extended period. The concerns that arose from this study are important to consider when making experiments in the future.

Contribution:

It brings into question areas of concern with the new methods and made other researchers consider problems in their projects. More recent research found other problems and referenced this article as a reason for considering them. It supports the observed behaviours but contradicts the idea that “no negative side effects” were observed. There is a great deal of new ideas overturned when looking at the behaviours observed for each of the studied groups. I included this article in my research because it is the first article to realize negative affects because it had more broad behavior observation.

Hötzel, M. J., Quintans, G., & Ungerfeld, R. (2012). Behaviour response to two-step weaning is diminished in beef calves previously submitted to temporary weaning with nose flaps. *Livestock Science*, 149(1–2), 88–95. <https://doi.org/10.1016/j.livsci.2012.06.029>

Summary:

The authors wanted to combine two different ideas about nose flaps and apply them to reduce stress at weaning. Nose-flaps can be put on calves for two reasons, weaning and breeding season. Past literature has discussed the benefits of using nose flaps to create a two-step weaning process. Nose flaps have also been used during the breeding season to boost fertility. Authors learned from past literature that nose flaps can increase frustration behaviours observed post-weaning when nose flaps are placed. The authors predicted that calves that received nose flaps during the breeding season would have a reduced stress response compared to the group that did not. To investigate this topic, researchers looked at two groups of calves. The first group consisted of 13 calves; they received nose-flaps for seven days during breeding time. The control group of 11 calves did not receive nose flaps. Both groups were then weaned using the two-step weaning process. After nose flaps were inserted, cows and calves remained in the dry pen for 14 days. Calves remained in the same pen, and the cows were removed. Behaviours were recorded for five days: with increased frequency for the first two days. One major finding of this study was that the group that was pre-exposed to nose flaps was back to baseline behaviour faster than the control. They also realized that calves that were exposed to nose flaps before two-step weaning had a reduced stress behaviour response. This indicated that the nose flaps themselves were causing a stress behaviour. The idea is that the nose flaps affect the time it takes for a calf

to return to a baseline response. The authors concluded that two-step weaning is more beneficial to calves that have experienced nose flaps before weaning.

Contribution:

This study brought a new variable to researchers' attention. The nose flap being a stress cause is something that will greatly affect future studies. The behaviour observed agreed with past data on the two-step weaning but it also brought a lot of new ideas forward that had not been considered in past research projects. I included this article in my review because it is very different than other data from past research. It is important to understand all the variables affecting the stress behaviours being observed.

Price, E. O., Harris, J. E., Borgwardt, R. E., Sween, M. L., & Connor, J. M. (2003). Fenceline contact of beef calves with their dams at weaning reduces the negative effects of separation on behavior and growth rate. *Journal of Animal Science*, *81*(1), 116–121.
<https://doi.org/10.2527/2003.811116x>

Summary:

This article wanted to compare different weaning methods and the calf's observed behaviours. The authors knew that weaning can be a stressful time for calves as past studies have noticed an increase in stress behaviours at this time. The cost of these behaviours can lead to a loss economically to farmers. Researchers want to improve the weaning experience of calves and reduce the economic impact associated with increased stress behaviours. The hypothesis tested if fenceline contact reduced the number of stress behaviours observed and limited short-term weight gain. Five different treatments occurred in this study. The first was not weaned calves still on pasture (C-P). The second was calves separated by a fence and still on pasture (F-P). The third group remained on pasture after removal from their mothers (S-P). The last two groups were fully separated from their mothers, one group was on a feedlot with prior exposure to hay (S-D-P) and the other was without pre-exposure (S-D-N-P). Each treatment consisted of 10 calves; there were two groups per treatment (100 calves studied in total). This was repeated for three years. Behaviours observed were eating, pacing, lying down, proximity to dam/ fence (not separated groups), and vocalization. After the 7-day observational period, group C-P and F-P spent more time eating than the other groups. The C-P group rarely vocalized, and the F-P vocalized the least of the other four groups. The behaviour of the F-P group was more like the C-

P group than it was to any of the other three groups. The significance of the findings is that vocalizations decreased when calves were still in the presence of their mother even though they had minimal contact and were unable to drink. This is evidence suggests that fence-line contact is an effective way of decreasing vocalizations post-weaning.

Contribution:

The results agreed with previous studies that said social contact with dam can reduce stress behaviours in newly weaned calves. This article is highly referenced in more recent studies that have looked at weaning methods. Very few articles before this one discussed different method to weaning and based a great portion of the study on animal behaviour instead of weight gain. This study was the first to compare a proposed weaning method to a control group of calves not weaned as well as a group that was weaned traditionally.

Nickles, K. R., Relling, A. E., Moraes, L. E., & Parker, A. J. (2021). The effect of a social facilitator cow on the distance walked and time spent walking by abruptly weaned beef calves. *Animal Production Science*, 61(6), 596. <https://doi.org/10.1071/AN20434>

Summary:

The authors wanted to look at ways to encourage feed intake during the stressful weaning time. Stress behaviours observed at weaning time, including reduced feed and water consumption, can affect the bodyweight of calves. When calves are removed from mothers, their source of food changes, and so does their environment. All these changes often cause a great deal of pacing. The authors wanted to test if a facilitator cow would decrease stress behaviours. The behaviour they wanted to focus on was pacing. They predicted that the presence of a facilitator cow would reduce walking. The group of calves with the facilitator cows consisted of 40 replicates; they were placed on pasture after abrupt weaning. The second group was abruptly weaned and placed on pasture without a facilitator cow. Collars were used to record walking activity through GPS tracking. Data was collected every 10 seconds for 24 hours on days zero, seven and fourteen. Every 10 seconds, GPS location on the calf's position in the paddock is recorded. The results indicate that a facilitator cow does not have a significant effect on the distance walked by calves. There was also no difference in time spent walking between the two groups. These results are significant because researchers were looking for changes that would impact cattle efficiency. Adding a facilitator cow does not reduce stress behaviours enough to be beneficial for ranchers. Despite not finding results, it would be beneficial to look at activity for days one, two and three, or maybe other behaviours. Cattle are herd animals, so the idea of a facilitator cow could be beneficial. There is not a great enough effect to impact the body weight.

Contribution:

Despite the data not supporting the hypothesis it contributes to future ideas regarding a facilitator cow and how it may help minimizing other stress behaviours. There were no previous studies on the use of a facilitator cow but the increase in stress behaviours at weaning was observed and agreed with past literature. This article was included because the use of a facilitator cow was a good idea, but the wrong behaviour was focused on. Another research discusses how it can help in a feedlot environment where food and water sources are unknown.

Freeman, S., Poore, M., Pickworth, C., & Alley, M. (2021). Influence of weaning strategy on behavior, humoral indicators of stress, growth, and carcass characteristics. *Translational Animal Science*, 5(1), txaa231. <https://doi.org/10.1093/tas/txaa231>

Summary:

This article focuses on various stress behaviours including growth, humoral response, rumination, feeding frequency, vocalization, and activity. Freeman et al. (2021) wanted to understand the short-term and long-term effects of different weaning methods. To quantify how stressful the different treatments were, the team created three groups. The first was weaned by abruptly being removed from their mothers at weaning time (group A). The second group, known as group N, had nose flaps inserted, so they could not drink from their mothers. After 7- days of still being with the mothers, they were removed and fully weaned. The third group also underwent abrupt weaning but remained with the mother an extra 49 days than the other groups before being removed. The industry standard for wean time is 7- months so groups A and N were weaned at that time. One big finding in this study was that the nose flaps resulted in nasal sores on 12 of the 39 subjects. This was not mentioned in past nose flap experiments. The stress behaviours that did not show a significant difference between treatments were growth, rumination, and humoral response. Feeding frequency had some variation between treatments with the N group having a lower feeding frequency than the other two groups before returning to normal. Activity levels did differ having a greater level of walking and standing for group A and

group D. Overall the conclusion was that abrupt weaning under the presented conditions was similar when comparing stress responses to those who received nose flaps. The biggest question I have after reading this article, is about sample size and if weaning large groups would have the same small variation as a larger group would? Would it increase the number of stress behaviours, or would it reduce them?

Contribution:

This article provides unique insight into the long-term effects of different weaning methods and data on the short-term responses. This research is unique because it compares many ideas into a single research project, accounting for possible error areas in past research: allowing for data collection about many different stress behaviours. By looking at many stress behaviours, a greater sense of impact can be understood. The controlled groups allowed for direct comparison between behavioural responses associated with different weaning methods making it very important for understanding the stress on beef calves at weaning time.