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## REPRODUCTIVE PERFORMANCE OF BISON AT THE NATIONAL BISON RANGE

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**ABSTRACT:** The recruitment of calves at the National Bison Range (NBR) near Moiese, MT has dropped from the historic average of 87 to 33 calves per 100 breeding age cows in 2008. The purpose of this study is to monitor the NBR bison pregnancy rates and calf recruitment in an effort to determine where in the reproductive cycle NBR female bison fail to recruit calves. The reproductive cycle was divided into 3 stages: conception to early embryonic development; maintenance of pregnancy during the second and third trimesters; and, calving to recruitment. Herein we report results related to the first two stages. Pregnancy rate of 41 cows, ages 4 to 12 yr, were determined by transrectal ultrasonography of the uterine contents of each cow in early October at the NBR's annual roundup. Pregnant cows were given a number, painted on the right flank of each animal, using a commercial hair-bleaching agent. Numbers were used to identify individual cows throughout the study period. A blood sample, collected by jugular venepuncture and fecal sample were collected from each cow and from 3 bulls for assay of progesterone (P4) by RIA. Serum and fecal P4 concentrations from anovular cows and bulls were used to determine a P4 baseline to evaluate pregnancy rate using P4 concentrations in fecal samples collected from cows, collected in the field, in early January. The criterion used for evaluating pregnancy was based on fecal P4 concentrations of bulls and anovular cows plus 2 SDs or 20.4 ng/g of feces. Additional fecal samples were collected from cows that were not painted with a number to better estimate the overall pregnancy rate of the herd. During the 2008 roundup, 28 of 41 (68%) cows were determined to be pregnant. During the second trimester samples were collected from 26 of the 28 numbered cows and 28 unmarked cows. Of those, 15 (58%) numbered and 4 (14%) unmarked cows had fecal progesterone concentrations that exceeded the criterion for a P4 concentration considered to be consistent with pregnancy. By establishing the timing of reproductive failures, managers will be able to focus their efforts in determining the causative agent(s) of the reproductive failure in this herd.

**Key words:** bison, fecal progesterone, pregnancy rate

### Introduction

The 18,500 acre National Bison Range (NBR) near Moiese, MT was established by Congress in 1908. In 1909-1910, 40 bison were brought to the NBR, and by the early 1920's the herd size was near 300 animals. NBR bison have historically had little problem with recruitment, which for the purpose of this study is defined as the survival of a calf until the bison roundup that occurs each year usually during the first week of October. The National Bison Range Fenced Animal Management Plan states that over 32 years (1956-1987) the average recruitment was 87%. The lowest recruitment recorded during that same period of time was 72% in 1970. Then bison of the NBR have had little trouble with diseases that are known to affect reproduction. According to the National Bison Range Fenced Animal Management Plan, the herd was certified brucellosis free in 1983 by the Montana Department of Livestock. In 1979 it was believed that the bison experienced an outbreak of Leptospirosis characterized at the time by late calving. In 1980 calf recruitment had dropped to 74%. Personnel at the NBR initiated an annual Leptospirosis vaccination program for an unknown length of time and the problem seemed to be resolved, as calf recruitment was back up to 85% in 1981. During the last 3 years (2005-2007) recruitment has dropped to an average of 54%, and the cause of this decrease in production is unknown (U.S. Fish and Wildlife Service, unpublished data). The objective of this study was to determine when during the reproductive cycle of bison at the NBR are failing to recruit calves. Specifically we evaluated losses associated with early embryonic and fetal loss by transrectal ultrasonographic evaluation of the contents of the uteri of female bison and by fecal concentration of progesterone during gestation.

### Materials and Methods

This study will be conducted over a two-yr period. For the purpose of this study in each year gestation of female bison will be broken into 3 periods. In the first period we will monitor conception to early embryonic development. In early October, pregnancy rates will be determined during the NBR annual bison roundup using transrectal ultrasonographic evaluation of the contents of the uteri of cows with a Titan Ultrasound Imaging System (SonoSite, Bothell, WA) equipped with a selectable 5 to 10 MHz transducer. The accuracy of ultrasonic evaluation is approximately 100% at detecting

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pregnancy between 21 and 30 d after fertilization. Given the detection limit of 21 to 30 d there is the possibility of failing to detect the presence of an embryo in those females that bred late in the breeding season. Twenty-eight cows were determined to be pregnant at the 2008 roundup. These cows received a number on the right flank using a commercial hair-bleaching agent that allows us to identify these individuals for collection of fecal samples throughout the remainder of gestation.

Blood and fecal samples were collected from 41 cows (4 and 12 yr of age) at roundup. These samples were used to validate assays for fecal progesterone concentrations. Fecal progesterone concentrations were correlated with serum concentrations of progesterone to evaluate the accuracy of fecal progesterone concentrations for determining a criterion for the minimum fecal progesterone concentration associated with pregnancy.

During the second period cows will be monitored for maintenance of pregnancy using fecal progesterone concentrations. Limiting the invasiveness of sample collection is an important consideration when selecting a sampling method in bison. Pregnancy determination using fecal steroid concentration has been validated using bovine (Desaulniers, et al. 1989), and bison feces (Kirkpatrick et al., 1992). Using fecal samples to determine pregnancy status will allow us to avoid the unnecessary handling of cows and will limit animal stress during pregnancy. Fecal material has been collected from adult cows and assayed for progesterone using solid phase radioimmunoassay as described in Kirkpatrick et al. (1992), and Custer et al. (1990). Samples were collected in January (second trimester) and in March (third trimester). Extraction of progesterone from fecal samples of bison was performed by the method described by Brown et al. (2005).

The method for collecting fecal samples in the field involved personnel that found and monitored groups of bison that included cows. Personnel observed these cows until a cow defecated. Any cow that defecated in that group was then marked with livestock paint using a paint dart. Then, the group was slowly pushed from that area so that fecal samples from cows could be safely collected. Every effort was made to collect as many samples from bleach-numbered cows as possible.

In the third period, calving to recruitment will be monitored by two methods. First, monthly calf counts will be conducted from late March until mid September. At least 200 bison will be observed and classified as calves or non-calves and the observed ratio will be extrapolated to the whole herd. Also, fecal samples from cows will be collected for progesterone assays during each monthly calf survey or until 2 consecutive fecal progesterone concentrations are below the minimum criterion established for progesterone concentrations in pregnant cows. These two rates should provide a reliable estimate of fetal losses that can be used to compare pregnancy rates estimated earlier in gestation. Bleach-numbered cows will be counted and monitored until it can be determined a cow is tending a calf. The calf will be

assumed to have been lost if it is not present with the cow in subsequent surveys.

## Results

In 2008, calf recruitment of the NBR was at an all time low of 33% (Figure 1). During the 2008 roundup 41 breeding-age cows were examined. Of those, 28 (68%) were determined to be pregnant via ultrasonic evaluation (Table 1).

Bull and anovular cow feces were used to determine extraction efficiencies and establish a pregnancy cutoff. Extraction efficiencies were approximately 79%. The minimum fecal concentration of progesterone for evaluating pregnancy was determined from concentrations from fecal samples collected from bulls and anovular cows. The mean concentration of these samples was to be 20.4 ng/g of feces. This was based on the concentration that was 2 SD above the average of bulls and anovular cows fecal progesterone concentrations.

During the second trimester, all 28 numbered cows were observed alive, and samples were collected from 26. Additionally, 28 samples from unmarked cows were collected. Of the numbered cows, 15 of 26 (58%) and 4 of 28 (14%) unmarked cows had fecal concentrations of progesterone that exceeded the criterion for pregnancy.

Fecal samples from numbered cows collected in January were extracted and assayed a second time to determine the repeatability of the assay. Results from the second assay were considerably different than the first assay. Of the 26 numbered cows 24 (90%) of them had fecal concentrations of progesterone that exceeded our criterion for pregnancy. Likewise of the 28 unmarked females 15 (58%) exceeded the criterion for concentrations of progesterone consistent with pregnancy. In order to evaluate the repeatability and reliability of our extraction and assay procedures, a subset was then homogenized and assayed a third time. The reason for this was that progesterone may be stratified within the fecal samples. So that taking an aliquot for assay from the top of our fecal sample may be different than taking an aliquot from the middle or bottom of our sample. Results from this assay were both higher and lower than the original assays (Table 2).

## Discussion

The list of possibilities that cause decreases in recruitment is lengthy. The bison could be experiencing an outbreak of a viral disease, a mineral or vitamin deficiency, an increase in predation or the herd is over habitat capacity. The magnitude of the list of diagnostics makes it essential that the timing of the recruitment failure be established before further testing is done to determine the exact cause of the failure.

The variation observed in fecal P4 in the same pregnant females among samples collected at roundup, in

January, and homogenized samples from January's collection indicate that fecal progesterone concentrations do not accurately or repeatably assess the pregnancy status of a cow. Additional assays of homogenized fecal samples are necessary to determine the repeatability and usefulness of fecal P4 assays as a non-invasive pregnancy detection method.

### Implications

The results from this study will be the foundation for future research into the exact cause of the decrease in recruitment. Data from this project will help managers determine if a change in management is warranted. If no reduction in recruitment is detected the problem has either resolved itself and no further research is needed or adjustments to our sampling or analyses are warranted. Data will reinforce existing data on collection and extraction techniques for fecal progesterone concentration as a criterion for determining pregnancy status of a herd of bison.

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Table 1. Number of pregnant and non-pregnant cows determined by ultrasonic evaluation during the 2008 roundup in early October.

Pregnant	Non-Pregnant	Total
28	13	41

Table 2. Progesterone concentrations (ng/g of feces) for 10 cows. Assay 1 and Assay 2 aliquots were collected from the sample before homogenization, while Assay 3 was collected after.

Assay 1	Assay 2	Assay 3
23.8	20.7	17.5
27.1	84.5	91.1
22.2	24.8	16.1
60.1	156.9	52.3
11.7	50.9	29.5
18.3	147.7	40.2
5.8	24.5	13.8
5.8	14.5	9.6
17.8	101.9	33.7
4.7	10.3	10.0

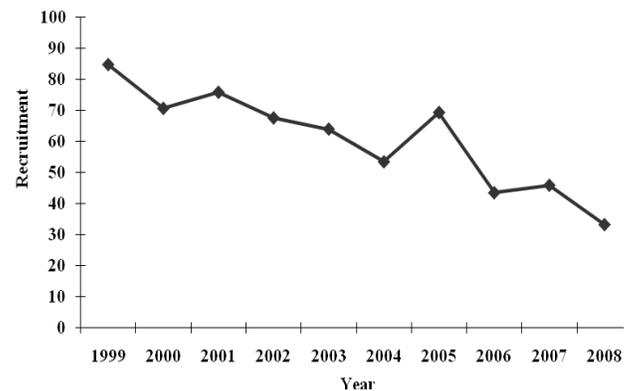


Figure 1. Calf recruitment at roundup for the National Bison Range bison herd over the last 10 yr. The long-term average recruitment is 87 calves per 100 breeding age cows. Calf recruitment has steadily declined over the last 10 years to an all time low of 33% in 2008.