# The Effect of Grazing on Evapotranspiration and Net Carbon Exchange in a Tallgrass Prairie

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Figure 6. Infra-red photo between grazed and ungrazed plots. Darker colors represent more exposed soil, the lighter colors are green grass.

## Introduction

- The Flint Hills region of Eastern Kansas remains one of the largest unbroken areas of tallgrass prairie in North America
- Grazing serves as primary agronomic management strategy for the region
- 1.5 million head beef cattle, generating over $1 billion
- Grazing may impact the hydrology of the region and effect long-term carbon storage
- Grazing is key to sustainability of the ecosystem and has regional and global impacts

## Objectives

- To determine how the removal of biomass by grazing impacts evapotranspiration (ET) and net carbon exchange (NCE) of a tallgrass prairie
- To estimate prairie ET from weather station data

## Materials and Methods

- Two adjacent annually burned prairies (grazed and ungrazed)
- Located in the Rannells Flint Hills Prairie Preserve 5 km South of Manhattan, Kansas, USA
- Big bluestem (*Andropogon gerardii*) and indian grass (*Sorghastrum nutans*)
- Yearling steers placed on early May and removed late July (Intensive Early Stocking, 0.81 ha/steer)
- Weather data from the Konza Prairie Biological Station was used to compute reference ET ($ET_o$)

## Eddy Covariance Equipment

- Open path Infrared Gas Analyzer (IRGA LI-7500) $H_20$ and $CO_2$
- Sonic Anemometer (CSAT- 3) 3-D wind profiles
- Measures the latent heat (LE) and $CO_2$ flux
- ET = Evaporation + Transpiration
  NCE = Gross Canopy Photosynthesis – Ecosystem respiration (GCP- $R_E$)

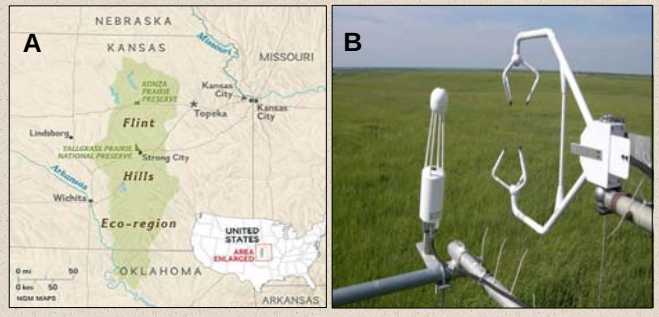


Figure 1. Map of the spread of the Flint Hills Region (A) and Eddy Covariance equipment (B).

## Results

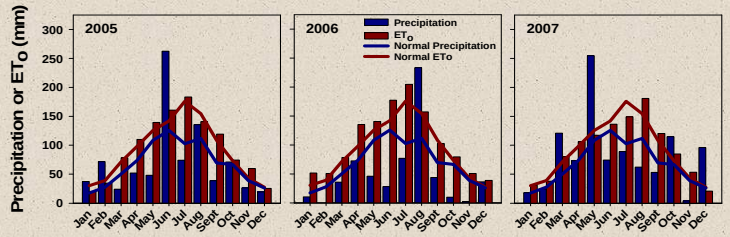


Figure 2. Monthly precipitation and reference crop evapotranspiration (ETo) during the study. Also shown are the 20 yr normals for precipitation and $ET_o$ by month.

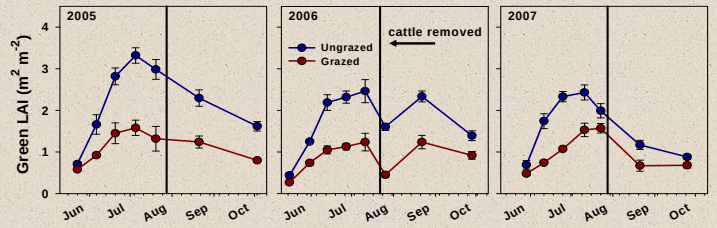


Figure 3.Seasonal trends in green leaf area index (LAI) among years compared between the ungrazed and grazed treatments.

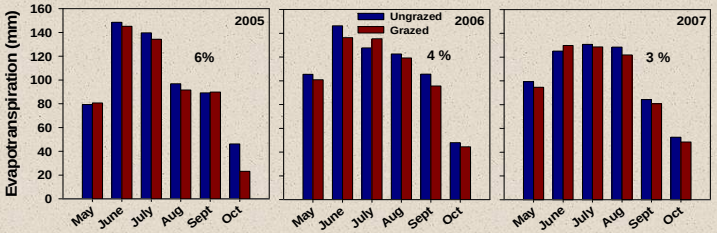


Figure 4. Monthly evapotranspiration (ET) compared between the ungrazed and grazed treatments measured by Eddy Covariance.

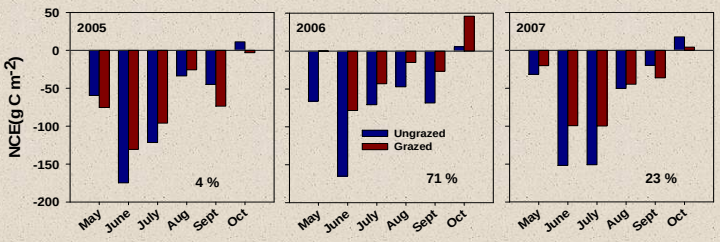


Figure 5. Monthly total net carbon exchange (NCE) compared between the ungrazed and grazed treatments. Negative values represent a gain of carbon to the system (i.e., downward net flux).

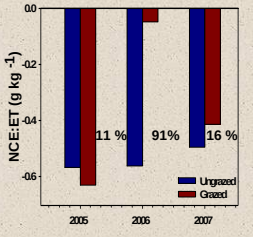


Figure 7. The ratio of NCE to ET compared between the ungrazed and grazed treatments. Negative numbers indicate the system was gaining carbon.

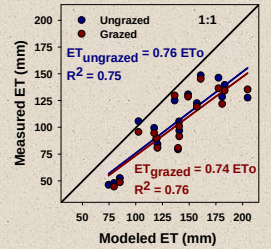


Figure 8. Comparison of measured monthly ET for the ungrazed (—) and grazed (—) sites to ETo calculated from local weather data.

## Conclusions

- Grazing caused small 3 to 6% reductions in ET despite large reductions in LAI.
- On a seasonal basis, ET is mainly governed by precipitation and evaporative demand rather than grazing-induced changes in canopy size and phenology. Grazing probably increased E and decreased T.
- Monthly ET could be modeled (±25 %) with reference ET.
- Grazing strongly influenced net carbon exchange and had a greater effect when early season water stress was present.
- Grazing effects on carbon flux resulted in large differences in the NCE:ET ratio between grazed and ungrazed grasslands.

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