University of Notre Dame Environmental Research Center – West

Charlo, MT

Grassland songbird occurrence across structural, temporal, and grazer-type categories in western Montana

Taylor Clark, Juniata College ’17

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Mentor: Sarah M. Russ

Abstract

The conflict of livestock grazing versus wildlife habitat is infamous in the conservation field, but in some cases, it need not be a conflict. Cattle (*Bos taurus*) grazing is one of the factors influencing loss and fragmentation of native grassland habitat for grassland-obligate songbird species. The purpose of this research is to join of wave of recent studies investigating these relationships and determining whether grazing is as bad for wildlife, especially birds, as it may seem; this research also intends to compare cattle grazing to bison (*Bison bison*) grazing. Rather than look at the response of individual species to grazing, I used species presence and number of individuals for my analysis. I conducted morning and afternoon point counts in ungrazed, cattle-grazed, and bison-grazed bunchgrass prairie sites and took visual obstruction readings (VOR) and bison and cattle fecal counts in each site. The results indicate that VOR significantly affected species presence at each point count and grazing type, time of day, VOR, and fecal counts significantly affected the number of individuals present at each point count. Significantly more individuals ($p<0.001$) were seen in bison and cattle-grazed sites than ungrazed sites, showing that grazing is not the problem when it comes to decreasing songbird habitat suitability, but that mindful grazing and vegetation quality itself should be the focus of management.

Introduction

North American songbirds are seeing population declines involving many factors; the major culprits are habitat loss and fragmentation (Peterjohn and Sauer 1999). Grassland songbirds are a specific group experiencing population effects that have not been noticed until recently, and efforts to understand grassland habitat loss problems are underway. The most popular use of grassland is cattle pasture so grazing must naturally have a relationship with wildlife using that habitat, including grassland songbirds. Several studies recently have focused on grassland pasture as nesting habitat for songbirds and have investigated the effects of grazing on songbird nesting, habitat use, and presence. The literature has shown that individual species tend to have preferences for a very specific habitat and vegetation type, and grazers can either augment or diminish these different habitat types. As such, it appears that domestic cattle (*Bos taurus*) can either be helpful or harmful to the success of a certain species (Fondell and Ball 2004; Krausman et al. 2009; Walk and Warner 2000). In order to clarify the overall effect that grazing has on grassland songbirds, this paper breaks the research down into number of species, number of individuals, and diversity of grassland songbirds instead of focusing on individual species. In addition, this project investigates the effects of bison (*Bison bison*) grazing compared to cattle grazing.

This research explores the potential effects of bison and cattle grazing on songbird presence in grassland habitats, organized by morning and afternoon. The National Bison Range and surrounding areas in western Montana are suitable for this research due to the bunchgrass prairie pastures within close proximity to each other, some grazed by cattle, some by bison, and others left ungrazed. The NBR is one of the United States' oldest National Wildlife Refuges, established in 1908 by Theodore Roosevelt. Refuge staff maintain a native dry bunchgrass prairie habitat for large North American fauna and over 200 species of birds on a small rolling mountain adjacent to the Mission Mountain Range (About the Refuge, USFWS). During the period of this study, bison had access to nearly the entire NBR. Domestic cattle graze in nearby private, Confederated Salish and Kootenai Tribes, and Ninepipe National Wildlife Refuge lands.

Ungrazed control sites were used as well. This study area provides the opportunity to test the effects of bison and cattle proximity on songbird habitat usage, which can guide management of bison and cattle grazing on or near potential grassland songbird habitat.

I investigated whether grazing by bison or cattle and lack of grazing, time of day, and vegetation structure affects songbird occurrence, abundance, and diversity. To achieve this objective, I conducted point counts during the morning and afternoon, visual obstruction readings (VOR) using a Robel pole, and bison or cattle feces counts in nine study sites, consisting of three control sites with no bison or cattle directly grazing, three sites of cattle pasture, and three sites of bison pasture. This allowed me to determine songbird occurrence and abundance, measure vegetation characteristics, and compare grazer effect.

Methods

Nine sites were selected for study. On the NBR, four sites were selected: three bison-grazed sites at Pauline Pasture, Mission Creek Pasture, and Trisky Creek Pasture, and one ungrazed site at the Triangle of the northeastern boundary. At Ninepipe National Wildlife Refuge, three sites were selected, one site cattle-grazed at Crow Waterfowl Production Area, one site cattle-grazed at Duck Haven WPA, and one site ungrazed at Anderson WPA. One site on tribal lands, leased for cattle grazing by a local rancher, was selected as an ungrazed site, located on Revais Creek Road near Dixon, MT. Lastly, one private land site was selected, owned by the Powells and located adjacent to the NBR Triangles. In total, there are three sites of each grazing type. All study sites are dry bunchgrass prairie habitat with varying levels of grazing pressure and are managed against invasive plant species. GPS coordinates and elevation were taken from all sites. I used ArcGIS software to map sites, as can be seen in Figure 1. Table 1 includes GPS coordinates.

Each site was assigned a categorical variable of ungrazed, cattle-grazed, and bison-grazed. Both Ninepipe cattle-grazed sites were grazed immediately prior to field season—cattle were removed shortly before point counts began and vegetation structure and fecal counts are expected to reflect the previous cattle grazing. Cattle and bison fecal counts were conducted as a direct indicator of ungulate presence. In four randomized (Frisbee throw) plots in each study site, feces were counted inside of a 5 m radius circle. The mean of the four counts was calculated and assigned to each site. Vegetation structure was quantified using the Robel pole method (Robel et al. 1970). Visual obstruction readings were taken at four randomized (Frisbee throw) plots in each study site; readings were taken four meters away from the Robel pole (bands measuring 5 cm) at a viewing height of 1 m in the four cardinal directions. The mean was taken for all measurements at each study site and assigned to the site.

I conducted point counts to obtain species occurrence data, number of species, number of individuals, and diversity. In each study site, two stations were located in the center of the interior grassland habitat and marked with flagging. Point counts were conducted in the morning between 7 and 11 am in optimal weather conditions and in the afternoon between 1 and 4 pm. During the research period, each station was counted six times, three times in the morning and three in the afternoon, for a total of 108 observations in nine study sites. Counts were conducted in a five-minute period: two minutes of quiet waiting upon arrival and three minutes of active counting. Only birds within a 50 m radius were counted, indicated as landed or flyovers. *The*

Sibley Field Guide to Birds of Western North America was used to identify birds. An attempt to identify each individual was made, without counting individuals twice; those with no possible ID were counted as unknowns. These methods were developed according to a widely agreed-upon method of standardization of avian point counts, written by Ralph et al. 1995.

My independent variables are type of grazing (ungrazed, bison, and cattle), time of day (morning and afternoon), fecal counts, and VOR. The dependent variables are number of species present and number of individuals present. To begin, these data were necessarily multiplied into two types of groupings: point counts including flyovers and point counts excluding flyovers. For each of these groups, I ran two analyses of covariance (using SYSTAT), one for number of species present and one for number of individuals present, including all independent variables. Shannon's Diversity Index was also calculated for each site, including morning and afternoon counts.

Results

Time of day, grazer type, and VOR all significantly affected the number of species when flyovers were included in these data—fecal counts were not significant (time of day: $p<0.001$, grazer type: $p<0.001$, VOR: $p=0.001$, fecal: $p>0.05$). When flyovers were excluded, VOR were significant but time of day, fecal counts, and grazer type were not significant (time of day: $p=0.447$, grazer type: $p>0.05$, VOR: $p<0.001$, fecal: $p>0.05$). Numbers of individuals during the point counts responded in similar ways: including flyovers, time of day, grazer type, and VOR were significant and fecal counts again were not significant (time of day: $p=0.003$, grazer type: $p<0.001$, VOR: $p=0.023$, fecal: $p>0.05$). Excluding flyovers, all independent variables significantly affected the number of individuals (time of day: $p=0.002$, grazer type: $p<0.001$, VOR: $p=0.037$, fecal: $p=0.038$). Figures 2 and 3 detail these analyses.

Shannon's Diversity Index was calculated for the nine study sites. An ANOVA indicated that diversity was not significantly different among the nine study sites ($p=0.282$) nor among the three grazer types ($p=0.765$). Figure 4 shows the diversity calculation for each site broken down into ungrazed, cattle-grazed, and bison-grazed.

Figure 5 and Figure 6 detail the VOR and fecal counts for each of the study sites. In addition, Figure 7 includes bar graphs detailing species present at each study site in the morning and afternoon. The songbird species most encountered were the vesper sparrow (*Poecetes gramineus*), savannah sparrow (*Passerculus sandwichensis*), and western meadowlark (*Sturnella neglecta*).

Discussion

I initially hypothesized that grazer type would have an effect on songbird diversity and abundance, predicting that ungrazed sites would have a greater number of species and individual birds, with bison and cattle-grazed sites having fewer species and individuals of a similar level to each other. I also predicted that fecal counts would behave in the same way as grazer type, predicting that they would be correlated with greater counts in bison and cattle-grazed sites, and that greater VOR would be correlated, having greater measurements in ungrazed sites. Secondly, I hypothesized that time of day would affect number of species and individuals, predicting that both number of species and number of individuals would decrease in the afternoon point counts. Necessarily, the null hypothesis of this project was that there is no significant difference in the number of species, number of individuals, or diversity due to grazing type or time of day.

First, I planned to exclude flyovers from the data entirely, as point count protocols indicate that only landed birds are using the habitat within the point count area and should be counted as such. For example, double-crested cormorants (*Phalacrocorax auritus*) were occasionally counted as flyovers at the Ninepipe sites as they were seen flying low over the point count site, but these are clearly not grassland birds. This project was intended to focus on grassland songbirds in general, and all landed birds were songbirds, with some flyovers belonging to other taxonomic groups. However, this study carries a relatively small sample size and excluding flyovers from the data does produce an even smaller sample size. This is why analyses were run on the data in two forms, with flyovers and without, and these tests did produce different results. Although including flyovers in the analysis is unconventional, these data may still hold some value. However, I suggest that future studies use more time and resources so that only landed birds are included in the data analysis.

Number of Species Discussion

In the number of species significance results, excluding flyovers, both time of day and grazer type had no significance. Fecal counts were not significant either, which seem to come hand in hand with grazer type, but VOR were significant. This could indicate that species are responding to vegetation height and structure only, and within grazer types the sites did vary in structure. For example, Anderson and Revais were both of the ungrazed type, but Anderson was planted in tall pasture bromes and wheatgrasses and Revais was had many sage shrubs but short vegetation otherwise, resulting in very different VOR (an average of 4.25 for Anderson and 2.88 for Revais). This could have been more of a factor for songbird habitat choice, showing that type of grazer can only impact the habitat of birds if the vegetation itself is of the appropriate type for habitat usage to begin with. The lack of effect from time of day could be due to an anecdotal note that there appeared to be fewer birds and fewer species as point counts went on later in the summer into July—there appeared to be a lesser number of birds active and able to be counted in the morning hours than was common earlier in the season, hence comparable to the afternoon hours later as the summer went on. This could have been due to a decrease in territorial nesting behavior as the nesting season waned. In the future, this could be avoided by performing all point counts within a one-month period during the heart of the nesting season, or all in the late summer, especially taking into consideration the heat that builds up in late summer as compared to early summer in western Montana. The point counts for this project were performed in chunks in both the middle and end of the nesting season which could account for errors in morning and afternoon point count significance.

Including flyovers, number of species was significantly affected by time of day, grazer type, and Robel measurements, and fecal counts were still insignificant. I have difficulty trusting these results as flyovers, as previously discussed, were not actually using the habitat type. It is possible that more flyovers occur in the morning hours as birds are more active. It is more difficult to contemplate an explanation for why including flyovers would cause grazer type and fecal counts to become significant as opposed to not significant without flyovers. It is possible that flyovers increased the number of species by a similar amount in all point counts, causing larger numbers to decrease the p-value enough to be significant, but this seems unlikely.

Number of Individuals Discussion

When flyovers are included, the next analyses of number of individuals behaved the same way as number of species, with all variables as not significant except for fecal counts. However, the surprise came when flyovers were then excluded and all variables were shown to have significantly impacted the number of individuals in each point count. Landed individuals may have been of the same species which is why the species results behaved differently. Figure 3B shows that number of individuals significantly decreased in the afternoon; in C, it is apparent that number of individuals was significantly lower in the ungrazed sites and higher in the bison and cattle sites, which are similar. This also shows as a trend in the species data, however not significantly different.

My prediction that I would see more individual birds in the ungrazed sites is not supported by the analysis; I expected the ungrazed sites to have a higher number of individuals (and species, which was not significant, so I failed to reject the null hypothesis for species) but instead the ungrazed sites had a significantly lower number of individuals. This could be due to the grazed sites being of a better habitat quality than ungrazed sites, which I did not expect. While VOR were on average higher in the ungrazed sites than the grazed sites (ungrazed: 3.85, cattle: 2.83, bison: 2.75), the ungrazed sites seemed anecdotally to have less forbs and less structure than many of the grazed sites did. Some of the ungrazed and cattle-grazed sites seemed to be partly planted with non-native pasture grasses, while sites on the National Bison Range were native dry bunchgrass prairie, which could have supported more individual birds in each point count site, but not of a wider variety of species.

Conclusion

In the future, I would suggest expanding the study to include more sites, categorizing the grazer type by including number of grazers and grazing pressure, and adding more staff to increase the number of point counts that could be performed. Due to these results, I would recommend that if land managers would like to increase the number of individuals and species of songbirds on their land, they should focus more on vegetation quality and invasive plant removal than the exclusion of grazers. As always, grazing species, whether wild or domestic, should be maintained and rotated at a level that pasture vegetation can afford, but mindful grazing does not affect songbird usage as much as sheer vegetation quality does.

Acknowledgements

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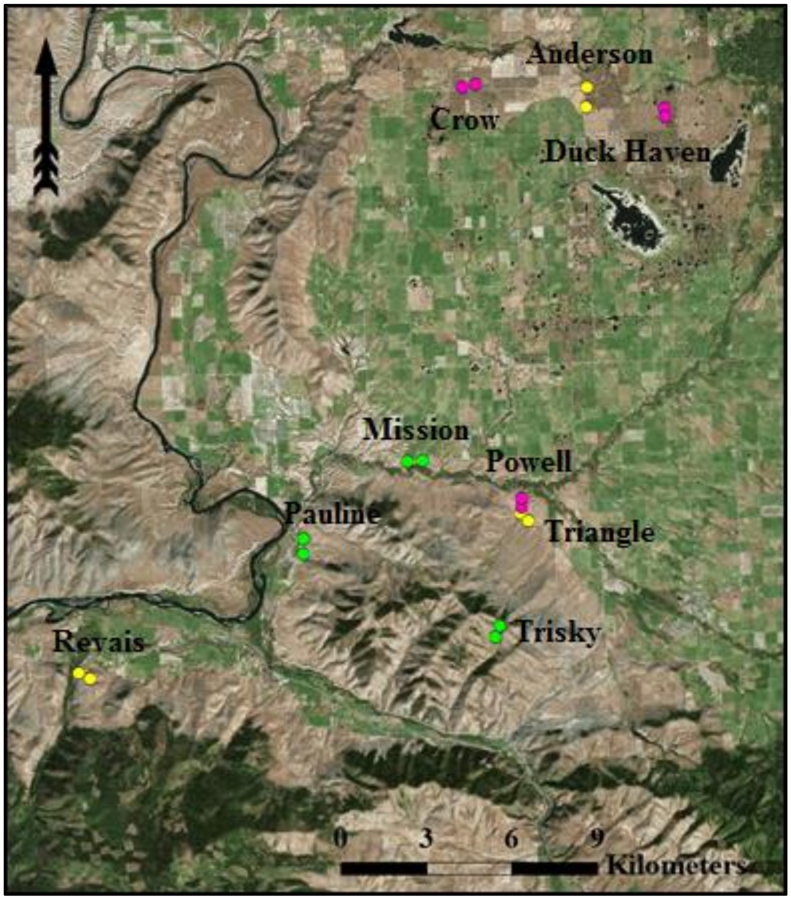
APPENDIX

Figure 1.



Point Count Stations

- Bison-Grazed
- Cattle-Grazed
- Ungrazed

This map details the locations of the nine study sites, broken into points to indicate the two point counts in each site. Green points are bison-grazed, pink points are cattle-grazed, and yellow points are ungrazed. The National Bison Range can be seen in the southern end of the map and Ninepipe National Wildlife Refuge in the northeastern corner.

Made using ArcGIS software.

Table 1.
GPS coordinates for the nine study sites.

Site Name	Latitude	Longitude
Anderson	47.48541	-114.13801
Crow	47.48748	-114.18961
Duck Haven	47.47783	-114.10217
Mission	47.36947	-114.22760
Powell	47.35381	-114.17548
Triangle	47.35182	-114.17577
Pauline	47.34618	-114.27712
Trisky	47.31666	-114.18736
Revais	47.30649	-114.38332

Figure 2.

These figures show the results of the ANCOVAs with the data including flyovers—all Y axes read as number of individuals or number of species. A and C show the number of species results, A for time of day and C for grazer type. B and D show the results for the number of individuals, B showing time of day and D showing grazer type.

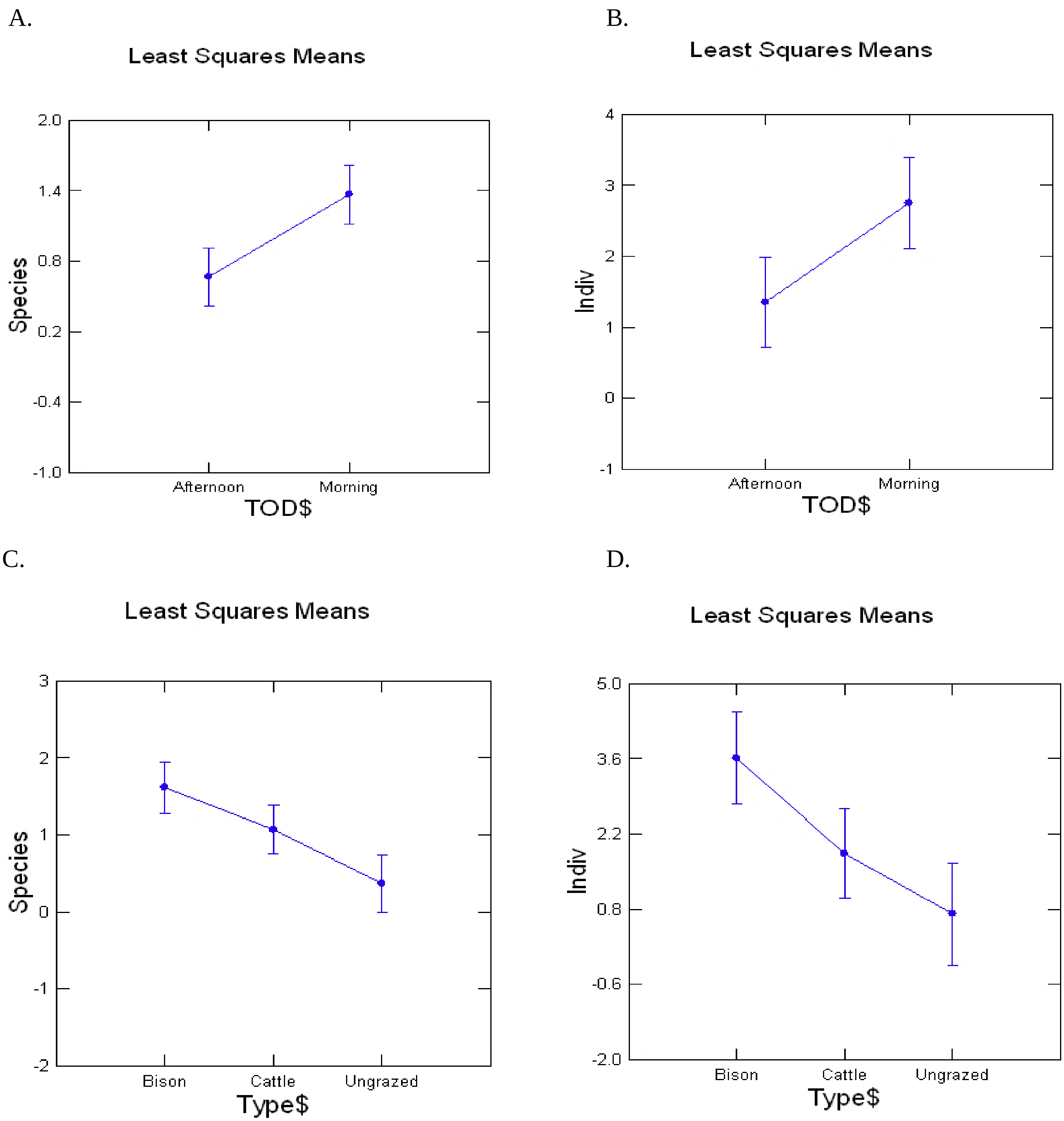
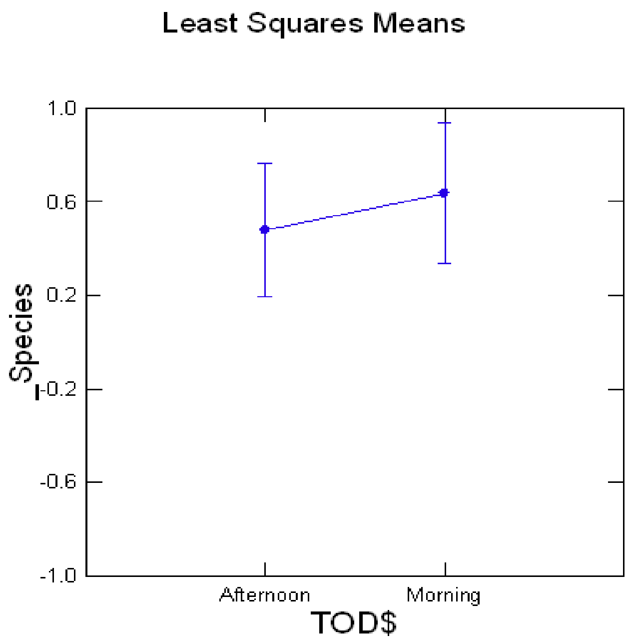


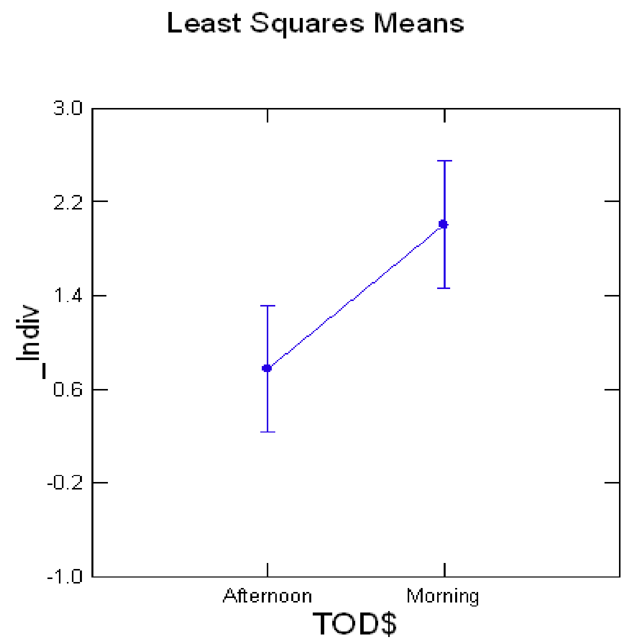
Figure 3.

These figures show the results of the ANCOVAs with the data excluding flyovers—all Y axes read as number of individuals or number of species. A and C show the number of species results, A for time of day and B for grazer type. B shows the results for the number of individuals for time of day. Type of grazer was not significant for number of individuals.

A.



B



C.

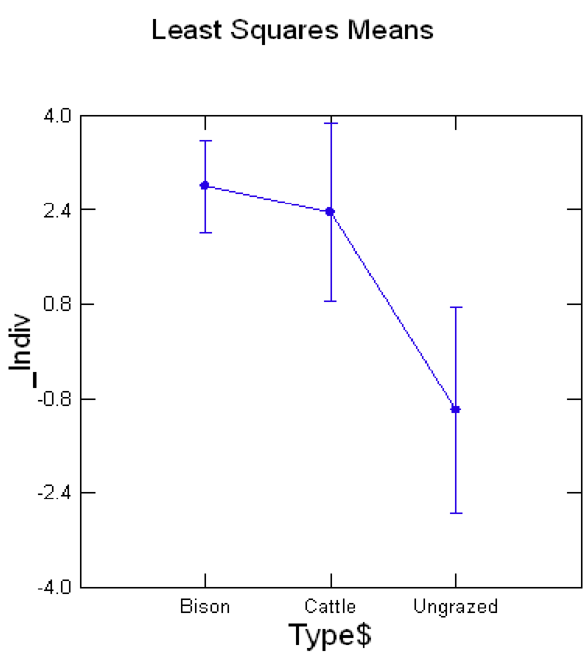


Figure 4.

Below is a bar graph detailing Shannon's Diversity Index for the nine study sites. Standard deviation was calculated by using the separate diversity calculations for the two point counts in each site. An ANOVA indicated that diversity was not significantly different among the nine study sites (p=0.282) nor among the grazer types (p=0.765).

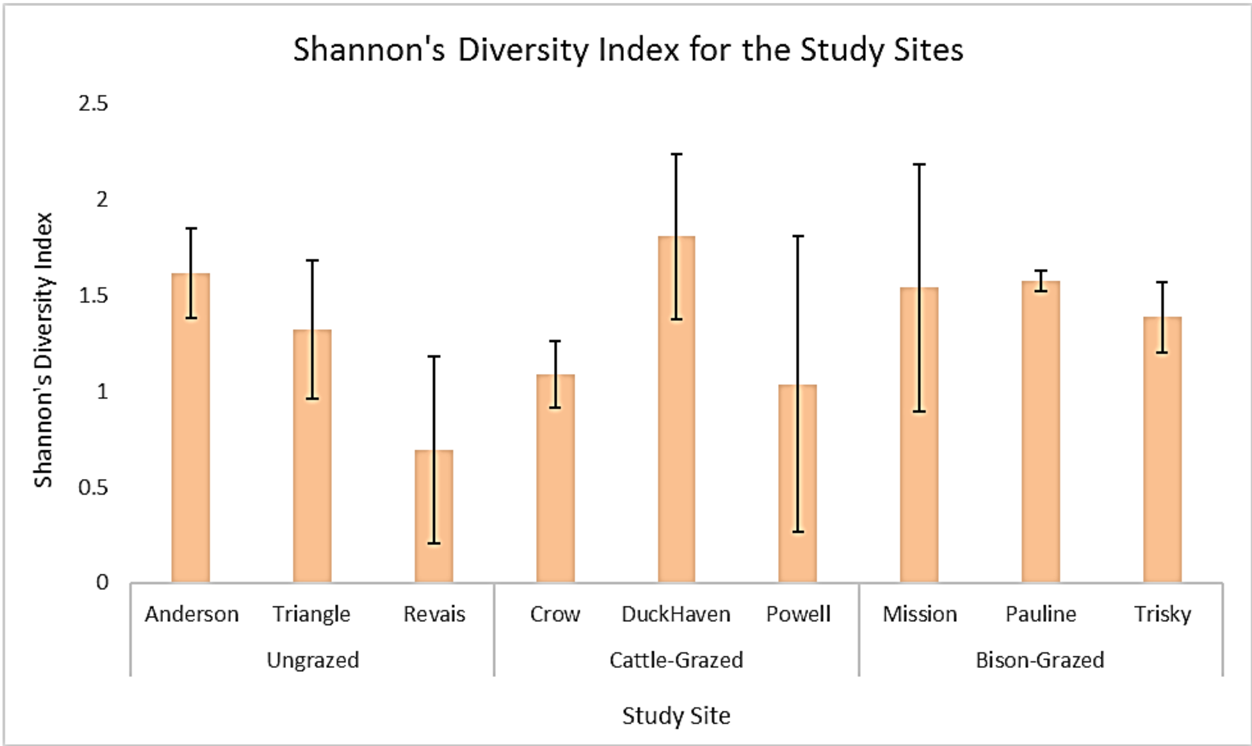


Figure 5.

Below is a bar graph showing the VOR for each of the study sites separated into grazer type.

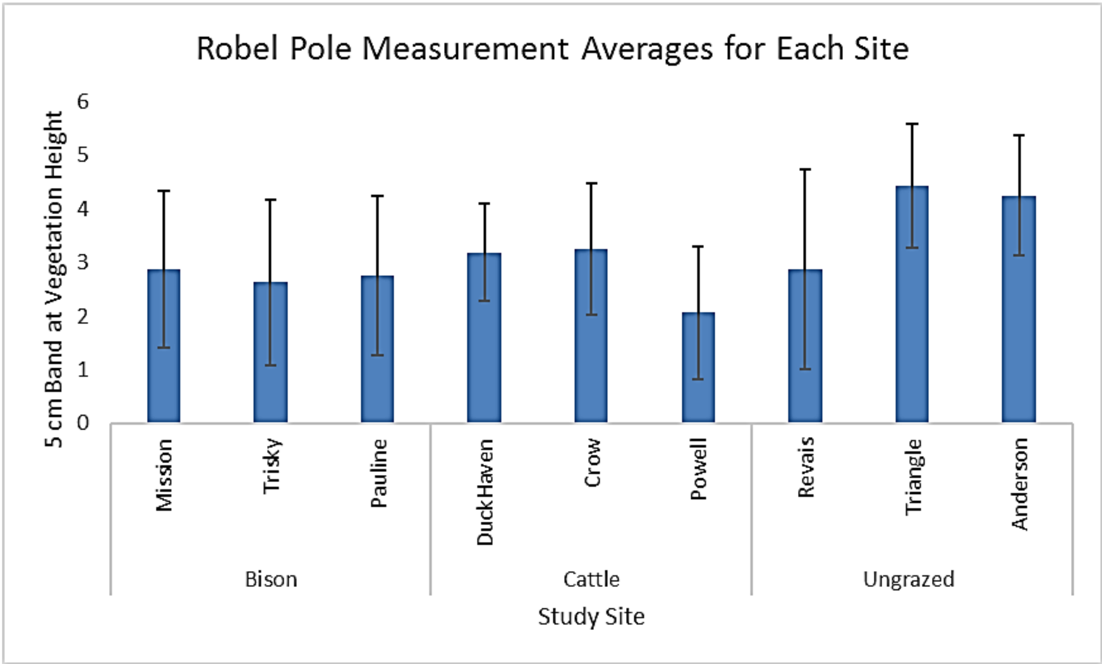


Figure 6.

Below is a bar graph showing the fecal count averages in each of the study sites, separated into bison and cattle-grazed sites. No feces were counted at the ungrazed sites.

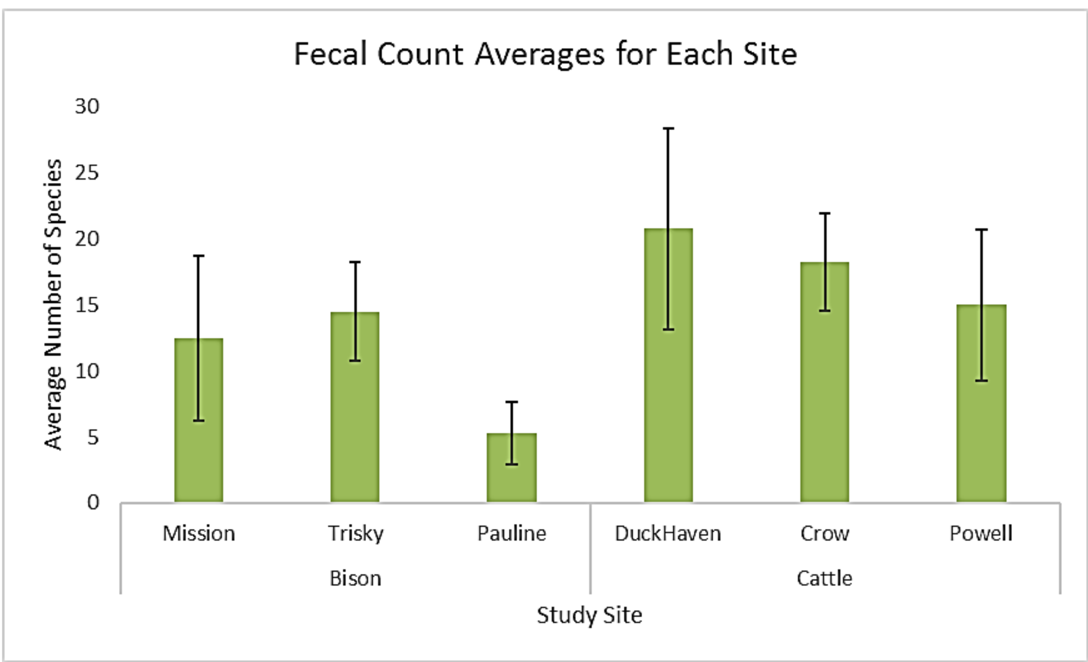
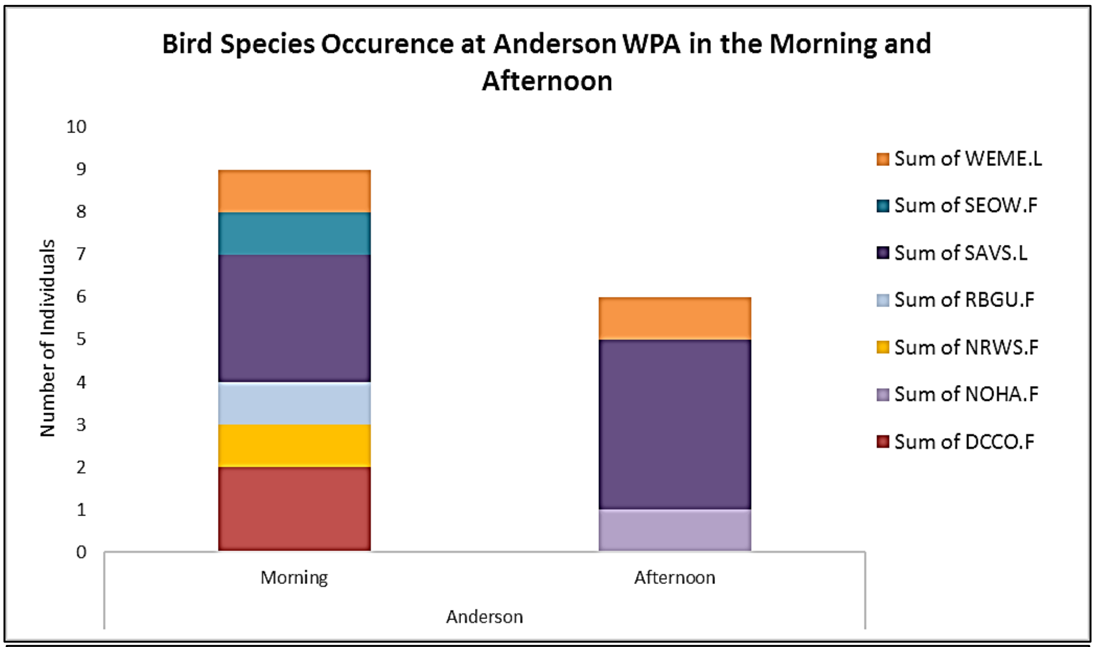
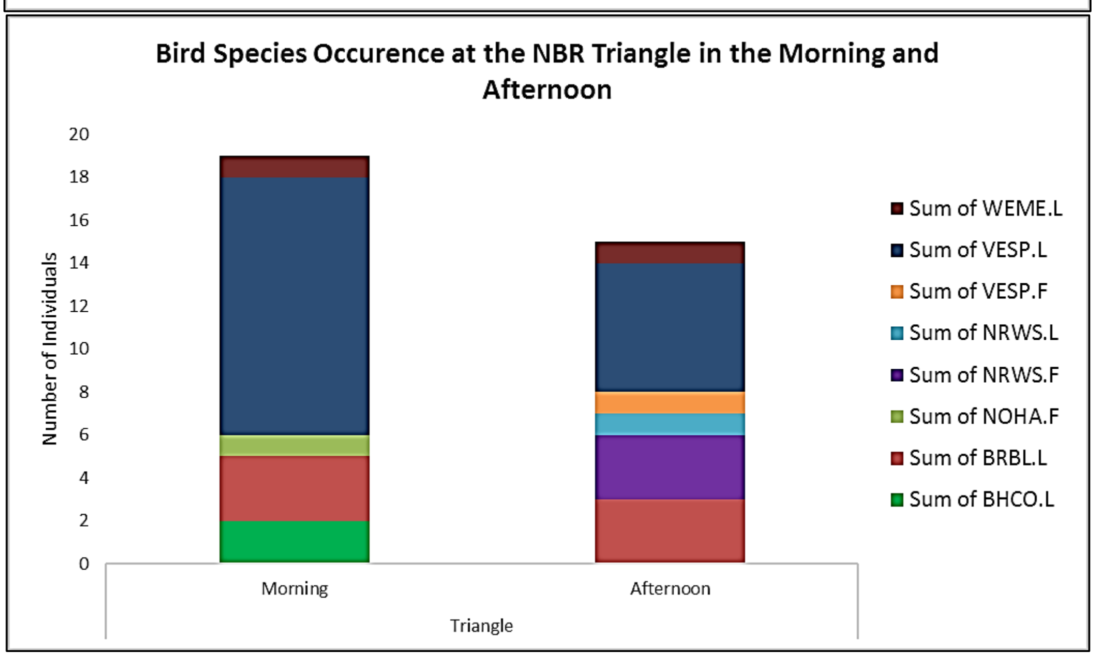


Figure 7.

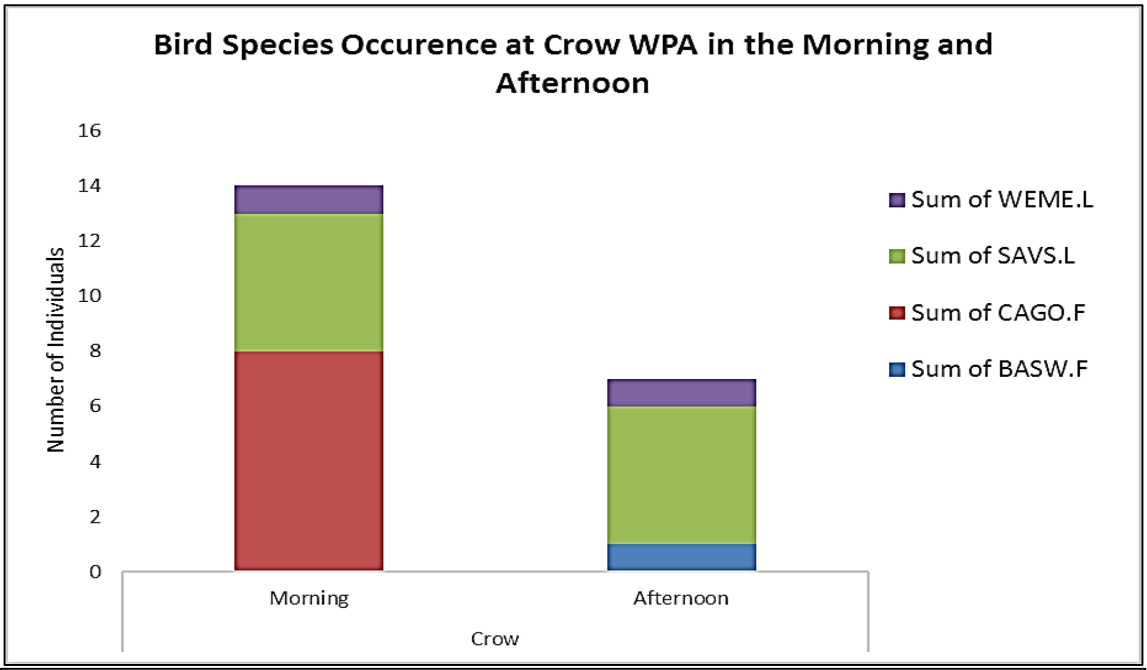
The graphs below are arranged by ungrazed, cattle-grazed, and bison-grazed categories. Revais pasture is not included in the ungrazed section because only two unidentified individuals were observed in all of the point counts there. Each graph details the species seen in the morning and afternoon at one study site. Species are organized by alpha code, and then by landed or flyover (ex. BHCO.F is flyover brown-headed cowbird and BHCO.L is landed brown-headed cowbird). “Unident” and “uni” indicate unidentified, with “humm” meaning hummingbird and “SP” meaning sparrow.

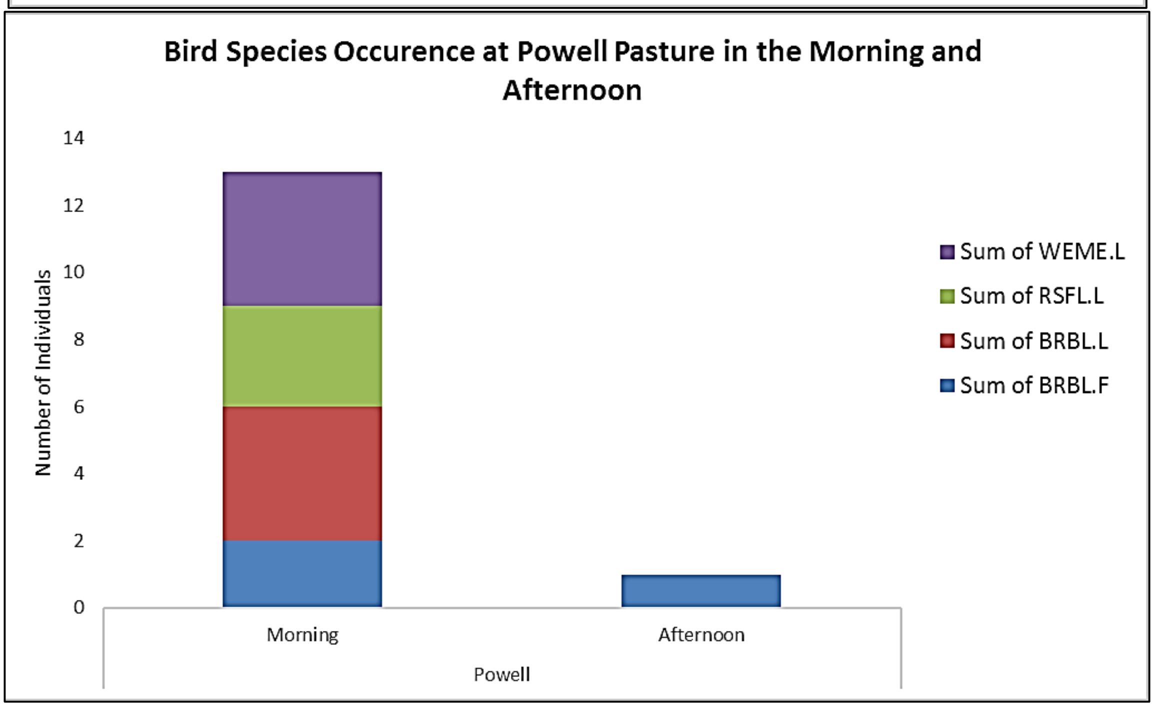
Ungrazed:

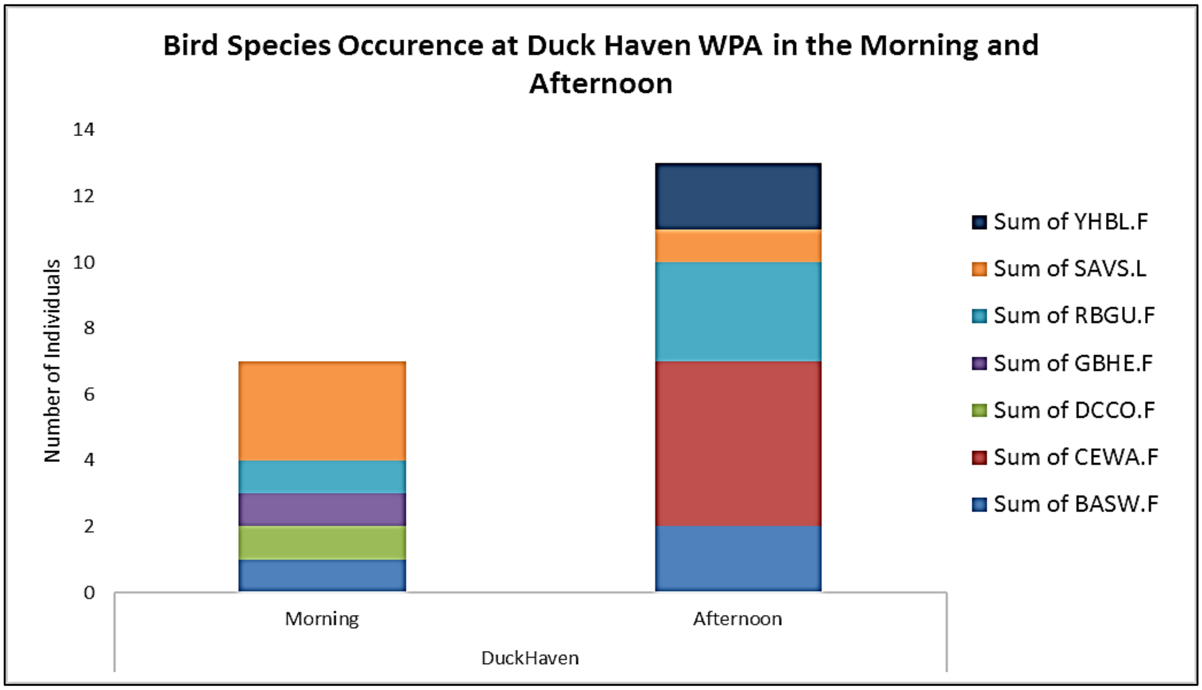




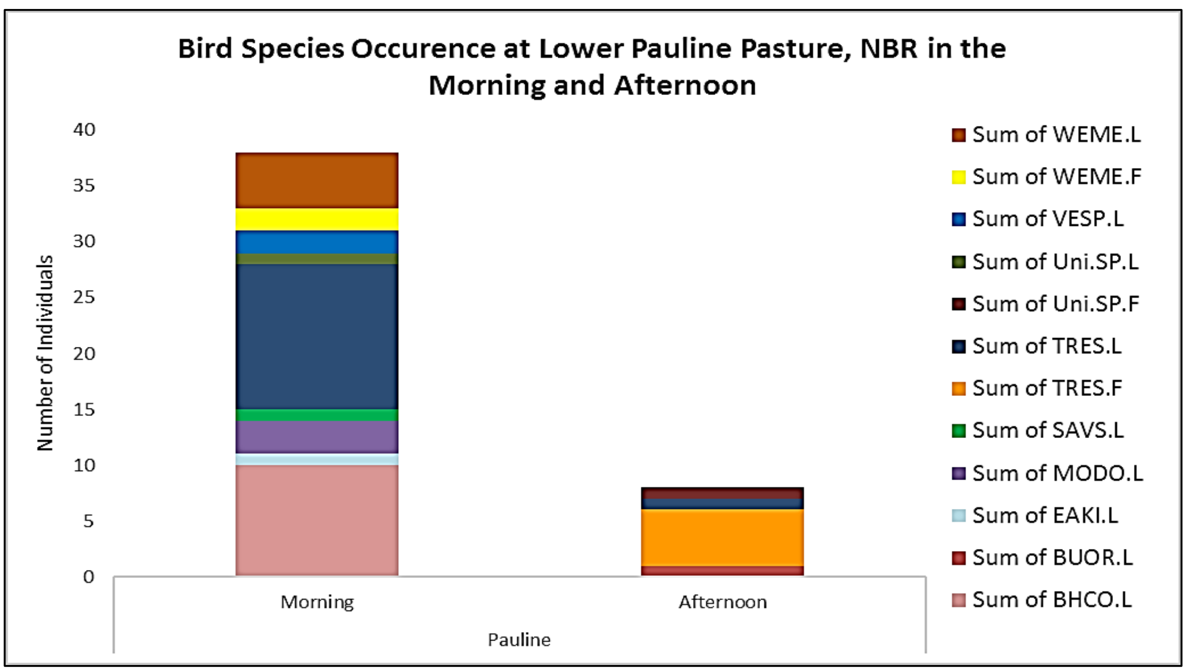
Cattle-Grazed:

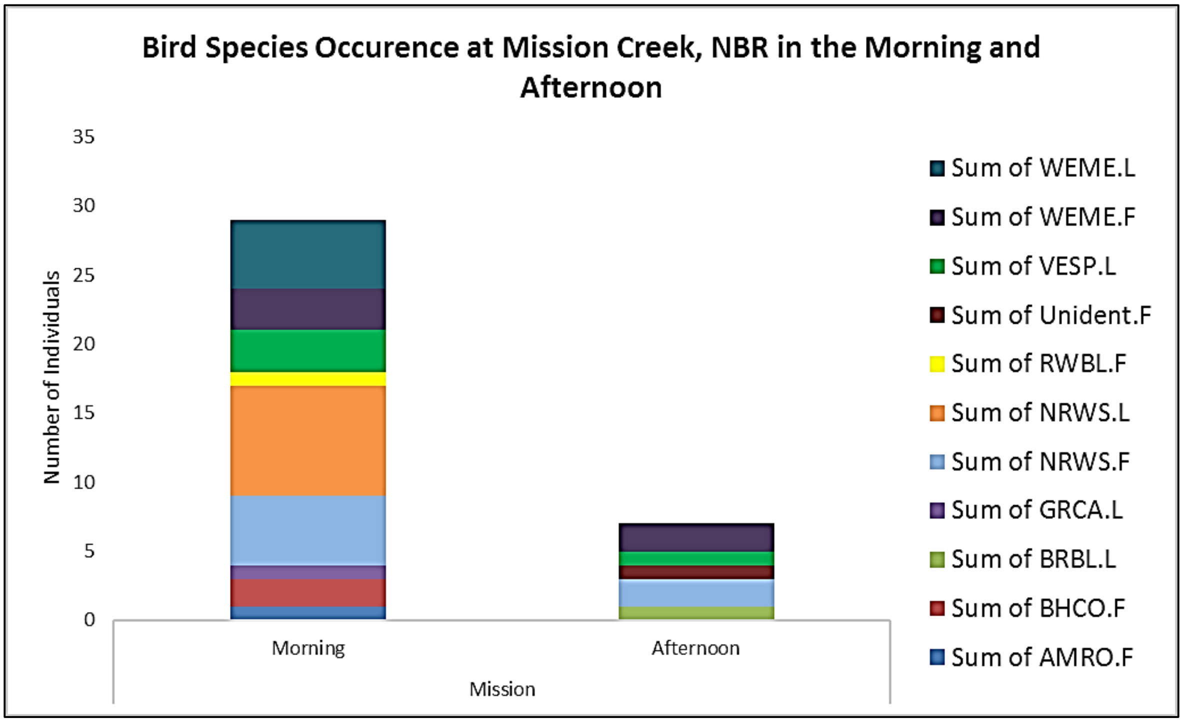


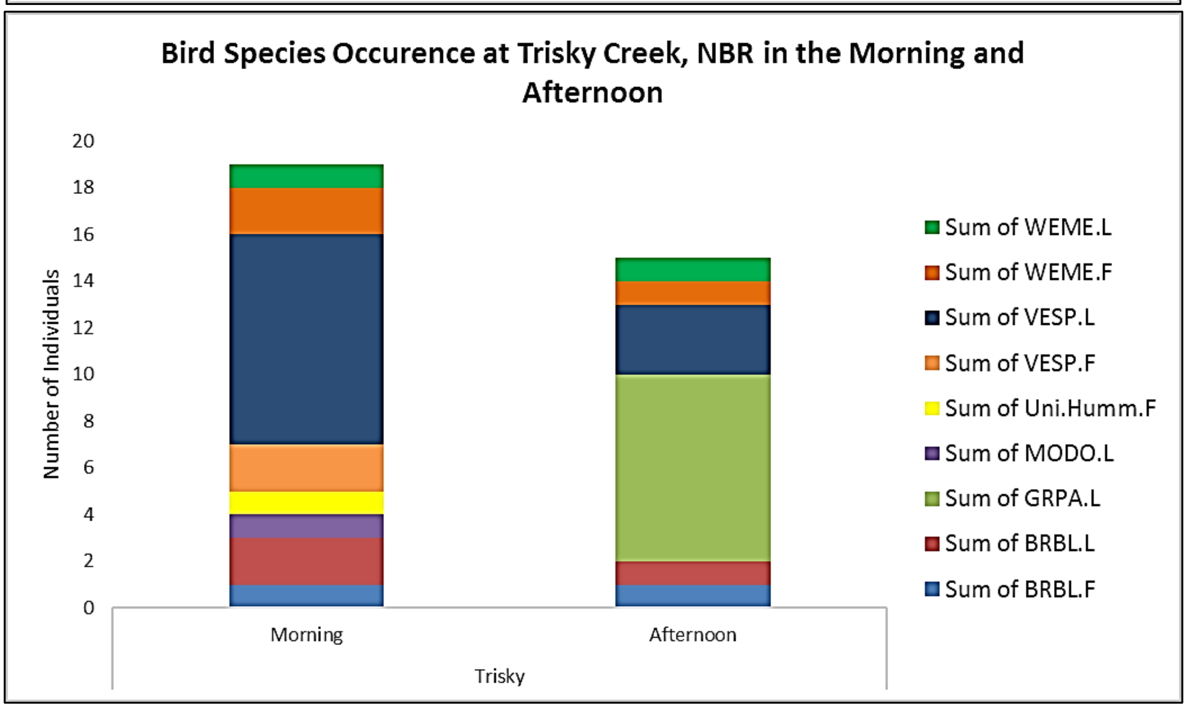




Bison-Grazed:




Bird Species Occurence at Mission Creek, NBR in the Morning and Afternoon
Number of Individuals
35
30
25
20
15
10
5
0
Morning
Afternoon
Mission
Sum of WEME.L
Sum of WEME.F
Sum of VESP.L
Sum of Unident.F
Sum of RWBL.F
Sum of NRWS.L
Sum of NRWS.F
Sum of GRCA.L
Sum of BRBL.L
Sum of BHCO.F
Sum of AMRO.F


Bird Species Occurence at Trisky Creek, NBR in the Morning and Afternoon
Number of Individuals
20
18
16
14
12
10
8
6
4
2
0
Morning
Afternoon
Trisky
Sum of WEME.L
Sum of WEME.F
Sum of VESP.L
Sum of VESP.F
Sum of Uni.Humm.F
Sum of MODO.L
Sum of GRPA.L
Sum of BRBL.L
Sum of BRBL.F