Nuria Gomez-Casanovas
Assistant Professor in Regenerative System Ecology
Texas A&M AgriLife Research
PO Box 1658
11708 HWY 70 S
Vernon, TX 76384

October 30, 2023

Peter Byck
Dept. of Journalism and Mass Communication
Arizona State University
PO Box 872020
Tempe, Arizona, 85287-2020

RE: Technical Report, Project Agreement M2301221
Title: Adaptive Multi-Paddock (AMP) Grazing Research project

Dear Mr. Byck:

As required by the project agreement, I am submitting a technical report for the 'Adaptive Multi-Paddock (AMP) Grazing Research project' (Award number: M2301221). Objectives, results and products are provided below.

Over the last decades, human activities have switched grasslands impacts on climate from a net cooling to a warming effect, indicating an urgent need for sustainable management strategies in grasslands directed to mitigate climate warming. Adaptive Multipaddock grazing (AMP) is a novel strategy that consists of mimicking how ancestral herds roamed the Earth. This strategy could enhance the environmental benefits from grasslands but knowledge of these potential benefits and their underlying mechanisms are highly uncertain. The overarching objective of this project was to investigate how AMP affects greenhouse gas (GHG; CO_2, H_2O, N_2O and CH_4) fluxes from subtropical pastures located in Alabama.

Field measurements were performed in two farm pairs (i.e. FP1, located in Piedmont, Alabama; and, FP2, located in Fort Payne, Alabama) from 2019 to 2021. Each pair consisted of one pasture managed under AMP and its control managed under continuous grazing (CG). The AMP plot was grazed by either cattle (FP1) or by both cattle and chicken (FP2), and the CG plots were grazed by cattle. At FP1, the AMP pasture was seeded with annual and perennial species at the beginning of summer and autumn during each year, and it was fertilized with chicken manure. At FP2, the AMP pasture was seeded with annual species, and the CG pasture was fertilized with inorganic fertilizer. Soil, surface elevation, and climate were similar in pastures within pairs.

The COVID-19 pandemic (March 2020-May 2023) restrictions on access to laboratory and instrumentation as well as travel to field sites negatively impacted research activities. In addition, the pandemic delayed hiring of personnel, particularly in 2021 and 2022. The negative consequences of the pandemic were mitigated to the best of the abilities of our research team to ensure a responsible safe environment.

Over the years studied, AMP enhanced forage productivity compared to CG. AMP consistently decreased ecosystem respiration. At FP1, Gross Primary Productivity was higher in the AMP pasture compared to CG pasture. Relative to CG, AMP increased both the net sink of CO_2, and all pastures were net sinks of CO_2. This increased sink strength in AMP vs CG was explained by higher ecosystem Carbon Use Efficiency (i.e., ratio between productivity and GPP; CUE) of AMP than CG pastures, likely led by both higher plant and enhanced soil microbial CUE. Although forage productivity was higher in AMP than in CG pastures, evapotranspiration was similar within farm pairs, and AMP consistently enhanced the Water Use Efficiency (i.e., ratio between productivity and ET) of pastures relative to CG.

AMP also affected the emission of CH_4 from pastures. At FP1, higher grazing intensity in AMP than in CG increased overall net CH_4 emissions from pasture to the atmosphere. Cattle CH_4 emission factors (i.e., CH_4 emissions per unit of animal) were similar for cattle grazing AMP and CG pastures, and they were similar to values reported by IPCC. At FP2, CH_4 emission factors were also similar for cattle grazing AMP and CG pastures. However, overall ecosystem CH_4

Texas A&M AgriLife Research and Extension Center at Vernon
Nuria Gomez-Casanovas, PhD
P.O. Box 1658
11708 Highway 70 South
Vernon, TX 76385
nuri.gomez-casanovas@ag.tamu.edu

emissions at FP2 over the years studied were similar between pastures. This was explained by the fact that slightly larger total net CH_4 emissions from cattle in CG than in AMP were compensated by higher CH_4 emissions from soils under AMP than CG.

Grazing strategy also affected N_2O emissions, but its impact varied between treatments. At FP1, soil N_2O emissions were larger in AMP than in CG pasture given the higher grazing intensity, and hence, urine deposition in AMP than in CG pasture. At FP2, soil N_2O emissions were larger in CG than in AMP given that while overall urine deposition was similar between treatments, enhanced inorganic fertilizer application in CG pasture compared to AMP pasture increased overall N_2O emissions.

In conclusion, these results suggest that grazing strategy affects the net CO_2 sink strength of subtropical pastures and emission of non-CO_2 GHGs. By providing the mechanisms by which AMP and CG affects biogeochemical cycles, our results reduce the uncertainty surrounding GHG emissions from subtropical pastures.

PRODUCTS

PEER REVIEWED PUBLICATIONS

Gomez-Casanovas N, Blanc-Betes E, Moore CE, Bernacchi CJ, Kantola I, DeLucia EH. (2021) A review of transformative strategies for climate mitigation by grasslands. Science of the Total Environment, 10;799:149466.

PRESENTATIONS AND CONFERENCE CONTRIBUTIONS

Gomez-Casanovas N, Blanc-Betes E, Hong D, Byck P, DeLucia E (December, 2022). Impact of Adaptive Multipaddock grazing on CO_2 and H_2O fluxes in subtropical pastures. AGU, Chicago (USA) (oral presentation).

Roscioli J, Shorter J, Lunny E, Meredith L, Gil-Loaiza J, Gomez-Casanovas N, Byck P, Eddy W, Yang W (December, 2022). Exploring Spatiotemporal Heterogeneity of Subsurface Gases Across Scales. AGU, Chicago (poster presentation)

Texas A&M AgriLife Research and Extension Center at Vernon
Nuria Gomez-Casanovas, PhD
P.O. Box 1658
11708 Highway 70 South
Vernon, TX 76385
nuri.gomez-casanovas@ag.tamu.edu

Gomez-Casanovas N (November, 2022) Enhancing the ecological and environmental sustainability of grassland and energy landscapes. Texas Land Grants Day. College Station, Texas (poster presentation; lighting talk).

Gomez-Casanovas N, Blanc-Betes E, Moore C, Bernacchi CJ, Kantola I, DeLucia E (December, 2020). Transformative management approaches for grasslands. AGU, San Francisco, CA, USA (oral presentation).

Gomez-Casanovas N, Bernacchi CJ, Boughton EH, Dracup E, Pierre S, Saha A, Boughton R, Smith B, Sparks J, Swain H, DeLucia EH (December, 2019). Impact of improved management and patch-burn grazing on the net CO_2 sink strength of subtropical humid grasslands. AGU, San Francisco, CA, USA (oral presentation).

Gomez-Casanovas N, DeLucia EH (August, 2019). Improving climate and water regulation services from grasslands with adaptive multi-paddock grazing management. McDonald's Headquarters, Chicago, USA (invited oral presentation).

Gomez-Casanovas N, DeLucia EH (November, 2018). Can adaptive multi-paddock grazing management increase the net Greenhouse Gas sink strength of grazed pastures?. McDonald's Headquarters, Chicago, USA (invited oral presentation).

POPULAR/EXTENSION ARTICLES

AgriLife Today. Ecological, environmental sustainability priorities for Gomez-Casanovas (July 18, 2022)

IN PREPARATION PEER REVIEWED PUBLICATIONS

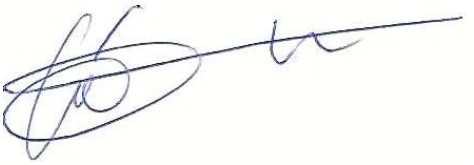
Gomez-Casanovas N, Blanc-Betes E, Hong D, Byck P, DeLucia E (In preparation). Adaptive Multipaddock grazing enhances the Carbon and Water Use efficiency of subtropical pastures. Target Journal: Science of the Total Environment.

Blanc-Betes E, Gomez-Casanovas N, Hong D, Byck P, DeLucia E (In preparation). Altered nitrous oxide fluxes in subtropical pastures under Adaptive Multipaddock grazing. Target Journal: Journal of Geophysical Union – Biogeosciences.

Texas A&M AgriLife Research and Extension Center at Vernon
Nuria Gomez-Casanovas, PhD
P.O. Box 1658
11708 Highway 70 South
Vernon, TX 76385
nuri.gomez-casanovas@ag.tamu.edu

Gomez-Casanovas N, Blanc-Betes E, Hong D, Byck P, DeLucia E (In preparation). Influence of Adaptive Multipaddock grazing on cattle and underlying ecosystem methane fluxes from subtropical pastures. Target Journal: Ecosystems.

Sincerely,



Texas A&M AgriLife Research and Extension Center at Vernon
Nuria Gomez-Casanovas, PhD
P.O. Box 1658
11708 Highway 70 South
Vernon, TX 76385
nuri.gomez-casanovas@ag.tamu.edu