# Pronghorn Monitoring in the Pinedale Anticline Project Area

## 2014 Annual Report

**Prepared for:**

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# SECTION I: Wildlife monitoring and mitigation matrix

## Overview

As part of the Record of Decision for gas development in the Pinedale Anticline Project Area (PAPA), the Bureau of Land Management (BLM) developed a Wildlife Monitoring and Mitigation Matrix (WMMM) that provides direction for development-phase wildlife monitoring (BLM 2008). For pronghorn (*Antilocapra americana*), the WMMM was intended to identify monitoring parameters that allow changes in pronghorn occupancy to be quantitatively assessed. The WMMM specifies that mitigation measures will be triggered if a 15% decline in pronghorn occupancy in the PAPA is detected in any year, or a cumulative change over all years beginning in the winter of 2009-10, relative to changes in the larger Sublette herd. Here, we report monitoring results for the winter of 2013-14, where estimates indicate an increase in pronghorn occupancy of the PAPA from 2009-10.

## Methods

We estimated pronghorn occupancy in the PAPA in January, February, and March 2014 using aerial line transect surveys. The goal of each survey was to obtain a complete count of the number of pronghorn occupying the study area. Conducting multiple surveys allowed us to assess the variability in occupancy over time and estimate the average number of pronghorn occupying the study area during the winter period.

Line transects were spaced approximately ½-mile apart and were flown in an east-west orientation (Fig. 1) using fixed-wing aircraft flying at 300–400 feet above ground level to minimize animal disturbance. Locations of all detected pronghorn groups were recorded using a Global Positioning System (GPS), and group sizes were visually counted. Groups with >50 animals were recorded with a hand-held video recorder (Sony HD Handycam HDR-CX100), so that group size could be determined by image analysis.

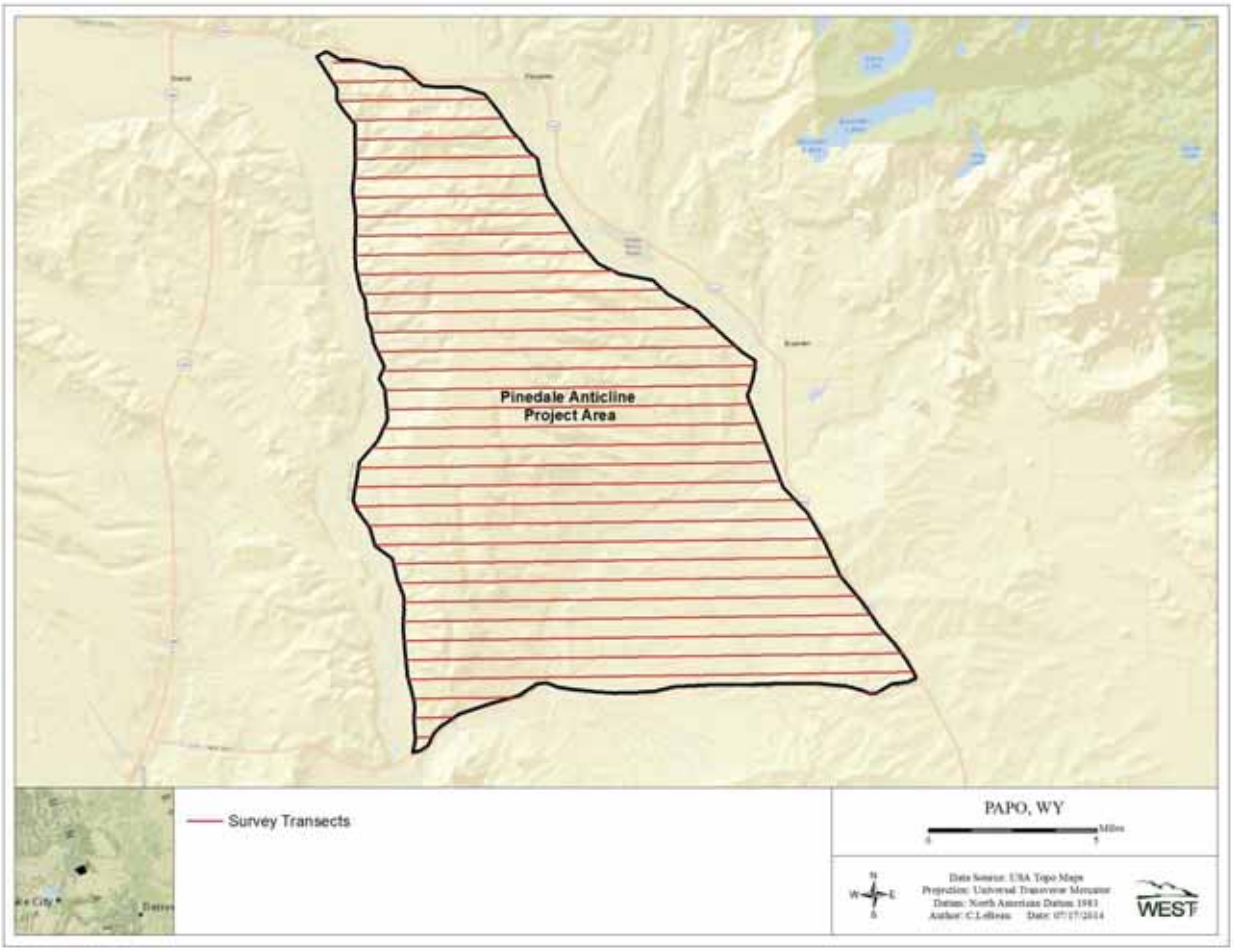


**Figure 1. Survey transects over the Pinedale Anticline Project Area.**

Video images were analyzed in the office by two independent observers. When a video clip could be reduced to one still image containing an entire pronghorn group, the two observers reviewed the image independently, and then collectively, until consensus was reached on the total group size (Fig. 2). When a video clip could not be reduced to a single image containing the entire group, we used the average of the two counts from independent observers viewing the same video clip as the estimated group size. The sum totals of observed group sizes were considered estimates of the total number of pronghorn occupying the PAPA during each survey.

**Figure 2. Example of a pronghorn group count (*n* = 165) based on a video clip from an aerial survey.**

We calculated 90% confidence intervals (CIs) for each occupancy estimate using a bootstrap procedure (Manly 2006) that involved randomly selecting one of the two observer counts for non-consensus counts and adding those to the sum of group sizes from the consensus counts. This process accounted for the variation between observers in counting large groups. A total of 200 bootstrap samples were used to calculate 90% CIs based on the central 90% of the bootstrap distribution (i.e., "Percentile Method") for each estimate.

Pronghorn occupancy varied substantially during the 2009-10, 2010-11, 2011-12, 2012-13, 2013-14 winters, so we calculated an average occupancy for each winter. Ninety-percent CIs were calculated by randomly sampling, with replacement, 2 survey days (for 2009-10 monitoring period; Nielson and Sawyer 2011) or 3 survey days (for 2010-11 through 2013-14 monitoring periods; Nielson and Sawyer 2012, Nielson et al. 2013a) from each winter, using the bootstrap procedure described above, and then averaging the new total counts. In addition, we calculated the percent change in occupancy from the 2009-10 winter to the 2013-14 winter.

## Results

Pronghorn occupancy in the PAPA was variable across the three monthly surveys. We counted 2,022 pronghorn in 17 groups on January 21, 2,975 pronghorn in 28 groups on February 21, and 2,232 pronghorn in 47 groups on March 13 (Table 1, Fig. 3). Based on these 3 surveys, the estimated average number of pronghorn occupying the PAPA during 2013-14 winter was 2,409 (90% CI: 2,050 – 2,774), compared to 1,533 (90% CI: 772 – 2,305) in the 2009-10 winter. This represents a 57% increase in average occupancy on the PAPA from 2009-10 to 2013-14 winters (90% CI: 5.2% decline to 239% increase; Fig. 4).

In contrast, WGFD population estimates for the entire Sublette herd unit reference area were 59,000 in 2010 and 34,000 in August of 2013, representing a 42% decline (Table 2).

**Table 1. Occupancy estimates for the Pinedale Anticline Project Area from winter aerial surveys. Ninety percent confidence intervals are to the right of each total count, unless a consensus was reached on all group sizes (indicated by 90% CI = 'NA').**

| Area | Month | Winter 2009-10 | | Winter 2010-11 | | Winter 2011-12 | | Winter 2012-13 | | Winter 2013-14 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Estimate | 90% CI | Estimate | 90% CI | Estimate | 90% CI | Estimate | 90% CI | Estimate | 90% CI |
| PAPA | Jan | 775 | 782<br>767 | 1,420 | 1,425<br>1,415 | 2,200 | NA<br>NA | 1,492 | 1,505<br>1,480 | 2,022 | 1,852<br>2,179 |
| | Feb | 2,290 | 2,323<br>2,256 | 505 | NA<br>NA | 1,126 | 1,142<br>1,109 | 605 | 610<br>600 | 2,975 | 2,884<br>3,056 |
| | Mar | NA | NA<br>NA | 1,184 | NA<br>NA | 2,258 | 2,263<br>2,253 | 2,604 | 2,609<br>2,599 | 2,232 | 2,201<br>2,261 |
| | ***Avg.*** | ***1,533*** | ***2,305***<br>***772*** | ***1,036*** | ***1,344***<br>***731*** | ***1,861*** | ***2,242***<br>***1,473*** | ***1,567*** | ***2,239***<br>***895*** | ***2,409*** | ***2,050***<br>***2,774*** |

**Table 2. Wyoming Game and Fish Department mule deer population estimates for the entire Sublette herd unit.**

| Year | Estimate | % Change from 2010 |
|---|---|---|
| 2010 | 59,000 | NA |
| 2011 | 37,800 | -36 |
| 2012 | 40,000 | -32 |
| 2013 | 34,000 | -42 |

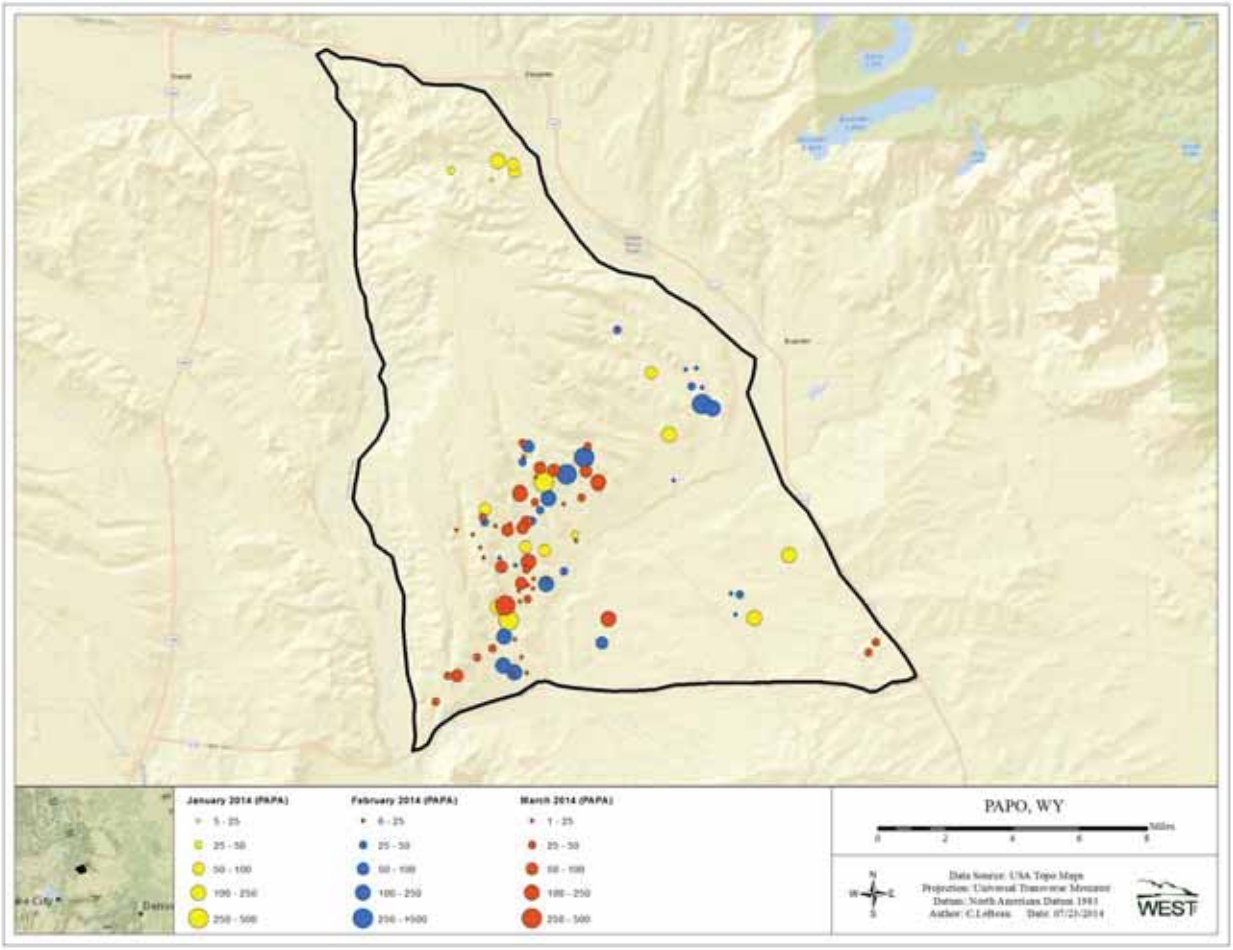


**Figure 3. Location and relative size of pronghorn groups observed during aerial surveys over the Pinedale Anticline Study Area.**

## Discussion

The current methodology for estimating pronghorn occupancy does not adhere to common line transect distance methodology (Buckland et al. 2001), but instead is based on a 'complete count' technique (Seber 2002), that accounts for differences in observers viewing each video segment, and variability across surveys. Current application of the complete count technique involves flying a dense sample of line transects (spaced ½-mile apart), attempting to locate every group of pronghorn in the study area, and using high-definition video images to determine group size. A key assumption of this method is that few, if any pronghorn groups were missed or incorrectly counted.

The problem with application of traditional line transect distance methodology (Buckland et al. 2001) for pronghorn during the winter is the assumption that animals do not move in response to observers. Obviously, pronghorn are very mobile and react quickly to nearby aircraft, which

would likely violate this assumption and result in observers detecting groups after movement and further from the transect line.

At this time, we believe the 'complete count' approach is the preferred method and that surveying line transects ½-mile apart using HD video to determine group size is likely the most efficient and reliable method of estimating pronghorn occupancy. However, it should be recognized that this technique can only produce an index, and not a complete count, unless we are confident that all pronghorn were detected and none were double-counted. Regardless of whether the estimate is considered a complete count or an index of occupancy, this approach should provide a reliable means to monitor trends in pronghorn occupancy through time, provided there is little movement of pronghorn in and out of the study area during the winter months. It is our opinion that the winter surveys provide accurate estimates of occupancy when snow conditions are optimal – when pronghorn congregate in large groups and probability of detection is high.

The WMMM specifies that mitigation measures will be triggered if a 15% decline in pronghorn occupancy in the PAPA is detected in any year compared to the first year of occupancy monitoring (2009-10 winter), or a cumulative change over all years since the first year, relative to the larger Sublette herd unit reference area. We estimated a 57% increase in occupancy of the PAPA in 2013-14 compared to 2009-10; however, this was not significant at the $\alpha = 0.10$ level. In addition, we estimated a 52% increase in occupancy of the PAPA in 2013-2014 compared to 2012-2013; however, this was not significant at the $\alpha = 0.10$ level.

## SECTION II: Resource selection modeling

### Overview

As part of the pronghorn monitoring effort we attempted to maintain a sample (~30 animals) of GPS-collared pronghorn in both the Pinedale Anticline Project Area (PAPA) and Bench Corral Study Area to document movements and understand whether occupancy estimates were influenced by movements of animals between the two areas (i.e., marked animals occupy their respective winter ranges when we conduct counts). The GPS data provide additional opportunity to examine winter habitat use patterns and document migration routes for the PAPA and Bench Corral (BC) Study Area sub-populations.

### Methods

*Capture and Collaring*

We captured 30 adult female pronghorn on December 16, 2013 and equipped them with store-on-board GPS collars (Generation 4; Telonics, Inc., Mesa, AZ) that were programmed to collect locations every 3 hours and drop off April 1, 2015. Capture efforts were split between the PAPA ($n$=17) and BC Study Area ($n$=13; Fig. 4). We attempted to sample pronghorn in proportion to their relative occupancy across both winter ranges (Fig. 4).

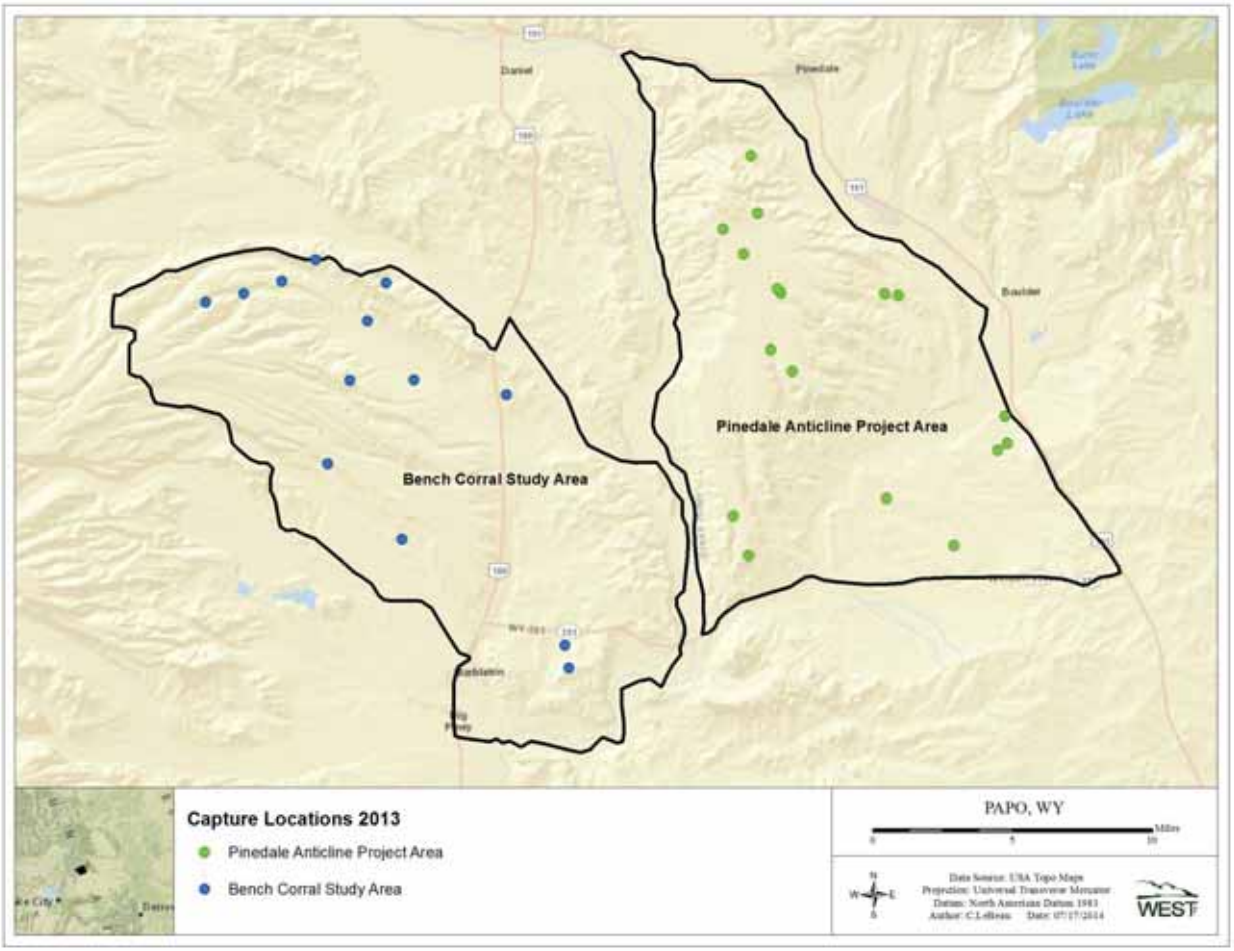


**Figure 4. Capture locations of pronghorn in the Pinedale Anticline Project Area and Bench Corral Study Area on December 16, 2013.**

*Habitat Use Modeling*

Habitat use analysis will not be completed until the summer of 2015, after GPS collars are recovered from marked animals.

## SECTION III: Trends in Pronghorn Occupancy in the Pinedale Anticline Project Area and the Bench Corral Study Area

### Overview

As part of the pronghorn monitoring effort we estimated pronghorn occupancy in the Bench Corral (BC) Study Area in January, February, and March 2014 in addition to the Pinedale Anticline Project Area (PAPA) using aerial line transect surveys. The goal of each survey was to obtain a complete count of the number of pronghorn occupying the study area. Conducting multiple surveys allowed us to assess the variability in occupancy over time and estimate the average number of pronghorn occupying the area during the winter period.

## Methods

Pronghorn occupancy in the PAPA and BC was estimated for each winter, beginning in 2009-10, using the same methods described in Section I. Again, line transects were spaced approximately ½-mile apart and were flown in an east-west orientation (Fig. 5) using fixed-wing aircraft flying at 300–400 feet above ground level to minimize animal disturbance. Locations of all detected pronghorn groups were recorded using a GPS, and group sizes were visually counted. Groups with >50 animals were recorded with a hand-held video recorder (Sony HD Handycam HDR-CX100), so that group size could be determined by image analysis.

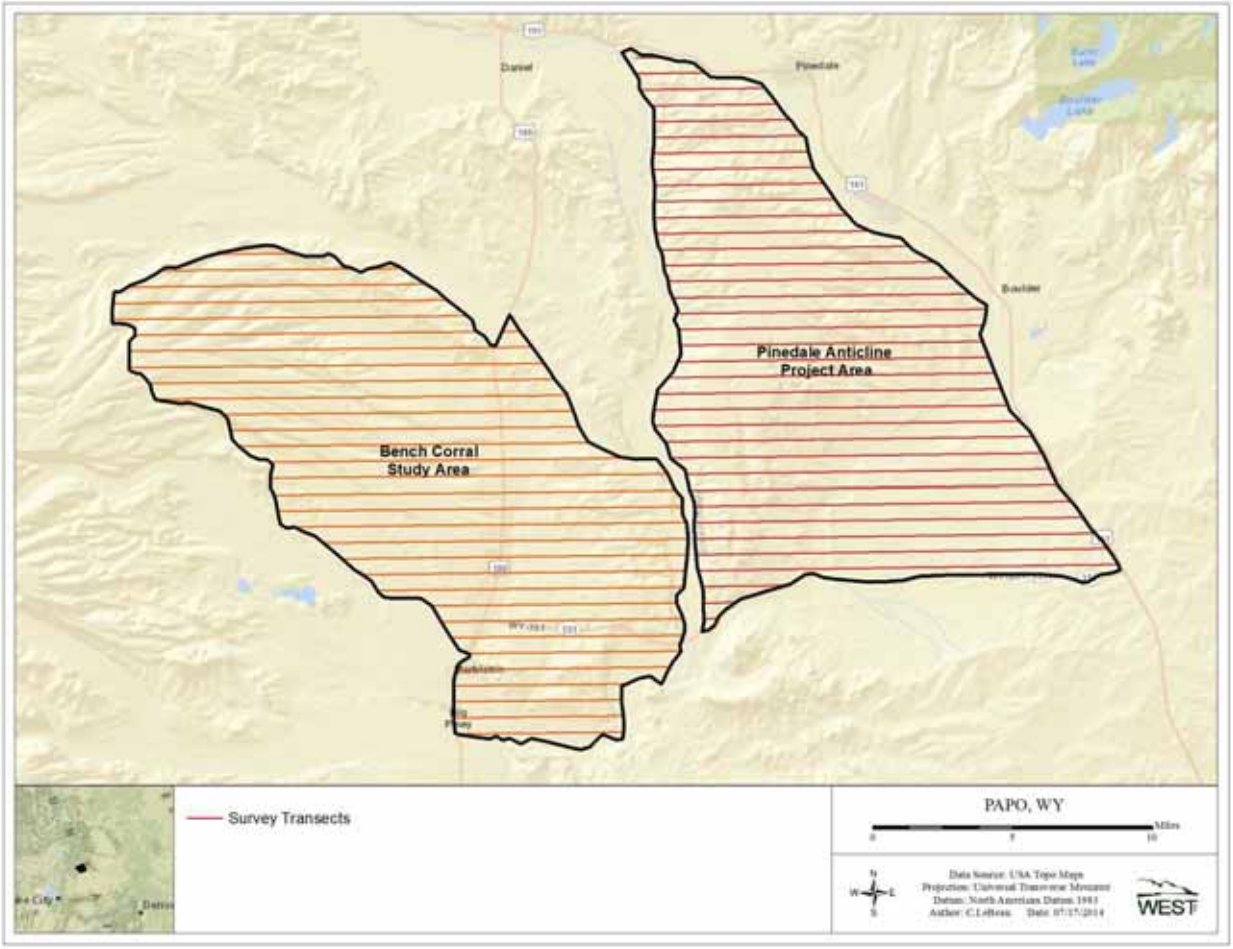


**Figure 5. Survey transects used to estimate pronghorn occupancy within the Pinedale Anticline Project Area and the Bench Corral Study Area.**

## Results

Pronghorn occupancy in the PAPA was variable across the three monthly surveys. We counted 2,022 pronghorn in 17 groups on January 21, 2,975 pronghorn in 28 groups on February 21, and 2,232 pronghorn in 47 groups on March 13 (Table 3, Fig. 3). Based on these 3 surveys, the estimated average number of pronghorn occupying the PAPA during 2013-14 winter was 2,409 (90% CI: 2,050 – 2,774), compared to 1,533 (90% CI: 772 – 2,305) in the 2009-10 winter. This

represents a 57% increase in average occupancy on the PAPA from 2009-10 to 2013-14 winters (90% CI: 5.2% decline to 239% increase; Fig 6).

Pronghorn occupancy was variable in the BC across the three surveys during the winter of 2013-14. We counted 495 pronghorn in 8 groups on January 22, 1,336 pronghorn in 7 groups on February 20, and 2,536 pronghorn in 38 groups on March 12 (Table 3, Fig. 7). The average number of pronghorn occupying the BC during the three surveys was 1,456 (90% CI: 713 – 2,190), compared to 2,742 (90% CI: 2,808 – 2,670) in the 2009-10 winter. This represents a statistically significant 48% decrease in the average occupancy in the BC from 2009-10 to 2013-14 winters (90% CI: 74% decrease to 19% decrease).

**Table 3. Occupancy estimates for the Pinedale Anticline Project Area and Bench Corral Study Area from winter aerial surveys. Ninety percent confidence intervals are to the right of each total count, unless a consensus was reached on all group sizes.**

| Area | Month | Winter 2009-10 | | Winter 2010-11 | | Winter 2011-12 | | Winter 2012-13 | | Winter 2013-14 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Estimate | 90% CI | Estimate | 90% CI | Estimate | 90% CI | Estimate | 90% CI | Estimate | 90% CI |
| PAPA | Jan | 775 | 782<br>767 | 1,420 | 1,425<br>1,415 | 2,200 | NA<br>NA | 1,492 | 1,505<br>1,480 | 2,022 | 1,852<br>2,179 |
| | Feb | 2,290 | 2,323<br>2,256 | 505 | NA<br>NA | 1,126 | 1,142<br>1,109 | 605 | 610<br>600 | 2,975 | 2,884<br>3,056 |
| | Mar | NA | NA<br>NA | 1,184 | NA<br>NA | 2,258 | 2,263<br>2,253 | 2,604 | 2,609<br>2,599 | 2,232 | 2,201<br>2,261 |
| | ***Avg.*** | ***1,533*** | ***2,305***<br>***772*** | ***1,036*** | ***1,344***<br>***731*** | ***1,861*** | ***2,242***<br>***1,473*** | ***1,567*** | ***2,239***<br>***895*** | ***2,409*** | ***2,050***<br>***2,774*** |
| BC | Jan | 2,682 | 2,713<br>2,656 | 1,307 | 1,318<br>1,294 | 1,856 | 1,871<br>1,840 | 510 | 533<br>487 | 495 | 487<br>503 |
| | Feb | 2,802 | 2,817<br>2,785 | 2,088 | 2,094<br>2,082 | 1,528 | 1,561<br>1,494 | 231 | NA<br>NA | 1,336 | 1,154<br>1,469 |
| | Mar | NA | NA<br>NA | 1,524 | NA<br>NA | 1,772 | 1,787<br>1,756 | 840 | NA<br>NA | 2,536 | 2,466<br>2,606 |
| | ***Avg.*** | ***2,742*** | ***2,808***<br>***2,670*** | ***1,640*** | ***1,902***<br>***1,375*** | ***1,718*** | ***1,837***<br>***1,591*** | ***527*** | ***743***<br>***316*** | ***1,456*** | ***713***<br>***2,190*** |

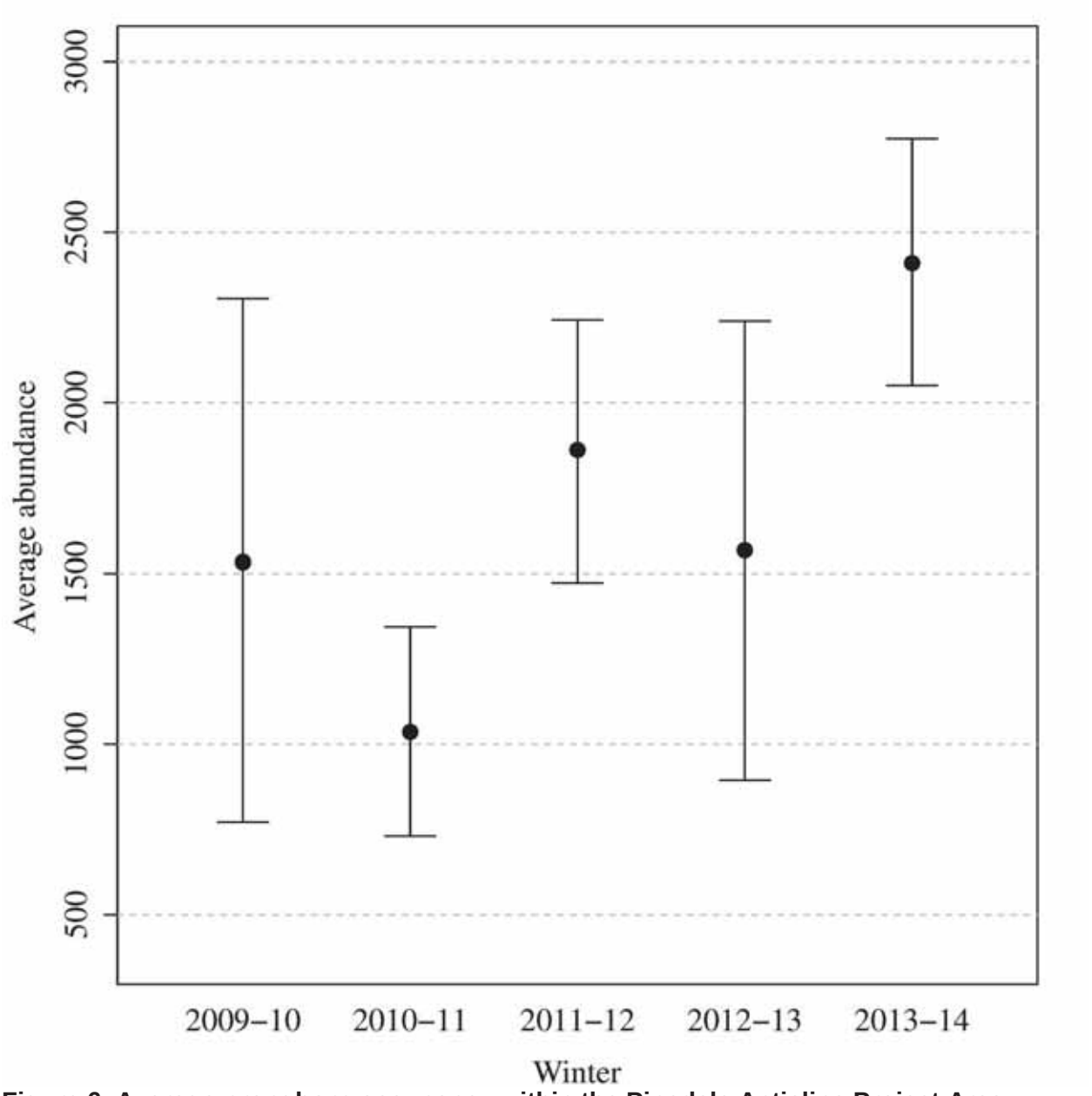


**Figure 6. Average pronghorn occupancy within the Pinedale Anticline Project Area.**

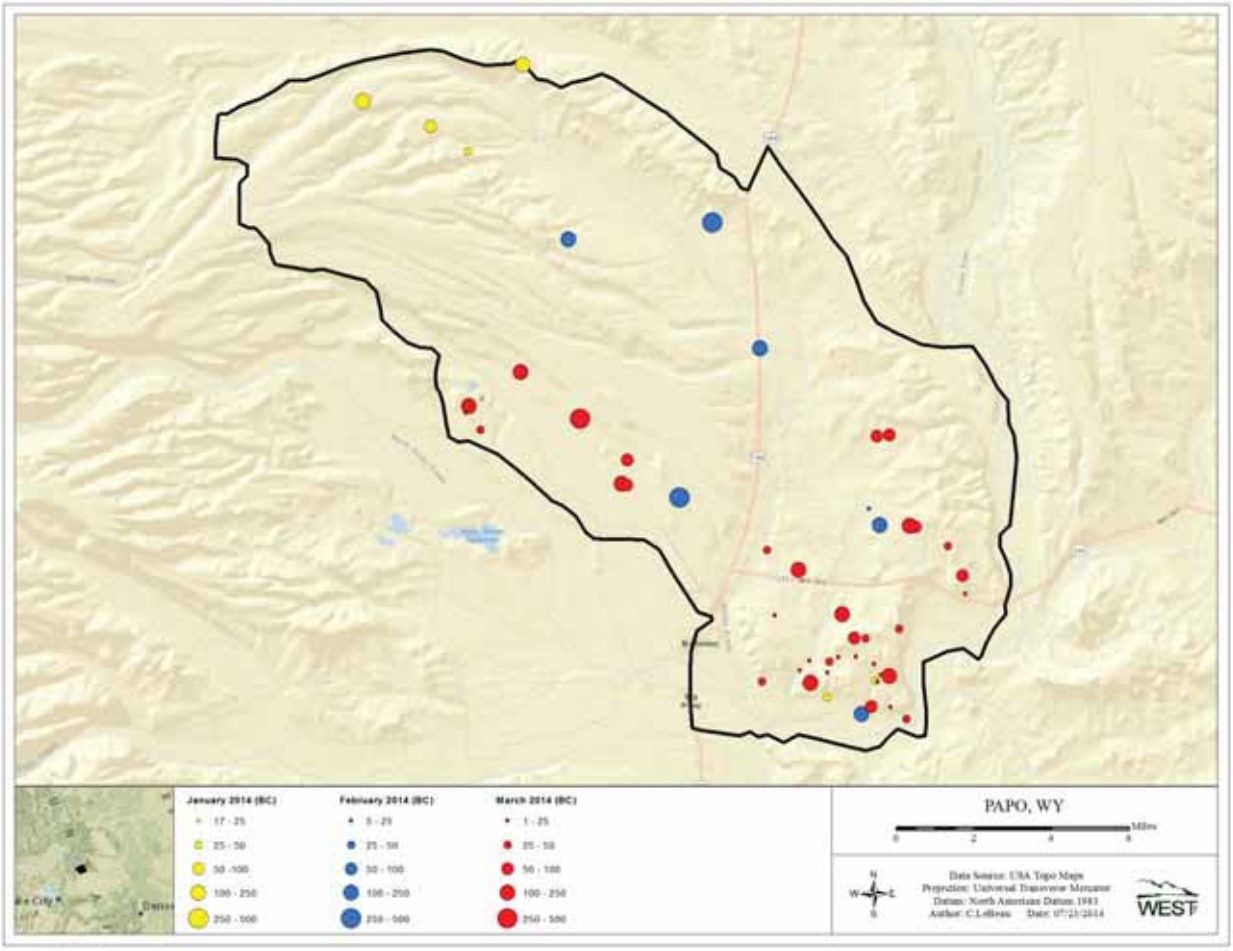


**Figure 7. Location and relative size of pronghorn groups observed during aerial surveys over the Bench Corral Study Area.**

## Discussion

We estimated a 57% increase in occupancy of the PAPA in 2013-14 compared to 2009-10; however, this increase was not statistically significant at an alpha level of α = 0.10 based on bootstrapping. However, we did detect a significant decrease (48%) in the average occupancy in the BC from 2009-10 to 2013-14. The high variability in the yearly estimates of pronghorn occupancy in the PAPA could be the result of changing snow conditions and probability of detection. However, we believe a more likely explanation is movement of animals outside of the designated study areas. Specifically, the southern boundaries of both study areas appear to be fluid. Pronghorn in the Sand Draw or Duke's Triangle region of the PAPA often move south of WY 351 and occupy a range that extends 10-20 miles south of the study area (Nielson et al. 2013b). Pronghorn that winter east of US 189 in the BC area appear to move south beyond the Green River another 10-15 miles (Nielson et al. 2013b). Movement data from individuals captured during the 2013-14 winter was not available as this report was prepared; however, an aerial telemetry flight was conducted during the month of January and all but two individual pronghorn were within their study area of capture. Both individuals located outside of the study areas were just north of their respective study area boundaries.

The winter of 2009-10 was the first attempt to estimate pronghorn occupancy in the PAPA and BC. In 2009-10 we tested two different HD video cameras, and we did not conduct a March survey due to a lack of snow and early detected migration of pronghorn from the study areas. Thus, we recommend considering the winter of 2009-10 to be a 'pilot' year, and winter of 2010-11 as the baseline to which future occupancy estimates will be compared to determine if the WMMM trigger has been met. If the 2010-11 winter is considered the baseline for calculating future changes in occupancy, there was an estimated 130% increase in occupancy of the PAPA in 2013-14 (90% CI: 57% increase to 369% increase). Change in occupancy from 2010-11 to 2013-14 declined by an estimated 13% within the BC (90% CI: 60% decline to 52% increase).

## LITERATURE CITED

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2001. Introduction to Distance Sampling: Estimating Occupancy of Biological Populations. Oxford University Press, USA, Oxford, England.

Bureau of Land Management. 2008. Record of Decision: Final Supplemental Environmental Impact Statement for the Pinedale Anticline Oil and Gas Exploration and Development Project. Pinedale Field Office, Wyoming, USA.

Manly, B. F. J. 2006. Randomization, bootstrap and Monte Carlo methods in biology. Second edition. CRC Press.

Nielson, R. M., and H. Sawyer. 2011. Pronghorn monitoring in the Pinedale Anticline Project Area: 2011 Annual Report. Report for the Bureau of Land Management Pinedale Anticline Project Office. Western EcoSystems Technology, Inc., Laramie, Wyoming, USA.

Nielson, R. M., and H. Sawyer. 2012. Pronghorn monitoring in the Pinedale Anticline Project Area: 2012 Annual Report. Report for the Bureau of Land Management Pinedale Anticline Project Office. Western EcoSystems Technology, Inc., Laramie, Wyoming, USA.

Nielson, R. M., H. Sawyer, and C. LeBeau. 2013a. Pronghorn monitoring in the Pinedale Anticline Project Area: 2013 Annual Report. Report for the Bureau of Land Management Pinedale Anticline Project Office. Western EcoSystems Technology, Inc., Laramie, Wyoming, USA.

Nielson, R. M., H. Sawyer, and C. LeBeau. 2013b. Pronghorn migration supplement for the Pinedale Anticline Project Area: 2013 Annual Report. Report for the Bureau of Land Management Pinedale Anticline Project Office. Western EcoSystems Technology, Inc., Cheyenne, Wyoming, USA.

Seber, G. A. F. 2002. Estimation of Animal Occupancy. Second edition. The Blackburn Press, Caldwell, New Jersey, USA.