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Cow attributes, herd management and environmental factors associated with the risk of calf death at or within 1 h of birth and the risk of dystocia in cow–calf herds in Western Canada

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ABSTRACT

The risks of stillbirth and dystocia were measured for 29,970 full term births from 203 privately owned cow–calf herds in the 2002 calving season using on-farm supervised data collection. Mixed models adjusting for clustering by herd were used to examine associations between animal, herd management, and environmental factors and the risks of calf death at or within 1 h of calving, any assistance at calving, and severe dystocia. The mean risk of stillbirth was 2.7%, any assistance at calving was 8.9%, and severe dystocia was 3.7%. After accounting for other risk factors including assistance at calving, calves from cows with a precalving body condition score (BCS) of ≤ 3 ($P=0.002$) or 4 ($P=0.007$) out of 9 were more likely to be dead at or within 1 h of birth than calves from cows with a BCS of 5. Bred replacement heifers ($P=0.003$) and cows >10 years old ($P=0.01$) were more likely to have a stillborn calf than mature cows. Other risk factors for stillbirth included whether the calf was a twin ($P=0.0001$), the cow having a retained placenta or uterine prolapse ($P=0.0001$), month of calving ($P=0.05$), low precipitation during the previous growing season ($P=0.0008$), and assistance during the previous calving season ($P=0.046$). Cows that gained body condition from pregnancy testing to calving were less likely to require any assistance at calving ($P=0.01$). Cows with a BCS ≤ 3, 6, or ≥ 7 were more likely to have severe dystocia than cows with a BCS of 5 before calving ($P=0.04$). Assistance at calving and severe dystocia were less likely with each subsequent calving from the first through the third calf. Other risk factors for any assistance at calving and severe dystocia included male gender, being born as a twin, and birth earlier in the calving season. This is one of very few published studies to examine individual cow, herd, and environmental risk factors for both stillbirth and calving difficulty in a large number of privately-owned beef herds.

1. Introduction

Calving difficulty and stillbirth continue to be important issues for the cow–calf industry despite some decreases in dystocia during the last 20–30 years (USDA, 2010c; Waldner et al., 2013). The National Health Monitoring System in the United States reported a decrease in hard pulls in heifers from 7.4% in 1992–93 to 3.4% in 2007–08 (USDA, 2010b). The percentage of cows requiring assistance at calving, however, did not change during that time. Despite the improvements made by the industry, calving difficulty is still a concern to producers. In the Beef 2007–08 survey more than 63% of

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producers who planned on purchasing a bull ranked calving ease and birth weight as their most important selection criteria (USDA, 2010c). The importance of dystocia to calf loss both at birth and in the early postnatal period has been well established (Patterson et al., 1987; Waldner et al., 2010; Wittum et al., 1993). While there are many studies and review papers looking at factors associated with the occurrence of calving difficulty and stillbirths in beef herds in North America (Berger et al., 1992; Dargatz et al., 2004; Ganaba et al., 1995; Holland et al., 1993; Laster and Gregory, 1973; McDermott et al., 1992; Meijering, 1984; Nix et al., 1998; Patterson et al., 1987; Price and Wiltbank, 1978; Zabrorski et al., 2008), most of these data were collected more than 20 years ago. The push to rapidly increase weaning weights and average daily gain in the commercial cow–calf industry resulted in the widespread use of large frame Continental bulls, and feto-pelvic disproportion was very common (Mathison, 1993; Meijering, 1984; Price and Wiltbank, 1978). Average herd size and the intensity of calving management have also changed during this period (USDA, 2010b).

Much of the existing cow–calf research on stillbirth and dystocia comes from multiyear studies of single research herds (Echternkamp and Gregory, 1999; Gregory et al., 1996; Holland et al., 1993; Laster and Gregory, 1973; Nix et al., 1998; Patterson et al., 1987) or analysis of purebred performance records (Berger et al., 1992), and focuses on specific cow and calf attributes. Many of the previously reported studies used simple single variable statistics that did not account for confounding. None of the multiyear studies accounted for the impact of repeated measures in the analyses beyond the inclusion of year as covariate.

There are relatively few studies that report stillbirth or dystocia in privately owned commercial herds (Dargatz et al., 2004; Dutil et al., 1999; Ganaba et al., 1995; USDA, 2010c; Waldner et al., 2013; Wittum et al., 1993). Even fewer include multivariable analyses of both individual animal and herd management factors, while accounting for the expected similarity or clustering of calving outcomes within herds (McDermott et al., 1992; Wittum et al., 1994). None of the studies used generalized linear mixed models (GLMM) and maximum likelihood estimation. Particularly when analyzing event outcomes that are clustered by herd, GLMM is a preferred method for estimating individual and herd level risk factors from complex observational studies (Dohoo et al., 2009). The most recent study to report cow level estimates was based on data from 10 herds in 1991 (Wittum et al., 1994).

Previous research on individual animal risk factors for stillbirth has focused on cow age and parity, genetics, birth weight, pelvic area, twinning, and dystocia (Berger et al., 1992; Dargatz et al., 2004; Echternkamp and Gregory, 1999; Gregory et al., 1996; Laster and Gregory, 1973; Nix et al., 1998; Patterson et al., 1987). There are few publications evaluating body condition scores at both pregnancy testing and calving on the risk of stillbirth or dystocia. In addition, information on the changes in body condition score over the winter feeding period and their association with stillbirth and dystocia rates in privately owned commercial herds is limited. Although there are no recent references documenting this association, Zabrorski et al. (2008) reported a higher risk of calving difficulty in over conditioned cows. Low body condition at calving has been associated with poor pregnancy rates in the subsequent breeding season (Waldner and Garcia Guerra, 2013), but there are no recent references examining whether there is a link to dystocia or stillbirth risk.

The primary objective of this paper was to describe the associations between cow attributes, such as age and body condition, herd management, environmental factors, and the risk of calf death near birth in commercial beef herds from Western Canada. Specifically, repeated on-farm observation of individual cows provided a unique opportunity to identify the measures of body condition score most closely associated with the risk of a calf death at or within 1 h of birth. The secondary objective of this study was to examine the associations between herd and cow attributes and the risk of any assistance at calving or more severe dystocia. Stillbirth was chosen as the primary focus of this study because it could be more objectively measured than the need for assistance at calving, was audited with the assistance of necropsy records (Waldner et al., 2010), and had immediate economic impact on the producer.

2. Methods

2.1. Study participants

In 2001, a large observational project was initiated in Western Canada to assess the association between the oil and gas industries and cow–calf herd health (Waldner, 2008). This study provided a rare opportunity to collect detailed on-farm information about herd demographics, management, cattle health and productivity. Only a subset of the animals included in that study with complete location and air quality data history has been reported to date (Waldner, 2009). The objectives of the primary reports were limited to examining the effect of exposure to the petroleum industry on health and reproductive performance. They did not specifically address the associations between herd management and cow-level factors and the risk of reproductive failure, other than to correct for these factors as confounders. Other risk factors were simply controlled in the original analysis without reporting or discussing estimates of their effect.

Herds were recruited by contacting veterinary clinics from cattle-producing areas in Alberta, Saskatchewan, and North-eastern British Columbia. Private veterinarians were asked to contact clients with herds matching a series of selection criteria. Herd size, where possible, was to be between 50 and 250 breeding females. All animals were to be individually identified with at least one readily visible ear tag. The herds were to have an established spring–summer breeding season. All calf births were to have been recorded during the previous calving season. The herd owner was to have access to facilities suitable for pregnancy testing, bull evaluation, and blood sample collection. Bulls were to have been evaluated by a licensed veterinarian before use in the previous breeding season. Cows and heifers had to have been pregnancy tested by a licensed veterinarian following the previous breeding