Effect of grazing system type on bird habitats and bird communities in the Nebraska Sandhills

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Grassland birds are declining faster than any other group of birds in North America (Sauer et al. 2013), which is in large part due to loss of habitat and degradation (Samson and Knopf 1994). One recent study showed that conversion of grasslands to croplands matches the rate at which rainforests are being lost in other parts of the world (Wright and Wimberly 2013). In Nebraska, we are fortunate to have the Sandhills, which is a large and relatively undisturbed landscape of native grassland that is home to many different types of birds and other wildlife, while also providing a resource for livestock production.

Grassland birds require a variety of habitats (Figure 1), with some requiring short, sparse vegetation and others requiring taller, thicker vegetation (Mengel 1970). Some require a mixture of these types of vegetation (for example, prairie chickens), with nesting taking place in one type of habitat and raising chicks taking place in another type of habitat. The different types of habitat are created through patterns of precipitation, soil types (ecological sites), and management, including grazing and fire (Lipsey 2015). Because of the severe declines in grassland birds, wildlife biologists are interested in ensuring that all different types of habitat needed by different birds are present across a landscape.

While people cannot control precipitation and soil types, we do control the use of management tools like grazing and fire. Landowners use grazing strategies to manage their livestock, and it seems logical that different grazing strategies should create different types of habitat (e.g., Reece, Volesky, and Schacht 2008). Thinking hypothetically, you would expect one animal on one acre for 30 days to have a different effect on grass structure than 30 animals on one acre for one day. Each individual animal's ability to be picky about what to eat is restricted as the stocking density grows, which is one premise behind grazing strategies (Teague and Dowhower 2003; Reece, Schacht, and Volesky 2007). Season-long, continuous grazing can have effects that producers see as detrimental for their business, such as a shift in species composition to less desirable forage or the degradation of preferred areas (Teague and Dowhower 2003). There has been a shift away from season-long, continuous grazing of individual pastures to rotational grazing strategies, which fits better with producer-oriented goals.

Some scientists have suggested that the use of rotational grazing strategies, which has the potential to increase the evenness of grazing across an area, has reduced the variety of habitats that exist on grassland landscapes, calling the phenomenon "managing to the middle" (Fuhlendorf and Engle 2001; Fuhlendorf et al. 2012; Toombs et al. 2010). The improved grazing distribution associated with rotational grazing, therefore, might be contributing to the decline in grassland bird habitat and numbers, even on large and intact grasslands. Thus, we asked the question: "Does a variety of grazing strategies used on multiple ranches across a landscape provide varied habitat for birds, or is the landscape basically the same throughout?" We hypothesized that different grazing strategies would create different types of habitat, which would support different types of birds.

We studied this question in the Nebraska Sandhills by sampling bird abundance and habitat structure on private and public land. Specifically, we surveyed portions of six private ranches and five forest service grazing allotments southwest of Valentine, NE, in 2014 and 2015. We surveyed five different grazing strategies, including season-long continuous (2 ranches), deferred rotation (5 ranches), management intensive (2 ranches), dormant season/spring rotational (1 ranch), and fixed sequential rotation (1 ranch). At each ranch, we sampled 24 plots within a portion of pastures that were within a management unit. At each plot we counted bird abundance and measured habitat structure variables (like grass cover, litter depth, visual obstruction readings).

For each plot we took measurements of habitat in May and July, and counted birds in late May and June of 2014 and 2015. For each plot we sampled, we collected information on the grazing strategy used there, the ecological site, the stocking rate for three different seasons (previous cool season, previous warm season, and previous dormant season), and the previous year's total stocking rate. We then used a data analysis procedure called mixed modeling within a framework called Information Theory to assess which of these factors were the most strongly related to the habitat variables and bird abundances. Our goal was to determine which management factors best predicted the structure of the habitat or abundance of different bird species.

Visual obstruction readings (VOR) ranged from 0 cm up to 120 cm where there were shrub thickets, with a mean of 4.3 cm across all ranches. Litter depth ranged from 0 cm up to 45 cm, with a mean of 2.8 cm across all ranches. A preliminary analysis indicated that ecological sites were the strongest driver of habitat structure variables that we measured. Ecological sites are "a conceptual division of the landscape that is defined as a distinctive kind of land based on recurring soil, landform, geological, and climate characteristics that differs from other kinds of land in its ability to produce distinctive kinds and amounts of vegetation and in its ability to respond similarly to management actions and natural disturbances" ("Interagency Ecological Site Handbook for Rangelands"). Visual obstruction readings and litter depth were higher on sandy and sands ecological sites than on choppy site or blowouts. These results were exactly as one would predict.

Since ecological sites are not a management tool, we decided to focus on models that included management options, such as grazing strategies and stocking rates. The results of our analysis showed that timing of grazing and previous year's total stocking rate were the best predictors for many of the habitat structure measurements. Grazing strategy, as we defined it, was not strongly correlated with our habitat structure measurements and did not have consistent or predictable effect on habitat structure. This could be because of the fact that we studied grazing strategies on private lands, where every producer has a slight variation on a given strategy, making it difficult to address the effects of single management variables (e.g., separating stocking rates from timing of grazing) or to categorize ranches into a given strategy. For example, the "deferred rotation" strategy included five different ranches, but each ranch had different overall stocking rates, different seasons of use for each pasture, and sometimes different age classes of cattle.

Even though timing of grazing was the best explanatory variable for many of the habitat measurements, the patterns for different habitat variables were inconsistent in relation to timing of grazing (see Figure 2). For example, dormant-season grazing appeared to affect VOR and liter depth, but sites grazed in the previous cool season and dormant season had relatively high VOR and litter depth whereas sites grazed in the previous warm season and dormant season had low VOR and litter depth. Again, this could be because we studied these factors on private land; it is difficult to make a conclusion about "cool + warm" timing of grazing when that category may have come from a single ranch and also had a different stocking rate associated with it than the rest of the categories.

Increased stocking rate generally resulted in decreased VOR (see Figure 3). In relation to the variety of habitats created through these different management scenarios, the range of structure is fairly small, with visual obstruction readings ranging from about 2.5cm to 5cm, and litter depth ranging from 1cm to 5cm (Figure 2).

Abundance of different bird species was best explained by a variety of management measures. Grasshopper sparrow abundance was best explained by the three seasonal stocking rates, and decreased with increasing stocking rates in the warm and dormant seasons (Figure 4). Horned larks were best associated with grazing strategies, with highest abundances on continuous, season-long grazed pastures (Figure 5). Only lark sparrows were most influenced by ecological sites: they had highest abundance in choppy ecological sites and lowest abundance in sandy ecological sites, which is in agreement with the habitat preferences for this species.

We did not detect certain bird species that are expected to be present in semi-arid grassland, such as chestnut-collared longspurs and long-billed curlews. Both of these species prefer shorter and sparser vegetation for nesting and foraging, which might indicate a lack of this type of habitat. With these results, we can draw some general conclusions about the question of whether landowners are really managing to the middle of the habitat spectrum in a large, unspoiled region like the Nebraska Sandhills. We found little evidence that grazing strategies were driving habitat structure, and rather saw that timing of grazing may be more important; however, the ranges of the different habitat measurements were generally small, perhaps indicating a lack of variation in habitats. It is difficult to draw conclusions about which management factors were most important, because many of the categories of timing of grazing occurred only on a single ranch (e.g., “Cool + Warm + Dormant” timing of grazing primarily occurred on a single ranch, as did “Cool + Dormant” timing of grazing). For that reason, we can’t be sure if it is the actual timing of grazing that was important, or some other unique characteristic about that ranch.

These results should not be taken as the final word on the effects of grazing strategies on habitat structure and bird abundance across grasslands. Other studies have been able to detect stronger differences between grazing systems (e.g., Davis et al. 2014; Ranellucci, Koper, and Henderson 2012). It is possible that in other regions there would be stronger effects of the different grazing strategies. However, a wide range of grazing strategies was used in our study area, yet the range managers appeared to be successful in maintaining a productive and efficiently-used vegetation cover regardless of the grazing strategy used. Our results suggest that grazing strategy is not a driver of habitat structure in some rangelands/grasslands *where distribution of grazing and vegetation type is comparable (low inherent variability in vegetation cover) at the pasture and landscape scale*.

For individuals and agencies interested in managing bird habitat, we do not have strong evidence that the choice of grazing strategy is important for managing bird habitats. Timing of grazing in a given pasture and the stocking rate used may be more important. Any planned management modifications should take into account the existing habitat type and bird community within the management unit and consider which habitats are lacking across the landscape. In the case of the Sandhills, there may be a need for more early successional type habitats. A general conclusion from this study is that the range of habitats available for wildlife may simply be quite low when studying a system where the primary goal is long-term livestock production.

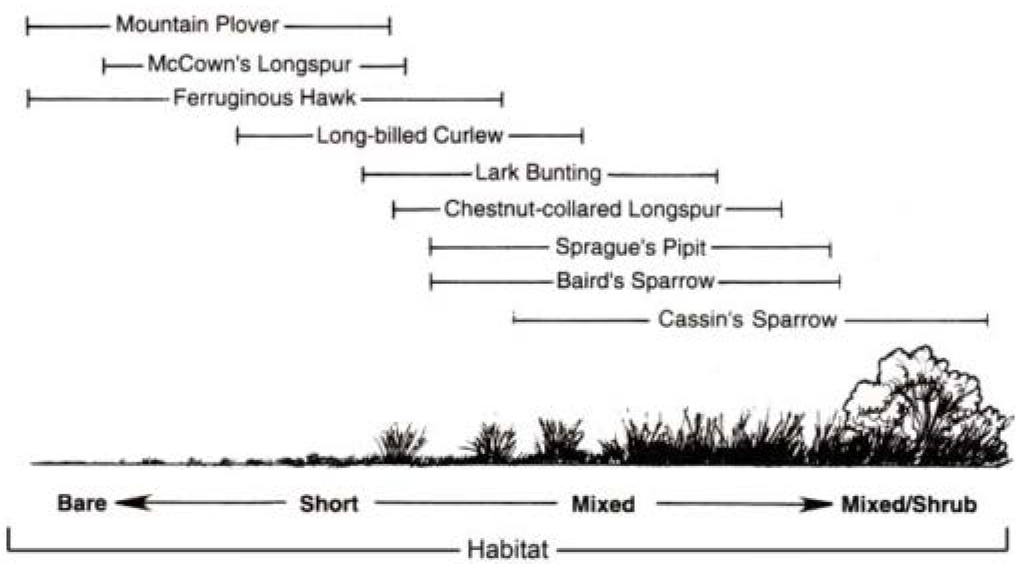


Figure 1. Habitat associations of birds in the Northern Great Plains (from Mengel 1970).

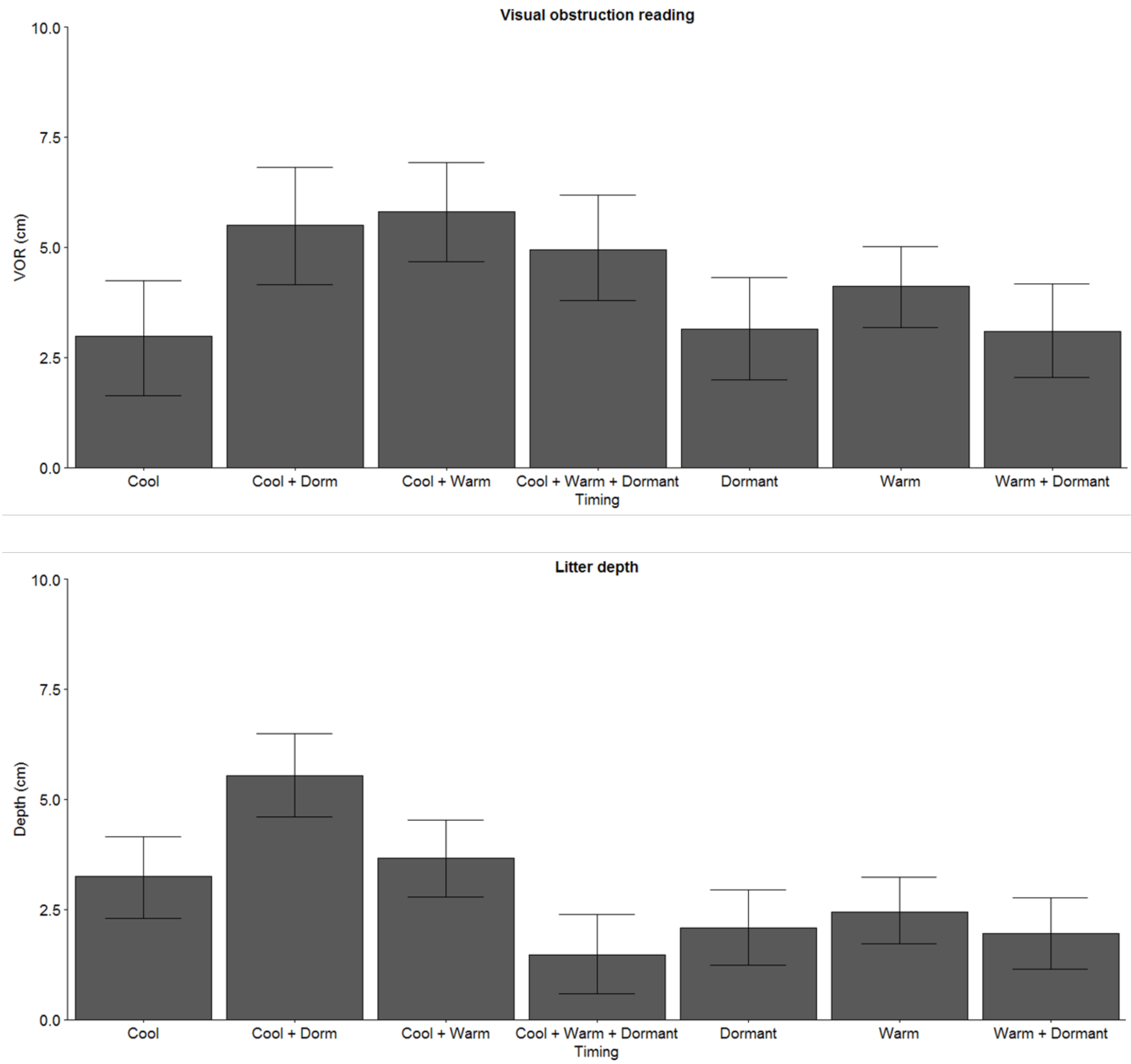
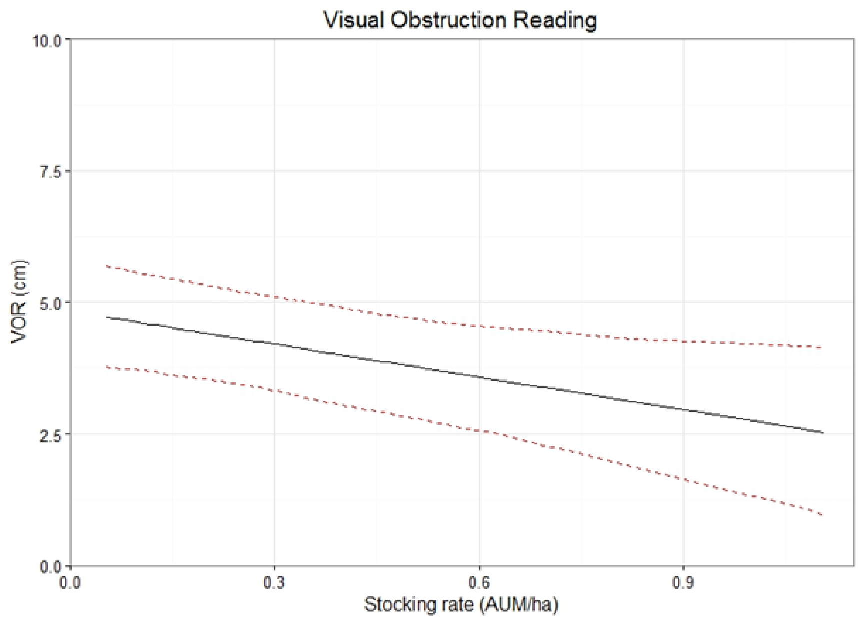


Figure 2. Relationship between timing of grazing and visual obstruction reading (top) and litter depth (bottom). Timing of grazing categories reflect when a plot we sampled was grazed (e.g., Cool + Dorm = grazed in both the cool seasons and dormant season). There are no clear patterns between timing of grazing and either habitat variable.



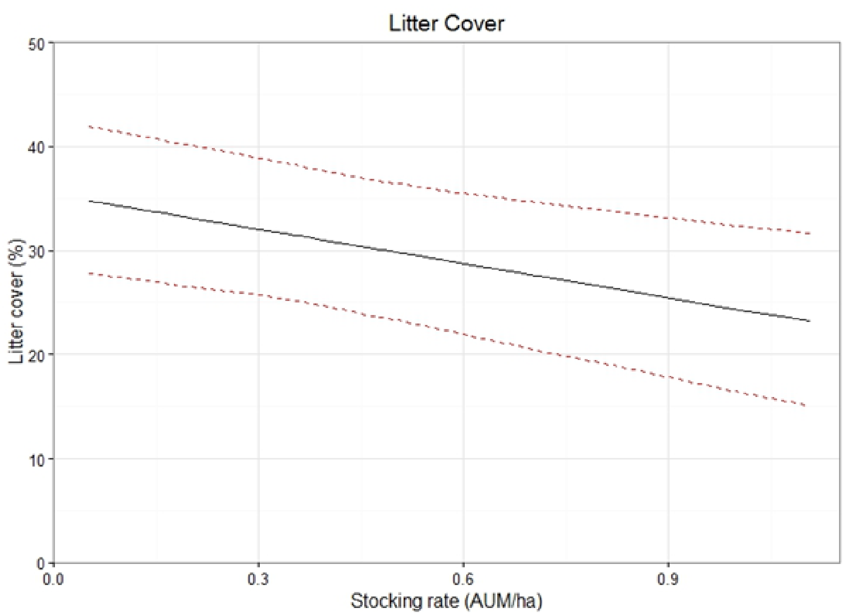


Figure 3. Relationship between visual obstruction readings (top) and litter cover (bottom) and stocking rate. Both measures decrease with increasing stocking rates.

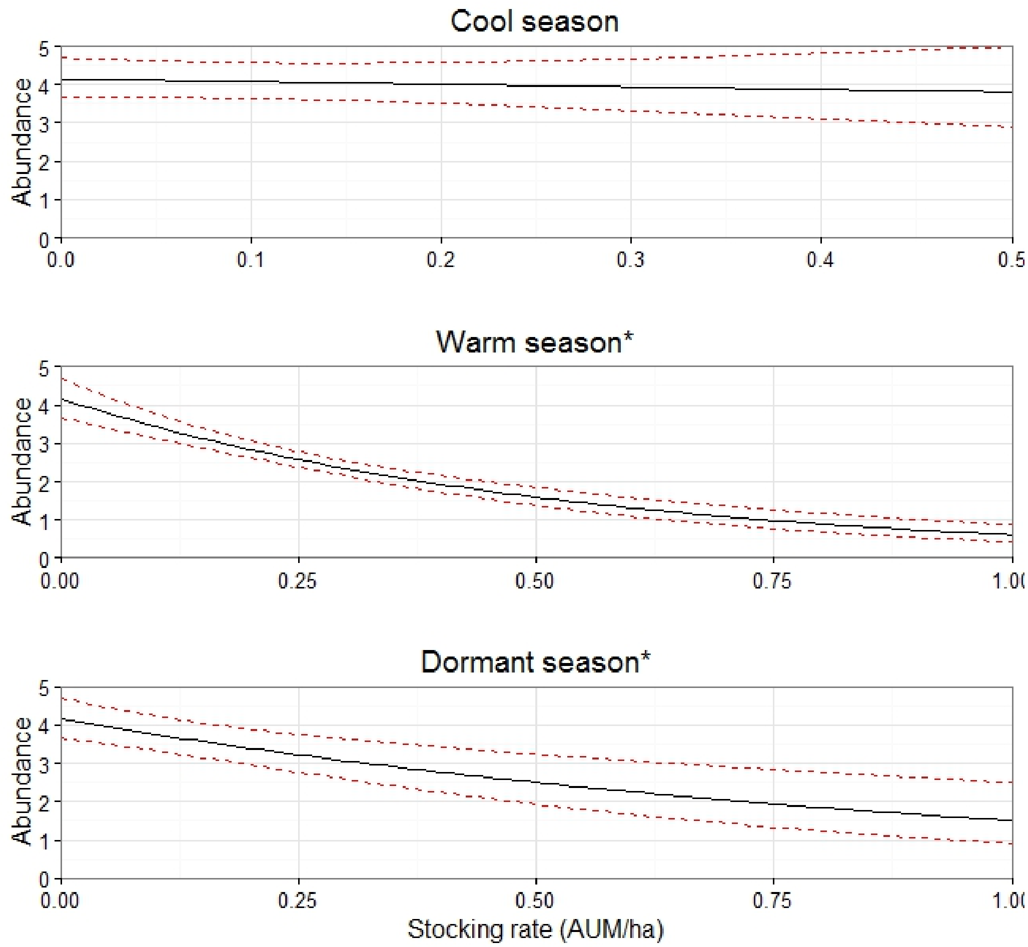


Figure 4. Response of grasshopper sparrow abundance to seasonal stocking rates in the Nebraska Sandhills, 2014-2015. Grasshopper sparrow abundance decreased with increased stocking rate in the warm and dormant seasons.

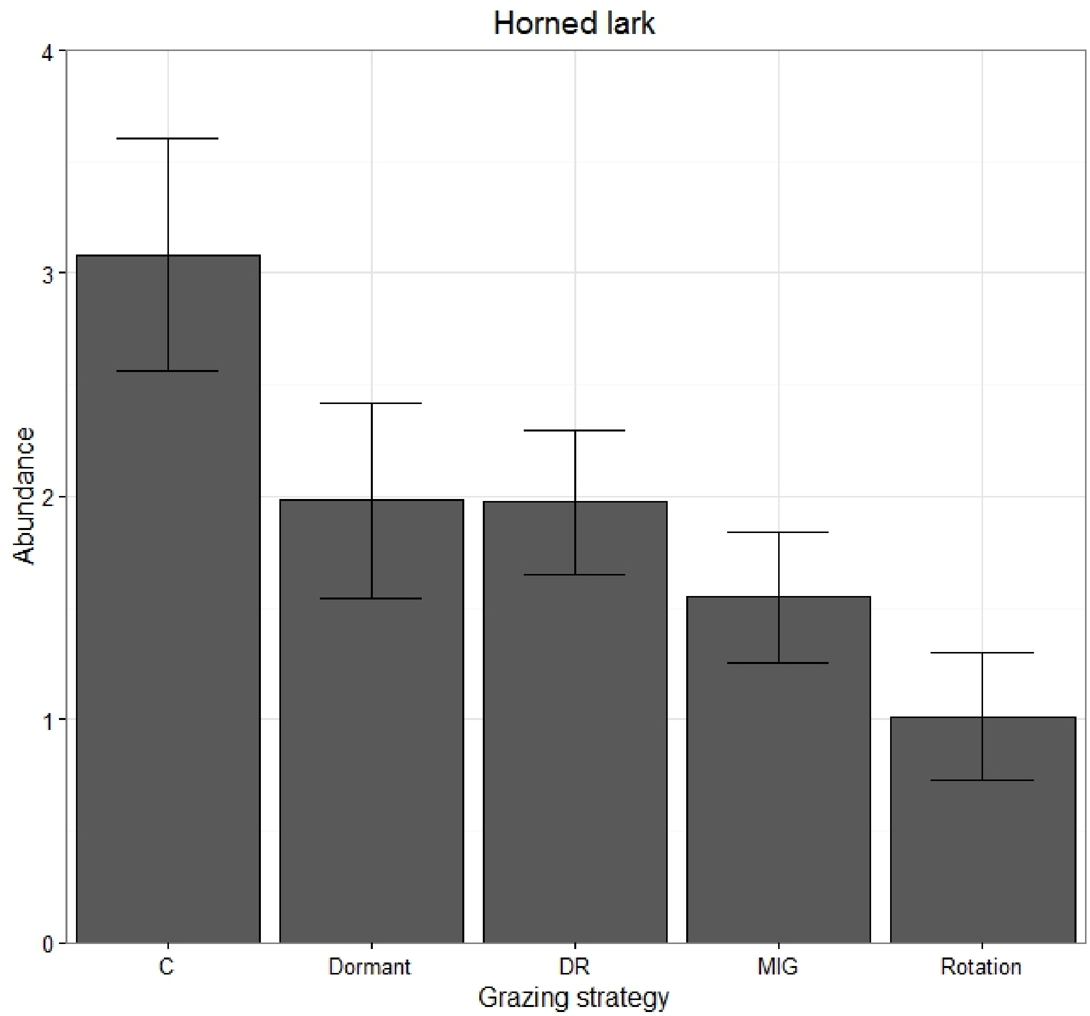


Figure 5. Relationship between horned lark abundance and grazing strategies in the Nebraska Sandhills, 2014-2015. Horned lark abundance was greatest on season-long, continuously grazed ranches, and lowest on the ranch using a fixed-sequential rotation. Abbreviations: C = continuous, season long; DR = deferred rotation; MIG = management intensive grazing, Rotation = fixed-sequential rotation.

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