RIVER PARTNERS

Applying Central Valley Joint Venture Population Objectives for Grasslands and At-Risk Riparian Birds – Final Report 2024

Prepared for the Central Valley Joint Venture

by River Partners

June 2024

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Executive Summary

With funding from the Central Valley Joint Venture, River Partners planned and implemented the Applying Central Valley Joint Venture Population Objectives for Grassland At-Risk Riparian Birds (Project hereafter). The Project was funded to apply population objectives for grassland and at-risk riparian birds to further inform restoration design to support conservation. The purpose of this Progress Report is to summarize the Projects accomplishments and result. Avian and vegetation surveys were conducted at 11 restored sites aged 5 to 21 years old.

Planning activities including monitoring design and site selection occurred in winter and spring 2023. Monitoring activities took place in May-June 2023 and consisted of avian point count surveys and vegetation relevés. Avian point count survey data were analyzed by Point Blue Conservation Science, with a report delivered to River Partners. In Spring 2024, River Partners analyzed vegetation data in relation to avian outcomes and prepared management recommendations. In May 2024, River Partners shared results in two presentations at the annual SERCAL conference in Redlands, CA. June 2024 marks the end of the Project.

Introduction

Given the dramatic loss of habitat in the Central Valley, many of the diverse avian species found here are now reduced to small populations or have been extirpated from the region. Ambitious conservation goals have been set by the Central Valley Joint Venture (CVJV) for birds of the Central Valley, including habitat protection and restoration, population targets, and breeding densities. The Project follows the CVJV 2020 Implementation Plan objective to apply the breeding density objectives for these birds to demonstrate that restoration activities are creating quality habitat.

The purpose of this Project is to evaluate restoration success on population measures of grassland and at-risk riparian bird focal species and as well as the restoration value of each site for the focal bird species. We selected 11 restoration sites of known age and performed point count surveys and vegetation surveys. In partnership with Point Blue Conservation Science, we compared population estimates to actual densities as calculated by point counts.

We present recommendations for habitat restoration that will maximize bird species densities at restored sites. Improving habitat for bird species has long been an intended co-benefit of River Partners' work since 1998. Project outcomes will be incorporated into active planning of restoration projects in the Sacramento and San Joaquin Valleys by River Partners.

Understanding the progress made towards the population objectives set by the CVJV 2020 Implementation Plan will facilitate science-based evaluation of restoration design and methods that can further improve projects, secure additional funding, and bring the CVJV closer to the ambitious conservation goals.

Project Accomplishments

A. Project Progress

Project design, data collection, and the analysis of the point county survey data has been completed (Table 1). Tasks that remain include analysis of vegetation data and a final report that details recommendations.

Table 1. Project Timeline

Invoice #	Invoice Period	Task Description
1	7/1/22 to 3/31/23	General management, subcontract execution, monitoring design (site selection), access permits
2	4/1/23 to 5/31/23	General management, monitoring design (point count location selection), access permits, first round of point counts, vegetation surveys, data entry
3	6/1/23 to 6/30/23	General management, second round of point counts, data entry
4	7/1/23 to 7/31/23	General management, data entry
5	8/1/23 to 9/30/23	General management, data analysis by Point Blue (subcontractor)
6	10/1/23 to 10/31/23	General management, data analysis and report writing by Point Blue (subcontractor)
7	11/1/23 to 12/31/23	General management, report preparation
8	1/1/23-6/30/23	General management, data analysis, report presentation, conference presentation, social media sharing

B. Project Design

River Partners worked with Point Blue Conservation Science to identify 11 restoration sites in the Sacramento Valley that had both riparian and grassland vegetation (Table 2, Figure 1). These sites were located along the Sacramento and Feather Rivers and varied in age since restoration of 5-21 years. Grassland and riparian habitat were identified via satellite imagery, knowledge of past restoration design, and a recent land cover data set compiled for the Great Valley Ecoregion which used NAIP imagery in 2009, 2012, and 2014 (CDFW 2018).

Depending on acreage, three to four survey points were identified for each the riparian and grassland vegetation habitats of each site; some points are legacy points and have had point counts taken in previous years by Point Blue Conservations Science (coordinates: Appendix A, maps: Appendix B). Hamilton City did not have enough grassland acreage to fit points greater than 250m apart, and so only riparian habitat was assessed.

Table 2. List of selected restored sites

Site	River	Landowner/Manager
Hamilton City	Sacramento	RD 2140
Pine Creek West	Sacramento	CDFW
Capay	Sacramento	Sacramento River NWR
Llano Seco	Sacramento	Sacramento River NWR
Del Rio	Sacramento	River Partners
Sul Norte	Sacramento	Sacramento River NWR
Drumheller	Sacramento	Sacramento River NWR
Colusa SRA	Sacramento	CA State Parks/City of Colusa
Abbott Lake	Feather	CDFW
O'Connor Lakes	Feather	CDFW
Bear River Setback	Feather	TRLIA/Sac Valley Conservancy/Sutter Buttes Land Trust

Figure 1. Location of the 11 restoration sites included in this study, shown within the Central Valley Joint Venture's Sacramento Planning Region (map by Point Blue Conservation Science).

C. Monitoring

1) Point Counts

Point count surveys measure relative abundance by counting all birds seen or heard at specific survey points. Survey points were established with a minimum distance of 250m between points in both grassland and riparian habitats. Surveys were performed twice during breeding season, in May and June, with a minimum of two weeks apart to give birds time to rest and resettle between visits. Survey methods followed the protocol described by Point Blue Conservation Science (Ballard et al, 2003).

Point Blue Conservation Science was subcontracted to estimate breeding densities of focal bird species and compare them to the population objectives as defined by the Central Valley Joint Venture that are expected to reflect habitat quality. More detailed methodology can be found in their report (Appendix B).

2) Relevé Monitoring

Relevé monitoring collects data on vegetation composition, cover, and structure by sampling 100 m^2 or 400m^2 plots following standardized relevé /rapid assessment protocols (California Native Plant Society Relevé Protocol, CNPS Vegetation Committee). Relevé plots were located at each point count location. Relevé plots were 100m^2 in grassland habitat and 400m^2 in riparian habitat. Using this standardized technique allows River Partners to compare restoration stands to vegetation across the state and is highly repeatable. River Partners' scientists conducted relevés in May and June 2023.

3) Photos

Photos were taken at each of the survey locations. Four photos were taken, facing each cardinal direction. Photos provide qualitative information of the vegetation at a site. As the locations of these photos are recorded, they can serve as photo points if the site is ever visited in the future to qualitatively monitor vegetation change over time.

Results and Recommendations

Restoration sites aren't expected to support the density objectives of all species simultaneously, due to their differing ages, vegetation structure, and goals that influenced the design. This was represented in the results, as no site met the density objectives of more than three focal species in each habitat. However, all species but three species met their density objectives on at least one site, and while some sites had fewer total species than others, they supported the density objective of a species not met at other sites. Thus, when considering the sites on a landscape scale, riparian forest and grassland savannah restoration has resulted in the creation of suitable habitat for riparian and grassland focal bird species.

A. Focal Species Density Objectives

This section is a summary of the more detailed results discussion by Point Blue Conservation Science found in Appendix B. The focal species for riparian, grassland and oak savannah habitats can be found in Table 3. Nine of the 12 riparian focal species were detected during

surveys, missing Bank Swallow, Yellow-billed Cuckoo, and Least Bell's Vireo. Of the grassland-oak focal species, only Western Meadowlark was detected of those that prefer grassland habitat, but species that prefer oak savannah were detected. The only at-risk species among both groups of focal species that were detected were Yellow Warbler and Yellow-breasted Chat.

There was considerable variation among species, sites, and habitat types in terms of meeting short-term density objectives. For riparian habitat, ten of the 11 sites had at least one riparian focal species meet or exceed the short-term density objective (Table 4). For grassland habitat, seven of the ten sites had at least one grassland-oak savannah focal species meet or exceed density objectives. All sites had several species not meet the objectives.

Ash-throated Flycatcher, Nuttall's Woodpecker, and Black-headed Grosbeak were the three riparian focal species that had density objectives met at the most sites (n = 4-6), as well as had among the highest densities of all focal species. These three species are all associated with mature riparian forest and woodland, indicating the success of the riparian restoration sites in creating suitable habitat. Fewer sites supported focal species associated with dense understory or shrubby thickets. Fewer grassland focal species met density objectives; the species whose density was met at the most sites was Western Kingbird. Only two grassland sites supported the density objective of the Western Meadowlark, the only focal species detected that prefers grassland habitat. Several species did not reach density objectives at any site.

Although there were not many restoration sites in this study that were young (<5 years) or middle-aged (5-15 years), the densities of some riparian focal species appeared to vary with time since restoration. Of the species that prefer mature forest, only Ash-throated Flycatcher – a cavity nester – appeared to increase in density with time since restoration. For the Nuttall's Woodpecker, the only other cavity nester, the sites with highest counts spanned the range of restoration ages while the highest densities for Black-headed Grosbeak were found in 15- to 20-year-old restoration sites, with lower densities at younger and older sites.

Spotted Towhee was one of the most abundant species across sites, and its densities also peaked in 15- to 20-year-old restoration sites. Other riparian focal species were only detected at very low densities and were not detected at all sites, including the Common Yellowthroat, Lazuli Bunting, Yellow Warbler and Yellow-breasted Chat; however, the former three of these species all had their highest density at the youngest restoration site. Many of these patterns are not unexpected: Lazuli Bunting and Yellow Warblers are associated with dense, shrubby riparian thickets that are more common in the early stages of riparian vegetation development, while the Ash-throated Flycatcher is a secondary cavity nester that relies on natural cavities or those made by other species, a habitat feature more likely to occur in mature riparian forest with older trees.

For the grassland focal species, most were only detected at a few sites, and there were no clear patterns of an association with time since restoration. However, Western Meadowlark, the only one that prefers grassland habitat over grassland-oak savannah, did have the highest densities at the oldest grassland restoration sites.

Table 3. Central Valley Joint Venture focal species for riparian, grassland, and oak savannah habitats, shown with their more specific habitat preferences. Species identified as at-risk are italicized (CVJV 2020).

Riparian Focal Species	Code	Grassland-Oak Savannah Focal Species	Code
Mature forest preferred		**Grassland preferred**	
Ash-throated Flycatcher	ATFL	*Burrowing Owl*[1]	*BUOW*
Black-headed Grosbeak	BHGR	*Grasshopper Sparrow*	*GRSP*
Nuttall's Woodpecker	NUWO	Horned Lark	HOLA
Western Yellow-billed Cuckoo	*YBCU*	*Northern Harrier*[1]	*NOHA*
Dense understory preferred		Western Meadowlark	WEME
Common Yellowthroat	COYE	**Oak savannah preferred**	
Song Sparrow	SOSP	Acorn Woodpecker	ACWO
Spotted Towhee	SPTO	American Kestrel	AMKE
Dense, shrubby thickets preferred		Lark Sparrow	LASP
Lazuli Bunting	LAZB	*Loggerhead Shrike*	*LOSH*
Least Bell's Vireo	*LBVI*	Western Bluebird	WEBL
Yellow Warbler	*YEWA*	Western Kingbird	WEKI
Yellow-breasted Chat	*YBCH*	*Yellow-billed Magpie*	*YBMA*
Other			
Bank Swallow[1]	*BANS*		

[1]Species with large territories and/or colonial nesters that are not adequately surveyed by point count surveys are not included in the analysis.

Table 4. Focal species that met their population density objective at each site.

	Riparian Forest									Grassland Savanna					
	Ash-throated Flycatcher	*Black-headed Grosbeak*	*Common Yellowthroat*	*Lazuli Bunting*	*Nuttall's Woodpecker*	*Song Sparrow*	*Spotted Towhee*	*Yellow-breasted Chat*	*Yellow Warbler*	*Acorn Woodpecker*	*American Kestrel*	*Lark Sparrow*	*Western Bluebird*	*Western Kingbird*	*Western Meadowlark*
Abbott Lake	x				x							x	x		
Bear River Setback		x			x		x			x			x		
Capay															
Colusa		x			x										
Del Rio	x														x
Drumheller Slough		x						x	x				x		
Hamilton City			x						x						
Llano Seco	x		x												x
O'Connor Lakes		x													
Pine Creek West	x					x						x	x		
Sul Norte	x				x								x		

B. Vegetation

River Partners collected data on vegetation composition and structure, assessing the metrics of percent cover, species richness, and strata height. Each metric was assessed as a whole as well as separated into different classes of strata [tree, shrub, woody (tree + shrub), herbaceous] and plant origin (native, non-native). Unfortunately, graphical representation of the data showed no correlation of any vegetation metric with avian species richness nor avian community composition in either habitat, and so no statistics were performed. Further analysis connecting vegetation data with the avian density estimates is outside the scope of this study.

Additionally, there was no correlation of the vegetation metrics with age since restoration (Figure 2). However, the percent cover of woody vegetation in the riparian forest followed expectations upon reflection of each sites' initial conditions, planting design, and goals. For example, Hamilton City, the youngest restored site at 5 years, had the lowest cover. While expected to be lowest as it was youngest, it was also planted at a much lower density than other projects to maintain flood conveyance. Similarly, while the oldest site at 21 years old, Llano Seco was also planted at low density for flood conveyance needs, and so only averaged at 25% cover, aligning with the initial planting design. Pine Creek West, Del Rio, and O'Connor Lake, all 18-19 years since restoration, had less than 30% cover on average, half the cover of younger sites Bear River, Drumheller Slough, Capay, and Abbott Lake. This difference in cover can be explained by soil conditions, as Pine Creek West, Del Rio, and O'Connor Lakes had poor soil and so dense growth was never expected. Colusa SRA had good soils, but still only 30% cover, which can be explained by the fire that went through the site in 2022. Bear River, Drumheller Slough, and Capay, the sites with highest cover (50-65%), were also planted at the highest density.

While more detailed analysis relating the density objectives to the vegetation is outside the scope of this work, it should be noted that the two sites with the most riparian focal species meeting density objectives also had the highest woody vegetation cover (Bear River Setback and Drumheller Slough), and interestingly only one of those riparian focal species was present at both sites (Black-headed Grosbeak). Additionally, Common Yellowthroat only met density objectives at Hamilton City and Llano Seco. These two sites, while they are the oldest and youngest sites, were both planted at low density and have low woody cover.

The grassland savannas had low native herbaceous cover across all of the sites, even sites that have been known to be grazed. While anecdotally, some sites had large patches of native grasses that weren't captured in the three-four data points, this result was not unexpected. The location of grassland restoration in riparian areas are often more dictated by flood conveyance needs rather than site conditions. Thus, we may plant a grassland where the site conditions are not always most suitable for grassland success, which increases the difficulty of the already difficult practice of managing native grasslands.

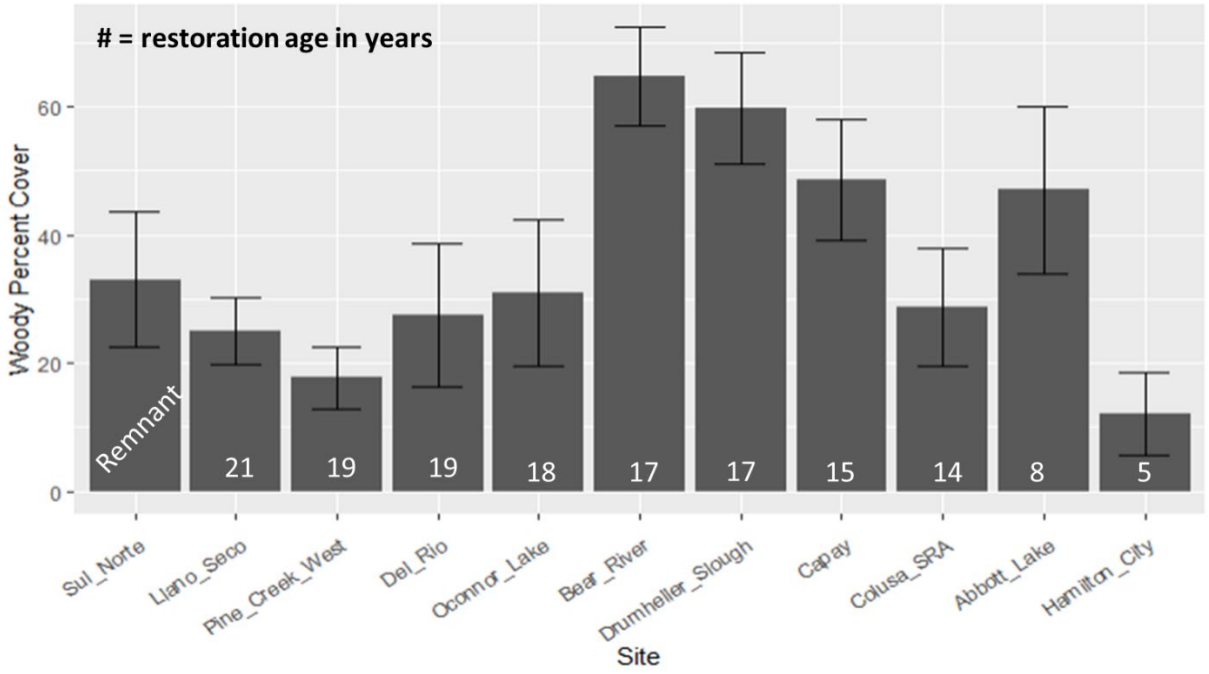

Figure 2. Percent cover of woody vegetation in the riparian habitats of each site. The number within the bars refers to the restoration age of the site in years.

C. Management Recommendations

By evaluating the success of restoration activities in meeting the CVJV's density objectives for breeding birds through post-restoration bird monitoring, we aim to help to inform future restoration design and support effective bird conservation. We have shown that riparian forest and grassland savannah restoration creates important habitats for birds, which can be seen by most focal bird species having their density objectives met on at least one site, when considering the sites on a landscape scale.

One of the most notable results of the Project is that some of the riparian focal species that were not present at most sites were species typical of early successional stages in riparian vegetation. This may be driven by the lack of young restoration sites in the study, however, it highlights the needs to increase the amount of early -successional habitat across the landscape. The land used to have a mosaic of different successional stages of riparian forest, and we need that range of habitat ages to maximize avian outcomes. This can be done in two ways. One, we should return to dense, older restoration sites to manage for the more open early successional habitat by clearing certain areas and replanting. The other, more important way is ensuring continual large-scale restoration projects across the landscape, so that at any given time there is large acreage plantings of early successional stage vegetation along the river.

Our results also highlight the difficulty in native grassland management. Native grasslands should undergo grazing and prescribed burns regularly to maintain native herbaceous dominance. These management practices would also prevent woody encroachment into the grasslands, which would ideally promote the focal species that prefer grassland habitat over grassland-oak

savannah, which we did not see much of in this Project. While not showing up in the small sample size (n = 3-4), several sites had large patches of native grasses. Next steps would include obtaining more information on how management actions impact native cover, as well as obtain more data points to get a more representative sample of native cover.

The need for multi-benefit restoration is being increasingly recognized. For example, restoration projects may aim to increase wildfire resiliency, groundwater recharge, and carbon sequestration in addition to creating wildlife habitat, of which different focal species may also require different vegetation structures. Assessing performance of a restoration site with multi-benefits in mind is complex when maximizing one benefit may reduce another. The lack of trends with age since restoration among bird species in this study highlights this, as the sites themselves varied greatly in planting density and soil quality, with some needing to place the goal of maintaining flood conveyance higher in priority than in maximizing bird habitat.

More study across more restoration sites that vary in age, size, density, and species composition is needed to better understand how restoration serves as habitat to riparian and grassland focal bird species.

Lessons Learned

Overall, the Project was successful in showing that, on a landscape scale, riparian and grassland restoration project sites have provided habitat to CVJV focal grassland birds and at-risk riparian birds. The Project also provided valuable lessons on how to further improve data collection and analysis in future River Partners' projects.

•**Increased survey effort.** In this study, we surveyed 3-4 points in each the grassland savannas and riparian forests at each site. We were able to determine whether species met objectives with high confidence for most species at most sites, but there were approximately 21% of species/site combinations that were uncertain due to insufficient precision in our density estimates. Increasing the number of points per site where feasible and/or repeating surveys in subsequent years may help to reduce this uncertainty for some species and sites. Future projects will increase the number of points per site. We also recommend increased vegetation survey efforts in addition to the vegetation surveys taking place at the point count location. Our vegetation data had greater uncertainty than the point county survey data, and increased sampling effort would help us better assess bird outcomes in relation to vegetation data.

•**Additional bird surveys methods.** Several of the CVJV focal species are not easily surveyed using the point count method, due to their large home ranges or colonial nesting behavior. More specialized survey methods designed to target these species would be helpful in estimating their breeding densities and whether their density objectives have been met. These species include the Western Yellow-billed Cuckoos and Burrowing Owls. Detections of rare or less frequently vocal species may also be improved through acoustic monitoring methods. Future projects will deploy Acoustic Recording Units (ARUs) at the same location as the point counts. ARUs record bird calls continuously during the sunrise hours every day throughout the breeding season, are better able to capture the presence of rare birds, although they cannot provide abundance information. However, methods for estimating densities from these data would require additional development and testing.

•**Additional sites** (including more younger restoration sites). We found that some of the riparian focal species that were not present at most sites were species that are typical of early successional stages in riparian vegetation growth, which may have been driven in part by the small number of young restoration sites in this study. Future studies could include a more even distribution of sites in terms of years since restoration, to better understand how early successional species are responding to restoration activities. In addition, repeated surveys at the same sites over time, starting just after restoration, would provide a more comprehensive view of their contributions to the CVJV's conservation objectives and how they change over time.

Sharing Outcomes

River Partners has and will continue to share the results from this work with practitioners in public and private institutions. River Partners Restoration Ecologists presented two presentations at the 2024 SERCAL (California Society for Ecological Restoration) in May, titled 1) Informing restoration design: Applying Central Valley Joint Venture Population Objectives for Grassland and At-Risk Riparian Birds, and 2) Assessing riparian restoration project performance: Multiple benefit perspectives. The annual SERCAL conference is one of the largest gatherings of restoration professionals in the state, allowing us to reach a wide audience. As funding allows, we aim to present this work at other conferences. We will also share the report by Point Blue as well as the recommendations discussed in this report with the land agencies where the data was collected. The report by Point Blue was written in draft manuscript form and will continue to be edited with the intention to submit to a journal.

River Partners also drafted a social media post about the results of this work, which will be shared in the coming months to an audience of over 3,800 followers.

Importantly, the outcomes of the Project were shared internally and used to develop and improve our monitoring practices. The lessons we learned from the Project have already been implemented in two other monitoring projects this year, one in Sacramento River Wildlife Area units, and the other in the San Joaquin Valley, which combined are our largest monitoring effort yet and providing further information of both remnant and known-age restoration forests.

References

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[CDFW] California Department of Fish and Wildlife. 2018. Vegetation—Great Valley Ecoregion [ds2632] [GIS dataset]. Available from: https://map.dfg.ca.gov/metadata/ds2632.html

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Appendix A

Table A1. Survey point coordinates for each site.

Point	Habitat Type	New/ Legacy	Longitude (WGS84)	Latitude (WGS84)
Hamilton City				
HAMC_201	riparian	new	-121.9709697	39.71439244
HAMC_202	riparian	new	-121.9800913	39.73048909
HAMC_203	riparian	new	-121.9762415	39.71662824
HAMC_204	riparian	new	-121.9692958	39.71673972
Pine Creek West				
PINE_1	grassland	legacy	-121.965	39.72383
PINE_121	grassland	new	-121.9586723	39.73368106
PINE_122	grassland	new	-121.9606805	39.73274391
PINE_123	grassland	new	-121.9625986	39.72004129
PINE_11	riparian	legacy	-121.9622	39.72242
PINE_214	riparian	new	-121.9587301	39.72277955
PINE_8	riparian	legacy	-121.96239	39.72826
PINE_9	riparian	legacy	-121.961	39.7258
Capay				
KAIS_101	grassland	new	-121.9491612	39.70625784
KAIS_102	grassland	new	-121.9565131	39.70614103
KAIS_103	grassland	new	-121.9571321	39.70964037
KAIS_104	grassland	new	-121.959739	39.70889699
KAIS_13	riparian	legacy	-121.95046	39.71205
KAIS_5	riparian	legacy	-121.9481	39.7025
KAIS_7	riparian	legacy	-121.95246	39.7021
KAIS_9	riparian	legacy	-121.95276	39.7049
Llano Seco				
LLSE_29	grassland	legacy	-121.95176	39.58914
LLSE_31	grassland	legacy	-121.95068	39.58684
LLSE_32	grassland	legacy	-121.95261	39.58436
LLSE_34	grassland	legacy	-121.94707	39.58771
LLSE_201	riparian	new	-121.9479718	39.5908035
LLSE_25	riparian	legacy	-121.95016	39.59072
LLSE_28	riparian	legacy	-121.94637	39.58972
Del Rio				
DELR_101	grassland	new	-121.9637837	39.52657634
DELR_103	grassland	new	-121.9635031	39.52887146
DELR_104	grassland	new	-121.9635522	39.53070318
DELR_1	riparian	legacy	-121.96642	39.5232
DELR_3	riparian	legacy	-121.9665	39.52679
DELR_4	riparian	legacy	-121.96654	39.52862
DELR_9	riparian	legacy	-121.96405	39.52362
Sul Norte				
SUNO_101	grassland	new	-122.0002322	39.47489533
SUNO_102	grassland	new	-122.002297	39.47198835

SUNO_103	grassland	new	-122.0015043	39.46912806
SUNO_104	grassland	new	-122.0041002	39.45950815
SUNO_1	riparian	legacy	-121.99799	39.46455
SUNO_4	riparian	legacy	-121.99784	39.46248
SUNO_5	riparian	legacy	-122.00066	39.46662
SUNO_9	riparian	legacy	-121.99807	39.46843
Drumheller				
PRFE_101	grassland	new	-122.000364	39.41716247
PRFE_102	grassland	new	-122.0000229	39.41523372
PRFE_103	grassland	new	-121.9964996	39.41297005
PRFE_12	grassland	legacy	-122.0028335	39.41512251
PRFE_10	riparian	legacy	-122.0055647	39.41665965
PRFE_11	riparian	legacy	-122.003261	39.41691024
PRFE_8	riparian	legacy	-122.0014876	39.41338095
PRFE_9	riparian	legacy	-122.0056499	39.41475017
Colusa SRA				
COLU_101	grassland	new	-122.0052291	39.23369291
COLU_102	grassland	new	-122.0076567	39.23026392
COLU_103	grassland	new	-122.0054864	39.23157049
COLU_201	riparian	new	-122.0108223	39.22880698
COLU_202	riparian	new	-122.0134109	39.23047367
COLU_203	riparian	new	-122.0120465	39.2270775
COLU_204	riparian	new	-122.0096914	39.23395358
Abbott Lake				
ABBL_101	grassland	new	-121.6103744	39.04197747
ABBL_102	grassland	new	-121.6013651	39.02366401
ABBL_103	grassland	new	-121.6116401	39.03035524
ABBL_104	grassland	new	-121.6024144	39.02566601
ABBL_201	riparian	new	-121.5982449	39.02465588
ABBL_202	riparian	new	-121.6076089	39.02903042
ABBL_203	riparian	new	-121.6091395	39.03120911
O'Connor Lakes				
OCLA_101	grassland	new	-121.5818848	39.00755942
OCLA_102	grassland	new	-121.5934007	39.00703023
OCLA_103	grassland	new	-121.5886306	39.00747162
OCLA_104	grassland	new	-121.5911195	39.00554378
OCLA_201	riparian	new	-121.5957544	39.00649741
OCLA_202	riparian	new	-121.5943198	39.00228897
OCLA_203	riparian	new	-121.5907378	39.00233581
OCLA_204	riparian	new	-121.5945473	39.00410672
Bear River Setback				
BEAR_101	grassland	new	-121.5499482	38.96340506
BEAR_102	grassland	new	-121.5498691	38.95963773
BEAR_103	grassland	new	-121.5485124	38.96153917
BEAR_104	grassland	new	-121.5463562	38.96973133
BEAR_201	riparian	new	-121.567875	38.94827647
BEAR_202	riparian	new	-121.5706468	38.95187739
BEAR_203	riparian	new	-121.5505518	38.95759006
BEAR_204	riparian	new	-121.5666435	38.95374732

Appendix B.

Report/draft manuscript by Point Blue Conservation:

Applying Central Valley Joint Venture Population Objectives for Grassland and At-Risk Riparian Birds

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1 November 2023

OVERVIEW

The objectives of this study were to inform restoration design and support conservation of Central Valley grassland and riparian birds by evaluating the success of restoration sites in meeting Central Valley Joint Venture objectives for the breeding densities of several focal species. Breeding densities are expected to reflect the quality of habitat for nesting birds, and the restoration of high-quality habitat that meets or exceeds density objectives will be required to meet the CVJV's long-term goals of supporting robust and resilient populations of riparian and grassland birds. Here, we report on the study design, data analysis, and results of this one-year study.

METHODS

Study Design & Data Collection

We worked with River Partners staff to identify 11 restoration sites in the Sacramento Valley that had both riparian and grassland vegetation for inclusion in this study (**Figure 1**). Three sites were located on the Feather River, and the rest on the Sacramento River. The ages of these restoration sites ranged from 5 to 21 years old, with all but Hamilton City and Abbott Lake at least 14 years old (**Table 1**). We identified grassland and riparian portions of each restoration site based on a recent land cover data set compiled for the Great Valley Ecoregion which used NAIP imagery in 2009, 2012, and 2014 (CDFW 2018). We considered areas classified as "Valley Foothill Riparian" in the California Wildlife Habitat Relationships (CWHR) system as riparian vegetation, as well as areas classified as "Coastal Scrub" in the CWHR system that were more specifically identified as Coyote Brush (*Baccharis pilularis*). We also considered areas classified as "Perennial Grassland" or "Annual Grassland" as grassland vegetation, as well as areas classified as "Fresh Emergent Wetland" in the CWHR system and "Wet Meadows, Perennial Grasses and Forbs" using the Classification and Assessment with Landsat of Visible Ecological Groupings (CALVEG) system. In addition, the Hamilton City restoration site was mapped as entirely "Urban", and we updated the vegetation layer using River Partners' estimates of areas known to be grassland and assuming the remainder was riparian.

Figure 1. Restoration sites selected for inclusion in this study, shown within the Central Valley Joint Venture's Sacramento Planning Region.

For each restoration site, we aimed to select three to four point count survey locations each in riparian vegetation and grassland vegetation. We first reviewed the locations of any historical point count survey locations to identify existing points that were: (1) mapped as having entirely riparian or entirely grassland vegetation within 50 m, (2) at least 50 m from the restoration site boundary, and (3) at least 200 m away from other point count survey locations (**Figure A1**). Six of the 11 restoration sites contained historic point count survey locations meeting these criteria, all in riparian vegetation except for four grassland points at Llano Seco and one at Pine Creek West (**Table 1**). We then added new, randomly-selected point count locations as needed to meet our target sample size. To randomly select new survey locations, we used the "spsurvey" package in R to identify candidate locations (Dumelle et al. 2023; R Core Team 2023). The riparian vegetation within the Llano Seco site was slightly too small to fit at least three points, and we reduced the distance requirement between points to 180 m to be able to retain this site in our survey of points in riparian vegetation. The grassland vegetation area within the Hamilton City site was much too small and fragmented to fit at least 3 points that met our criteria, and we dropped this site from our survey of grassland points.

Table 1. Site name, site code, number of point count stations in grassland and riparian habitats, and the first year of restoration for each site/habitat type.

Site Name	Site Code	No. Grassland Points	No. Riparian Points	Grassland First Year Restored	Riparian First Year Restored
Abbott Lake	ABBL	4	3	2017	2015
Bear River Setback	BEAR	4	4	2006	2006
Capay*	KAIS	4	4	2007	2007
Colusa	COLU	3	4	2009	2009
Del Rio*	DELR	3	4	2004	2004
Drumheller Slough*	PRFE	4	4	2008	2006
Hamilton City	HAMC	0	4	2019	2018
Llano Seco*	LLSE	4	3	2002	2002
O'Connor Lakes	OCLA	4	4	2006	2005
Pine Creek West*	PINE	4	4	2004	2004
Sul Norte*	SUNO	4	4	2004	NA (remnant)

*Historic point count survey locations included

The final set of point count survey locations included 42 riparian points and 38 grassland points across 11 restoration sites (**Table 1**). River Partners staff with training and experience in the point count survey method visited each survey location twice during the peak of breeding season (May—June) in 2023 and conducted 5-minute point count surveys on each visit following standardized protocols (Ralph et al. 1995). All birds detected were recorded, along with the method of detection and the estimated distance to each individual bird, grouped into distance bands (VCP10_30 protocol, with bands of 0—10 m, 10—20 m, 20—30 m, 30—50 m, 50—100 m, and >100 m); individuals flying over were recorded separately. River Partners staff entered all bird survey data at the password protected Avian Knowledge Network (AKN; Ballard

et al. 2008). For quality assurance, all data entry was reviewed and checked by River Partners staff and with AKN's built-in tools.

Focal Species and Density Objectives

We used previously selected focal species to assess bird response to riparian and grassland restoration (**Table 2**; DiGaudio et al. 2017, Dybala et al. 2017). Focal species were selected because they use a specific vegetation type for breeding in the Central Valley, were identified as warranting special management status or have experienced declines or reductions in their breeding range, or are useful in monitoring the effects of management actions (DiGaudio et al. 2017, Dybala et al. 2017). In addition, the suite of focal species for each vegetation type was intended to represent a diverse range of more specific vegetation associations (e.g., early- and late-successional species) and nesting requirements (e.g., shrub and cavity nesters) within their preferred habitat. We used riparian focal species to assess points in riparian habitat, and we used grassland-oak savannah focal species to assess survey points in grassland habitat. While grassland-oak savannah focal species can use both vegetation types, they are considered to have a preferred habitat of the two (**Table 2**). We excluded from these analyses focal species with very large territories (Burrowing Owl, Northern Harrier) and colonial breeding species (Bank Swallow), as they are not well sampled with the point count method and would require more targeted, species-specific survey effort. Additionally, five riparian focal species, three grassland focal species, and two oak savannah species were identified as at-risk species by the Central Valley Joint Venture (CVJV 2020). At-risk species – in some cases, subspecies or distinct populations – are those that are state or federally listed as threated or endangered, considered a bird species of special concern in California (Shuford and Gardali 2008), or are on one or more national or regional conservation lists (CVJV 2020).

For each focal species, long-term (100-year) and short-term (10-year) breeding bird density objectives have been developed to support long-term and short-term population objectives (DiGaudio et al. 2017, Dybala et al. 2017). The long-term population objectives are based on the conservation goal of having genetically robust, self-sustaining, and resilient populations, while the short-term objectives can be used to track progress toward the long-term goal for each species (DiGaudio et al. 2017, Dybala et al. 2017). The population objectives may be achieved through a combination of restoring additional high-quality habitat and enhancing existing habitat so that it can support a higher density of breeding birds. The corresponding long-term and short-term density objectives were based on maintaining or improving current average densities and are intended to represent targets for future average densities over a large region. For riparian species, density estimates and objectives were developed by CVJV planning region (Sacramento, Yolo-Delta, San Joaquin, and Tulare) within the CVJV "primary" focus area (the Central Valley floor; Dybala et al. 2017). For grassland-oak savannah focal species, density estimates and objectives were developed for each species' preferred habitat (**Table 2**) across the entire "primary" focus area, with separate estimates for "secondary" focus area (surrounding foothills; DiGaudio et al. 2017).

Although the density objectives are intended to represent region-wide averages, they can be used to evaluate the contribution of individual restoration projects to these objectives. If

grassland and riparian restoration projects are successful in providing high-quality breeding habitat, we would expect the breeding densities of one or more focal species to meet or exceed the short-term (10-year) density objectives for the relevant geographic region. However, because the focal species each have their own habitat requirements and preferences, they are not all expected to meet the density objectives simultaneously, and the contribution of a restoration project to the CVJV conservation objectives must be considered over time as the project ages and the habitat evolves.

Table 2. Central Valley Joint Venture focal species for riparian, grassland and oak savannah habitats (DiGaudio et al. 2017, Dybala et al. 2017), shown with their more specific habitat preferences. Species identified as at-risk are italicized (CVJV 2020).

Riparian Focal Species	Code	Grassland-Oak Savannah Focal Species	Code
Mature forest preferred		**Grassland preferred**	
Ash-throated Flycatcher	ATFL	*Burrowing Owl*[1]	*BUOW*
Black-headed Grosbeak	BHGR	*Grasshopper Sparrow*	*GRSP*
Nuttall's Woodpecker	NUWO	Horned Lark	HOLA
Western Yellow-billed Cuckoo	*YBCU*	*Northern Harrier*[1]	*NOHA*
Dense understory preferred		Western Meadowlark	WEME
Common Yellowthroat	COYE	**Oak savannah preferred**	
Song Sparrow	SOSP	Acorn Woodpecker	ACWO
Spotted Towhee	SPTO	American Kestrel	AMKE
Dense, shrubby thickets preferred		Lark Sparrow	LASP
Lazuli Bunting	LAZB	*Loggerhead Shrike*	*LOSH*
Least Bell's Vireo	*LBVI*	Western Bluebird	WEBL
Yellow Warbler	*YEWA*	Western Kingbird	WEKI
Yellow-breasted Chat	*YBCH*	*Yellow-billed Magpie*	*YBMA*
Other			
Bank Swallow[1]	*BANS*		

[1]Species with large territories and/or colonial nesters that are not adequately surveyed by point count surveys are not included in the analysis.

Data Analysis

We conducted all data cleaning and analyses in R version 4.1.3 (R Core Team 2022), primarily using the core "tidyverse" packages, and the "cowplot" and "viridis" packages were used to create some of the figures (Garnier et al. 2023, Wilke 2020, Wickham et al. 2019). We included all data from point count surveys conducted in 2023 at the 11 selected restoration sites (**Figure 1; Table 1**).

To estimate the density of each focal species at each site, we included all detections within 50 m of the observer, and we excluded all individuals coded as juveniles or flyovers. All points were surveyed twice, and as an estimate of the abundance of each species, we used the maximum number of detections within 50 m of the survey point across both visits. We did not attempt to model detection probabilities with this dataset, but we adopted the general

assumption that the detection probability of each of these focal species is relatively high within 50 m of the observer. However, we also assumed that there was no change in the true breeding density of any focal species between the two surveys at each point and that if a higher count occurred during one of the two visits, then that represented a more accurate count of the true number of individuals in the area. To estimate density (individuals per hectare), we then divided this estimate of abundance by the area of a 50 m circle. For each focal species, we then calculated the mean density and standard error (SE) of all points by site and by habitat type (grassland or riparian).

Focal Species Density Objectives. To evaluate the current contribution of each restoration site to meeting CVJV objectives, for each site and habitat type, we compared the mean density estimates ± SE for each species against the short-term (10-year) objectives. For riparian focal species at riparian survey points, we used regional species density objectives for the Sacramento Valley (Dybala et al. 2017) and for grassland and oak savannah species at grassland points, we used the objectives for the primary focus area (the floor of the Central Valley; DiGaudio et al. 2017). We then considered the precision of each estimate to determine if the objective was met, not met, or if we lacked certainty to make a determination (**Table 3**).

Time Since Restoration. Although this was not a primary objective of this study or a formal analysis, we also explored evidence for any patterns in the density of each species based on the age of the restoration. We visualized mean density estimates for each focal species over the number of years since restoration in grassland and riparian habitats. For sites where restoration activities took place over more than one year, we used the earliest year of restoration. In some cases, riparian and grassland restoration activities at the same site were started in different years, and we used the different years of restoration between habitats for these sites (**Table 1**). At Sul Norte, the riparian habitat was not restored, and we consider it to be a remnant riparian site.

Table 3. Score descriptions and criteria used to determine whether short-term density objectives for each focal species were met.

Assessment of Short-Term Objective	**Description**
Met, high confidence	mean-SE > short-term objective
Uncertain	mean > short-term objective AND mean-SE < short-term objective OR mean < short-term objective AND mean+SE > short-term objective
Not met, high confidence	mean+SE < short-term objective

RESULTS

Focal Species Density Objectives. Nine of the 12 riparian focal species were detected during surveys; Bank Swallow, Yellow-billed Cuckoo, and Least Bell's Vireo were not detected on any surveys, so those species are not included in figures. Least Bell's Vireo are largely extirpated from the Central Valley with population estimates assumed to be near zero (Dybala et al. 2017). Yellow-billed Cuckoo populations are very small and likely require more targeted survey effort

with call playback (Dettling et al. 2015). Bank Swallow are also inadequately surveyed using point counts (see methods) and require more targeted survey effort (BANS-TAC 2013).
Of the five grassland-oak savannah focal species that prefer grassland habitat, Western Meadowlark was the only species detected during surveys, so we did not estimate densities for the other four species. We did include results for five of the seven grassland-oak savannah focal species that prefer oak savannah in our assessment of the grassland restoration sites; we excluded Loggerhead Shrike, which was not detected on any point count survey, and Yellow-billed Magpie, which was only detected once, greater than 50 m from the survey point. Aside from the single detection of the magpie, Yellow Warbler and Yellow-breasted Chat were the only at-risk species among both groups of focal species that were detected during surveys in 2023.

We found considerable variation among species, sites, and habitat types in terms of meeting short-term density objectives (**Figures 1—2, A2**). For riparian habitat, ten of the 11 restoration sites had at least one riparian focal species meet or exceed the short-term density objectives with high confidence, and three sites had three species meet the objectives (Figure 1). For grassland habitat, just seven of the ten sites with sufficient grassland vegetation to survey had at least one grassland-oak savannah focal species meet or exceed the density objectives. However, most sites, including the remaining three grassland sites, had species whose density estimates lacked sufficient precision to determine whether they met the density objectives. Repeated surveys over additional seasons and/or adding point count survey locations at these sites could help to reduce the uncertainty in these estimates. However, all 11 sites also had several species that did not meet the objectives, with high confidence.

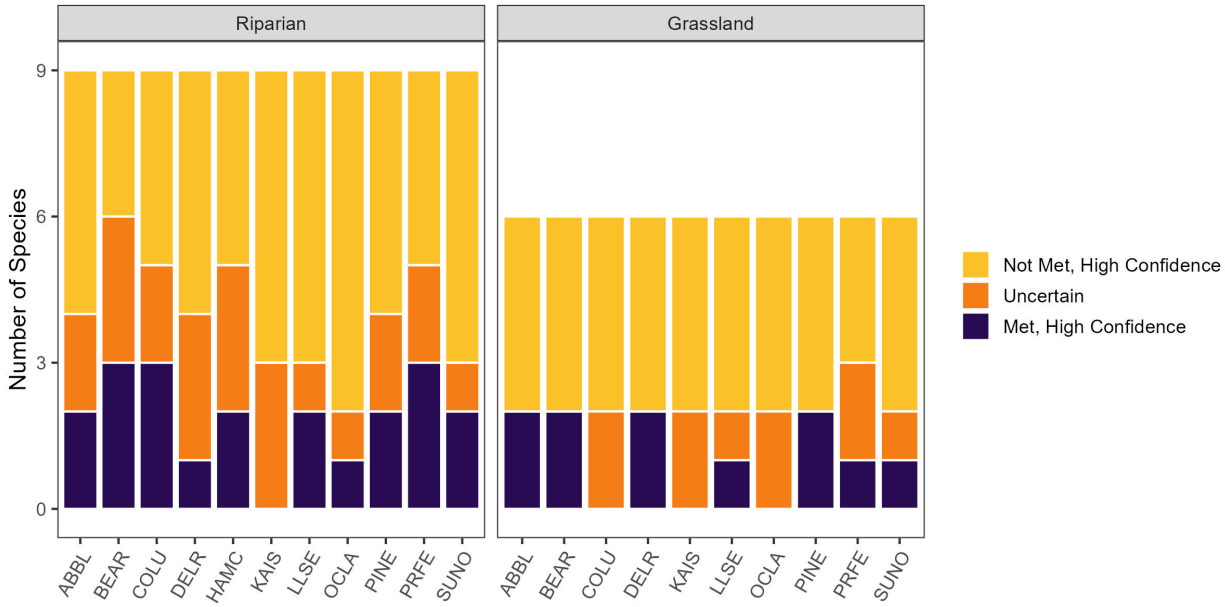

Figure 1. Number of focal species at each site in riparian and grassland habitats that exceeded breeding bird density objectives (met, high confidence), did not meet the objectives (not met, high confidence), and those whose status was uncertain at sites in the Sacramento Valley, California. Site codes on the x-axis are defined in Table 1.

Considering the responsiveness of each focal species to restoration across all sites, among the riparian focal species, Ash-throated Flycatcher, Nuttall's Woodpecker, and Black-headed Grosbeak had density estimates that met or exceeded the objectives at the most sites (n = 4-6), with several more that were uncertain (Figure 2). These species are all associated with mature riparian forest and woodland (Table 1), indicating the success of the riparian restoration sites in creating suitable habitat for them. There were fewer sites that supported the density objectives for other focal species associated with dense understory or dense, shrubby riparian thickets. Among the grassland-oak savannah focal species, restoration sites were the most successful in supporting the density objectives for Western Kingbird, a species that prefers oak savannah habitat. For Western Meadowlark, the only focal species detected at any of the sites that prefers grassland habitat, just two of the 10 sites supported their density objectives, although three more were uncertain. Several species did not reach their density objectives at any sites, including Lazuli Bunting among the riparian focal species, and Lark Sparrow and American Kestrel among the grassland-oak savannah focal species (**Figure 2**).

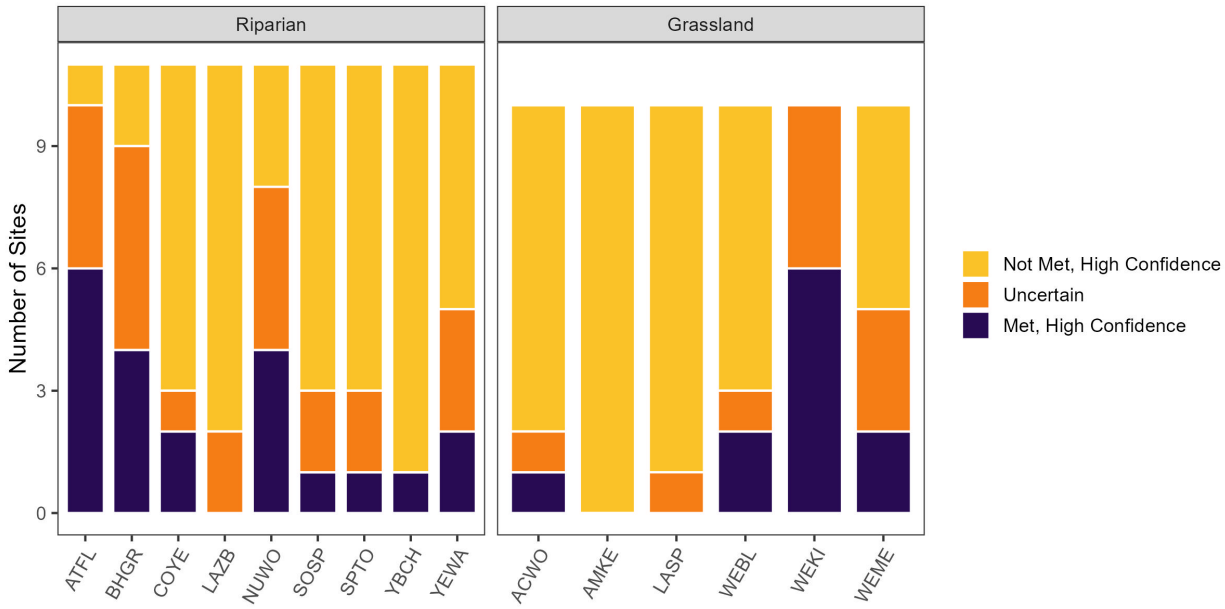

Figure 2. Number of sites for each focal species that exceeded breeding bird density objectives (met, high confidence), did not meet the objectives (not met, high confidence), and those whose status was uncertain at riparian and grassland restoration sites in the Sacramento Valley, California. Bird species codes on the x-axis are defined in Table 2.

Considering both riparian and grassland species together, all sites except Capay (KAIS) met the density objectives for at least one species. While some sites may appear relatively less successful, in that they had fewer total species with density estimates that exceeded their objectives, some of these sites supported the density objectives of individual species that were not being met at other sites. For example, at Del Rio (DELR), only one riparian species (Ash-throated Flycatcher) met its density objective, but it was also one of only two sites where Western Meadowlarks were above the short-term objective (**Figure A2**). The variation in response to restoration by different species among sites likely reflects variation in the specific

vegetation composition, structure, and other features of each site – even among sites of similar restoration ages – in addition to variation in the requirements of different species. Each individual restoration site is not expected to support the density objectives of all species simultaneously, but the combined effect of a suite of restoration sites of different ages and structures may be more effective in supporting the diverse suite of focal species and their habitat requirements. Evaluating multiple sites across a range of habitat conditions and over time will continue to inform the evaluation of the bird community response to restoration.

Time Since Restoration. Although there were not very many restoration sites in this study that were very young (<5 years) or middle-aged (5-15 years), the densities of some riparian focal species appeared to vary with time since restoration (**Figure 3**). As mentioned above, Ash-throated Flycatcher, Nuttall's Woodpecker, and Black-headed Grosbeak, species associated with mature forest, met their objectives at the most sites and also had among the highest densities of all focal species. However, the Ash-throated Flycatcher – a cavity nester – was the only one of the three whose densities appeared to increase with time since restoration. For the Nuttall's Woodpecker, the only other cavity nester, the sites with highest counts spanned the range of restoration ages while the highest densities for Black-headed Grosbeak were found in 15- to 20-year-old restoration sites, with lower densities at younger and older sites. Similarly, Spotted Towhee was one of the most abundant species across sites, and its densities also peaked in 15- to 20-year-old restoration sites. Other riparian focal species were only detected at very low densities and were not detected at all sites, including the Common Yellowthroat, Lazuli Bunting, Yellow Warbler and Yellow-breasted Chat; however, the former three of these species all had their highest density at the youngest restoration site. Many of these patterns are not unexpected: Lazuli Bunting and Yellow Warblers are associated with dense, shrubby riparian thickets that are more common in the early stages of riparian vegetation development (Greene et al. 2020, Lowther et al. 2020), while the Ash-throated Flycatcher is a secondary cavity nester that relies on natural cavities or those made by other species (Cardiff and Dittmann 2020), a habitat feature more likely to occur in mature riparian forest with older trees. These results also reflect the need for a range of ages of riparian habitats across the landscape to support a range of habitat requirements (Gardali et al. 2006, Dybala et al. 2017). Additionally, most of the sites in our study were restored more than 14 years ago and may have provided more support for the density objectives of early successional species when they were younger. Repeated surveys at the same sites over time, beginning just after restoration, would provide a more comprehensive view of their contributions to the CVJV's conservation objectives and how they change over time.

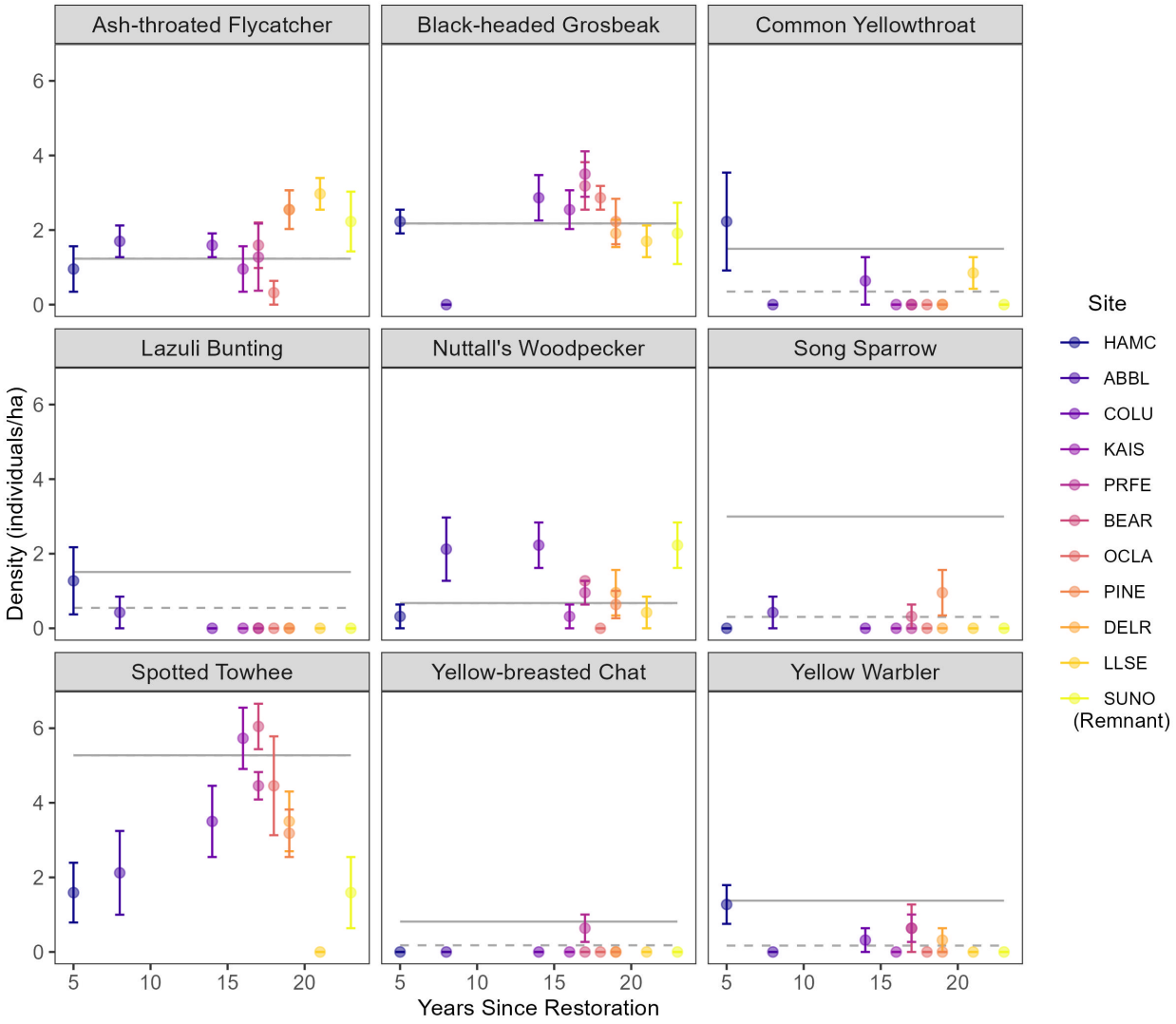

Figure 3. Mean density ± standard error for riparian focal species of landbirds since the initial year of riparian restoration (plus one unrestored remnant site) at sites in the Sacramento Valley, California. Horizontal gray lines represent long-term (solid) and short-term (dashed) breeding density objectives for each species (Dybala et al. 2017); for species with equal long- and short-term objectives, only a single solid line is shown. Site codes in legend are defined in Table 1.

For the grassland focal species (**Figure 4**), most species were only detected at a few sites, and thus there were no clear patterns of an association with time since restoration for these, including Acorn Woodpecker, American Kestrel, Lark Sparrow, or Western Bluebird. For the most abundant focal species in this group, the Western Kingbird, there was not an obvious pattern with time since restoration, although the sites with the highest numbers were at sites that were restored 15 to 20 years earlier. The sites with the highest densities of Western Meadowlarks were the oldest grassland restoration sites. Variation in the densities of grassland and oak savannah bird species across sites could relate to differences in vegetation structure or density, size of the grassland patch, and/or the prevalence of edge habitat (Davis 2004). These

same variables may also influence the lack of certain focal species from the sites, including those that were not detected at any sites; for example, many grassland species tend to occupy larger patches of grassland (Johnshon and Igl 2001, Davis 2004, Ribic et al. 2009).

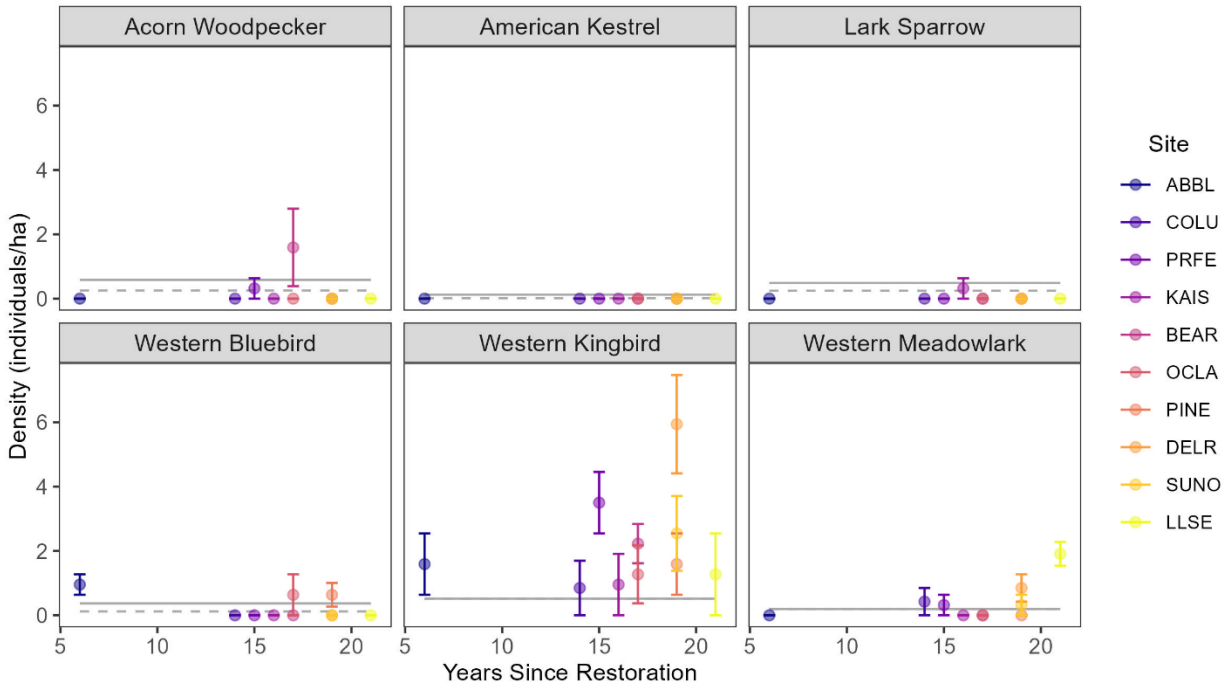

Figure 4. Mean density ± standard error for grassland and oak savannah focal species of landbirds since the initial year of grassland restoration at sites in the Sacramento Valley, California. Horizontal gray lines represent long-term (solid) and short-term (dashed) breeding density objectives for each species (DiGaudio et al. 2017); for species with equal long- and short-term objectives, only a single solid line is shown. Site codes in legend are defined in Table 1.

RECOMMENDATIONS

Evaluating the success of restoration activities in meeting the CVJV's density objectives for breeding birds through post-restoration bird monitoring can help to inform future restoration design and support effective bird conservation. Based on the results of this study, we provide recommendations for future work that may contribute toward the ongoing progress of meeting these objectives and evaluating success:

- **Increased point count survey effort.** In this study, we were able to determine whether species met objectives at each site with high confidence for most species at most sites, but there were approximately 21% of species/site combinations that were uncertain due to insufficient precision in our density estimates. Increasing the number of points per site where feasible and/or repeating surveys in subsequent years may help to reduce this uncertainty for some species and sites. For simplicity in the analysis for this one-year study, we prioritized selecting survey locations that were mapped as 100%

riparian or grassland vegetation in the surrounding 50 m, which limited the number of possible survey locations in some sites, but this requirement could be relaxed with additional survey and analysis effort.

- **Additional bird surveys methods.** Several of the CVJV focal species are not easily surveyed using the point count method, due to their large home ranges or colonial nesting behavior (Table 1). More specialized survey methods designed to target these species would be helpful in estimating their breeding densities and whether their density objectives have been met. For example, protocols for surveying Western Yellow-billed Cuckoos include using call playback (Dettling et al. 2015), and surveys of Burrowing Owls include systematic searches of survey areas (Wilkerson and Siegel 2010). Detections of rare or less frequently vocal species may also be improved through acoustic monitoring methods using recording units deployed in the field for longer periods of time (Schroeder and McRae 2020), although methods for estimating densities from these data would require additional development and testing.

- **Additional sites** (including more younger restoration sites). We found that some of the riparian focal species that were not present at most sites were species that are typical of early successional stages in riparian vegetation growth, which may have been driven in part by the small number of young restoration sites in this study. Future studies could include a more even distribution of sites in terms of years since restoration, to better understand how early successional species are responding to restoration activities. In addition, repeated surveys at the same sites over time, starting just after restoration, would provide a more comprehensive view of their contributions to the CVJV's conservation objectives and how they change over time.

- **Habitat covariates.** Future studies could evaluate the variation in bird densities across different subclasses of riparian and grassland habitat to further investigate the differences in bird densities among sites and even among survey points within sites. In addition, while a more detailed analysis of the variation in vegetation features at each point (e.g., plant species composition and structure, patch size) was beyond the scope of this study, including more specific habitat covariates in a future analysis of restoration sites may help to elucidate some of the differences we observed among species and sites.

- **Biodiversity indicator scores.** Restoration sites aren't expected to support the density objectives of all species simultaneously, complicating the interpretation of restoration success. Focal species densities are expected to change over time as the vegetation structure and composition matures and evolves, resulting in a complex and dynamic story. To track and help communicate the overall support of each site for riparian and grassland birds over time in a simpler way, future studies could develop and test a multispecies biodiversity indicator score for riparian and grassland bird communities in the Central Valley, such as has been developed for riparian birds in Marin County (Seavy and Gardali 2012).

- **Quantify multiple benefits.** Restoration projects can provide high quality habitat for birds, but they can also provide many other benefits of interest to local communities, such as carbon sequestration in trees and soil, improved water quality and soil health, water storage and flood protection, and habitat for many other species of interest (Golet et al. 2011; Dass et al. 2018; Dybala et al. 2019a; Conlisk et al. 2023). Quantifying other metrics of interest alongside bird surveys would help identify how the benefits to bird conservation may be correlated with other benefits, or where there are trade-offs, and how restoration design and age influences these patterns (e.g., Dybala et al. 2019b).

- **Maintain riparian habitat of varying successional stages.** Riparian focal species were selected to represent a range of more specific riparian vegetation associations, including early successional stages with dense understory and dense, shrubby riparian thickets. Because riparian restoration strategies commonly include planting trees, these sites can rapidly mature into riparian woodland and forest and may only briefly provide support for early successional species. To meet the CVJV objectives for all riparian focal species across all riparian habitat in the region, it will be important to maintain a mosaic of early-, mid-, and late-successional habitats across the landscape. Strategies to create and maintain this mosaic could include a change in planting designs to promote areas with dense understory and shrub layers and less canopy cover and/or restoring natural processes of disturbance on the landscape, such as flooding, that would create open areas for early successional habitat to establish.

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Appendix A

Figure A1. Land cover class and point count survey locations at each restoration site.

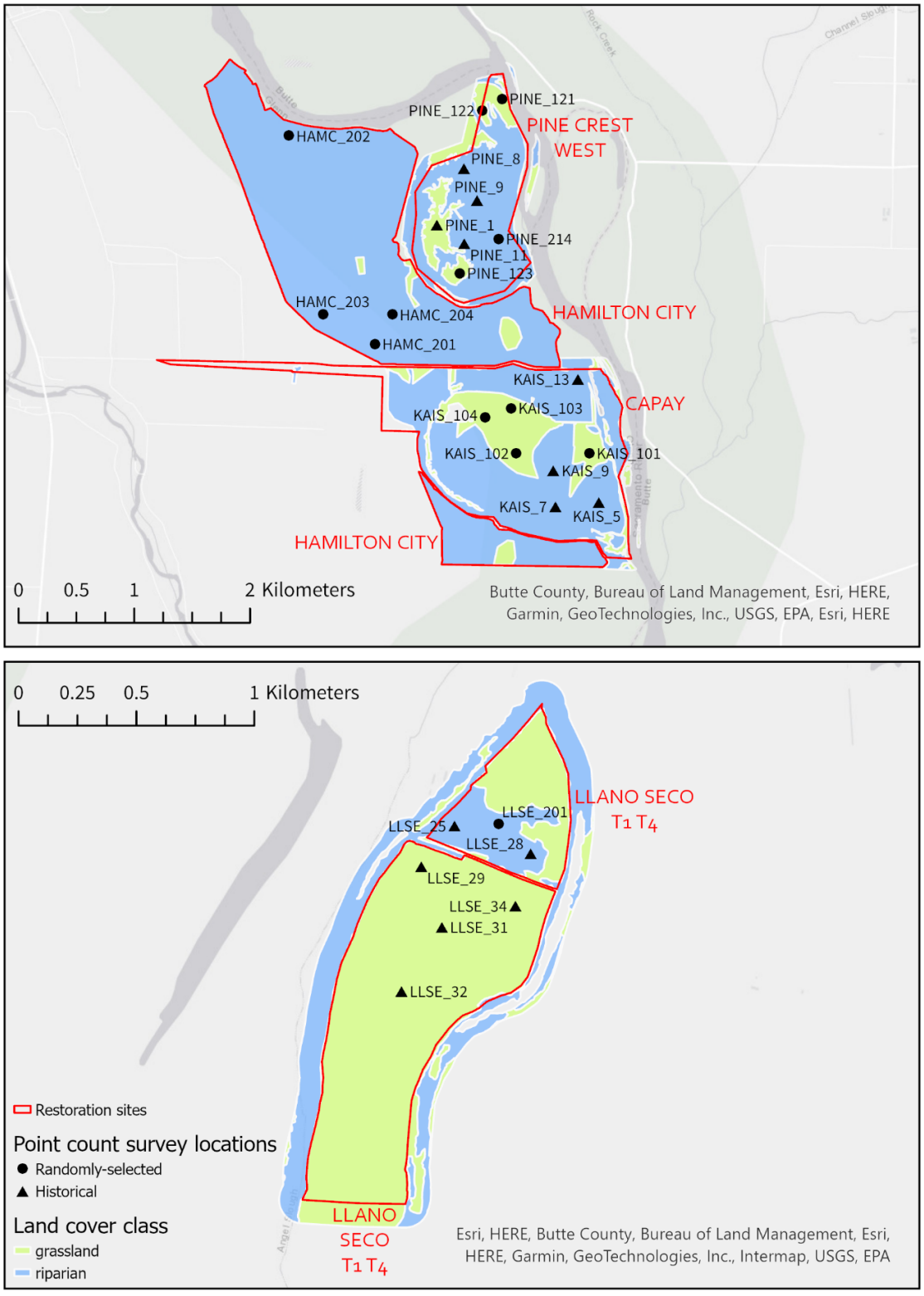
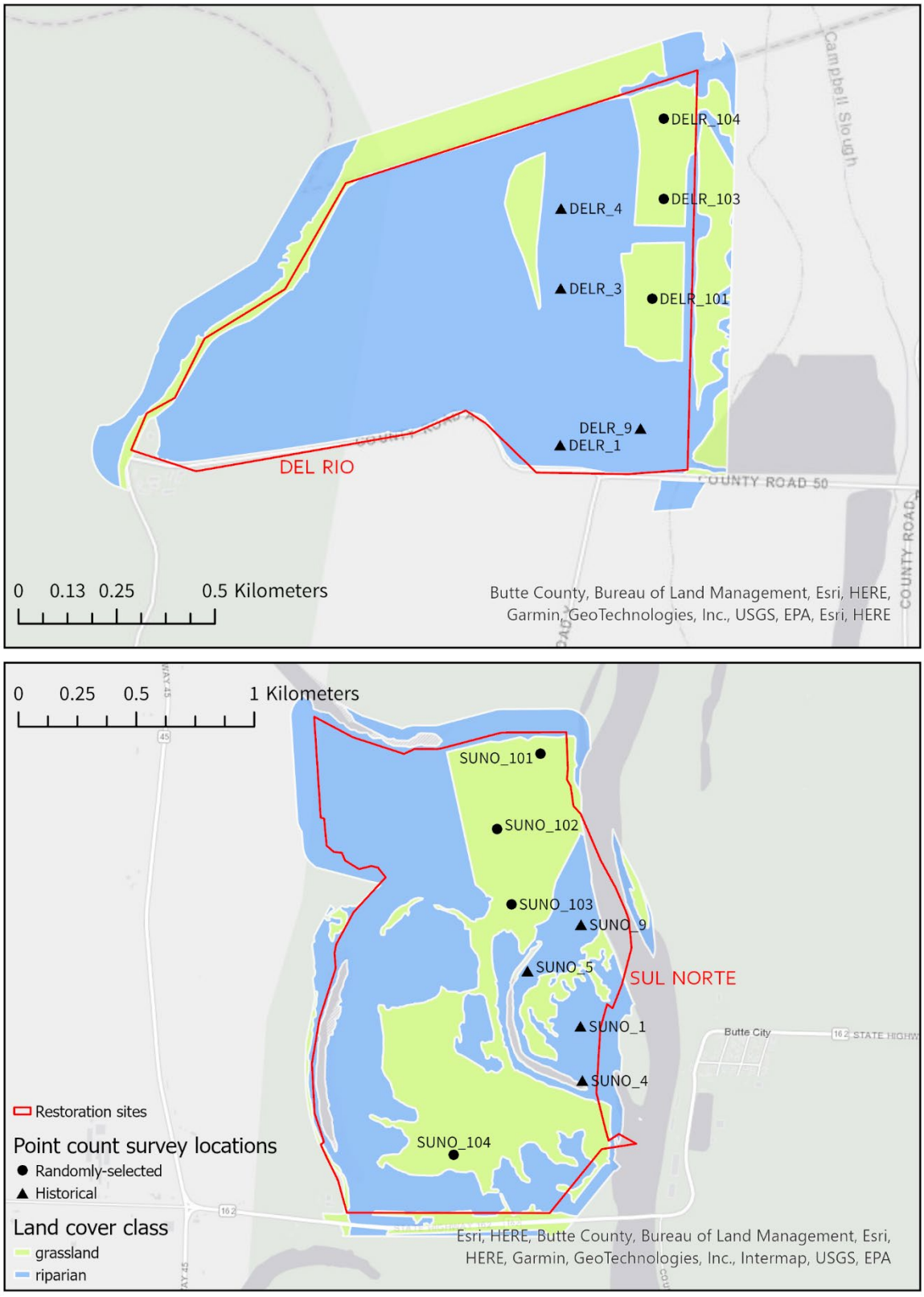


Figure A1. (continued)



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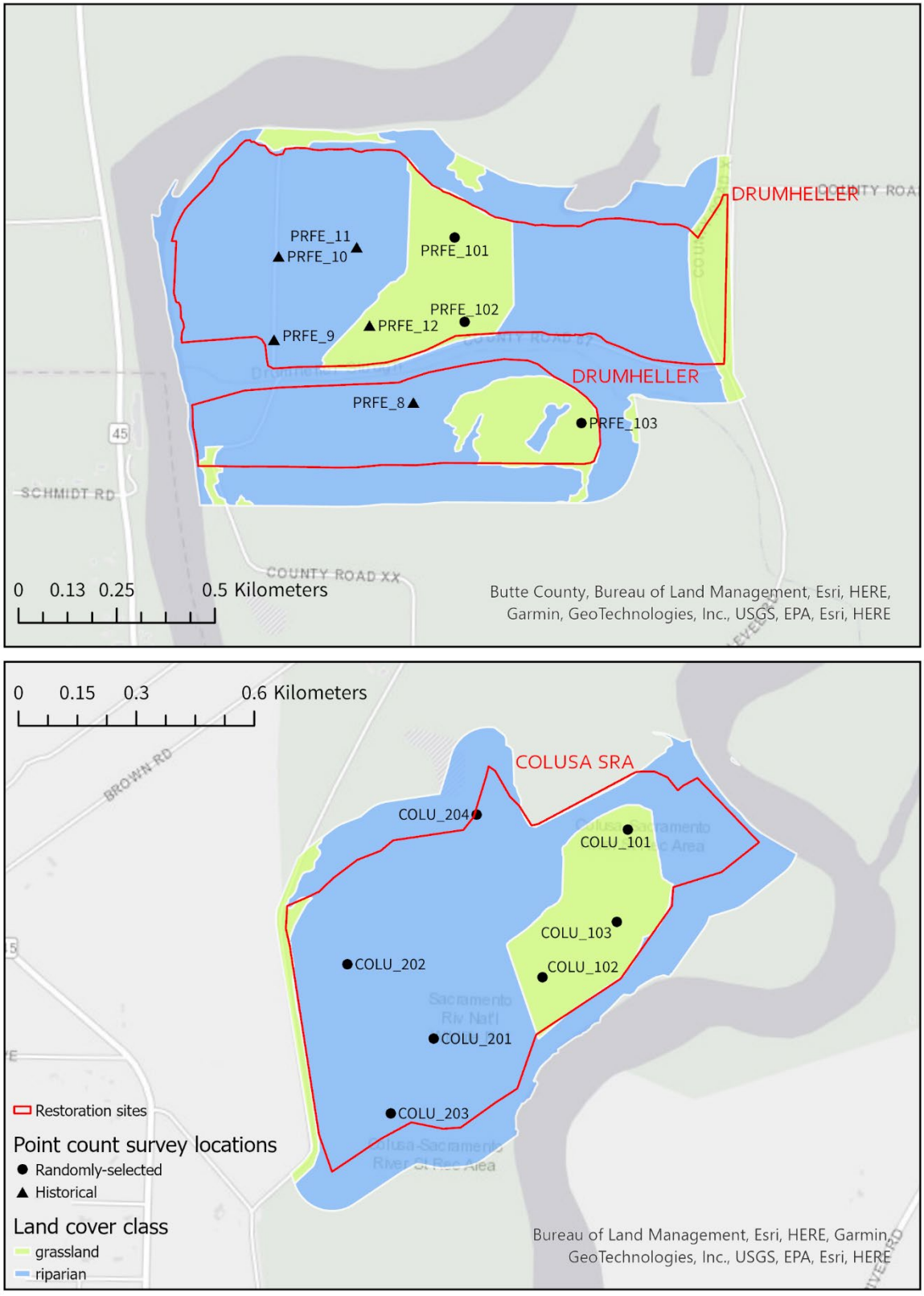

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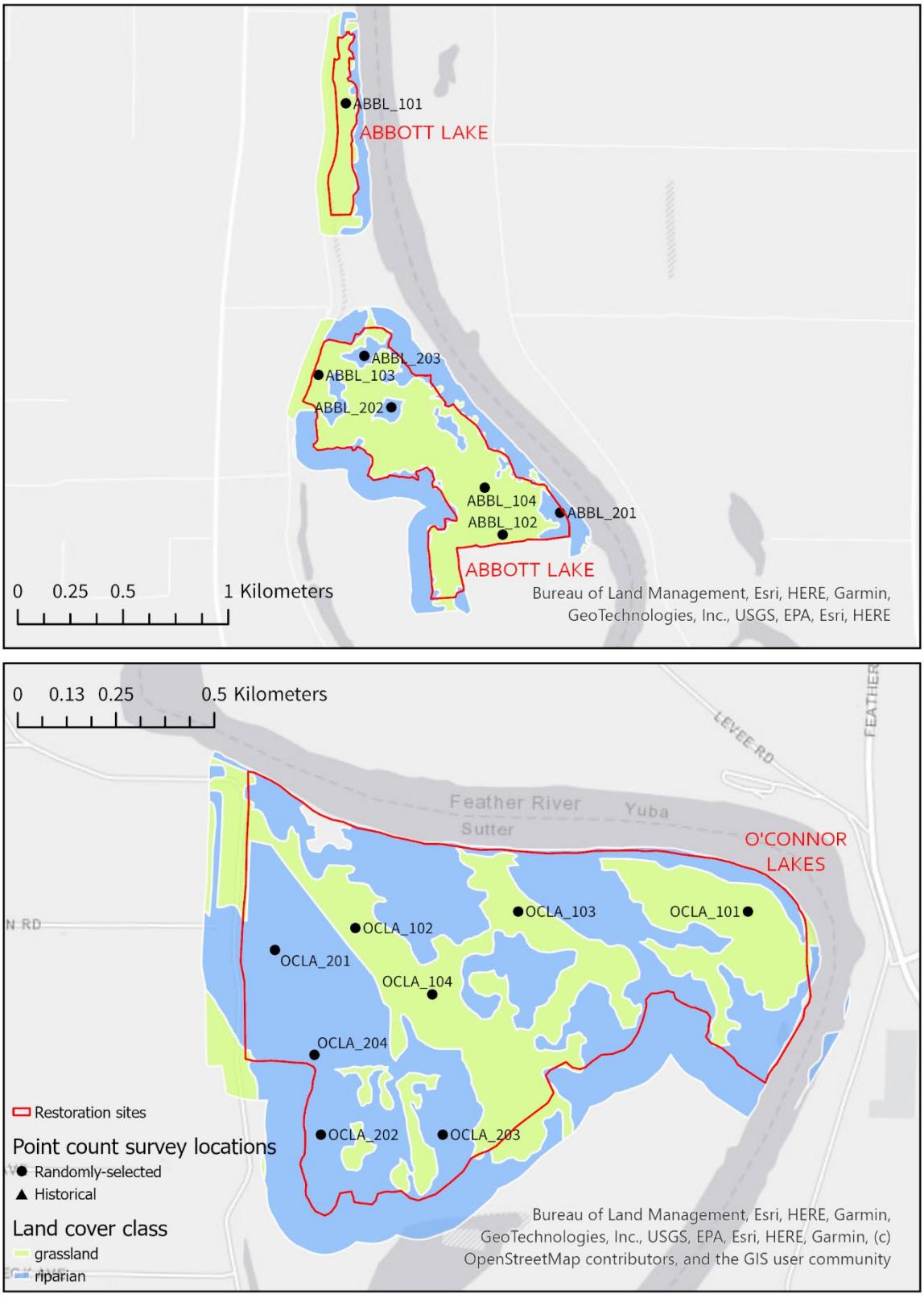

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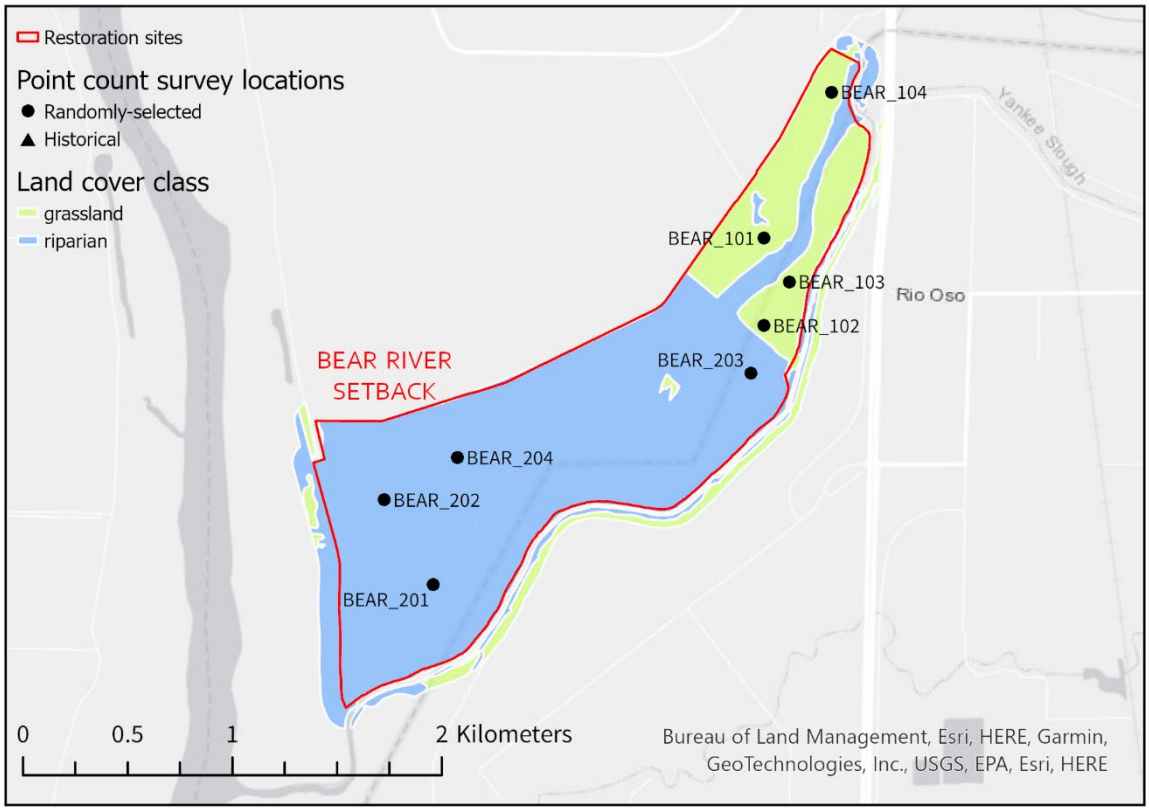

Figure A2. Mean density estimates ± SE for riparian and grassland/oak-savannah focal species at riparian and grassland restoration sites in the Sacramento Valley, California. Short-term (orange bars) and long-term (yellow bars) density objectives are shown; for species where the short- and long-term objectives are equal, only an orange bar is shown (DiGaudio et al. 2017, Dybala et al. 2017). Mean density values are symbolized by a star if the estimate was high and above the short-term density objective, a closed circle if the estimate was below the density objective, and an open circle if uncertain (see methods for how we defined certainty).

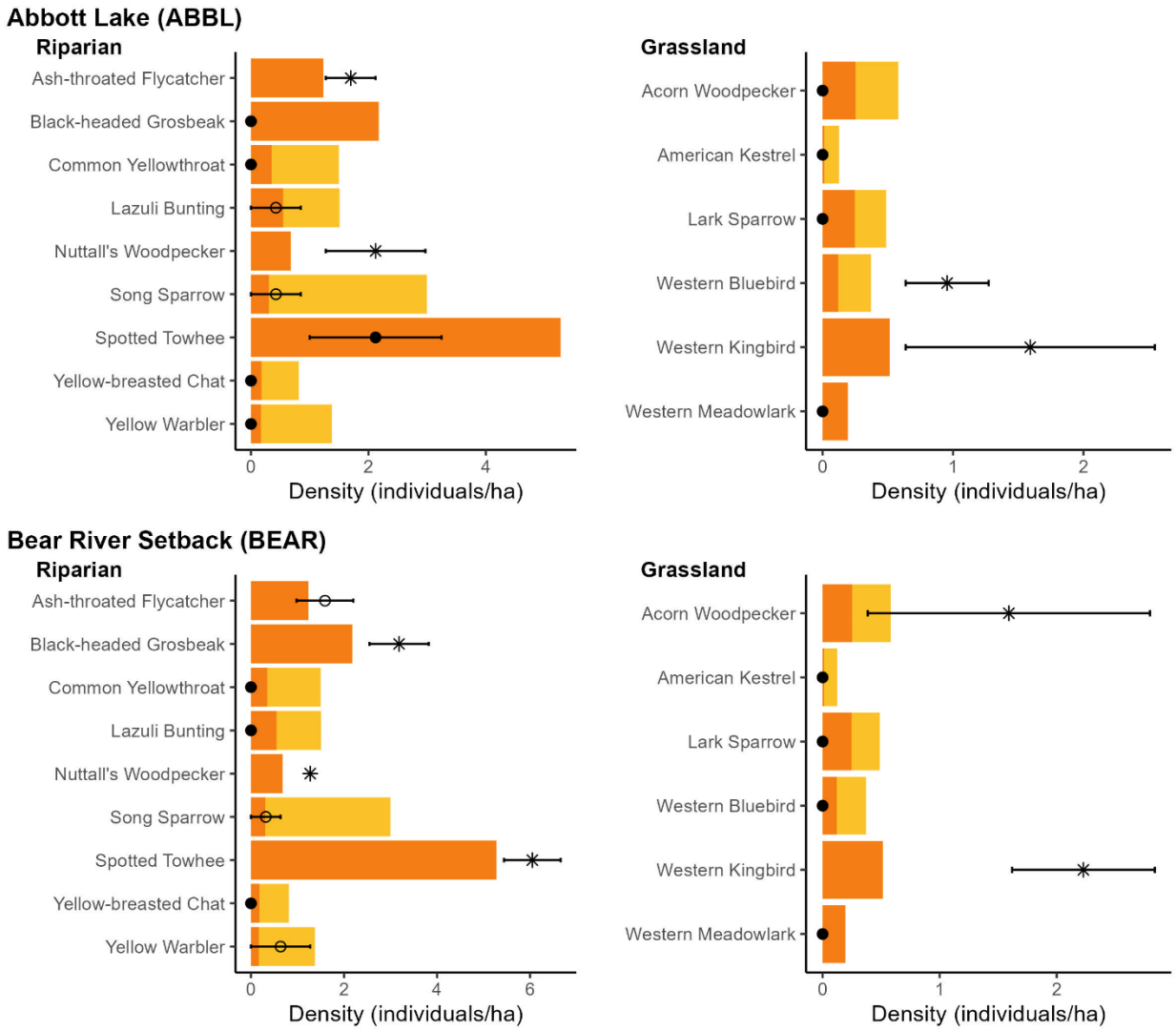

Figure A2 (continued)

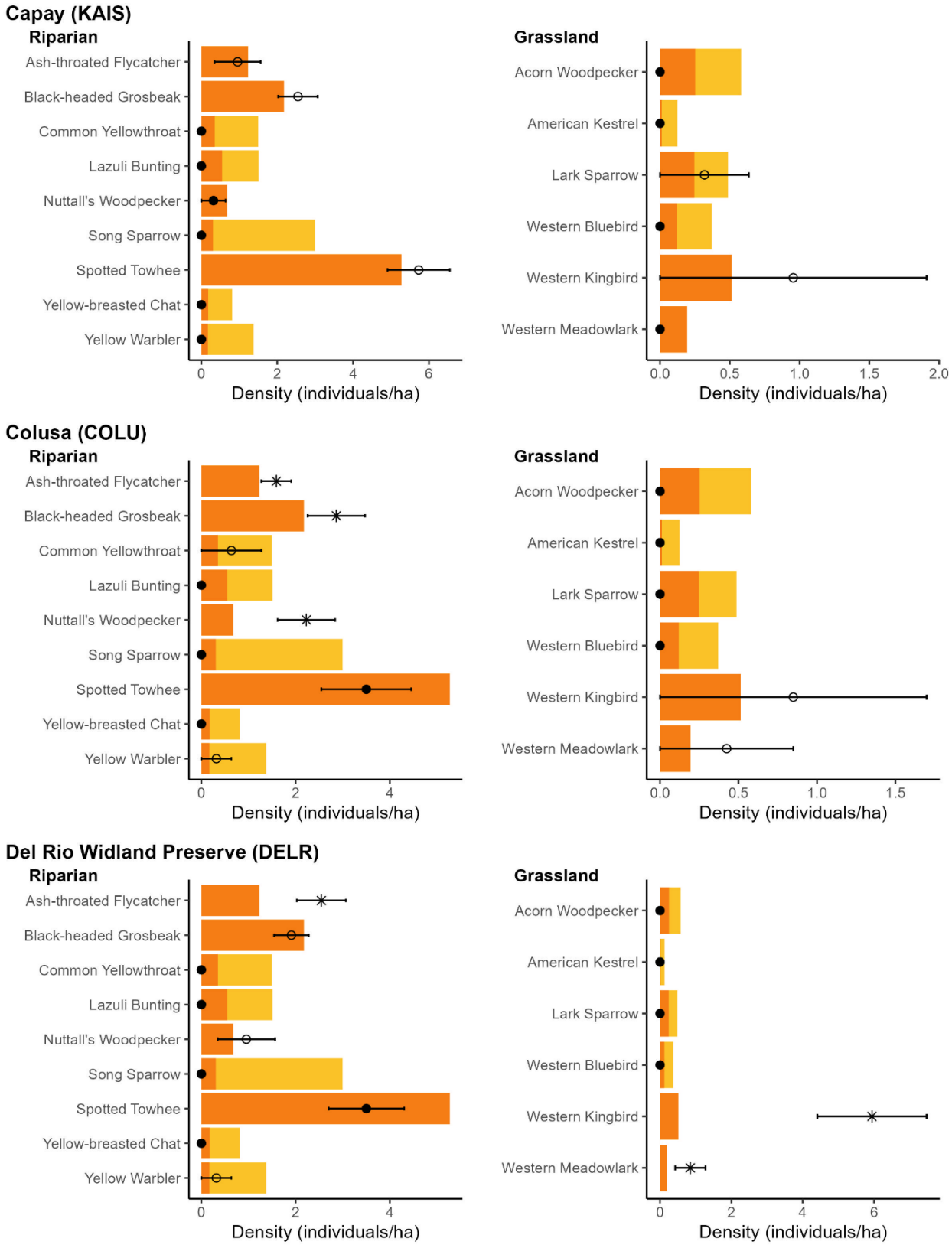

Figure A2 (continued)

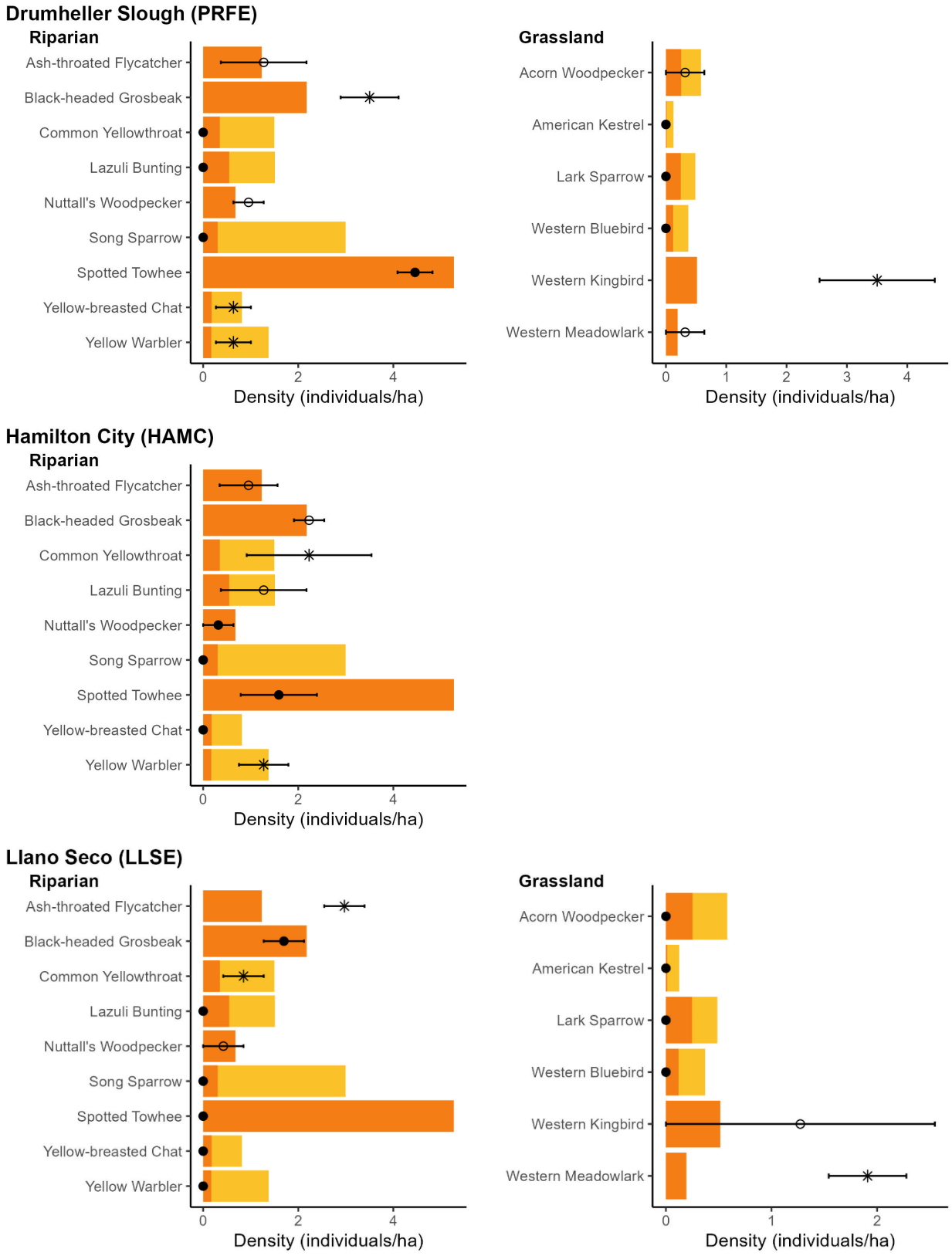

Figure A2 (continued)