# Butterfly Community Response to Cattle Management Strategies

**Brooke Karasch and Torre Hovick**
North Dakota State University, School of Natural Resource Sciences, Fargo, N.D.

*We are assessing the influence of three cattle management regimes on butterfly species richness and abundance. Our three regimes are season-long 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 years one and two 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 can be 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 season-long grazing.

## Procedures

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

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.

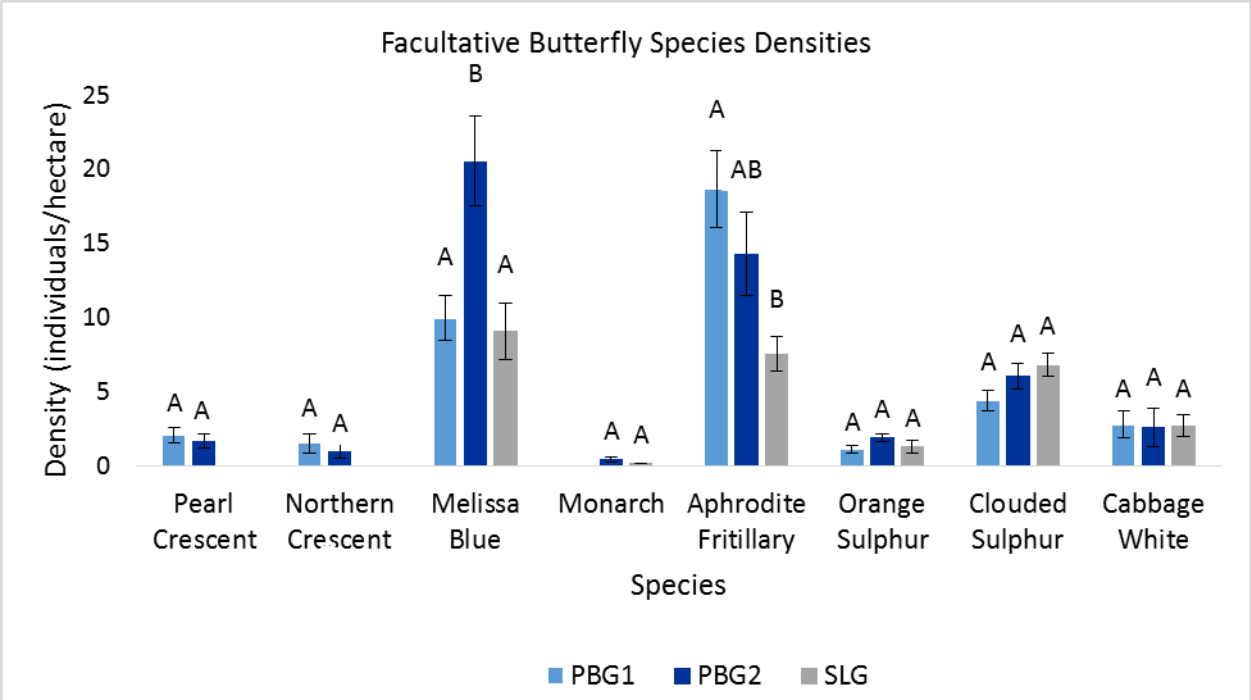
Each pasture has eight permanent 150-meter transects for conducting butterfly surveys, for a total of 96 transects. We conducted line-transect distance sampling using these transects, wherein we walked each transect and recorded the species and distance perpendicular from the line for each adult butterfly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

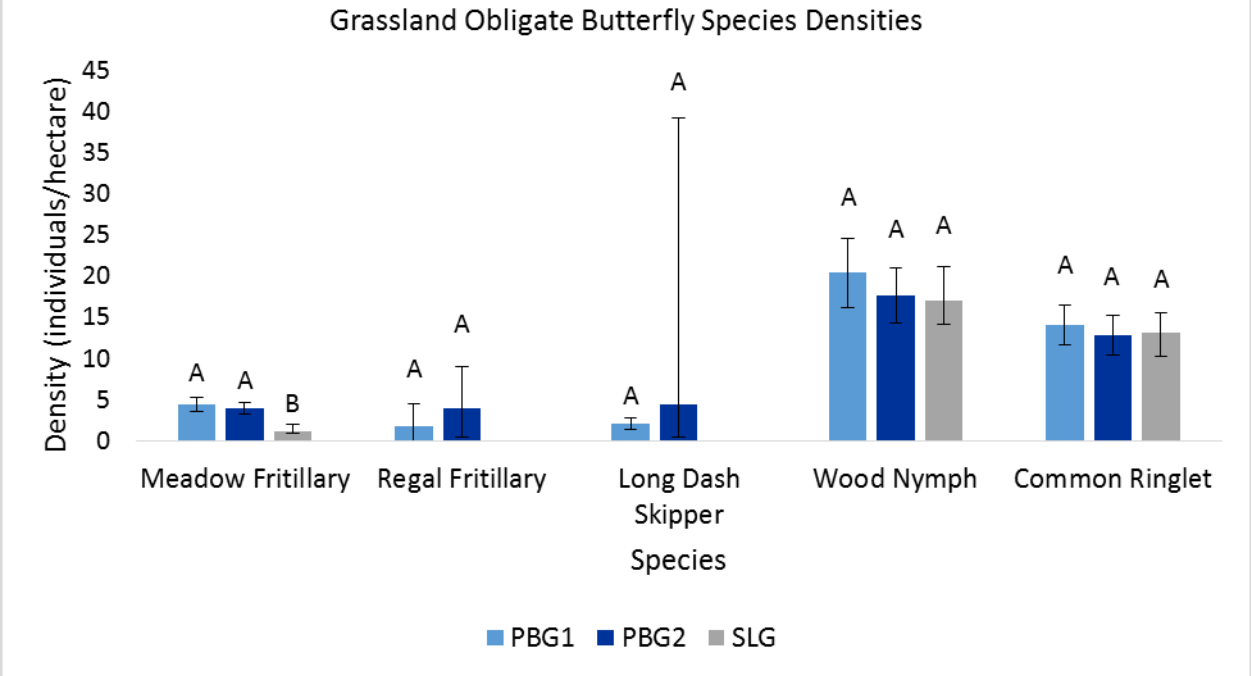
Observers walked each transect three times throughout the butterfly flight season to capture the most accurate data across the season. The survey period corresponds with the butterfly flight period, and surveys in both years took place between June 1 and Aug. 15.

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*

We used the statistical program Distance 7.1, release 1 (Thomas et al., 2010) to calculate densities for all butterfly species with a minimum of 60 detections.




**Figures 1a-1b.** These graphs show the density per hectare of 13 butterfly species. They are grouped by habitat specialization, with facultative species being those that are habitat generalists, and grassland obligate species being those that require grassland habitats for their entire life cycle. Letters indicate significant differences among the three treatments within each species.

**Results**

In the 2017 and 2018 field seasons, we recorded a total of 4,856 butterflies, representing 44 species, across the three cattle management treatments (Table 1). We also recorded 91,800 total flowering plants of 128 species.

*Butterfly Abundance*

In 2018, butterfly total abundance was highest in the patch-burn grazing with two seasons of fire, which had 33.4 detections/ transect (SE ± 3.5). Abundance was similar in the patch-burn grazing treatment with one season of fire, with 28.6 detections/ transect (SE ± 2.6). The season-long grazing treatment had 24.3 detections/transect (SE ± 2.4).

*Butterfly Density*

We had 13 species with a minimum of 60 detections for analysis in program Distance. Eight of these species showed higher densities in at least one of the treatments involving fire rather than season-long grazing. The remaining five species had similar densities across all three treatments. (Figures 1a and 1b).

*Floral Diversity and Abundance*

Floral species richness was highest in the patch-burn grazing with two seasons of fire treatment, with a total of 88 flowering species, followed by the patch-burn grazing with one season of fire at 77 species, and lastly the season-long grazing treatment with 62 species.

Floral abundance in patch-burn grazing with two seasons of fire was the highest of the three treatments, with 251.9 flowering stems/transect (SE ± 32.6). Patch-burn grazing with one season of fire had an average of 164.1 flowering stems/transect (SE ± 13.6). Season-long grazing had the fewest flowering stems of the three treatments at 82.3 per transect (SE ± 6.6).

**Discussion**

Our results show that butterfly species respond differently to the reintroduction of fire and grazing. What is important to note is that no species showed a negative response to fire; that is, no species had a lower density in both of the treatments including fire than in the treatment without fire.

One factor that could be driving some species to respond positively to treatments including fire is that floral abundance was higher in these treatments. In fact, all three treatments were significantly different from one another, with patch-burn grazing with two seasons of fire having the greatest floral abundance, and season-long grazing having the least. Many butterfly species rely on floral forb resources not only for adult feeding, but for oviposition and larval feeding as well.

Although we still have one season of data collection before this study is completed, what is apparent from the current data is that the butterfly community benefits from the inclusion of fire in this grassland landscape. Previous studies have found that butterflies responded neutrally or negatively to fire (Kral et al. 2017), but our results are in contrast.

No butterfly species that we analyzed had a negative response, and more than half of the species (8 of 13) had higher densities in areas including fire. This could be because our fires are relatively small, and most of each pasture is left unburned each year. These unburned areas may be refuges for low-mobility larvae, which then recolonize the burned areas after metamorphosing into adult butterflies.

We suggest that future research focus on long-term studies, which will provide a more complete picture of how butterflies respond as fire becomes a management legacy, and more importantly, on spatiotemporally varied application of fire to the landscape.

**Literature Cited**


Allen-Wardell, G., Bernhardt, P., Bitner, R., Burquez, A., Cane, J., Cox, P. A., … Torchio, P. 1998. The potential consequences of pollinator declines on the conservation of biodiversity and stability of food crop yields. Conservation Biology, 12(1), 8–17.

Allred, B.W., Fuhlendorf, S.D., Hamilton, R.G. 2011. The role of herbivores in Great Plains conservation: comparative ecology of bison and cattle. Ecosphere, 2(3), 1–16.

Anderson, R.C. 2006. Evolution and origin of the Central Grassland of North America: climate, fire, and mammalian grazers. The Journal of the Torrey Botanical Society, 133(4), 626–647.

Brereton, T., Roy, D.B., Middlebrook, I., Botham, M., Warren, M. 2010. The development of butterfly indicators in the United Kingdom and assessments in 2010. Journal of Insect Conservation, (15), 139 –151.

Debinski, D.M., Moranz, R.A., Delaney, J.T., Miller, J.R., Engle, D.M., Winkler, L.B., … Gillespie, M.K. 2011. A cross-taxonomic comparison of insect responses to grassland management and land-use legacies. Ecosphere, 2(12), art131.

Fuhlendorf, S.D., and Engle, D.M. 2001 Restoring heterogeneity on rangelands: Ecosystem management based on evolutionary grazing patterns. BioScience, 51(8), 625–632.

Fuhlendorf, S.D., and Engle, D.M. 2004. Application of the fire-grazing interaction to restore a shifting mosaic on tallgrass prairie. Journal of Applied Ecology, 41(4), 604–614.

Kopper, B.J., Charlton, R.E., Margolies, D.C. 2000. Oviposition site selection by the regal fritillary, *Speyeria idalia,* as affected by proximity of violet host plants. Journal of Insect Behavior, 13(5), 651–665.

Losey, J., and Vaughan, M. 2006. The economic value of ecological services provided by insects, BioScience 56(4), 311–323.

Moranz, R.A., Debinski, D.M., McGranahan, D.A., Engle, D.M., Miller, J.R. 2012. Untangling the effects of fire, grazing, and land-use legacies on grassland butterfly communities. Biodiversity and Conservation, 21(11), 2719–2746.

New, T.R. 1997. Are Lepidoptera an effective "umbrella group" for biodiversity conservation? Journal of Insect Conservation, 5–12.

Peterson, A.T., Martínez-Meyer, E., González-Salazar, C., and Hall, P.W. 2004. Modeled climate change effects on distributions of Canadian butterfly species. *Canadian Journal of Zoology*, *82*(6), 851–858.

Potts, S.G., Biesmeijer, J.C., Kremen, C., Neumann, P., Schweiger, O., Kunin, W.E. 2010. Global pollinator declines: Trends, impacts and drivers. Trends in Ecology and Evolution, 25(6), 345–353.

Rortais, A., Arnold, G., Halm, M.P., Touffet-Briens, F. 2005. Modes of honeybees exposure to systemic insecticides: estimated amounts of contaminated pollen and nectar consumed by different categories of bees. Apidologie, 38(6), 71–83.

Thomas, L., Buckland, S.T., Rexstad, E.A., Laake, J.L., Strindberg, S., Hedley, S.L., … Burnham, K.P. 2010. Distance software: design and analysis of distance sampling surveys for estimating population size, 47, 5–14.