





UF | IFAS
UNIVERSITY of FLORIDA

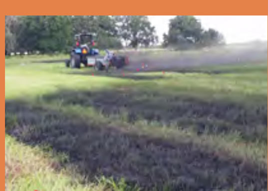
Range Cattle
Research & Education Center




Virtual Field Day & 80th Anniversary

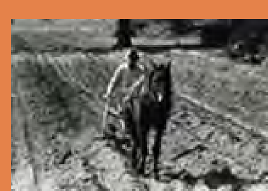
October 7, 2021







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Thank You to Our Field Day Sponsors

Additional Features

Schedule

8:15 a.m. Zoom connection opens

8:30 a.m. **Welcome & Moderator Introduction** - Dr. Brent Sellers, Center Director

Moderator, Laura Bennett, UF/IFAS Extension Pasco County

8:40 a.m. **IFAS Update**
Dr. Scott Angle, VP for Agriculture and Natural Resources

8:50 a.m. **Department Updates**
Agronomy – Dr. Kevin Kenworthy
Wildlife Ecology and Conservation – Dr. Eric Hellgren
Animal Science – Dr. John Arthington

9:10 a.m. **Florida Cattlemen's Association Update**
Cliff Coddington, President

9:20 a.m. **Using Nutrition and Management to Alleviate Heat Stress in Grazing Cattle** *Philipe Moriel, Beef Cattle Nutrition and Management*

9:40 a.m. **Beef Cattle Market Outlook**
Chris Prevatt, Beef Cattle and Forage Economics

10:00 a.m. **Intermission – Meet our Sponsors**

10:10 a.m. **Graduate Student Presentations**
Jaime Garzon, Ph.D. Agronomy
Caetano Sales, M.S. Agronomy
Leandro Vieira-Filho, Ph.D. Soil and Water Sciences

10:20 a.m. **Coyote Behavior: Lessons from the city and applications to the ranch** *Dr. Hance Ellington, Rangeland Wildlife and Ecosystem*

10:40 a.m. **New Potential Warm-Season Perennial Grasses Propagated by Seed** *Dr. Joao Vendramini, Forage Management*

11:00 a.m. **Update on Biosolids Research**
Dr. Maria Silveira, Soil and Water Science

11:20 a.m. **DuraCor Tank Mixes for Pasture Weed Control**
Dr. Brent Sellers, Pasture and Rangeland Weed Management

11:40 a.m. **Closing Remarks** - Dr. Brent Sellers, Center Director

Welcome

Dear Friends and Colleagues:

On behalf of the Range Cattle REC faculty, staff, and students, I welcome you to the 2021 field day and 80th Anniversary Celebration. While we would have rather held this as an in-person event, the faculty, staff, and students felt it was in everyone's best interest to move to a virtual platform to keep everyone as safe as possible. This was a difficult decision as many of us know that face-to-face learning events tend to be the most educational, and we enjoy being able to visit with you in person.

A lot has changed over the past 80 years at the center, but what hasn't changed is that we continue to provide our clientele with science-based information to help them make timely decisions in their operations. This is something that we are very proud of, and it is heartening to hear many refer to us as the "Cattlemen's Research Center", or "we would not be where we are today without the Range Cattle REC."

Whether we focus our efforts on supplementation, new forage varieties, improving soil fertility, pasture management, the economics surrounding each of these practices, maintaining wildlife habitat, or understanding wildlife-livestock interactions, our faculty continue to look for ways for our clientele to remain profitable yet conserve our resources. Today, you will hear updates from each of our faculty programs at the center as well as what some of our graduate students have been working on for their degree programs.

I hope you enjoy the information you hear today and that you are able to implement something that you have learned on your ranch or be able to help those who you serve. If you have questions about any of the topics covered today, or any other topic, please reach out to your county Extension Agent or any of us here at the center.

Best Wishes,

Brent Sellers

UF/IFAS Range Cattle Research and Education Center Faculty

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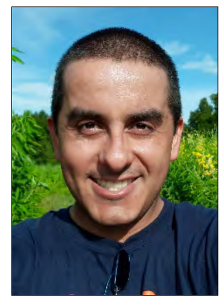
UF/IFAS Range Cattle Research and Education Center

Graduate Students

Clay Cooper

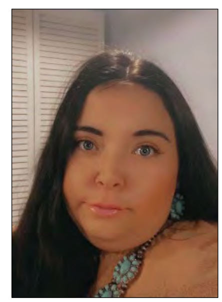
Advisor: Dr. Brent Sellers
Degree program: M.S. Agronomy
Thesis topic: Brunswickgrass management in bahiagrass pastures
Hometown: Lecanto, Florida
Previously attended: College of Central Florida

Jaime Garzón



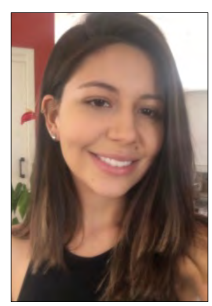
Advisor: Dr. Joao Vendramini
Degree program: Ph.D. Agronomy
Dissertation topic: Ecosystems services provided by two warm-season forage legumes in South Florida
Hometown: Bogotá, Colombia
Previously attended: National University of Colombia

Molly Jones



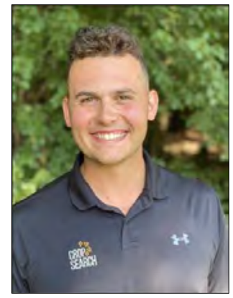
Advisor: Dr. Joao Vendramini
Degree program: M.S. Agronomy
Thesis topic: Refining P fertilization recommendations for limpograss in South Florida
Hometown: Haines City, Florida
Previously attended: Warner University

Lais Lima



Advisor: Dr. Philipe Moriel
Degree program: Ph.D. Animal Science
Thesis topic: Effects pre- and post-partum access to shade and OmniGen-AF supplementation on thermoregulation of Brangus heifers and growth and physiological responses of their offspring.
Hometown: Jundiaí, Sao Paulo, Brazil
Previously attend: Sao Paulo State University

Seth Oren



Advisor: Dr. Brent Sellers
Degree program: Non-Thesis M.S. Agronomy
Hometown: Edgerton, Wisconsin
Previously attended: University of Wisconsin-Platteville

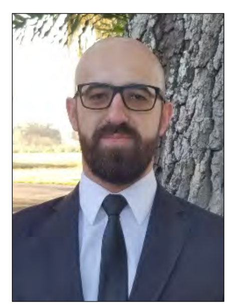
Elizabeth Palmer

Advisor: Dr. Philipe Moriel
Degree program: Ph.D. Animal Science
Dissertation topic: Supplementation strategies for *Bos Indicus*-influenced cows and the impact on calf post-natal performance
Hometown: Bernville, Pennsylvania
Previously attended: Pennsylvania State University and University of Arkansas

Caetano Sales

Advisor: Dr. Brent Sellers
Degree program: M.S. Agronomy
Thesis topic: Efficiency of florpyrauxifen-benzyl on weed control and forage tolerance in Florida grazing lands.
Hometown: Berkeley, California
Previously attended: Sao Paulo State University

Leandro Vieira-Filho



Advisor: Dr. Maria Silveira
Degree program: Ph.D. Soil and Water Sciences
Dissertation topic: Soil phosphorus dynamics in subtropical grazing land ecosystems: agronomic and environmental impacts
Hometown: São José dos Ausentes, Rio Grande do Sul, Brazil
Previously attended: University of Sao Paulo

Using Nutrition and Management to Alleviate Heat Stress in Grazing Cattle

Philipe Moriel - Associate Professor - Beef Cattle Nutrition and Management
Elizabeth Palmer - Ph.D. Animal Science Student; Lais Lima - Ph.D. Animal Science Student
Vinicius Izquierdo - Research Scholar

Heat stress is detrimental to cattle metabolism, growth, reproduction, health, and welfare. In just the U.S., heat stress leads to annual losses of $900 million for the dairy industry and $300 million for the beef and swine industries (St. Pierre et al., 2003). Environmental conditions are considered thermoneutral when the thermal-humidity index (**THI**) ≤ 70, mild heat stress when 70 ≤ THI < 74, heat stress when 74 ≤ THI < 77, and severe heat stress when THI ≥ 77. Figure 1 shows the average, minimum and maximum daily THI values obtained at the University of Florida/IFAS - Range Cattle Research & Education Center (Ona, FL). From June to October, average THI values were always above the threshold considered as heat stress. Also, maximum THI values often reached severe heat stress levels for several hours of the day. These challenging conditions during summer decrease growth performance of beef cattle, despite the greater nutritional value of forages during summer compared to fall. The major issue is that this period of heat stress in southern Florida corresponds with critical periods in beef cattle production, which are late gestation period in first cows and mature cows, weaning and shipping of young calves, and developing period of replacement beef heifers.

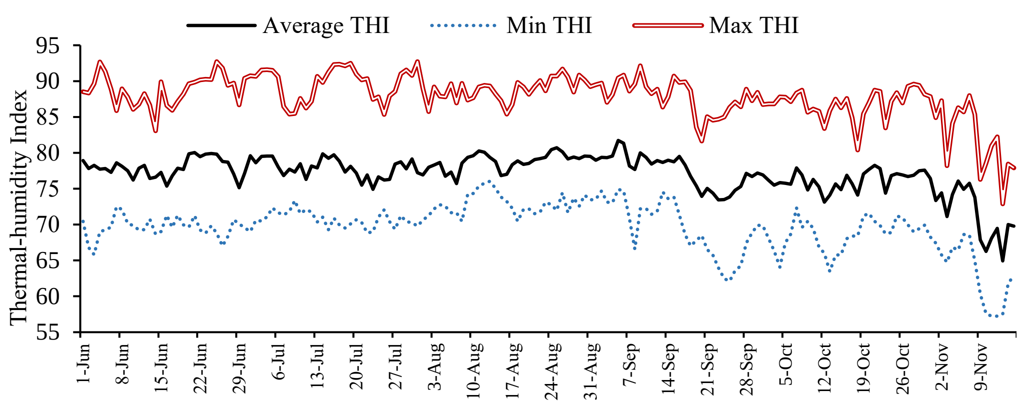


Figure 1. Daily average, minimum and maximum thermal-humidity index (THI) values observed from June to November 2019 at the Range Cattle Research and Education Center. THI = (1.8 × Temperature + 32) – [(0.55-0.0055 × Relative Humidity) × (1.8 × Temperature – 26)].

Gestational heat stress programs offspring life: Heat stress during gestation reduced fetal growth and birth weight of dairy calves in 10 of 12 studies (on average by 10 lb; Tao et al., 2019). Weaning weights were decreased in calves born from heat stressed vs. cooled cows in 4 of 5 studies (on average by 20 lb; Tao et al., 2019). The birth weight deficit observed for dairy calves born from heat stressed cows remained even after 1 year of age (Monteiro et al., 2016ab). Also, dairy heifers heat stressed during gestation produced 7.7 lb/day less milk during their first and second lactations than cooled heifers (Laporta et al., 2018) and led to multigeneration effects by reducing milk yield of the dam's granddaughters (Laporta et al., 2020). Thus, growth, immune function and thermoregulation of dairy calves can be programmed by their previous in utero heat stress management. The effects of heat stress exposure during gestation on beef cattle performance have not been explored.

Differences between *Bos taurus* vs. *Bos indicus*-influenced cattle: Another challenge is that heat stress effects vary among breeds. Nearly 45% of beef cows in U.S. are located in southern states where *Bos indicus*-influenced cattle and elevated heat and humidity conditions predominate (NASS, 2017). *Bos indicus* cattle are more thermotolerant than *Bos taurus* cattle due to lower metabolic rate, lower resistance in heat transfer from tissues to skin, different sweating patterns, and shorter hair length (Roland et al., 2016; Davila et al., 2019). *Bos taurus* cattle experience significant physiological changes during heat stress, whereas *Bos indicus* experiences less pronounced physiological alterations, such as no reductions in feed intake and minor decrease in blood concentrations of carbon dioxide and bicarbonate (Beatty et al., 2006). However, even cattle with some level of *Bos indicus* genetics experience reductions in performance during heat stress. Average daily gain of Brangus heifers was decreased by 63% during summer compared to winter (Moriel et al., 2017). Under the same environment conditions, *Bos taurus* and *Bos indicus* cattle exhibited differences in intake, digestion, and ruminal fermentation (Bell et al., 2017), ovarian function, circulating hormones and metabolites (Sartori et al., 2016), fetal growth (Fontes et al., 2019) and trace mineral metabolism (Ranches et al., 2021). These differences regulate the direction and magnitude of performance when similar management is provided to *Bos taurus* vs. *indicus* breeds. Hence, a fundamental step to meet the rising global demand for beef includes determining the specific impacts of heat stress on performance of grazing *Bos indicus*-influenced beef cattle in tropical/subtropical regions. In the absence of such knowledge, optimal management interventions tailored to alleviate heat stress and enhance beef production from *Bos indicus*-influenced beef cattle grazing tropical/subtropical forages will remain elusive. For those reasons, our beef cattle nutrition laboratory is dedicated to understanding the mechanisms leading to poor performance and identifying novel nutrition and management strategies to optimize the performance of heat stressed *Bos indicus*-influenced beef cattle.

Range Cattle REC - Research efforts on heifer development: Stair-Step Strategy

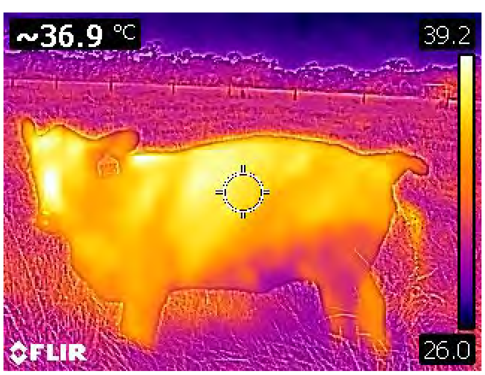


Figure 2. Body surface temperature of a Brangus heifers on bahiagrass pastures. 36.9ºC = 98.4 F

A major limiting factor for reproductive success of *Bos indicus*-influenced beef heifers is the late attainment of puberty due to genetics, heat stress, and nutrition. Modifying the growth pattern during the post-weaning phase has been used to promote reproductive success of *Bos taurus* heifers. Previous studies developed *Bos taurus* beef heifers to achieve an even weight gain from weaning until breeding (EVENGAIN) or achieve a low weight gain from weaning until 45 days before breeding followed by a high weight gain in the final 45 days before breeding (LOW-HIGH). Both groups were fed enough nutrients to achieve 65% of the expected mature body weight by the start of the breeding season.

The strategy of low weight gain followed by high weight gain is called **Stair-Step strategy** and is usually implemented to explore compensatory gains that occur when nutrition level is increased immediately after a period of nutrient restriction. In that study (Lynch et al., 1997), LOW-HIGH heifers had greater first-service conception rate compared to EVENGAIN heifers (71% vs. 56%). Although final pregnancy rates did not differ between these two treatments (88%), the greater first conception rates of LOW-HIGH heifers led to increased percentage of heifers calving early in their first calving season, which has been associated with greater lifetime productivity and longevity. Hence, the Stair-Step strategy may allow producers to further improve the reproductive performance of their heifers without increasing feed costs. It is important to highlight that the studies described above used *Bos taurus* heifers. It is unknown if this strategy would generate similar results in heifers developed in the Florida, particularly due the *Bos indicus* genetic contribution and the hot and humid summer/early-fall period delaying puberty attainment. Our study (**funded by the FL Cattle Enhancement Board**) explored the Stair-Step strategy for developing Brangus heifers and our group has some promising results to share with you.

Experimental design: The experiment was conducted at the UF/IFAS Range Cattle REC (Ona, FL) from September 2019 to June 2020 (Year 1) and from September 2020 to June 2021 (Year 2). In September of each year, 64 Brangus heifers were allocated into 1 of 16 bahiagrass pastures (4 heifers/pasture). Treatments were assigned to pastures (8 pastures/treatment) and consisted of: control heifers supplemented with concentrate dry matter (DM) at 1.50% of body weight from September until the start of the breeding season in December (day 0 to 100 of the study; **CON**); or stair-step heifers initially offered concentrate DM at 1.05% of body weight from September to October (day 0 to 50 of the study), and then, concentrate DM at 1.95% of body weight (DM basis) from October until the start of the breeding season in December (**SST**; day 50 to 100 of the study). On average, both treatments consumed concentrate DM at 1.50% of body weight from September to December (22% CP and 73% TDN; DM basis).

Results: As designed, total supplement DM offered to heifers from August to December did not differ between treatments in year 1 (**Table 1**). In terms of growth, average daily gain from day 0 to 50 did not differ between treatments but was greater for SST vs. CON heifers from day 50 to 100 (Table 1), leading to greater overall average daily gain for SST vs. CON heifers. Hence, growth performance of grazing heifers was boosted by the stair-step strategy without increasing feed costs, and such differences in growth performance are likely explained by the results observed for intravaginal temperatures.

Table 1. Growth, reproduction, and supplement intake data (Year 1 only) of control heifers supplemented with concentrate dry matter (DM) at 1.50% of body weight from September until the start of the breeding season in December (day 0 to 100 of the study; **CONTROL**); or stair-step heifers initially offered concentrate DM at 1.05% of body weight from September to October (day 0 to 50 of the study), and then, concentrate DM at 1.95% of body weight (DM basis) from October until December (**STAIR-STEP**; day 50 to 100 of the study).

	Treatment			
Item	**CONTROL**	**STAIR-STEP**	**SEM**	***P*-value**
Body weight, lb				
August (day 0)	**534**	**534**	4.7	0.98
Mid-September (day 50)	**603**	**602**	4.7	0.90
November (day 100)	**666**	**684**	4.7	0.01
Average daily gain, lb/day				
August to mid-September	**1.39**	**1.37**	0.09	0.87
Mid-September to November	**1.23**	**1.61**	0.09	0.01
August to November	**1.30**	**1.50**	0.07	0.07
Total supplement DM offered, lb				
August to November	**891**	**904**	7.8	0.26
Pubertal in November, % of total heifers	**71.9**	**82.1**	6.77	0.30
Pregnant heifers, % of total heifers	**71.9**	**89.5**	6.76	0.07

Intravaginal thermometers were inserted into heifers to determine the internal body temperatures during September and November. In September (heat stress period), SST heifers had significantly lower intravaginal temperatures from 9:30 am to 6:00 pm compared to CON heifers (**Figure 3**), which is likely a result of lower heat increment and partially explains the lack of treatment effects on heifer average daily gain from day 0 to 50. In November (no heat stress period), supplement DM amount did not affect ($P = 0.39$) intravaginal temperature of heifers (**Figure 4**), which likely reduced energy needed to cope with heat stress and allowed the greater average daily gain of SST vs. CON heifers. Percentage of pubertal heifers at the start of the synchronization protocol did not differ between treatments. However, SST heifers had greater final pregnancy rates compared to CON heifers (**Table 1**). Therefore, **the Stair-Step strategy may be a great opportunity to boost growth and reproductive performance of grazing *Bos indicus*-influenced beef heifers in Florida, without increasing feed costs.**

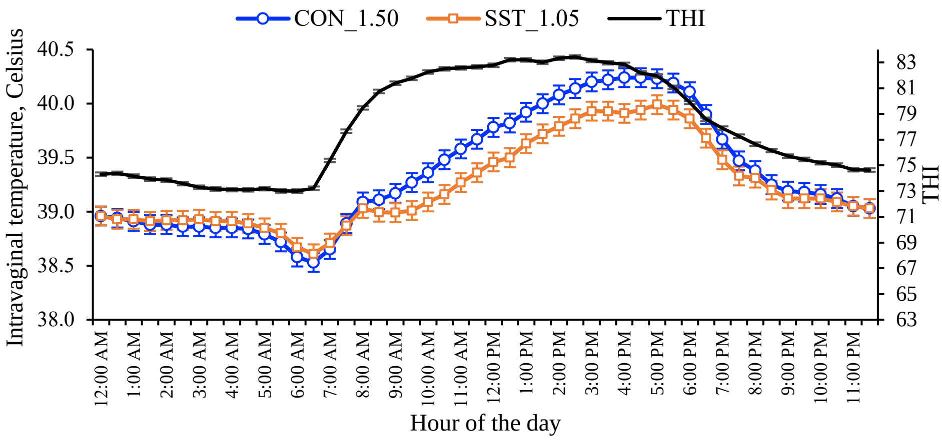


Figure 3. Average intravaginal temperature in September when control heifers were receiving concentrate DM supplementation at 1.50% of body weight (**CON**) and when stair-step heifers were receiving concentrate DM supplementation at 1.05% of body weight (**SST**). Note the greater intravaginal temperatures when greater amounts of concentrate were provided.

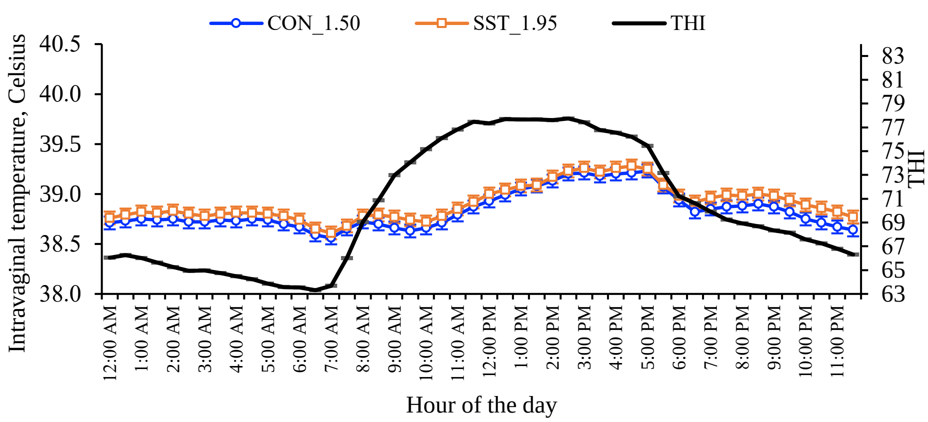


Figure 4. Average intravaginal temperature in November when control heifers were receiving concentrate DM supplementation at 1.50% of body weight (**CON**) and when stair-step heifers were receiving concentrate DM supplementation at 1.95% of body weight (**SST**). Note that when severe heat stress was not occurring (significantly lower THI and intravaginal temperatures compared to Figure 3), the greater amounts of concentrate supplementation did not increase intravaginal temperatures.

Range Cattle REC – Research efforts on pregnant cows

Experiment 1 – Effects of access to shade and OmniGen-AF supplementation during pre- and postpartum periods on performance of heat stressed cow-calf pairs.

Figure 5. Artificial shade structure implemented in Experiments 1 and 2.

Access to artificial shade reduced intravaginal temperature by 0.5°C and increased body weight gain by 0.5 lb/day of grazing Brangus beef heifers compared to no access to artificial shade (Silva et al., 2021). In terms of nutrition, feeding an immunomodulatory supplement (**OMN**; OmniGen-AF; Phibro Animal Health Corp.) during late gestation reduced rectal temperature in dairy cows and improved growth and immune response of their calves. Our study will evaluate whether pre- and post-calving access to artificial shade (**Figure 5**) and OMN supplementation impact: (1) precalving body temperature, body condition score and physiological measurements of heat-stressed *Bos indicus*-influenced beef heifers; and (2) offspring growth and immune response to vaccination following birth. At 60 days before calving (day 0), 64 Brangus heifers will be provided: no access to shade and no OMN supplementation from day 0 until calf early weaning on day 200; access to shade but no OMN supplementation from day 0 to 200; no access to shade but offered OMN supplementation from day 0 to 200; and access to shade and OMN supplementation from day 0 to 200. Calves will be early-weaned on day 200 and then assigned to a 60-day period of growth and immune response evaluation in drylot. Calves will be fed concentrate at 3.5% of their body weight and vaccinated against pathogens associated with bovine respiratory disease.

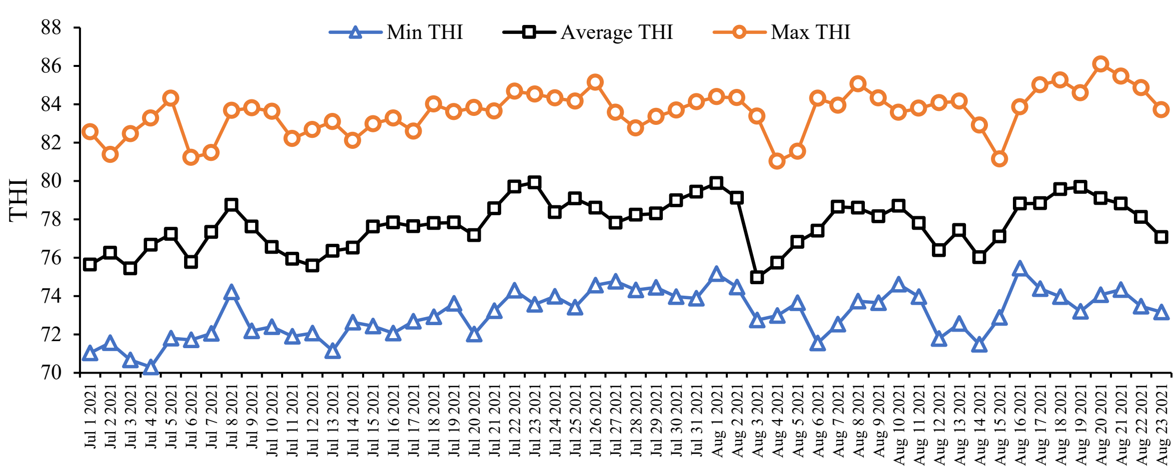


Figure 6 - Average, minimum and maximum daily THI values obtained at the University of Florida/IFAS - Range Cattle Research & Education Center (Ona, FL). From July to August 2021, average THI values were always above the threshold considered as heat stress ($74 \leq THI < 77$). Also, maximum THI values often reached severe heat stress levels ($THI \geq 77$) for several hours of the day.

The study began on July 1st, 2021. The performance and behavior responses of heifers collected up to this moment are summarized in **Table 2**. Briefly, access to shade reduced the respiration rate, intravaginal temperatures and allowed heifers to achieve a greater body condition score at the start of the calving season (August 25), likely due to changes in behavior and energy requirements to cope with the heat stress. Contrary to what we expected, the addition of OmniGen-AF slightly increased intravaginal temperatures of heifers and reduced body condition score at the start of the calving season compared to no supplementation of OmniGen. We will continue collecting performance and behavior data on all heifers until January 2022, when their calves will be weaned and allocated to a 60-day period in the feedlot where calves will be fed a high-concentrate diet and receive an immunological challenge. Our goal is to evaluate the impact of access to shade and OmniGen supplementation on future offspring performance. These data will be available in May 2022.

Table 2. Performance and behavior of pregnant heifers that were provided or not access to artificial shade (No shade vs. Shade) and supplementation of soybean hulls added or not with OmniGen-AF (study began on July 1st, 2021).

	Shade access			Omnigen		
Item	**No Shade**	**Shade**	**SEM**	**No**	**Yes**	**SEM**
Respiration rate, breaths per min						
July 20	105 [b]	63 [a]	4.5	85 [a]	83 [a]	4.5
August 9	107 [b]	78 [a]	4.5	93 [a]	92 [a]	4.5
August 25	101 [b]	72 [a]	4.5	84 [a]	89 [a]	4.5
Body condition score						
July 1	6.35 [a]	6.35 [a]	0.045	6.35 [a]	6.34 [a]	0.046
August 25	6.15 [a]	6.43 [b]	0.045	6.42 [b]	6.15 [a]	0.046
Intravaginal temperature, Celsius						
1:00 PM	39.7 [b]	39.1 [a]	0.11	39.4 [a]	39.4 [a]	0.11
5:00 PM	40.0 [b]	39.5 [a]	0.11	39.7 [a]	39.7 [a]	0.11
Standing under shade, %						
1:00 PM	0 [a]	51.0 [b]	4.18	24.0 [a]	27.1 [a]	4.18
5:00 PM	0 [a]	17.7 [b]	4.18	10.4 [a]	7.3 [a]	4.18
Standing outside shade, %						
1:00 PM	76.0 [b]	1.0 [a]	5.34	39.6 [a]	37.5 [a]	5.33
5:00 PM	45.8 [b]	13.5 [a]	5.34	22.9 [a]	36.5 [b]	5.33
Laying under shade, %						
1:00 PM	0 [a]	44.8 [b]	5.78	21.9 [a]	22.9 [a]	5.78
5:00 PM	0 [a]	13.5 [b]	5.78	6.3 [a]	7.3 [a]	5.78
Laying outside shade, %						
1:00 PM	7.3 [a]	0 [a]	3.19	4.2 [a]	3.1 [a]	3.13
5:00 PM	18.8 [b]	3.1 [a]	3.19	14.6 [a]	7.3 [a]	3.19
Drinking, %						
1:00 PM	7.3 [b]	0 [a]	2.08	4.2 [a]	3.1 [a]	2.08
5:00 PM	4.2 [a]	2.1 [a]	2.08	3.1 [a]	3.1 [a]	2.08
Grazing, %						
1:00 PM	8.3 [a]	0 [a]	5.53	2.1 [a]	6.3 [a]	5.53
5:00 PM	31.3 [a]	50.0 [b]	5.53	42.7 [a]	38.5 [a]	5.53

[ab] Within a row, means without a common superscript differ ($P < 0.01$).

Experiment 2 - Heat stress during gestation of grazing beef cows: does it help or impair their offspring performance under similar challenging conditions?

In southern Florida, periods of heat stress coincide with critical periods of cow-calf production (*final 6 months of gestation of beef cows* and *post-weaning beef heifer development*). In dairy cattle, heat stress exposure during the last 45 days of gestation reduced calf body weight, immunoglobulin transfer, and heat tolerance during a heat stress challenge immediately following birth but increased their heat tolerance at maturity. Therefore, heat stress exposure during gestation can either improve or impair the offspring thermoregulation and performance following birth. The specific effects of exposing grazing beef cows to heat stress during gestation and its consequences to future offspring performance during heat stress remains to be explored.

In other words, if grazing beef cows are exposed to long periods of heat stress during gestation, does it help or impair the ability of their offspring to perform under similar challenging conditions? This 2-year project will combine heat mitigation strategies during gestation and post-weaning periods (2 × 2 factorial arrangement) to enhance the productive responses of grazing *Bos indicus*-influenced cow-calf pairs under heat stress conditions. We expect that heat abatement of pregnant cows followed by post-weaning heat abatement of their offspring will lead to the greatest additive improvements on body weight gain, immunocompetence and reproduction of *Bos indicus*-influenced beef progeny.

Additional ongoing research efforts

Experiment 3 - Biomarkers to predict future cow response to precalving supplementation

Brief Overview: This project will address Florida Cattlemen's Association Priorities #2 (Calf Weaning Rate) and #5 (Herd nutrition). Identifying nutritional strategies that improve cow reproduction and subsequent calf growth and health is crucial to optimize cow-calf production. Precalving supplementation of protein and energy for Brangus cows (60 to 90 days before calving) improved growth and reproductive performance of cows and their calves. The next frontier in cow-calf nutrition is to develop the ability to early predict which cows will or will not respond to precalving supplementation. **Objectives:** evaluate the plasma profile of metabolites and hormones (*collected 60 to 90 days before calving*) to identify potential biomarkers that could be used to predict which cows will respond to maternal precalving supplementation. Rather than supplementing the entire herd, producers would be able to focus their investments on supplementation only for cows that will positively respond to precalving supplementation (*cows that if supplemented will become pregnant*), improving the efficiency of their nutrition program and leading to massive savings and increased profitability of cow-calf systems. **Significant findings to date:** Samples currently under processing; **Future steps:** If successful, the next steps are validating our results in commercial operations; **Funding source:** 2021/2022 Florida Cattle Enhancement Board.

Experiment 4 - Maternal supplementation of bakery waste to increase cow-calf performance

Brief Overview: Precalving supplementation of dried distiller's grains, range cubes and molasses for Brangus cows increased pregnancy rates of cows by 13% and calf body weight at weaning by 24 lb compared to no precalving supplementation. Other locally available feed byproducts should also be evaluated (for instance, bakery waste). **Objectives:** Our proposal will evaluate whether maternal bakery waste supplementation during late gestation will enhance reproductive success and offspring growth and health compared to no maternal supplementation. We also want to investigate whether bakery waste composition (high vs. low fat) could further increase cow and calf long-term performance. More specifically, our objectives include using maternal pre-calving supplementation of bakery waste (high vs. low fat) to: (1) increase their body condition score at calving and pregnancy rates; (2) improve calf immune response and growth following birth; (3) improve our understanding of the differences on the metabolism of mature cows and their calves under different precalving supplementation strategies; and (4) generate novel information to further assist producers and county agents on cowherd supplementation strategies, and ultimately, expand their annual calf production. **Significant findings to date:** Ongoing data collection; **Future work:** Bakery waste supplementation at different stages of production (i.e., creep-feeding, early-weaning, post-weaning, and heifer development); **Funding source:** Organic Matters (AWD190573).

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Beef Cattle Market Outlook

Chris Prevatt
Beef Cattle and Forage Economics
UF/IFAS Range Cattle REC

1

2020

NOT MUCH WENT SMOOTHLY

High Risk. Chaos.
What works?

2

Sorting through this years Challenges

- ~~Expect the Unexpected.~~ Everything is on the Table.
- Survive.
  - Develop a Written Plan.
  - Maintain Cash Flow. **Absolutely Critical.**
    - **Debt payments**
    - **Family living expenses**
    - **Savings – working expenses**
    - **Reinvestment – expansion** *(Grow Slowly)*

Demand.

State of the U.S Restaurant Industry

- U.S. Consumer Beef Demand Remains Strong…
  - Yet, the U.S. lost 110,000 restaurants in 2020…. that's a lot of restaurants that aren't selling Beef anymore…

3

Beef Cattle Market Thoughts

- Increased Beef, Pork, and Poultry Supplies Available…
- CFAP payments and a recovery in Feeder Cattle Prices have produced significant profits for some…
  - CFAP provided support for Summer 2020 Feeder Calf Sales
- What will Consumer Discretionary Spending Look Like Going Forward??
- Decline in Food Service Outlets…
- Corn "To the Moon"?

4

Economic Market Thoughts

- Unemployment remains elevated and inflation is high…
- Stimulus measures and the price of stock markets around the world mask the serious impacts of the pandemic.

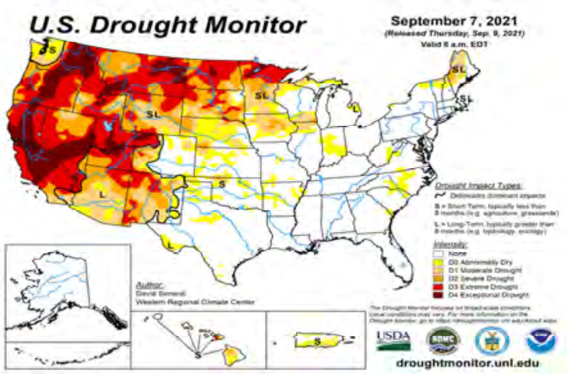
5

The Ball is in the Consumers Court

- Consumer demand for U.S. Beef will determine if Packers bring more inventory to the Grocery store shelf.
- For Live Cattle Prices to increase in the near term, consumers must demand more beef at higher prices.
- Where will consumers find more discretionary income?
- Will consumers balk at higher prices?

6

Severity of the Drought in the Western United States



Drought will likely influence liquation decisions in the West and Northern Plains

7

Risk Concerns

- **COVID-19**
- Global Recession
- **African Swine Fever**
- **China**
- Supply Chain Disruptions
- Meat Packing Plant Fires
- Trade Agreements
- Record Meat Production
- Export Markets
- WEATHER (Blizzards/Floods/**Drought**)
- **Domestic Consumer Demand**
- **Competing "Meats"**
- **Corn Prices**

8

January 2021 U.S. Cattle Inventory Report

- U.S. Beef Production and Cattle Numbers are now beginning to **TIGHTEN.**
- Inventory numbers confirm that herd expansion for the current U.S. cattle cycle has ended.
  - Peaked in 2019 @ 94.8 million head

9

July 2021 Mid-Year U.S. Cattle Inventory Report

- U.S. Beef Production and Cattle Numbers are now beginning to **TIGHTEN.**
- All Cattle and Calves: 1.3% ↓
- Beef Cows: ~2% ↓
  - Largest mid-year decline since 2012
  - Beef Cow herd 3% below the 2018 high

10

MARKET PRICE RISK

<u>*Markets are reflections of all sorts of things*</u>

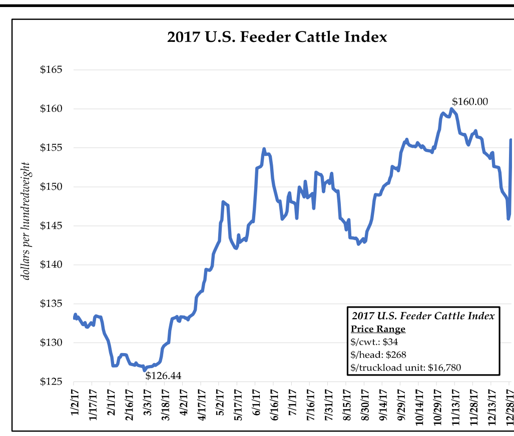
Supply and Demand Fundamentals

from human emotions to herd behavior

to changes in the underlying status quo (how stuff gets done, made, distributed, paid for, etc.)

"Outside Market Forces"

11



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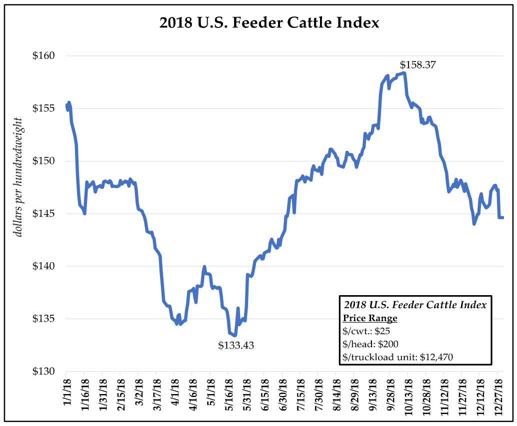

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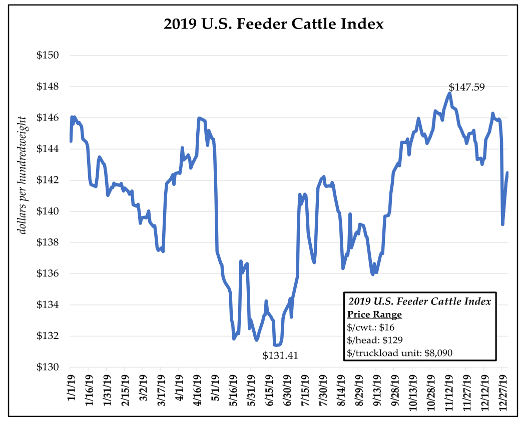

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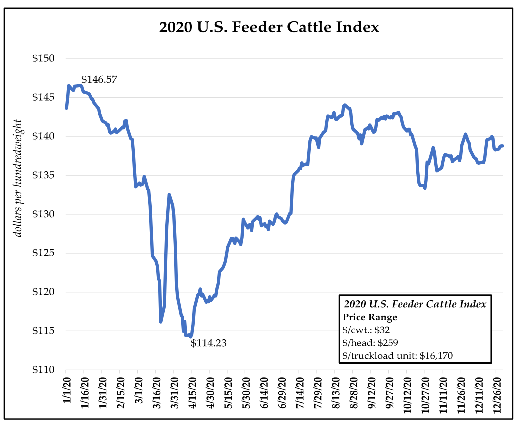

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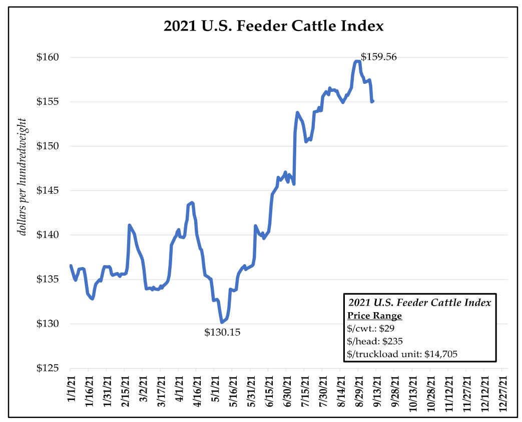

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CME Feeder Cattle Futures

- Futures Traders are Bull'ish on Feeders
- **Premium on Future Contract Months.**
  - Lock in Optimism in Futures?
  - Don't always anticipate the cash market to trade up to Futures.
  - Sometimes Futures will erode the premium and trade down to Cash.

May 17, 2021

MONTH	OPTIONS	CHARTS	LAST	CHANGE	PRIOR SETTLE
MAY 2021	OPT		138.075	+0.525	137.550
AUG 2021	OPT		152.725	+1.575	151.150
SEP 2021	OPT		154.250	+1.575	152.675
OCT 2021	OPT		155.325	+1.475	153.850
NOV 2021	OPT		155.800	+1.275	154.525
JAN 2022	OPT		154.625	+1.150	153.475
MAR 2022	OPT		153.375	+1.125	152.250
APR 2022	OPT		-	-	152.625
MAY 2022	OPT		-	-	0.000

Legend: OPT Options   Price Chart

17

CME Feeder Cattle Futures

July 7, 2021

MONTH	OPTIONS	CHART	LAST	CHANGE	PRIOR SETTLE
AUG 2021 GFQ1	OPT		159.100	-1.525 (-0.95%)	160.625
SEP 2021 GFU1	OPT		161.550	-1.175 (-0.72%)	162.725
OCT 2021 GFV1	OPT		163.500	-1.150 (-0.70%)	164.650
NOV 2021 GFX1	OPT		164.250	-1.650 (-0.99%)	165.900
JAN 2022 GFF2	OPT		163.950	-2.175 (-1.31%)	166.125
MAR 2022 GFH2	OPT		164.475	-2.375 (-1.42%)	166.850
APR 2022 GFJ2	OPT		165.550	-2.125 (-1.27%)	167.675
MAY 2022 GFK2	OPT		166.050	-1.950 (-1.16%)	168.000

18

CME Feeder Cattle Futures

August 5, 2021

MONTH	OPTIONS	CHART	LAST	CHANGE	PRIOR SETTLE
AUG 2021 GFQ1	OPT		157.450	-1.750 (-1.10%)	159.200
SEP 2021 GFU1	OPT		161.075	-1.800 (-1.11%)	162.875
OCT 2021 GFV1	OPT		163.700	-1.750 (-1.06%)	165.450
NOV 2021 GFX1	OPT		165.350	-1.825 (-1.09%)	167.175
JAN 2022 GFF2	OPT		164.875	-1.925 (-1.15%)	166.800
MAR 2022 GFH2	OPT		164.600	-2.025 (-1.22%)	166.625
APR 2022 GFJ2	OPT		166.200	-1.675 (-1.00%)	167.875
MAY 2022 GFK2	OPT		167.400	-1.025 (-0.61%)	168.425
AUG 2022 GFQ2	OPT		-	-	-

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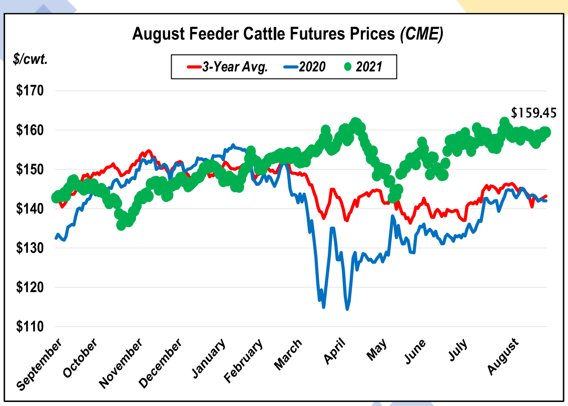
CME Feeder Cattle Futures

September 2, 2021

20



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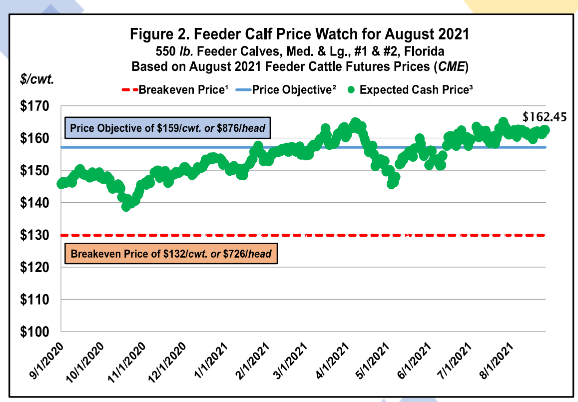

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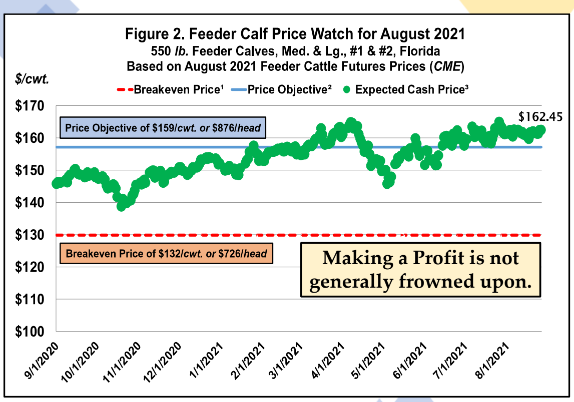

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Focus on Feedlots

K·STATE Research and Extension

Kansas Feedlot Performance and Feed Cost Summary*

Justin Waggoner, Extension Beef Systems Specialist, Kansas State University

December , 2020 Closeout Information

Sex	No	In Weight	Final Weight	Avg. Days on Feed	Avg. Daily Gain	Feed/Gain (Dry Basis)	% Death Loss	Avg. Cost of Gain/Cwt.	Projected Cost of Gain Current Month's Placed Cattle
Steers	22110	832	1478	166	3.83	6.08	1.20	$77.92	$97.50
				(138 - 182)	(3.55 - 4.15)	(5.53 - 6.57)		$71.37 - $86.58	$95.00 - $100.00
Heifers	15496	751	1294	158	3.41	6.28	1.40	$83.94	$101.50
				(143 - 178)	(3.07 - 3.87)	(5.69 - 6.86)		$75.02 - $93.63	$100.00 - $103.00

Current Feed Inventory Costs: Mid-January, 2021		Range	No. Yards
Corn	$4.72 /bu	$4.38-$5.00	5
Ground Alfalfa Hay	$137.81 /ton	$120.00 - $148.83	5

*Appreciation is expressed to these Kansas Feedyards: Brookover Ranch Feed Yard, Deseret Cattle Feeders, Hoxie Feedyard, HyPlains Feed Yard, Kearny County Feeders, Poky Feeders, Pratt Feeders, and Supreme Cattle Feeders.

**Closeout figures are the means of individual feedyard monthly averages and include feed, yardage, processing, medication, death loss and usually sold FOB the feedlot with a 4% pencil shrink. Interest charges normally are not included.

December 2020 Feedlot Cost of Gain:

Steers: $0.78/lb.
Heifers: $0.84/lb.
Corn: $4.72/bu.

Moving forward, every kernel that is consumed must now be replaced by another at a significantly higher price.

24

Focus on Feedlots

K·STATE
Research and Extension

Kansas Feedlot Performance and Feed Cost Summary*
Justin Waggoner, Extension Beef Systems Specialist, Kansas State University

May , 2021 Closeout Information

Sex	No	In Weight	Final Weight	Avg. Days on Feed	Avg. Daily Gain	Feed/Gain (Dry Basis)	% Death Loss	Avg. Cost of Gain/Cwt.	Projected Cost of Gain Current Month's Placed Cattle
Steers	17560	716	1413	206	3.32	6.20	1.82	$98.82	$114.00
				(168 - 245)	(2.99 - 3.77)	(5.69 - 6.57)		$91.45 - $104.38	$114.00 - $114.00
Heifers	15758	694	1280	193	2.98	6.74	2.68	$109.04	$117.00
				(155 - 245)	(2.64 - 3.38)	(6.16 - 7.33)		$101.86 - $118.34	$117.00 - $117.00

Current Feed Inventory Costs: Mid-June, 2021		Range	No. Yards
Corn	$6.45 /bu	$6.08-$7.00	5
Ground Alfalfa Hay	$170.92 /ton	$134.80 - $243.88	5

*Appreciation is expressed to these Kansas Feedyards: Brookover Ranch Feed Yard, Deseret Cattle Feeders, Hoxie Feedyard, HyPlains Feed Yard, Kearny County Feeders, Poky Feeders, Pratt Feeders, and Supreme Cattle Feeders.

**Closeout figures are the means of individual feedyard monthly averages and include feed, yardage, processing, medication, death loss and usually sold FOB the feedlot with a 4% pencil shrink. Interest charges normally are not included.

May 2021 Feedlot Cost of Gain:

Steers: $0.99/lb.
Heifers: $1.09/lb.
Corn: $6.45/bu.

Moving forward, every kernel that is consumed must now be replaced by another at a significantly higher price.

25

Focus on Feedlots

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Research and Extension

Kansas Feedlot Performance and Feed Cost Summary*
Justin Waggoner, Extension Beef Systems Specialist, Kansas State University

June , 2021 Closeout Information

Sex	No	In Weight	Final Weight	Avg. Days on Feed	Avg. Daily Gain	Feed/Gain (Dry Basis)	% Death Loss	Avg. Cost of Gain/Cwt.	Projected Cost of Gain Current Month's Placed Cattle
Steers	24769	748	1438	191	3.52	6.04	1.74	$101.10	$109.00
				(167 - 226)	(3.14 - 3.91)	(5.54 - 6.64)		$92.76 - $110.25	$105.00 - $113.00
Heifers	22647	676	1226	181	2.97	6.31	1.93	$108.19	$110.50
				(135 - 248)	(2.74 - 3.32)	(5.21 - 7.76)		$96.01 - $129.79	$105.00 - $116.00

Current Feed Inventory Costs: Mid-July, 2021		Range	No. Yards
Corn	$7.50 /bu	$6.74-$8.25	6
Ground Alfalfa Hay	$178.00 /ton	$147.80 - $238.86	6

*Appreciation is expressed to these Kansas Feedyards: Brookover Ranch Feed Yard, Deseret Cattle Feeders, Hoxie Feedyard, HyPlains Feed Yard, Kearny County Feeders, Poky Feeders, Pratt Feeders, and Supreme Cattle Feeders.

**Closeout figures are the means of individual feedyard monthly averages and include feed, yardage, processing, medication, death loss and usually sold FOB the feedlot with a 4% pencil shrink. Interest charges normally are not included.

June 2021 Feedlot Cost of Gain:

Steers: $1.01/lb.
Heifers: $1.08/lb.
Corn: $7.50/bu.

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Focus on Feedlots

K·STATE
Research and Extension

Kansas Feedlot Performance and Feed Cost Summary*
Justin Waggoner, Extension Beef Systems Specialist, Kansas State University

July , 2021 Closeout Information

Sex	No	In Weight	Final Weight	Avg. Days on Feed	Avg. Daily Gain	Feed/Gain (Dry Basis)	% Death Loss	Avg. Cost of Gain/Cwt.	Projected Cost of Gain Current Month's Placed Cattle
Steers	22761	783	1453	178	3.65	6.03	1.80	$103.52	$106.50
				(164 - 191)	(3.40 - 3.97)	(5.61 - 6.38)		$95.65 - $109.85	$105.00 - $108.00
Heifers	16837	749	1295	167	3.15	6.61	2.25	$115.31	$110.50
				(160 - 188)	(2.82 - 3.47)	(5.84 - 7.44)		$101.80 - $129.34	$110.00 - $111.00

Current Feed Inventory Costs: Mid-August, 2021		Range	No. Yards
Corn	$6.90 /bu	$6.50-$7.46	4
Ground Alfalfa Hay	$177.80 /ton	$165.00 - $188.40	4

*Appreciation is expressed to these Kansas Feedyards: Brookover Ranch Feed Yard, Deseret Cattle Feeders, Hoxie Feedyard, HyPlains Feed Yard, Kearny County Feeders, Poky Feeders, Pratt Feeders, and Supreme Cattle Feeders.

**Closeout figures are the means of individual feedyard monthly averages and include feed, yardage, processing, medication, death loss and usually sold FOB the feedlot with a 4% pencil shrink. Interest charges normally are not included.

July 2021 Feedlot Cost of Gain:

Steers: $1.04/lb.
Heifers: $1.15/lb.
Corn: $6.90/bu.

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Cattle Feeders Continue to Bleed

High Feed Costs
High Feeder Cattle Prices
Low Fat Cattle Prices

WON'T WORK.

One or more of these factors will eventually change abruptly.

The Easiest Way for the Cattle Feeders to Fix this:

Is To Pay Less for Feeder Cattle

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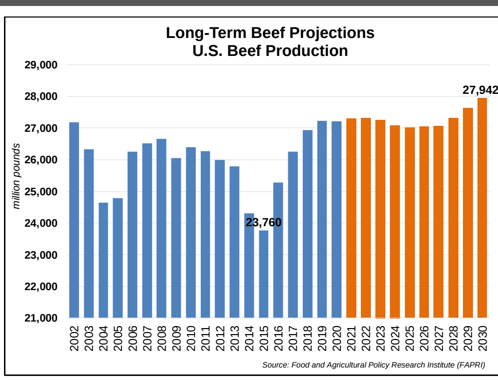

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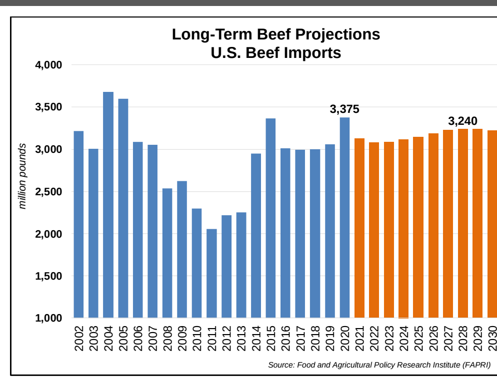

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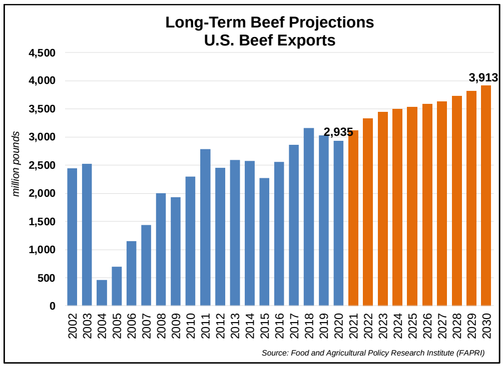

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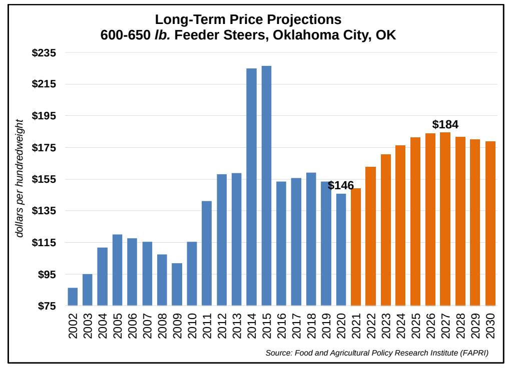

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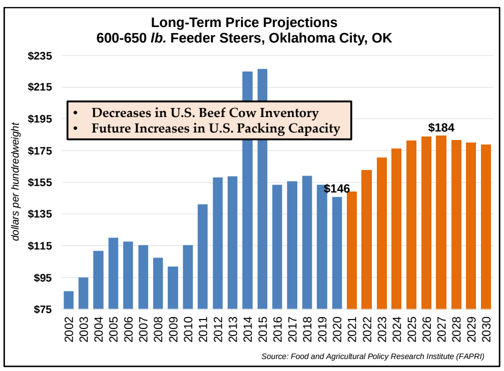

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Have a Plan

"With inflation running persistently below 2%, we will aim to achieve inflation moderately above 2% for some time so that inflation average is 2% over time and longer-term inflation expectations remain well-anchored at 2%."

- Federal Reserve

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At Some Point, Have a Plan for Inflation

At that point, it will be critical for producers to consider the needs of your business moving forward.

- Feed
- Land Rent
- Animal Inventory
- Labor
- Interest Rates

Feeder Calf Revenues: 5% ↑
Cost of Production: 12% ↑

Planning ahead will impact your bottom line.

35

Five Things I'm Thinking About RIGHT NOW

- 1) The Cost of EVERYTHING
- 2) What are you gonna feed? And at what price?
- 3) Wintering Your Cowherd – DO THE MATH
- 4) Could processing speeds at meat packing facilities be inhibited further by COVID protocols or mandates?
- 5) Price Fluctuations

36

There is no telling what may transpire between now and the end of the pandemic.

- Develop a marketing plan, work on it weekly.
  - Identify your marketing window
- **Stay Flexible**… include risk management strategies in your marketing plan.
- Develop a relationship with your lender/broker/insurance agent/etc.
- Maintain the working capital needed to complete your marketing scenario.
- Evaluate your Cash Flow, Potential for Liquidity

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WORDS ARE JUST WORDS.

What to focus on?

Only two numbers matter:

THE BOTTOM LINE

What you spend and what you receive…

38

Beef Cattle Market Outlook

Chris Prevatt

Beef Cattle and Forage Economics

UF/IFAS Range Cattle REC

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ECOSYSTEM SERVICES OF OVERSEEDING AESCHYNOMENE INTO BAHIAGRASS PASTURES IN FLORIDA

UF IFAS UNIVERSITY of FLORIDA

Supported by FULBRIGHT Colombia

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INTRODUCTION

Aeschynomene (*Aeschynomene americana* L.) is a warm-season legume commonly used in association with bahiagrass (*Paspalum notatum* Flügge) pastures. Previous studies evaluated the effect of aeschynomene on pasture and animal performance; however, this legume can also provide additional ecosystem services. The objective of this study was to quantify the effect of the legume-grass association and N fertilization on herbage accumulation, crude protein concentration and two N cycling processes (biological N fixation and N_2O emissions),

MATERIAL AND METHODS

- **Location:** Range Cattle Research and Education center. Ona, FL.
- **Management:** Plots were seeded (9 lb/acre) in April 2019-2020, with the first harvest 8 wk after seeding. Plots were fertilized with 12 lb P and 22 lb K/acre.
- **Treatments:** Split-plot arrangement of two treatments in a randomized complete block design with four replicates.
  - ✓ ***Main plot:*** Overseeing strategy of aeschynomene in bahiagrass plots (Yes and No).
  - ✓ ***Split-plot:*** Fertilization level (0 and 54 lb N/acre)
- **Response variables:**
  - ✓ ***Herbage accumulation and crude protein (CP) concentration:*** Manual clipping at 6 inches stubble height. Harvest at 35-d regrowth interval. Nitrogen analyzed by dry combustion.
  - ✓ ***Biological N fixation:*** Proportion of N derived from the atmosphere (%Ndfa) and atmospheric N fixed determined by ^{15}N isotope abundance technique.
  - ✓ ***Nitrous oxide emissions:*** Closed static chamber technique. Gas samples taken at 0, 10, 20 and 30 min.
  - ✓ **Statistical analysis:** Differences between treatments determined by analysis of variances, considering year, blocks and their interactions as a random effect. Treatments were considered different when $P \leq 0.05$.

RESULTS

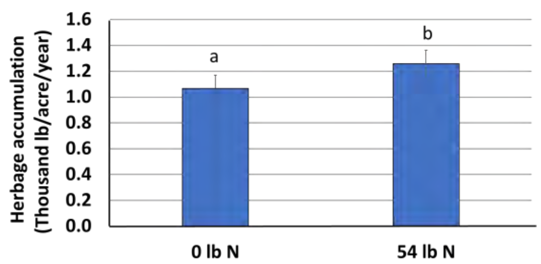


Figure 1. Fertilization effects on herbage accumulation of bahiagrass pastures. Columns with the same letter are not different (P>0.05)

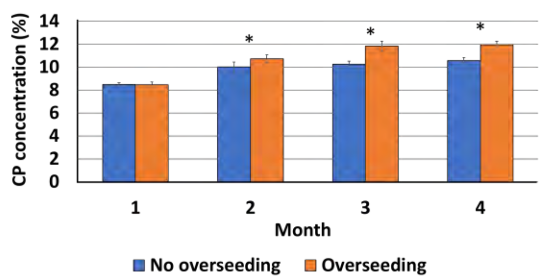


Figure 2. Overseeding effects on crude protein concentration of bahiagrass pastures. *Columns within month are different at $P \leq 0.05$.

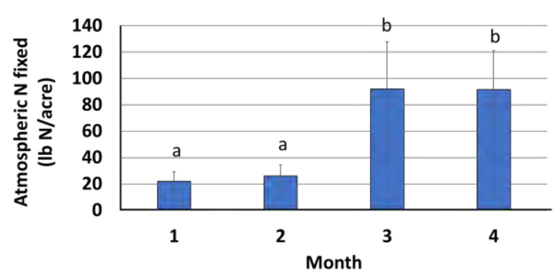


Figure 3. Atmospheric N fixed by aeschynomene without N fertilization. Columns with the same letter are not different (P>0.05)

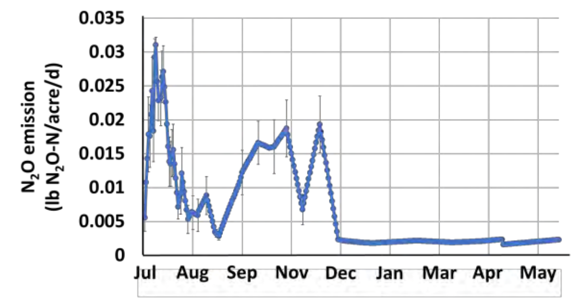


Figure 4. Calculated N_2O emissions in 2019-2021.

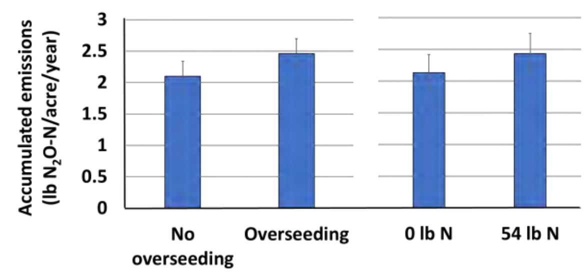


Figure 5. Averaged accumulated N_2O emissions by overseeding management and fertilization in 2019-2021.

- Overseeding aeschynomene increased CP concentration and N fertilization raised herbage accumulation.
- Aeschynomene fixed up to 100 lb N/acre/year, derived from biological N fixation. The magnitude of the fixation was driven by herbage accumulation.
- Overseeding aeschynomene increased 0.3 lb N_2O-N/acre/yr into bahiagrass pastures, the same amount than N fertilization.

CONCLUSIONS

Overseeding aeschynomene into bahiagrass increased crude protein concentration of the pasture, causing no differences in herbage accumulation. Aeschynomene was effective to fix biological N. Nitrogen fertilization and overseeding aeschynomene impacted N_2O fluxes.

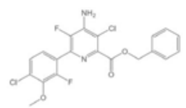
Efficiency of DuraCor on weed control and forage tolerance in Florida Grazing Lands

Caetano A.R. Sales, Brent Sellers, Pratap Devkota, and Marcelo Wallau

- DuraCor® is a premix of florpyrauxifen-benzyl & aminopyralid developed by Corteva Agriscience and recently approved for use on pastures and rangeland.

- DuraCor is emphasized by:

  Low use rate
  Nonrestricted use
  Does not contain 2,4-D or dicamba



florpyrauxifen-benzyl chemical structure

DuraCor®
HERBICIDE

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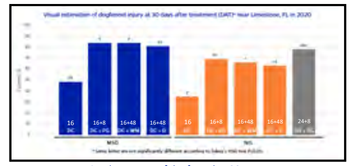
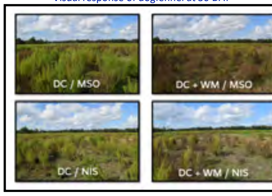
Objectives:

Evaluate weed response to DuraCor and along with tank-mix partners for optimum weed control.

Evaluate established forage tolerance as well as during establishment .



Visual response of dogfennel at 30 DAT



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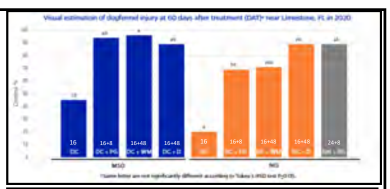
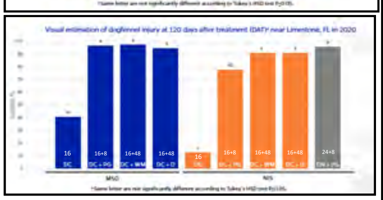
Preliminary Conclusion:

The data indicates that DuraCor will require additional tank-mix partners for optimum dogfennel control.

Similar results were seen with GrazonNext HL (Sellers and Ferrell, 2008)





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Evaluating the Agronomic and Environmental Impacts of New FL-DEP Biosolids Rule

PhD Student: Leandro Vieira-Filho
Advisor: Dr. Maria Silveira

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New FL-DEP Biosolids Rule

Public concerning on nutrient loss

What changes?

Other problems

- Seasonal high water table <6 in.
- Mandatory BMP enrollment.
- P-based rates.
- Water quality monitoring.

Vieira-Filho, Soil and Water Sciences Department, Range Cattle REC

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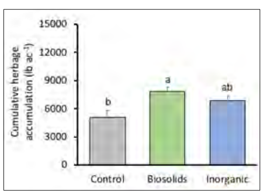
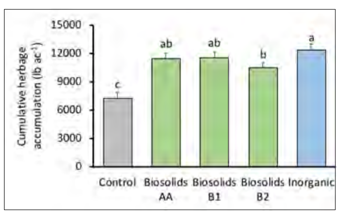
New Biosolids Rule — Old Biosolids Rule

Preliminary data



Adapted from Lu et al. (2019)



Vieira-Filho, Soil and Water Sciences Department, Range Cattle REC

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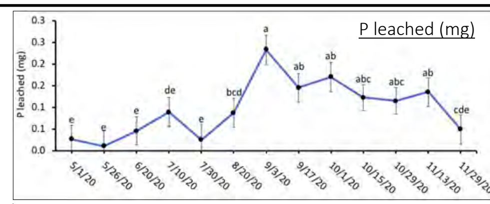

Conclusions:

- New FL-DEP biosolids rule will cause reduction in bahiagrass herbage accumulation when using biosolids as the only nutrient source.
- Regardless the rate or source, no environment impact was observed.

Vieira-Filho, Soil and Water Sciences Department, Range Cattle REC

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Coyote Behavior: Lessons from the city and the country and applications to the ranch

Hance Ellington, Assistant Professor - Rangeland Wildlife

Coyotes are a medium-sized (20lb – 35lb) carnivore and in the same family as domestic dogs and wolves (Boughton and Wight 2018). Prior to 1900, coyotes were mostly found in western North America (Figure 1; Hody and Kay 2018), however, coyotes rapidly expanded their distribution across North America during the 1900s. The loss of most large carnivore species and the conversion of forests to agriculture possibly aided in this expansion (Gompper 2002). As coyotes expanded across the southeastern United States, they interbred with feral domestic dogs and to a lesser extent remnant red wolves (von Holdt et al. 2011). Thus, today, southeastern coyotes likely have small amounts of domestic dog and red wolf DNA (von Holdt et al. 2011). Coyote populations with some wolf or dog DNA tend to be slightly larger (Kays et al. 2010) and occupy larger home ranges (Ellington and Murray 2015). These same coyote populations occur in ecologically distinct landscapes compared to western '*pure*' coyotes, so changes in body size and space use cannot be conclusively linked to hybridization without establishing a genotypic pathway, which has not yet been established.

Coyote expansion into Florida likely began in the 1950s and coyotes now occur in all of Florida's counties; they have even been detected in the Florida Keys (Main et al. 2000, Greene and Gore 2013). Coyotes can be seen as nuisance animals and in some places, individual coyotes can have large impacts on livestock production via predation (especially for sheep operations; Sacks et al. 1999). In places where other large carnivores are extirpated (wolves, mountain lions, brown bears), coyotes have few, if any, natural predators. In Florida, black bears could be predators of coyote pups and Florida panther could be predators of pups and adults. Coyote presence can alter the ecological community, especially of other carnivores (e.g., red fox and bobcat; Thornton et al. 2004). In some ecosystems coyotes can exhibit, substantial predation pressure on native ungulates (e.g., white-tailed deer), however this remains an active area of research (Kilgo et al. 2010).

The complete removal of coyotes from Florida is extremely unlikely as coyotes now play important roles in Florida's ecosystems, and any large-scale removal effort would involve extraordinary amounts of money and time, would need to be constantly maintained, and would still likely be unsuccessful. Coyotes are here to stay in Florida. To establish strategies to address or minimize human and/or livestock conflict with coyotes, it is important to better understand coyote behavior. To this end, coyotes are among the most widely studied carnivores in North America, although research on the behavior of coyotes in Florida has been limited. Nonetheless, we can look to research on coyote behavior conducted in other areas to help us understand how coyotes likely behave in Florida.

We can think about coyote behavior at multiple spatiotemporal scales. First, coyote behavior can be defined at the landscape scale over a period of months. Behavior at this spatiotemporal scale influences coyote population density and ecological community responses, including responses to management actions. Coyote behavior can also be defined at the patch scale over a period of minutes, hours, or days. At this spatiotemporal scale, we can examine how coyotes partition their day into different behaviors such as resting, foraging, and traveling, and the types of land cover features coyotes use or avoid while engaging in these behaviors.

Coyote behavior at the landscape scale

At the population level, coyotes persist on the landscape in three broadly different space use strategies. **Resident** coyotes (typically a mated pair and offspring; Figure 2) maintain territories that they defend against other coyotes not in their social group. Pups are born in the spring to resident, mated pairs (Boughton and Wight 2018). Typically, young coyotes leave their parents' territory in the fall, while some pups might linger within their parents' territory into the following year. When this happens, family groups in a territory can consist of the alpha breeding pair, adult subordinates, and juveniles. When a young coyote does leave its parents' territory, it attempts to find a mate and establish its own territory so that the newly mated pair can raise their own young. For most coyotes, however, finding a new territory is difficult because at any given time most of the available land is already occupied by other territorial coyotes. This leaves young coyotes with two options: hang around the neighborhood and wait for a territory to become available (these individuals are called **local transients**; Figure 2) or set off even further, in search of an available area to establish a territory (called **long-distance transients**; Figure 2).

Because a resident coyote regularly reuses the area within its territory, it can develop a cognitive map of its territory (Ellington 2015). A cognitive map consists of <u>spatial memory</u> that the coyote uses to navigate the landscape (similar to a natural GPS) and <u>attribute memory</u> that the coyote uses to recall the quality or type of resource available at a location (for example, rabbits can be found in this field). The cognitive map of a resident coyote allows it to reliably predict and obtain food items within its territory, thus allowing it to successfully raise young coyotes. Local transients can develop a cognitive map of their surroundings as well, although their mental map might not be as effective or complete as that of a resident coyote. In Chicago, IL, my colleagues and I found that resident coyotes are more likely to tolerate incursions into their territories by related local transients and furthermore, related resident coyotes have higher territorial overlap (Ellington, Wurth, Gehrt *in progress*; Figure 3). Conversely, long-distance transients often only spend a few weeks in any given area and so they do not develop a cognitive map of their surroundings. Lacking a cognitive map, these coyotes are not as efficient at finding food and rely more on linear corridors like roads, trails, and utility right-of-ways to aid in travel (Ellington 2015), all of which results in lower survival rates and higher susceptibility to harvest.

My colleagues and I were interested in examining how the cognitive map of coyotes might impact their ability to make resource choices on the landscape. So, we compared the resource choices of resident, local transient, and long-distance transient coyotes across Newfoundland, Canada. We found that all coyotes were able to make effective resource choices within the perceptual range (what they could see, hear, and smell) but only resident and local transients were able to make resource choices beyond their perceptual range (Ellington, Bastille-Rousseau, & Murray *in progress*; Figure 4). This suggests that the cognitive map of residents and local transients allows these coyotes to make more effective resource choices than long-distance transients that lacked a cognitive map. Furthermore, we found that resident coyotes were able to make more consistent resource choices beyond their perceptual range than local transient coyotes, suggesting that the cognitive map of a resident coyote was more developed or detailed than the cognitive map of a local transient (Ellington, Bastille-Rousseau, & Murray *in progress*). The final distinction we found was that transients (both local and long-distance) were more likely to use roads (Ellington, Bastille-Rousseau, & Murray *in progress*).

Coyotes are famously difficult to remove from an area and this is related to the variation in different space use strategies employed by coyotes in any given landscape. First, most coyotes that are harvested by either trapping or shooting are young and therefore they are either local or long-distance transients. The resident coyotes (the reproductively active coyotes) typically have a well-developed cognitive map - they can more easily detect changes in their territory and subsequently might be more wary of novel objects or situations within their territories. Thus, the reproductive coyotes are less likely to be removed. Second, if a resident coyote or pair *is* removed, that vacant territory will quickly become occupied by either a local transient that has been waiting or by a passing long-distance transient that got lucky. The new territory holders will quickly develop a cognitive map and be more difficult to remove. As such, it takes a lot of harvest effort to see a difference in coyote population abundance.

Among resident coyotes, the size of their territories on the landscape and how they are configured is heavily influenced by the landscape itself. For example, across North America, coyote territories are larger the further north you go, because these northern regions generally have fewer prey items, so coyotes need to occupy larger territories to secure enough food to meet their daily needs (Ellington and Murray 2015; Figure 5). At a finer scale, across Chicago, IL my colleagues and I found that coyote territories were smaller in suburban landscapes than at the edge of the city in large nature preserves, presumably because they were consuming easy-to-find food waste produced by humans in these suburban areas (Figure 6). We found that territories were larger, however, in the highly urbanized downtown core of Chicago (Ellington and Gehrt 2019; Figure 6). This suggests that highly urbanized landscapes, such as downtown Chicago, that have very little natural spaces (or food) are not ideal coyote habitat. We also found that the shapes of coyote territories are more complex in areas that are highly disturbed by human presence, meaning that coyotes work around disturbances and landscape features that are inhospitable to them, but still manage to find the most suitable land, which might include city parks, cemeteries, and golf courses (Ellington and Gehrt 2019, Wurth et al. 2019).

Coyote behavior at the patch scale

At the patch scale, the daily movement of coyotes can be broadly separated into three types: encamped, foraging, and traveling. Each of these broad behaviors can include multiple types of similar behaviors and even more motivations. For example, a coyote displaying the encamped behavior could be resting in the traditional sense, digesting a big meal, consuming a large prey item over an extended period, or hiding. Furthermore, in the spring, resident females displaying the resting behavior could be nursing or caring for pups. A coyote displaying the foraging behavior could be meandering along a berry patch, searching for small mammal prey (e.g., mice), pursuing the scent trail of a rabbit, or searching for a deer fawn. Furthermore, resident coyotes could be patrolling and scent-marking territorial boundaries. A coyote displaying the traveling behavior could be traveling between resources patches, traveling to or from a resting site to a resource patch, or could be fleeing a disturbance or a perceived threat.

Furthermore, resident coyotes could quickly patrol a territorial edge while a long-distance transient could be exploring, in search of an unoccupied territory.

By broadly classifying coyote movement into these three behaviors, we can learn a lot about how the coyote views the landscape. For example, knowing how much time per day and at what time a coyote forages can tell us about the prey availability on the landscape and when prey might be more vulnerable to coyotes. Furthermore, by identifying these broad movement behaviors we can then further examine what landscape features coyotes use or avoid when engaged in these behaviors. This information can help us clarify what types of areas might be at higher risk to coyote predation.

For the past several years, my colleagues and I have addressed some of these questions by studying coyote movement behavior in Chicago, IL and in Cape Breton, Nova Scotia, Canada. In the highly urbanized downtown core of Chicago, IL we found that coyotes spent more time traveling relative to foraging than in the less urbanized suburban areas (Figure 7) – this indicated to us that coyotes in highly urbanized landscapes either consumed higher quality food resources (therefore did not need to forage as frequently) or that resource patches in their landscapes were more distant from each other, necessitating increased travel time to find productive patches of food (Ellington and Gehrt 2019). Interestingly, we also found that coyotes that consumed more anthropogenic food (i.e., food waste and pet food) traveled less – implying that anthropogenic food was more abundant and predictable, so coyotes needed to travel less to obtain the necessary food (Ellington, Newsome, & Gehrt *in prep*; Figure 7). The consumption of anthropogenic food also impacted how coyotes foraged – the more anthropogenic food that a coyote consumed, the more time they spent making small foraging movements (think circling a trash bin) and the less time they spent making long foraging movements (think coursing along a forest edge looking for fawns; Ellington, Newsome, & Gehrt *in prep*; Figure 8). Diet also impacted coyote foraging behavior in other ways. For example, if a coyote primarily consumed food resources higher in the trophic level (think deer vs blackberries), the more time they spent making long foraging movements and the less time they spent making small foraging movements (Ellington, Newsome, & Gehrt *in prep*; Figure 9). Our work in Chicago also suggested that as human disturbance increased, coyotes spent more time encamped – presumably hiding or avoiding human presence. On average, coyotes in Chicago spent 50% more of their time encamped (Ellington and Gehrt 2019). This is further supported by our findings that coyotes in more urbanized landscapes are more stressed (Robertson et al. *in prep*; Figure 10). In addition, coyotes that primarily consumed food resources higher in the trophic level also spent more time encamped – this could have been driven by the need to spend time digesting large, protein-rich meals (Ellington, Newsome, & Gehrt *in prep*).

Conversely, coyotes in the extremely rural Cape Breton, Nova Scotia, Canada only spent about 33% of their time encamped (Ellington et al. 2020). By studying coyote movement behavior in Cape Breton, my colleagues and I found that coyotes were most active foraging and traveling during the crepuscular period (dawn and dusk; Ellington et al. 2020; Figure 11). Coyotes also foraged during the day and night, but the types of land cover and landscape features coyotes used while foraging differed by the time of day. For example, during the day, foraging coyotes selected for open areas without trees but during the crepuscular period and at night they avoided open landscapes. Further, during the crepuscular period coyotes focused on the edges of forest and open landscapes with a mixture of land cover types (Ellington et al. 2020). Another interesting finding from this study was how foraging coyotes responded to features associated with humans (roads and trails). Here, coyotes employed a close but not too close strategy – they avoided roads within a football field's length but beyond that preferred areas with roads (Ellington et al. 2020). Interestingly, when coyotes were encamped (likely resting), they were not choosing or avoiding any the land cover or landscape features that we examined – including those associated with humans (Ellington et al. 2020).

Across all these studies, one of the most striking results is that the behavior of some coyotes is markedly different from that of other individuals. For example, two coyotes experiencing the exact same degree of human disturbance in the form of urbanization might have very different behavioral responses: one coyote might spend 30% of its time encamped whereas the other coyote might spend 70% of its time encamped. One coyote might consume nearly 100% of its diet from food waste and pet food, while another coyote might consume nearly 100% of its diet from rabbits and berries. This is why I always refer to coyotes as a generalist species, but often an individual specialist.

Coyote behavior in Florida's rangelands

There has been one recent study that examined coyote behavior in Florida, conducted from 2014 to 2015 across multiple ranches in south-central Florida. In this study, Ke Zhang and colleagues found that coyotes home ranges (likely including both resident's territories and the general areas used by local transients) were on average 10.4 $miles^2$ (more than 6600 acres; Zhang 2017). These home range estimates are a bit larger than expected given the likely high prey availability in south-central Florida but are similar to those found in earlier study conducted in south-central Florida (Thornton et al. 2004). Zhang and colleagues found that coyotes in south-central Florida were most active during dawn and dusk (Zhang 2017) – this agrees with my own findings about coyotes in Cape Breton, Canada (Ellington et al. 2020). Interestingly, Zhang and colleagues found that as temperature and rainfall increased, coyote movement decreased (Zhang 2017). In other words, when the weather became harsher coyotes reduced their activity. We found the same pattern further north in Cape Breton, Canada, but here the harsh weather came in the form of colder temperatures and heavy snow (Ellington et al. 2020).

Zhang and colleagues did not look at coyote movement behavior, however, they did find that coyotes in south-central Florida preferred improved pastures, forest, and scrub/shrubland, and avoided wetlands, dry prairies, roads, and other human-associated landscape features. While coyotes could be a potential predator of young cow calves, they did not find that coyotes responded differently to improved pastures with and without cows (Zhang 2017).

Future directions

While baseline studies of what land cover and landscape features coyote prefer or avoid (e.g., Zhang 2017) are important, they do not account for differences in movement behavior, meaning that some important relationships can be missed (Ellington et al. 2020). To this end, it is important to examine how foraging coyotes respond to different landscape features, including whether foraging coyotes respond to cow or cow-calf presence within improved pastures. We found a strong link between behavior, diet, and urbanization among coyotes in Chicago

(Ellington, Newsome, & Gehrt *in prep*), thus it is likely that there is a strong link between coyotes' behavior, diet, and landscape features in south-central Florida. This potential relationship warrants further investigation. In my future research, I plan to link movement behavior and diet of coyotes in south-central Florida. I also plan to build landscapes of prey availability, using a combination of remote cameras, acoustic recording units, and other methods. This contrasts with previous research that utilized land cover features, allowing me to examine how coyote behavior responds to landscapes of prey availability. Finally, prescribed fire is an important component of healthy ecosystem management in south-central Florida, yet it is unknown how different fire management regimes might influence coyote behavior in the short-term (days and weeks) and the long-term (months and years).

We found evidence that a coyote's cognitive map (especially the spatial memory component) has a strong impact on its behavior on the landscape (resource selection and avoidance; Ellington, Bastille-Rousseau, & Murray *in prep*). However, this work was conducted in Newfoundland, Canada where prey availability is considerably lower, and coyotes must navigate much larger territories (avg. coyote territory on Newfoundland was more than 20,000 acres; Ellington 2015). Thus, it is important to explore the role of spatial memory in coyote behavior in more resource-rich environments, like south-central Florida. I plan to explore whether spatial memory develops faster in complex environments with distinct landmarks and crucial or clumped resources, and whether the characteristics of these features affect spatial memory development. Ultimately, negative human-wildlife interactions can be related to repetitious activity by animals (e.g., success in foraging in trash bins or success in raiding livestock), and an understanding of spatial memory could play a role in addressing or mitigating negative human-wildlife interactions, such calf loss.

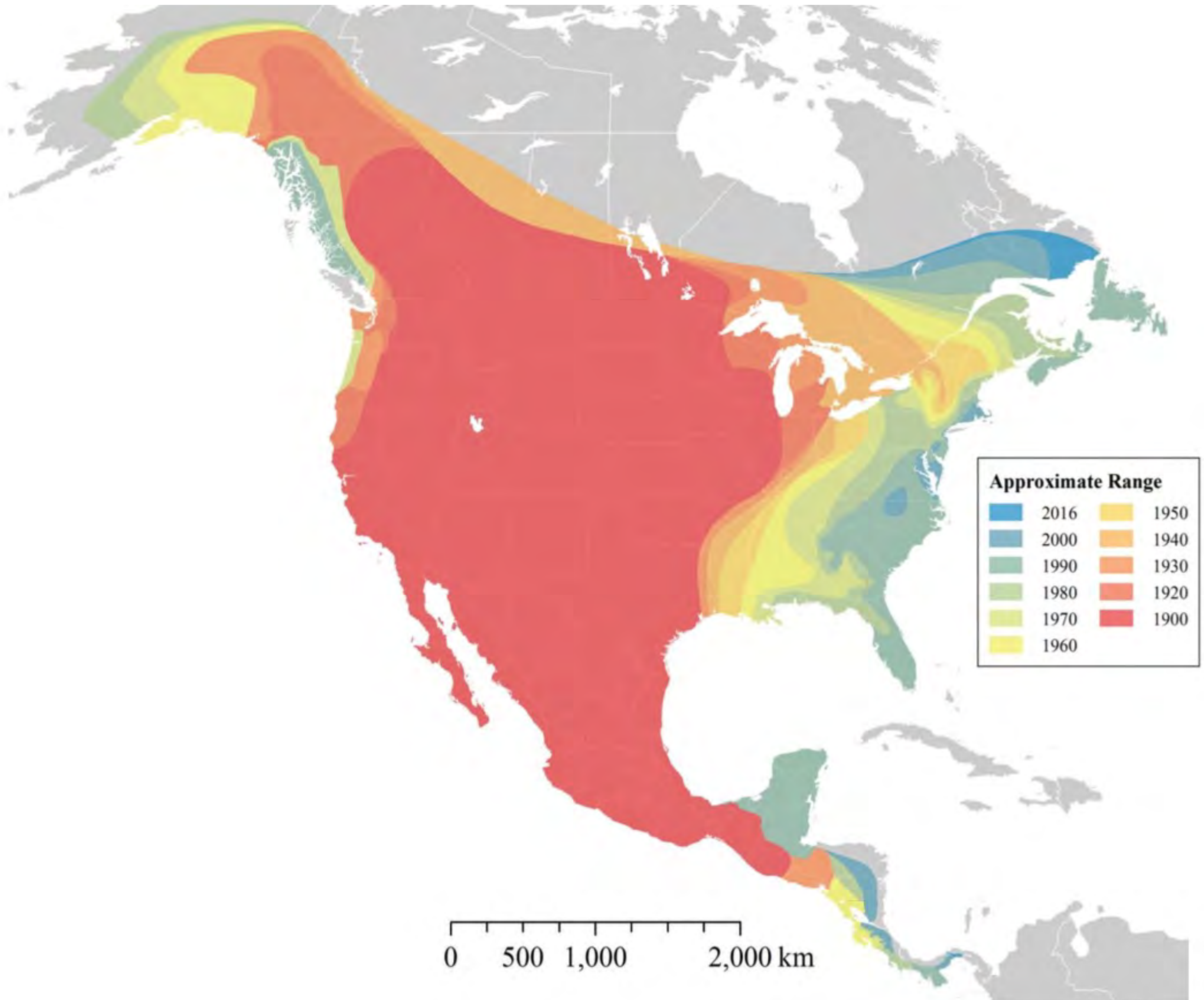


Figure 1. Map of historic (prior to 1900) distribution of coyote in North America and the estimated years that coyotes expanded their distribution across North America. Modified from Hody and Kays 2018.

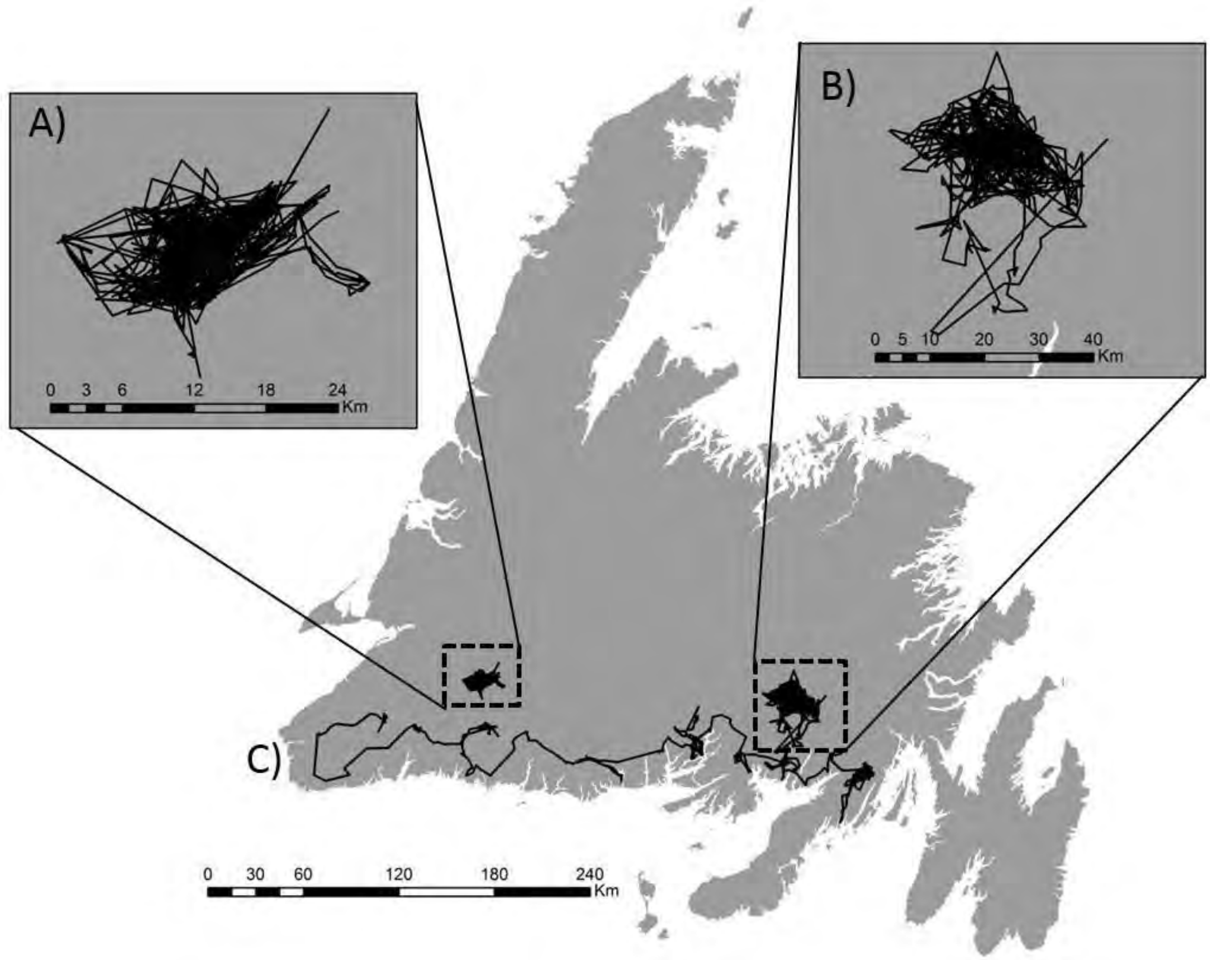


Figure 2. Maps of a resident coyote movement path (a), local transient coyote movement path (b), and long-distance transient coyote movement path (c) in Newfoundland, Canada.

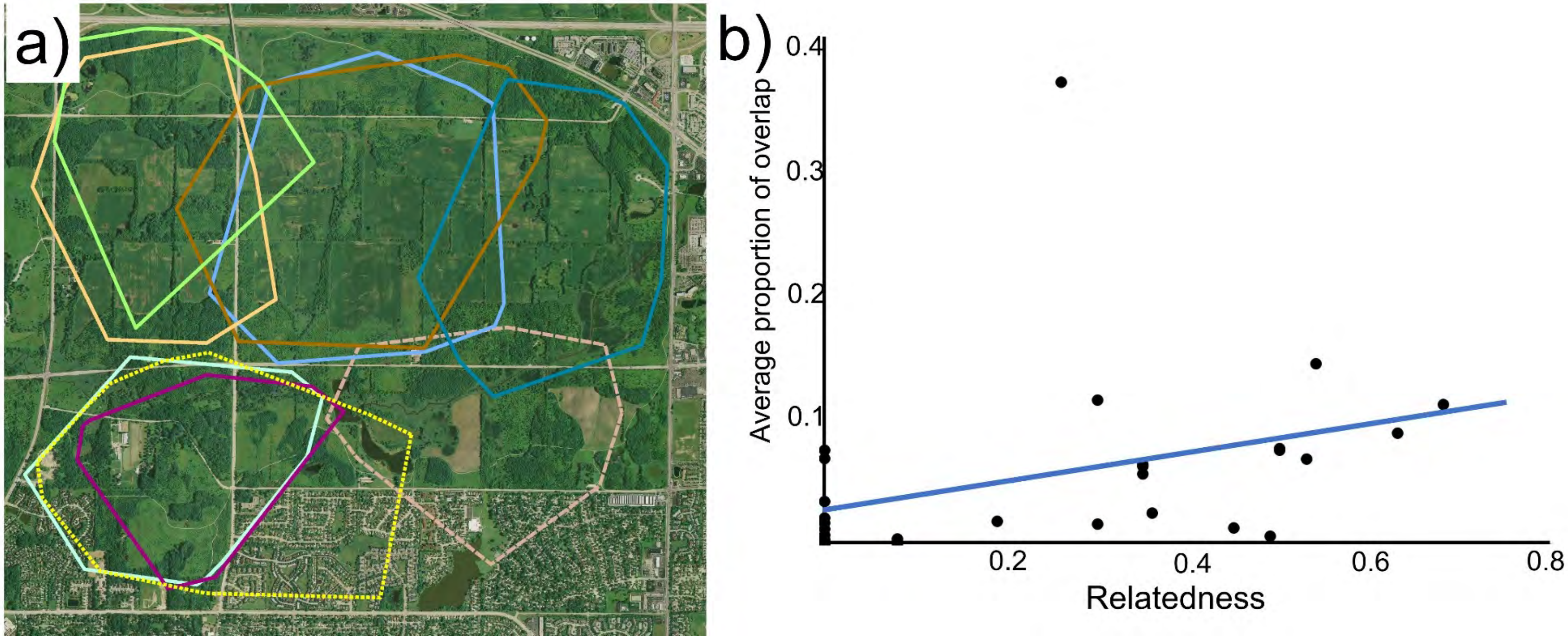


Figure 3. Map of overlapping resident coyote territories within a nature area in the greater Chicago Metropolitan Area (a; the estimated boundary of each coyote territory is shown in a different color). Note that when territories completely overlap these individuals are considered part of the same family-based social group. Relationship between relatedness of a pair of coyotes and how much of their territories overlapped (b; excluding individuals within the same social group), coyotes that were more closely related were more likely to have a higher degree of overlap between their territories.

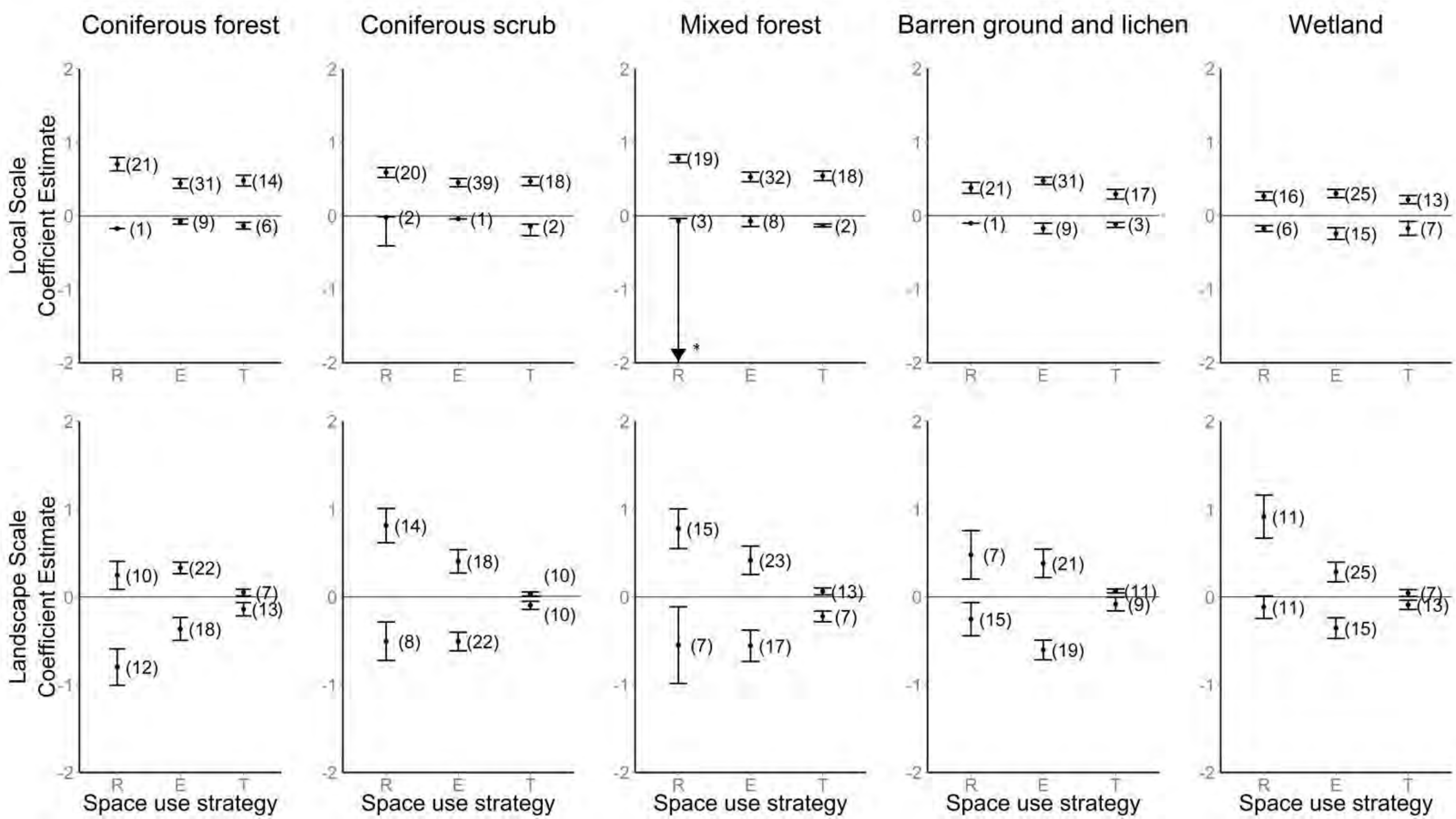


Figure 4. Weighted average positive (selection) and negative (avoidance) resource selection coefficients across 5 land cover classes at local and landscape spatial scales for resident (R), local transient (E), and long-distance transient (T) coyotes in Newfoundland, Canada. Sample size of each group for the positive and negative coefficients is in parentheses. Error bars represent the weighted standard error of the resource selection coefficient, except when sample size was less than five, in which case the error bars represent the range of resource selection coefficients. *Lower limit of residents avoiding mixed forest at the local scale is -14.1.

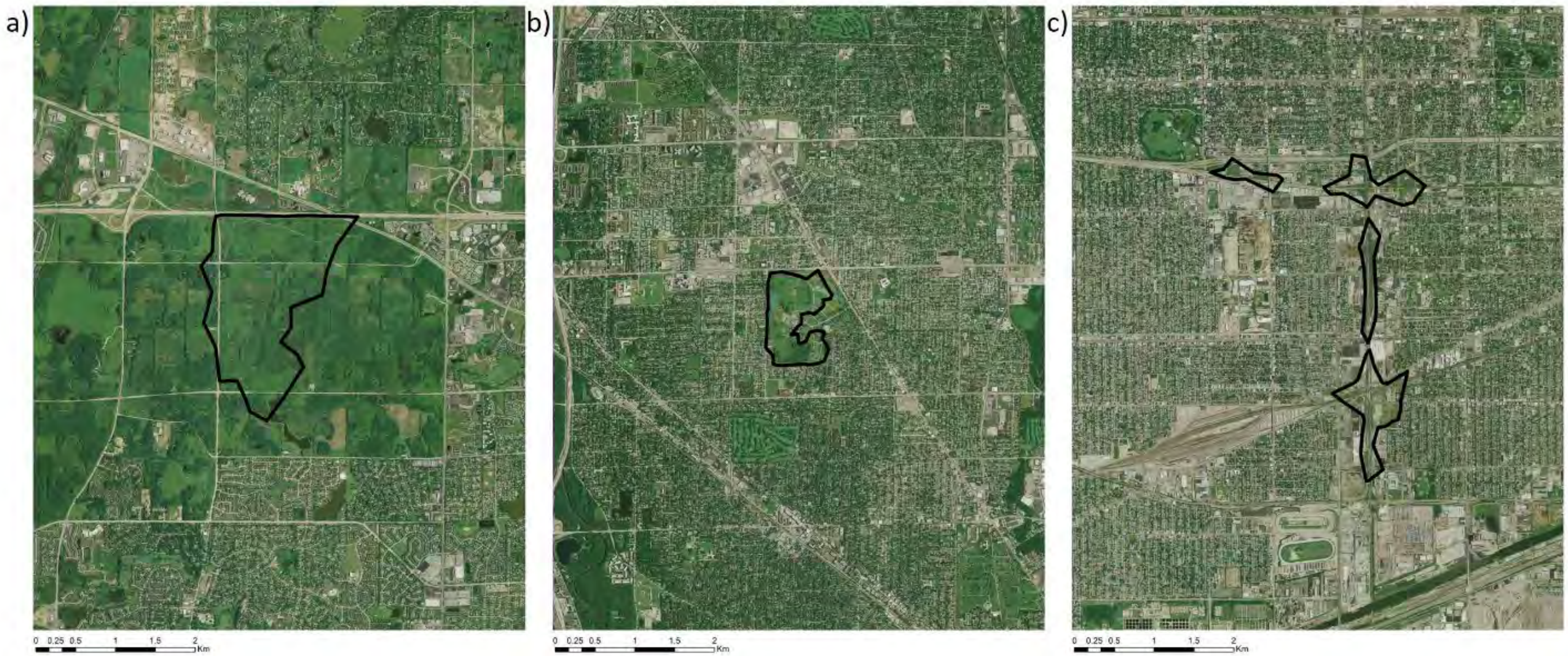


Figure 5. Maps of resident coyote territories within the greater Chicago Metropolitan Area, resident coyotes had the smallest territories in suburban areas (b) and the largest territories in highly urbanized areas (c), while territories completely in nature areas (a) were of moderate size. Overall, the complexity of resident coyote territories increased as the landscape became more urbanized.

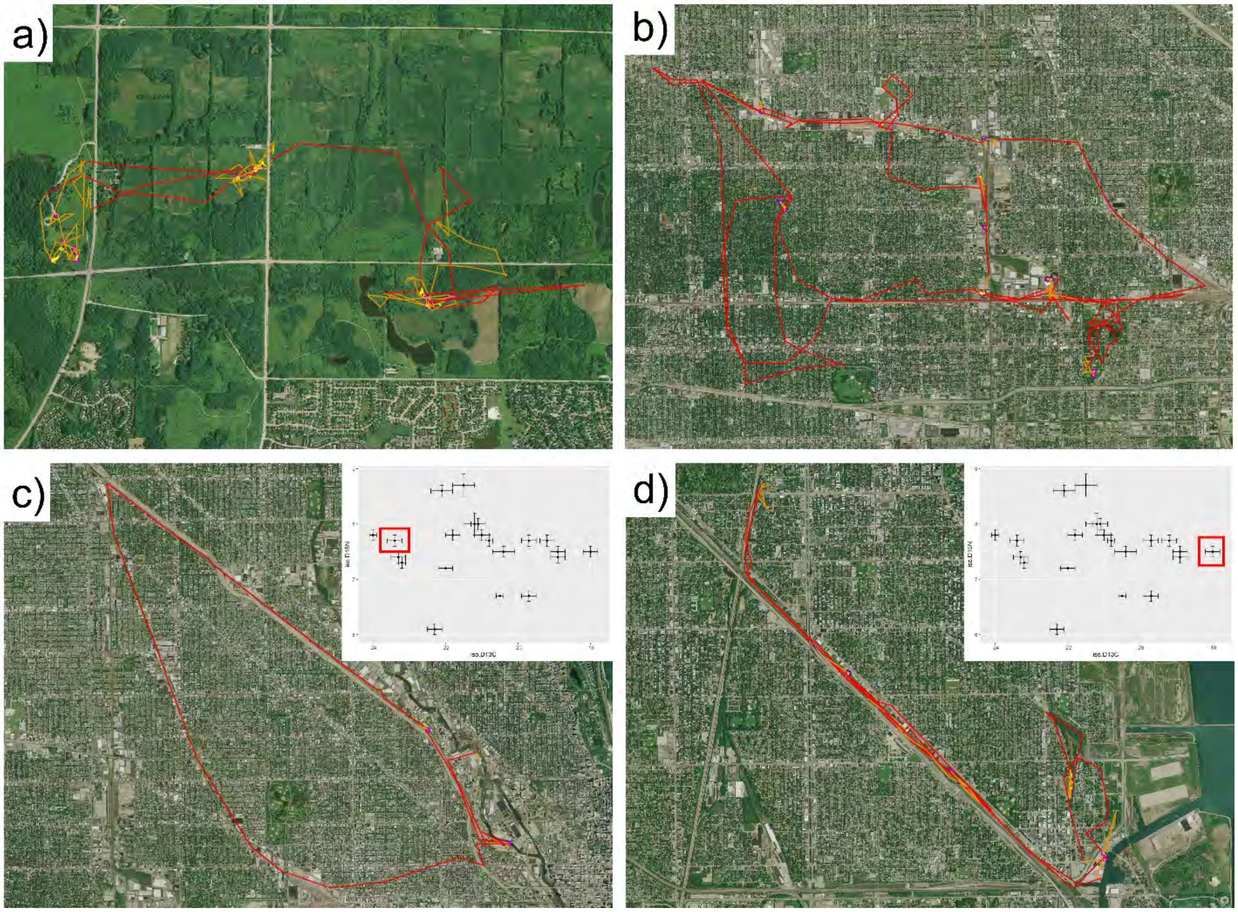
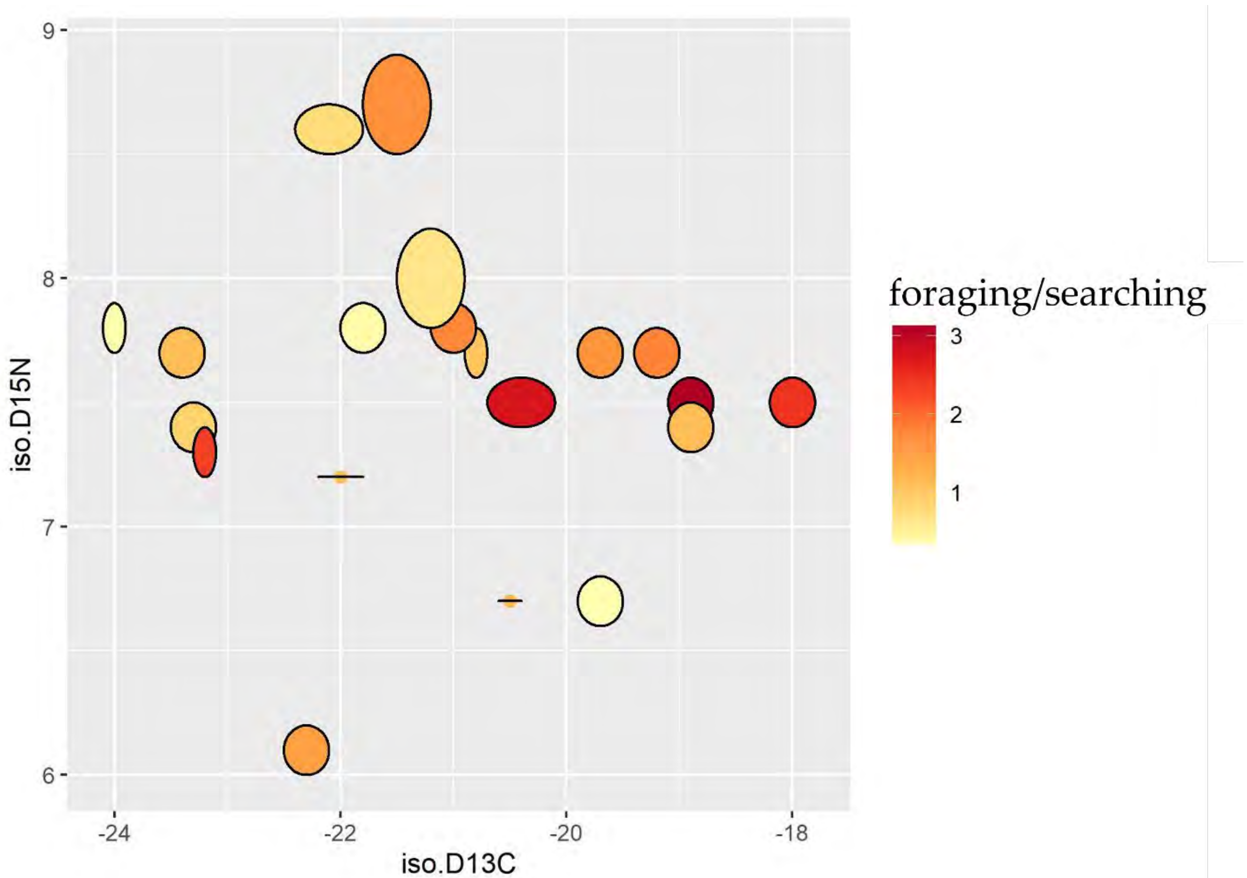


Figure 6. Maps of movement behavior (encamped – purple dots, foraging – yellow lines, searching – orange lines, traveling – red lines) within the greater Chicago Metropolitan Area, as urbanization increased the amount of time that coyotes spent traveling increased. For example, a coyote in a nature area spent approximately 6% of its time traveling (a), while a coyote in a highly urbanized area spent approximately 27% of its time traveling (b). Coyotes that consumed more anthropogenic prey items spent less time traveling. For example, a coyote that consumed mostly natural food items in a highly urbanized area spent 31% of its time traveling (c), while a coyote that consumed mostly anthropogenic food items in a highly urbanized area spent 14% of its time traveling (d).



9
8
7
6
iso.D15N
-24
-22
-20
-18
iso.D13C
foraging/searching
3
2
1

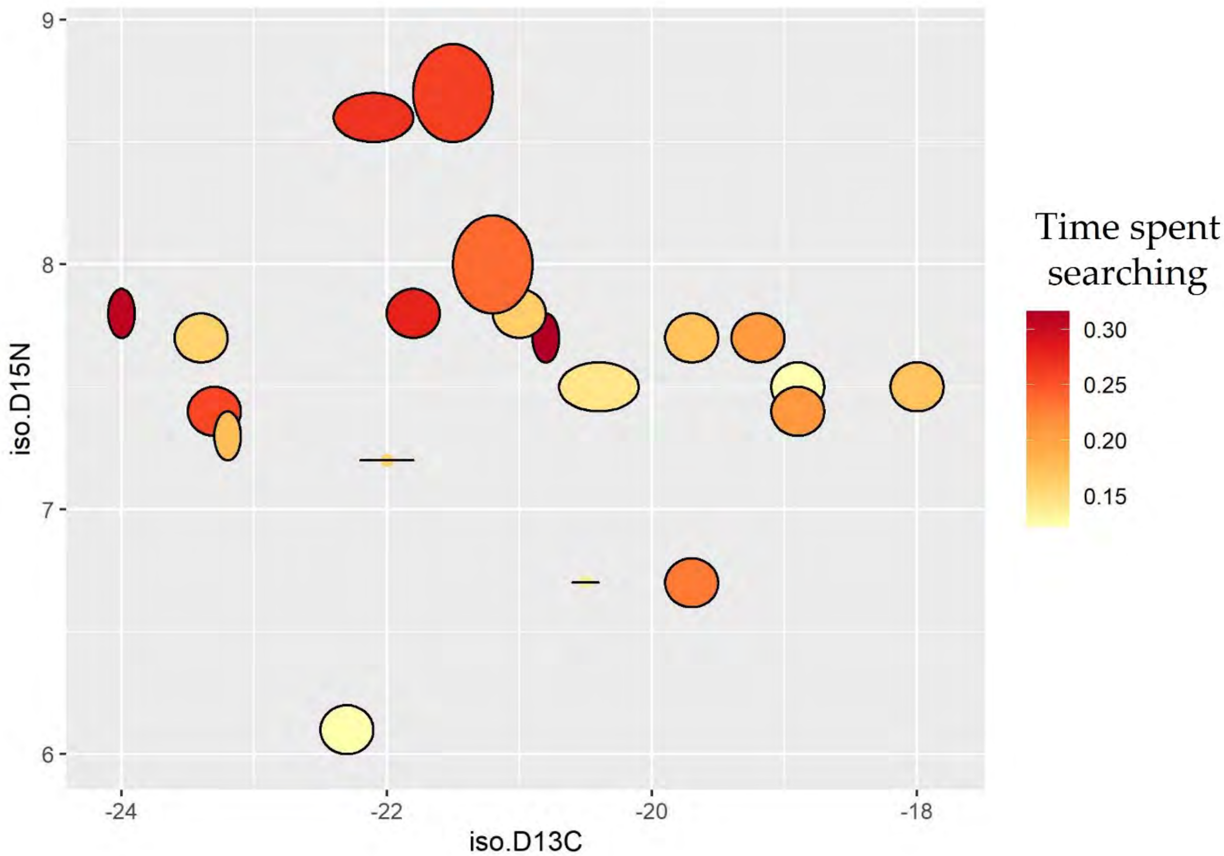


Figure 8. Relationship between coyote diet in the greater Chicago Metropolitan Area as described by stable isotopes (D15N – is a metric of trophic level and D13C is a metric of anthropogenic food) and how much time a coyote spent searching in a day (making long foraging movements; red). Coyotes that primarily consumed food items at a higher trophic level spent more time searching (darker red).

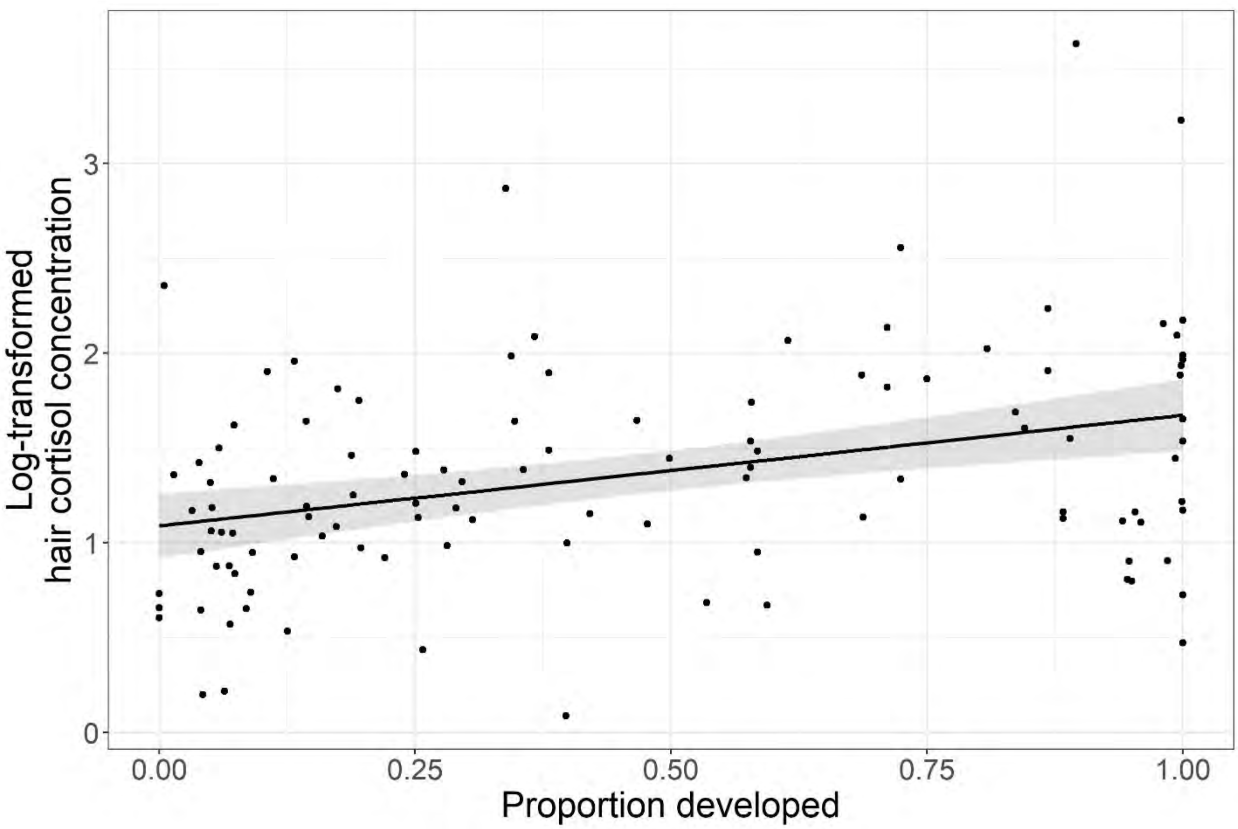


Figure 9. Relationship between hair cortisol concentration (an index of stress) in coyotes living within the greater Chicago Metropolitan Area and the proportion of the landscape these coyotes experienced that was developed land. Stress experienced by coyotes increased as the area that inhabited became more developed.

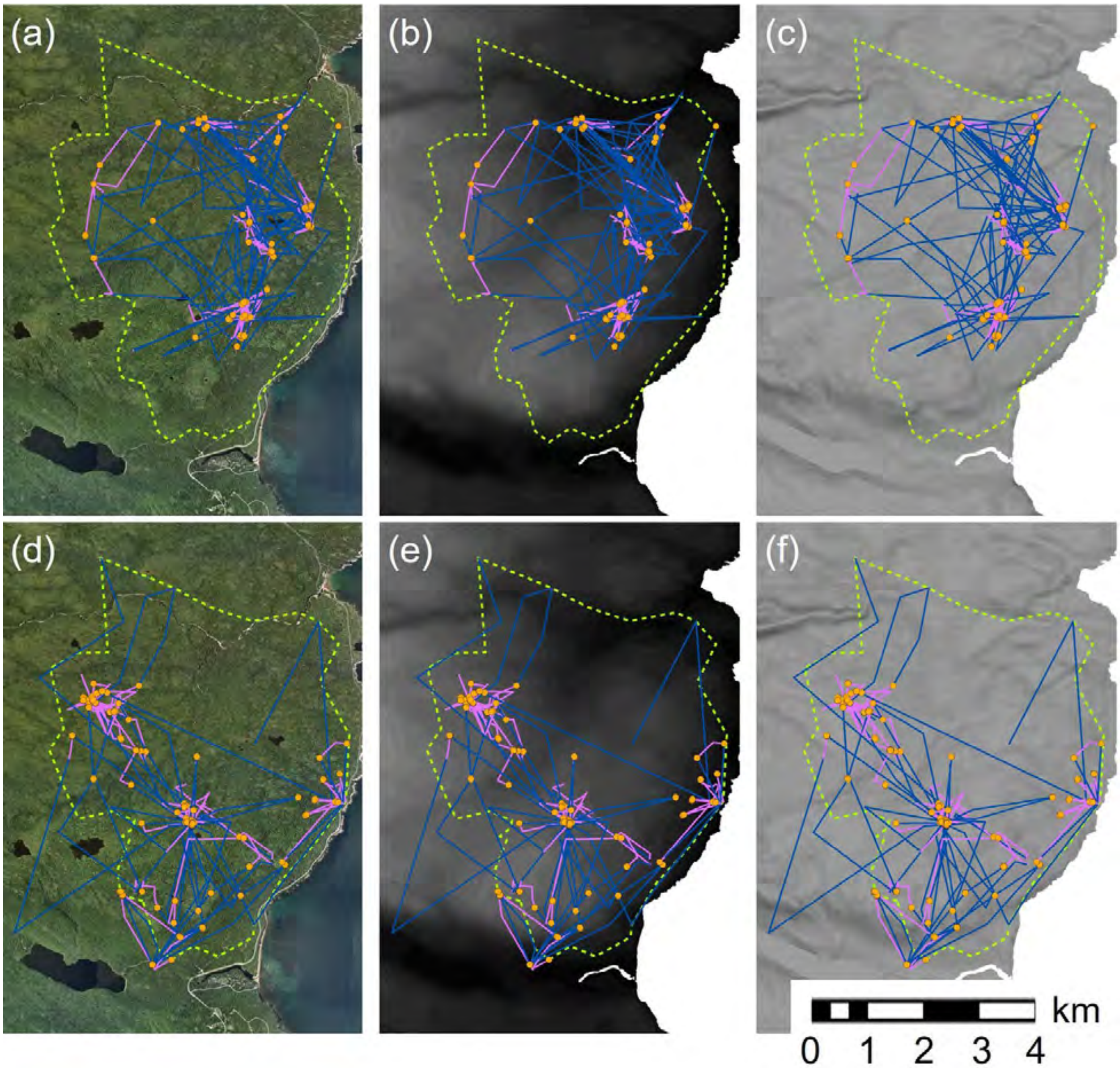


Figure 10. Estimated movement behavior (encamped—orange dots, foraging—pink lines, traveling—blue lines) of a male resident coyote during the snow-free season (**a**–**c**) and snow season (**d**–**f**) in Cape Breton, Nova Scotia, Canada. Movement behaviors are mapped onto aerial imagery (**a**, **d**), elevation (low—dark, high—light; **b**, **e**), and slope (shallow—light, steep—dark; **c**, **f**). The estimated territorial boundary is represented by the dashed green line.

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Evaluation of new forage cultivars in south and north-central Florida

Joao (Joe) Vendramini, Professor - Forage Management
and Lynn Sollenberger, Distinguished Professor - Forage Crops, UF Agronomy Department

Warm-season perennial grasses are the dominant forages used by beef cattle and dairy producers in Florida. Forage production, nutritive value, and persistence are the main desirable agronomic traits in warm-season perennial grasses. In addition, adaptability is also important due to differences in edaphic and climatic conditions in distinct regions of the state.

The most productive and adapted warm-season perennial grasses in Florida are propagated by vegetative plant material. There are several limitations of planting vegetative material, such as unpredictable climatic conditions to produce vegetative plant material, logistics of transporting vegetative material between locations, and machines and labor required for planting. In addition, it is estimated that the cost to establish a warm-season perennial grass by vegetative plant material is approximately $700.00/acre.

Therefore, research was conducted to evaluate forage accumulation and nutritive value of new forage cultivars propagated by seed.

A 2-yr experiment was conducted at the Plant Science Research and Education Center in Citra, FL and at the Range Cattle Research and Education Center, Ona, FL in 2019 and 2020. Treatments were three forage species/cultivars, ‘Spain’ (*Megathyrsus maximus)*, ‘Camello’ (*Brachiaria* spp.), and Jiggs (*Cynodon dactylon*). Please note that Spain and Camello are still not commercially available, and the result of our current research projects will dictate the merit of introducing these new cultivars.

Plots were 15 x 15 ft with 5 ft alley between plots. Plots were harvested at 7 inches stubble height and fertilized with 300 lb/acre of 20-05-20 every 6 weeks. An area of 18 sq ft was harvested at the center of the plot and used for forage production calculation, crude protein and in vitro digestible dry matter.

At Ona, Camello and Spain had greater forage accumulation than Jiggs during the 2-yr period (Figure 1).

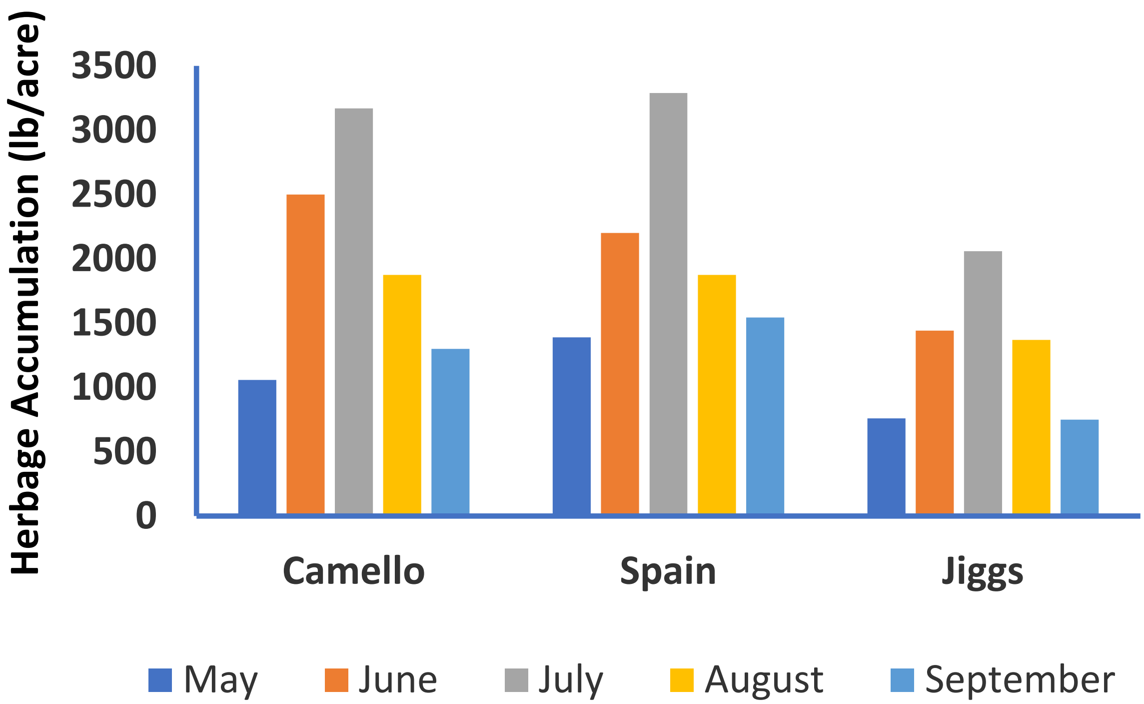

Figure 1. Forage accumulation of Camello, Spain, and Jiggs at Ona in 2019 and 2020.

Jiggs had greater crude protein than Camello and Spain in July; however, there was no differences in the other months. However, Camello and Spain had greater digestibility than Jiggs during all months of the experimental period, except August (Figure 2 and 3).

In Citra, an additional forage cultivar was added to the trial, Mombaca, which is an improved cultivar of guineagrass. Similar to the results at Ona, Camello and Spain had greater forage accumulation than Jiggs. Mombaca had greater forage accumulation than Jiggs but lesser than Camello and Spain (Figure 4). There were no differences in crude protein in June; however, Camello and Jiggs had greater crude protein than Spain and Mombaca in August. Jiggs had the greatest crude protein in September and there was no difference among the other cultivars. Jiggs had the least digestibility in June and Camello had the greatest in August, but the digestibility did not differ among cultivars during most of the experimental period.

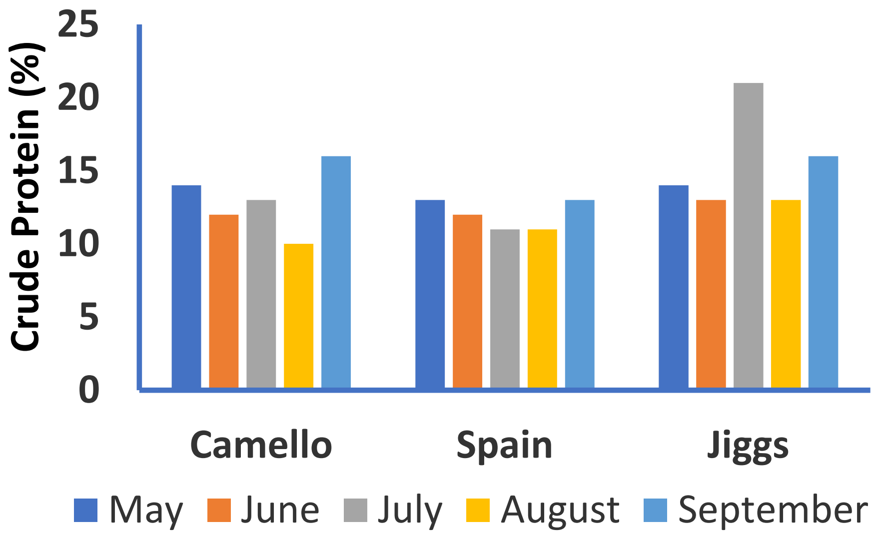

Figure 2. Crude protein concentration of Camello, Spain, and Jiggs at Ona in 2019 and 2020.

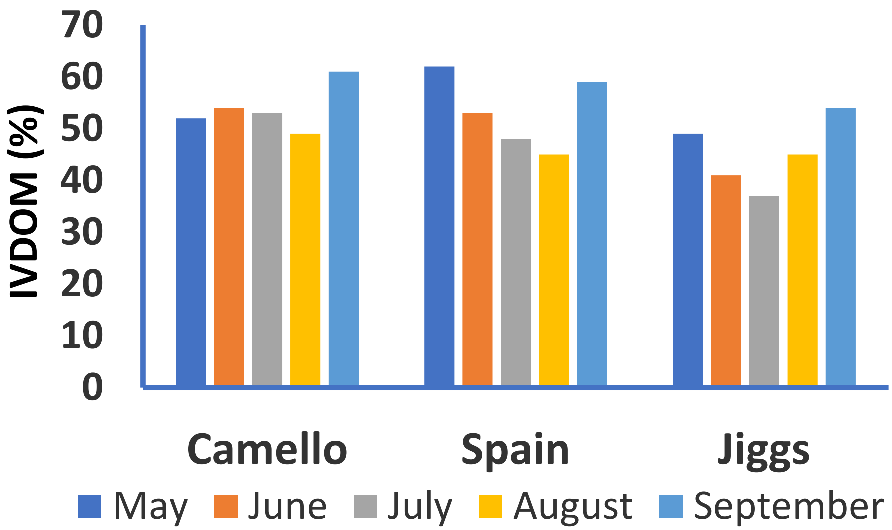

Figure 3. In vitro digestible organic matter of Camello, Spain, and Jiggs at Ona in 2019 and 2020.

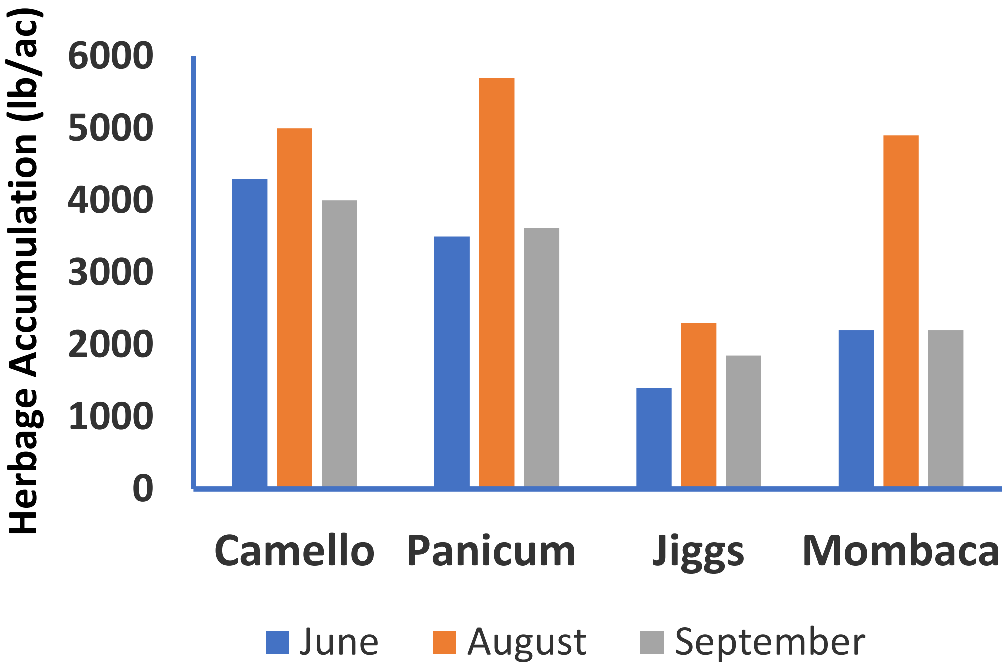

Figure 4. Forage accumulation of Camello, Spain, Jiggs, and Mombaca at Citra in 2019 and 2020.

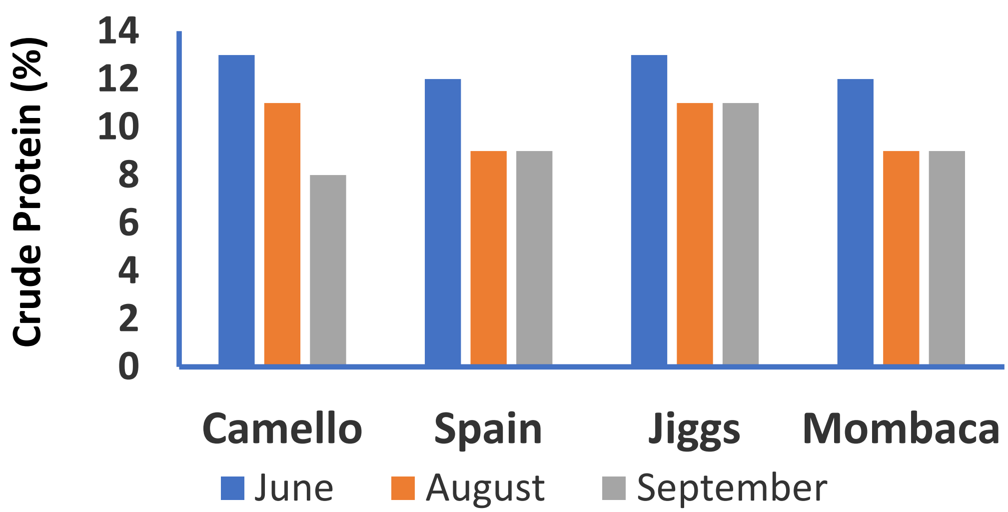

Figure 5. Crude protein concentration of Camello, Spain, Jiggs, and Mombaca at Citra in 2019 and 2020.

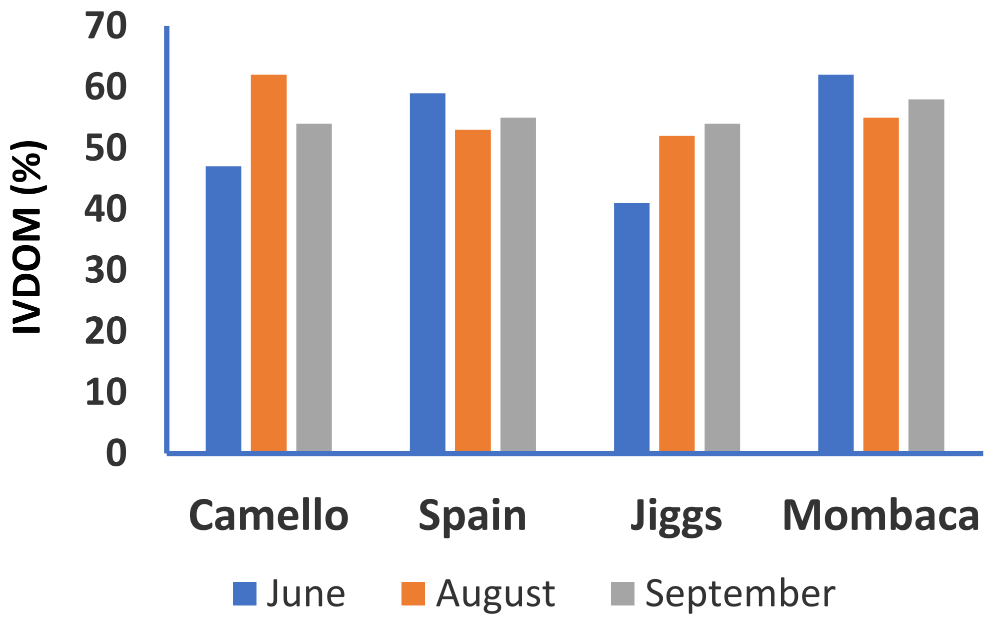

Figure 6. In vitro digestible organic matter (IVDOM) concentration of Camello, Spain, Jiggs, and Mombaca at Citra in 2019 and 2020.

There was no difference in cold tolerance among the cultivars at Ona and all cultivars maintained the stand above 85% ground cover; however, Spain and Mombaca did not persist after the 2020-2021 winter in Citra. Jiggs had the greatest cold tolerance (78% ground cover), followed by Camello (60% ground cover). There were 8 freezing events during the winter at Citra and the coldest temperature was 25.6°F.

In conclusion, the new cultivars propagated by seed tested in Ona and Citra have potential to be used as forage due to greater production and nutritive value than Jiggs. However, Spain has reduced cold tolerance and should be used with caution in northern locations of the state. Further studies are being conducted at Ona and Citra to test persistence of Spain and Camello under frequent grazing and harvest. The studies are funded by the Dairy Check-off Program and Florida Cattle Enhancement Board. If you have any questions about the new seeded forage cultivars, please contact Joe Vendramini at jv@ufl.edu.

Biosolids Research Update

Maria Silveira, Professor – Soil and Water Science

Biosolids represents a viable alternative to supply nutrients and organic matter to perennial forage crops while reducing the dependence on inorganic fertilizer. Although biosolids have clear agronomic benefits, concerns over nutrient accumulation in soils and subsequent impacts on water quality can limit land application in Florida. In this article, a brief overview of past and current biosolids research efforts are presented.

Biosolids Field Trial at Ona

A field trial was established in 2016 to evaluate the agronomic and environmental impacts of various biosolids sources applied to bahiagrass pastures at the Range Cattle REC in Ona (Fig. 1). Our principal hypothesis was that most biosolids applied to pastures convey significant agronomic benefits as they behave as "slow release" nutrient sources with minimal negative environmental impact.

During the 4 yr study (2016 to 2019), one Class A biosolids, two Class B biosolids materials, and one wood biochar were annually applied to the experimental area and compared to nutrition provided with inorganic fertilizers. Biosolids sources were applied either alone or in combination with biochar to supply an estimated rate of 160 lb plant available nitrogen (N)/A/yr, which correspond to UF/IFAS high N option for established bahiagrass and the most common application rate used by commercial cow-calf operations in Florida. The availability of N in the biosolids was estimated using Florida -DEP factor of 1.5. Biochar was also applied annually at a rate of 50 tons/A, which corresponds to an application rate of approximately 1% (wt. basis). Control treatments included plots receiving inorganic commercial fertilizer (ammonium nitrate + triple superphosphate alone and in combinations with biochar) and pastures receiving no biosolids, fertilizer, or biochar. Forage, soil, water quality, soil moisture, ground water levels, and gas emissions were monitored during the 4 yr study.

Results

<u>Bahiagrass Responses</u> - A peer-reviewed publication was published in 2020 on bahiagrass response to biosolids and biochar application (Lu et al., 2020). Briefly, bahiagrass total annual herbage accumulation was similar for biosolids and inorganic fertilizer treatments in 2017; however, inorganic fertilizer and aerobically-digested Class B biosolids increased total annual herbage accumulation by as much as ~29% relative to other sources in 2018. Biosolids and inorganic fertilizer increased bahiagrass crude protein concentration by as much as ~22 and ~39% in 2017 and 2018, respectively, compared to unfertilized bahiagrass. No treatment effects were observed on *in vitro* digestible organic matter (IVDOM) concentration in 2017; however, in 2018 biosolids resulted in greater IVDOM than inorganic fertilizer. Bahiagrass tissue mineral concentrations in both biosolids and inorganic fertilizer treatments were generally within sufficient range for optimum plant growth. Biosolids can be a viable alternative for sustainable bahiagrass production while reducing the dependence on inorganic fertilizer.

Soil Responses - The majority (64%) of applied N accumulated in above-ground bahiagrass biomass, while ~ 63% of applied phosphorus (P) was retained in subsurface soil layers (<20 inches). Neither soil N nor P concentrations were affected by repeated annual application of biosolids or inorganic fertilizer. Despite the relatively high annual loads (average of 98 lb P/A/yr) that far exceeded agronomic recommendations, repeated application of biosolids or inorganic fertilizer showed no effects on soil total P concentrations at any soil depth. At the end of the study, soil P decreased by ~ 15% in the top 12 inches depth followed by an associated increase in the 24 to 36 inches depth (1431 lb P/A/yr in 2016 vs. 1740 lb P/A/yr in 2019). These data suggested potential vertical redistribution of P within the soil profile. Phosphorus vertical transport is highly influenced by fluctuating water table commonly experienced in Florida Spodosols.

Water Quality and Greenhouse Gas Responses

Water quality and greenhouse responses to biosolids and biochar application were reported in 2 recently published peer-reviewed publications (Lu et al., 2020a,b). Briefly, results demonstrated significant temporal variability in leachate N and P, with larger pulses generally occurring during periods of high water table levels or following intensive (> 1.5 inches) rainfall. Inorganic fertilizer generally resulted in greater leachate N and P losses than biosolids. No differences in leachate N and P losses between biosolids and control were observed. Approximately 1% of applied N was lost via leaching from biosolids treatments vs. 16% for inorganic fertilizer. Regardless of the P source, negligible (0.1 to 0.2% of applied P) cumulative P leaching occurred during the 3-yr study. Biochar had no effect on P leaching, but reduced N leaching from treatments receiving inorganic fertilizer by 60%. Nutrient source had no effect on soil CO_2 and CH_4 emissions, but annual and cumulative (3-yr) N_2O emissions increased with biosolids (7 lb N_2O/A/yr) compared with inorganic fertilizer (5 lb N_2O/A/yr) application. Data suggested that environmental conditions played a more important role on GHG fluxes than nutrient additions. Biochar reduced CO_2 emissions modestly (<9%), but had no effects on N_2O and CH_4 emissions. Data suggested that prudent nutrient management is possible even on biosolids-amended Spodosols with high water tables.

Summary and Conclusions

During the first 4 years of this project, significant resources and efforts were committed to two main priorities: 1. documenting soil, forage, water, and gas emissions baseline data, and 2. instrumenting the experimental area. However, several biotic and abiotic factors (e.g., rainfall, temperature, and timing of fertilizer application) can affect bahiagrass responses to biosolids application. Thus, multi-year research is necessary to confirm and validate the data. Pastures represent the major cropping system for biosolids recycling in Florida, but multi-year **field** data to support the sustainability and safety of the practice are scarce. Most previous studies were conducted in greenhouses or laboratories. The agronomic and environmental impacts must be demonstrated in the field to credibly promote environmentally-sound biosolids land applications in livestock production systems. Data obtained in this study suggested no significant differences in bahiagrass herbage accumulation between commercial inorganic fertilizer and Class AA biosolids. Application of biosolids (either alone or in combination with biochar) had no significant impact on water quality or greenhouse gas emissions.

Future Direction

In 2021, new treatments were imposed onto the experimental area to evaluate the impacts of new FL DEP biosolids rule on bahiagrass responses, soil health, and water quality. Based on the new Rule 62-640, Florida Administrative Code, biosolids will have to be applied at reduced rates (to meet crop P requirements). This approach significantly limits the rates of biosolids that can be recycled in pastures in Central and South Florida; such low rates are unable to supply adequate amounts of N and other essential nutrients to sustain adequate forage production. In addition, water quality monitoring will be required when annual P application rates exceeds 40 lb P_2O_5/A. Our hypothesis is that biosolids application will result in no significant impact on water quality but reduced (P-based) rates will detrimentally affect bahiagrass production and nutritive value. The new regulations will also require supplementation and/or replace pasture fertilization with inorganic fertilizer, which will likely have considerably greater greenhouse gas emission footprint. Currently there is no scientific evidence demonstrating that biosolids application above 40 lb P_2O_5 A^{-1} may result in negative impacts on water quality. In fact, most of the previous papers published by our group (Silveira et al., 2019, Lu et al., 2019, 2020a, 2021) demonstrated that prudent nutrient management is possible even on biosolids-amended Spodosols with high water tables. The main objectives of this new study are (1) to maintain an established, long-term, instrumented research and demonstration field trial designed to evaluate the agronomic benefits and environmental risks associated with land application of biosolids, and (2) to evaluate the impacts of new FL DEP biosolids rule on bahiagrass responses, soil health, and water quality.

The current experimental area offers a unique scenario where science-based information regarding the benefits of land application of biosolids can be generated and disseminated. In addition to the research component, the site has also been also utilized for educational purposes. Preliminary research results have already been disseminated though extension presentations, field days, and popular press magazine articles.

Ackknowledgement

We thank the Florida Cattle Enhancement Board for providing the funds to support this project.

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DuraCor Tank-mixes for Pasture Weed Control

Brent Sellers, Professor – Pasture and Rangeland Weed Management
Caetano Sales, M.S. Agronomy Student
and Pratap Devkota, Assistant Professor – Weed Science, UF/IFAS WFREC

It is not often that a new active ingredient is labeled for Florida pastures, but last year we started seeing DuraCor being marketed for weed control. DuraCor contains aminopyralid, the active ingredient in Milestone, GrazonNext HL (aminopyralid + 2,4-D) as well as Chaparral (aminopyralid + metsulfuron), and the new active ingredient, florpyrauxifen-benzyl. Florpyrauxifen-benzyl was first commercially released for weed management in rice production in 2018. Since this is a new active ingredient for the pasture market, we knew very little about this product when it was labeled. We continue to evaluate the effectiveness of DuraCor for broadleaf weed control and hope to have concrete recommendations in the coming year or so.

At this point in time, we have primarily investigated the effectiveness of DuraCor on dogfennel and tropical soda apple, which are our two most problematic broadleaf weeds in pastures, at the suggested use rates of 12, 16, or 20 fl oz/A. Our initial research indicated that 12 oz/A was too low to provide adequate control of tropical soda apple, and like GrazonNext HL, an additional tank-mix partner like Pasturegard HL, WeedMaster, or 2,4-D is necessary to obtain adequate dogfennel control. In fact, our research is showing that increased rates of these tank-mix partners may be necessary when using DuraCor to obtain the same level of control compared to when using GrazonNext with the same tank-mix partners; this appears to be especially true for goatweed. Additionally, the use of methylated seed oil (MSO) as the surfactant appears to provide better initial control of broadleaf weeds than when using non-ionic surfactant.

Forage tolerance to DuraCor is also something that we are concerned about. We have seen no injury to bahiagrass or bermudagrass from any rate of DuraCor or the tank-mix partners. However, we did notice a bit of bronzing on stargrass, especially when methylated seed oil (MSO) was used as the surfactant. We have also observed very little injury in limpograss following DuraCor applications and yield 60 days after treatment was similar to limpograss treated with Banvel (dicamba) and untreated limpograss.

This year we have expand beyond dogfennel and tropical soda apple to get a better understanding on how we can use DuraCor to control other common weeds like goatweed, flat-top goldenrod, and blackberry.

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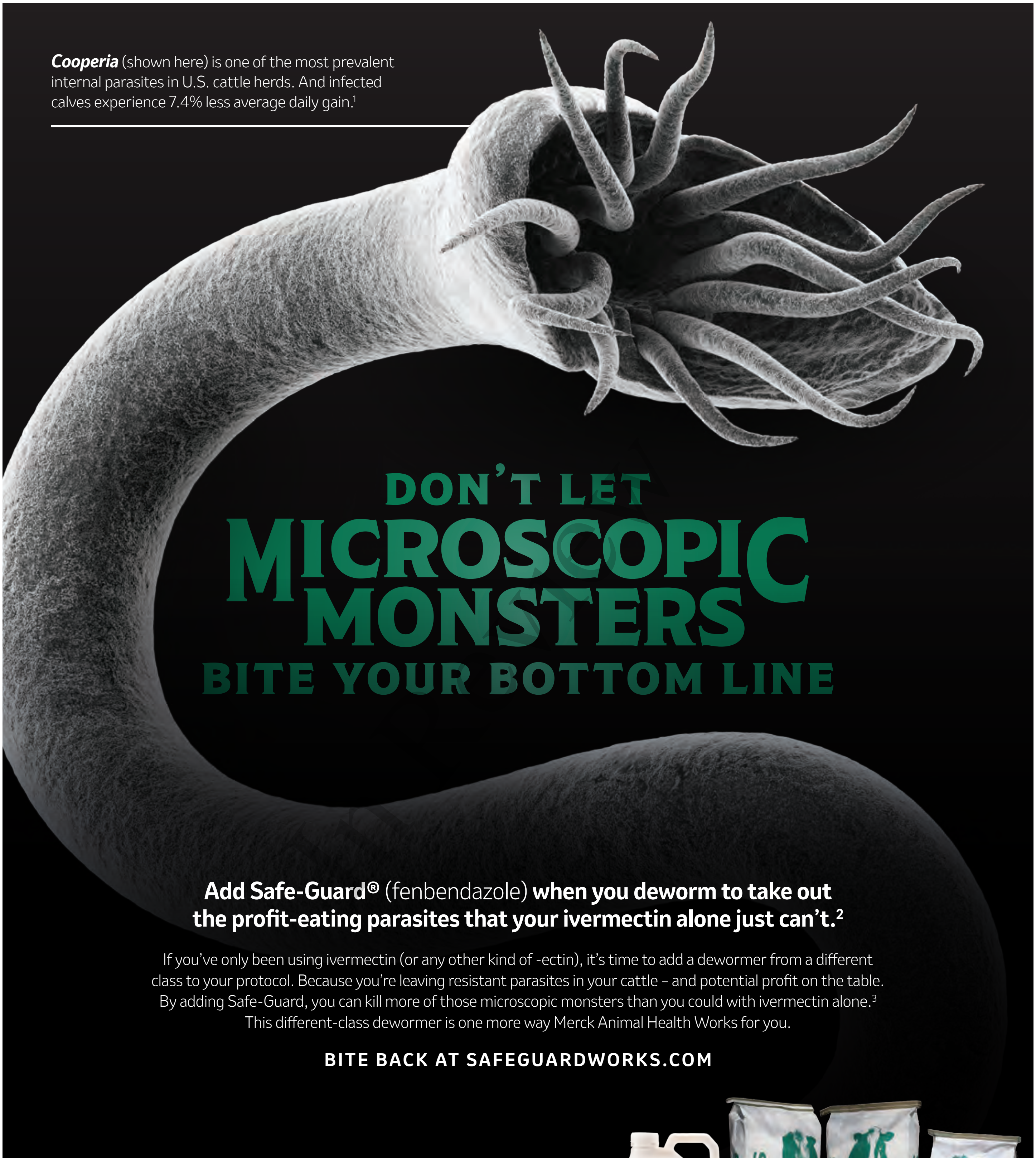

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[1]Stromberg BE, et al. *Cooperia punctata*: Effect on cattle productivity. *Vet Parasitol*. 2012;183(3-4):284-291.
[2]Lawrence JD, Ibarburu MA. Economic analysis of pharmaceutical technologies in modern beef production. *Proceedings* of the NCCC-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. 2007;1-18.
[3]Merck Animal Health National FECRT Database.

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DOSAGE RECOMMENDATIONS:

CALVES: Up to 1 year .... 1 mL/per 100 lbs. bodyweight
CATTLE: From 1-2 years .... 1 mL/per 150 lbs. bodyweight
CATTLE: Over 2 years .... 1 mL/per 200 lbs. bodyweight

PRECAUTION:

Selenium and copper are toxic if administered in excess.

Always follow recommended label dose. Do not overdose.

It is recommended that accurate body weight is determined prior to treatment.

Do not use concurrently with other injectable selenium and copper products.

Do not use concurrently with selenium or copper boluses.

Do not use in emaciated cattle with a BCS of 1 in dairy or 1-3 in beef.

Consult your veterinarian.

CAUTION:

Slight local reaction may occur for about 30 seconds after injection. A slight swelling may be observed at injection site for a few days after administration. Use standard aseptic procedures during administration of injections to reduce the risk of injection site abscesses or lesions.

WITHDRAWAL PERIOD:

Meat 14 days. Milk zero withdrawal.

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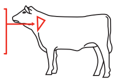
It is recommended to administer the product in accordance with Beef Quality Assurance (BQA) guidelines. Minimum distance between injection sites for the MULTIMIN® 90product and other injection sites should be at least 4 inches.

Inject under the loose skin of the middle of the side of the neck. Max volume per injection site is 7 ml.

Subcutaneous injection in middle of side of neck.



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DAIRY COWS	4 weeks before calving 4 weeks before insemination at dry-off
CALVES	at birth at 3 months and/or weaning
HEIFERS	every 3 months – especially 4 weeks before breeding
(program gives planned dates that can be varied to suit management programs)	

DOSAGE TABLE

ANIMAL WEIGHT (lbs)	CALVES UP TO 1 YEAR 1 ml/100 lb BW	CATTLE 1 - 2 YEARS 1 ml/150 lb BW	CATTLE > 2 YEARS 1 ml/200 lb BW
50	0.5 ml	-	-
100	1 ml	-	-
150	1.5 ml	-	-
200	2 ml	-	-
300	3 ml	-	-
400	4 ml	-	-
500	5 ml	-	-
600	6 ml	-	-
700	7 ml	-	-
800	-	5.3 ml	-
900	-	6 ml	-
1000	-	6.6 ml	5 ml
1100	-	-	5.5 ml
1200	-	-	6 ml
1300	-	-	6.5 ml
1400	-	-	7 ml

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- Festulolium
- Red Clover
- Orchardgrass
- Forage Alfalfa
- Bermudagrass
- Forage Bluegrass
- Soft Leaf Tall Fescue
- Soft Leaved Redtop Bent
- Diploid Perennial Ryegrass
- Tetraploid Annual Ryegrass
- Tetraploid Perennial Ryegrass
- NEW Teff
- NEW Black Oats
- NEW Italian Ryegrass

Scan to Watch

youtube.com/user/PureSeedRPMS

PURE-SEED TESTING, INC.

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Bovi-Shield GOLD® HB

GIVE YOUR COWS THE HIGHEST LEVEL OF FETAL PROTECTION AVAILABLE

Bovine viral diarrhea (BVD) is one of the biggest challenges for any operation — especially when it comes to reproduction. Help protect your herd with the **BOVI-SHIELD GOLD FP® 5** and **BOVI-SHIELD GOLD FP 5 HB** vaccine lines from Zoetis. They offer the strongest level of fetal protection against BVD Types 1 and 2 viruses of any product line on the market. Plus, they aid in prevention of abortion caused by infectious bovine rhinotracheitis (IBR) virus. Best of all, both are backed by the Zoetis Fetal Protection Guarantee.

THE COSTLY IMPACT OF BVD VIRUS FETAL INFECTION:[1]

INFECTION AT **0-40 DAYS** GESTATION CAN LEAD TO:	INFECTION AT **40-120 DAYS** GESTATION CAN LEAD TO:	INFECTION **UP TO 160 DAYS** GESTATION CAN LEAD TO:	INFECTION **AFTER 160 DAYS** GESTATION CAN LEAD TO:
EARLY EMBRYONIC DEATH	ABORTION	ABORTION	HIGHER RISK OF SERIOUS HEALTH PROBLEMS IN THE FIRST YEAR OF A CALF'S LIFE
OPEN COWS	BVD PI CALVES	BIRTH DEFECTS	
LATE-CALVING COWS		WEAK CALVES	
		STILLBIRTHS	

KEEP YOUR HERD AND BOTTOM LINE HEALTHY.

The BOVI-SHIELD GOLD FP 5 and BOVI-SHIELD GOLD FP 5 HB vaccines help provide the highest level of fetal protection to maximize the reproductive potential of your cows, helping to ensure a healthy, productive calf every year. Learn more at **CattleReproVaccines.com**.

zoetis™

Upcoming Events

October 19, 11:00 – 11:45 a.m.

Ona Long-Term Agroecosystem Research (LTAR) Highlight with Guest Presenter Dr. Sheri Spiegal, will present, 'Using Manureshed Management to Connect Distant Links of the Beef Supply Chain.' She is a Range Management Specialist at the USDA-ARS Range Management Research Unit in Las Cruces, New Mexico.
Click here to register for this webinar.

October 21, 9:00 a.m. – 4:00 p.m

Environmental Lands Management Seminar and Tour
Cross Bar Ranch, 20031 Locket Ave., Spring Hill.
This program is designed for managers of properties who currently have grazing leases or would like to learn more about the benefits.
Click here to register and here to see the flier.

November 9, 11:00 – 11:45 a.m.

Ona Soil and Water Science Program Highlight with Dr. Maria Silveira
Dr. Silveira will be presenting "The Florida Phosphorus Budget." Maria is a Professor at the UF/IFAS Range Cattle Research and Education Center in Ona where she specializes in soil. Click here to register for this webinar.

December 14, 11:00 – 11:45 a.m.

Ona Graduate Student Highlight with Clay Cooper
Clay will be presenting his research findings as a master's student under the advisement of Dr. Brent Sellers at the UF/IFAS Range Cattle Research and Education Center in Ona. His research focused on investigating management strategies for controlling brunswickgrass in bahiagrass seed production fields in Florida. Click here to register for this webinar.

January 13

Florida Cattlemen's Institute & Allied Trade Show
Sebring

March 10, 9:00 a.m. - 1:00 p.m.

Forage Management Tour & Workshop
Mudge Ranch, 1323 Loblolly Bay Road, LaBelle
Need more information, contact: forages@ifas.ufl.edu

June 30

13th Annual Youth Field Day
UF/IFAS Range Cattle REC, Ona

Take a Video Tour of the UF/IFAS Range Cattle REC

Visit the UF/IFAS Range Cattle Research and Education Center in Ona, FL, see the facilities, land, and cattle, and meet everyone and see what they do.

Click here to watch now. Run time 47.49 minutes.

UF/IFAS COLLEGE OF AGRICULTURAL AND LIFE SCIENCES

FAST FACTS

Fall 2020

CALS awards the largest undergraduate scholarship portfolio at UF with nearly **$1 million** of college and departmental scholarships

CALS has one of the **top 5 highest enrollments in study abroad** programs at UF, with **20+ college-specific programs** across **6 continents**.

CALS students hail from **50 states**

89% Undergraduate students from Florida

33% Male Undergraduates

67% Female Undergraduates

11:1 Student-to-Faculty Ratio

FYI

CALS hosts Florida Youth Institute, a week-long summer program for high schoolers to explore science careers that help solve global food insecurity

29% Undergraduate Minority Students

22 Graduate Majors

23 Undergraduate Majors

18 STEM Majors in CALS, the most out of all colleges at UF

6 Undergraduate Pre-Health Majors

8 Master's & **2** Bachelor's programs **ONLINE**

TOP 5 One of the 5 largest colleges of agriculture and related sciences in the U.S.

55+ CALS Student Organizations

CALS has **MORE USDA teaching awards** than any other land-grant institution

6,627 Total Students

1,997 Graduate Students

428 Non-Degree Students

4,202 Undergraduate Students

40,000+ Living Alumni Around the World

Home of the **ONLY** formal undergraduate upper-division Honors Certificate Program at UF

Questions?
Contact us at
cals-dean@ufl.edu
352-392-1963

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COLLEGE OF AGRICULTURAL AND LIFE SCIENCES

CALS INFO

MAJORS

- Agricultural Education and Communication
- Agricultural Operations Management
- Animal Sciences*
- Biology*
- Botany
- Dietetics
- Entomology and Nematology*
- Environmental Management in Agriculture and Natural Resources
- Environmental Science
- Family, Youth and Community Sciences
- Food and Resources Economics
- Food Science
- Forest Resources and Conservation
- Geomatics
- Horticultural Science
- Marine Sciences
- Microbiology and Cell Science*
- Natural Resource Conservation
- Nutritional Sciences*
- Plant Science
- Soil and Water Sciences
- Wildlife Ecology and Conservation*

** Pre-professional majors*

ONE-ON-ONE ADVISING

View the advising list at www.cals.ufl.edu/undergraduate

ENRICHMENT OPPORTUNITIES

CAREER RESOURCES

- Hands-on experience in your field
- Financial assistance for legislative internships
- Annual CALS Career Expo

RESEARCH

- Create and apply knowledge
- Available for freshmen to seniors
- Funding available
- Opportunities to publish and present

INTERNATIONAL EXPERIENCES

- CALS offers programs in 15 different countries
- Study abroad for a week, a semester or a year
- Minor in International Studies in Agricultural and Life Sciences

SCHOLARSHIPS

CALS awards more than $550,000 in scholarships each year! Many CALS departments also offer scholarships.

LEADERSHIP

- More than 50 CALS student organizations
- CALS Ambassador Program
- CALS Leadership Institute
- Minors in Leadership and Nonprofit Organizational Leadership
- Global Leadership and Change Certificate

FOR MORE INFORMATION CONTACT:

H. Charlotte Emerson | Director, Student Development and Recruitment
PO Box 110270, Gainesville, FL 32611
352-392-1963 | cemer@ufl.edu
www.cals.ufl.edu | @UFCALS

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UNIVERSITY of FLORIDA

College Requirements and Shared Majors

REQUIRED COURSEWORK

The College of Agricultural and Life Sciences (CALS) requires three specific courses of all students:

- Economics (AEB 2014 or ECO 2013 or ECO 2023)
- Public Speaking (AEC 3030C or SPC 2608)
- Advanced Writing (AEC 3033C or ENC 2210 or ENC 3254)

In addition, all CALS students will complete a minimum of 10 credits of physical and biological sciences, including 1 credit of laboratory science. For most majors, specific courses in science are required.

SHARED MAJORS

The College of Agricultural and Life Sciences “shares” four degree programs with the College of Liberal Arts and Sciences (CLAS):

- Biology
- Botany
- Marine Sciences
- Microbiology and Cell Science

The main difference between CALS and CLAS majors is college requirements. CALS requirements are listed above. CLAS requires all students to complete 2 semesters of foreign language or otherwise demonstrate proficiency in a foreign language.

There are also some differences in the specializations that are available for Biology and Botany. Students interested in these majors should look at the semester plans in the Guide to Majors to see where they differ.

Biology

Biology Specializations in CALS

- Applied Biology
- Biotechnology
- Natural Science
- Pre-Professional

Biology Specializations in CLAS

- Pre-Professional
- Integrative Biology
- Secondary Education (B.A.)

Botany

Botany Specializations in CALS

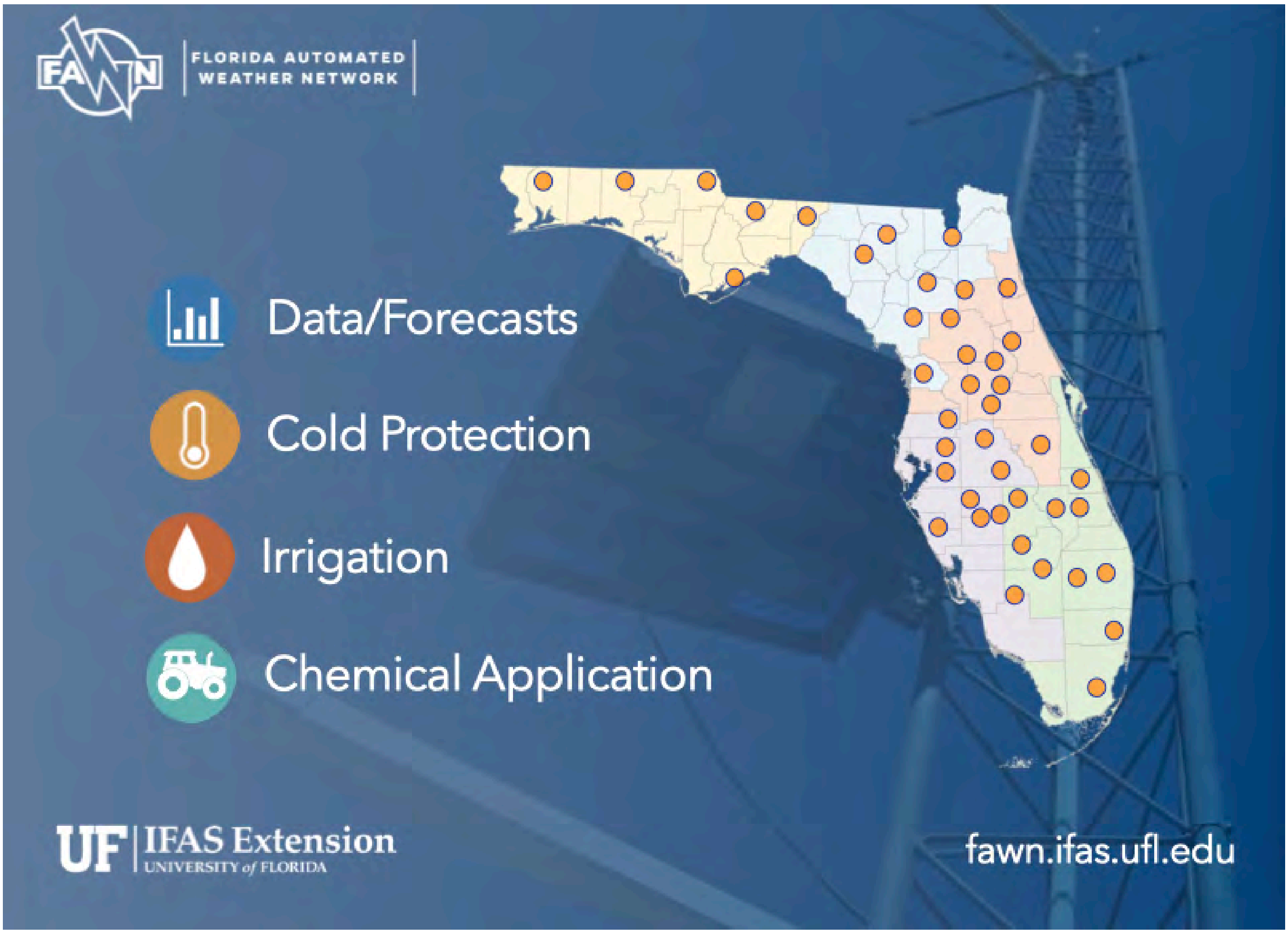
- Botanical Research
- General Botany

Botany Specializations in CLAS

- Botanical Research
- General Botany

Marine Sciences

The foundational courses are the same for both colleges. Through upper-division required and elective courses, CALS majors focus on marine ecology and resource management while CLAS majors integrate marine biology with marine geology and geochemistry.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