2024-25 BEMP ANNUAL REPORT FOR US ARMY CORPS OF ENGINEERS PREPARED BY THE BOSQUE ECOSYSTEM MONITORING PROGRAM (BEMP)

Submitted September 18, 2025

Reporting Period: 7/22/2024 - 7/21/2025

Annual Performance Report submitted to:

US Army Corps of Engineers, Grant No W912HZ-24-2-0029

Federal Award Identification Number (FAIN): W912HZ-24-2-0029

Key personnel and contact information:

Dr. Kim Eichhorst, Program Director, kimde@unm.edu

Matt Leister, Science Director, matt.leister@bemp.org

Zoe Wadkins, Education Director, zoe.wadkins@bemp.org

Dr. Ara Winter, Information Manager, akooser@unm.edu

1.1 DELIVERABLES

1.1.1 Key deliverables

Long-term monitoring
- 25 sites
- Monthly monitoring (groundwater, precipitation, ditches, litterfall) at 25 sites
- Temperature at 12 sites
- Surface-active arthropod monitoring at 15 sites
- Vegetation surveys at 20 sites
- Tamarisk leaf beetle monitoring at 10 sites

Short-term monitoring
- 2 short-term sites in Corrales

Data analysis
- Long-term and short-term trends

1.2 DATA AND ASSOCIATED STATISTICAL ANALYSIS

1.2.1 Timing of collections (from previous reports)

From August 22, 2024 through August 21, 2025, BEMP staff, UNM students (through the BEMP Bosque Internship class at UNM), and K-12 students and their teachers continued to collect data on depth to groundwater, water level in nearby ditches and/or drains, precipitation, and litterfall monthly, during the week of the third Tuesday of each month. Surface-active arthropods were collected the first week of October 2024, first week of May 2025, and the last week of June 2025. Vegetation cover was completed by October 2024. Tamarisk leaf beetle monitoring was completed in September 2024 and started again in May 2025.

1.2.2 Our data collection (from previous reports)

BEMP monitors biotic and abiotic variables at our research sites. Our abiotic datasets include: depth to groundwater; water level in ditches and drains; precipitation; above- and below-ground temperature; and water quality in the Rio Grande. Our biotic datasets include native and exotic tree and shrub productivity (using leaf litterfall in g/m^2 as a proxy) reproductive effort (reproductive parts in g/m^2), and wood fall (g/m^2); vegetation cover; surface-active arthropod richness and abundance; and tamarisk leaf beetle distribution, abundance and impact.

2.1 BEMP RESEARCH SITES

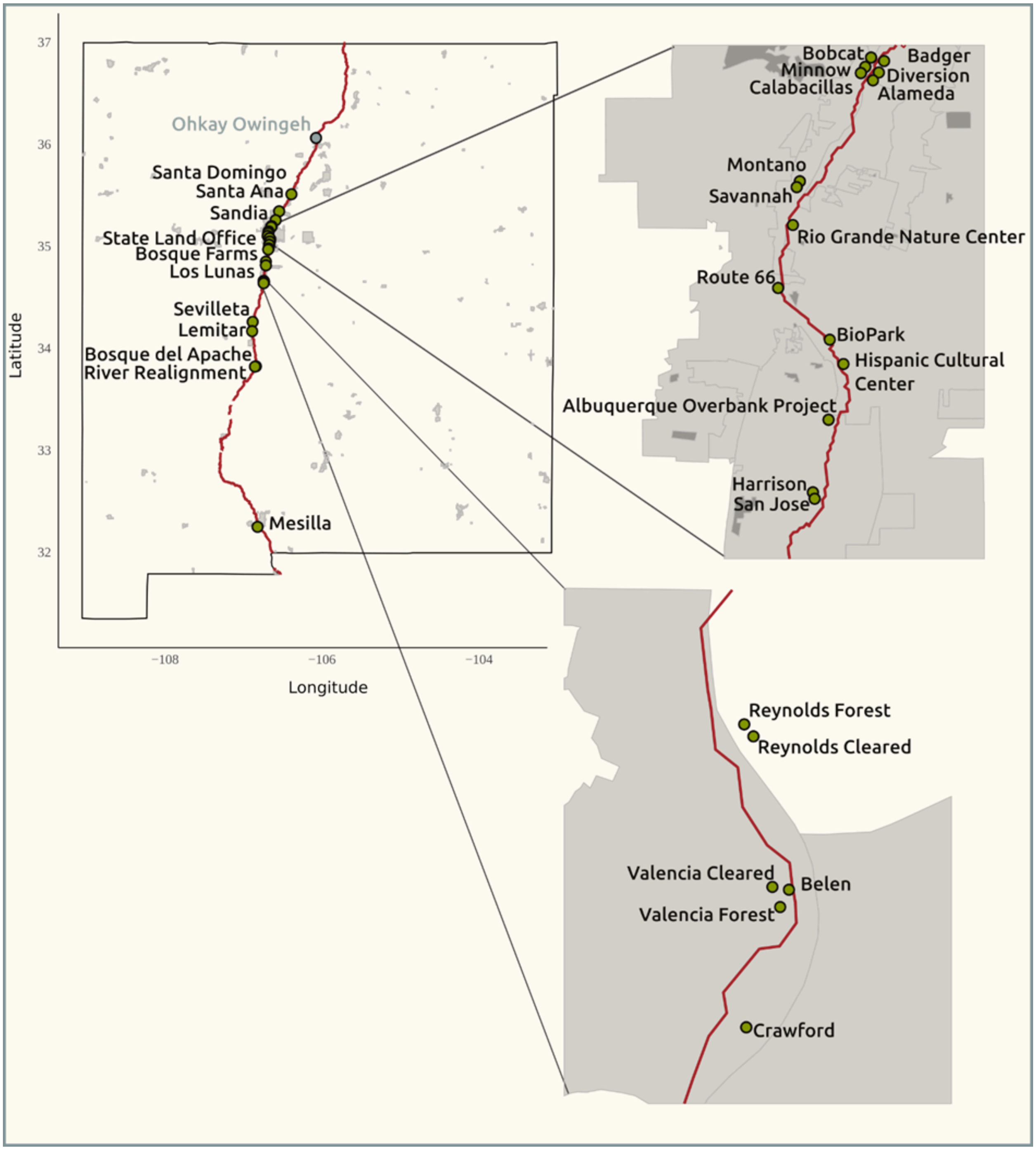

Figure 2.1.a Map of 34 historic BEMP sites along the Rio Grande.

Table 2.1.a BEMP sites and locations along the Rio Grande by Reach, listed from north to south. * denotes inactive site (either no longer active or temporarily inactive)

Site number	Site name	Latitude	Longitude	Reach
9	Ohkay Owingeh*	36.0618	-106.0761	Cochiti
24	Santo Domingo*	35.50989	-106.3896	Cochiti
5	Santa Ana	35.34284	-106.5458	Angostura
32	Sandia	35.255	-106.5907	Angostura
22	Bobcat*	35.19705633	-106.6439494	Angostura
21	Badger	35.1956	-106.6402	Angostura
12	Minnow	35.19315094	-106.646915	Angostura
10	Diversion	35.1908	-106.6429	Angostura
11	Calabacillas*	35.19056822	-106.6491626	Angostura
1	Alameda	35.1875	-106.6459	Angostura
17	Montano	35.14528819	-106.6803699	Angostura
6	Savannah*	35.14285294	-106.6819814	Angostura
2	Rio Grande Nature Center (RGNC)	35.127	-106.6854	Angostura
20	Route 66	35.1006408	-106.6914783	Angostura
23	BioPark	35.079	-106.668	Angostura
8	Hispanic Cultural Center (HCC)*	35.06881267	-106.6580575	Angostura
29	Albuquerque Overbank Project (AOP)	35.04546	-106.6657	Angostura
13	Harrison	35.01505603	-106.6736953	Angostura
31	San Jose	35.012375	-106.6728	Angostura
28	Valle de Oro	34.97895	-106.6801	Angostura

30	State Land Office (SLO)	34.96785	-106.6856	Angostura
27	Bosque Farms	34.848851	-106.714722	Isleta
3	Los Lunas	34.81236936	-106.714458	Isleta
19	Reynolds Forest	34.66054583	-106.7429525	Isleta
18	Reynolds Cleared*	34.65966431	-106.7421328	Isleta
15	Valencia Cleared	34.64863444	-106.7391728	Isleta
4	Belen	34.6484315	-106.7377022	Isleta
16	Valencia Forest	34.64716225	-106.738482	Isleta
25	Crawford	34.63835	-106.74277	Isleta
14	Sevilleta	34.25834233	-106.8831845	San Acacia
7	Lemitar	34.16703188	-106.8899486	San Acacia
34	River Realignment*	33.8227	-106.8419	San Acacia
33	Bosque del Apache (BDA)	33.8197	-106.8539	San Acacia
26	Mesilla*	32.248328	-106.821014	South of San Marcial

2.2 SITE UPDATES

2.2.1 Regular maintenance at BEMP sites

To ensure that BEMP sites remain in good condition and are accessible to staff and students, routine maintenance was performed as necessary. This included clearing trails to facilitate easier access, as well as replacing equipment that had worn out or been damaged by vandalism.

2.2.2 BEMP site updates

Post fire succession continues at Reynolds Forest after the extensive burn damage following the Big Hole Fire, no tree felling or fuel removal is evident in this area. In Spring of 2025 fuel reduction and exotic vegetation removal by the City of Albuquerque Open Space Division took place on the northern half of the Bio Park site impacting litter tubs A–D, pitfall traps 1–8 and the north and east wells. The ecological impacts of this management will be monitored. The Bureau of Reclamation's Los Lunas River Mile 163 River Maintenance Project has impacted the western portion of the Los Lunas site; collections are continuing and ecological impacts of this project will be monitored.

3.1 LONG-TERM MONITORING

3.1.1 Data collections (From previous reports)

Data collections included the monthly monitoring of depth to groundwater of the shallow riparian aquifer, water level in the nearby ditch or drain, precipitation, and litterfall (leaves, reproductive parts, and wood fall) of the dominant shrub and tree species. BEMP staff and UNM students continue to process data and BEMP staff enter and analyze the data for the reporting period. BEMP collected monthly data at 25 sites. BEMP staff and students also monitor surface-active arthropods three times/year at 15 sites and monitor vegetation cover at 20 sites. Tamarisk leaf beetle monitoring occurs May-September at 10 sites. BEMP methods can be found on www.BEMP.org or https://github.com/BEMPscience/bemp_data/tree/master

3.1.2 Temperature

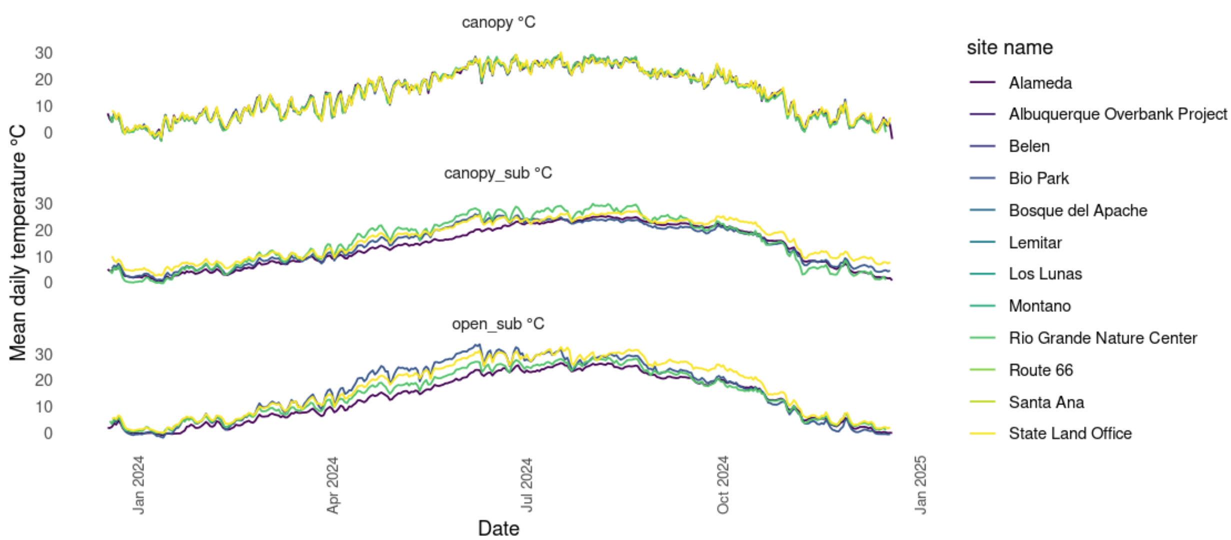

Figure 3.1.2.a Mean daily temperature across sites.

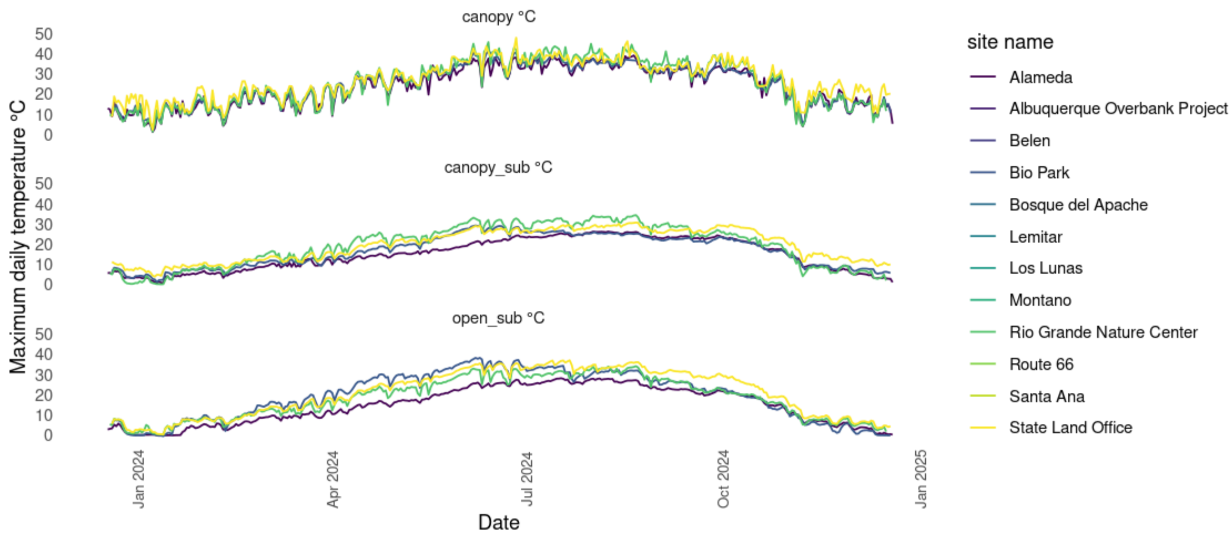

Figure 3.1.2.b Maximum daily temperature across sites.

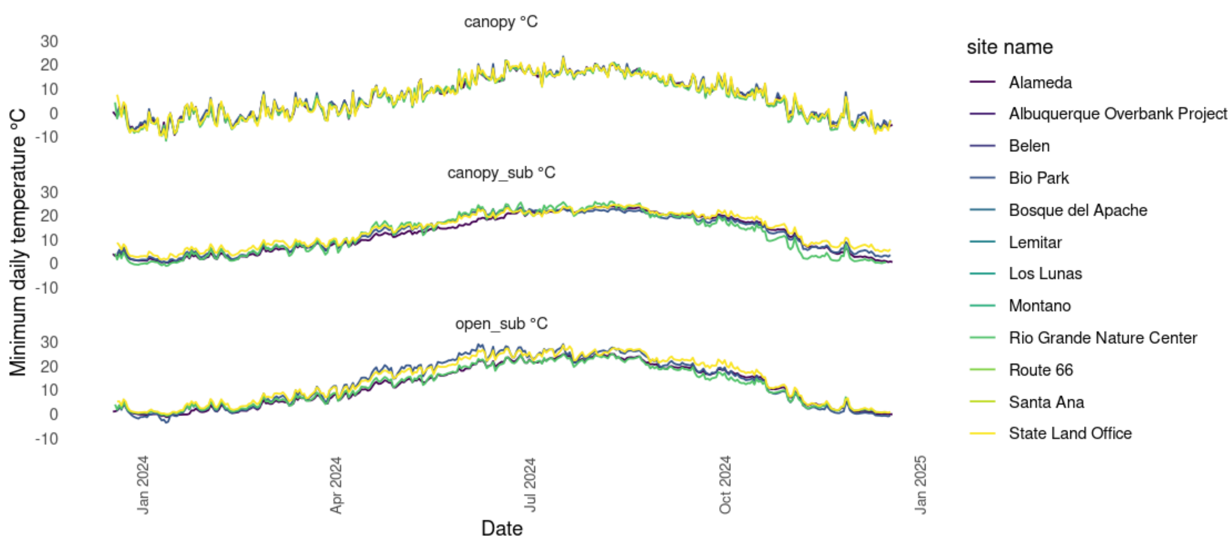

Figure 3.1.2.c Minimum daily temperature across sites.

Long term high resolution temperature measurements are critical for understanding how increasing temperatures, fires, and revegetation events will impact the bosque. A clear example was at the BioPark site where temperatures were highest at the open canopy subsurface due to a combination of time of year, fire, revegetation, and clearing, which can be seen in Figure 3.1.2.b .

3.1.3 Precipitation

Precipitation is measured at all of our sites, except for Bosque Farms (due to repeated vandalism), Bosque del Apache (due to interference from local wildlife), and occasionally Valle de Oro (due to interference from birds perching on rain gauges). At each other site, two Tru-Chek precipitation gauges are installed on a post; one under the forest canopy, and one out in the open, except for Valle del Oro, with a single, open, gauge due to a lack of canopy. Each rain gauge is monitored and emptied by BEMP staff and community scientists once per month. A small amount of oil is added to the empty gauge to prevent evaporation and to ensure capture of the full month's precipitation.

Figure 3.1.3.a Mean monthly precipitation (mm) at each site for 2005.

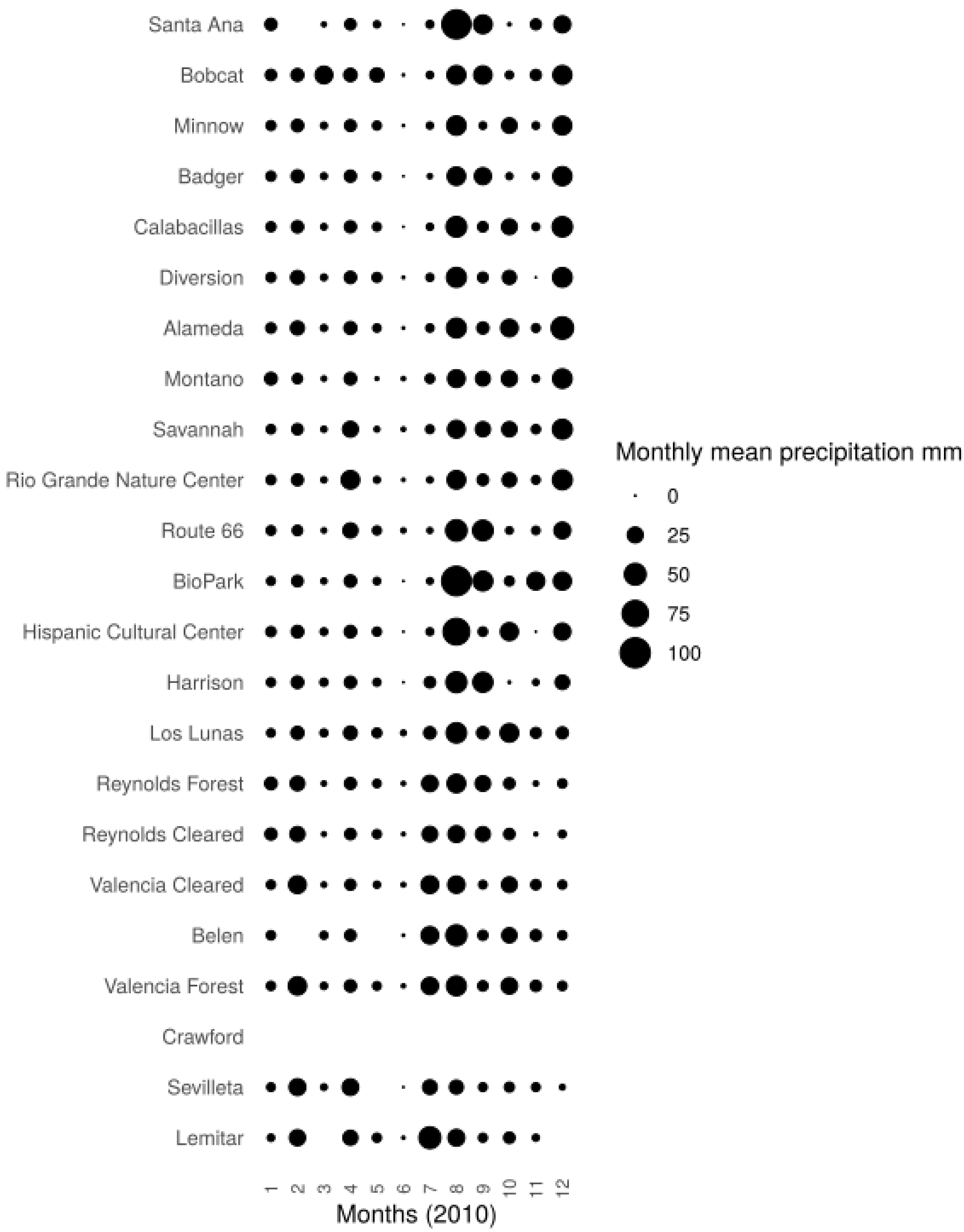

Figure 3.1.3.b Mean monthly precipitation (mm) at each site for 2010.

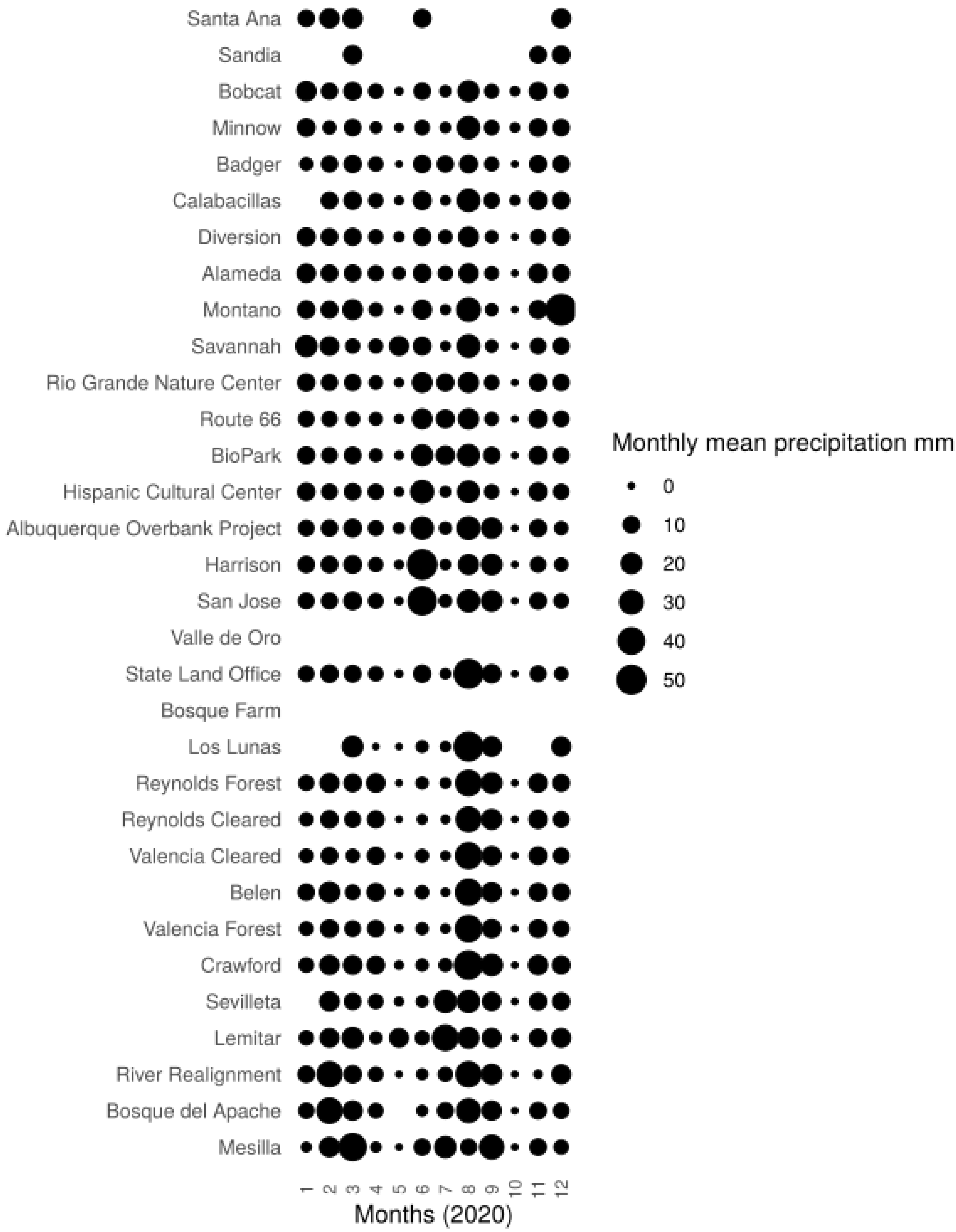

Figure 3.1.3.c Mean monthly precipitation (mm) at each site for 2020.

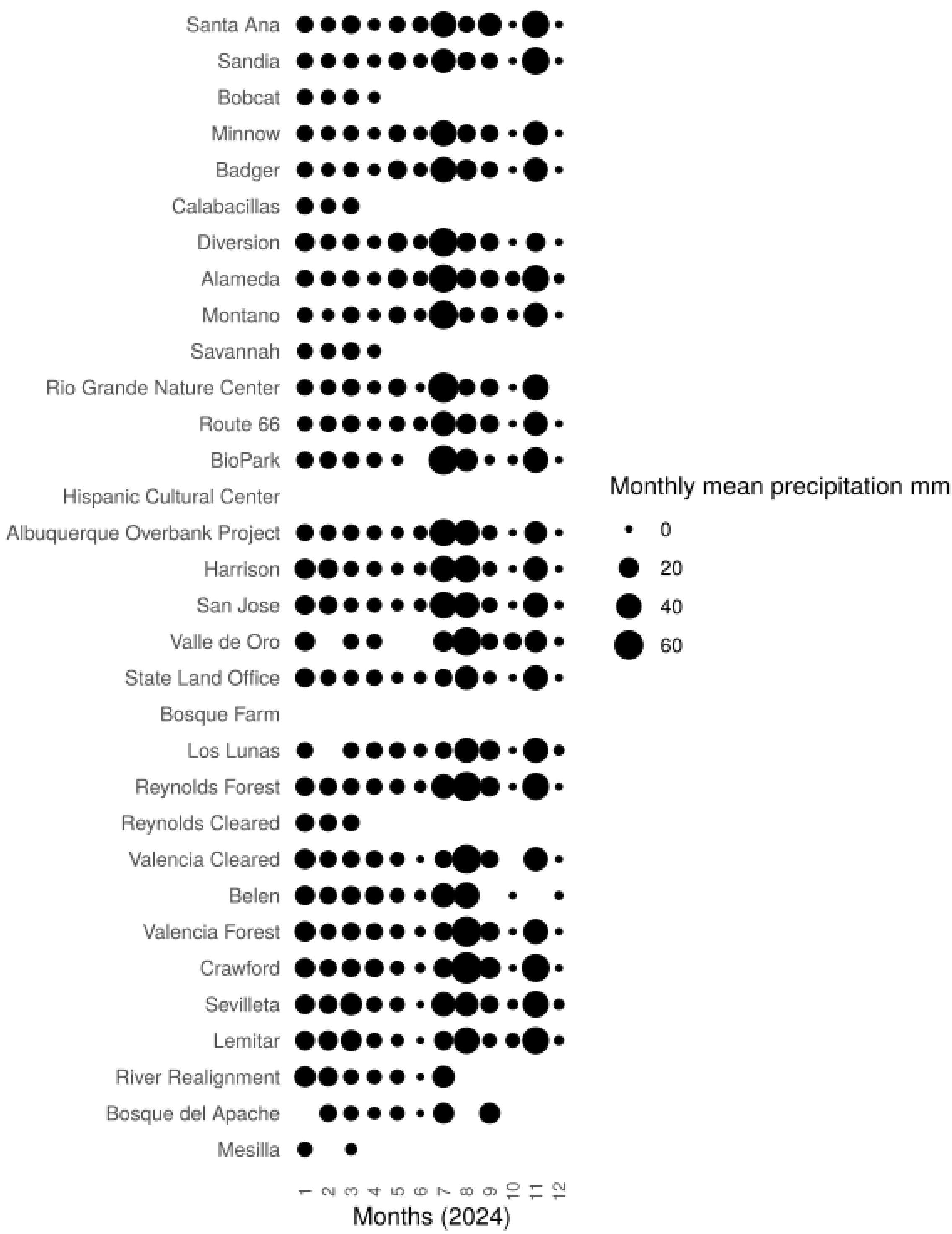

Figure 3.1.3.d Mean monthly precipitation (mm) at each site for 2024.

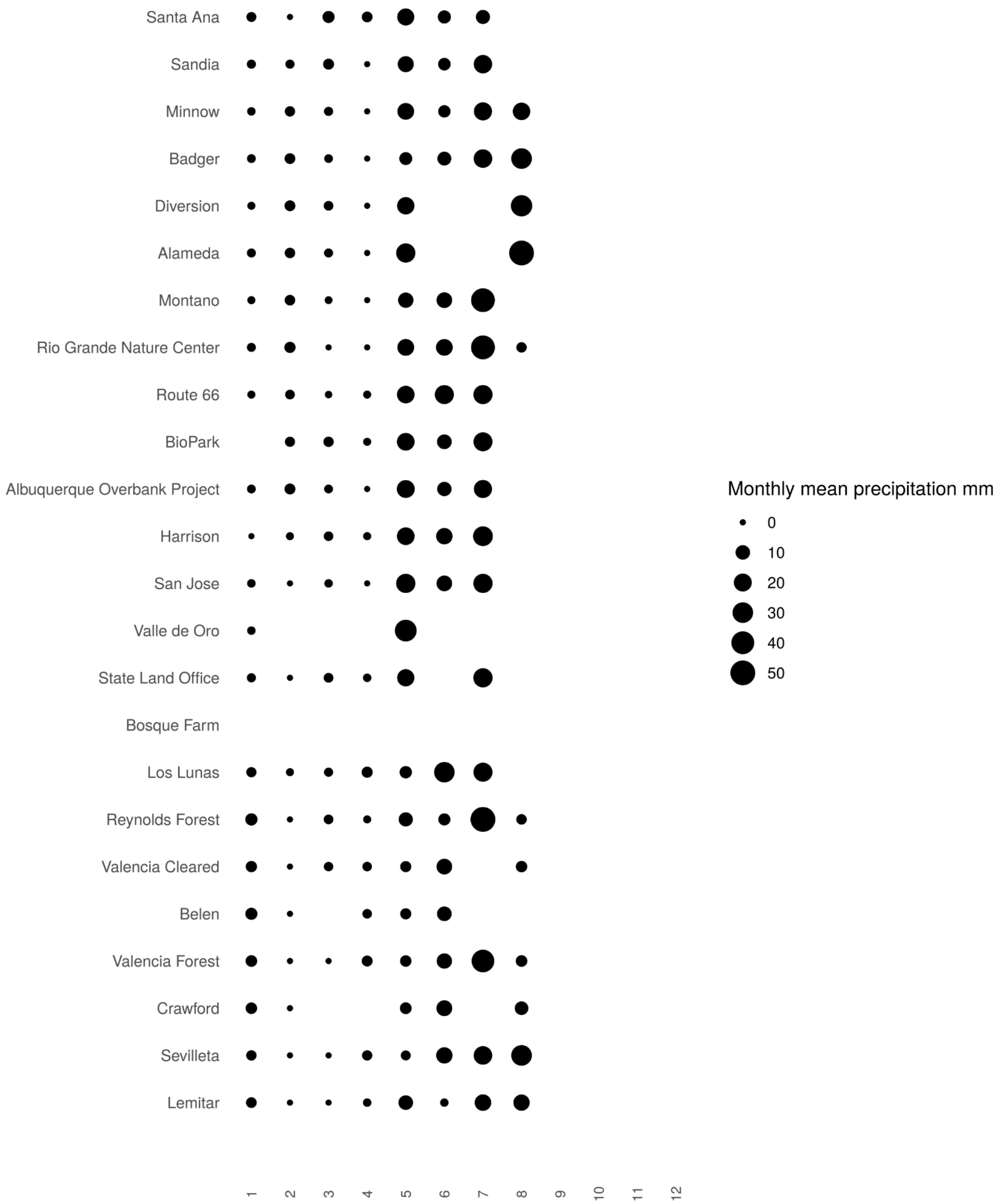

Figure 3.1.3.d Mean monthly precipitation (mm) at each site for 2025 (still collecting).

Table 3.1.3.a Knapp et al. (2015) definitions: an extreme wet year, precipitation > 90th %-ile; extreme dry year, precipitation < 10th %-ile; average year, precipitation > 45th and < 55th %-ile; for Sevilleta Long-Term Ecological Research data classifications, Kris Hall added; above average - >= 55th and <= 90th; below average - <= 45th and >= 10th. Values in cells are annual precipitation (mm) for sites across years of monitoring.

Site name	Extreme wet	Extreme dry	Avg low	Avg high
Alameda	267.5	98.2	152.5	168.3
Albuquerque Overbank Project	173.4	76.5	126.1	132.7
Badger	209.0	84.0	119.8	135.2
Belen	253.7	109.0	155.5	170.1
BioPark	231.5	103.4	147.7	153.0
Bobcat	221.7	46.4	124.8	135.2
Bosque del Apache	166.1	62.3	135.1	141.3
Calabacillas	219.6	75.8	133.5	142.4
Crawford	264.1	91.5	161.0	193.4
Diversion	246.4	73.2	149.7	154.1
Harrison	248.9	89.4	152.3	172.3
Hispanic Cultural Center	204.6	77.6	144.5	162.6
Lemitar	228.9	92.5	162.5	167.9
Los Lunas	195.6	68.1	151.8	168.4
Mesilla	147.5	37.7	108.4	115.9
Minnow	213.9	63.6	123.0	135.4
Montano	221.9	116.9	134.6	156.1
Ohkay Owingeh	275.9	133.9	204.3	232.1
Reynolds Cleared	229.3	85.5	143.3	151.7
Reynolds Forest	237.1	112.5	156.6	168.8
Rio Grande Nature Center	213.4	98.5	157.6	166.6
River Realignment	171.8	50.3	133.2	138.0
Route 66	203.9	97.3	123.7	136.1
San Jose	184.2	66.4	148.9	151.3
Sandia	160.1	46.2	131.0	131.0

Santa Ana	217.9	71.1	123.6	144.4
Santo Domingo	290.2	52.1	148.7	164.5
Savannah	203.5	90.3	141.1	146.6
Sevilleta	204.8	77.0	142.6	161.3
State Land Office	199.5	102.3	127.1	135.7
Valencia Cleared	215.3	102.7	161.3	168.1
Valencia Forest	275.7	115.9	183.9	186.6
Valle de Oro	160.1	42.8	96.2	115.6

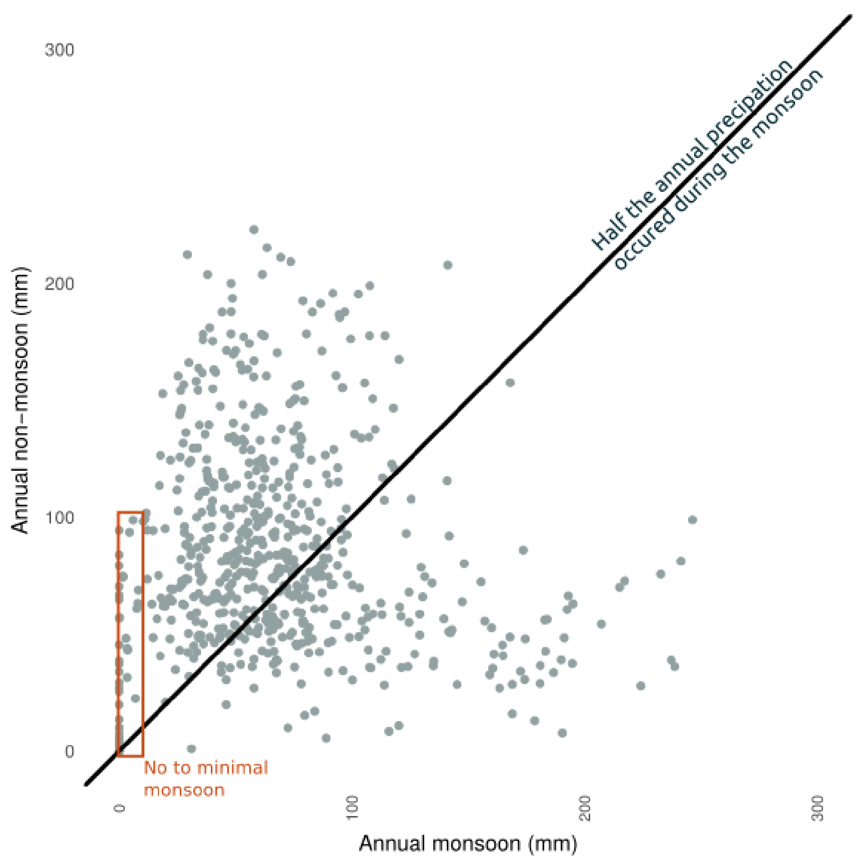

Figure 3.1.3.e Annual precipitation divided by timing between monsoon season and all other months. Non-monsoon and monsoon annual sums can show how much precipitation is being contributed by monsoon rains. Monsoon rains are designated as July through September for each year. The black line represents years and sites where half the precipitation occurred during monsoons and half occurred during other months. The orange box outlines the years with no monsoon rains.

Spatial variability in precipitation is evident across the sites but is not consistent in its pattern across years. For example, in 2005, monsoon rains were heaviest in Albuquerque, slightly lighter in Belen sites, and heavier again south of Belen (Figure 3.1.3.a). In 2010, monsoons were light everywhere, but the most precipitation was recorded north of Albuquerque and in the southernmost Albuquerque sites (Figure 3.1.3.b). In 2020, monsoon rains were heaviest to the south of Albuquerque (Figure 3.1.3.c), and in 2024, there was a fairly even distribution of monsoonal rains (with a split in timing between early and late July, which shows up as July in the northern sites and August in the southern sites) (Figure 3.1.3.d). Although the size of the precipitation data points in each of the 3.1.3 figures is scaled to the graphed year, the preliminary data for 2025 (Figure 3.1.3.e) highlight the drought conditions in the Middle Rio Grande for this year, as low to no precipitation resulted in the drought status of the Middle Rio Grande shifting from "severe drought" to "extreme drought" in mid-April and back to "severe drought" in early September (U.S. Drought Monitor). This resulted in noticeable impacts on vegetation at bosque sites. Table 3.1.3.a gives an overview of the variability between sites. Most years, the majority of the annual rainfall occurs in non-monsoon months and there are many years where the precipitation at sites is close to 50% from monsoon events and 50% from non-monsoon events (Figure 3.1.3.e). In many climate models there is a prediction for less monsoon rainfall (which many native plants rely on) and less monsoon rainfall contributions to annual precipitation. There are also predictions for later monsoons and increased variability. These shifts have implications for river flow, groundwater, vegetation communities, and the animal communities they support.

3.1.4 Depth to groundwater

Depth to groundwater is monitored at all current BEMP sites except the Pueblo of Santa Ana. Pueblo of Sandia groundwater data are proprietary and must be requested through the Pueblo's Department of Natural Resources. Each month, BEMP staff, along with UNM interns, K-12 students, and teachers monitor the five groundwater wells at BEMP sites. The nearby ditch/drain is also monitored and USGS river flow data are downloaded based on the monitoring day from the closest gauge to the north of each site. This allows BEMP to track the shallow riparian aquifer response to changes in river flow.

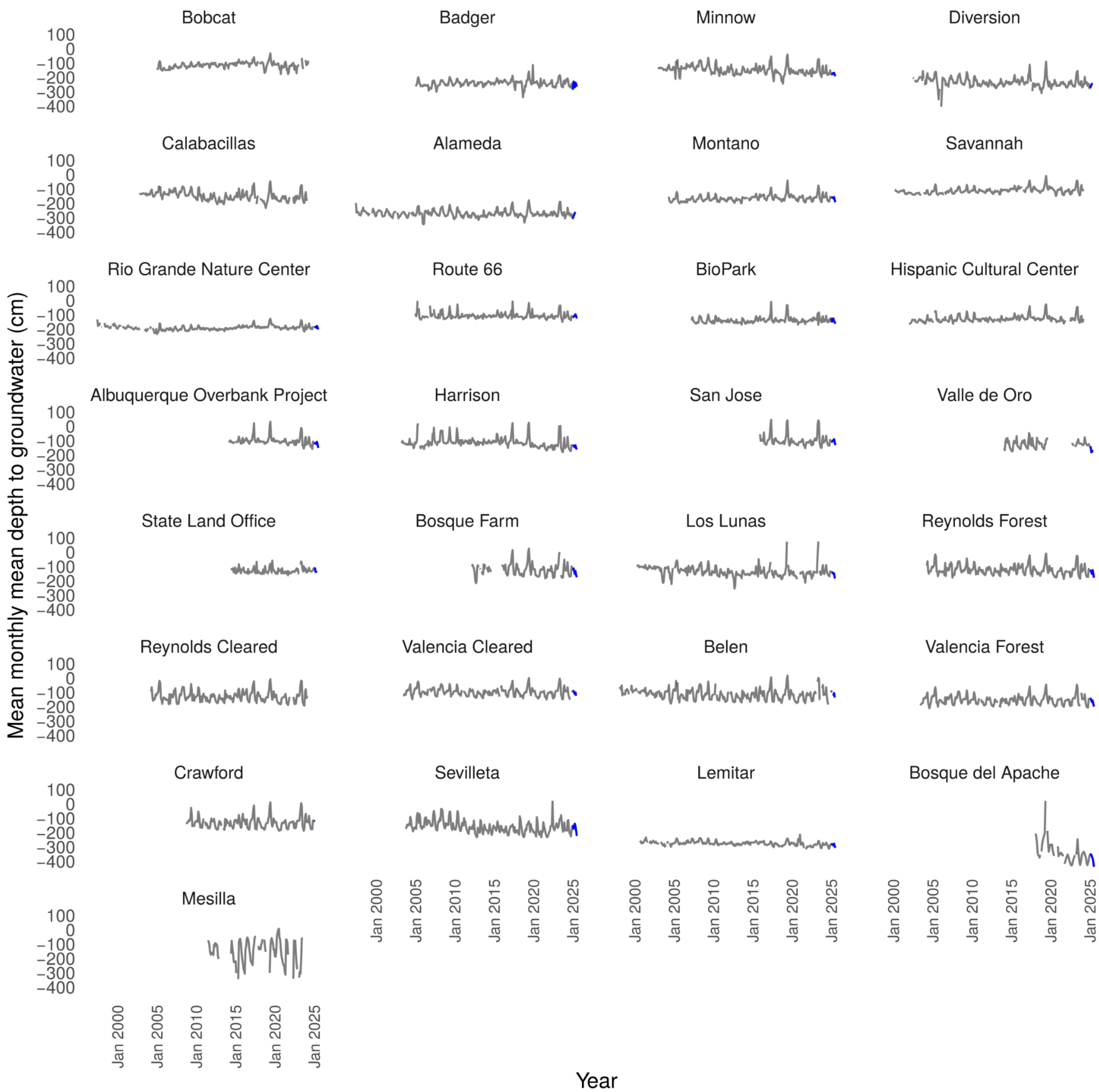

Figure 3.1.4.a Plot of the mean monthly depth to groundwater in cm across all BEMP sites from 1997 to June 2025. Sites arranged geographically from north to south.

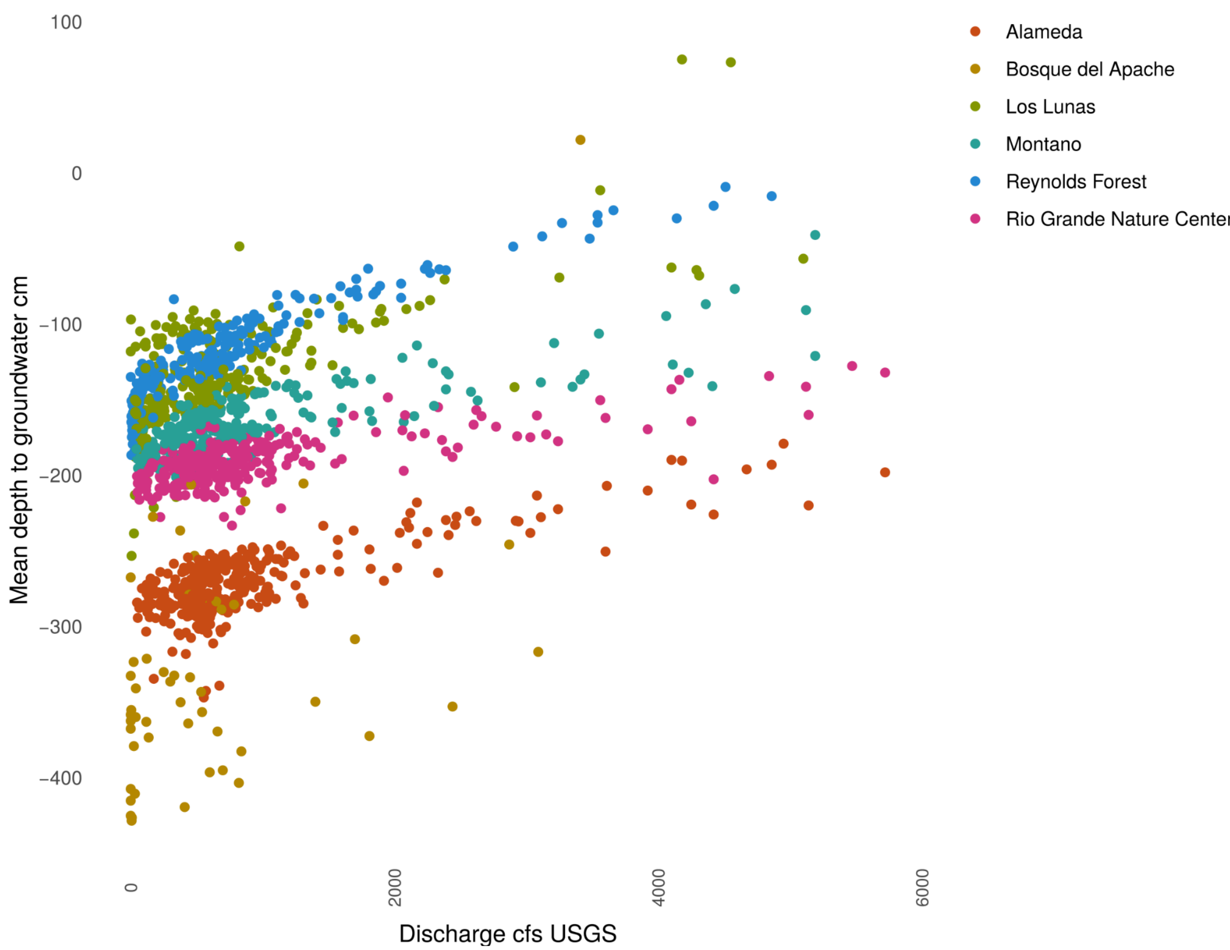

Figure 3.1.4.b Mean depth to groundwater (cm) vs Rio Grande river flow (cfs) across years at sites in Bernalillo County (Montano and Rio Grande Nature Center), Valencia County (Reynolds Forest and Los Lunas), and Socorro County (Bosque del Apache).

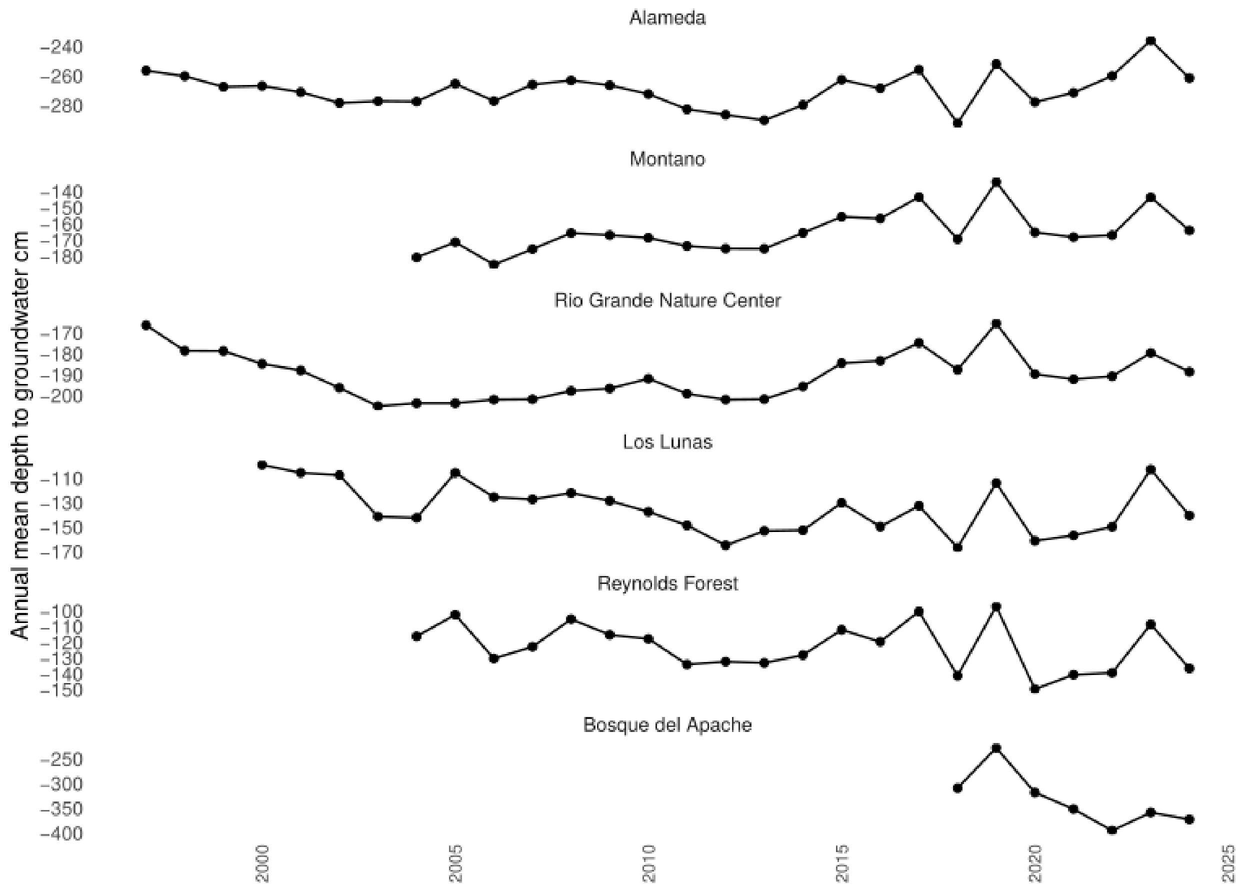

Figure 3.1.4.c Annual mean depth to groundwater (cm) from 1997 through 2024 at sites in Bernalillo County (Montano and Rio Grande Nature Center), Valencia County (Reynolds Forest and Los Lunas), and Socorro County (Bosque del Apache).

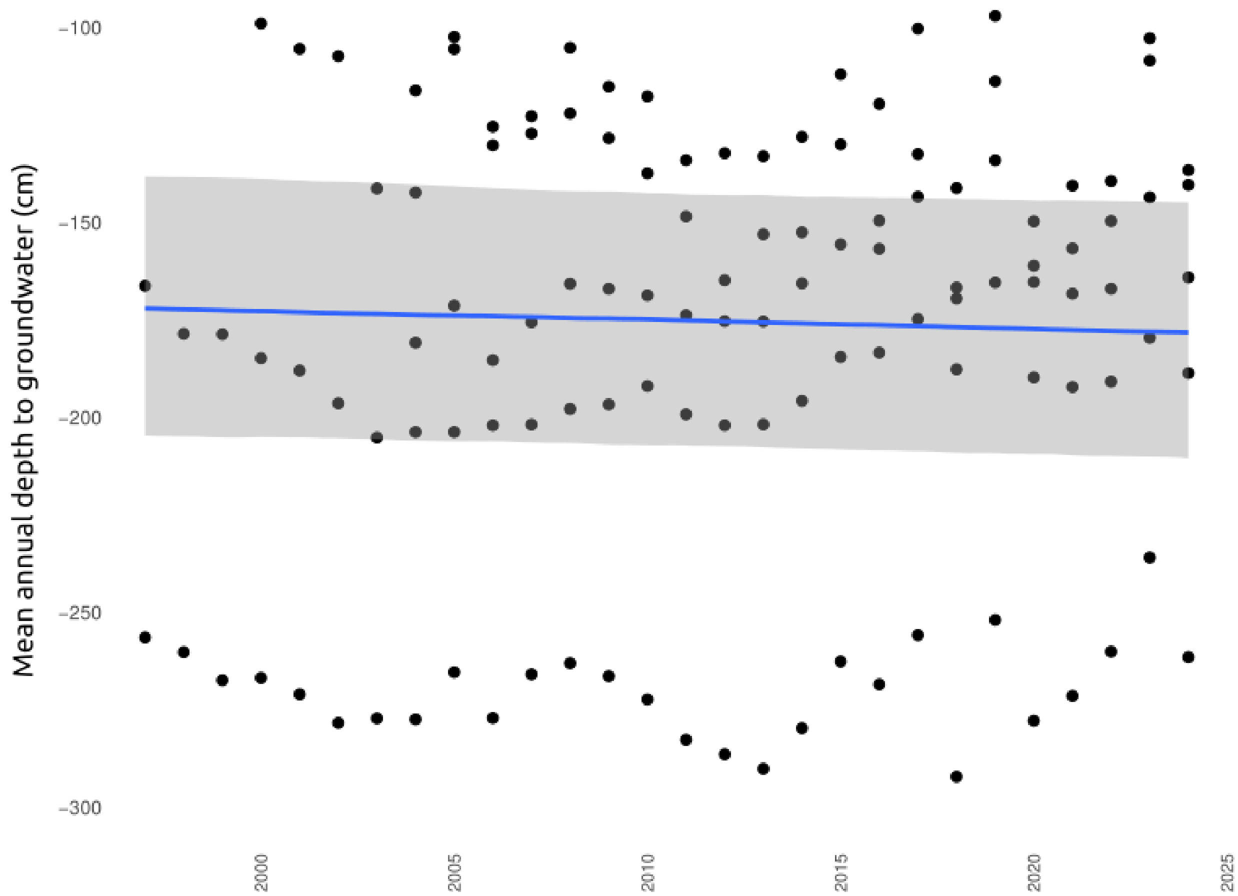

Figure 3.1.4.d Mean annual depth to groundwater (cm) from 1997 through 2024 at sites in Bernalillo County (Montano and Rio Grande Nature Center), and Valencia County (Reynolds Forest and Los Lunas).

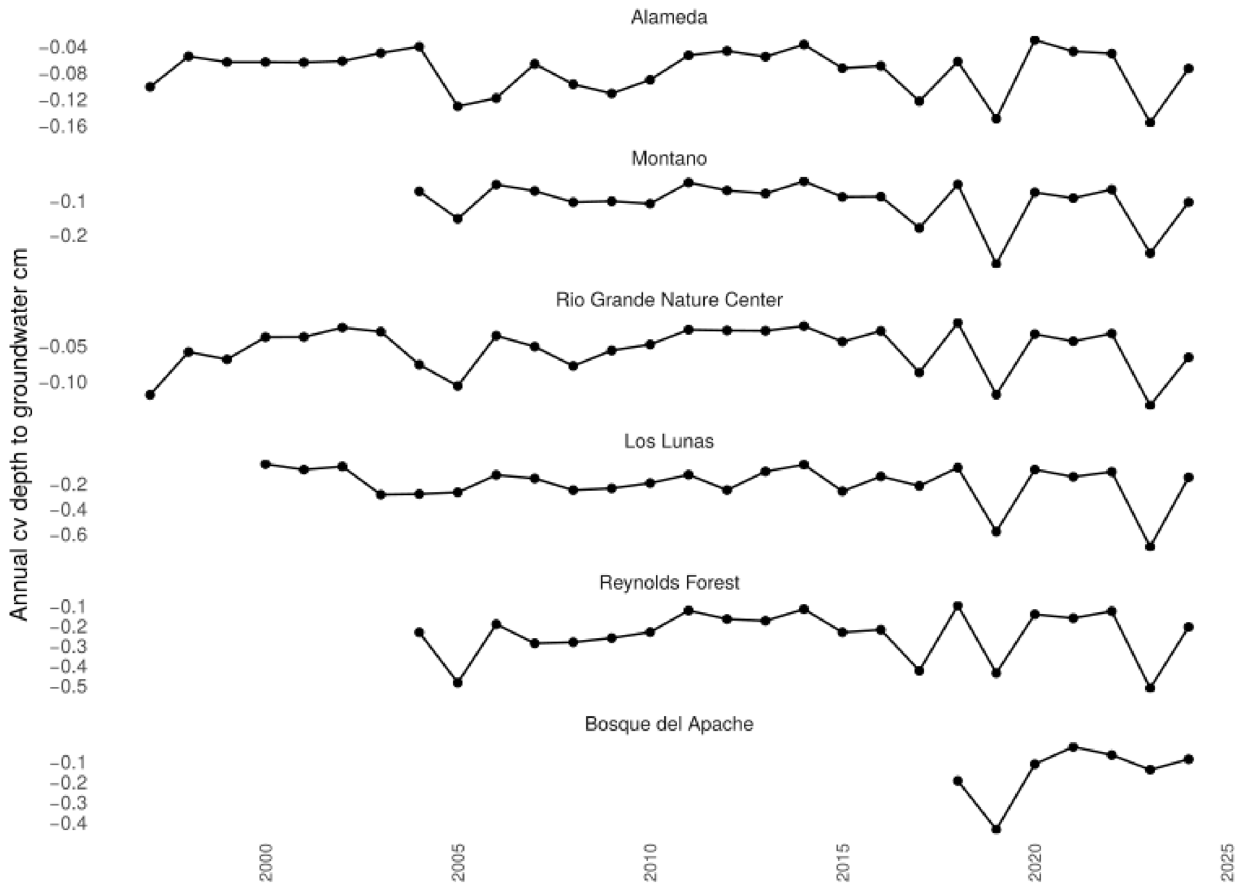

Figure 3.1.4.e Annual coefficient of variation (cv) in depth to groundwater (cm) from 1997 through 2024 at sites in Bernalillo County (Montano and Rio Grande Nature Center), Valencia County (Reynolds Forest and Los Lunas), and Socorro County (Bosque del Apache). This is a measure of variation within a year. Numbers are negative as they reflect depth to water below the surface, so increasing variability is indicated by the larger negative numbers.

Over time, the mean depth of the groundwater is decreasing (50% UI -0.41 - -0.07) across five representative sites in Bernalillo County (Montaño and Rio Grande Nature Center), Valencia County (Reynolds Forest and Los Lunas), and Socorro County (Bosque del Apache) (Figures 3.1.4.c & 3.1.4.d). There are highly variable responses largely driven by the geomorphology in the different reaches (some are gaining reaches others are losing reaches). The sharp decline in groundwater at Bosque del Apache (Figure 3.1.4.c) and the shift in correlation between groundwater and river flow there (Figure 3.1.4.b) is an expected result from the River Realignment Pilot Project and moving the active river channel further to the east. Even with declining river flows, most sites still exhibit a strong correlation and connection between groundwater and river flow (Figure 3.1.4.b). Within-year variability has become more variable since 2017, due to the years with high spring runoff (2017, 2019,

2023) resulting in flooding and high groundwater at sites, followed by low late summer river flows, river drying, and subsequent groundwater declines at sites (Figure 3.1.4.e). Groundwater declines are strongest in the San Acacia Reach sites, where river drying is more extensive, even during spring runoff (Figure 3.1.4.f). High flow years, with resulting higher groundwater levels, provide mitigation of the overall decline in the Isleta Reach during the spring runoff season, with more noticeable declines in summer and winter. The Albuquerque Reach, both north and south, have a shallower slope but there are distinctly lower groundwater levels in the northern section of Albuquerque compared to the south (Figure 3.1.4.f).

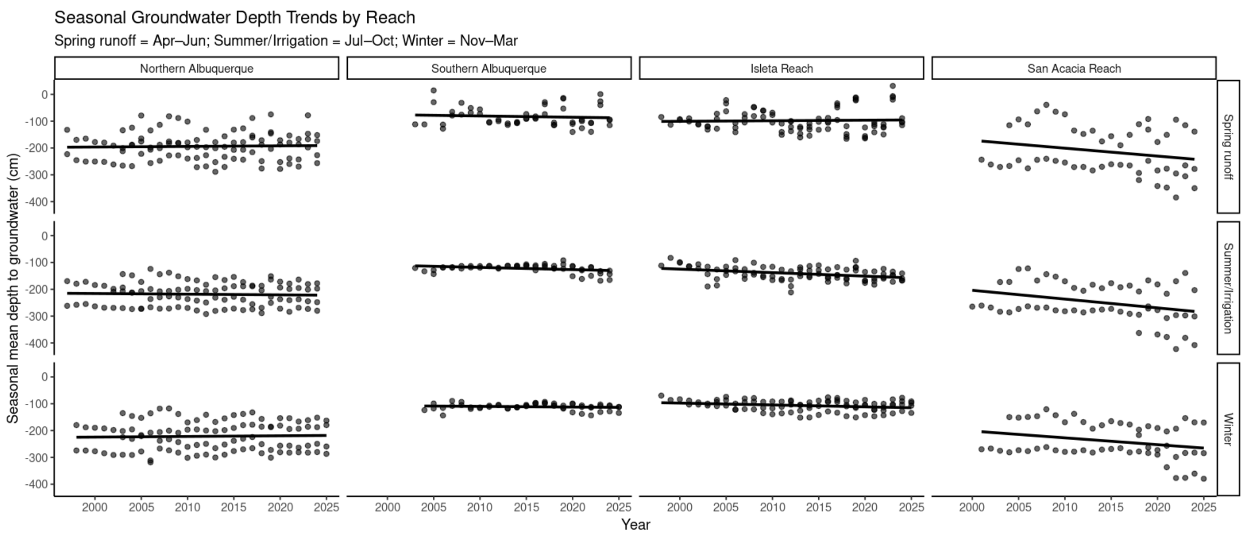

Figure 3.1.4.f Seasonal groundwater trends by reach, with the Albuquerque Reach divided into northern (Alameda Bridge to I-40 Bridge) and southern (I-40 Bridge to I-25 Bridge) sections.

3.1.5 Leaf Litterfall and Vegetation Cover

Leaf litterfall is a measure of productivity at sites by dominant tree species. Cottonwoods still dominate the canopy at most sites, although they are declining or remaining low and stable at most sites (Figure 3.1.5.a). Cottonwood productivity is increasing at ~5 sites, primarily due to management efforts like bank lowering or pole planting (Figure 3.1.5.a). There is high variability of willow leaf fall (Figure 3.1.5.b) across years when compared at small scales (cottonwood leaf fall ranges from 0 to 500 g/m^2 while willow leaf fall ranges from 0 to 2 g/m^2, though at most sites is below 1 g/m^2). Most willow leaf fall is from coyote willow (*Salix exigua*) rather than tree willows. Russian olive leaf fall ranges from 0 to 60 g/m^2 and is low or steady at most sites, there is an increase at 9 sites (Figure 3.1.5.c). The sites with increasing Russian olive productivity tend to be sites with open areas (due to clearing, bank lowering, or cottonwood canopy decline). Several sites with dense Russian olive thickets show a slow decline over the years. Saltcedar leaf fall is highly variable across sites, with some sites and years at 0 g/m^2 and others as high as 200 g/m^2 (at Reynolds Forest, in Belen, before clearing and fire) (Figure 3.1.5.d).

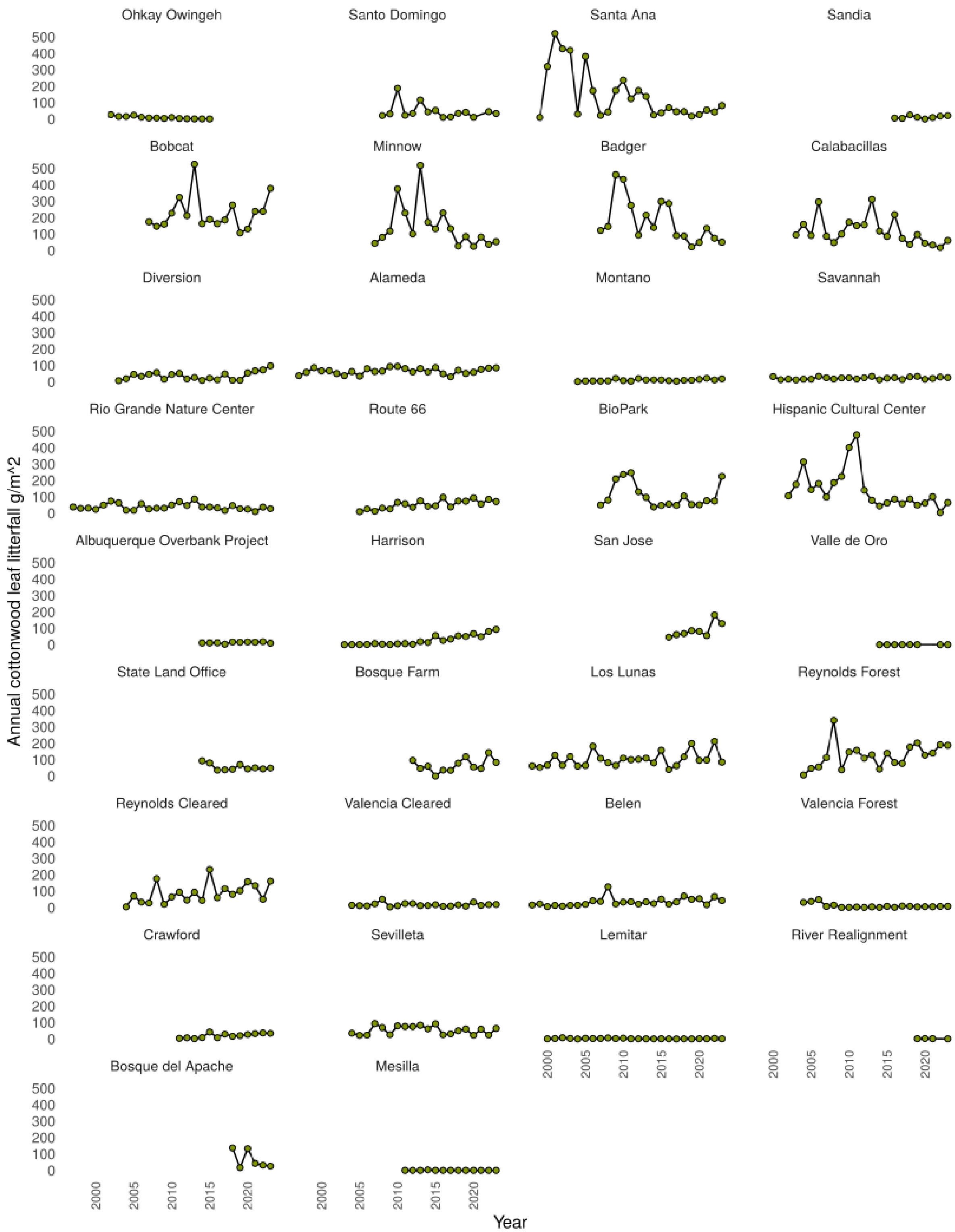

Figure 3.1.5.a Annual cottonwood leaf litterfall (g/m^2) at all BEMP sites from 1997 through 2023. Sites arranged geographically from north to south.

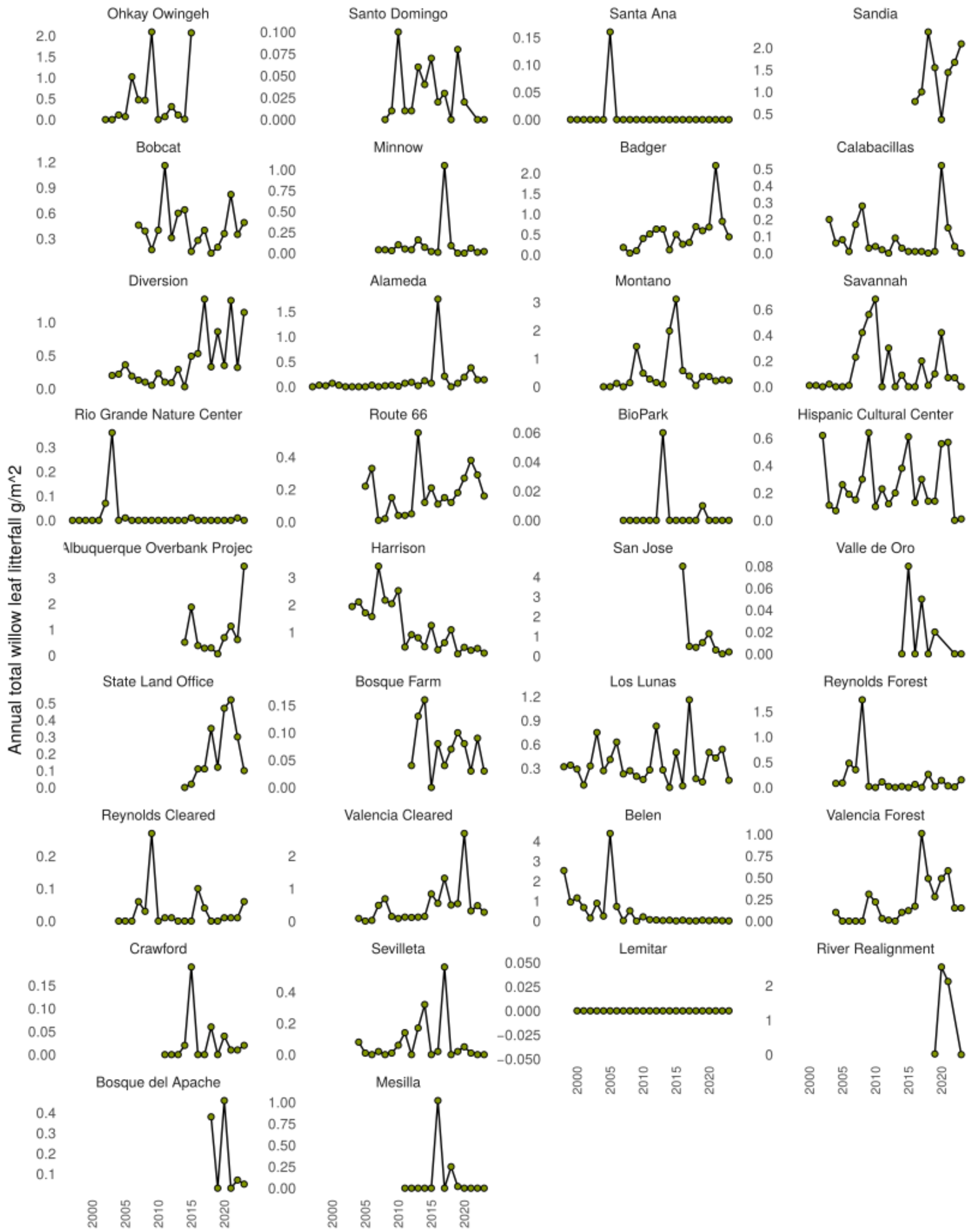

Figure 3.1.5.b Annual total leaf litterfall (g/m^2) for willows (*Salix* spp.) at all BEMP sites from 1997 through 2023. Sites arranged geographically from north to south. Y-axes are free scale (vary depending on the site data) to show variability between years. Negative numbers at Lemitar are there to allow the data points at zero to be clearly seen.

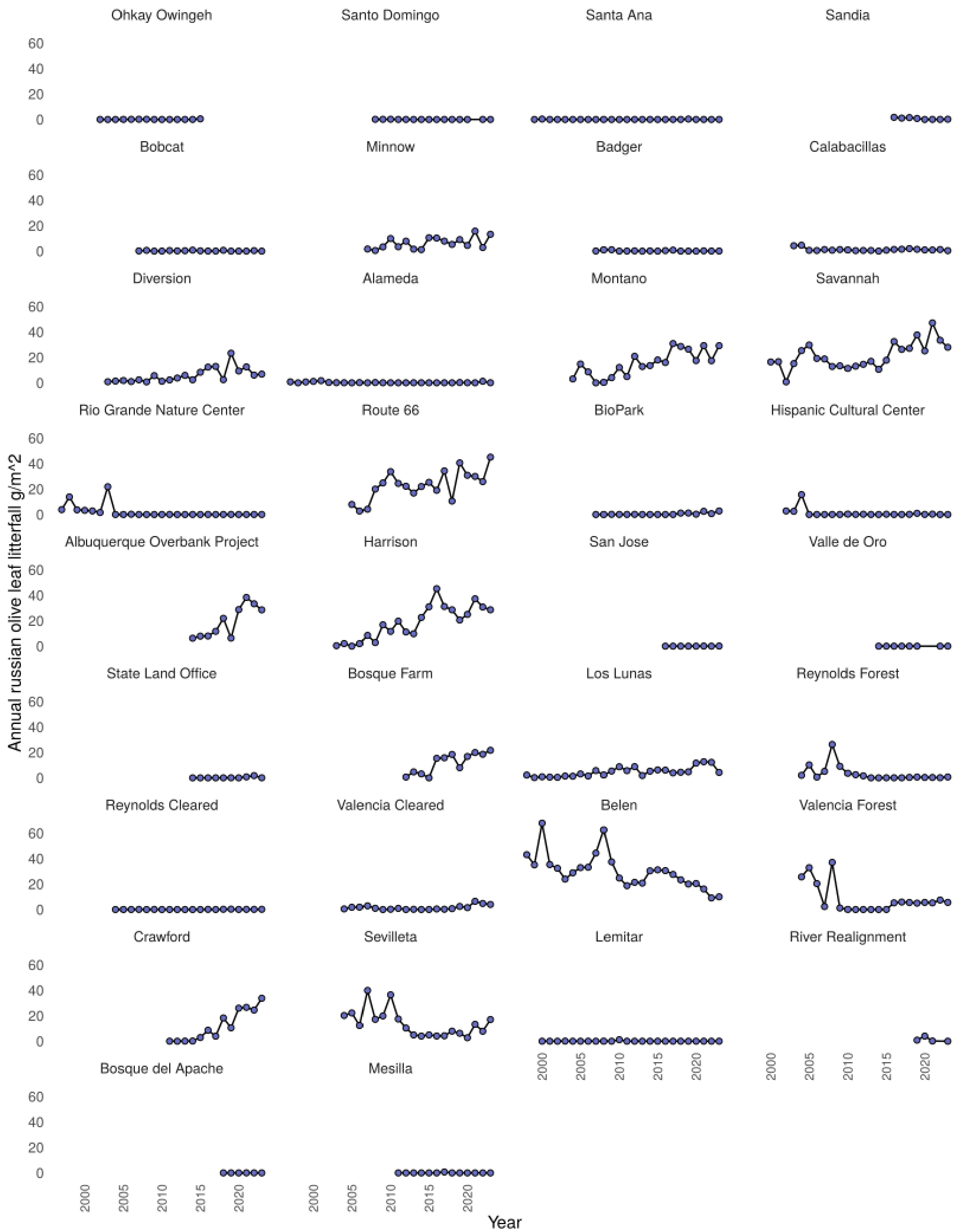

Figure 3.1.5.c Annual Russian olive leaf litterfall (g/m^2) at all BEMP sites from 1997 through 2023. Sites arranged geographically from north to south.

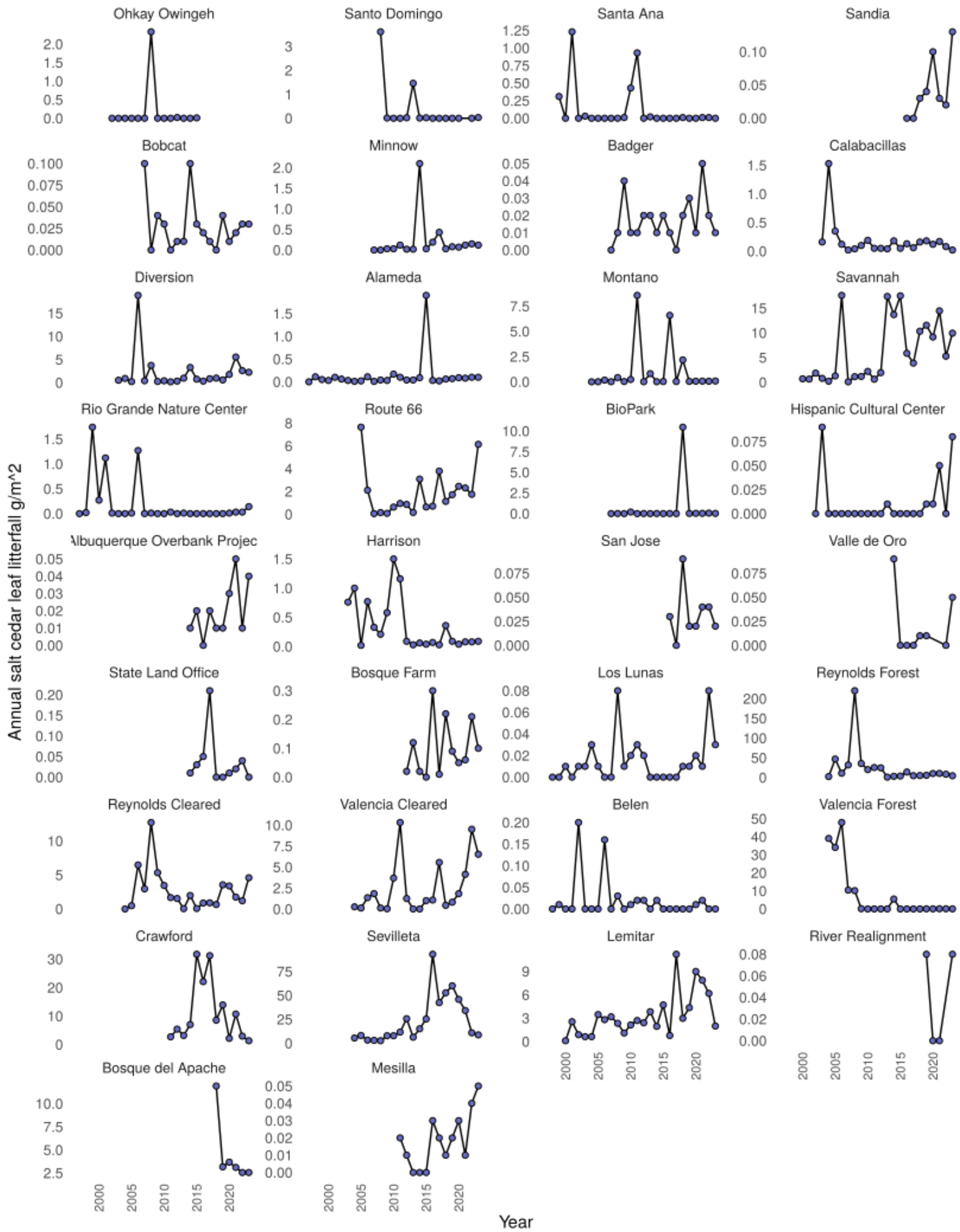

Figure 3.1.5.d Annual saltcedar leaf litterfall (g/m^2) at all BEMP sites from 1997 through 2023. Sites arranged geographically from north to south. Y-axes are free scale (vary depending on the site data) to show variability between years.

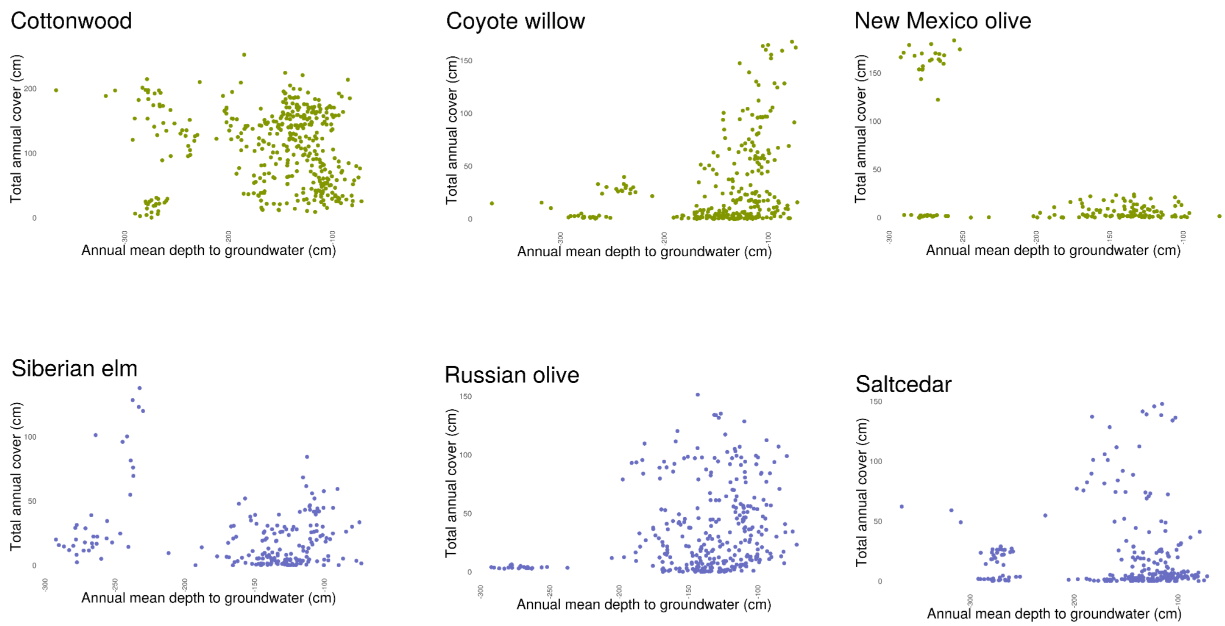

Figure 3.1.5.e Vegetation cover (cm) vs annual mean depth to groundwater (cm) for cottonwood, coyote willow, New Mexico olive, Siberian elm, Russian olive, and saltcedar. Native species are in green and exotic species are in purple.

When analyzing vegetation cover with groundwater (Figure 3.1.5.e), cottonwoods show the highest cover with depth to groundwater between 1-2 m, with some sites supporting high cottonwood cover at groundwater depths around 2.7m. Siberian elm has a similar pattern, but the highest cover is supported at sites with groundwater around 2.5 m; much of this is skewed by exotic removal at sites. Coyote willow does best with groundwater levels around 1 m, as does saltcedar, though saltcedar has a broader tolerance of lower water tables. Russian olive cover is highest at sites with groundwater between 1-2 m. New Mexico olive is not as common at BEMP sites and shows a wide tolerance of varying groundwater depths, with the highest cover at Alameda, with a depth to groundwater of close to 3 m.

3.1.6 Surface-Active Arthropods

Surface-active arthropods are monitored three times each year, in May, June, and October, to capture shifts in arthropod communities through the growing season. Twenty pitfall traps are placed along every other vegetation line at key sites. Isopods are an indicator species for sites with higher litter and moisture levels, like Alameda (high litter layer, low groundwater) and Belen (high groundwater and high litter layer) as opposed to sites that are shifting to more open, dryland conditions, like Diversion and Lemitar.

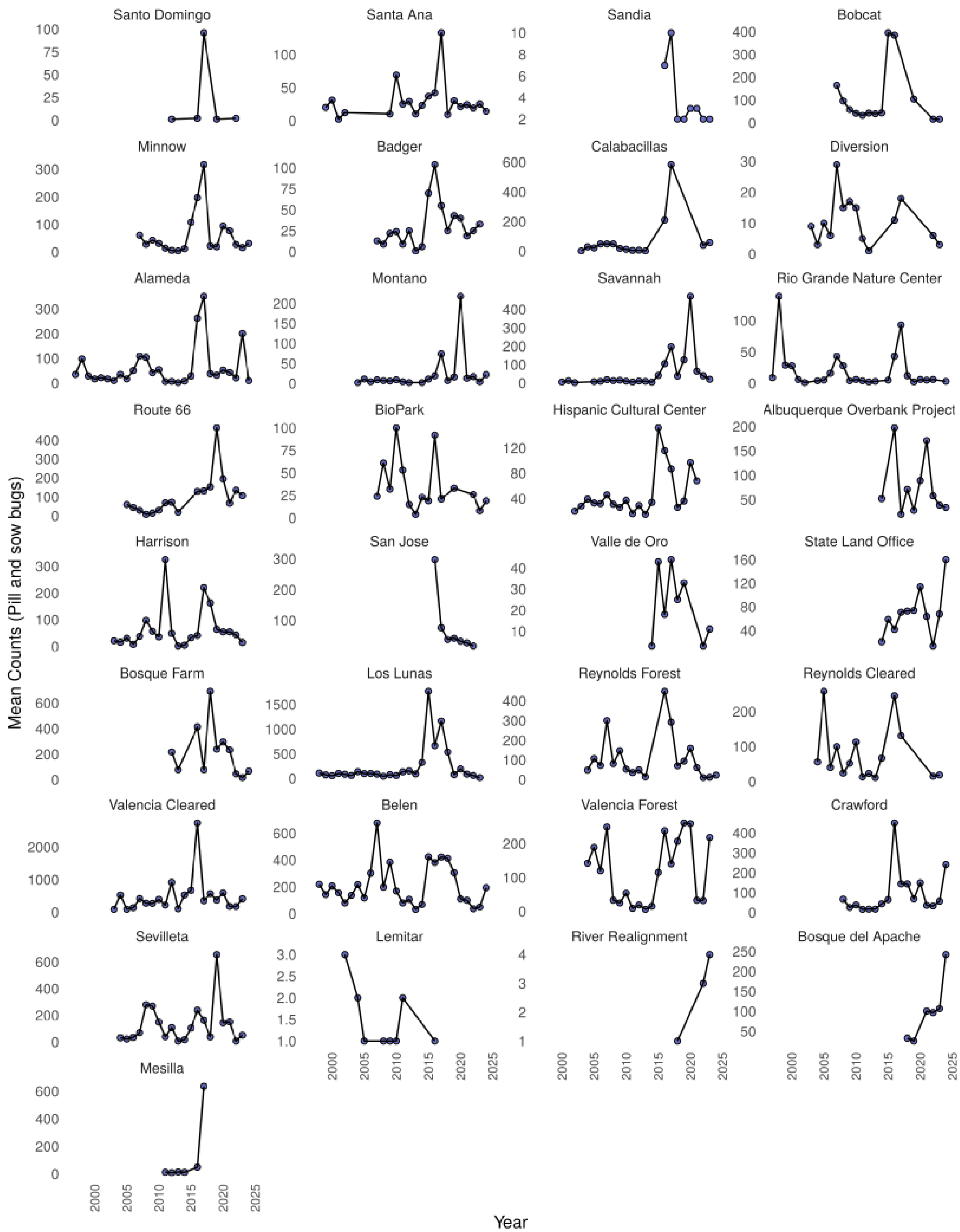

Figure 3.1.6.a Terrestrial isopod (*Armadillidium vulgare* and *Porcellio laevis*) abundance at BEMP sites from 1997 through 2024. Sites arranged geographically from north to south. Y-axes are free scale (vary depending on the site data) to show variability between years.

Isopods (*Armadillidium vulgare* and *Porcellio laevis*) commonly referred to as pill and sow bugs respectively, are non-native terrestrial crustaceans. These arthropods are detritivores aiding in the decomposition of biological matter including leaf litter. In the absence of historic overbank floods that would scour, and help to hasten the decomposition of this material, these arthropods are essential to helping break down organic matter. Active mostly at night, these arthropods require high levels of humidity and soil moisture to thrive but populations are shown to decline with flooding events as they are not well adapted to flooding. They can be useful indicators of relative soil moisture and ground cover.

3.1.7 Tamarisk Leaf Beetle

BEMP has monitored for tamarisk leaf beetles (TLB) (*Diorhabda* spp.) since 2013; sampling in 2024 continued at 10 BEMP sites and one additional Greater Rio Grande Watershed Alliance (GRGWA) site (Rio Abajo, in Valencia County) monthly from May through August, with a subset of sites continuing through September to track late season TLB. TLB are counted separately according to life stage: early TLB larvae, late TLB larvae, adult TLB and TLB egg masses. *Coniatus splendidulus*, the splendid tamarisk weevil (and associated life stages); *Opsius stactogalus*, tamarisk leafhoppers; and generalist predators (ants, spiders, and ladybugs) are also identified and counted, along with other captures. At the request of River's Edge West, specimens of *Diorhabda* spp. were collected into 95% ethanol from a subset of sites (Diversion, Valencia Cleared, BDA, Rio Abajo, and Sevilleta, and from Crawford instead of Valencia Cleared in September) to submit for DNA sampling in support of research being conducted by Northern Arizona University. BEMP records the percent of dead branches, yellow (leafhopper) and brown (TLB) defoliation, refoliation, and flowering for each tree sampled. Photos are used to visually track the impact of the beetle on the trees.

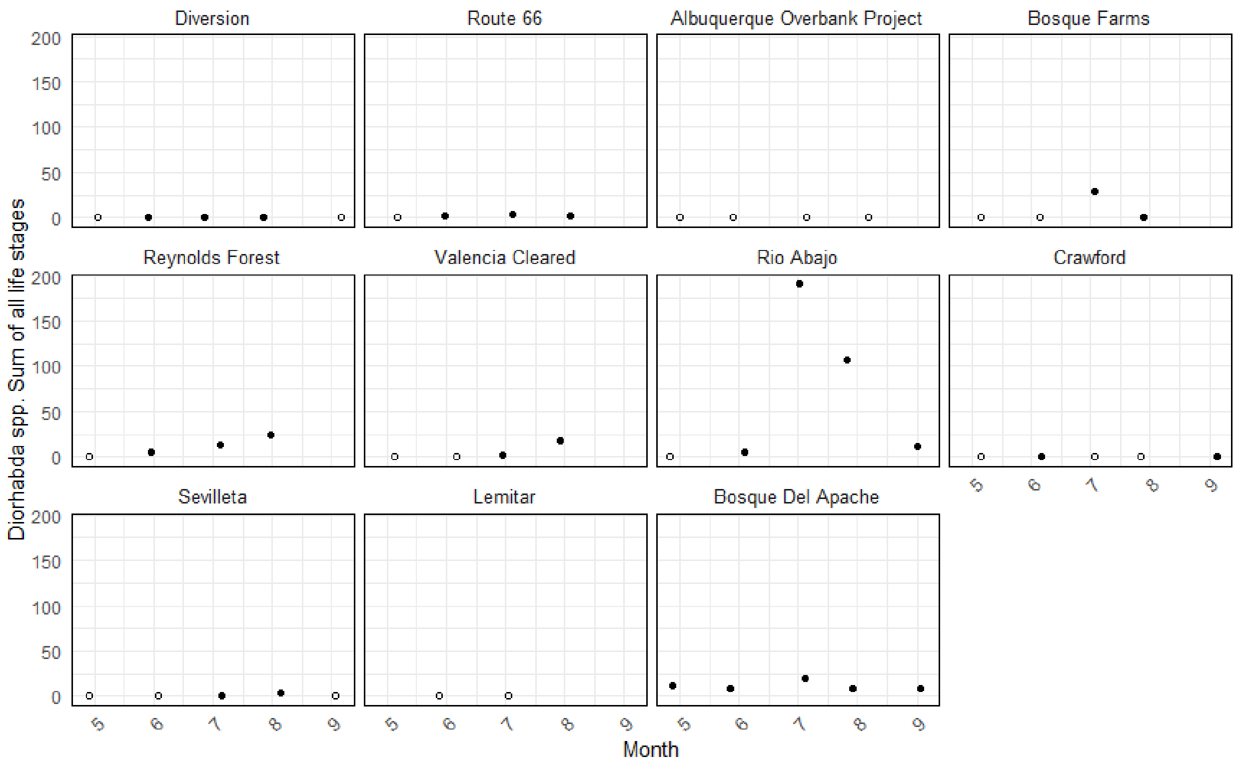

Figure 3.1.7.a Total *Diorhabda* spp. for all life stages found at sites from May through August or September (five sites) 2024. All life stages include egg masses, early and late larvae, and adults. Hollow dots represent zeros. Sites are arranged from north to south.

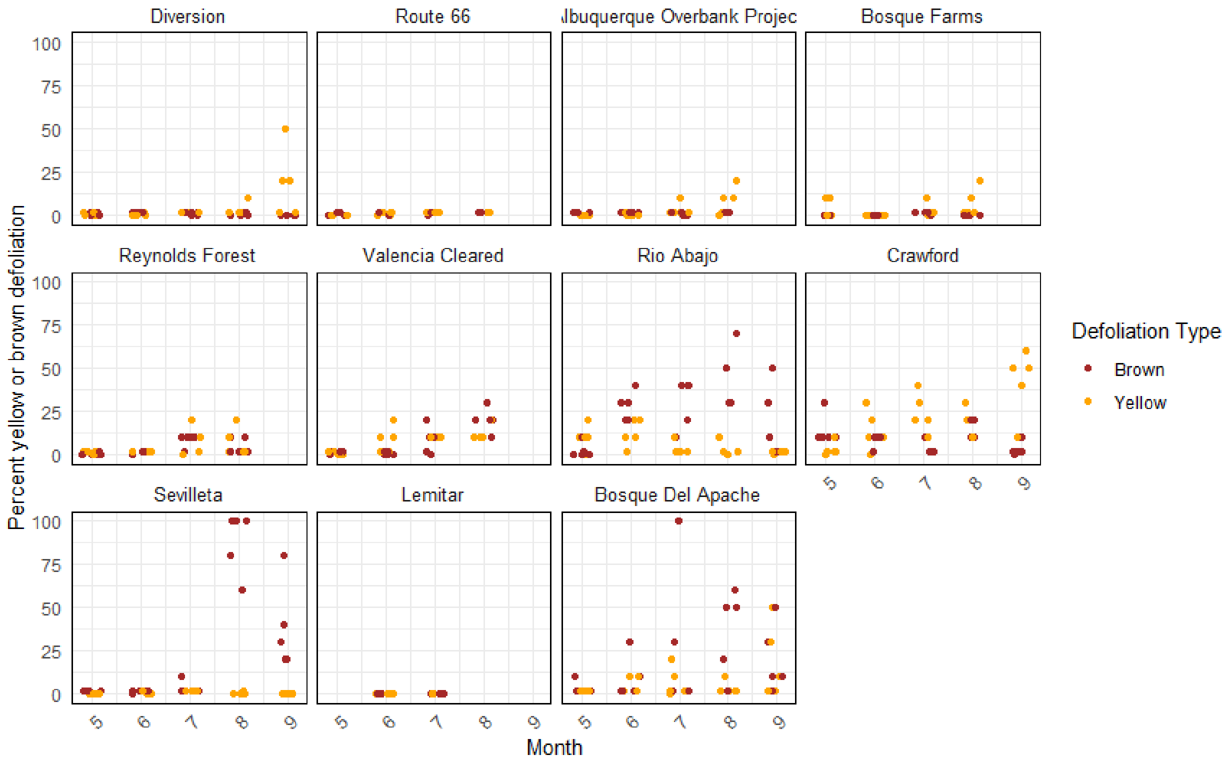

Figure 3.1.7.b. Percent yellow (leafhopper) and brown (TLB) defoliation shown by tree across the sample sites for 2024. Sites are arranged from north to south.

Table 3.1.7. Total TLB all life stages found at all sites May through September 2024. Sites arranged from north to south. "-" represents no sampling.

Site name	May	June	July	August	September	Total
Diversion	0	1	1	1	0	3
Route 66	0	2	4	2	-	8
Albuquerque Overbank Project	0	0	0	0	-	0
Bosque Farms	0	0	30	1	-	31
Reynolds Forest	0	6	14	25	-	45
Valencia Cleared	0	0	3	19	-	22
Rio Abajo	0	6	192	107	12	317
Crawford	0	1	0	0	2	3
Sevilleta	0	0	1	4	0	5
Lemitar	-	-	-	-	-	-
Bosque Del Apache	12	9	20	9	9	59

TLB abundance peaked in July at most sites, with three peaking in August (except for Crawford, which went from 0 TLB in July and August to 2 in September). During the September sampling, 12 adult TLBs were collected at the Rio Abajo site. This marks the second year that a high amount of TLBs were collected in September, the only other year being 2023 (BEMP started doing September collections in 2018). Continued sampling needs to occur to determine if this is a phenological shift, an artifact of sampling efforts, or due to other environmental factors.

Despite the varied TLB numbers (Figure 3.1.7a and Table 3.1.7), defoliation levels ranged from 0 to 100% at the sites (Figure 3.1.7.b). Defoliation typically attributed to the tamarisk leafhopper, which results in yellow foliage, ranged from 0 to 60%, while defoliation typically attributed to the TLB, which results in brown/dead foliage, ranged from 0 to 100%. A late season increase in brown defoliation occurred at sites where few or no TLB were collected. This phenomenon was most notable at the Sevilleta site, which jumped from an average of 3.6% brown defoliation in July, to 88% in August, despite only capturing 1 TLB in July, and 4 in August. This increase in defoliation underlines the importance of the full range of monitoring, as the beetle populations were potentially missed on the specific sampling date, but the evidence of beetle damage was still observable and quantifiable. Another consistent way to track the impacts of TLB on tamarisk stands is to record the percent of dead canopy each month. This year, the percent of dead branches for individual trees ranged from 0 to 90%. In previous years percent dead canopy is shown to increase during the peak of TLB activity, which may be due to branches being denuded but not actually dead. As refoliation occurs, branch death may seem to recover. For example, in the May, Sevilleta tree #2 had 70% dead branches and tree #5 had 50% dead branches. In June, percent dead branches on these two trees were recorded as 40% and 30%, respectively, indicating some of these branches were denuded but not actually dead.

Currently, BEMP data show declines in tamarisk cover, increases in branch die-off, and continued early leaf fall due to the TLB. Analyses do not currently show changes in vegetation communities following defoliation by TLB. Considering that the TLB have only been present at BEMP sites for about 10 years, fewer for southern sites, this is not surprising. Perennial vegetation is well-established and slow to change without other disturbances in the landscape. Annual vegetation should be the first to respond positively to declines in tamarisk, but will likely need corresponding precipitation and soil disturbance events to become established. If a better understanding of population fluctuations and capturing peak population abundances are desired, the total number of sites sampled should be decreased and the frequency of collections at a subset of the remaining sites should be increased.

4.1 SHORT-TERM MONITORING

Corrales sites – SWFL-1E and RAV-1E.

In 2025, BEMP started monitoring two short-term sites, SWFL-1E and RAV-1E, located on the west bank of the Rio Grande, north of Alameda Bridge, at the location of previous USACE project sites. The goal is to assess biotic and abiotic parameters at two adjacent USACE restoration projects with differing vegetation communities and endangered species habitat. In April, BEMP monitored depth to groundwater, vegetation species cover, arthropod community structures, basic soil classifications, and elevation. Depth to groundwater was also monitored at the center of the SWFL-1E site in May, June, and July. Groundwater levels will be monitored monthly at the SWFL site, and in the fall, vegetation, arthropods, and fuel load will be monitored at both sites. Inundation was to be monitored this year, but low river flows meant no overbank flooding occurred at either site, although moist soils were found at the RAV-1E site during vegetation monitoring.

4.1.1 Elevation, soil classifications, and channel morphology

Elevation data were collected at both sites but need to be QA/QCed before reporting. Soil type and texture and channel morphology were also tracked to provide baseline information for understanding changes in groundwater, inundation, vegetation, and arthropod community differences.

Table 4.1.1.a Soil types and thicknesses of horizons at SWFL well locations

SWFL East		SWFL Center		SWFL West	
0-49cm	Loamy Sand	0-49cm	Silty Clay	0-49cm	Sandy Clay Loam
50-69cm	Sandy Clay Loam	50-119cm	Sandy Loam	50-87cm	Sandy Clay
70cm-water table	Silty Clay Loam	120cm-water table	Loamy Sand	88cm-water table	Loamy Sand

Table 4.1.1.b Soil types and thicknesses of horizons at RAV well locations

RAV East		RAV Center		RAV West	
0-49cm	Loam	0-99cm	Sandy Loam	0-90cm	Loamy Sand
50-99cm	Sandy Loam	100cm-water table	Sand	91-water table	Sand (Coarse)
100-149cm	Loamy Sand				
150cm-water table	Sandy Loam				

Soils were very similar between sites, as was expected in river valley sites in close proximity. Clays (sandy clay and silty clay) were found at SWFL whereas sand and sandy loam dominated RAV, although the moist soils were found at RAV and not SWFL.

Channel morphology was tracked in addition to elevation to help evaluate the role of the nearby islands in inundation of the SWFL site. A vegetated island is located east of the SWFL site and has been identified as a potential target for destabilization. To evaluate the role of this island in influencing inundation potential of the SWFL site, channel morphology data were collected on May 14, 2024, in the secondary channel separating the island from the eastern edge of the SWFL site. At the time of sampling, discharge in the Rio Grande was 580cf/s. The distance from the east well sampling location and west bank of the channel was 875cm. The secondary channel was measured to be 23.3 m wide, and water depth was recorded in one meter intervals along the east-west transect from the water surface to the riverbed. In addition, monthly measurements were taken from the east well location to the west bank of the active channel (Table 4.1.2.a; Figure 4.1.1.a).

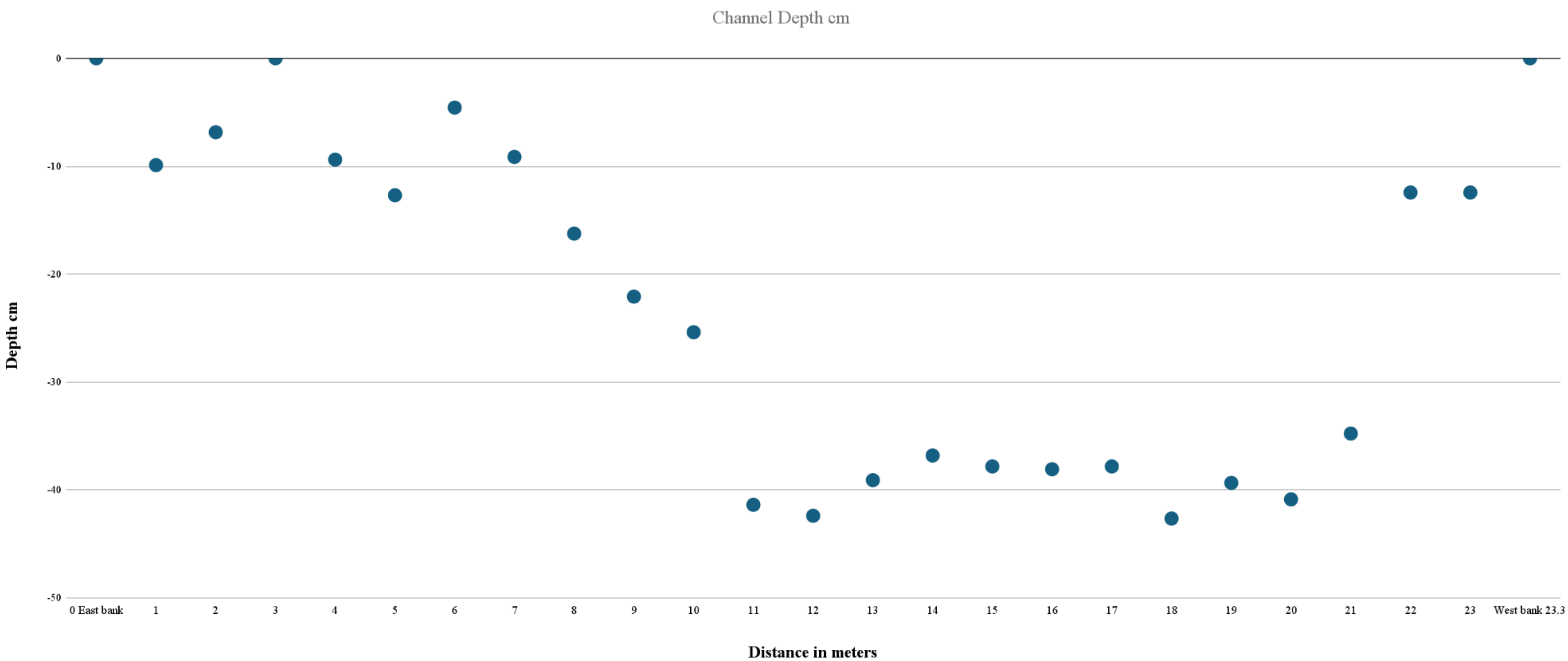

Figure 4.1.1.a Channel morphology of secondary channel adjacent to SWFL site.

4.1.2 Groundwater and river discharge

Table 4.1.2.a Depth to groundwater, river discharge and distance from east well location to river channel (SWFL only) by month.

Year	Month	Day	Site	East well (cm)	Center well (cm)	West well (cm)	Distance from East well to river (cm)	Discharge cfs USGS (mean daily) USGS-08329918
2025	5	12	SWFL	111	66.5	88	630	1030.0
2025	5	30	RAV	115.5	77.5	78	745	592.0
2025	5	30	SWFL	NA	87	NA	972	592.0
2025	6	17	SWFL	NA	96.5	NA	NA	423.0
2025	7	15	SWFL	NA	130	NA	9050	67.8
2025	8	20	SWFL	NA	170*	NA	9077	28.4

*August 20, 2025 the center well touched wet mud. We are unable to determine if this is the top of the water table or a result of wicking.

Both SWFL and RAV sites maintain good connectivity to groundwater. As river flows declined, the active channel shifted farther from the SWFL site, and by July the secondary channel had dried. A corresponding decline in groundwater depth predictably followed the reduction in river discharge.

4.1.3 Vegetation surveys

The SWFL site was dominated by dense Russian olive (twice as much Russian olive as found at the RAV site), coyote willow (over five times as much as found at RAV), and ravennagrass (cover is similar between sites) (Figures 4.1.3.a and 4.1.3.b). Ravenagrass cover was underestimated, as monitoring was conducted in early May to avoid Southwestern Willow Flycatcher nesting season. Followup monitoring (to be conducted in September) will reveal a more representative cover of ravennagrass (e.g., Picture 4.1.3.a). Evidence of planted willow swales were noted, but most of the willows were tall yet sparsely leafed out and crowded by Russian olive and ravennagrass.

Total cottonwood cover was similar between the two sites, but was slightly higher at RAV (almost 18 m of cover out of 300 linear meters compared to 13 m of cover at SWFL). Seepwillow (both *Baccharis salicina* and *B. salicifolia*) were found at both sites, but cover more than double at the RAV site compared to SWFL (Figure 4.1.3.a). *Carex* spp. (sedge) cover was much higher at SWFL (over 9 m, compared to 0.28m), found primarily along the edge of the site near the river, while *Cyperus* spp. (flatsedge) was found only at RAV. Rushes were also predominantly found at RAV (Figure 4.1.3.b).

The SWFL site has higher tree and shrub cover, but this is dominated by the aforementioned Russian olive and coyote willow (Figure 4.1.3.a). The RAV site, which has more understory vegetation, also has a higher diversity of vegetation communities (Figure 4.1.3.c), including bare areas as well as wet meadow areas that had moist soils and supported species like toadbugs (Gelastocoridae), which are indicative of damp areas. These wet areas, near the D line of the site, had many cottonwood seedlings and a few saplings. SWFL has a few lines of higher diversity (A-D), which are closer to the river, while the majority of the site has more similar species (Figures 4.1.3.a and 4.1.3.d). The diversity of vegetation at RAV and the dominance of three species (Russian olive, coyote willow, and ravennagrass) at SWFL leads to the calculations of higher species diversity at RAV, where more lines within the site have higher species diversity and the overall site has higher diversity (Figure 4.1.3.d and Table 4.1.3.a). Shannon diversity (H') is measured using the total number of species (richness) and the evenness of each species, or their relative proportions (Figure 4.1.3.e). The low evenness on the vegetation transects at SWFL are indicated by the low J (Pielou evenness), indicating that a few species have high abundance and, in this case, many other species have low cover (Figure 4.1.3.e and Table 4.1.3.a). (For evenness, values close to 1 indicate equal abundance across species while a value of 0 means that one species is dominant.) The full list of plant species identified in the May surveys is on Table 4.1.3.b.

Picture 4.1.3.a Ravennagrass at RAV site showing the larger area of last year's growth and minimal new green growth.

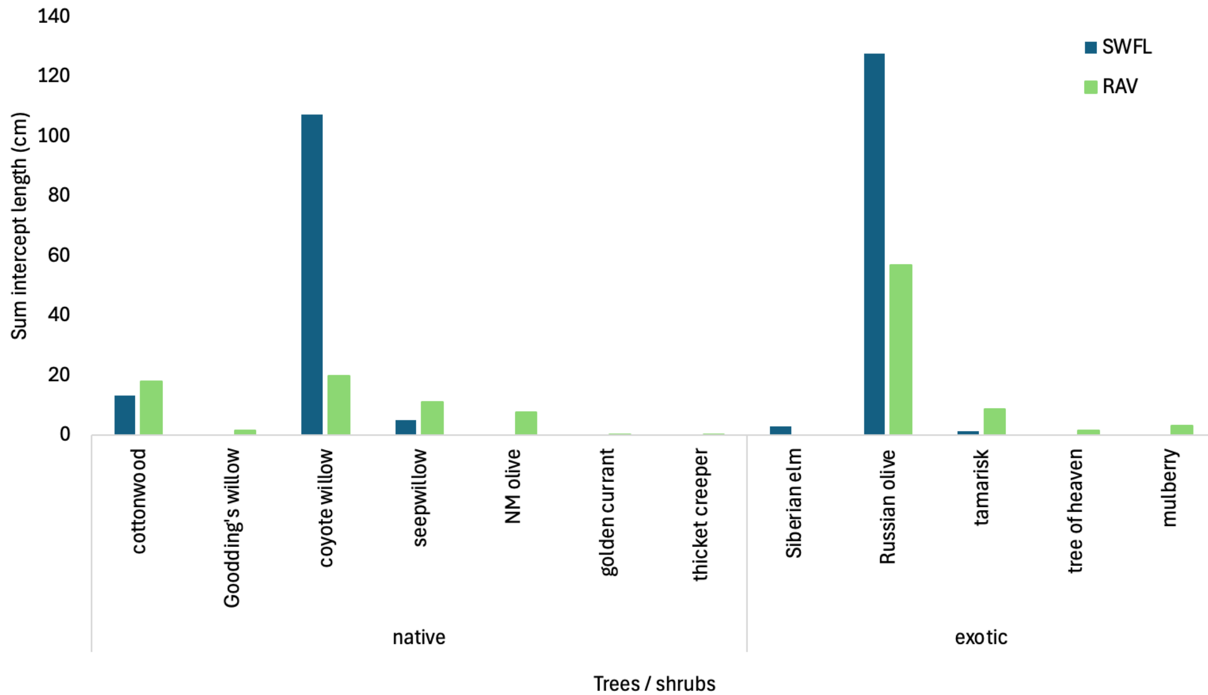

Figure 4.1.3.a Canopy cover (trees and shrubs) at the two sites, divided into native and exotic plants.

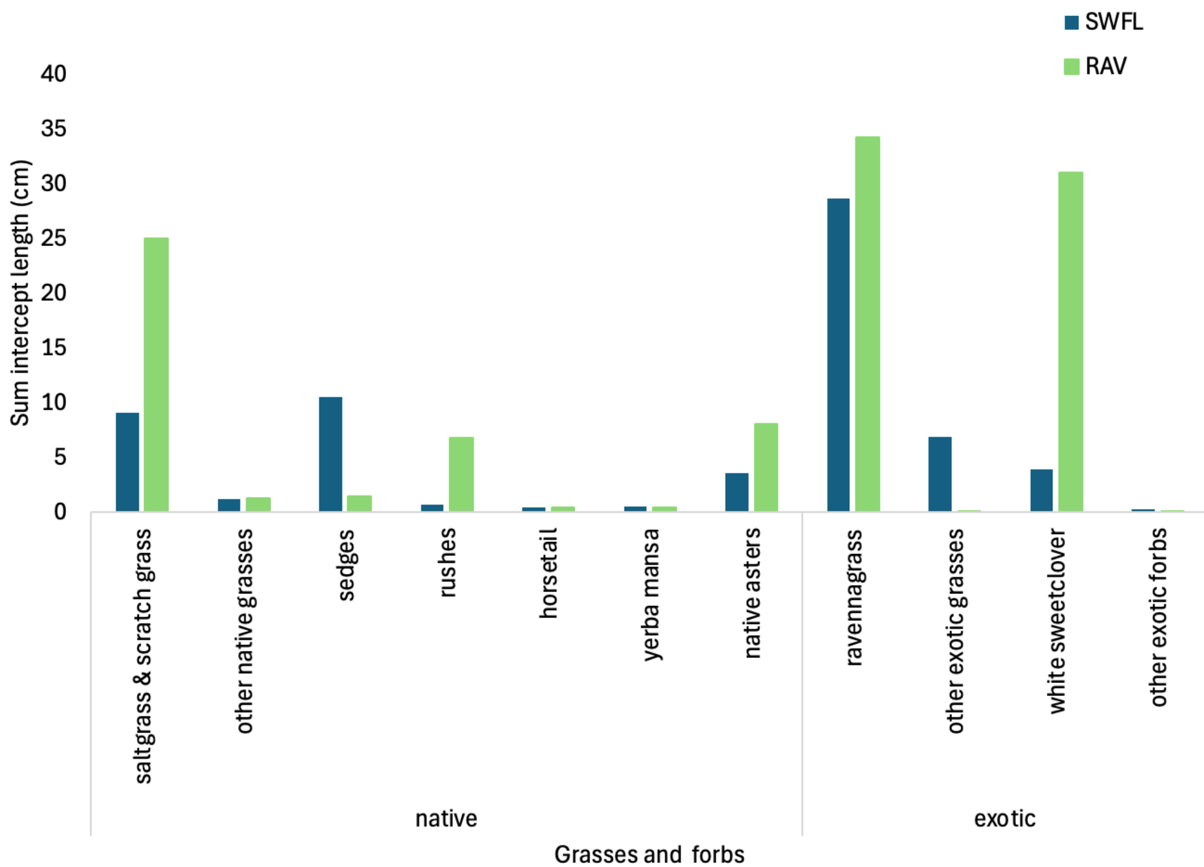

Figure 4.1.3.b Understory cover (grasses and forbs) at the two sites, divided into native and exotic plants.

Figure 4.1.3.c Vegetation survey data showing the center position of each plant along each 30m transect along with its species code. X-axis is the total cover of each species at the midpoint on the transect while circle size indicates the total length of the plant at that location.

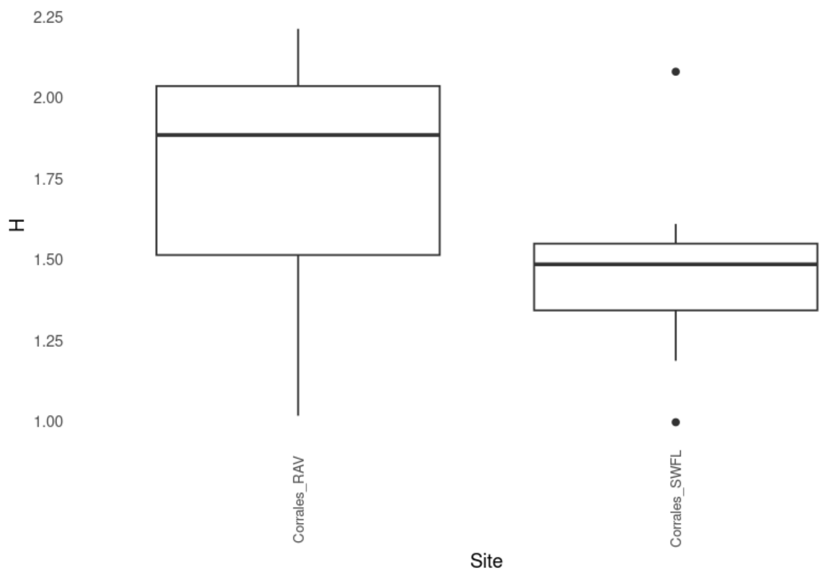

Figure 4.1.3.d Shannon Diversity Index between the SWFL and RAV sites as measured across each of the 10 vegetation transects. Higher values indicate higher Shannon species diversity, which weighs both species richness (number of species present) and the evenness of the species cover.

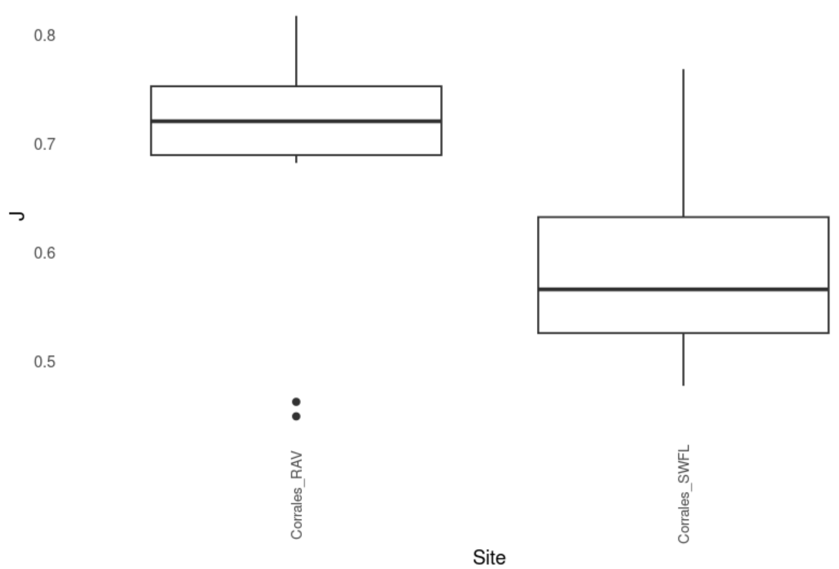

Figure 4.1.3.e J Pielou evenness of plant species across transects at SWFL and RAV. Higher values have more evenly distributed cover of species, or relative proportions that are more similar. Value of 1 means all species are equally abundant; a value of 0 means that a single species is dominant.

Table 4.1.3.a Vegetation diversity (H' Shannon), richness (S number of species), and evenness (J Pielou evenness) along each transect at SWFL and RAV.

Site	Transect	H' Shannon	S Richness	J Pielou evenness
Corrales_RAV	A	1.80	14	0.68
Corrales_RAV	B	1.93	15	0.71
Corrales_RAV	C	2.21	15	0.82
Corrales_RAV	D	1.84	13	0.72
Corrales_RAV	E	2.19	17	0.77
Corrales_RAV	F	1.04	10	0.45
Corrales_RAV	G	1.02	9	0.46
Corrales_RAV	H	2.01	14	0.76
Corrales_RAV	I	1.42	7	0.73
Corrales_RAV	J	2.05	17	0.72
Corrales_SWFL	A	1.51	12	0.61
Corrales_SWFL	B	1.50	14	0.57
Corrales_SWFL	C	1.19	12	0.48
Corrales_SWFL	D	1.00	7	0.51
Corrales_SWFL	E	1.56	16	0.56
Corrales_SWFL	F	1.41	9	0.64
Corrales_SWFL	G	2.08	15	0.77
Corrales_SWFL	H	1.61	11	0.67
Corrales_SWFL	I	1.47	17	0.52
Corrales_SWFL	J	1.32	11	0.55

Table 4.1.3.b. Plant USDA code, scientific name, common name, origin, and site where it was found.

code	scientific name	common name	origin	site
AIAL	*Ailanthus altissima*	tree of heaven	Exotic	RAV
AMPS	*Ambrosia psilostachya*	Cuman ragweed	Native	both
APCA	*Apocynum cannabinum*	Indianhemp	Native	RAV
ASTER		unidentified aster	Either	RAV
BASA	*Baccharis salicina*	willow baccharis	Native	both
BASA4	*Baccharis salicifolia*	Great Plains false willow	Native	both
BASC5	*Bassia scoparia*	kochia	Exotic	SWFL
CAPE42	*Carex pellita*	woolly sedge	Native	SWFL
CAREX	*Carex* spp.	sedge	Either	both
CIRSI	*Cirsium* spp.	thistle	Either	RAV
COCA5	*Conyza canadensis*	Canadian horseweed	Native	both
CYPER	*Cyperus* spp.	flatsedge	Either	RAV
DEIL	*Desmanthus illinoensis*	Illinois bundleflower	Native	SWFL
DISP	*Distichlis spicata*	inland saltgrass	Native	both
ELAN	*Elaeagnus angustifolia*	Russian olive	Exotic	both
EQLA	*Equisetum laevigatum*	smooth horsetail	Native	both
EQUIS	*Equisetum* sp.	horsetail	Native	SWFL
FOPUP	*Forestiera pubescens* var. *pubescens*	New Mexico olive	Native	both
FORB		unidentified forb		
GRASS		unidentified grass		
JUARL	*Juncus arcticus*	mountain rush	Native	both
JUNCU	*Juncus* spp.	rush	Native	both
LACTU	*Lactuca* spp.	lettuce	Either	SWFL
LATAP	*Lactuca tatarica* var. *pulchella*	blue lettuce	Native	SWFL
MACA2	*Machaeranthera canescens*	hoary tansyaster	Native	SWFL
MEOF	*Melilotus officinalis*	white sweetclover	Exotic	both
MOAL	*Morus alba*	white mulberry	Exotic	both
MUAS	*Muhlenbergia asperifolia*	scratchgrass	Native	both
PAOB	*Panicum obtusum*	vine mesquite	Native	RAV
PASM	*Pascopyrum smithii*	western wheatgrass	Native	SWFL
PAVI5	*Parthenocissus vitacea*	thicket creeper	Native	RAV
PODEW	*Populus deltoides* ssp. *wislizenii*	Rio Grande cottonwood	Native	both
POPR	*Poa pratensis*	Kentucky bluegrass	Exotic	RAV

RIAU	*Ribes aureum*	golden currant	Native	RAV
SAEX	*Salix exigua*	narrowleaf/coyote willow	Native	both
SAGO	*Salix gooddingii*	Goodding's willow	Native	RAV
SARA3	*Saccharum ravennae*	ravennagrass	Exotic	both
SCAR7	*Schedonorus arundinaceus*	tall fescue	Exotic	RAV
SCPU10	*Schoenoplectus pungens*	common threesquare	Native	SWFL
SOAS	*Sonchus asper*	spiny sowthistle	Exotic	RAV
TACH2	*Tamarix chinensis*	saltcedar	Exotic	both
THPO7	*Thinopyrum ponticum*	tall wheatgrass	Exotic	SWFL
ULPU	*Ulmus pumila*	Siberian elm	Exotic	SWFL

4.1.4 Arthropod surveys

Table 4.1.4.a Summary of surface-active arthropods at Corrales sites.

Site	RAV-1E	SWFL-1E
Total Abundance	1736	463
Mean count	555	257
Richness	37	40
Unique species	14	17
Shannon Diversity	1.35	2.31
Total ants	403	133
Ant richness	6	5
Total spiders	37	18
Spider richness	9	11
Sow bugs	40	4
Pill bugs	1141	154
Darkling beetles	9	2
ground beetles	8	9
Total beetles	41	41

A total of 1,736 arthropods were collected from RAV and 463 from SWFL. Species richness was slightly higher at SWFL (40 species) compared to RAV (37 species). The Shannon diversity [$H = -\Sigma(p_i * \ln(p_i))$] was also higher at SWFL (2.31) than at RAV (1.35), indicating a more even distribution of arthropods at SWFL (Table 4.1.4.a). There was a two week gap between pitfall trapping at SWFL and RAV (in order to complete all surveys at the SWFL site before nesting season), which means that some arthropods had more time to emerge and be active at RAV. Trapping in October will occur in the same week.

Isopods were the most abundant arthropod at both sites with pill bugs (*Armadillidium vulgare*) being the most dominant (Figure 4.1.4.a). Although they were the most abundant arthropod captured, the difference seen between sites is significant with 1,141 collected at RAV compared to 154 collected at SWFL (Table 4.1.4.b). Both species of isopods collected (*Armadillidium vulgare* and *Porcellio laevis*) are exotic terrestrial crustaceans that occupy the same ecological niche as native crickets functioning as decomposers. Isopods are commonly encountered in the Rio Grande bosque. These arthropods do not tolerate flooding, and, in areas prone to floods their numbers are shown to decline while native cricket populations increase.

Ants were common at both sites with more individuals captured from RAV (403 vs. 133), despite this species richness was similar (six species at RAV, 5 species at SWFL) (Table 4.1.4.b). Despite similar species richness, community makeup differed between sites. The exotic *Tetramorium immigrans* was found to be the dominant species at the RAV site whereas native *Monomorium carbonarium* (*Monomorium minimum* species complex) was the dominant species seen at SWFL. The bosque inhabiting *Crematogaster* was found in low numbers at both sites.

Beetle abundance was identical across the two sites (41 individuals), however, composition differed. Ground beetles (Carabidae), a common mesic indicator, were slightly more abundant at SWFL (9 vs. 8), whereas darkling beetles (Tenebrionidae) were more abundant at RAV (9 vs. 2).

Arthropod community structure differed between the two sites in both abundance and diversity. RAV exhibited a higher overall abundance, largely due to the dominance of isopods. This dominance reduced community evenness, reflected in the lower diversity index. In contrast, SWFL supported fewer individuals but a greater richness and higher diversity, indicating a more balanced community composition.

The community structure at the SWFL site is consistent with more frequent flooding events, as seen by the relatively lower number of isopods and a higher ground beetle to darkling beetle ratio (9:2).

The community structure at RAV site favored arthropods adapted to drier environments and fewer flooding events as seen by the relatively higher number of isopods and the higher abundance and richness of darkling beetles.

Community structures differed between sites but both contained a good variety of arthropods occupying important niches.

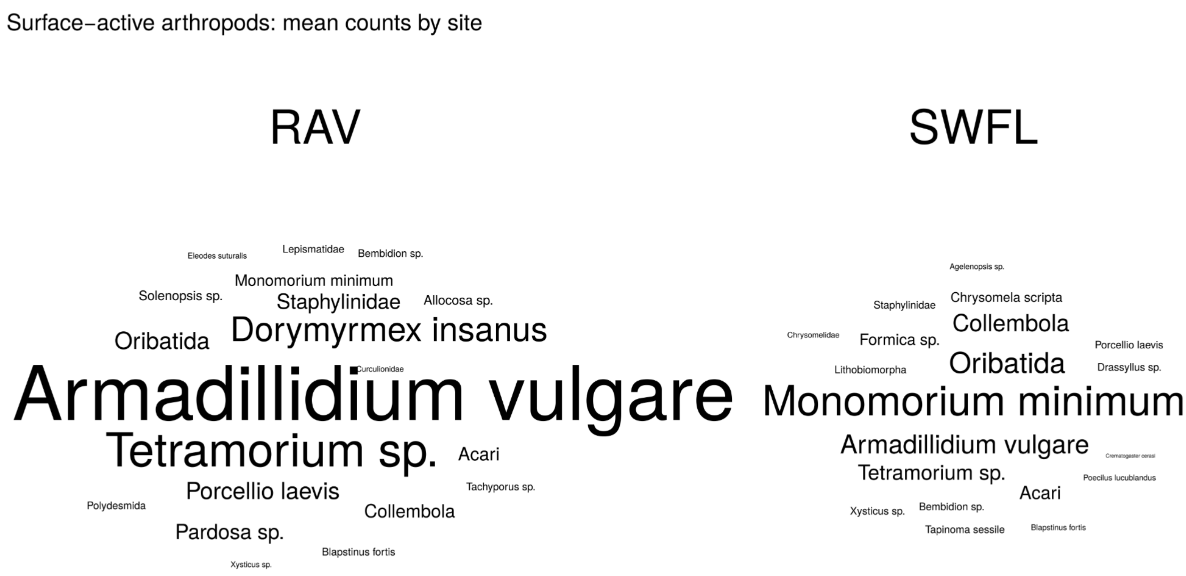

Figure 4.1.4.a Visualization of mean counts of surface active arthropods between the RAV and SWFL sites in Corrales, NM from Table 4.1.4.b.

Table 4.1.4.b Mean abundance at each site (numbers are rounded up to prevent partial counts)

Name	Number code	RAV mean abundance	SWFL mean abundance
Polyxenida	7030000	0	1
Polydesmida	7010000	3	0
Armadillidium vulgare	6020202	286	38
Porcellio laevis	6020101	19	3
Pseudoscorpiones	5030000	0	1
Oribatida	5020100	12	21
Acari	5020000	4	4
Xysticus sp.	5014502	2	3
Dictyna sp.	5012503	0	1
Dictynidae	5012500	1	0
Varacosa sp.	5012425	0	1
Pardosa sp.	5012404	12	1
Allocosa sp.	5012403	4	1
Linyphiidae	5012200	1	1
Drassyllus sp.	5011637	1	3

Herpyllus sp.	5011612	0	1
Zelotes lasalanus	5011609	0	2
Zelotes sp.	5011604	2	0
Theridiidae	5011500	1	0
Dysdera crocata	5011402	1	1
Agelenopsis sp.	5010101	0	2
Lithobiomorpha	2020000	1	5
Hemiptera	1750000	1	0
Lepismatidae	1420200	4	1
Psocoptera	1220000	0	1
Orthoptera	1190000	1	0
Myrmeleontidae larva	1160101	0	1
Ponera sp.	1111355	1	0
Dorymyrmex insanus	1111354	52	0
Tetramorium sp.	1111351	78	17
Tapinoma sessile	1111318	0	4
Monomorium minimum	1111317	13	87
Crematogaster cerasi	1111316	1	2
Formica sp.	1111309	0	7
Solenopsis sp.	1111305	6	0
Lepidoptera larva	1090001	1	0
Diptera	1060000	0	1
Collembola	1040000	9	16
Poecilus lucublandus	1025539	0	3
Bembidion sp.	1025523	4	4
Carabidae	1025500	1	0
Corylophidae	1024700	0	1
Embaphion contusum	1024651	1	0
Blapstinus fortis	1024648	5	2
Eleodes suturalis	1024607	3	0
Anthicidae	1024100	0	1
Curculionidae	1023100	2	0
Tachyporus sp.	1021707	4	2
Staphylinidae	1021700	15	0
Staphylinidae	1021700	0	4
Chrysomela scripta	1020904	1	8
Chrysomelidae	1020900	1	2
Cryptophagus sp.	1020801	0	1
Aeolus sp.	1020506	1	1
Insecta larva	1000001	0	1

4.1.5 Other findings and concluding statement

While laying out the sites and conducting surveys, bird nest locations were recorded when noticed, but nests were not actively looked for. (BEMP staff do not have training in locating and identifying bird nests, so this is anecdotal and varies by staff person.) Five nests of varying sizes were recorded and pictures were taken. All nests were located in Russian olive in the SWFL site.

Table 4.1.5.a Coordinates for nests

near	lat	long	Picture # and notes
near F10 and F11	35.206587	-106.6295	1
D SW corner	35.20672	-106.629024	2, plastic incorporated in nest
C line	35.206346	-106.628664	3, small nest with medium one 7 feet to west
north of site	35.206439	-106.627893	4

Picture 1 (off line, near pitfall traps F10 and F11)

Picture 2 (near SW corner of D plot; plastic incorporated into nest)

Picture 3 (near C line; small nest with medium nest 7 feet to west/background of pic)

Picture 4 (nest off site, near trail to river)

Both sites have features of successful restoration, depending on the metrics used. The SWFL site has mature tree/shrub structures that support nesting Southwestern Willow Flycatcher (as the name of the site indicates) as well as numerous Spotted Towhee, wrens, Black-headed Grosbeak, and chats. The RAV site has a diversity of habitat types, with wet meadows, grassy meadows, and canopy, that support Lesser Goldfinch, Black-headed Grosbeak, Yellow-breasted Chat, Brown-headed Cowbird, Ash-throated Flycatcher, Rose-breasted Grosbeak, Spotted Towhee, Mourning Dove, and Lesser Goldfinch. Both sites supported unique arthropod species and had similar species richness. Vegetation cover was predominantly exotic at both sites but both had higher native species richness. Simultaneous monitoring in October will provide more insight to plant and arthropod communities.

5.1 EDUCATIONAL OUTREACH

BEMP has provided dynamic educational programming throughout the Middle Rio Grande Valley, emphasizing immersive experiences in science for K–12 students. These experiences included hands-on water quality testing, macroinvertebrate sampling, phenological data collection through Nature's Notebook, and repeated monthly monitoring. Students analyzed groundwater levels, observed seasonal ecological shifts, and learned how science intersects with stewardship. During FY 2024–2025, we served 3,488 students and 857 adults at 39 schools and community organizations. Students participated through a combination of in-person school visits, remote lessons, and field trips to the bosque.

For those unable to travel, BEMP brought science directly to students via on-campus and virtual activities, ensuring that transportation barriers didn't impede access. Activities such as precipitation and litterfall data collection took place right on school grounds. Moreover, students were empowered to take ownership of their scientific learning by presenting their data interpretations to peers, community leaders, and the general public during BEMP annual events. These events foster a culture of science communication and civic engagement. Projects often centered on issues relevant to students' daily lives—such as local pollution sources or water conservation—demonstrating science as a practical tool for change.

With ongoing collaborative support from its partners, BEMP has continued to meet and exceed goals for student engagement, community involvement, and environmental education. In so doing, our programming reaches diverse communities across the county and cultivates an early connection between youth and the land they inhabit.

6.1 SUMMARY

Decision-makers need continuous, high quality data about hydro-climatic variability and ecological response along the Middle Rio Grande. BEMP continues to provide community driven data sets and analyses to address issues on the Middle Rio Grande. The new temperature loggers installed at 12 sites show a shift in temperature in response to fire, clearing, and revegetation at the Biopark site. These data give insights into what future temperature regimes will look like in the bosque as fires and a declining cottonwood canopy become more common. BEMP's long term precipitation data show an increasing unpredictability in the timing and amount of monsoon rainfall. This can inform native vegetation restoring project timings. The shallow riparian groundwater is still tightly influenced by the amount of water in the river. The long term data show a decline in the shallow riparian aquifer, particularly in the southern reaches, which impacts the native vegetation and arthropod communities. The groundwater data can inform where restoration projects will be successful,e.g., pole plantings are likely to fail at sites with deep groundwater unless earth is removed. The leaf litterfall data show that even invasives like Russian olives are struggling under prolonged drought and increasing variability in climate. The tamarisk leaf beetle collections have been ongoing for over a decade. The data show declining tamarisk cover (present in the TLB, litterfall, and vegetation survey data), increases in branch die-off and browning, and multiple leaf drops throughout the year due to the presence of TLB.