Butterfly Community Response to Cattle Management Strategies

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We are assessing the influence of three cattle management regimes on butterfly species richness and abundance. Our three regimes are seasonlong grazing without fire, meant to mirror traditional management practices, and two forms of patch-burn grazing, which are meant to mimic the natural heterogeneity in vegetation structure in grasslands. One of our patch-burn grazing treatments has a single season of fire, and the other has two seasons of fire. Here we present results from year one of a multiyear study.

Introduction

Pollinators provide valuable ecosystem services worldwide. Native pollinators provide up to $3.07 billion in the U.S. in agricultural pollination (Losey and Vaughn, 2006), in addition to preserving biodiversity through native plant pollination (Allen-Wardell et al., 1998).

However, pollinator populations are in decline worldwide (Potts et al., 2010). The drivers of this decline include climate change (Peterson et al., 2004), pesticide-induced mortality (Rortais et al., 2005) and habitat degradation through mismanagement (Potts et al., 2010).

To combat these declines, creating land management plans that account for native pollinators is important. In the Great Plains, such a plan should reinstitute the natural disturbances of fire and grazing, alongside which native species evolved (Anderson, 2006).

When combined in a patch-burn grazing framework, fire and grazing create a "shifting mosaic" of patches, where grazers utilize the most nutritious forage in the most recently burned patch (Allred et al., 2011; Fuhlendorf and Engle, 2001). This allows for a variety of vegetation structure, including forb diversity, deep litter and bare ground throughout the patches (Fuhlendorf and Engle, 2004).

Different pollinator species have different habitat requirements, so this variety of vegetation could prove beneficial for many native pollinators throughout their life cycles.

Previous research into the influence of patch-burn grazing on pollinators has focused on tallgrass prairie in the southern Great Plains (Debinski et al., 2011; Moranz et al., 2012) and not the mixed-grass prairie in the northern Great Plains. Additionally, past research has included only one season of fire, and our work will include dormant and growing-season prescribed burns to determine how this influences the butterfly community.

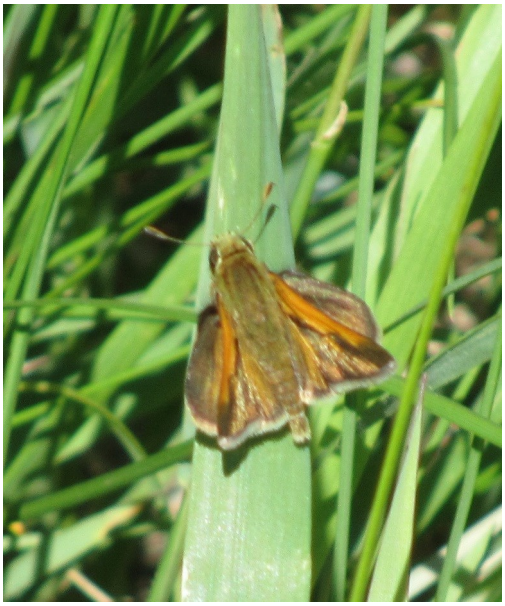
Further, studying the butterfly response to management practices could provide important insight into other native insects because butterflies sometimes are used as indicator species (Brereton et al., 2010; New. 1997).

As such, our main objective for this study is to assess the butterfly community response to three treatment types. Our three treatments are patch-burn grazing with one season of fire, patch-burn grazing with two seasons of fire and seasonlong grazing.

Photos by Brooke Karasch, NDSU

Aphrodite fritillary (*Speyeria aphrodite)*

Gorgone checkerspot (*Chylosyne gorgone)*



Long dash skipper (*Polites mystic)*

Procedures

Our research takes place in the Missouri Coteau ecoregion. The region is typified by mixed-grass prairie and a semiarid climate. Specifically, we are using the Central Grasslands Research Extension Center in central North Dakota, which is managed by North Dakota State University.

Each of our three treatment types has four replicates for a total of 12 pastures, each 160 acres. The patch-burn grazing treatments with one season of fire have a 40-acre prescribed burn applied each spring. The patch-burn grazing treatments with two seasons of fire have a 20-acre patch burned each spring, and an adjacent 20-acre patch burned in late summer or early fall. The spring prescribed burns are dormant-season burns, and the late summer or early fall burns are growing-season burns.

All pastures are moderately stocked with mixed-breed cow-calf pairs from mid-May to mid-September for 30 percent forage utilization. Cattle in each treatment may freely roam within their treatment but do not have access to other treatments or replicates.

Each pasture has eight permanent 150-meter transects for conducting butterfly surveys, for a total of 96 transects. We conducted line-transect distance sampling using these transects, wherein we walked each transect and recorded the species and distance perpendicular from the line for each adult butterfly seen.

Observers walked each transect three times throughout the butterfly flight season to capture the most accurate data across the season. In 2017, surveys took place from June 5 to Aug. 9. We then pooled data from all three sampling periods and used this to obtain density estimates.

We also are collecting floral resource data along the same transects. This involves identifying and recording all forbs and legumes in flower within 1 meter of the transect line during butterfly surveys.

Statistics

Butterfly species richness was calculated as the total number of species present in each treatment. Total abundance was calculated as the average number of detections per transect within each treatment.

We calculated floral species richness and abundance in the same way. We also used the statistical program Distance 6.2, release 1 (Thomas et al., 2010) to calculate densities for all butterfly species detected a minimum of 60 times.

Results

In the 2017 field season, we recorded a total of 2,031 butterflies, representing 39 species, across the three cattle management treatments (Table 1). We also recorded 60,019 total flowering plants of 92 species.

Butterfly Species Richness

Butterfly species richness was highest in the patch-burn grazing with two seasons of fire (33 species), followed by the patch-burn grazing with one season of fire (30 species) and, finally, the seasonlong grazing treatment (22 species). Species composition varied among treatments, and a total of 39 species were observed in 2017.

Butterfly Abundance

Butterfly total abundance was highest in the patch-burn grazing with one season of fire, which had 32.3 detections/transect (SE ± 1.7). Abundance was similar in the patch-burn grazing treatment with two seasons of fire, with 26.1 detections/transect (SE ± 1.9). The seasonlong grazing treatment had 12.1 detections/transect (SE ± 1.1).

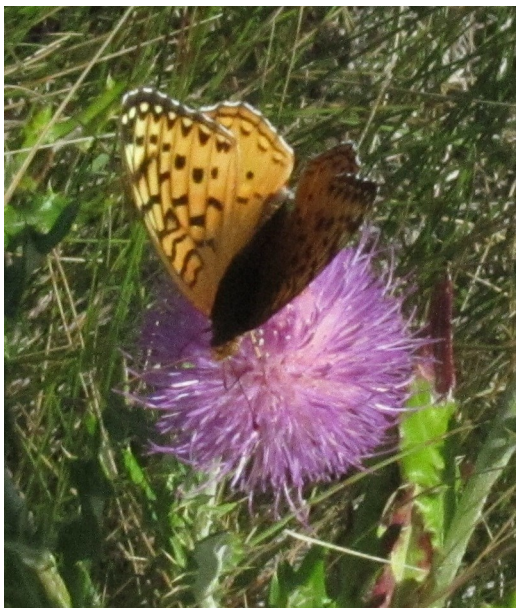
Butterfly Density

Of the six species analyzed, three had higher densities in both of the patch-burn grazing treatments, and only one species had a higher density in the seasonlong grazing treatment than either of the patch-burn grazing treatments (Figure 1A-C).

Floral Diversity and Abundance

Floral species richness was highest in the patch-burn grazing with two seasons of fire treatment (22.4 species/transect SE ± 1.3), followed by the patch-burn grazing with one season of fire (20.1 species/transect SE ± 0.9) and lastly the seasonlong grazing treatment (16.4 species/transect SE ± 0.9).

Floral abundance in the seasonlong grazing treatment was 423.7 (SE ± 33.7) blooming flowers/transect; in the patch-burn grazing with one season of fire it was 430.7 (SE ± 40.5) blooming flowers/transect. The patch-burn grazing with two seasons of fire had 510.5 (SE ± 47.7) blooming flowers/transect.

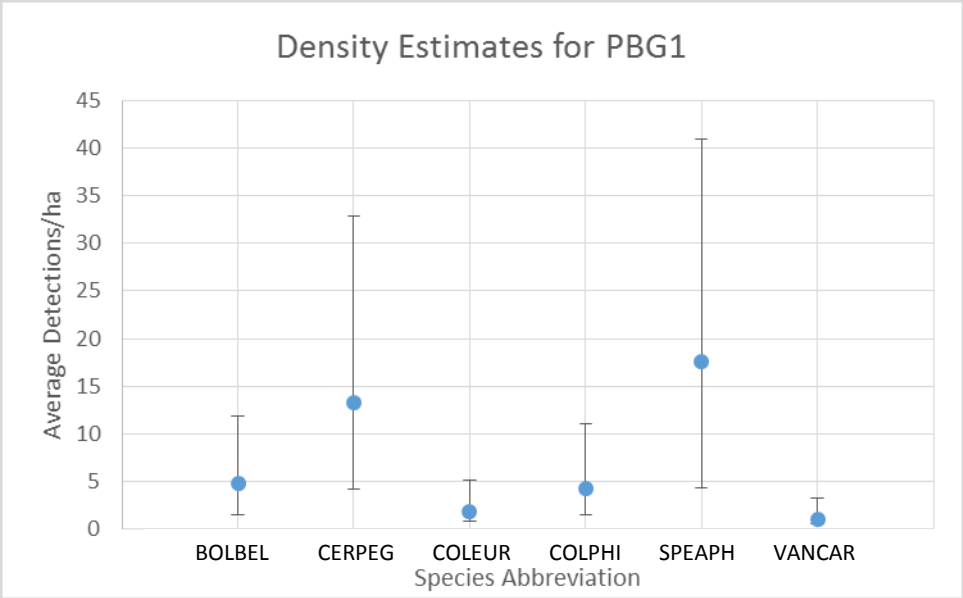


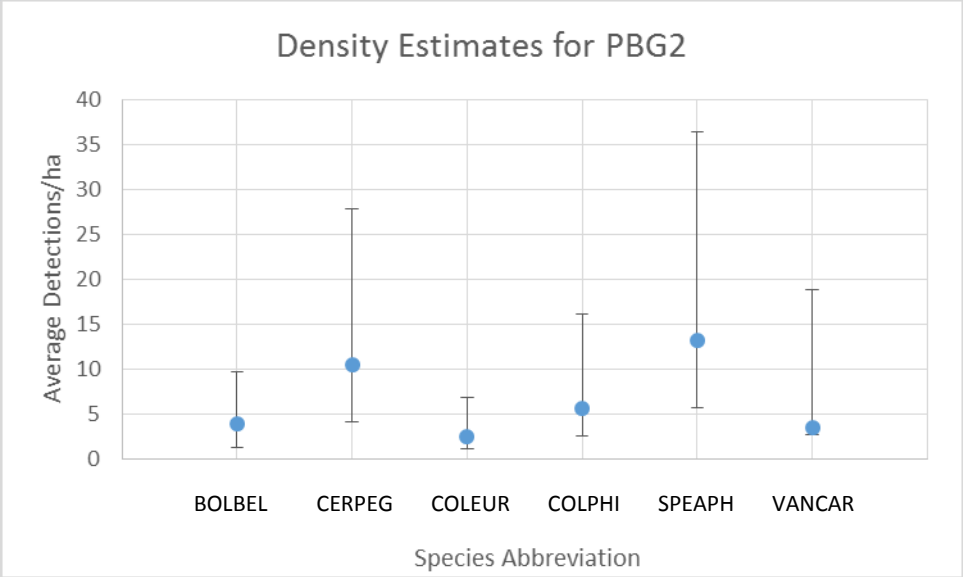
Silver-bordered fritillary (*Boloria selene)*

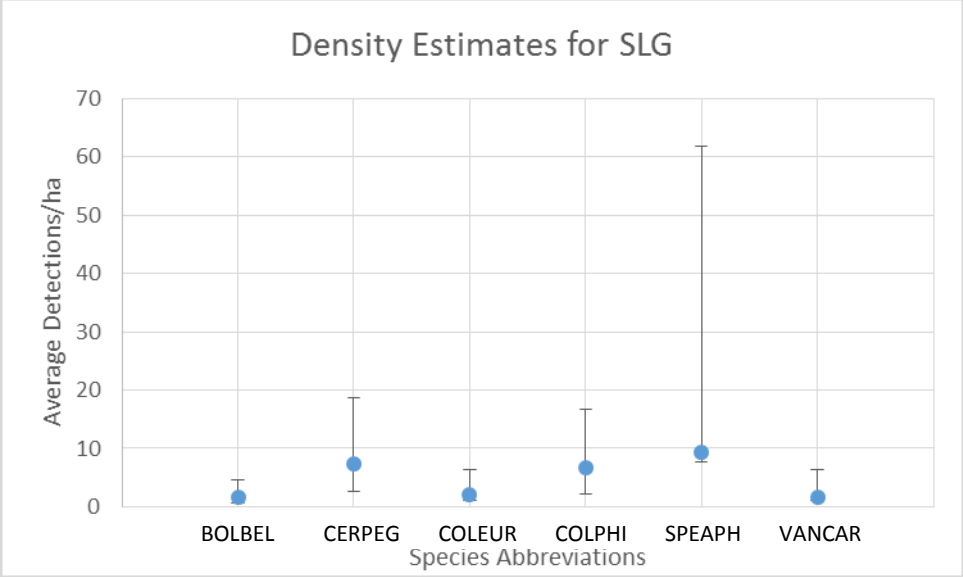
Melissa blue (*Lycaena melissa)*

Common Name	Scientific Name	Detections in PBG1	Detections in PBG2	Detections in SLG
Meadow fritillary	*Boloria bellona*	82	65	26
Silver-bordered fritillary	*Boloria selene*	26	16	6
Summer azure	*Celestrina neglecta*	11	7	8
Wood nymph	*Cercyonis pegala*	141	97	62
Gorgone checkerspot	*Chylosyne gorgone*	3	1	0
Common ringlet	*Coenonympha tullia*	76	82	3
Orange sulphur	*Colias eurytheme*	27	27	31
Clouded sulphur	*Colias philodice*	58	55	75
Monarch	*Danaus plexippus*	6	7	6
Silver-spotted skipper	*Epargyreus clarus*	0	0	1
Variegated fritillary	*Euptoieta claudia*	23	23	8
Eastern tailed blue	*Cupido comyntas*	0	1	0
Silvery blue	*Glaucopysche lygdamus*	12	27	5
Viceroy	*Liminitus archippus*	3	3	0
Gray copper	*Lycaena dione*	2	0	0
Purplish copper	*Lycaena helloides*	1	2	1
Bronze copper	*Lycaena hyllus*	0	1	0
Melissa blue	*Lycaena melissa*	80	83	22
American copper	*Lycaena phlaeas*	1	0	0
Eastern tiger swallowtail	*Papilio glaucas*	0	1	0
Black swallowtail	*Papilio polyxenes*	0	2	0
Tawny crescent	*Phyciodes batesii*	0	7	0
Northern crescent	*Phyciodes selenis*	4	4	0
Pearl crescent	*Phyciodes tharos*	8	5	0
Cabbage white	*Pieris rapae*	35	37	36
Long dash skipper	*Polites mystic*	7	6	2
Peck's skipper	*Polites peckius*	1	0	0
Tawny-edged skipper	*Polites themistocles*	0	0	1
Checkered white	*Pontia protodice*	1	5	8
Common checkered skipper	*Pyrgus communis*	4	0	1
Eyed brown	*Satyrodes eurydice*	14	2	1
Coral hairstreak	*Satyrium titus*	0	1	0
Aphrodite fritillary	*Speyeria aphrodite*	175	140	62
Great spangled fritillary	*Speyeria cybele*	3	6	0
Regal fritillary	*Speyeria idalia*	39	46	11
Gray hairstreak	*Strymon melinus*	0	1	0
Red admiral	*Vanessa atalanta*	1	1	0
Painted lady	*Vanessa cardui*	18	10	11
American lady	*Vanessa virginiensis*	3	7	1
Total detections	39	865	778	388

Table 1. Butterfly species detected at the CGREC in 2017 and the number of detections in each treatment. Patch-burn grazing with one season of fire is denoted as "PBG1," patch-burn grazing with two seasons of fire is denoted as "PBG2" and seasonlong grazing is denoted as "SLG."







Figures 1A-1C. Density estimates for the six species with the required number of observations to calculate for all three treatments at the CGREC in 2017. Abbreviations are: BOLBOL (meadow fritillary), CERPEG (wood nymph), COLEUR (orange sulphur), COLPHI (clouded sulphur), SPEAPH (aphrodite fritillary) and VANCAR (painted lady). Treatments are denoted by PBG1 (patch-burn grazing with one season of fire), PBG2 (patch-burn grazing with two seasons of fire) and SLG (seasonlong grazing).

Discussion

In year one of this study, we found that the patch-burn grazing treatment with one season of fire and the patch-burn grazing treatment with two seasons of fire had similar butterfly species richness and abundance. This is likely because the summer prescribed fire in the patch-burn grazing treatment with two seasons of fire took place after the surveys had ended, so the two patch-burn treatments were structurally similar in the first year of the study.

Both of these treatments had higher butterfly species richness and abundance than did the seasonlong grazing treatment, which had less than half as many detections as the patch-burn grazing treatments. This likely was driven by floral diversity and abundance, which were higher in the patch-burn grazing treatments. Many butterfly species rely on a specific host plant (for example, Kopper et al., 2000), which in many cases may have been more available in the patch-burn grazing treatments than the seasonlong grazing treatment.

An interesting component of the year one results is that along with the variation in total species richness, we also found some variation of community composition among treatments. All three treatments had at least one species that was found only in that treatment and was not detected elsewhere.

Although these may be misidentifications, having all 12 species unique to a treatment be misidentified every time seems unlikely. Instead, what is more likely is these species have some habitat requirement that is best filled by their treatment of choice. If this difference in species composition continues throughout the study, this would suggest that a variety of cattle management regimes would be the best to promote the highest biodiversity in butterflies.

Although these results appear to show that patch-burn grazing – with one and two seasons of fire – creates the best habitat for supporting the most diverse and abundant butterfly community, we must stress that this is year one of a multiyear study. These results may differ year to year as more prescribed burns are applied, and the "shifting mosaic" becomes more apparent in the pastures. Particularly, in future years, we expect to see further differentiation between the two patch-burn grazing treatments once surveys can occur in patches with the different seasonal burns applied and an increasing number of times-since-fire in patches.

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