DIXON WATER FOUNDATION

2023 ANNUAL REPORT

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HEALTHY LAND. HEALTHY WATER. HEALTHY LIVING FOR ALL.

The Dixon Water Foundation promotes healthy watersheds through sustainable land management to ensure that future generations have the water resources they need.

Through our ranches, grants, education programs, and research partnerships, we hope to help people protect the great environmental resources of our country.

This report summarizes the efforts taken by Dixon Water Foundation to achieve the goals of this mission in the year 2023.

Report written and compiled by-
Philip Boyd, Vice President of Science and Research,
Dixon Water Foundation

Cover photo by – Hilary Knight
This page photo by – Hilary Knight

Staff and Board of Directors

Staff:

- Casey Wade – President and CEO
- Philip Boyd – Vice President of Science and Research
- Rachel Vasquez – Vice President of Grants
- Hilary Knight – Vice President of Operations

Ranch Managers:

- Jake McNamara – North Texas Ranch Manager
- Zach Vaughn – West Texas Ranch Manager

Board of Directors:

- Robert Potts – Chairman of the Board
- Jerry Addison
- Hugh Aljoe
- Melissa Bookhout
- Robert Potts
- Leslie C. Rauscher
- Kathy Smyth
- Dr. Richard Teague
- Laura Whiting

Advisory Board Members:

- Clint Josey
- Dr. Bonnie Warnock

2023 changes in Board of Directors and Staff:

Robert Potts retired as CEO/President but remained Chairman of the Board. Casey Wade was elected President/CEO and began in that role March 2023. Melissa Bookhout replaced Clint Josey as a voting board member. Richard An left his position as North Texas Education Coordinator.

Press Release: Dixon Water Foundation Selects Casey Wade as New President and CEO

Decatur, Texas (March 10, 2023) – Dixon Water Foundation, a Texas-based non-profit organization that promotes healthy watersheds through good land management, is announcing the selection of Casey Wade as new President and CEO. Wade has been with the Foundation for 12 years, first serving as West Texas ranch manager before being promoted to Vice President of Ranching Operations. Wade was selected by the Foundation's Board in early February 2023. Wade will immediately begin to succeed out-going President and CEO Robert Potts who is retiring March 16, 2023 while still serving as Chairman of the Board for the Foundation. Potts has served as President and CEO since 2007.

"I am pleased that the board chose Casey Wade, our current VP for Ranching Operations, to be my successor," states Potts. "He is an excellent choice and will lead the Foundation to the next level of effectiveness."

Wade's selection as President and CEO follows years of commitment to the management of the Foundation's ranches, communication of the Foundation's mission and guiding principles, and role as a valuable advocate of regenerative agriculture and watershed health.

"I'm really honored to have been chosen by the Board of Directors to serve as the new President and CEO of Dixon Water Foundation. Robert has done an amazing job of establishing the Foundation as a leader in watershed and ecological health. I'm looking forward to continuing to work with Robert as he serves as Chairman of the Board." states Wade. "Looking ahead, I see so many great opportunities for the Dixon Water Foundation. We have an amazing staff, really talented people, who are very knowledgeable and care deeply about our mission. It's such a pleasure to get to work with them and be part of guiding the Foundation into the future."

Wade is a husband and a father of three young sons. He has a love of the land and has enjoyed caring for wildlife and livestock for many years. He is a graduate of Hardin Simmons University and has spent most of his career managing hunting and wildlife operations as well as livestock ranches.

After a two year stay in Kenya, Africa, Casey was introduced to holistic land management while working with a wildlife management consulting firm. He was drawn to the idea of using livestock to improve degraded landscapes. At that point Casey began searching out further education and eventually a career in regenerative land management through ranching.

Dixon Water Foundation strives to achieve its mission through its research and demonstration ranches in Presidio County, near Marfa, Texas, and Cooke and Wise Counties, near Decatur, Texas. The Foundation hosts education events, supports research, awards grants and partners with organizations in line with their mission.

Questions: media@dixonwater.org

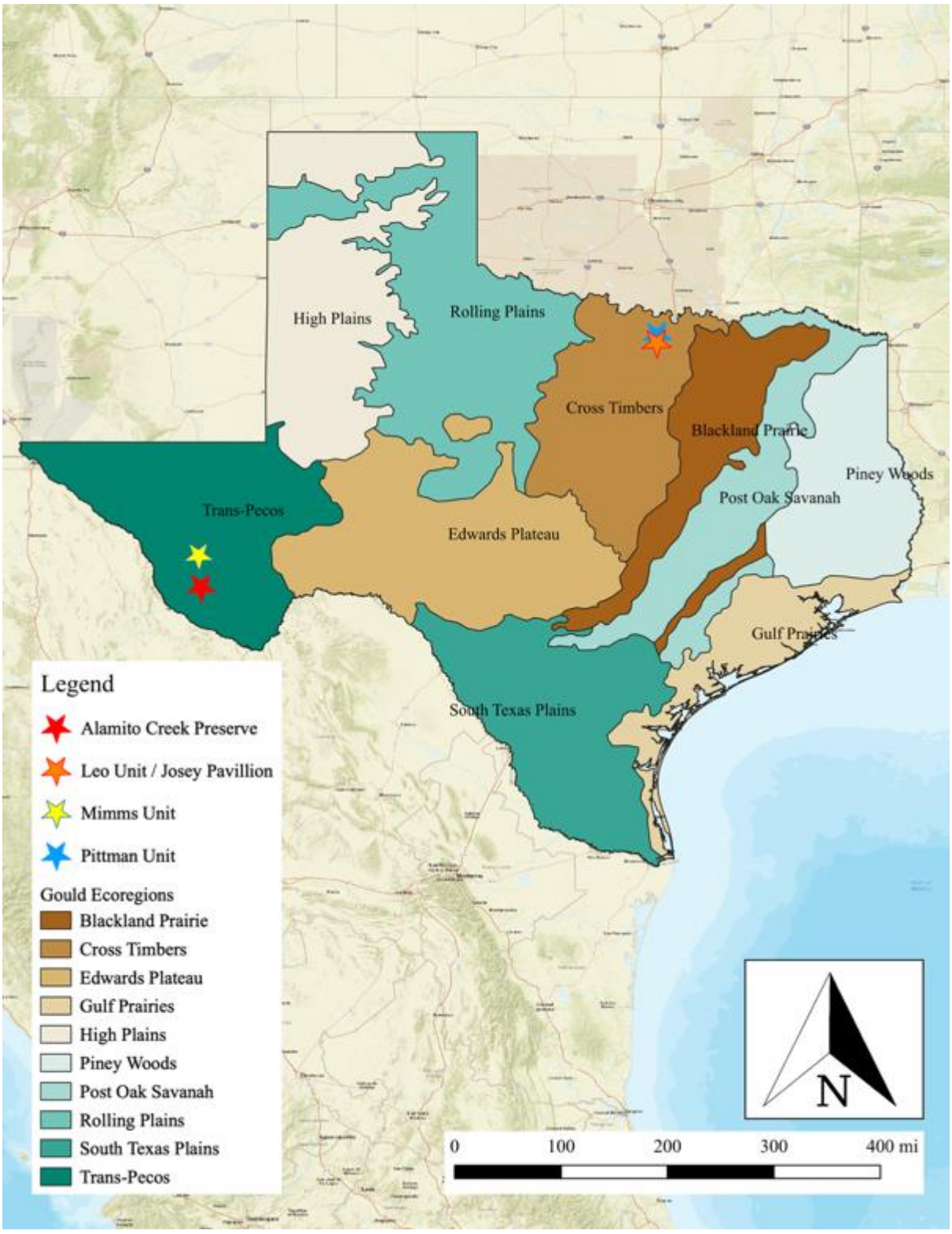

Figure 1. Dixon Water Foundation Ranch locations and Texas Ecoregions created from map in Gould, F. W. 1975, updated by Texas Parks and Wildlife Department (TPWD) GIS Lab 1/09/2004 and downloaded from the TPWD GIS Website

Letter from the President and CEO

Dear Reader,

The past year, 2023, in many ways, has felt like a fresh start. It was the first year in my new role as President/CEO. The first full year for Hilary Knight, VP of Operations and Zach Vaughn, Mimms Ranch Manager in their new positions. It was the first full year for the new Dixon Water Foundation team to work together. Looking back, I don't think it could have gone any better. This is due to the talented and willing staff, who have worked hard to continue the Foundation's legacy of regenerative land management. More importantly, this smooth transition has been facilitated by a consistent and dedicated Board of Directors. Former board Chairman, Clint Josey and current board Chairman Robert Potts created an organization with focus and purpose. This has allowed a new team to step in and continue the mission with certainty.

As I mentioned 2023 was a year of transition for the Foundation and me personally. I stepped into the role of President/CEO last March. I was excited to be selected by the Board of Directors. After having managed the Foundation's ranches for over 12 years it felt like a natural next step. It's a bit of a daunting challenge but the fact that I continue to work closely with Robert Potts, the former President and current Chairman, helps smooth the transition. The history and knowledge I have of the organization has also helped as I have settled into the new position.

The Dixon Water Foundation's two demonstration ranches continue to be a centerpiece for our work. 2023 was a difficult year for both ranches. Extreme heat and record low rainfall made things difficult. We reduced stock numbers and worked with partner organizations for supplemental grazing land. Good regenerative land management really begins to show during these tough times. Having a drought strategy and being able to implement it quickly leaves us prepared to receive the rain when it eventually comes. Jake McNamara and Zach Vaughn continue to learn and do an excellent job caring for the Leo and Mimms Units.

Research and monitoring on the ranches expanded the past year thanks to Philip Boyd, VP of Science and Research. He added new metrics to our in-house monitoring, including water infiltration rates and drone monitoring. Philip engaged with numerous partners to enhance Dixon's contribution to the study of regenerative agriculture.

Education remains a major focus with our new staff. We saw an increase in visitors to the ranches, whether they were school children, landowners, managers, agency folks or scientists. We hosted visitors from around the world in 2023, from South America to Asia, to Africa. Hilary Knight and Philp Boyd coordinated education activities in North Texas and West Texas respectively, but all staff members were active in our education efforts.

We supported partners doing good work in conservation and regenerative land management through grants and sponsorships, including a water conference at Sul Ross that was a huge hit. Rachel Vasquez, VP of Grants and Board Secretary has used her expertise from the non-profit world to help us maximize our resources in this area. I'm looking forward to increasing our grants in 2024 as well. Rachel and I also worked towards the Foundation's goal of an

apprenticeship program in 2023. We moved the program forward and hope to see it implemented in early 2025.

2023 was also the first year that our Five-year strategic plan, adopted by the board in 2022, had been utilized. The staff created objectives that were used to implement and execute the strategic plan. These objectives will be adjusted annually to achieve our Five-year plan. We were able to surpass many of these objectives. This plan and related objectives have given us focus and targeted our efforts in ranching, science and research, communication, apprenticeship program, and partnerships. The Strategic Plan has been vital in easing the numerous transitions over the past year.

I believe 2023 was a successful year for the DWF. It was a year of transitions, a year for a new staff to work together with a great board to develop a firm foundation. From this foundation we can move forward as a team to influence regenerative land management and watershed health.

Sincerely,

Casey Wade, President / CEO

Dixon Water Foundation President and CEO, Casey Wade (Photo by Terrie Wade)

5-Year Strategic Plan

This plan was outlined in 2022 for the subsequent 5-Year period (2023-2027). The year 2023 was the first year of the current plan.

MISSION: The Dixon Water Foundation promotes healthy watersheds through sustainable land management to ensure that future generations have the water resources they need.

STRATEGIC GOALS:

1. Operate the Foundation's ranches (Ranches) as model ranches for watershed and grazing land health using adaptive multi-paddock (AMP) grazing.

2. Conduct and host monitoring and research on the Ranches to understand the changing conditions of the Ranches and the role of management in influencing those changes.

3. Share information about the management and changing conditions of the Ranches as well as the benefits of AMP grazing to land managers and the general public through direct communications and through education events with the Foundation's partners at the Ranches.

4. Develop and implement an annual apprenticeship program to train future ranch managers in the techniques and benefits of AMP grazing.

5. Develop and support partnerships with other organizations to encourage the implementation of good watershed and grazing land management practices beyond the Ranches.

2023 Ranching Operations and Property Updates

North Texas

Dixon Water Foundation owns and manages roughly 4,800 acres in Wise and Cooke Counties. The ranches are in the Cross Timbers and Prairies Ecoregion (*Figure 1)* in North-Central Texas, 22 miles northeast of Decatur, Texas, and 32 miles northwest of Denton, Texas. The Foundation ranches sheep and cattle in North Texas.

Figure 2. North Texas Ranch Manager Jake McNamara closes a gate while cattle and sheep graze a pasture on the Foundation's Leo Unit.

The Foundation's North Texas ranches became certified under Audubon's Conservation Ranching program in 2023. This means that beef produced on all the Foundation's ranches now qualifies to carry Audubon's Bird-Friendly Beef certification.

Figure 3. Dixon staff attach a sign indicating that the Foundation's North Texas ranches are certified under Audubon's Conservation Ranching program for Bird-friendly beef.

Precipitation

Precipitation at the Leo was measured with an analog gauge at the ranch office which is documented on a paper grazing chart until January 2022 when a HOBOlink weather station was installed at the Josey Pavilion.

In 2023, the Leo Unit recorded 31.57” of precipitation (*Figure 4*). The months of March and October brought the most rainfall. Temperatures rose in June and remained at their highest through September, during which time the ranch saw the least rainfall. This is a trend that continued from 2022, with both years receiving about 5” of rain June through September, though 2022 saw more spring precipitation while 2023 saw more fall precipitation. The month of August saw the hottest average temperatures for the year (90.63 °F) and average maximum temperatures above 100 °F, while also receiving the least amount of precipitation (0.46”). The first frost came on the last day of October, which was also the month with the highest rainfall.

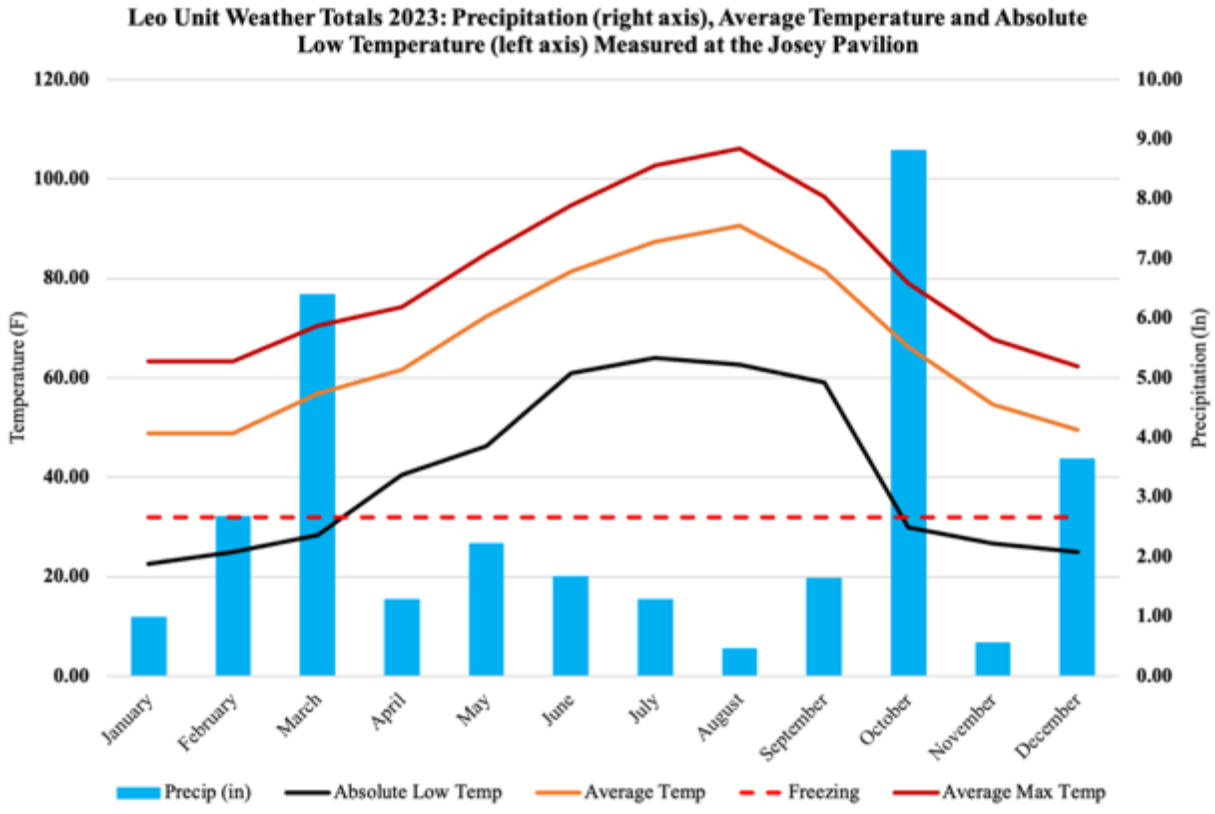

Figure 4. Weather summary for Leo Unit, Decatur, Texas, 2023. Precipitation totals are shown in blue bars with inch measurements on right axis, average temperatures are shown on the orange line with degrees Fahrenheit on left axis. Absolute minimum temperature is marked in black with the freeze threshold marked in red. Average high monthly temperatures are represented by the dark red line.

Biological Monitoring update

Foundation staff conducted annual biological monitoring at the North Texas ranches in November 2023. The biological monitoring process is modeled after a method developed by Holistic Management International. The process involves traveling to fixed monitoring points each year where staff throw 100 darts into the air around each point. As the darts hit the ground, staff document what type of ground cover the dart landed on: bare ground, litter, or basal plant cover. Staff members also document the type of plant closest to the dart, based on 10 categories: Prairie complex, Johnson Grass, High Seral Forb, Mid Seral Grass, Mid Seral Forb, Introduced Grass, Sedges, Bermuda Grass, Low Seral Grass, and Low Seral Forbs.

Additionally, Foundation staff began collecting infiltration rate data during the biological monitoring process (*Table 1*). The sampling point was randomly chosen within a 6' radius of the PVC-covered t-post marking each biological monitoring point. The bearing to the point was recorded. Infiltration rates were measured by using a 6" x 12" AMS infiltration ring. Water was poured into the outer 12" ring to begin saturating soil. A layer of plastic was laid into the 6" ring and 1" of water was poured onto the plastic. The plastic was removed while simultaneously starting a stopwatch. Once all visible water had soaked into the soil, the stopwatch was stopped, and time was documented. The process was repeated to get a second measurement. The second measurement gives a better estimate of infiltration rate after the first measurement has wet the soil. This process is based on the USDA's *Soil Quality Test Kit Guide* (2001). The points were photographed to document ground cover composition.

Figure 5. Philip Boyd, Vice President of Science and Research, records infiltration rates for a monitoring point on the Leo Unit in North Texas (Photo by Hilary Knight).

Date	Unit	Point	Distance (Feet)	Bearing (Degrees)	1st Infiltration Time (Seconds)	2nd Infiltration Time (Seconds)
11/13/23	Leo Complex	Forman 2 (East)	6'	230	41.35	44.22
11/13/23	Leo Complex	Forman 3 (West)	6'	62	29.80	43.17
11/13/23	Leo Complex (Original)	Harold Bottom	6'	305	9.00	1.60
11/13/23	Leo Complex (Original)	Harville Prairie	6'	170	19.20	31.09
11/13/23	Leo Complex (Original)	Harville Bottom	6'	259	14.86	12.03
11/13/23	Leo Complex	Forman 1 (South)	6'	327	5.85	6.62
11/13/23	Leo Complex (Original)	Aunt Ann's (Pavillion)	6'	17	83.41	60.60
11/13/23	Leo Complex (Original)	Moss Prairie	6'	233	36.33	73.33
11/13/23	Leo Complex	Heard 2 (NW)	6'	168	4.17	2.81
11/13/23	Leo Complex	Heard 1 (Bdahl)	6'	281	4.29	5.95
11/13/23	Leo Complex	Heard 3 (NE)	6'	205	210.00	443.40
11/14/23	Pittman	Pittman MP 6	6'	330	95.58	182.51
11/14/23	Pittman	Pittman MP 7	6'	87	11.62	7.88
11/14/23	Pittman	Pittman MP 10	6'	162	12.17	27.60
11/14/23	Pittman	Pittman MP 9	6'	201	5.79	5.54

Table 1. This table shows the infiltration rate records for fall 2023 monitoring efforts at the Foundation's North Texas ranches.

Figure 6. After infiltration rates were recorded, photographs were taken to document vegetative ground coverage at each of the sampling sites. This photograph shows a sampling site at the Leo Unit "Aunt Ann's" monitoring point, near the Josey Pavilion, Fall 2023. (Photo by Philip Boyd)

Leo Unit- On the Leo Unit, this type of ground cover monitoring has been conducted since 1989. A primary goal of the Foundation has in place is to reduce the amount of bare ground across all Dixon ranches. Through annual monitoring, the Foundation can track any changes in conditions. On the Leo Unit, there are 5 fixed monitoring points. The 2023 biological monitoring efforts reported an average of 40.40% basal plant cover, 53.80% litter, and 6.20% bare ground (*Table 2*). This is a change of 1.40% in bare ground from the 2022 monitoring effort, and a reduction of 16.00% in bare ground and an increase in basal plant cover of 3.80% since 1989 (*Figure 7*).

Leo Unit Ground Cover Averages			
	Basal Plant	**Litter**	**Bare Ground**
1989	36.60%	41.20%	22.20%
2022	24.60%	70.60%	4.80%
2023	40.40%	53.80%	6.20%

Table 2. Percent cover for each cover type on the Leo Unit between 1989, 2022, and 2023.

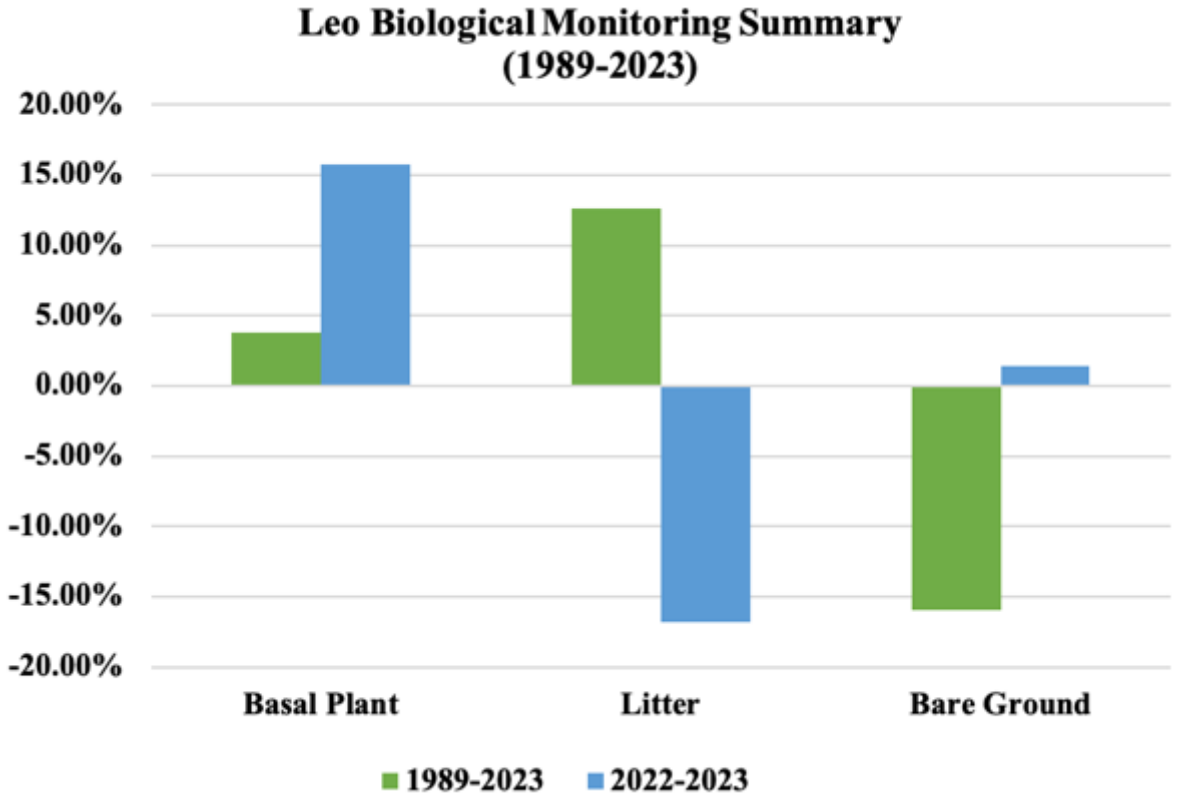

Figure 7. Percent change in ground cover types on the Leo Unit between 1989-2023 (green) and 2022-2023 (blue).

Each individual year and monitoring point may show some variation. When all monitoring point results are averaged and plotted on a chart for each year that has been surveyed, an overall trend in ground cover change can be seen (*Figure 8*). Through consistent monitoring efforts, staff has recorded a decreasing bare ground trend at the Foundation's Leo Unit.

The Leo Unit is comprised of various parcels of varying topography, ecology, and management history. Through decades of multi-paddock grazing, the Foundation has been able to re-establish high plant diversity and the return of many native prairie grasses. However, some pastures are in different successional stages than others due to the state they were in at the time of inclusion into the Foundation's management, or the ecological site in which the pastures are situated, such as the which may support a different plant community by nature.

When averaging successional plant community ground coverage from all Leo monitoring points (including Forman and Heard), a downward trend can be seen in low seral ($y = -0.0004x + 0.3238$) and mid seral communities ($y = -0.0078x + 0.5958$). An upward trend in high seral communities ($y = 0.008x + 0.0871$), which include prairie complex grasses, Johnson grass, and high successional forbs, can also be seen. This suggests that, on average, the Leo Unit is transitioning towards a high seral, or the desired climax, native prairie vegetative community (*Figure 9*).

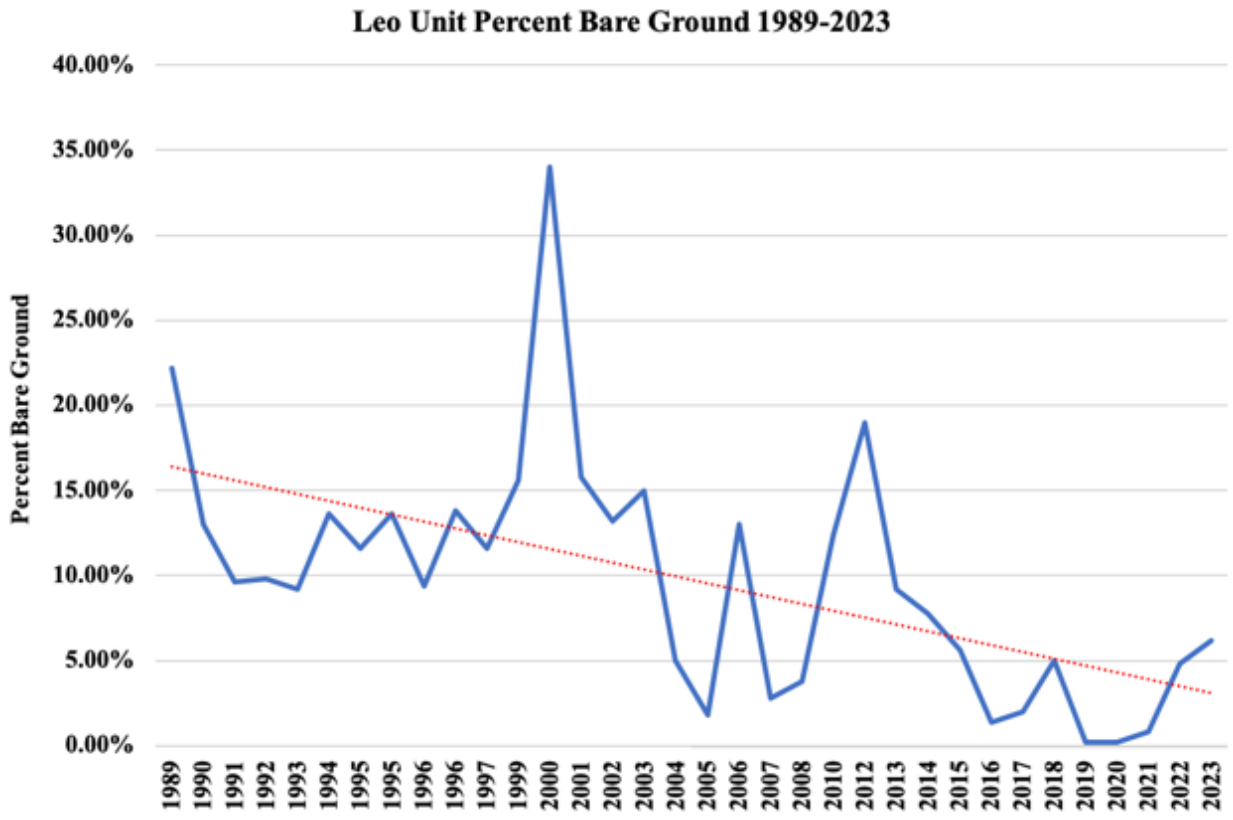

Figure 8. Leo Unit- Percent bare ground recorded 1989-2023 (blue line) and trend of change in bare ground 1989-2023 (red line). Note: The years 1995 and 1996 were monitored in both the Summer (June) and Fall (October) seasons

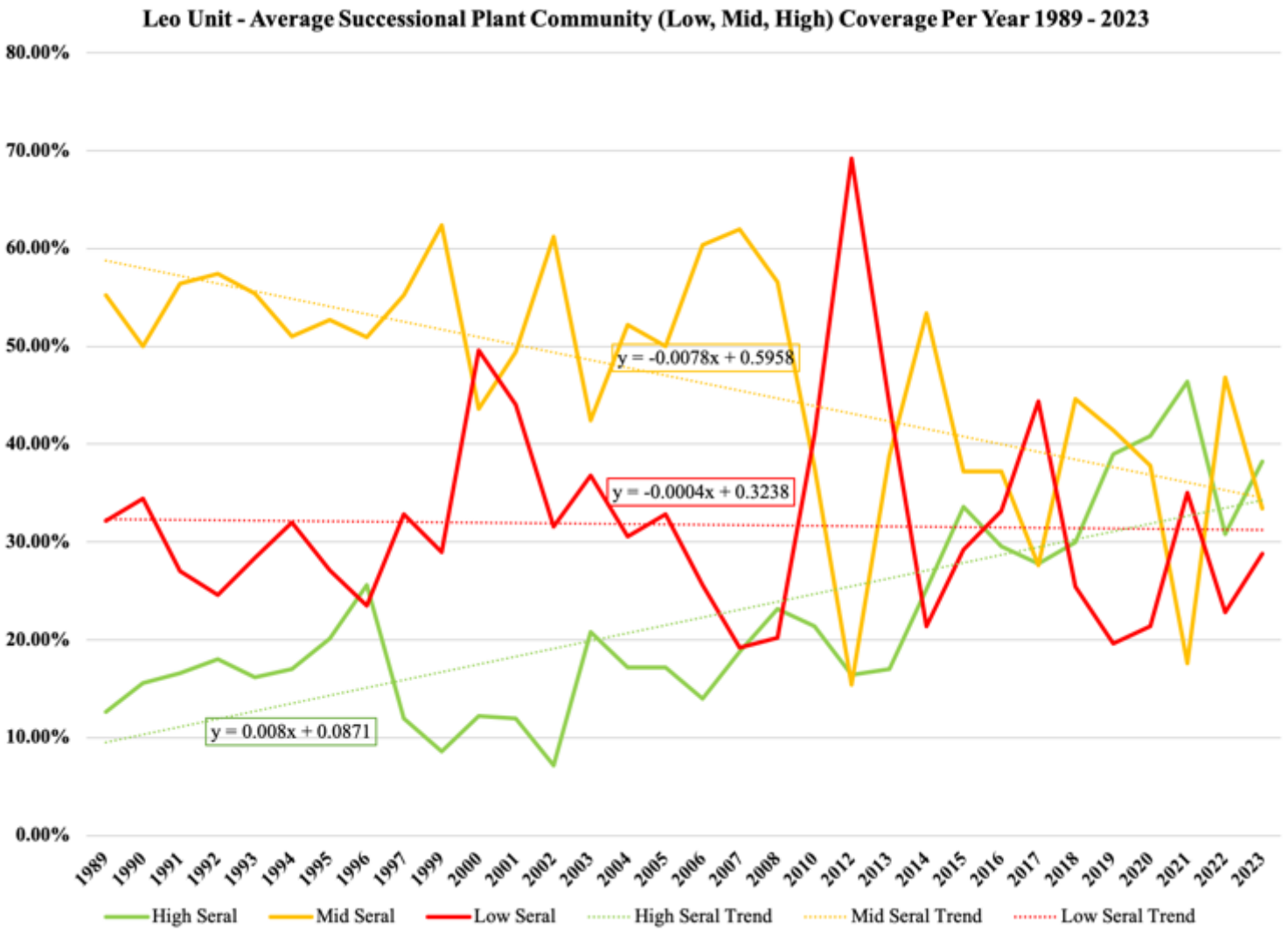

Figure 9. Leo Unit- Percent ground cover by seral plant community (low shown in solid red, mid shown in solid yellow, and high shown in solid green lines) recorded 1989-2023. Trend data is depicted by the dashed line in the same color as it's associated data set.

Heard Unit- The Heard Unit is a property connected to the Leo Unit. The Heard Unit has been surveyed utilizing the same biological monitoring method as the Leo Unit since 2015, when the Foundation bought the land. The infrastructure and management transition have been completed, though it will take some time for management to fully transition the successional states of this property. There are 3 fixed monitoring points on the Heard Unit. One of these points was not surveyed in 2018. Overall, there is good ground cover at this site, including some high successional grasses. One monitoring point is situated in a pasture of b-dahl grass, which is an introduced grass from previous management. While it provides good ground cover, the Foundation will aim to shift this community towards a native grass community. An increasing trend in bare ground was documented from 2015-2023 (*Figure 10*). One of the 3 monitoring points is located on a former utility easement and is on a gravel hillside. Observations of monitoring data among staff led to discussions regarding why bare ground cover had increased, concluding that it was due to this site. Disturbance from utility vehicle traffic and topography had reduced topsoil coverage on this site, leading to this degraded trend. Foundation staff will consider this point as a reclamation site monitoring point moving forward as staff will explore restoration options such as hay bale feeding to reintroduce organic matter to this location.

**Note: an error was found in the Heard Unit Bare Ground chart posted in the 2022 Annual Report. The error was correct here in the chart below.*

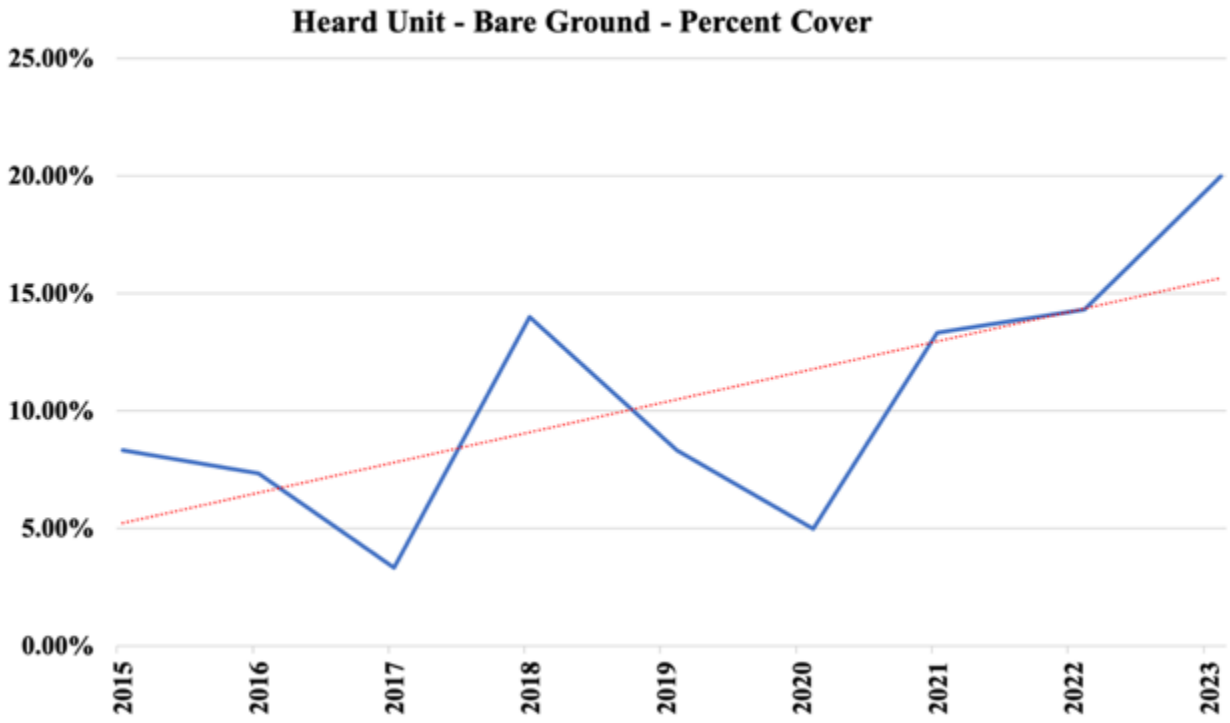

****Figure 10. Heard Unit – Percent bare ground recorded 2015-2023 (blue line) and trend of change in bare ground 2015-2023 (red line)***

Forman Unit- The Forman Unit is a property connected to the Leo Unit. The Forman Unit has been surveyed utilizing the same biological monitoring method used on the Leo and Heard Units since 2016. There are 3 monitoring points on the Forman and 2023 marked the 8th year of monitoring. Infrastructure updates were completed in 2022. A decreasing trend in bare ground was tracked throughout the monitoring dataset until 2022 when a bare ground percentage of 3% was documented and shifted the trend, though bare ground cover percentage still remains minimal. This average returned to a lower average of 0.67% during 2023's measurements (*Figure 11*). Overall, the Forman features good ground cover with varying degrees of successional communities. The property has some history of being plowed and farmed prior to Foundation ownership.

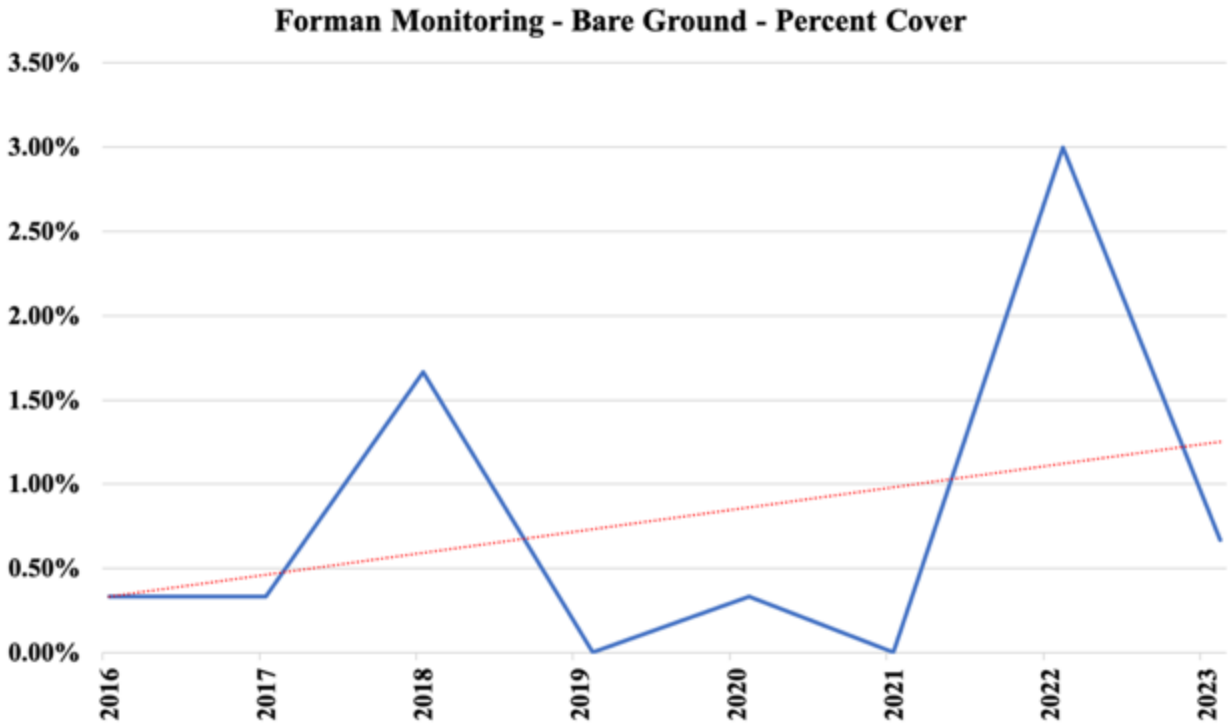

Figure 11. Forman Unit - Percent bare ground recorded 2016-2023 (blue line) and trend of change in bare ground 2016-2023 (red line)

Pittman Unit- The Pittman Unit is a property roughly 7 miles north of the Leo Unit. The Pittman Unit has been surveyed utilizing the same biological monitoring method used on the Leo Unit since 1999. There are 5 monitoring points on the Pittman Unit. The unit was not monitored in 2018 due to wet conditions and one point (#8) was not monitored in 2023 due to difficulty locating the point. This was attributed to cattle potentially knocking over the marker and ground cover concealing it. As with all ranches managed by the Foundation in North Texas, the Pittman showed signs of stress from climate conditions of a hot summer with no precipitation in 2022 and 2023. Generally, the site features good ground cover and high successional communities, though some areas are still in a lower successional state transitioning towards a native prairie complex. The site has shown considerable improvement from its purchase in 1999, which was followed by the transition out of continuous grazing to the introduction of adaptive multi-

paddock grazing. The average amount of bare ground surveyed in 2022 was 3.00%, an increase of 1.80% from 2021. The 2023 monitoring efforts recorded a repeated average of 3.00% bare ground cover. Overall, a decreasing trend in bare ground cover remains throughout the monitoring dataset (*Figure 12*).

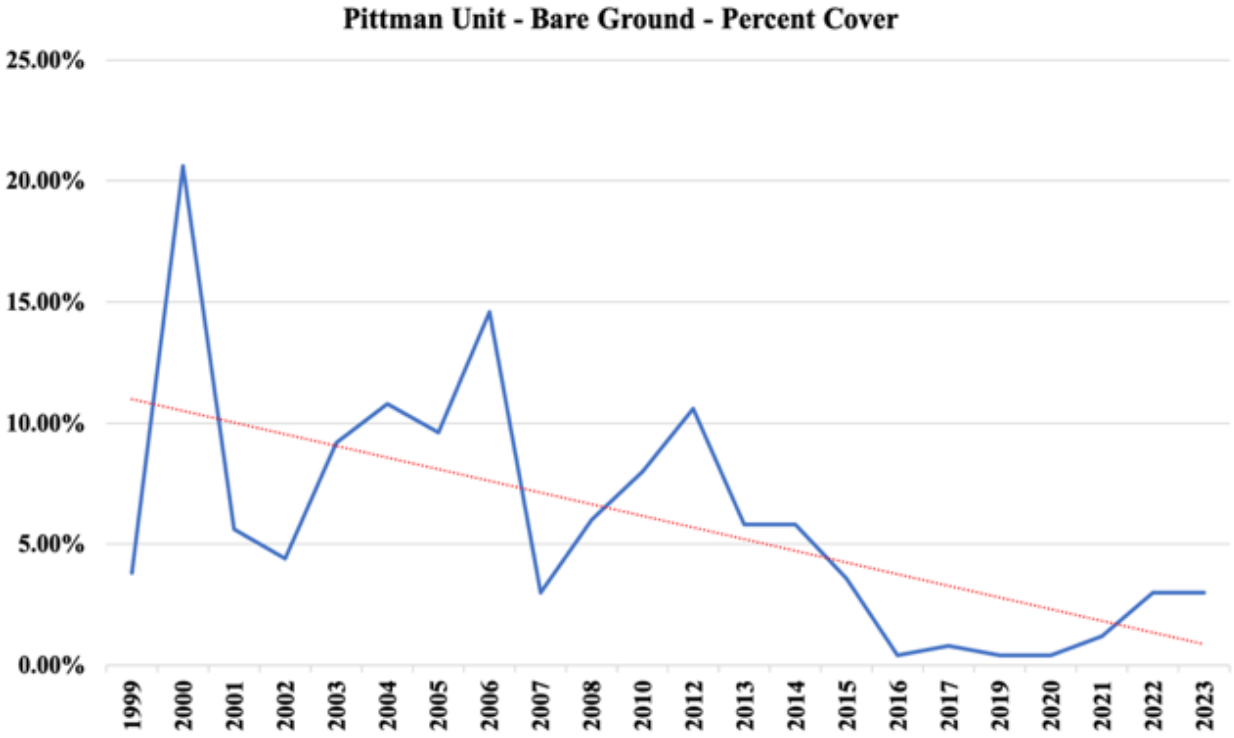

Figure 12. Pittman Unit - Percent bare ground recorded 1999-2023 (blue line) and trend of change in bare ground 1999-2023 (red line). *Note this average did not include Pittman Monitoring Point 8 as its physical not able to be located in 2023.

When averaging successional plant community ground coverage from all Pittman Unit monitoring points, a downward trend can be seen in low seral ($y = -0.0102x + 0.3797$) and mid seral communities ($y = -0.0051x + 0.4339$). An upward trend in high seral communities ($y = 0.0157x + 0.1838$), which include prairie complex grasses, Johnson grass, and high successional forbs, can also be seen. This suggests that, on average, the Leo Unit is transitioning towards a high seral, or the desired climax, native prairie vegetative community (*Figure 13*).

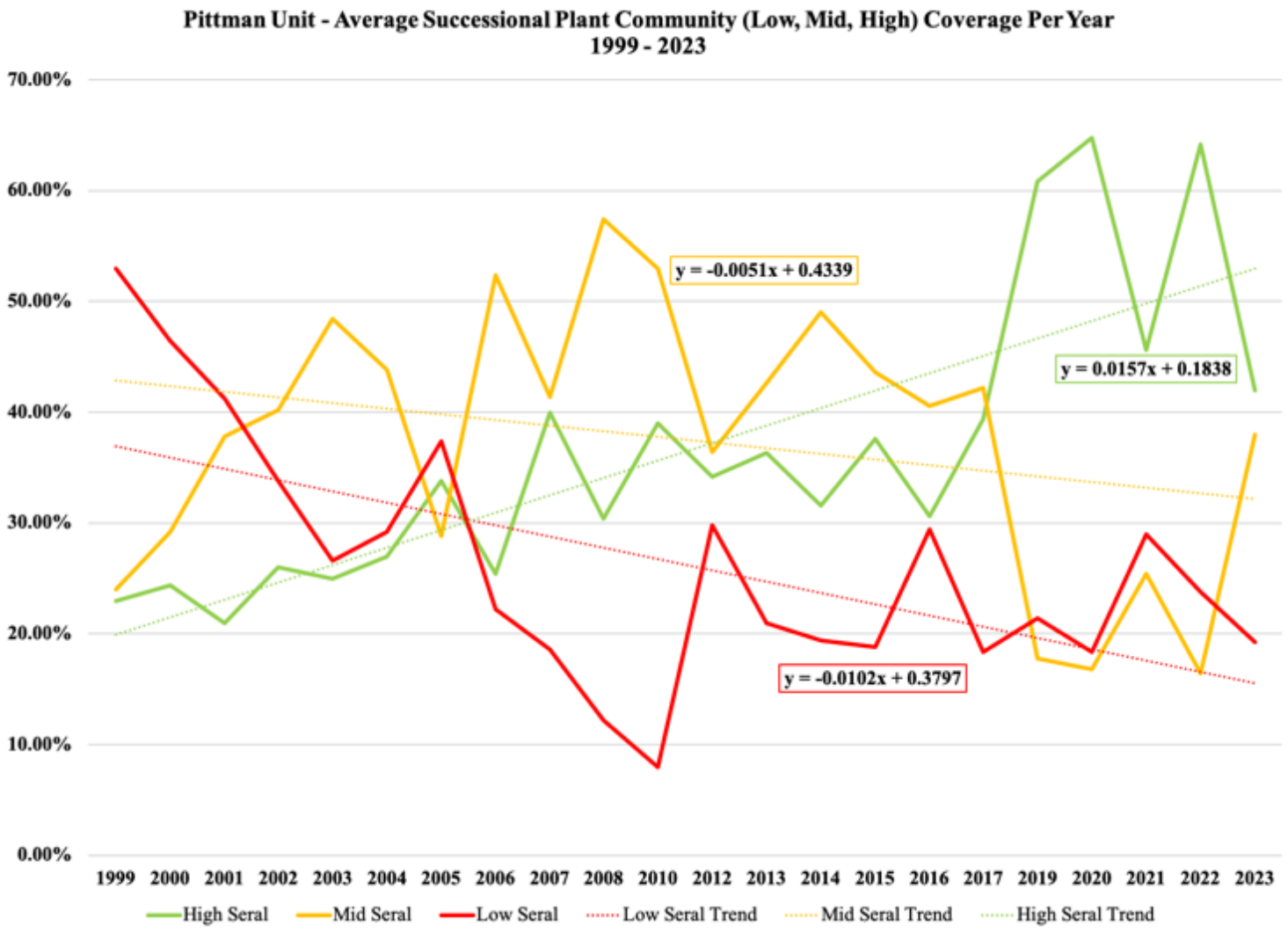

Figure 13. Pittman Unit- Percent ground cover by seral plant community (low shown in solid red, mid shown in solid yellow, and high shown in solid green lines) recorded 1989-2023. Trend data is depicted by the dashed line in the same color as it's associated data set.

West Texas

Dixon Water Foundation owns and manages roughly 30,500 acres in Presidio County. The ranches are in the Trans-Pecos Ecoregion (*Figure 1*). The Foundation's ranches are located near the town of Marfa, Texas, and along Alamito Creek, roughly 30 miles south of Marfa, Texas. The Foundation grazes cattle on the Mimms Unit ranch and occasionally grazes on Alamito Creek Preserve depending on annual weather conditions and management objectives.

Figure 14. A new calf lies down while a protective mother watches on, Mimms Unit, Fall 2023. (Photo by Zach Vaughn)

Property Updates

Marfa Plateau

A small wildfire broke out on July 31, 2023 on the western edge of the Mimms. The fire burned about 4 acres and was quickly extinguished by the Marfa Volunteer Fire Department who spotted the fire, caused by a dry lightning strike, while operating nearby (*Figure 15*).

Figure 15 – Photo of 4-acre wildfire site on western edge of Mimms Unit, Marfa, Texas, July 31, 2023. Latitude: 30° 21' 11.568" N, Longitude: 104° 4' 26.72" W. (Photo by Philip Boyd)

Precipitation

Alamito Creek Preserve

The Alamito Creek Preserve received 11.87” of rain at the Matonoso Pens location, on the northwest corner of the property. Over the last few years, the Preserve has received more rainfall than the Marfa Plateau to the north.

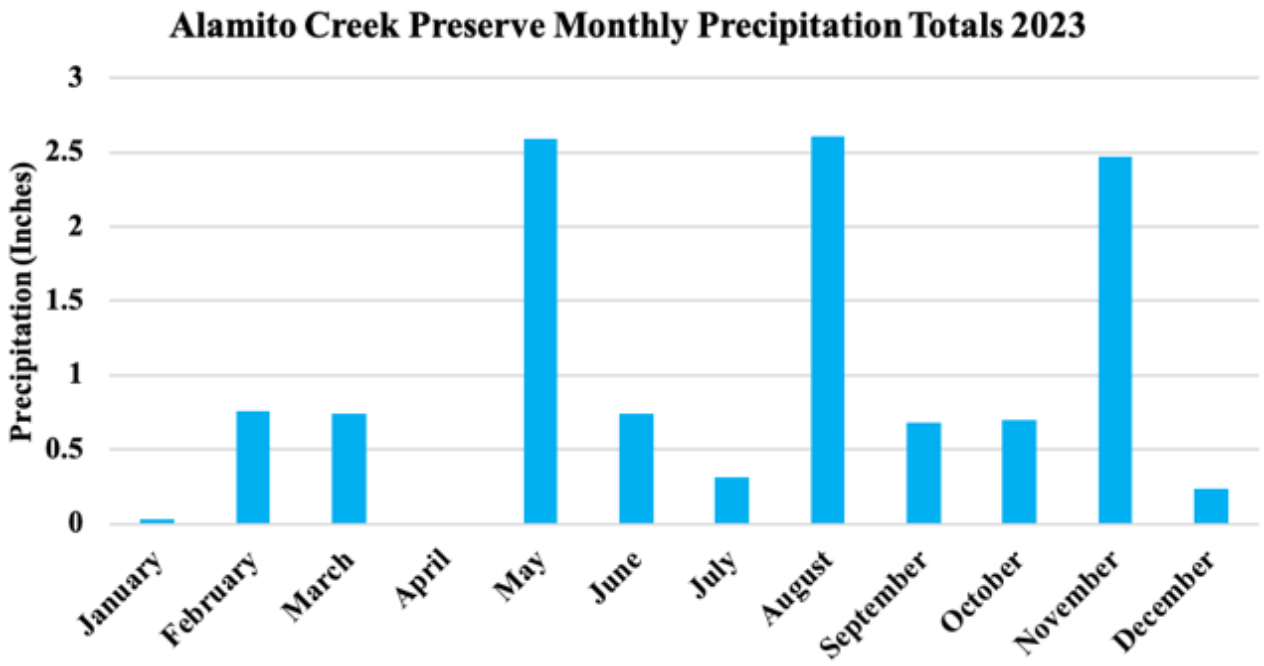

Figure 16. Rainfall totals (inches) per month for Alamito Creek Preserve (Matonoso Pens location), 2023.

Mimms Unit, Marfa Plateau

Precipitation on the Mimms Unit is measured by 3 methods:

1. Weather station data from the Marfa Municipal airport was obtained through the Weather Underground website reported 4.42” of precipitation in 2023, though the station was not updating for September and October and is presumably under-reporting total precipitation for the year. The airport is located on the eastern side of the middle of the Mimms Unit. Additionally, temperature data was compiled from this source. (*Figure 17*).

2. HOBOLink rain gauges installed in the southwest portion of the ranch and at headquarters at the southern edge of the ranch boundary (*Figure 17*). The southwest rain gauge report 7.94” of rainfall and the headquarters gauge, on the southern end of the ranch, reported 8.83”.

3. University of Texas Bureau of Economic Geology has 6 weather and soil moisture monitoring stations on the northern end of the Mimms Unit. These stations recorded 7.22” of rainfall (*Figure 17*).

The Foundation estimates that there are roughly 4 rainfall zones on the ranch and utilizes these gauges to account for these zones (*Figure 18*). During 2019 and 2020 the south side of the ranch received more precipitation than the north side. In 2021, this trend reversed as both the airport weather station and the northern Mimms Unit weather stations recorded more rainfall than the ranch headquarters. In 2022 and 2023, conditions returned to the trend of the southern end of the ranch receiving more rainfall. It must be noted that some weather stations and gauges were inaccessible for maintenance or timely readouts due to muddy road conditions or technical issues. This may have affected accuracy of readings.

A historical average precipitation amount was compiled using data from the National Oceanic and Atmospheric Administration (NOAA) from accessible weather stations in the Marfa Plateau near to the location of the Mimms Unit, paper grazing charts in the Mimms Unit headquarters, as well as data pulled from Weather Underground at the Marfa Municipal Airport (*Figure 19*). The long-term average was 15.78”, over a roughly 40-year period, with 32 years of accessible data, between 1960 and 2005. The recent average, from 2011 through 2023, using Weather Underground data and Foundation rain gauge data, is 9.07”. Recent annual totals comparing historical totals to the drought year of 2011, and the most recent 4-year period show these years to have received roughly half of the annual average between 1960 and 2005. (*Figure 20*).

The Mimms Unit is on a monsoonal pattern, creating a single growing season, with most of the rainfall typically falling between June and September, when temperatures are consistently warm. Weather conditions for 2023 on the Mimms Unit saw July and September bringing the most growing season rain (1.08” and 1.74”, respectively) and June and August receiving 0.20” and 0.37” of growing-season precipitation, respectively. The first freeze occurred October 30, 2023 (*Figure 21*).

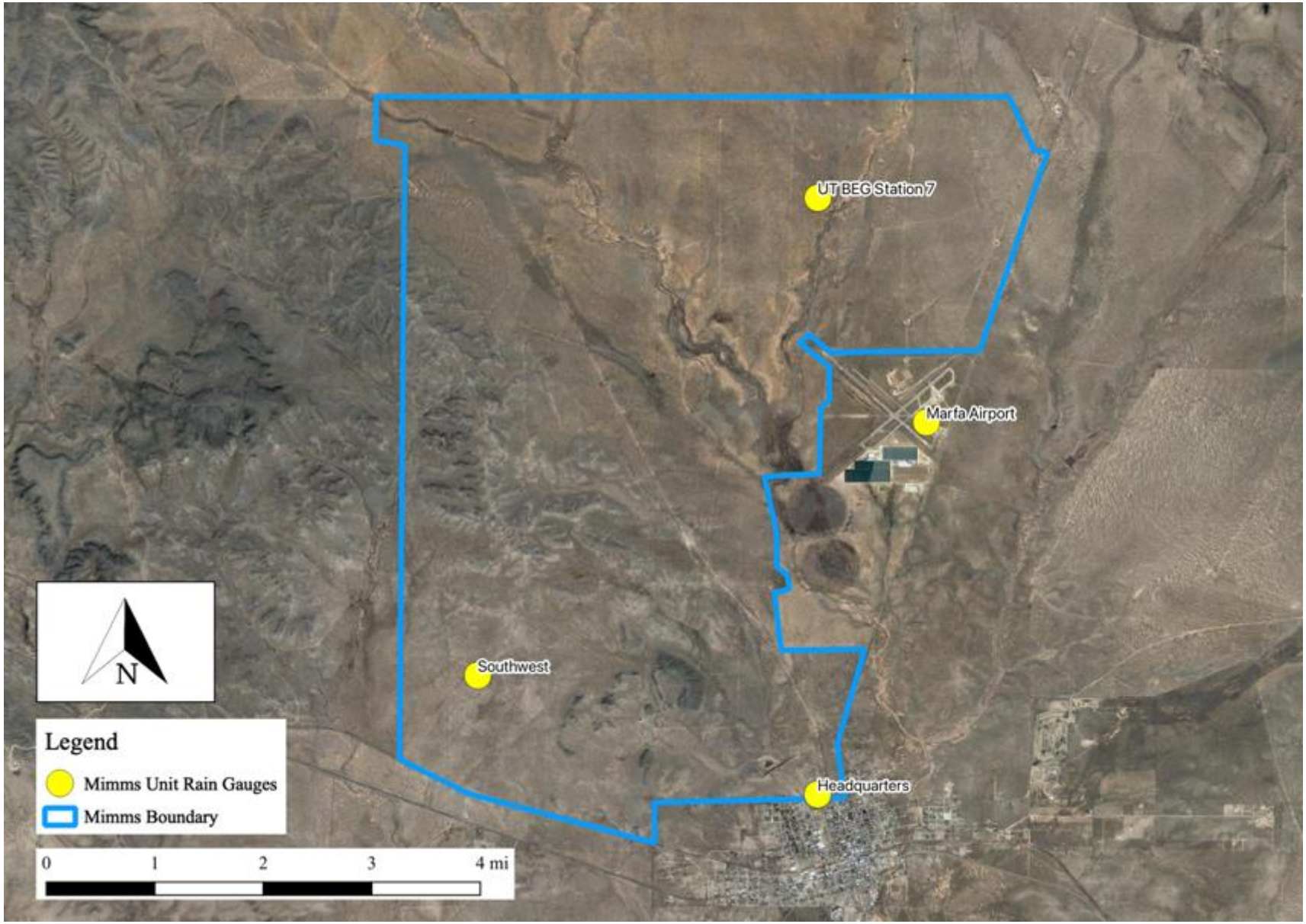

Figure 17. Locations of rain gauges on Mimms Unit, Marfa, Texas

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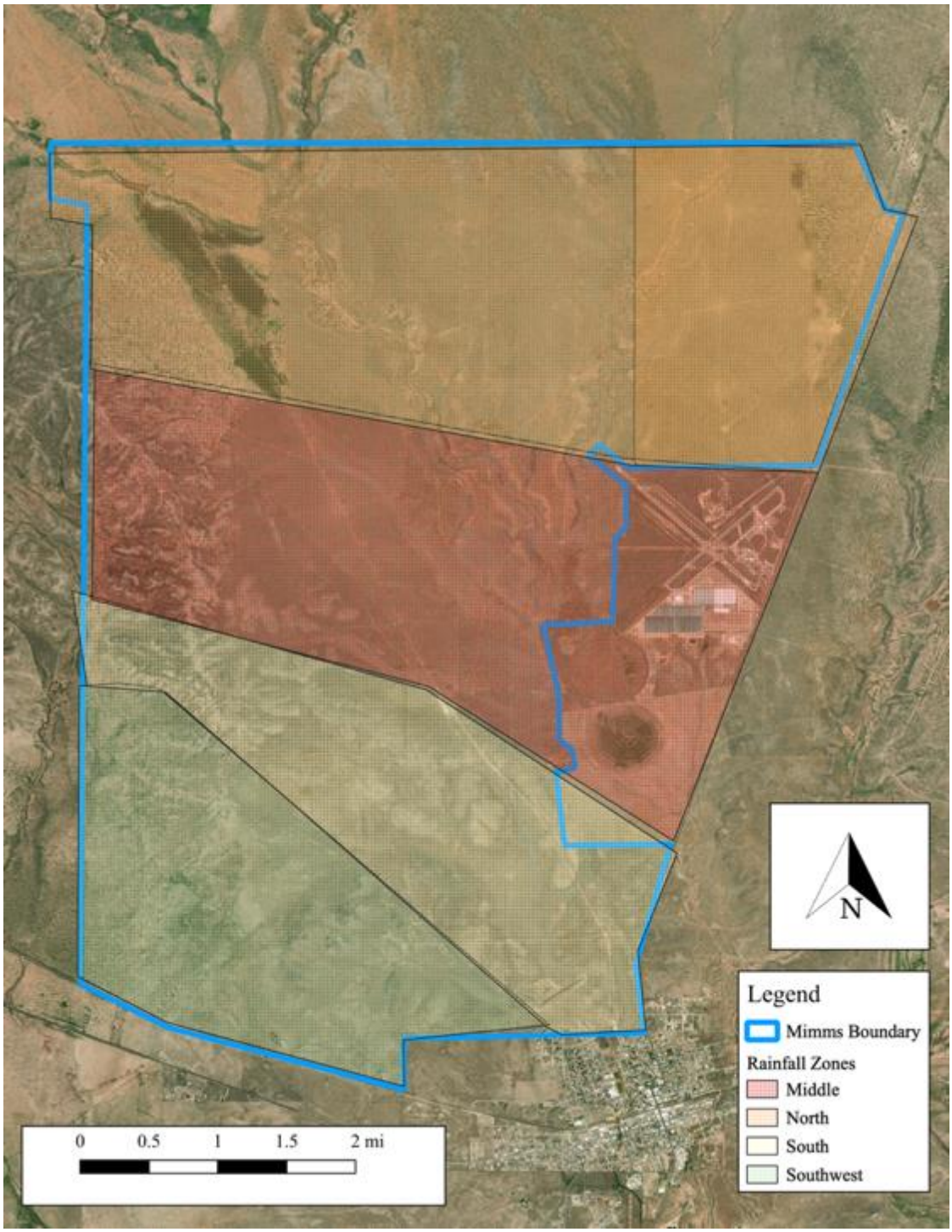

Figure 18. Estimated rainfall zones on Mimms Unit.

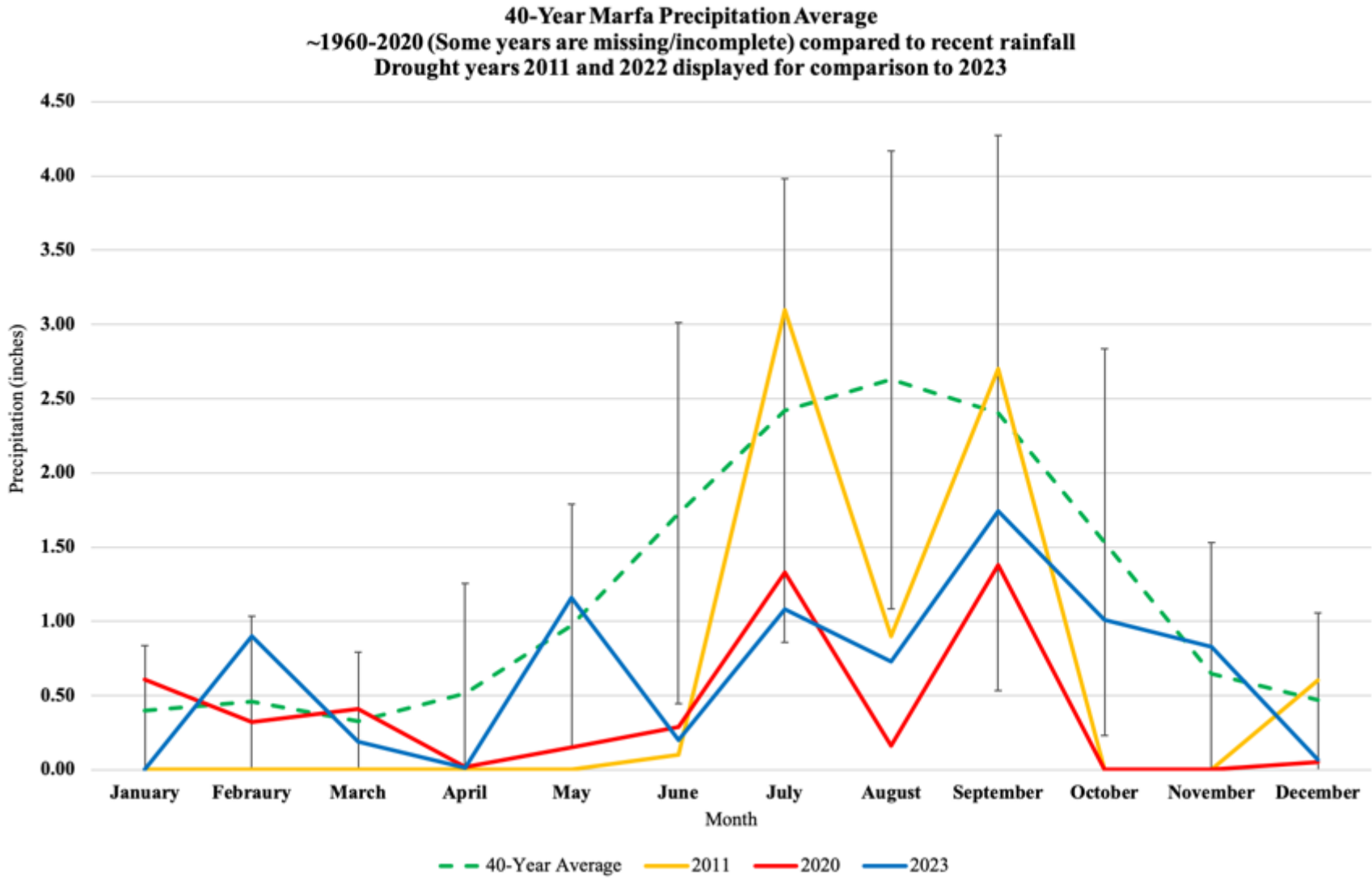

Figure 19. Precipitation data for Marfa, Texas, including a 40-year average (1960-2020, dotted green line with standard deviation error bars), 2011 (yellow), 2020 (red), 2023 (dark-blue) total. Recent years use Marfa Municipal Airport rainfall data (from Weather Underground). *Some 2023 months supplemented by Mimms rain gauges where airport data unavailable.

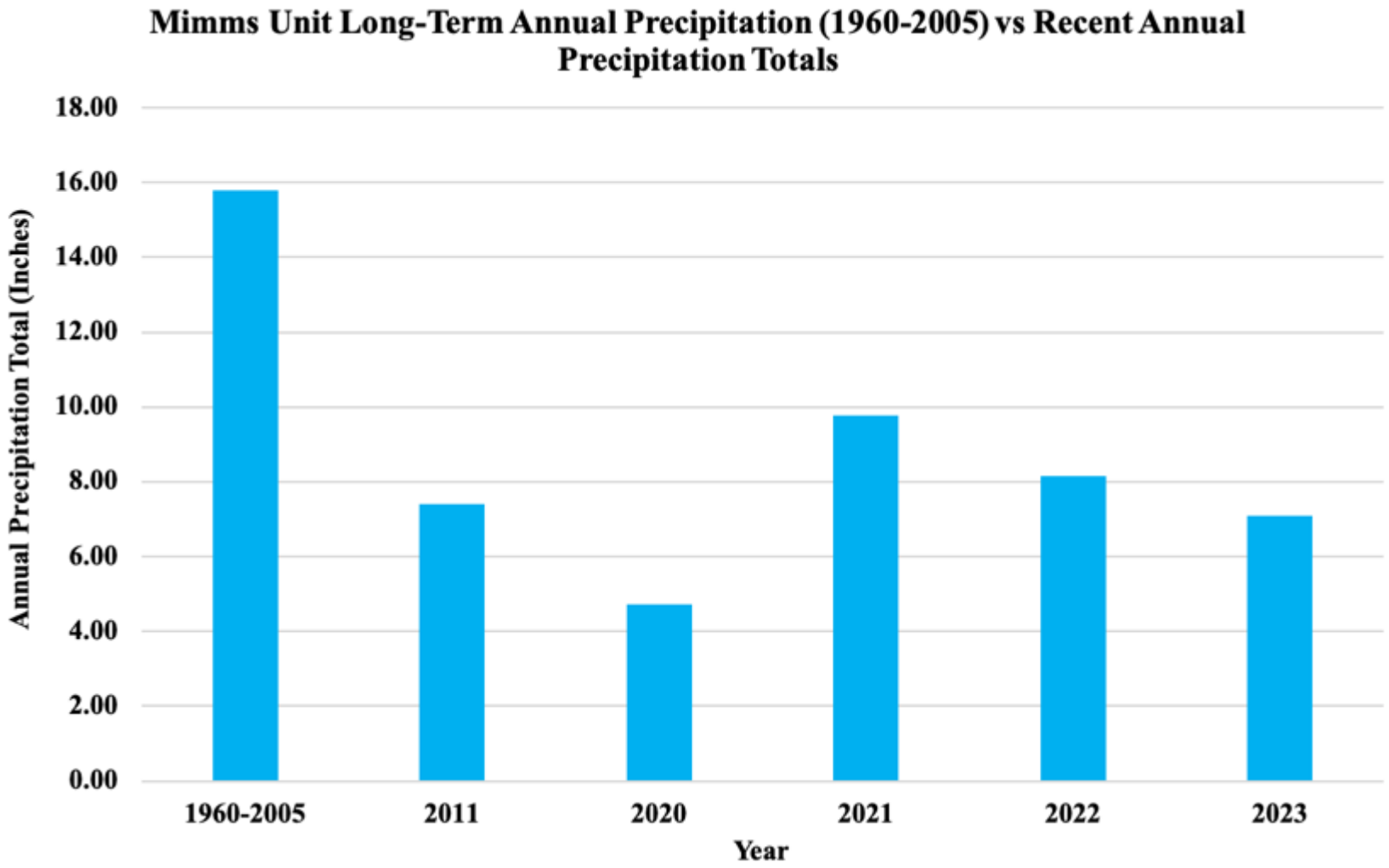

Figure 20. Long-term annual precipitation totals for Marfa, Texas for the years 1960 through 2005, compared to annual totals on the Mimms Unit from 2011, 2020, 2021, 2022, and 2023

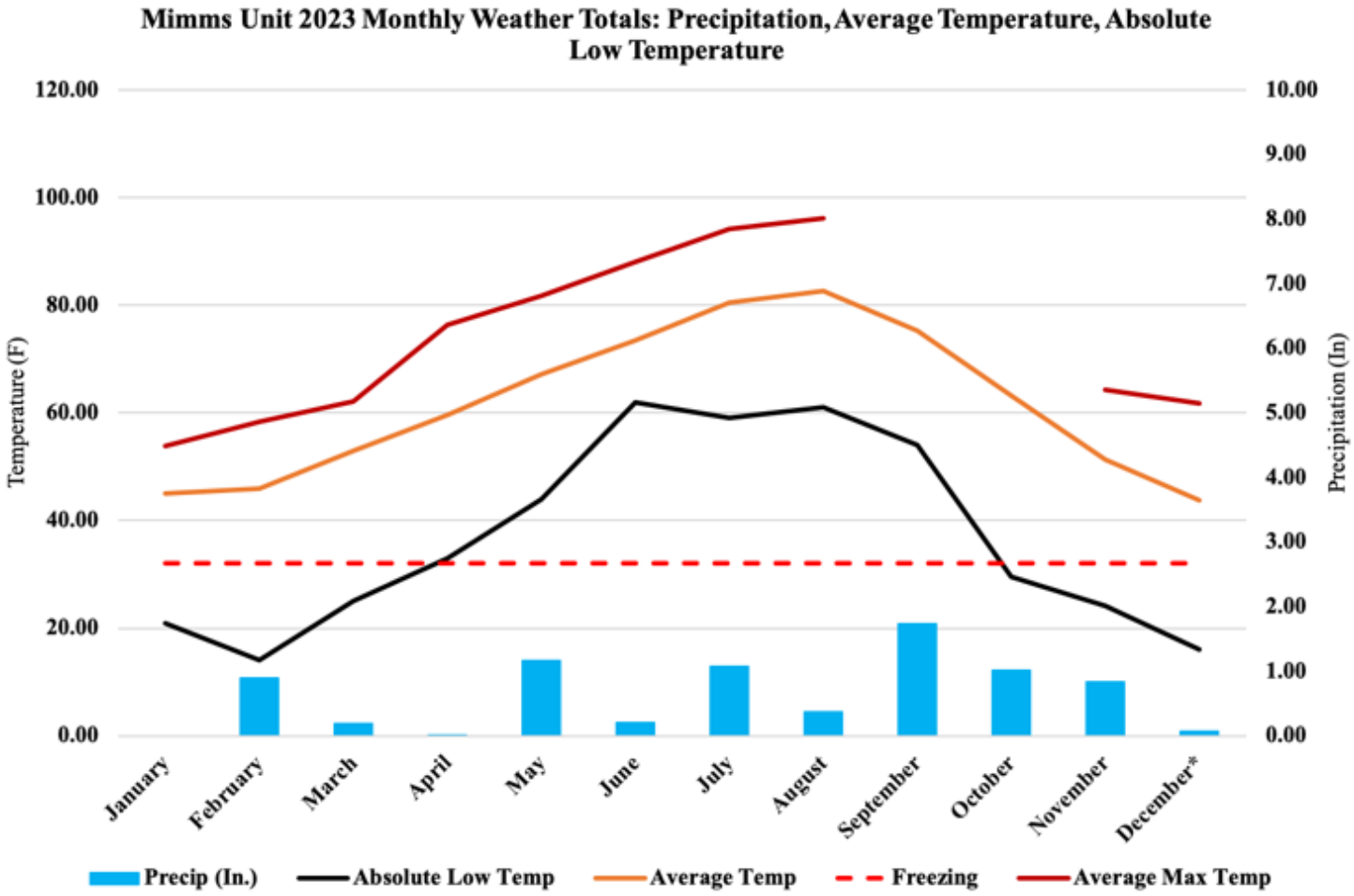

Figure 21. Weather summary for Mimms Unit, Marfa, Texas, 2022. Precipitation totals are show in blue bars with inch measurements on right axis, average temperatures are shown on the orange line with degrees Fahrenheit on left axis. Absolute temperature is marked in black with the freeze threshold marked in red. Average high monthly temperatures are represented by dark red line. Note: This data was compiled using the Marfa Municipal Airport weather station viewed through Weather Underground, which was not reporting during the early fall months, so temperature data is inconsistent during those months and average highs were unable to be calculated. Rain data was combined with rain gauge data from the Mimms Unit.

Biological Monitoring update

Foundation staff conducted the majority of annual biological monitoring at the West Texas ranches in November 2023. Staff monitored the Mimms Unit, the George Property, and Hip-O East, which shares the Mimms Unit's western boundary and is leased by the Dixon Water Foundation and under the Foundation's grazing management. The Hip-O East was monitored in January 2024. With only one annual growing season occurring and no grazing occurring between November and January, there would have been no change to ground cover conditions between when the Hip-O East was monitored and when the rest of the West Texas monitoring was done. The biological monitoring process is modeled after a method developed by Holistic Management International and is the same as the methodology used at the Foundation's North Texas ranches, with the only difference being 10 categories of plants documented as nearest to each dart. These categories are specific to the West Texas ecoregion: Prairie complex, High Seral Grass, High Seral Forb, Blue & Black Grama, Mid Seral Grass, Mid Seral Forb, Introduced Grass, Sedges, Low Seral Grass, and Low Seral Forbs.

Foundation staff began collecting infiltration rate data during the biological monitoring process using the methods described in the North Texas monitoring section above.

Date	Unit	Point	Distance (Feet)	Bearing (Degrees)	1st Infiltration Time (Seconds)	2nd Infiltration Time (Seconds)
10/19/23	Mimms	Mimms MP1	6	107	49.7	223.4
10/19/23	Mimms	Mimms MP2	6	349	110.5	108.4
10/19/23	Mimms	Mimms MP3	6	311	42.174	639
10/19/23	Mimms	Mimms MP4	6	345	963.7	1334.4
10/19/23	Mimms	Mimms MP5	6	356	1121.4	1388.3
10/19/23	Mimms	Mimms MP6	6	196	1189.2	1273.5
10/19/23	George	George MP1	6	294	136	618.1
10/19/23	George	George MP2	6	288	40.1	197.8
1/14/24	Hip-O	Hip-O MP1 (S)	Random*	Random*	460.6	>900
1/14/24	Hip-O	Hip-O MP2 (N)	Random*	Random*	243.2	738.5

*Monitoring points on the Hip-O are marked by painted fence posts along fence line. Due to lack of PVC post, as well as tumbleweeds and other obstructions along the fence, the 6'-from-post method of determining infiltration measurement point was abandoned. Instead, a dart was randomly thrown in the monitoring area. For Hip-O MP1 the point was west of the fence line, for Hip-O MP2, it was south of the fence line.

Table 3. This table shows the infiltration rate records for fall 2023 monitoring efforts at the Foundation's North Texas ranches.

Mimms Unit- Dixon Water Foundation purchased the Mimms Unit in 2008 and began grazing it in 2009. The Mimms Unit has been monitored since 2010. The ranch succumbed to a large fire ("The Rockhouse Fire") in April 2011, and most of the ranch burned. A shared goal across all Dixon Ranches is to utilize the grazing plan to reduce the amount of bare ground on the landscape. Another goal of the Mimms Unit is to be able to compare pastures grazed in a low stock density/continuous setting to pastures grazed in a high stock density rest/rotational setting.

The Foundation has 4 monitoring points across the larger portion of the ranch which encompasses the rotational grazing pastures, and 2 monitoring points in the continuously grazed pasture. Across the entirety of the ranch, bare ground has slightly increased between the years of 2010 (37.00%) and 2023 (41.17%) (*Figure 22*). However, data averaged for all monitoring points shows a decreasing *trend* in bare ground cover, as well as a decreasing trend for all points in each grazing regime (*Figure 23*, *Figure 24*, *Figure 25*). The 2023 monitoring efforts recorded that the rotationally grazed pasture showed an average of 17% less bare ground than the continuously grazed pasture.

Seral plant community monitoring, averaged across all grazing regimes from 2010-2023, shows a slight increase in high seral plant and mid seral plant communities and a decrease in low seral communities (*Figure 26*). When breaking seral plant community monitoring data out for each grazing regime, the rotationally grazed pastures show a greater increase in high seral plant community trends ($y = 0.0054x + 0.4109$, *Figure 27*) than the continuously grazed pasture ($y = -0.0099x + 0.5815$, *Figure 28*), which shows a decreasing trend in high seral plant community ground cover. Conversely, the rotationally grazed pastures show a decreasing trend in low seral plant community coverage ($y = -0.0095x + 0.480$, *Figure 27*) while the continuously grazed pastures show an increase in low seral plant community coverage ($y = 0.0029x + 0.3854$, *Figure 28*). Anecdotal observations by Foundation staff and guests suggest a similar conclusion when visiting various areas on the ranch to make visual comparisons. This could be that, given the prolonged exposure and opportunity, the continuously grazing herd has selected out more of the high seral plants and that the rest and recovery periods built into the rotationally grazed, adaptive multi-paddock system, has encouraged high seral plant community succession. One important note is that there are fewer monitoring points, and thus a smaller sample size, in the roughly 2,100 ac continuous pasture (2) than there are in the roughly 9,000 acre rotationally grazed pasture. (4)

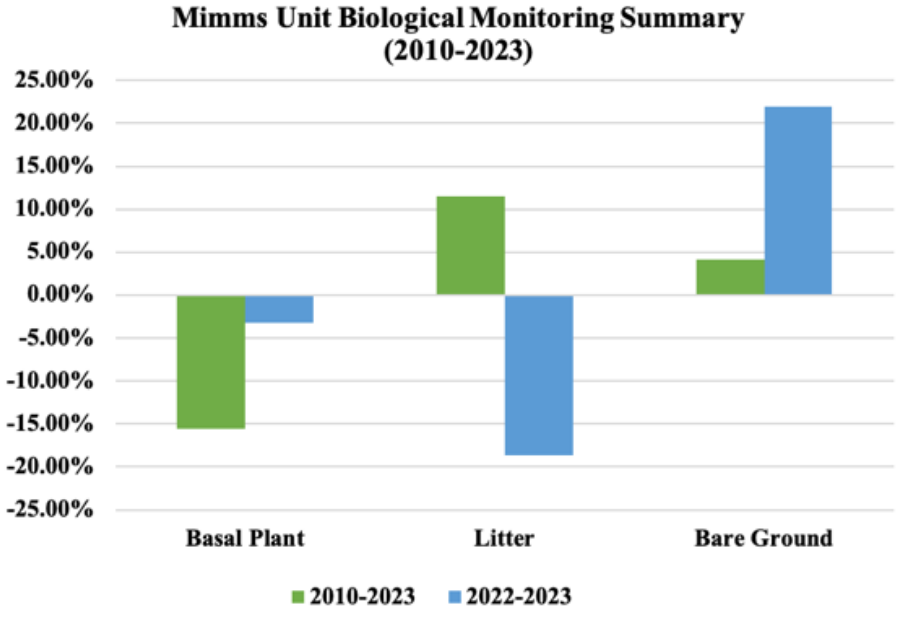

Figure 22. Percent change in ground cover types between 2010-2023 (green) and 2022-2023 (blue).

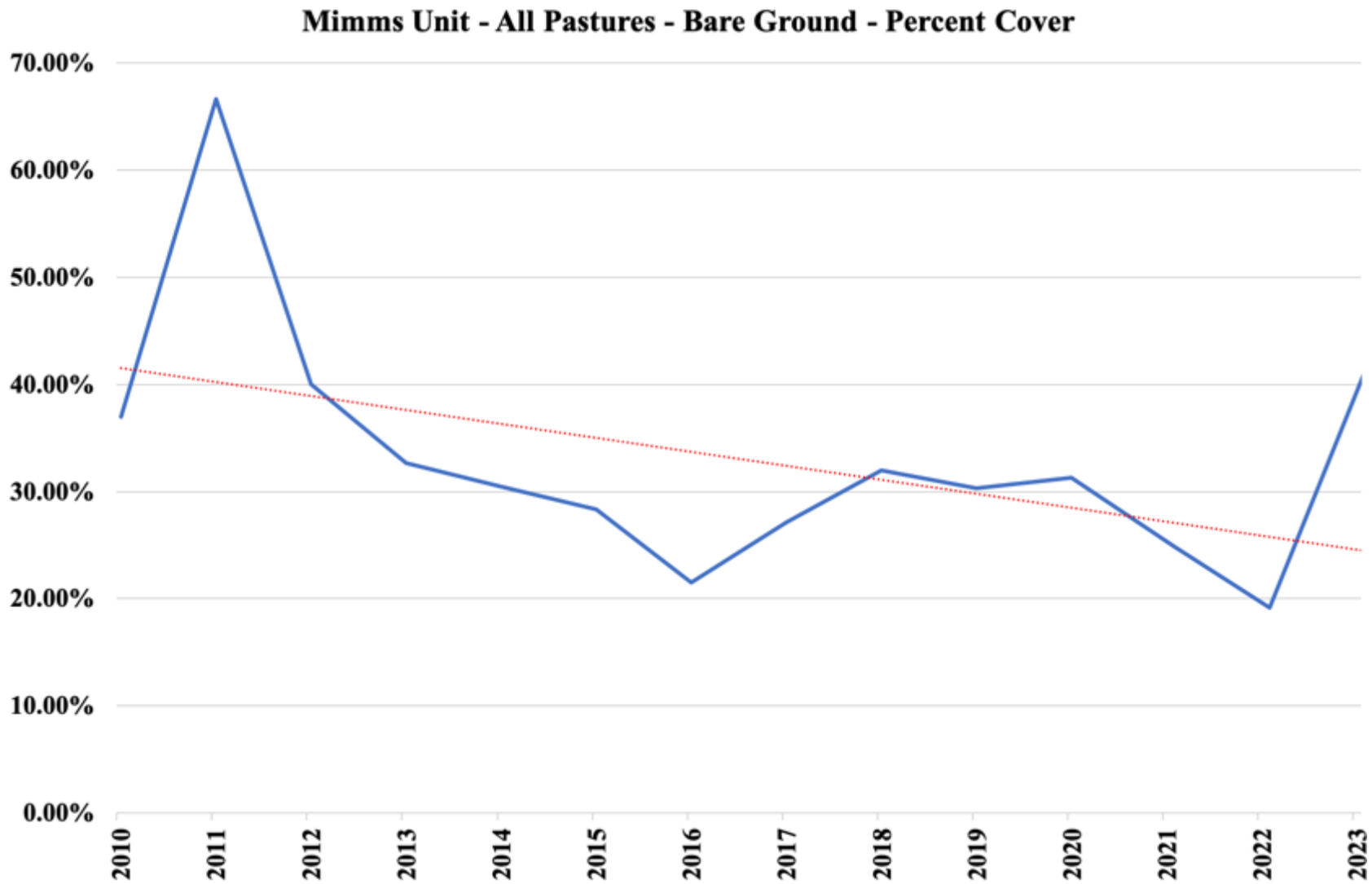

Figure 23. Mimms Unit (Low Stock Density/Continuously Grazed Pasture) - Percent bare ground 2010-2022 (blue line) and trend of change in bare ground 2010-2022 (red line)

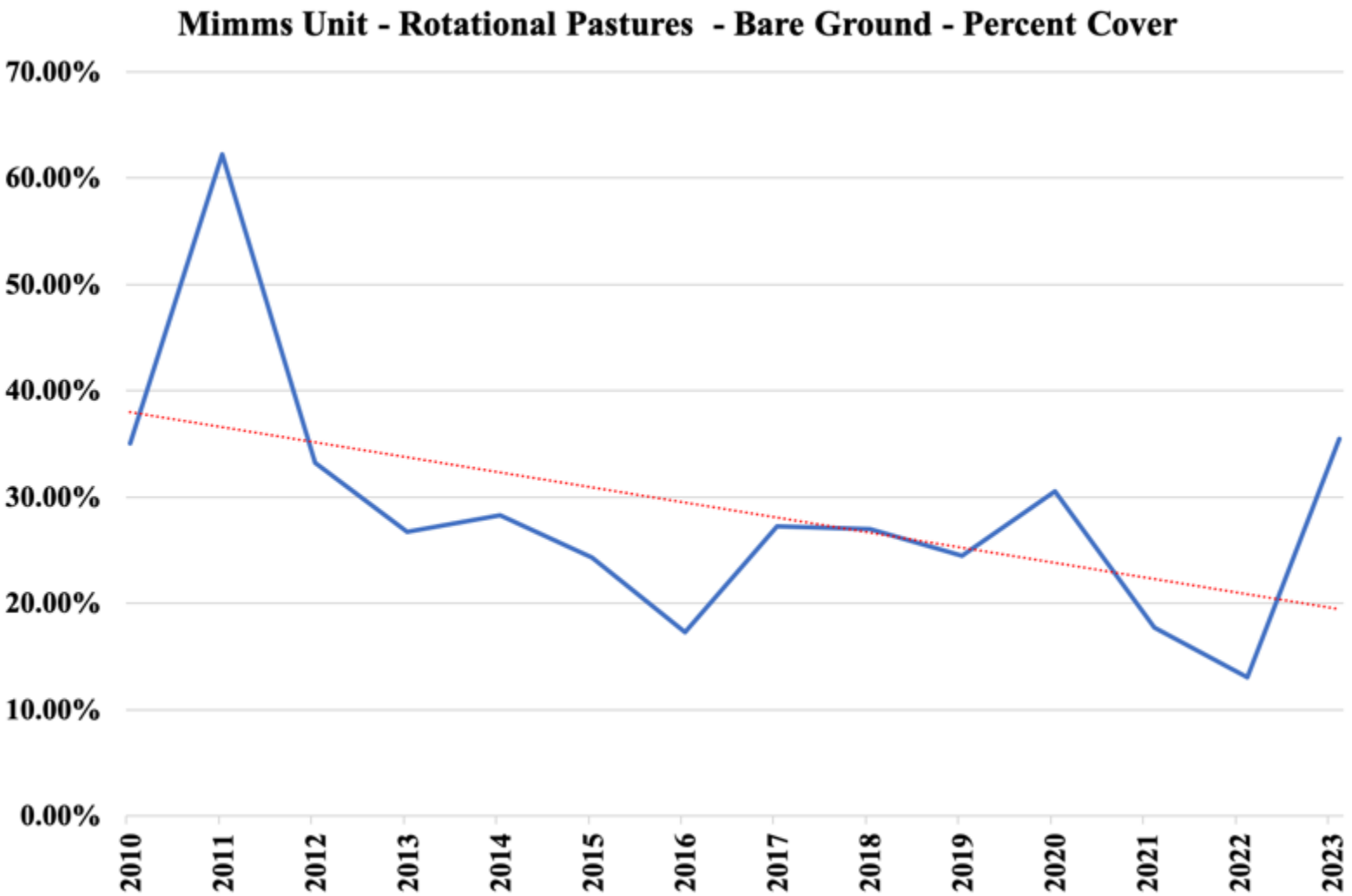

Figure 24. Mimms Unit (Rotationally Grazed Pasture) - Percent bare ground 2010-2023 (blue line) and trend of change in bare ground 2010-2023 (red line)

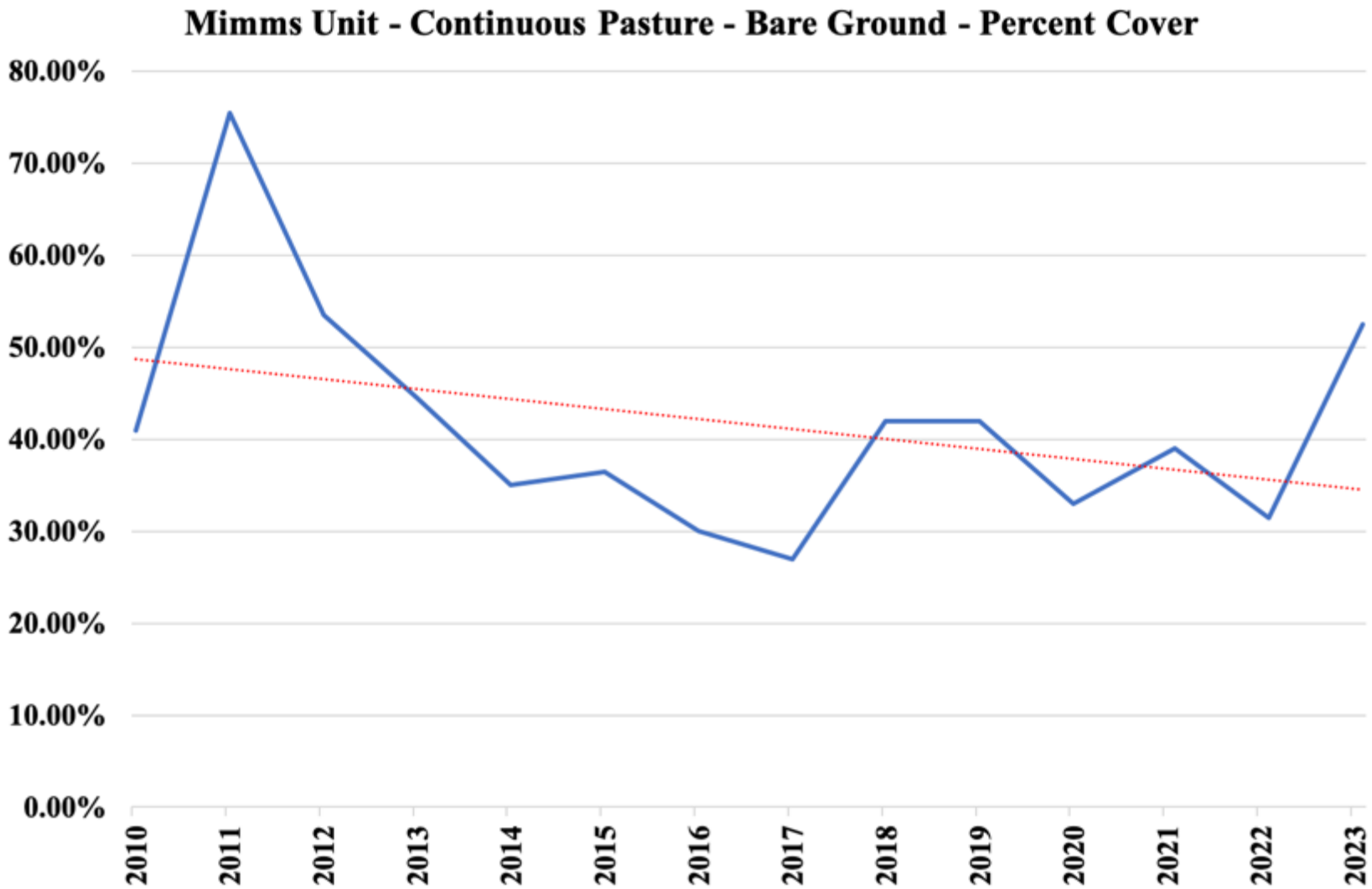

Figure 25. Mimms Unit (Average across all pastures) - Percent bare ground 2010-2023 (blue line) and trend of change in bare ground 2010-2023 (red line)

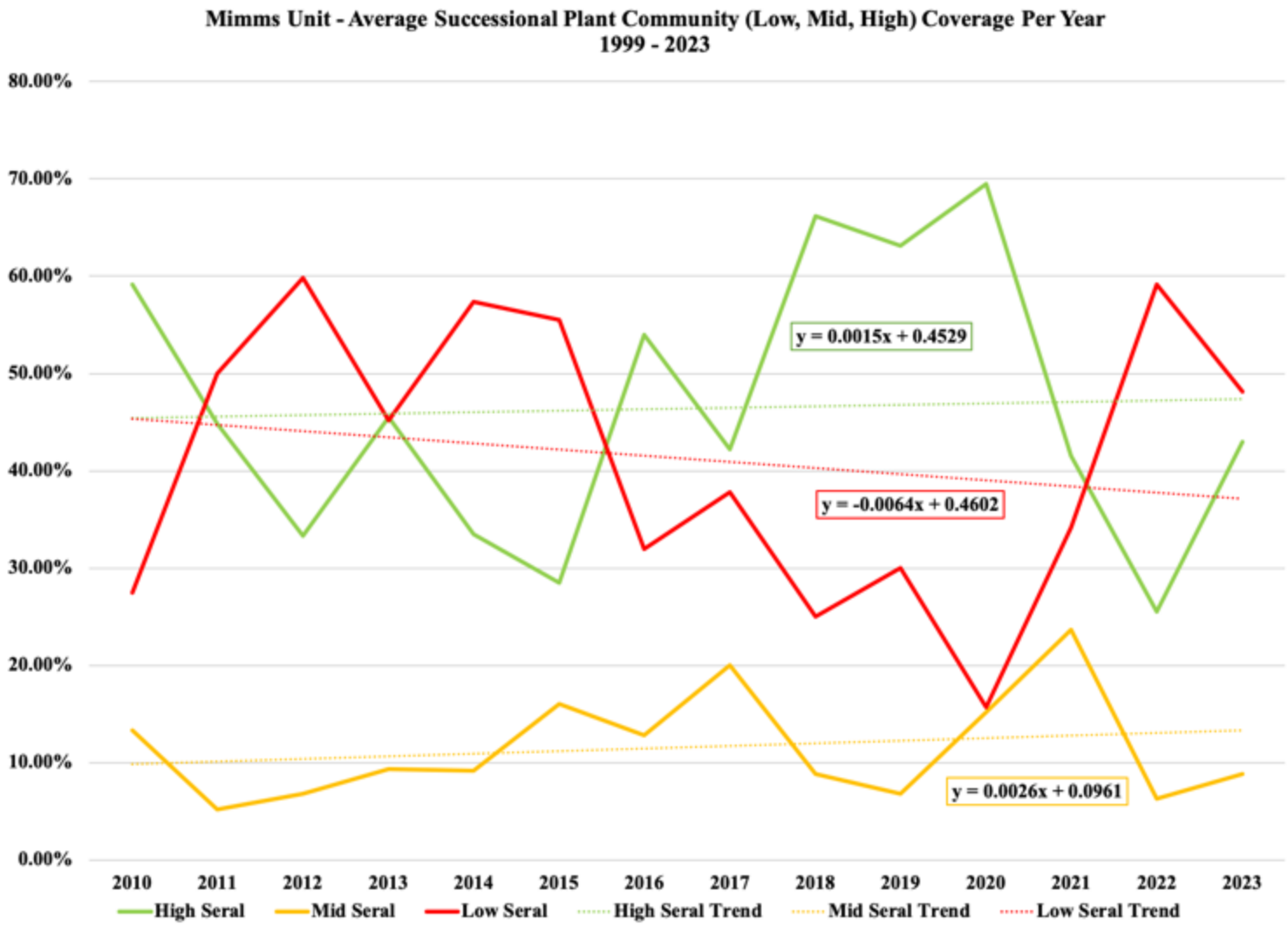

Figure26. Mimms Unit- Percent ground cover by seral plant community (low shown in solid red, mid shown in solid yellow, and high shown in solid green lines) recorded 2010-2023. Trend data is depicted by the dashed line in the same color as it's associated data set. This chart represents all ground cover data from both rotationally grazed and continuously grazed pastures.

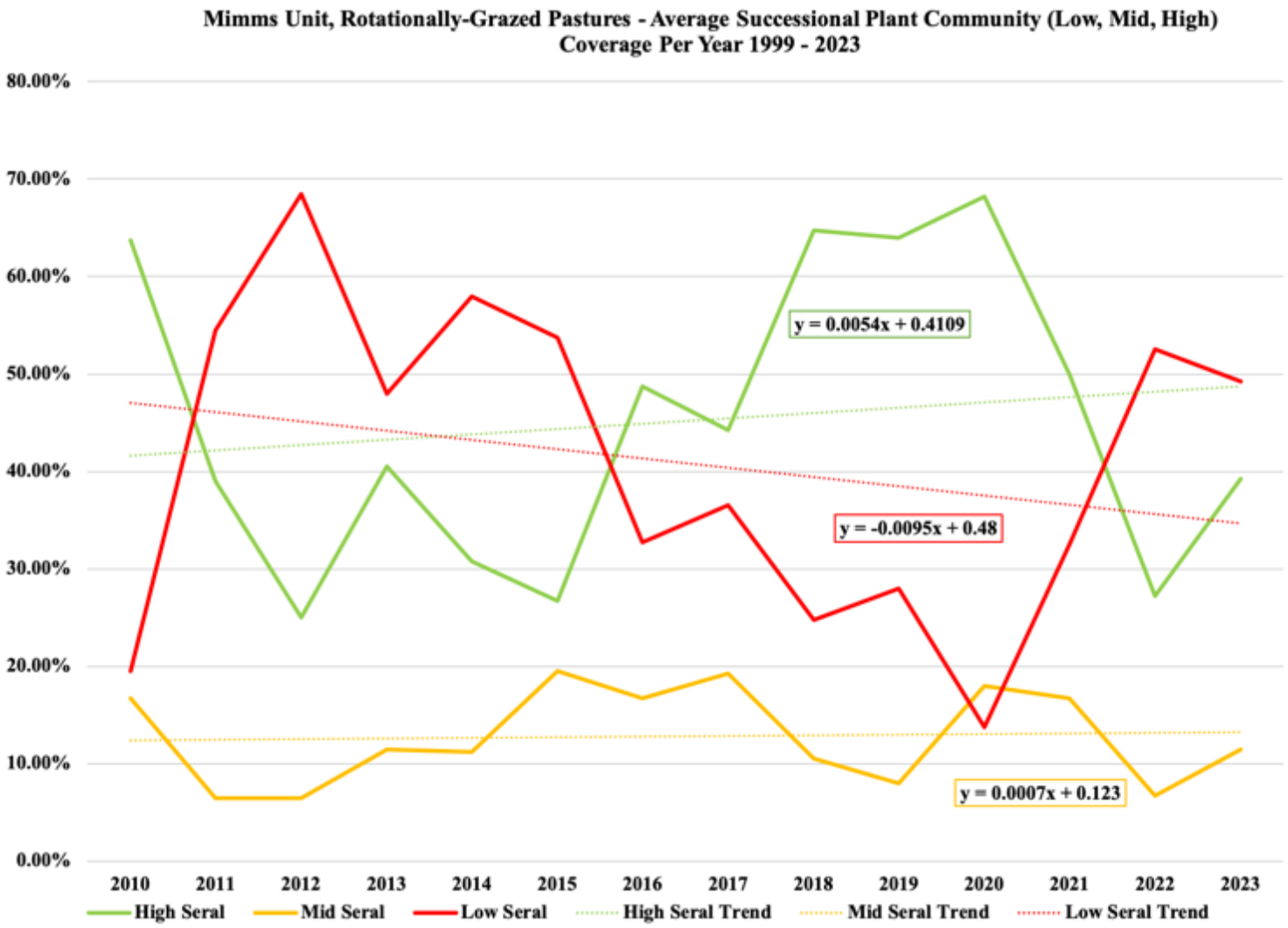

Figure 27. Mimms Unit- Percent ground cover by seral plant community (low shown in solid red, mid shown in solid yellow, and high shown in solid green lines) recorded 2010-2023. Trend data is depicted by the dashed line in the same color as it's associated data set. This chart represents all ground cover data from the rotationally grazed pastures.

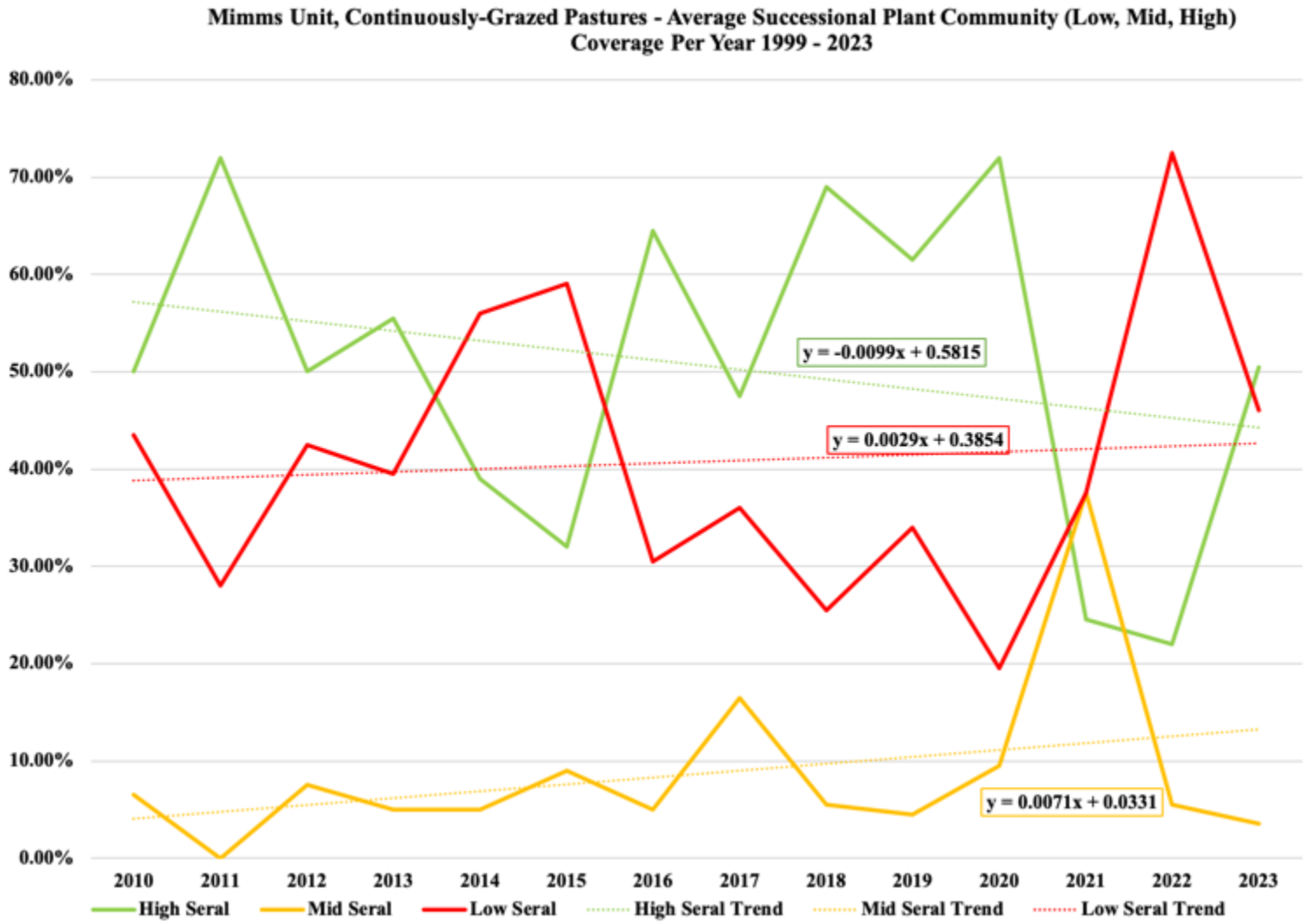

Figure 28. Mimms Unit- Percent ground cover by seral plant community (low shown in solid red, mid shown in solid yellow, and high shown in solid green lines) recorded 2010-2023. Trend data is depicted by the dashed line in the same color as it's associated data set. This chart represents all ground cover data from the continuously grazed pastures.

George Property – The George Property was purchased by the Foundation in 2019. The current year marks the 5th monitoring effort on the George. In 2020, 3 points were monitored, but the Foundation returned to monitoring 2 points in 2021 for the sake of efficiency in the monitoring program. When reducing the number of points on the George to 2, staff can complete the monitoring process for the Mimms and George in 1 day. In 2023, staff monitored the same two points as 2019, 2021 and 2022. With a sample size of only 5 years, it is difficult to determine any trends. An average decrease in bare ground has of -17.0% has been documented across the two monitoring points from 2019-2023 (*Figure 29, Table 4*).

Both George monitoring points suggest a decrease in high and mid seral plant communities and an increase in low seral plant communities (*Figure 30 and Figure 31)*. It is the Foundation's understanding that the George Property was part of the original Mimms Unit ranch as it was composed in the early part of the 20th Century. At the time of purchase in 2019, the property was not under heavy grazing management.

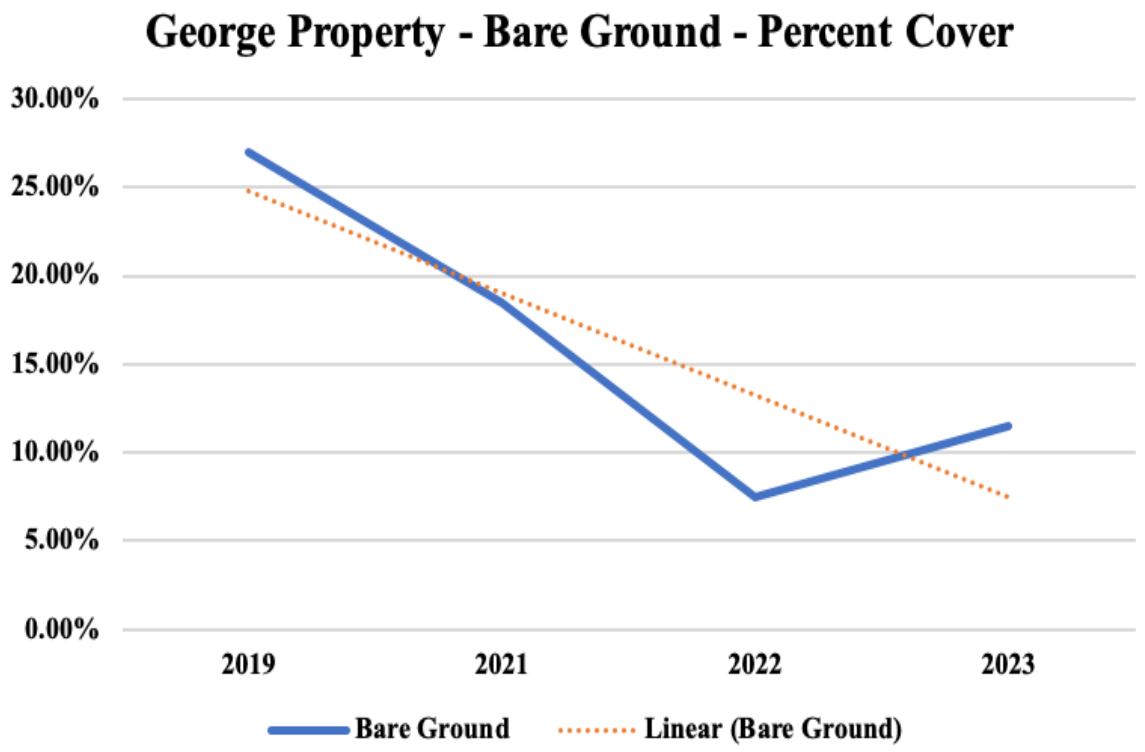

Figure 29. Percent of each cover type for monitoring point G2 on the George Property from the initial monitoring effort in 2019 until 2023.

Ranch Unit	Monitoring Point	Year	Basal Plant	Litter	Bare Ground
George	George MP1	2019	38.00%	23.00%	39.00%
George	George MP1	2020	32.00%	37.00%	31.00%
George	George MP1	2021	26.00%	38.00%	36.00%
George	George MP1	2022	21.00%	64.00%	15.00%
George	George MP1	2023	20.00%	59.00%	21.00%

Ranch Unit	Monitoring Point	Year	Basal Plant	Litter	Bare Ground
George	George MP2	2019	47.00%	38.00%	15.00%
George	George MP2	2020	37.00%	54.00%	9.00%
George	George MP2	2021	38.00%	61.00%	1.00%
George	George MP2	2022	38.00%	62.00%	0.00%
George	George MP2	2023	28.00%	70.00%	2.00%

Ranch Unit	Monitoring Point	Year	Basal Plant	Litter	Bare Ground
George	George All	2019	35.00%	30.00%	35.00%
George	George All	2020	29.00%	37.50%	33.50%
George	George All	2021	23.50%	51.00%	25.50%
George	George All	2022	20.50%	61.50%	18.00%
George	George All	2023	33.50%	48.50%	18.00%

Table 4, Figure 26. Percent of each cover type for monitoring point G2 on the George Property from the initial monitoring effort in 2019 until 2023.

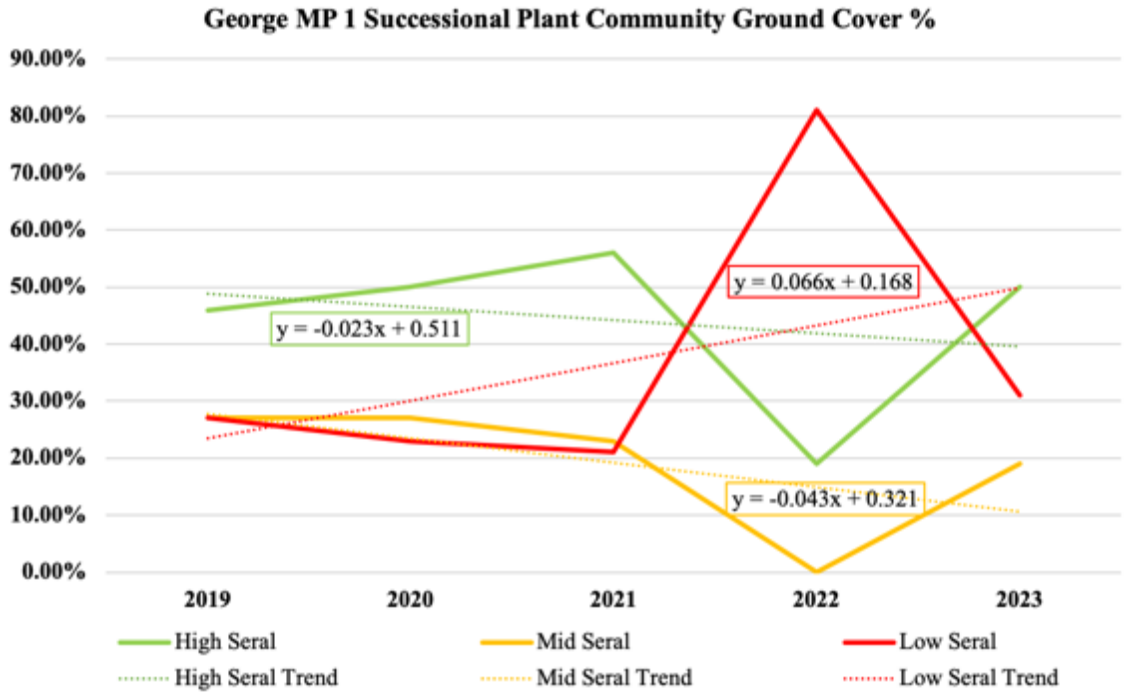

Figure 30. Percent of each cover type for monitoring point G2 on the George Property from the initial monitoring effort in 2019 until 2023

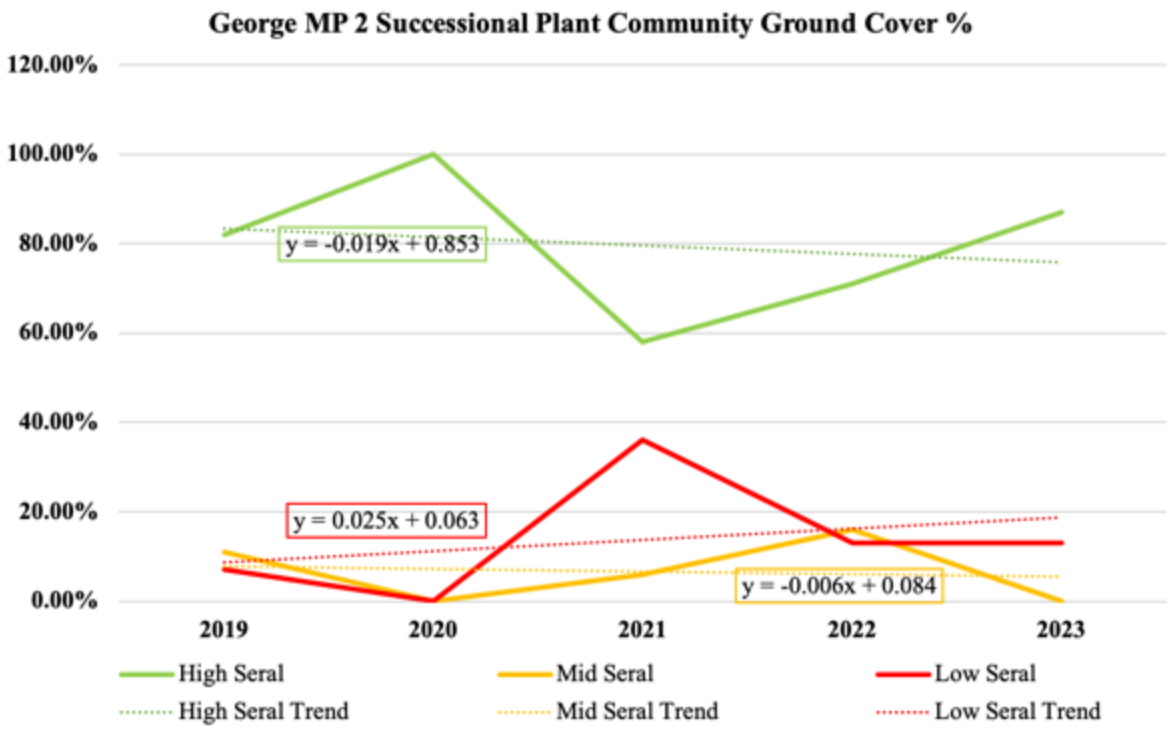

Figure 31. Percent of each cover type for monitoring point G2 on the George Property from the initial monitoring effort in 2019 until 2023

Hip-O East- The Hip-O East is directly west of the Mimms Unit. The ranch is 8,000 acres and is leased by the Dixon Water Foundation. The Foundation grazed the Hip-O in the first quarter of 2023.

Staff conduct biological monitoring at 2 fixed points on the Hip-O East property. The methodology is the same as that which is conducted on the Mimms Unit. Biological Monitoring of the Hip-O East began in 2015. High seral plant communities appear to be on an upward trend, with low and mid seral communities showing a downward trend (*Figure 32*).

On average, there has been a slight increasing trend in bare ground across the 2 monitoring points over the 6-year period, though 2020 recorded the highest amount of bare ground during all sampling years, most likely due to the 2020 drought. The monitoring efforts for 2023 documented more bare ground than the 2022 effort (*Figure 33*).

Visual assessment of the Hip-O monitoring points recorded good ground cover and diversity, though targeted conditions may not be able to be reached due to lack of ability to graze this leased property with the same management that may be applied to DWF properties. The points appear to be in recovery. As detailed earlier in the Mimms Unit Precipitation section, the Marfa Plateau and area around the Mimms Unit has not received rainfall similar to averages seen throughout previous decades and may still be suffering from lack of ideal growing condition.

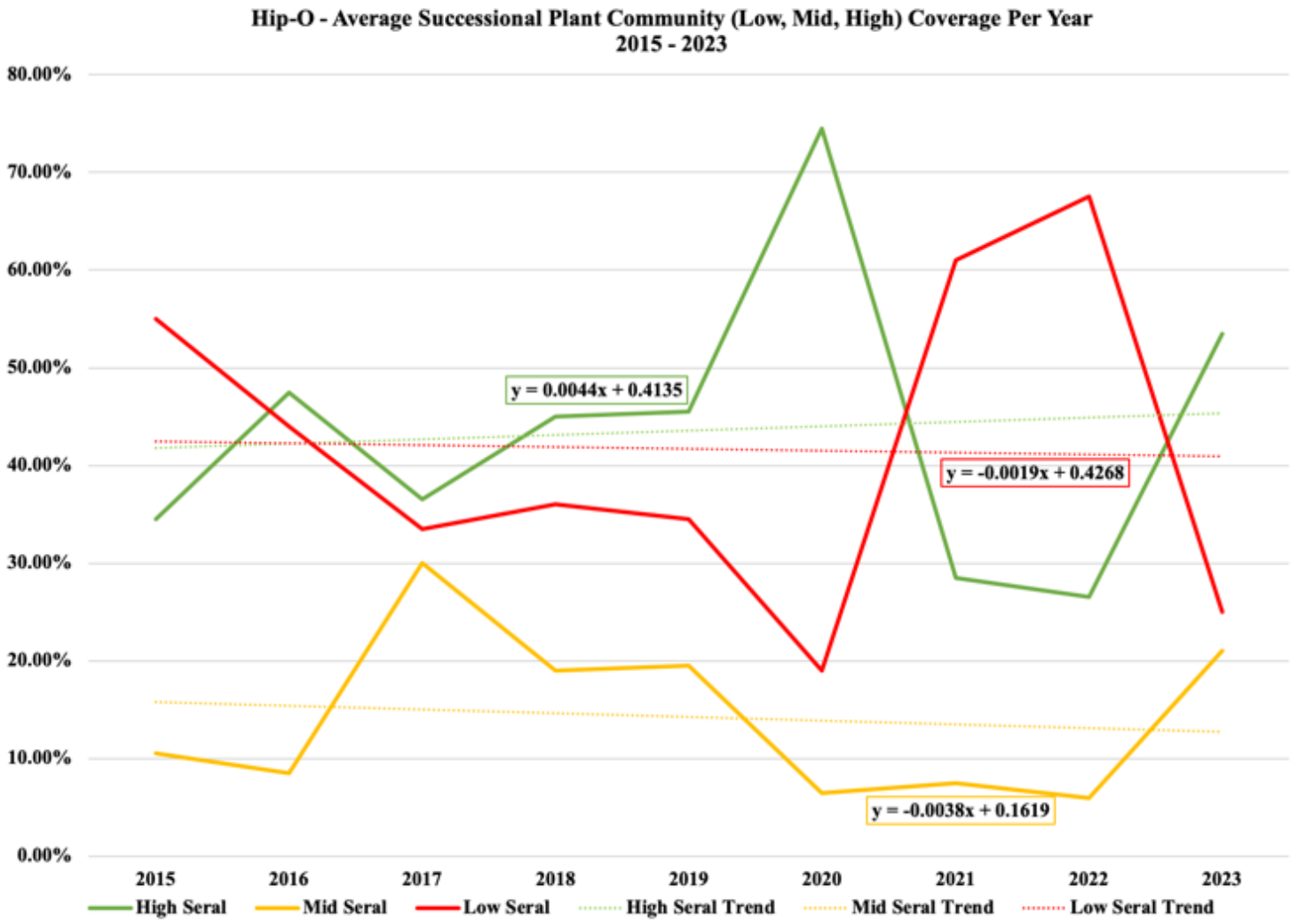

Figure 32. Hip-O East - Percent bare ground 2015-2022 (blue line) and trend of change in bare ground 2015-2022 (red line)

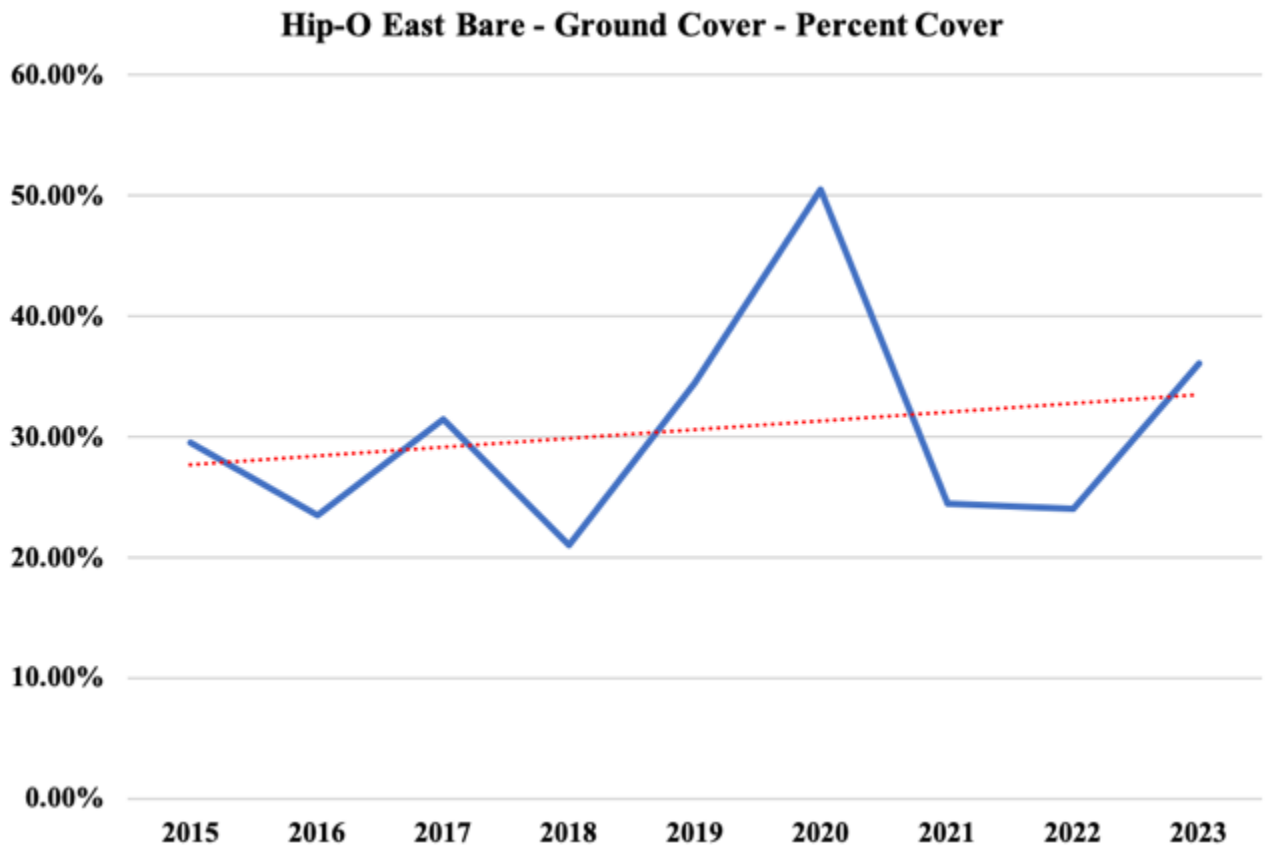

Figure 33. Hip-O East - Percent bare ground 2015-2023 (blue line) and trend of change in bare ground 2015-2023 (red line)

Additional Monitoring Efforts

Alamito Creek Preserve Monitoring

Zone-Tailed Hawk Migration Monitoring

The Alamito Creek Preserve hosts at least two pairs of nesting zone-tailed hawks (ZTHAs) during the breeding season. Trail camera photos indicate that the birds arrive in March of each year and depart in late August. Dr. Clint Boal, of Texas Tech University, is studying the migration patterns of ZTHAs using GPS backpacks and the Foundation allowed Dr. Boal to deploy a backpack on one of the males from the Preserve in summer of 2023. In the fall of 2023, the ZTHA had left the Preserve in Far West Texas and had flown to Panama in Central America. According to Dr. Boal, this was the southernmost known migration of North American ZTHAs (*Figure 34*).

Figure 34. A map shows the fall southern migration path of a Zone-Tailed Hawk that was affixed with a GPS tracking backpack on the Alamito Creek Preserve in June 2023. The bird traveled from Presidio County, Texas to Panama in Central America.

Figure 35. A zone-tailed hawk photographed at the Alamito Creek Preserve by Mike Gray, June 2023.

Trail Camera Monitoring

The Foundation uses trail cameras to monitor activity at the Preserve. In August of 2022, flood waters appeared to fill and recharge the small spring-fed pools that the trail cameras are aimed at. Overland flow connected two pools with flow extending several hundred yards downstream (*Figure 36*). The southernmost trail camera pool hosted some fish, of which only 1 bluegill was identified, and various insects for several months. By June of 2023 the pool had dried up (*Figure 37*). The cameras captured 2 flood events in 2023, in May and in July (*Figure 38*).

Figure 36. A camera facing upstream on Alamito Creek captures persistent overland flow from a small spring-fed pool (top) which flows into a second pool downstream (bottom), captured by a second trail camera. These pools and overland flow persisted from August 2022 until June 2023.

Figure 37. A trail camera facing downstream on Alamito Creek shows a bobcat approaching the spring-fed pool site which has gone dry June 2023. Water sometimes seeps beneath the tree roots along the creek bank and is most likely the discharge point of a small spring, and a water source known to wildlife.

Figure 38. Trail cameras capture flood events in the Alamito Creek channel in May 2023 on the downstream-facing camera (top) and in July 2023 on the upstream-facing camera (bottom, *photo is tagged with incorrect date).

Groundwater Monitoring

Steel pipes driven into the bedrock in the Alamito Creek channel were marked (29°54'44.49"N, 104° 0'25.30"W) in summer 2020. One pipe is topped with a cap which can be removed so that a measuring stick can be dropped into the pipe. A measuring stick can reach 49” into the ground before hitting a solid surface. The tape can be extracted and observed to identify how far the water surface is from the top of the well cap. In 2020 DWF set a goal to quarterly monitor of the water level in these wells, however, the increase of flood-deposited gravel and sediment in the creek channel that has destroyed or buried the wells, has made access difficult. The continued monitoring of these wells is in question due to these conditions. There were no monitoring efforts in 2022 or in 2023.

Tamarisk (Salt Cedar) Removal

In late 2021, several salt cedar plants were identified along the Alamito Creek channel on Alamito Creek Preserve. This species has proven to be problematic along other major water bodies in the region, so staff worked to remove the plants. Removal was carried out by sawing the trunk of each plant close as close to the ground as possible, and then treating the remaining stump with a small amount of herbicide, sprayed from a bottle directly into grooves cut in the stump. Since there were not many plants, they could be treated on an individual basis. Initial efforts to treat the plants were followed up in late 2023. Plants treated in 2021 were revisited and, if still living, were given an additional treatment. The remaining untreated plants were treated and will be monitoring annually. More plants may live in canyons and tributaries upstream from the creek but have yet to be identified.

Figure 39. Tamarisk, aka Salt Cedar, along Alamito Creek. This plant and others that were located were treated in fall of 2021 and winter 2023. Progress on their removal will be monitored.

2023 Research Efforts

North Texas

Soil Health, Pasture Health, Ranch Profitability

Grassroots Carbon and BCarbon

Carbon Storage, Leo and Pittman Units- The North Texas DWF ranches are participating in a pilot project to provide payments to ranchers who are actively sequestering carbon in their soil. These payments are provided by corporations that are looking to offset their own carbon emissions. In accordance with a protocol and certification process developed by the BCarbon working group, Grassroots Carbon visited the Leo and Pittman Units in 2021 to collect soils samples and establish baseline carbon measurements. These measurements and management practices were then factored into modeled projections of future carbon drawdown potential for the properties. Grassroots Carbon then provides a payment and estimated future payments based on this potential, the cost of sample collection and analysis, and the market value of carbon. This project is on-going, carbon payments were provided in 2023, and samples will be taken again in 2026.

Texas AgriLife Extension

Pasture Cropping, Leo and Pittman Units- This project looks to combine pasture cropping with Adaptive Multi-Paddock grazing practices to determine if these practices could potentially increase ecosystem health and resilience, improve farm productivity and net income by improving ecosystem services and reducing farming input costs, while preventing degradation of soil and watershed function.

Evaluations will be conducted through field experiments, measurements taken through drone photography, ecosystem modeling, and economic analyses. The projected has an estimated timeline of January 2021 – December 2024 and is on-going.

Surface Water Quality and Biodiversity

University of North Texas

Leo Unit – The University of North Texas (UNT) was given a grant in 2019 to begin looking into how land management impacts vegetation, hydrology, and soil properties and how those may affect water quality and biodiversity in surface water. The 2019 grant funded the first phase of this research, involving surface water surveys, on-site water quality monitoring, and habitat and biodiversity surveys focused on the Leo Unit to establish baseline conditions and inventory.

In 2020, the lab was awarded a grant for Phase 2 of this project. Phase 2 looks at how ecosystem processes may impact conditions in communities surveyed in Phase 1, with a goal of evaluating how land management practices play a role in these processes. This project has a timeline of September 2020 – August 2022. Some updates from the UNT lab in charge of this project follow: Due to COVID, there was some personnel turnover that stalled operations, but the project was able to get back on track.

The disruptions from COVID forced the project to reboot and recruit to fill personnel needs. One undergraduate student who had done some work on the project is not pursuing a master's on this project in an increased role. A second student was hired as well and is a PhD candidate. The project is making progress and, though some adjustments have been made along the way, the team is analyzing linkages between terrestrial and aquatic food webs.

Pollinator Biodiversity

University of North Texas

Leo and Pittman Units – In the Spring of 2021, University of North Texas faculty member Dr. Elinor Lichtenberg and her lab established a project investigating impacts of grazing practices on pollinators and the resources they require at 9 sites on the Leo and Pittman Units. Dr. Lichtenberg's lab continued their work in 2023.

Master's student Shannon Collins was investigating habitat needs for ground-nesting bees. She defended her thesis in winter of 2023 and is working on revising some of her analysis before publishing her research. Masters student Avery Pearson is investigating how habitat affects plant visitation networks, and whether different types of flower visitors (bees, beetles, flies, butterflies) are differentially affected by the local habit.

Figure 40. A member of Dr. Lichtenberg's research team netting pollinators in the field (Photo – Hilary Knight)

Bird Diversity

University of North Texas

Leo and Pittman Units - A graduate researcher, Barbie Kalta from the University of North Texas began working in May 2022 with Audubon Texas on a project to survey 10-12 ranches that employ a range of grazing management practices. These practices include traditionally grazed and managed ranches, ranches in the process of adopting bird friendly management practices, and ranches fully enrolled an accredited in Audubon's Bird-Friendly program. The Foundation's ranches use multi-paddock grazing and are all enrolled in the Audubon certification program. The researcher measured soil health (pH, Nitrogen/Phosphorus/Potassium, and water infiltration), vegetation diversity and forage density, and bird diversity.

Kalta successfully defended her thesis in winter of 2023. Her project suggested that regeneratively-grazed ranches supported more biodiversity than conventionally managed properties, with management having a greater impact on soil health, which in turn promoted more robust plant communities that can be utilized by birds. Regeneratively managed ranches in Audubon's Conservation Ranching program had higher species richness than conventionally managed properties. The lab at University of North Texas that conducted this project is planning on continuing the project with a new student in 2024.

Plants, Pollinators, and Phenological Data Capture Techniques

Botanical Research Institute of Texas

Leo and Pittman Units – In the spring and summer of 2022, Dixon Water Foundation helped sponsor and host a project that utilized novel imaging technology to track prairie plant phenology. Phenology is the study of cyclic and seasonal natural phenomena, especially in relation to climate, plant and animal life. As phenology relates to plants, it refers to flowering and seeding.

This project, conducted by the Botanical Research Institute of Texas, explored the use of time-lapse cameras and community science protocols to observe and analyze pollinator abundance and plant phenology within various pastures of Dixon's Leo Unit in North Texas. By understanding when and where pollinators and resources important to pollinators were on the landscape throughout the year and considering this information when making a grazing plan, ranchers may be able to promote conservation of essential species and native prairie functionality.

The researchers met with Dixon staff to review the project and make suggestions about which pastures to potentially avoid grazing during certain times of the year due to the flowering of important plant species for monarchs and other pollinators.

See the results of the pilot study in the report posted on the Foundation's website.

West Texas

Stock Density and Animal Impact

Dixon Water Foundation and Holistic Management International

Mimms Unit- In September 2022, Holistic Management International (HMI) hosted a "Turning Desert into Grassland in West Texas" workshop in Marfa, Texas, with field visits to the Mimms Unit. The goals of the workshop were "for ranchers and those who want to learn how livestock grazing management strategies benefit rangeland and businesses with a focus on land literacy." (From the HMI website). The field visits incorporated a "Safe-to-Fail" experiment in a pasture adjacent to the George working pens. The "Safe-to-Fail" concept is one shared by Australian rancher Graeme Hand and is considered a "low-risk" experiment with ultra-high stock density. In the experiment, a small paddock is packed with a much higher density than the paddocks around it. The livestock are in the trial paddock for long enough to trample the vegetation and then are moved out. The resulting paddock conditions and subsequent recovery can be monitored for infiltration rates and vegetation density and composition and compared to other paddocks under the normal management regime. This trial is meant to allow the producer to learn the effects of animal impact on their property.

During the September workshop, staff moved 1,000,000 lbs./ac into a trial paddock for about 3 hours. The trial was conducted on a warm afternoon and yearling heifers and steers were used. They were kept in the working pens and then, after guests attending the workshop could view the trial area before the experiment (*Figure 41*), the yearlings were moved into the paddock. Attendees left to view other parts of the ranch before returning to the trial site where the yearlings were removed. The vegetation was sufficiently trampled, but not much was consumed and there was not much manure left behind, most likely to the stress of the new conditions and the heat of the afternoon (*Figure 42*). The trial area will be continually monitored with new treatment sites to be added. (*Figure 43, Figure 44*).

Figure 41. Safe-to-fail trial area in the George Property, pre-treatment, September 2022, (Photo by Philip Boyd)

Figure 42. Safe-to-fail trial area in the George Property, post-treatment of 1,000,000 lbs/ac of livestock impact for 3 hours, September 2022, (Photo by Philip Boyd)

Figure 43. Safe-to-fail trial area in the George Property, 6-weeks post-treatment of 1,000,000 lbs./ac of livestock impact for 3 hours, November 2022, (Photo by Philip Boyd)

Figure 44. Safe-to-fail trial area in the George Property, 56-weeks post-treatment of 1,000,000 lbs./ac of livestock impact for 3 hours, October 2023, (Photo by Philip Boyd)

Texas Tech University

Mimms Unit- Former Mimms Unit ranch manager invented and produced some experimental ear tags that use radio frequencies and electric pulses intended to encourage cattle to remain in herds. Dixon Water Foundation supported this work financially with the purchase of a patent for the technology. The potential benefits are a reduced need in physical infrastructure to maintain animal impact desired by dense herd grazing.

In July 2022, ear tags were deployed amongst the yearling herd on the George Property and testing began with researchers from Texas Tech University. This trial continued in 2023.

The researchers have compiled notes and lessons-learned from this project and are exploring funding opportunities to continue to research and develop their product and associated impacts on grazing management and range health.

Ecological and Economic Grazing Analysis

Sul Ross State University, Borderlands Research Institute

Multiple students from Sul Ross State University began participating in a comprehensive project to look at the economic and ecological impacts of continuous grazing as compared to adaptive multi-paddock grazing on the Foundation's Mimms Unit. The project is looking at similar ecological sites between the two grazing regimes on the northern portion of the ranch. There are components examining dung beetle presence, economics, forage biomass, grass composition, soil moisture, and mycorrhizal communities. The students collected one season of data and are exploring funding opportunities for year 2 while their preliminary analysis is being done. This project will take some of the data collected on the Mimms Unit and simulate scenarios into the future under each regime to examine potential long-term implications, costs, and benefits of each approach to running a grazing operation in the Marfa Plateau.

Range Inventory

Sul Ross State University

Mimms Unit- Dr. Robert Kinucan brought the range inventory class to the Mimms Unit to conduct vegetation surveys in fall 2023 (*Figure 45*). These surveys were part of an annual inventory that takes place across 35 points that include all the grazing regimes on the ranch. For the past two sampling seasons, the class has focused on sampling half of the total inventory points. The 2023 efforts focused on the central and norther portions of the ranch. While data is provided to the Foundation, this project is largely used as a learning exercise for students. The Foundation is exploring ways to increase usage of the accumulated data and of these survey sites.

Figure 45. Students from Sul Ross State University stretch a measuring tape to mark a transect for ranch inventory monitoring, Mimms Unit, October 2023 (Photo by Philip Boyd)

Grassland Bird Research

Bird Conservancy of the Rockies

Mimms Unit Surveys – The Bird Conservancy of the Rockies returned to Marfa for the winter season. The team of winter technicians utilized the Mimms Unit and Alamito Creek Preserve as training sites for survey techniques and plant ID before dispersing to their various study areas. Surveys were conducted by technicians throughout the winter. Survey data will go into a larger report on wintering-grassland bird life cycles.

Mimms Unit Motus Station – In December 2021, Bird Conservancy of the Rockies visited the Mimms Unit to install the first Motus station in the Chihuahuan Desert. The tower is now one of several in the Chihuahuan Desert. Motus stations are receiver towers that detect wildlife individuals that are equipped with a radio transmitter and are moving nearby. The placement of the station gives researchers an opportunity to detect migrating birds that may pass within roughly 10 – 12 miles of the station. There are plans to continue to build this network.

The tower continued to operate through 2023 and detected several individuals arriving for the winter season or passing through on their way to their more permanent wintering grounds. Detections can be viewed on the motus.org website and are part of a larger effort to track the life-cycles of migratory birds.

Mimms Unit Banding – The Bird Conservancy of the Rockies arrived in early December 2023 and used the Mimms Unit and Alamito Creek Preserve to practice plant identification for their surveys. A crew also worked through the season to band birds and affix radio transmitters to key species to track their migration movements through methods like the Motus tower mentioned above (*Figure 46 and Figure 47*).

Figure 46. Bird Conservancy of the Rockies bird-banders set up a mist net on the Mimms Unit, Marfa, Texas, Winter 2023.

Figure 47. Bird Conservancy of the Rockies field technicians display a Baird's Sparrow with a newly-equipped Motus tag on the Mimms Unit, Marfa, Texas, Winter 2023 (Photo by Travis Voytko)

Sul Ross State University - Borderlands Research Institute

Mimms Unit- A new project began in the fall of 2023 that aims to look at how migratory birds utilize earthen livestock tanks and ephemeral ponds on ranches in West Texas. This project was somewhat inspired by success that the Bird Conservancy of the Rockies had in tagging chestnut-collared longspurs in 2022 on a stock tank on the Mimms Unit that Foundation staff kept stocked with water in the winter months. This project uses Autonomous Recording Units (ARUs) and point count surveys to determine which types of tanks may promote more bird diversity and priority species abundance.

The Mimms Unit also remains a reference habitat site for priority grassland bird species and is surveyed in comparison to other sites in the region that are undergoing restoration attempts. These restoration efforts are being studied by graduate researchers. Data collected at the Mimms Unit provide targets for habitat and species conservation goals.

Additional grassland bird research conducted on the Mimms Unit includes a continuation of a brush control management study that examines the response of grassland birds to treated sites. In this study, which has been going on for several years, the Mimms Unit is surveyed as a reference site, or control site, for these treatments.

Carbon Sequestration

BCarbon, ExxonMobil Research and Engineering, Earth Optics

Mimms Unit- In Fall of 2022, sampling began on the Mimms Unit as part of a new 3-year research project that will measure variation in carbon sequestration rates between tallgrass, shortgrass, and Texas coastal prairie ecosystems across a variety of climate and soil conditions as well as quantify range management impacts on water and biodiversity. Other key capacity and cost issues will be studied, including new measurement technologies and regional soil carbon analysis infrastructure including data analytics, laboratories, education, and training. The team returned to the Mimms in fall of 2023 to complete the second year of sampling and plan to return in September 2024 for the final sampling effort.

Yale University

Mimms Unit- In June 2023, a Yale PhD candidate researcher installed a study site that is part of a larger project examining changing climate conditions on greenhouse gas exchanges in the Central North American Grasslands across a temperature gradient. All sites share similar vegetation and precipitation characteristics. The Mimms Unit site serves as site in the hotter, semi-arid grasslands. This researcher is collecting soil samples, and is measuring soil carbon dioxide, nitrous oxide, and methane fluxes under control and treated (warmed) sites. This project will continue through 2026.

Groundwater Measurement

Texas Water Development Board

Mimms Unit – A hydrologist from the Texas Water Development Board visited the Mimms Unit in summer of 2023. The goal of the visit was to take measurements from wells on the ranch in order to compare them to a report from 1959 that measured the same wells. A table provided by these efforts show that two wells had shorter depth to water levels, or a higher water table, and two wells had a deeper, or lower, depth to water. On average, the depth to water has increased at a rate of -0.045 ft/yr over a 64-year period (Table).

Well Name	Depth to water level (Feet)		WL Change (feet)	Approx Rate of change (ft/yr)
	4/22/1959	7/26/2023		
HQ windmill	218.44	216.15	+2.29	+0.04
Two mile	258.02	253.48	+4.54	+0.07
Middle well	274.30	282.29	-7.99	-0.12
George pens	325.64	336.23	-10.59	-0.17
George House	NA	446.47	NA	NA

Table 5. This table, provided by Texas Water Development Board hydrologist Cody Bjornson, shows comparative depth to water well measurements on the Mimms Unit from 1959 and 2023.

Riparian Avian Habitat Research

Rio Grande Joint Venture and Borderlands Research Institute

Alamito Creek Preserve - Three Autonomous Recording Units (ARUs) were deployed on Alamito Creek Preserve from May to August of 2023. These recording units are programmed to record bird calls to better understand the breeding avian communities utilizing the creek corridor at the Preserve. Researchers will use this information as reference for future monitoring efforts.

Erosion Control/Low Tech Process-Based Restoration

Rio Grande Joint Venture

Alamito Creek Preserve- In April 2021, students from the Steamboat Mountain School in Steamboat Springs, Colorado, visited Far West Texas. The group volunteered with the Rio Grande Joint Venture (RGJV) to install 12 one-rock, or "leaky" rock dams to slow water and catch sediment in the degraded flood plain next to Alamito Creek.

By fall of 2023, the structures were still standing and showing good results. Many had caught sediment and slowed water enough to moisten soil and grow grasses on the upstream side of the structures. (*Figure 48, Figure 49, Figure 50*).

Figure 48. Photographs of a leaky rock structure built in April 2021 on the Alamito Creek Preserve.. The top photo shows the structure one month after construction and after a recent rain. In 2023, new plant growth on the upstream side of the structure can be seen (bottom photo) where water has been slowed and sediment has been dropped and collected. (These structures of examples of low-tech approaches to restoring eroded sites as they help slow water and capture sediment that would normally be carried away in runoff).

Figure 49. Photograph taken November 2023 facing downstream from the upstream side of leaky rock structure built in 2021 on the Alamito Creek Preserve. This photo shows newly piled sediment on the upstream side with grasses growing through the soil. These structures of examples of low-tech approaches to restoring eroded sites as they help slow water and capture sediment that would normally be carried away in runoff.

Figure 50. Grass grows behind a leaky-rock dam that was built in an incised tributary at Alamito Creek Preserve, April 2021. These structures allow water to filter through while also slowing the water, dropping sediment on the upstream side of the structure. This sediment also retains moisture for longer periods of time than a channel in which water passes through quickly during a flashing event. This photo shows the lifted channel in 2023, resulting from this sediment capture and the resulting vegetation that grew from these conditions in what was formerly an incised and bare channel. (Photo by Philip Boyd)

In winter 2022 through spring of 2023, DWF staff and RGJV staff started installing brush weirs, or beaver dam analogs, into the Matonoso Creek channel of Alamito Creek Preserve (*Figure 51*). These structures utilize the same principles as the loose rock filter dams but are made with wood materials. They were built under the principle that increased residence of water can create potential aquatic habitat and increase potential ground water recharge time by allowing the water more opportunity to soak into the gravel creek bed. Additionally, the reduced velocity of water decreases erosive forces that further disconnect the creek channel itself from floodplains. There have been some successful experiments with these structures in Far West Texas, though installation of brush weirs on the Alamito Creek Preserve may be the first in the region in such a dry, gravelly desert creek channel.

Students from Sul Ross State University's Hydrology course volunteered to assist in building the structures in mid-March 2023. A contractor was subsequently hired to remove some brush from

around the Matonoso cattle pens on the property and to clear that site and make it more navigable while also providing material to weave in with the wooden posts of the brush weirs.

Figure 51. Sul Ross State University Students visit the Alamito Creek Preserve during a field trip for their Hydrology course to help install experimental brush weir structures with the Rio Grande Joint Venture. (Photo by Philip Boyd)

An early rain in spring of 2023 tested the structures by flooding the creek channel. The structures seemed to hold well and do their job, with evidence of water pooling on the upstream side, dropping sediment, and filtering out of the downstream side of the structures (*Figure 52*). However, another, heavier, rain in late-May 2023 added more flood water to the channel and strained most of the structures passed their limit (*Figure 53*). With most of the structures destroyed, DWF and RGJV staff have been forced to consider their approach to these structures and plan to attempt to learn from these failures and build more in 2024.

Figure 52. Brush weirs structures show uniformly-moist soil evidence of pooling, on the upstream side of structure (top) and more unevenly-moist soil on downstream side (bottom) after water has filtered through the structure after a mid-May 2023 flow event in creek. (Photo by Philip Boyd)

Figure 53. Photograph showing the aftermath of a late-May 2023 flood in Matonoso Creek on the Alamito Creek Preserve. Several brush weir structures were built by the Rio Grande Joint Venture and Dixon Water Foundation with the intention of slowing water down to improve hydrological function, reduce runoff, and improve riparian habitat. This flood proved to overwhelm the structures as they were installed. The organizations plan to evaluate lessons-learned and attempt a second round of structures in 2024. (Photo by Philip Boyd)

Range-C Monitoring Program

Quivira Coalition- Carbon Ranch Initiative

Alamito Creek Preserve – The Range-C Program was developed by Point Blue Conservation and a Rangeland Carbon Monitoring Program Technical Working Group. This program was developed with the intention of providing guidance to land management practitioners that want to measure above and below ground carbon when evaluating the impacts of management practices. As part of a pilot effort for this program, Quivira Coalition conducted Range-C monitoring efforts in areas adjacent to one of the brush weir structures built with the Rio Grande Joint Venture on Matonoso Creek, on the Alamito Creek Preserve. These measurements were intended to provide baseline measurements for future monitoring efforts that will help evaluate potential changes in soil and vegetative health provided by these low-tech restoration tools.

Biological Soil Amendments

Quivira Coalition- Carbon Ranch Initiative

Alamito Creek Preserve – The Quivira Coalition visited West Texas in June to deploy biochar, or partially burnt biomass, and composted cattle carcasses from a local butchering facility, to plots of soil on the Preserve as a project to evaluate the potential for these amendments to benefit soil health. Some of these practices are ancient practices, but these recent efforts are aimed to study their impacts on soil health, particularly in arid regions where soil loss and drought have stressed rangelands. Foundation staff helped deploy the amendments and the Quivira team will return to continue monitoring (*Figure 54*).

Figure 54. Quivira Coalition staff spread compost on Alamito Creek Preserve uplands as part of a study on the benefits of biological soil amendments, Summer 2023. (Photo by Megan O'Connell)

Alamito Creek Conservation Initiative

Press Release from Borderlands Research Institute, October 16, 2023:

Three nonprofit conservation-focused organizations located in the Trans-Pecos region of West Texas are partnering on a watershed enhancement project with an emphasis on landowner participation. The Borderlands Research Institute, Rio Grande Joint Venture, and Dixon Water Foundation are teaming up to roll out the Alamito Creek Conservation Initiative.

This new initiative will provide the capacity to partner with landowners to implement restoration and enhancement projects within a portion of Alamito Creek in Presidio County, as well as associated tributaries and uplands. The project will utilize outreach and education efforts to broaden the impact throughout the Trans-Pecos region.

"The Alamito Creek Conservation Initiative is an excellent example of how conservation partners can work together with local land stewards to further shared conservation goals, enhance rangeland sustainability, and create vital wildlife habitat," says Billy Tarrant, Associate Director of Stewardship Services at Borderlands Research Institute. "We're looking forward to working with landowners to enhance habitat in the critical Alamito Creek watershed."

Through funding provided by the Dixon Water Foundation and Horizon Foundation, the Alamito Creek Conservation Initiative will utilize existing cost share programs to carry out voluntary incentive-based conservation projects. The goal is to implement enhancement techniques in a portion of the creek that still has some functionality and then to expand to other tributaries and upland sites.

Historical accounts of watersheds across the arid Chihuahuan Desert landscape indicate many had more perennial streams and were lined with gallery forests of cottonwood and willow. Past land use activities led to deforestation along many Chihuahuan Desert streams. Once the riparian forests were gone, normal annual flood flows scoured young plants and prevented recolonization by trees. Today, summer thunderstorms and the resulting runoff are no longer absorbed by the riparian floodplains and adjacent uplands, resulting in less recharge to aquifers, greater erosion and downcutting of stream bottoms, and less desirable vegetation communities. Well-developed and vegetated floodplains can absorb and store annual flood flows, resulting in wetter watersheds, and healthier riparian and wetland communities for wildlife and livestock.

Riparian enhancement efforts will utilize low-tech process-based restoration techniques. These practices use simple structural additions to mimic riparian functions and initiate specific processes. Management of invasive brush and placement of brush weir dams will slow floods and promote recovery. "We have been using these process-based techniques for riparian restoration for the past three years in West Texas," explains Jeff Bennett, the Rio Grande Joint Venture's Habitat Restoration Hydrologist. "Initial monitoring has shown the bed of one creek has been built up by one foot in two years' time."

The Borderlands Research Institute will manage administration and coordination responsibilities and will develop a strategic restoration and monitoring program. The Rio Grande Joint Venture will focus on implementation and monitoring of conservation projects.

The Alamito Creek Conservation Initiative seeks to address problems associated with historical riparian forest loss by improving overall riparian health through its riparian and grassland enhancement projects.

Outreach Efforts

North Texas

Leo and Pittman Units, Josey Pavilion- In 2023, the Foundation's North Texas ranches hosted over 879 people from 20 event field visits, meetings, and workshops including the Holistic Management International, Texas Grazing Lands Coalition, University of North Texas, Drury University, the Noble Foundation and more.

West Texas

Mimms Unit – In 2023, the Foundation's Mimms Unit ranches hosted 128 visitors through 20 events, field visits, workshops, research visits, and meetings including Yale University, Universidad Politécnica de Piedras Negras, Coahuila, University of Texas Bureau of Economic Geology, Texas Parks and Wildlife Department, and others.

Alamito Creek Preserve – The Preserve hosted over 91 visitors through 11 events, field visits, restoration workshops, birding visits, and meetings including the Marfa Middle School, The Davis Mountain Hummingbird Celebration, Rio Grande Joint Venture, Sul Ross State University, and the Bird Conservancy of the Rockies.

State-wide

Foundation staff attended and spoke at several in-person conferences and webinars throughout 2023.

Social Media

In the summer of 2019, the Foundation launched its first Instagram account (@dixonwaterfoundation). The account has 866 followers and there were 49 posts made to the account in 2023.

Figure55 . Participants work on ranch planning exercises at the Holistic Management International Training, Leo Unit, April 2023 (Photo by Hilary Knight)

Figure 56. Marfa ISD Middle School visits the Alamito Creek Preserve for a field day, May 2023. (Photo by Philip Boyd)

Figure 57. Texas Parks and Wildlife Department share a river simulator with the The Kids on the Land program at the Josey Pavilion at the Leo Unit, in North Texas, April 2023 (Photo by Hilary Knight)

2023 Grants

In 2023, Dixon Water Foundation awarded $114,013 in grants to 5 organizations.

2023 Sponsorships

In 2023, Dixon Water Foundation awarded $19,470 in sponsorships to 9 organizations and events.