Ona Long-Term Agroecosystem Research (LTAR) Highlight

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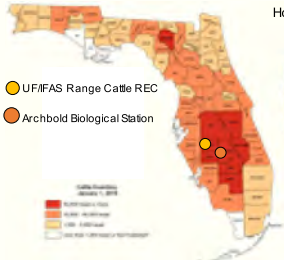
USDA, Long-Term Agroecosystem Research Network (LTAR)

https://ltar.ars.usda.gov/

Research network focused on finding solutions that **increase** agricultural production while also improving the quality of the environment and the well-being of America's farming communities.

Archbold Biological Station & University of Florida LTAR Site



How does management affect cow-calf production and multiple ecosystem services across a land use intensity gradient?

1. Cultivated pastures – 16 x 20 acres (UF RCREC)
2. Cultivated pastures – 8 x 40 acres (Archbold BIR)
3. Semi-native pastures – 8 x 40 acres (Archbold BIR)
4. Native rangeland – 16 x 40-70 acres (UF RCREC)

https://ltar.ars.usda.gov/sites/abs-uf/

Source: Florida Department of Agriculture, 2018.

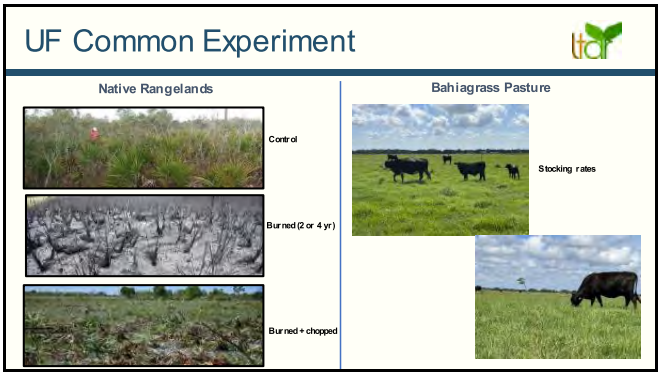
UF/RCREC LTAR team

- Maria Silveira
- Abmael Cardoso
- Priscila Cruz
- Rosvel Bracho
- João Vendramini
- Philipe Moriel
- Brent Sellers
- Hanna Baker

Students:

- Ana Silveira
- Julian Bernal
- Nikitha Kovvuri

UF Common Experiment



UF Common Experiment - Rangelands

- Prescribed fire in 2019, 2021, and 2023
- 16 experimental units (~40-70 acres each)
- 5 transects (150 ft) in each experimental unit
- Winter grazing (90 d; Nov. to Jan; ~13 acres/animal)

June 6-8 2023

UF Common Experiment - Pastures

2 stocking rates : a) 0.66 AU/ha; and b) 20% increase in stocking rate (0. 8 AU/ha). 1. 6 or 2 acres/cow-calf pair

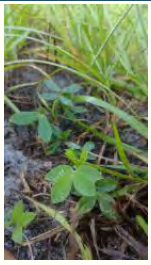
Optimum utilization of forage resources and animal performance with minimum impact on soil and GHG responses

- Forage mass and nutritive value, tissue mineral comp.
- Soil health, soil carbon (up 3 ft)
- Greenhouse gas emissioms
- Animal responses

"Ancillary" Projects

- Climate-smart practices

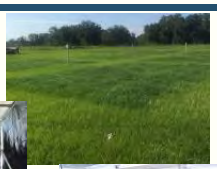
- Annual and perennial legumes and native grasses overseeded into grass pastures) andnutrient management (urfertilized vs. organic or inorganic amendments) impacts on pastureproductivity, soil health, soil C, and GHG emissions



"Ancillary" Projects

- Nutrient Management

- Biosolids field study
- Rainfall simulation project
- Refining fertilizer recommendations for forage crops



Measurements in the Common Experiment

- **Fire characteristics**: peak temperature, heating duration, % combusted biomass, ash deposition
- **Vegetation**: composition, herbage mass, nutritive value, tissue mineral composition
- **Soils**: soil chemical, physical and biological properties, nutrient cycling, soil carbon (quantity and quality, spatial distribution of nutrients/soil properties
- **Environmental**: greenhouse gas measurements (2 eddy covariance towers ($CO_2$$CH_4$) and chamber-based)
- **Animals**: body condition score, body weight, blood metabolites (cortisol, plasma urea N, glucose, IGF1), animal behavior, calf birth and weaning wt.

Common Experiment - Results

Native Rangelands

Fire-induced vegetation responses

Fire-induced vegetation responses

Functional groups	Above-ground biomass (kg ha^{-1})					Anova effects		
	Control	4-yr Fire	2-yr Fire	Fire + chopping	SE	Fire	Year	Fire*Y
Undesirable grass	250b	480ab	380b	820a	120	0.0004	0.0766	0.0865
Desirable grass	70b	360ab	550a	310b	100	0.0059	0.2052	0.0631
Forbs	80b	260b	220b	390a	60	0.0027	<0.0001	0.0204
Shrubs	750	600	640	940	80	0.473	0.472	0.741
Palmetto	4460a	4290a	3390b	1520c	670	<0.0001	<0.0001	0.314
Total	5610	5930	5170	4020	420	0.0866	<0.0001	0.3643

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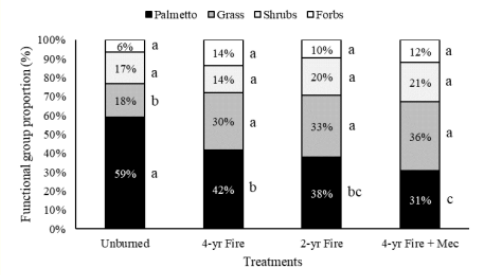
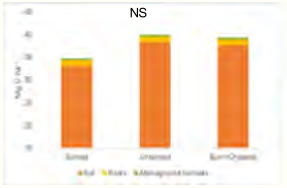
Ground cover



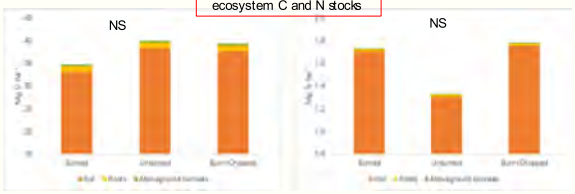
Fire effects on above- and below-ground (0-20 cm) C and N stocks



Carbon stocks (Mg N ha^{-1})
Soil: *P*-value=0.5
Roots: *P*=0.4
Above-ground: *P*=0.5

Fire effects on above- and below-ground (0-20 cm) C and N stocks

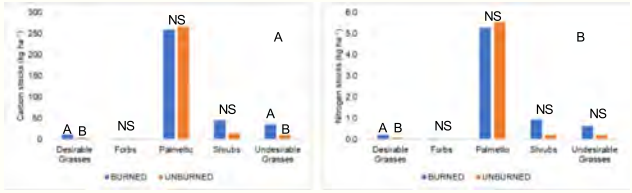
Soil accounted for 98% of ecosystem C and N stocks



Carbon stocks (Mg N ha^{-1})
Soil: *P*-value=0.5
Roots: *P*=0.4
Above-ground: *P*=0.5

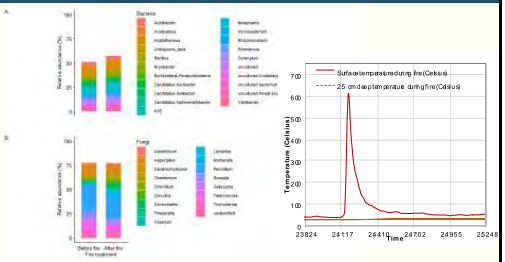
Nitrogen stocks (Mg N ha^{-1})
Soil: *P*-value=0.9956
Roots: *P*=0.3910
Above-ground: *P*=0.5565

Fire effects on C and N stocks



Above-ground C (A) and N (B) stocks (kg ha^{-1}) as affected by fire management and functional group (P<0.10).

Fire-induced changes in soil microbial community



Relative abundance of bacterial (A) and fungal (B) genera for 0-10 cm soil depth before and 2 days after fire.
Rai, et al. 2023. Short-term prescribed fire-induced changes in soil microbial communities and nutrients in native rangelands of Florida. *Applied Soil Ecology* 189,104914 https://doi.org/10.1016/j.apsoil.2023.104914

Results

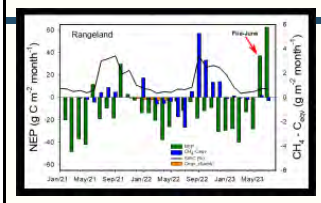
- Fire effect was short-lived: 60 d after fire vegetation photosynthetic capacity
- Native rangeland acted as a C sink sequestering ~ -1148 g C m^{-2} during the 4-yr study (2.9 Mt C ha^{-1} yr^{-1})
- Florida's rangeland a very resilient ecosystem and a viable option for C mitigation under forecasted climate scenarios and management

Year	NEP	GPP	R_{eco}	R_a	ET (mm)	Precip (mm)	ET/Precip
2016	-409	1864	1445	NA	1062	1089	0.97
2017	-327	1750	1422	NA	1021	1121	0.91
2018	-369	1862	1492	811	1070	1309	0.81
2019	-182	2033	1851	785	1147	1026	1.11

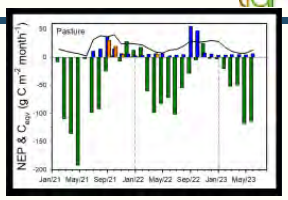
Common Experiment - Results

Bahiagrass

Net productivity (NEP, g C m^{-2}) & Ceqv



Year/Annual	NEP (g C m^{-2} yr^{-1})	CH4-Ceqv (g C m^{-2} yr^{-1})	Total Ceqv (g C m^{-2} yr^{-1})
2021	-180		
2022	-202	7.38	-194.62
2023(Jan-June)	-101	-0.39	-101.39



Year/Annual	NEP (g C m^{-2} yr^{-1})	CH4-Ceqv (g C m^{-2} yr^{-1})	Total Ceqv (g C m^{-2} yr^{-1})
2021	-699		
2022	-495	151	-344
2023(Jan-June)	-358	28	-330

Forage and Animal Performance

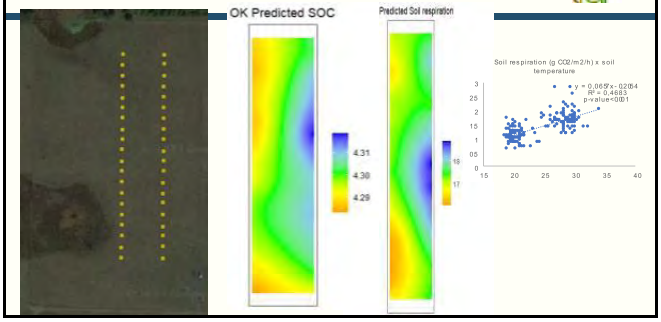
Response	Period Aug 2022	Sep 2022	Oct 2022	Nov 2022
HM, kg/ha				
SR10	3478	5523	5026	5625
SR12	3552	5223	4656	5283
P-value	0.82	0.36	0.26	0.30
HA, kg DM/kg BW				
SR10	7.75	4.96	7.83	6.93
SR12	6.15	4.40	6.51	5.40
P-value	0.01	0.35	0.03	0.01
Crude protein, % of DM				
SR10	9.9	9.2	7.5	8.0
SR12	9.5	9.1	7.2	7.3
P-value	0.44	0.81	0.47	0.14
IVDOM, %				
SR10	41.8	35.8	38.0	31.5
SR12	41.5	35.2	34.0	29.5
P-value	0.84	0.64	0.42	0.11

Forage and Animal Performance

Response	Day of the study 0	30	60	150	230	330
Cow BCS						
SR10	5.71	5.54	5.53	5.01	4.62	5.34
SR12	5.69	5.57	5.32	4.80	4.59	5.33
P-value	0.81	0.72	<0.01	<0.01	0.67	0.90
Cow BW, lb						
SR10	1231	1260	1297	1091	1078	1187
SR12	1230	1260	1285	1071	1069	1171
P-value	0.94	0.95	0.25	0.06	0.44	0.15
Calf BW, lb			birth (±0.9)			
SR10			80	192	348	581
SR12			74	180	326	543
P-value			0.46	0.13	<0.01	<0.01

Response	Stocking rate SR10	SR12	SE	P value
Weaned calf production				
lb/pasture	5581	6199	179	0.02
lb/acre	281	313	12.8	0.10
Cows pregnant with a 2nd calf, % of total	93.8	85.1	3.47	0.06

Spatial and temporal variability associated with GHG emissions



Thank you!

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