



INTRODUCTION

In locations above 1,600 meters, high altitude disease manifests itself in cattle and can lead to economic hardship by causing a five percent death loss in high altitude cattle herds (Williams, et al., 2012). In addition, little is known regarding how high altitude effects other traits in beef cattle (Holt & Callan, 2007). Reproductive performance is one such trait, and is one of upmost importance to beef producers, since it is the most economically important trait in beef cattle (Gutierrez et al., 2002). It is critical to minimize economic loss, however, it is unclear how high altitude and reproductive performance interact.

It has been found that high elevation (greater than 1,600 meters) can cause a physiological state of pulmonary hypertension in cattle (Pauling, et al., 2018). Reduced atmospheric oxygen at elevation causes the cardiopulmonary system to compensate, leading to alveolar-hypoxia. This induces pulmonary arterial vaso-constriction and vascular wall remodeling, ending in right side heart failure and eventually death (Pauling, et al., 2018). However, pulmonary arterial pressure (PAP) testing can predict a disposition for pulmonary hypertension. Normal PAP scores at 5,000-6,000 feet elevation are between 34-44 mmHg, while scores ranging from 48 to 213 mmHg can display signs of pulmonary artery hypertension (Holt & Callan, 2007). Management decisions can be completed based on PAP scores, and level for pulmonary hypertension (Holt & Callan, 2007). While there is limited research on how high altitude and pulmonary arterial pressure effects other traits in beef cattle, high altitude disease (HAD) has been found to be heritable. *Therefore, it was hypothesized that there will be no effect of PAP scores on pregnancy and first service conception rates.*

OBJECTIVE

Determine the effect of high altitude on reproductive performance in Angus heifers



Figure 1. Normal heifer and beef heart



Figure 2. Heifer and beef heart with HAD

MATERIALS & METHODS

Location, animals and management

- Location: Colorado State Beef Improvement Center (CSU-BIC), Saratoga, WY
- Elevation: 2,150-2,411 m
- Historical data collected from 1995-2016
- 2,503 head of *Bos taurus* yearling Angus-influenced heifers
- Management: commercial setting, spring calving
- Artificial Insemination (AI) occurred in May using an estrus synchronization protocol
- Females exposed to a natural service bull 60 days post AI

Trait collection

- Data: herd identification, sire, dam, birth year, mating year, AI technician, AI sire, mating age, first service conception, age at first calving, PAP score and collection date
- First service conception (FSC) - determined via ultrasonography via rectal palpation at 30 and 60 days post AI
- PAP scores collected each spring (Holt & Callan 2007)
- Treatments: Females sorted into **low** (>41 mmHg) or **high** (<41 mmHg) groups based on PAP score and CSU-BIC selection criteria

Data analysis

- Reproductive rate (first service conception, overall pregnancy rate):
 - ANOVA (Statistix, v. 10)
 - Randomized block design, block = year of birth
 - Fixed effect = PAP classification (low vs. high)
- Relationship of PAP and reproductive rates
 - Logistic regression (SPSS, v. 25)
 - Predictor = PAP



Figure 3. Cows grazing in Saratoga, WY



Figure 4. PAP collection



Figure 5. Cows grazing in Saratoga, WY

RESULTS AND DISCUSSION

First Service Conception ($P = 0.55$)

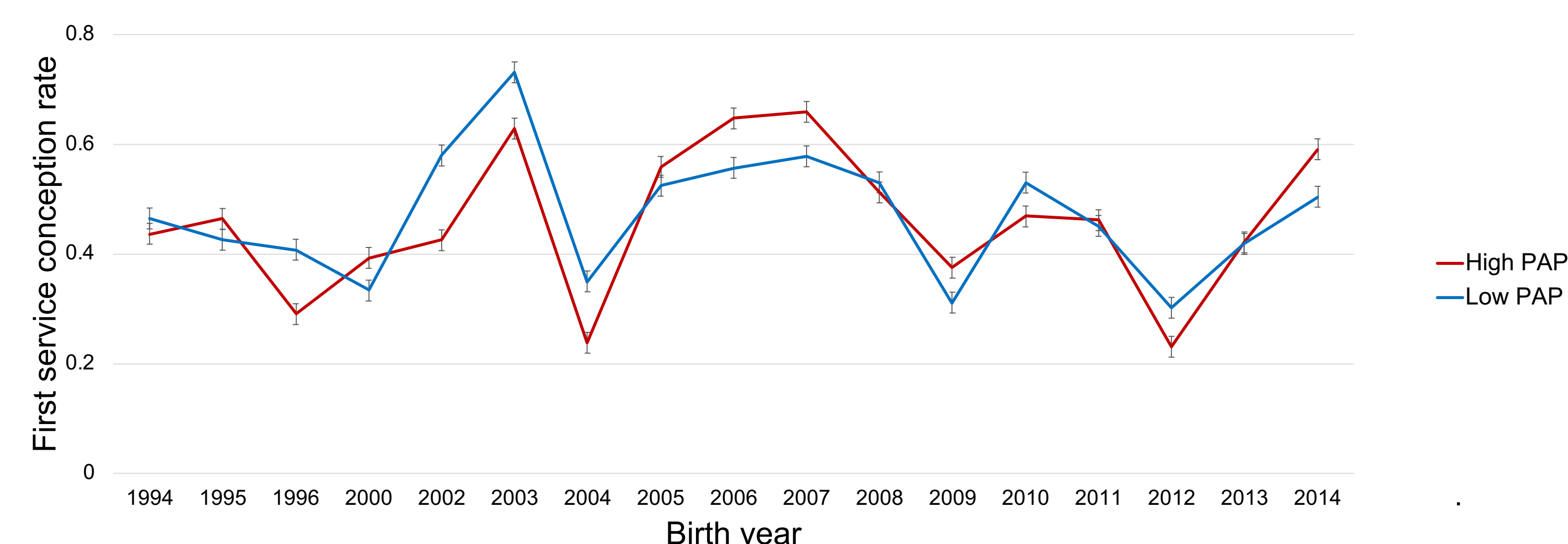


Figure 6. First service conception rate in first-calf heifers raised at high altitude (2,150 to 2,411 m), grouped by birth year, and PAP score (i.e., high = ≥ 42 mmHg ($n = 940$), and low = < 42 mmHg ($n = 1563$)).

RESULTS AND DISCUSSION CONT.

Overall Pregnancy Rate ($P = 0.03$)

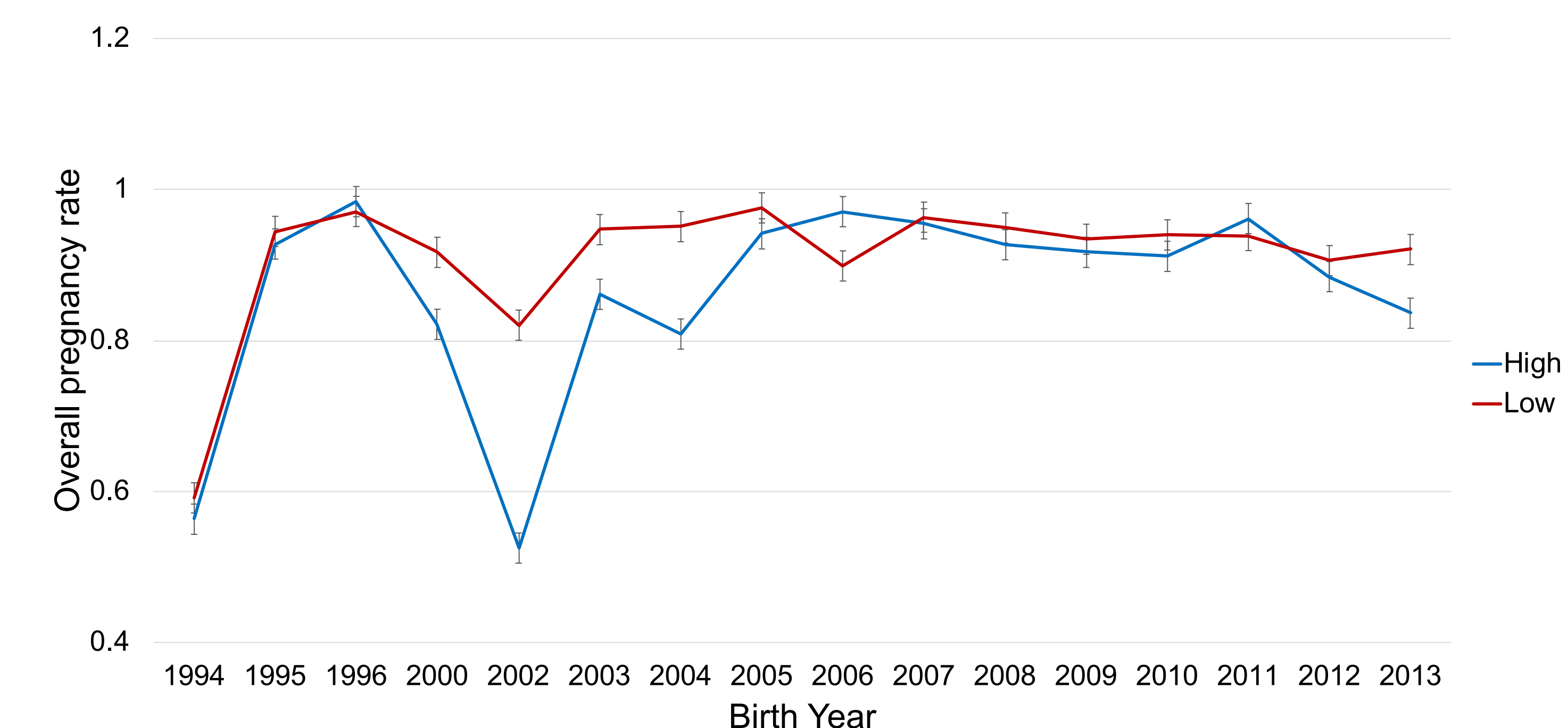


Figure 7. Overall pregnancy rate in first calf heifers raised at high altitude (2,150 to 2,411 m), grouped by birth year, and by high (≥ 42 mmHg; $n = 896$), and low (< 42 mmHg; $n = 1450$) PAP score.

- Logistical regression showed a negative relationship between fertility traits and PAP
 - Low PAP females had a higher overall fertility
 - High PAP females had lower overall fertility
- First service conception vs. overall conception
 - Conception vs. maintenance of fetus and effect of oxygen on conceptus possibly accounts for difference between first service conception results and overall conception results (Fischer and Bavister, 1993)

CONCLUSION AND IMPLICATIONS

High altitude disease is an issue for cattle producers in the west, causing pulmonary arterial vaso-constriction and vascular wall remodeling, and eventually heart failure and death, leading to economic hardship for ranchers above 1,600 m. The objective of this study was to look at the effect of high altitude on reproductive performance in Angus heifers. Using pulmonary arterial pressure (PAP) as an indicator for predicating pulmonary hypertension, the correlation between PAP score and first service conception, and overall pregnancy rate was evaluated in 2503 head of yearling *Bos taurus* Angus heifers between 1995-2016, located at 2150-2411 m. in Encampment, WY. It was found that PAP was not a significant indicator of first service conception, however it was found to be a significant indicator of overall pregnancy, as low PAP groups had higher conception rates. Future research should focus on other reproductive health indicators and PAP, while accounting for factors such as climate events and differences in ranch management over the years.

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