Cow attributes, herd management, and reproductive history events associated with the risk of nonpregnancy in cow-calf herds in Western Canada

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ABSTRACT

To identify herd management and cow characteristics associated with the reproductive success of cow-calf herds in Western Canada, 33,391 beef cows were followed from the beginning of the breeding season in 2001 through pregnancy testing in 2002. Breeding management and cow-level risk factors such as age, body condition score (BCS), and previous reproductive history, were measured through a series of herd visits by project personnel and records maintained by the herd owner. Pregnancy status was measured in 205 herds in the fall of 2001 and again in 200 herds in the fall of 2002. Cows least likely to be pregnant in the fall of the year were 10 years old or older, exposed to a bull less than 84 days, had a BCS ≤ 5 of 9 at pregnancy testing, <5 of 9 before calving, and lost condition between calving and the start of the breeding season, or had a prebreeding BCS <5 of 9 with a loss of condition between breeding and pregnancy testing. Other factors identified that decreased the likelihood of pregnancy in at least one of the 2 years included being a heifer or being a cow exposed to breeding after her first calf, and using a single bull on breeding pasture. Cows vaccinated for bovine viral diarrhea virus and infectious bovine rhinotracheitis and bred on community pastures were more likely to be pregnant than cows that were not vaccinated and bred on community pastures. Cows bred on community pastures that were not vaccinated were also less likely to be pregnant than cows that were not on community pastures regardless of vaccination status. Calving-associated events such as twin birth, Cesarean section or malpresentation, problems such as uterine prolapse or retained placentas, abortion or calf death within 1 hour after birth, or calving late after the start of the breeding season, were also associated with fewer pregnancies after accounting for all other factors.

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1. Introduction

Reproduction is one of the most important factors affecting the success of cow-calf operations [1–3]. Failure to conceive and early pregnancy failure are the primary causes for lost net calf crop [1] and important reasons for culling cows from the herd [4–6]. Losses from abortions and stillbirths are the next most important determinants of economic success [1,7].

Reproductive success measured by the proportion of cows pregnant after a defined breeding period can be affected by herd management, cow attributes, and previous reproductive history. Commonly employed herd management practices include: controlling the length of the breeding season, minimizing biosecurity risks, vaccination, and optimizing nutrition. For example, shorter breeding seasons have been associated with decreased costs and improved productivity [8]. The use of community pastures during the breeding season is a common challenge to biosecurity in many herds and can be linked to reduced reproductive performance because of increased exposure

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to infectious agents such as *Tritrichomonas foetus* [9]. However, vaccines can be used to help manage biosecurity risks for some pathogens. In experimental studies, vaccines against bovine viral diarrhea virus (BVDV) and infectious bovine rhinotracheitis (IBR) have been shown to protect against abortion and fetal infection [10–13].

The most commonly used measure of nutritional management is body condition score (BCS). Body condition score, parity, and age [9,14–19] have all been identified as important risk factors for pregnancy status. Similarly, dystocia and the degree and timing of assistance at calving have been associated with increased interval from calving to estrus and a decreased conception rate in cows that have previously calved [20,21]. Problems after calving such as retained placenta, metritis, and prolapsed uterus can also reduce cow fertility [22]. Although associations have been reported between each of these factors and reproductive performance in beef or dairy cows, the most of these studies were conducted in individual research herds or using data collected from producer surveys. There are few large observational studies assessing the relative importance of herd management and individual animal risk factors for pregnancy status in commercial beef herds. To generate effective evidence-informed recommendations for the cow-calf industry, conclusions from existing experimental studies and surveys should be supplemented with accurate individual animal data collected from large numbers of privately owned herds.

The primary objective of this study was to examine the associations between herd management choices, and cow attributes, such as age and BCS, and the risk of non-pregnancy in commercial beef herds from western Canada. Specifically, repeated on-farm observation of individual cows provided a unique opportunity to identify the measures of BCS most closely associated with reproductive performance. Biosecurity concerns associated with the use of community pastures also prompted interest in the relative importance of vaccination history for reproductive performance in cows that were exposed to communal grazing pastures compared with those that were not. An additional objective was to examine the potential effect of adverse events in the previous calving cycle on subsequent reproductive performance.

2. Materials and methods

2.1. Herd selection

In 2001, a large study was undertaken to measure the effect of the oil and gas industry on beef cattle health in Western Canada [23]. This project provided a unique opportunity to collect detailed on-farm information about management, herd demographic characteristics, and herd productivity. To date, information on only a subset of the animals included in that study with complete location and air quality data history have been reported. The objectives of the initial studies were limited to describing the effect of exposure to the petroleum industry on herd productivity, and did not provide detailed information on the associations between herd management and cow-level factors on reproductive success. Other risk factors were simply

controlled for in the original analysis as covariates, but their effect estimates were not reported or discussed. There were no associations identified between measures of exposure to the oil and gas industry and the risk of nonpregnancy in these herds [24], so industry exposure was not considered in the subsequent analyses.

Briefly, herds were recruited by contacting veterinary clinics from cattle-producing areas in Alberta, Saskatchewan, and northeastern British Columbia. Private veterinarians were asked to contact the owners of herds that met the following selection criteria: (1) herd size, where possible, was to be between 50 and 250 breeding females; (2) all animals were to be individually identified with at least one readily visible ear tag; (3) all calf births should have been recorded during the previous calving season; (4) the herd owner was to have access to facilities suitable for pregnancy testing, bull evaluation, and blood sample collection; (5) cows and heifers should have been tested for pregnancy by a licensed veterinarian after the previous breeding season; (6) the herd owner needed to have an established spring through summer breeding season for the herd; (7) bulls should have been evaluated by a licensed veterinarian before use in the previous breeding season; (8) the herd owner needed to have an established, working relationship with a local veterinary clinic; and (9) the herd owners and their veterinarians had to be interested in the study and commit to completing the study protocol.

Participating herd owners continued to use their regular herd veterinarians for bull evaluations and pregnancy examinations. All pregnancy testing was to be completed by a licensed veterinarian. Cooperating herd owners were paid a token amount for each cow that was tested for pregnancy in 2001 and 2002 and for cows with calving records in spring 2002 to maximize the completeness of individual animal records for each herd.

2.2. Risk factors, herd management, and reproduction data

Early in 2001, five veterinarians were employed by the study to initiate on-farm data collection and establish an initial inventory for each herd. Animal identification, date of purchase, date of removal from inventory, and the reason for removal were recorded by the herd owner.

The veterinarians employed by the study also collected data on individual and herd-level risk factors that might be associated with reproductive status including cow age, breed, and BCS (using a nine-point scale [25]) before breeding and at pregnancy testing in 2001; the latter activities provided opportunities to verify the herd inventory reported by the herd owner. The veterinarians also assessed BCS before calving, before breeding, and at pregnancy testing in 2002. One study veterinarian visited the same herd across all time periods to ensure consistency within herd. They were also trained and evaluated as a group at the start of the study to optimize consistency of collected BCS data across herds. Herd management data, including vaccine use, were collected during farm visits and verified where practical with direct observation.

Before the breeding seasons in 2001 and in 2002, bulls were evaluated for breeding soundness by a veterinarian chosen by the herd owner, using the criteria and forms