Perennial Pasture Systems in Florida are Strong Carbon Sinks

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More than half of the agricultural lands in Florida are used for cattle production, providing food to millions and many other societal benefits. Among the important ecosystem services that pastures provide, carbon sequestration and climate regulation are perhaps one of the most underrated, particularly by society at large. Pasture soils are one of the most significant reservoirs of soil organic carbon, accounting for approximately 30% of total global soil organic carbon. Soil carbon sequestration provides a long-term alternative to mitigate greenhouse gas emissions and to adapt to the adverse impacts of global climate change. However, the magnitude of carbon sequestration in pastures depends on management. Current pasture management strategies (e.g., fertilization strategy and grazing management) are generally aimed at increasing forage and animal production but they can also have positive impacts on carbon sequestration. This project was designed to evaluate ecosystem carbon balance (difference between the amount of carbon fixed through photosynthesis and carbon losses by respiration) and global warming potential associated with a typical pasture-based cow calf production system in Florida.

The experimental sites were located in Ona FL and were part of the USDA, Long-Term Agroecosystem Research Network. Two native rangelands (54 acres) and two established bahiagrass pastures (46 acres) were selected for this study. Ecosystem carbon balance was estimated using a combination of eddy covariance technique and static chambers (**Figure 1**). Eddy covariance towers in both native rangelands and bahiagrass pastures were equipped with carbon dioxide and methane sensors. Ancillary meteorological data including precipitation, air temperature, relative humidity, radiation (global incoming, net, and photosynthetically active radiation), soil temperature, soil moisture and soil heat flux were also measured at each site.

Some of the key parameters either measured or estimated at each study site included Net Ecosystem Productivity (NEP), methane emissions, and global warming potential. NEP is the difference between gross primary production and total ecosystem respiration. It represents the rate of carbon accumulation in the system with negative NEP values indicating a net gain ("sink") of carbon. Methane emissions included both soil and animal emissions; values were converted into carbon dioxide equivalents (CO_2eqv) in a 100 year scenario. Global warming potential is a metric to compare the ability of different greenhouse gases (carbon dioxide, nitrous oxide and methane) to trap heat in the atmosphere. Greenhouse gases differ in their ability to absorb energy and in their atmospheric residence times. Each gas has a specific global warming potential, which allows comparisons of the amount of energy the emissions of 1 ton of a gas will absorb over a given time period, usually a 100-year averaging time, compared with the emissions of 1 ton of CO_2.

Monthly carbon equivalent fluxes. Both native rangeland and bahiagrass pastures exhibited strong seasonal variability in NEP (**Figure 2**). Greater rates of carbon uptake generally occurred in the spring and summer months. Monthly carbon sequestration in bahiagrass pastures was high as -900 lbs of CO_2-C per acre^{-1}, while native rangeland reached maximum NEP of approximately -320 lbs CO_2-C acre^{-1} month^{-1}. Native rangeland acted as a carbon source in June, while bahiagrass pasture was a carbon source during the dormant season (December – February). Methane emissions from native rangelands were relatively less than bahiagrass pasture.

Annual balance and warming potential. On a yearly basis, both ecosystems were carbon sinks as indicated by negative NEP (**Table 1**). During the study period, bahiagrass pasture produced three times more biomass than native rangeland, which resulted greater net carbon accumulation (-2732 lbs CO_2-C acre^{-1} year^{-1} in bahiagrass pastures vs -1224 lbs CO_2-C acre^{-1} year^{-1} in native rangelands).

Table 1. Annual net ecosystem production, carbon equivalent methane emissions, and global warming potential for two typical Florida cow-calf production systems.

Pasture type	Net ecosystem production	Methane emissions (CO_2-C equivalent)	Global warming potential[1]
	---------------------- lbs CO_2-C acre^{-1} year^{-1} ----------------------		
Native Rangeland	-1233[2]	9	-1224
Improved Pasture	-3984	1252	-2732

[1]Warming potential = Warming Potential in 100 years scenario (IPCC, 2014).
[2]Negative values indicate C sink capacity while positive values indicate C source.

These results suggest that both cow-calf production systems are viable options for carbon mitigation while also providing many other ecosystem services such as food, biodiversity, and water protection among many others. Climatic variability is very strong in Florida, with common occurrence of extreme weather events such as droughts, tropical storms, and hurricanes. Thus, multi-year research is necessary to confirm and validate the data as well as to fully understand the impacts of climate and management on carbon fluxes in Florida pastures.

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References

Intergovernmental Panel on Climate Change (IPCC) 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Intergovernmental Panel on Climate Change, Geneva, Switzerland.

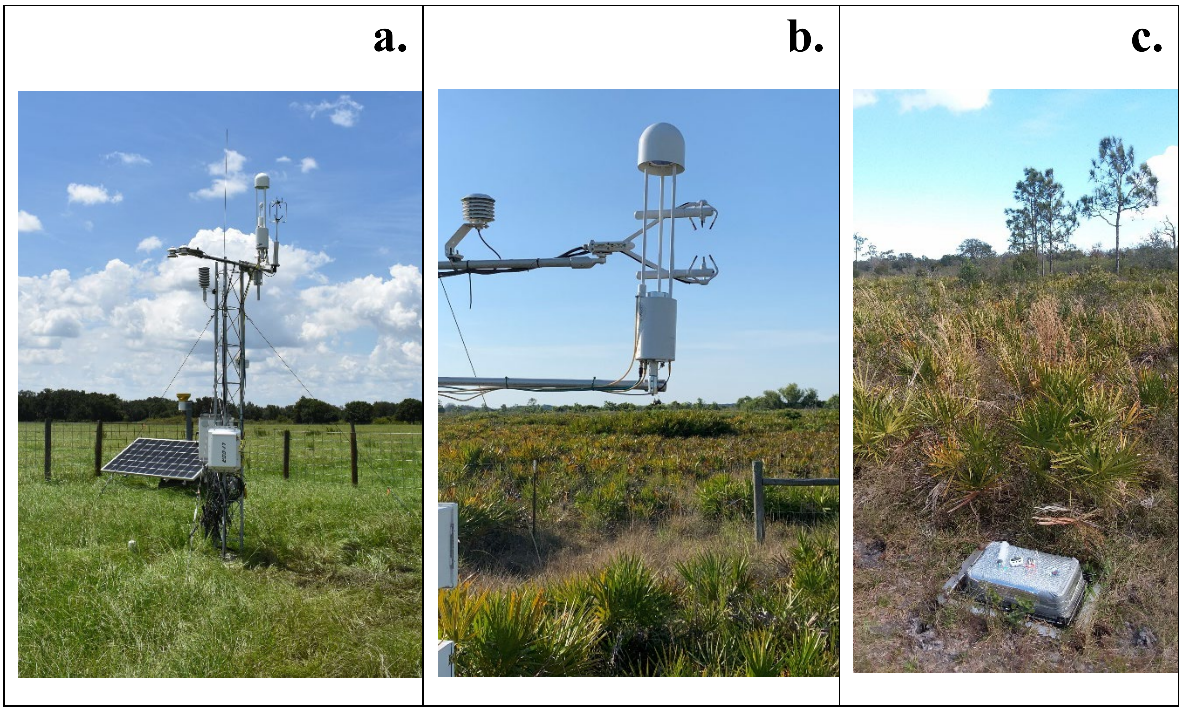

Figure 1. Eddy covariance towers (a and b) and chamber-based (c) measurements of greenhouse gas emissions from bahiagrass pastures and native rangelands

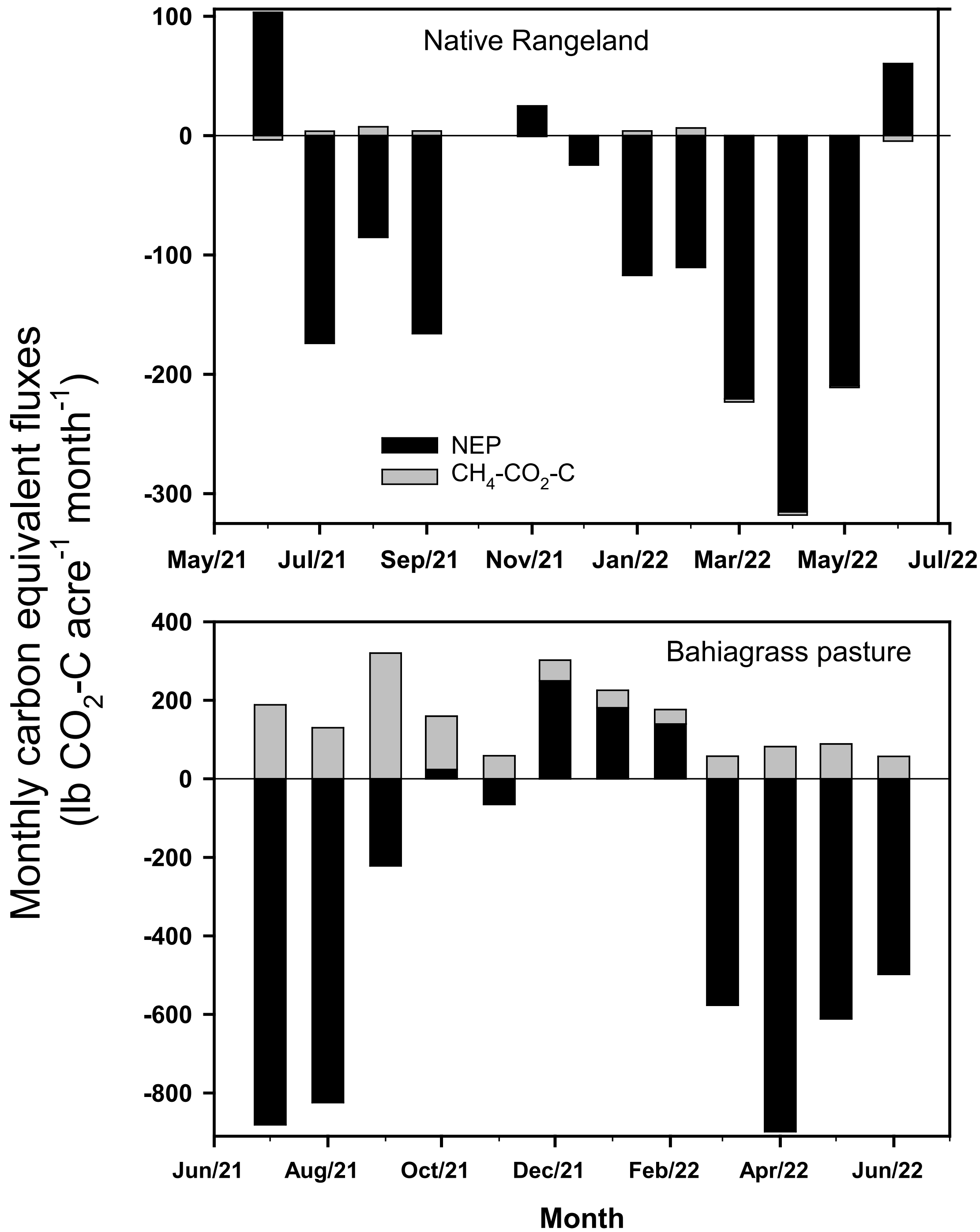

Figure 2. Monthly CO_2-C equivalent for native rangeland and bahiagrass pasture. NEP = net ecosystem productivity; CH_4_CO_2-C = methane emissions as CO_2-C equivalent.

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