Biomonitoring of the California Department of Water Resources Delta Levees Program Habitat Restoration Sites

2020 Annual Report

UCDAVIS
WILDLIFE, FISH, & CONSERVATION BIOLOGY

UCDAVIS
MUSEUM OF WILDLIFE AND FISH BIOLOGY

Biomonitoring of the California Department of Water Resources Delta Levees Program Habitat Restoration Sites:

2020 Annual Report

Prepared by:
Jason Riggio, Kristen Zumdahl, Danielle Fradet, Michelle Mah,
Molly Ferrell, Lynn Kimsey, & Andrew Engilis, Jr.

December 2020

Cover photo: Mixed blackbird flock on Twitchell Island as captured by a camera trap station
(All photos in this report were taken at our sites unless otherwise specified)

Acknowledgements

On behalf of the UC Davis Museum of Wildlife and Fish Biology and Bohart Museum of Entomology, we wish to thank everyone involved in the 2020 Biomonitoring of the California Department of Water Resources Delta Levees Program Habitat Restoration Sites survey season. We would especially like to thank all of the site managers who provided access to our study areas including Juan Mercado (Board President for both Sherman and Twitchell Island Reclamation District boards), Joel McElroy (Sherman Island Superintendent), Ricky Carter (Twitchell Island Superintendent), Katherine Bandy (acting Program Manager of Dutch Slough Tidal Marsh Restoration Project), and Harry McQuillen (Cosumnes River Preserve Manager). Additionally, our work at the Cosumnes River Preserve, McCormack-Williamson Tract and Grizzly Slough would not have been possible without the assistance of Sara Sweet (Cosumnes River Preserve Restoration Ecologist) and Anitra Pawley (CA DWR North Delta Program Manager). We are grateful to Chris Carlson (Solano Resource Conservation District Restoration Program Manager) for his assistance with protecting the invertebrate survey stations from livestock damage and Laureen Thompson (CDFW Environmental Scientist) for her help assessing the sites for endangered Salt Marsh Harvest Mouse habitat potential. Lastly but certainly not least, this project would not be possible without the dedication of our field teams and museum staff. Many thanks to our hard-working 2020 crew, including DWR's Beth Hendrickson and Grayson Sandy who performed the vegetation/habitat surveys, Bohart's Brennen Dyer and Steven Heydon who conducted field surveys, Socrates Letana, Jeff Smith and John DeBenedictis who made invertebrate species identifications, and MWFB's Hanika Cook, Irene Engilis and John Trochet who helped conduct vertebrate field surveys.

Executive Summary

- The University of California, Davis Museum of Wildlife and Fish Biology (MWFB) and Bohart Museum of Entomology are contracted to collect baseline inventory of multiple taxa (amphibians, bats, birds, insects, mammals and reptiles) in and near six California Department of Water Resources habitat management and restoration sites (Cosumnes River Preserve, Grizzly Slough, McCormack-Williamson Tract, Twitchell Island, Sherman Island, and Dutch Slough).

- These data will be used to correlate wildlife response to restored habitat versus surrounding land use across the Delta and provide vital information for habitat management and restoration designs.

- We established 279 herpetofauna (amphibian and reptile) coverboards, 152 avian (bird) point count stations, 69 acoustic bat monitoring stations and camera trap locations, 35 small mammal trap lines, and 11 invertebrate survey stations across 35 microsites where data on species presence/absence, abundance, and diversity are being collected.

- Small mammal surveys were conducted during fall (September and October) of 2020. We captured a total of 704 individuals of five species including the California native species Deer Mouse, Western Harvest Mouse, and California Meadow Vole, and introduced species House Mouse, and Black Rat. Small mammal capture rate was significantly higher on Grizzly Slough than all other macrosites, while the capture rate on Sherman Island was lowest. Capture rate of all small mammal species combined was higher in freshwater marsh and riparian forest than agriculture/pasture sites, and higher in restored sites than non-restored sites.

- Camera trap surveys were conducted during fall (September and October) of 2020. We observed a total of 13 species of mammalian mesocarnivores and herbivores at the six macrosite locations, including 11 California native species and 2 introduced species. Restored habitats supported a higher number of species of larger mammals than non-restored sites, but species richness was similar across macrosites and habitat types. We observed Coyotes and Raccoons in the greatest number of microsites.

- Avian point count surveys were conducted during the breeding season (May & June) of 2020. We identified a total of 92 birds species using the habitat during the surveys. There was no significant difference found in avian species richness between the macrosites. Avian species richness was highest in riparian forest sites and there was a significantly higher species richness observed at the restored sites compared to the non-restored sites.

- Herpetological coverboard surveys were conducted whenever a site was surveyed for birds or small mammals. We observed a total of 10 herpetofauna species, including 2 amphibians, 8 reptiles and 2 introduced species. We observed little variation in herpetofauna species richness between macrosites, but riparian forest and restored sites had the greatest number of species. The most common reptile species encountered by far was the Western Fence Lizard, and the most common amphibian was the Sierran Treefrog.

- Passive bat acoustic surveys were conducted during fall (September and October) of 2020. During the first two months of data collection, we recorded 177,141 acoustic files totaling 818 GB of storage. Analysis of bat acoustic data will be used to determine species diversity, occupancy and relative abundance at each site, across habitat types.

- Invertebrates were surveyed across 11 sites in the Sacramento-San Joaquin Delta using Malaise, pitfall, and blue vane traps. To date we have collected roughly 200,000 specimens, with huge series of some common species. We have identified and databased 336 species of insects in eight orders, including 2 cockroaches, 21 flies, 247 bees and wasps, 1 mantis, 46 moths and butterflies, 2 earwigs, 5 true bugs and plant bugs, and 11 beetles.

- Habitat and vegetation surveys were conducted at each avian point count station. Survey methodologies used elements from existing protocols of the California Native Plant Society (CNPS) and the California Department of Fish and Wildlife's Wildlife Habitat Relationships system (CWHR). To date we have identified 191 species of plants across 44 families at our survey sites (Appendix F). Of these, 54% are introduced species.

- We observed at total of 10 CDFW Species of Special Concern at our study sites during the 2020 survey season. These included 9 bird species (Least Bittern, Northern Harrier, Swainson's Hawk, Burrowing owl, Loggerhead Shrike, Yellow-breasted Chat, Yellow-headed Blackbird, Tricolored Blackbird, and Yellow Warbler) and Western Pond Turtle.

Introduction

The California Department of Water Resources (DWR) has funded development of habitat mitigation and enhancement sites in the Sacramento-San Joaquin Delta in accordance with Delta Levees Program (DLP) provisions that mandate no net loss of habitat as well as net long-term habitat improvement (Water Code §12314(c-d) and §12987(c-d)). Ongoing management activities of habitat sites are required to restore and maintain sites in good condition. Monitoring is an important facet of all DWR operations and is integral to adaptive management that is required to be consistent with the Delta Plan (California Water Code §85308(f) and §85052). This effort will inform habitat management decisions and restoration planning under the goals and direction of the California Water Plan and EcoRestore.

Figure 1: Various microsites in our study around the Sacramento-San Joaquin Delta. Rip rap levee on Twitchell Island (upper left), subsidence reversal freshwater marsh on Sherman Island (upper right), mature riparian forest clearing at the Cosumnes River Preserve (bottom left), and cattle pasture at Dutch Slough (bottom right).

The University of California, Davis Museum of Wildlife and Fish Biology (MWFB) and Bohart Museum of Entomology are contracted to collect baseline inventory of multiple taxa (amphibians, birds, invertebrates, mammals and reptiles) in and near six DWR habitat macrosites (Cosumnes River Preserve, Grizzly Slough, McCormack-Williamson, Twitchell Island,

Sherman Island, and Dutch Slough; Figure 1). We established 279 herpetofauna (amphibian and reptile) coverboards, 152 avian (bird) point count stations, 69 acoustic bat monitoring stations and camera trap locations, 35 small mammal trap lines, and 11 invertebrate survey stations across 35 microsites where data on species presence/absence, abundance, and diversity are being collected (see Appendix A for detailed maps of survey locations within microsites, and Appendix B for a list of sites and survey effort). These data will be used to correlate wildlife response to restored habitat versus surrounding land use across the Delta and provide vital information for habitat management and restoration designs. Each restored habitat site is paired with a non-restored reference site to compare the effect of habitat management and restoration in the Delta to a pre-restored condition.

This initial effort will yield baseline data and be the foundation for a long-term biomonitoring program in the Delta. Understanding species responses to habitat management activities, climate change events, vegetation structure, and habitat design can improve DWR's adaptive management strategies. This information can also be used to help restore and conserve habitats that are providing resilient ecosystem services such as biological diversity, nutrient cycling and flood protection.

Surveys include avian, small mammal, herpetofauna, bat, invertebrate and vegetation during varying times and durations throughout this 3-year period of baseline data collection (Table 1). Generally, the sample sites for this survey were based on Department of Water Resources (DWR) Delta Knowledge Improvement Program bird surveys that began in 2011 and continued through 2019 intermittently. Some of the points have changed due to land use changes.

While we have managed to avoid some of the disruption from the ongoing pandemic, the project has been impacted, nonetheless. We established field protocols for limiting COVID-19 risk including having fixed field crews from UC Davis working together, using proper PPE and adhering to strict disinfecting guidelines. The wildlife monitoring DWR Delta Levees Program fell under the category of research for which discontinuation would generate data and sample loss that would be effectively irreplaceable. Thus, UC Davis allowed us a variance to carry out work in the Delta while maintaining safety to our biologists. We argued that it was critical that we get the field study sites set up and data gathered this initial season. Many of these sites will undergo extensive habitat restoration in 2020 and losing pre-restoration data would render the study useless and jeopardize long-term funding and stated research goals. Unfortunately, we were restricted in hiring practices, and the undergraduates scheduled to work on the project were not involved. This delayed our ability to hire additional staff for the field crews, but we were able to increase our crew for the Fall surveys and as of November 1st all project hiring has been completed.

Table 1: Survey methods and timing of monitoring for various taxa across the DWR Delta Levees habitat restoration sites. Rows in light gray indicate surveys that have been completed in 2020 for a minimum of one season.

Taxa	Survey Method	Months	# of visits/site	Time of day
Avian (Breeding)	Point Count & Transect	May - June	1x per month (Point Counts) 1x per season (Transect)	Sunrise – 10am
Avian (Winter)	Transect	January - February	1x per season	Sunrise – 10am
Small mammal	Sherman Live Trap	September - October	3 consecutive nights per site	Sunset (open traps) and following sunrise (check traps)
Herpetofauna	Coverboard & Visual Encounter	May - June September - October January - February	Each avian and small mammal survey visit	Same as avian and mammal
Invertebrate	Malaise, Pitfall and Blue Vane Traps	April - November	2-4x per month	24 hours
Bat	Passive Acoustic Monitoring	May - June September-October	3 consecutive nights per site per season	Sunset to sunrise
Mammalian Mesocarnivore & Herbivore	Camera Trap & Visual Encounter	May - June September-October	3 consecutive nights per site per season	24 hours
Habitat/Vegetation	CNPS & CWHR Circle Plot	March - October	One time only (2020)	Varies

Small Mammal Trapping Survey

Methodology

Small mammal surveys were conducted during fall (September and October) of 2020 (see Appendix C for survey schedule) at six Delta Levees Program locations (Sherman Island, Twitchell Island, Dutch Slough, McCormack-Williamson Tract, Cosumnes River Preserve, and Grizzly Slough) across 35 sites in the Sacramento-San Joaquin Delta (Figure 2).

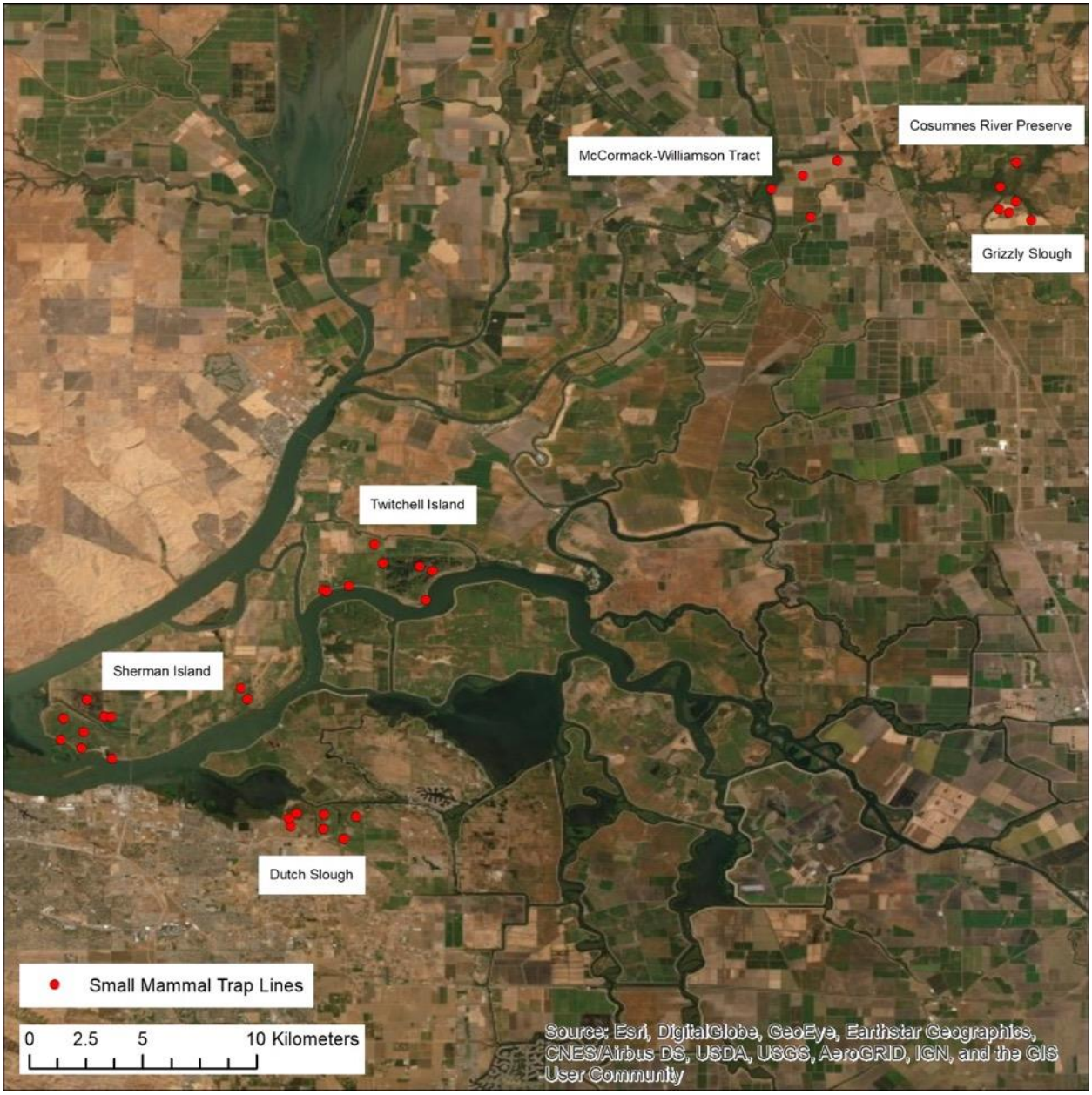

Figure 2: Overview map of small mammal trap line locations (35 in total) across the study area.

We live-trapped small mammals (<200 g) using Sherman traps (7.62x8.89x22.86 cm). Depending on the site, we placed the Sherman traps using one of two spatial layouts. At linear sites, such as along levees or roads, we arranged 50 traps 5 m apart in a 250 m line across the site. In all other sites we employed a nodal trapping protocol. For nodal trapping, traps were arranged in lines of ten trap nodes, each node separated by 20 m. Each node consisted of five Sherman live traps placed within 5 m of the node's center, with a total of 50 traps per 200 m long trap line (Figure 3).

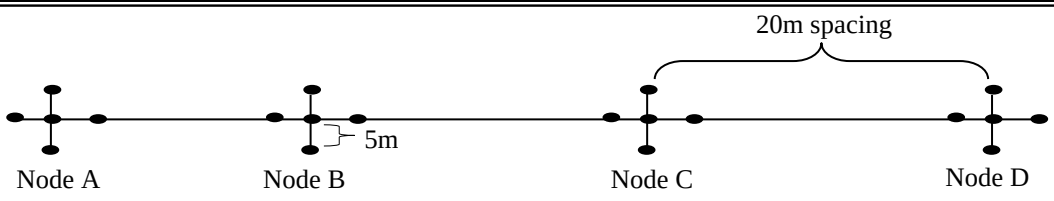

Figure 3. Schematic of small mammal trapping nodes employed by MWFB protocol.

We marked each trap location with plastic flagging tied to vegetation or a fence (Figure 4). When the temperature was forecasted to drop below 10 °C (50 °F), we added polyester batting to the traps for insulation/bedding. Each site was surveyed over three consecutive nights. We opened traps at sunset, baiting them with rolled oats, and returned to check them beginning at sunrise the next morning.

Figure 4: An example of a linear small mammal trap line in a pasture site at the Dutch Slough Boroughs parcel.

When we captured an animal, we identified it to species and noted its age, sex, weight, and reproductive status. We marked each captured animal by trimming a small area of fur from their rear to indicate if an animal was recaptured on a following night (Figure 5). Analysis of small mammal trapping data will be used to determine species diversity and relative abundance at each site, across habitat types and management regimes. Additionally, we conducted visual encounter surveys, recording all incidental observations of mammals or presence of scat, tracks, and other physical signs (gnawing, runs, etc.) at each site.

Figure 5: Marking a House Mouse on Sherman Island that was captured in a Sherman live trap.

There was some concern from DWR and CA Dept. of Fish and Wildlife (CDFW) scientists about capturing the endangered Saltmarsh Harvest Mouse (*Reithrodontomys raviventris)* at Dutch Slough, Sherman, and Twitchell Islands as they can be difficult to distinguish from the more widespread Western Harvest Mouse (*Reithrodontomys megalotis* - REME). Laureen Thompson of CDFW visited these sites during sampling on Oct. 7, 2020 to assess the habitats and provide a genetic test kit. She determined that the habitats were likely not suitable for saltmarsh harvest mice, and that the trapped Western Harvest Mice did not display the physical traits and behaviors associated with Saltmarsh Harvest Mice.

Small Mammal Preliminary Results

Small mammals captured across the six macrosites during the Fall 2020 survey season included the California native species Deer Mouse (*Peromyscus maniculatus* - PEMA), Western Harvest Mouse (*Reithrodontomys megalotis* - REME), and California Meadow Vole (*Microtus* californicus - MICA), and introduced species House Mouse (*Mus musculus* - MUMU), and Black Rat (*Rattus rattus* - RARA) (Figure 6; Table 2). Additional small mammal species that we observed directly or indirectly at the sites but not captured in our trapping effort include Ornate Shrew (Sorex ornatus), Broad-footed Mole (Scapanus latimanus), and Botta's Pocket Gopher (Thomomys bottae) (Table 2). We captured a total of 704 individuals dispersed over these six macrosites during the two-month (September-October) trapping period (Table 3).

Table 2: Small mammal species (<200g) identified in our 2020 surveys from small mammal trapping (marked by "X"s), or coverboard surveys and incidental sightings (marked by "*"s) in the Sacramento-San Joaquin Delta. Macrosite locations include Cosumnes River Preserve (CR), Dutch Slough (DS), Grizzly Slough (GS), McCormack-Williamson Tract (MW), Sherman Island (SH), and Twitchell Island (TW). (I) indicates introduced species.

Family	**Species**		**Macrosite**					
	(Common Name)	(Scientific Name)	CR	GS	MW	TW	SH	DS
Shrews (Soricidae)	Ornate Shrew	*Sorex ornatus*	*					
Moles (Talpidae)	Broad-footed Mole	*Scapanus latimanus*				*		
Pocket Gophers (Geomyidae)	Botta's Pocket Gopher	*Thomomys bottae*					*	*
New World Rats, Mice & Voles (Cricetidae)	Deer Mouse	*Peromyscus maniculatus*		X	X			X
	Western Harvest Mouse	*Reithrodontomys megalotis*	X	X	X	X	X	X
	California Meadow Vole	*Microtus californicus*	X	X	X	X	X	X
Old World Rats & Mice (Muridae)	House Mouse **(I)**	*Mus musculus* **(I)**	X	X	X	X	X	X
	Black Rat **(I)**	*Rattus rattus* **(I)**	X	X	X	X	X	

Figure 6: Examples of small mammal species captured during our 2020 fall survey season. House Mouse (Dutch Slough; upper left), Western Harvest Mouse (Sherman Island; upper right), Deer Mouse (Grizzly Slough; bottom left), and California Meadow Vole (Dutch Slough; bottom right).

Table 3: Summary of count of individuals by small mammal species captured at each macrosite during the September - October 2020 trapping period.

Macrosite	Species	Number of Individuals Captured
Cosumnes River Preserve (CR)		
	Deer Mouse	0
	Western Harvest Mouse	2
	California Meadow Vole	3
	House Mouse	7
	Black Rat	8
Grizzly Slough (GS)		
	Deer Mouse	13
	Western Harvest Mouse	5
	California Meadow Vole	42
	House Mouse	35
	Black Rat	8
McCormack-Williamson Tract (MW)		
	Deer Mouse	4
	Western Harvest Mouse	27
	California Meadow Vole	3
	House Mouse	19
	Black Rat	1
Twitchell Island (TW)		
	Deer Mouse	0
	Western Harvest Mouse	22
	California Meadow Vole	6
	House Mouse	40
	Black Rat	2
Sherman Island (SH)		
	Deer Mouse	0
	Western Harvest Mouse	3
	California Meadow Vole	4
	House Mouse	295
	Black Rat	9
Dutch Slough (DS)		
	Deer Mouse	35
	Western Harvest Mouse	5
	California Meadow Vole	12
	House Mouse	94
	Black Rat	0
Total		**704**

Small mammal capture rate was significantly higher on Grizzly Slough than all other macrosites ($p < 0.001$; Figure 7), while the capture rate on Sherman Island was lowest. Capture rate is the number of individuals trapped per trap night (the number of traps times the number of nights).

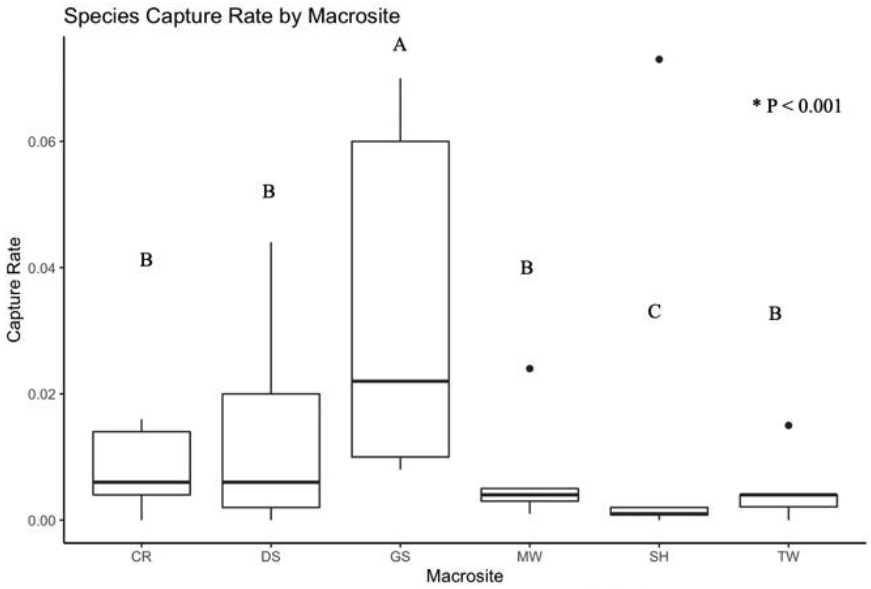

Figure 7: On average overall the small mammal species capture rate on Grizzly Slough (GS) was significantly greater than all other macrosites, while the capture rate on Sherman Island was lowest ($p < 0.001$).

The Cosumnes River Preserve (CR) sites are both restored riparian forest (RF) habitat. Black Rats were the most common species found on this macrosite (Table 3). Capture rates were significantly higher for Black Rats on CR than any other macrosite ($p < 0.001$; Figure 9). Black Rats prefer RF habitat (Figure 10 & 11) because they typically climb trees for shelter (Gillespie, 2004). Deer Mice were absent on this site, while Western Harvest Mice were least abundant (Table 3), possibly because of the lack of preferred open habitat on this site.

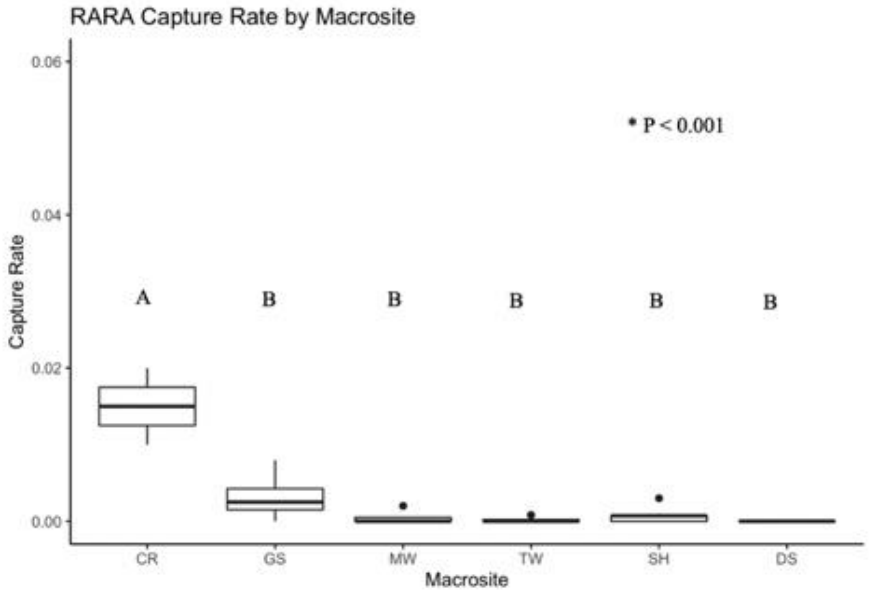

Figure 9: Black Rats (RARA) had significantly greater average capture rates at the Cosumnes River Preserve (CR; $p < 0.001$) than all other macrosites.

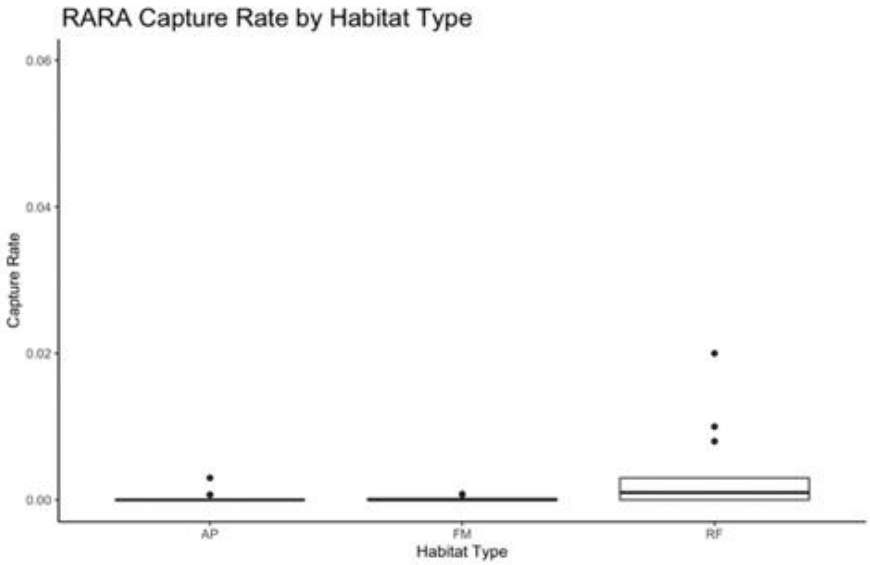

Figure 10: On average capture rates for Black Rats (RARA) did not statistically differ between habitat types but was highest in riparian forest (RF). Habitat types at microsites include agriculture/pasture (AP), freshwater marsh (FM) and riparian forest (RF).

Figure 11: A camera trap photo of a Black Rat investigating a bait station at Cosumnes River Accidental Forest.

Of the four microsites on Grizzly Slough (GS), two were comprised of restored RF, while the other two were comprised of non-restored agriculture/pastures (AP). The most abundant species discovered was the California Meadow Vole, however House Mouse abundance was not far behind. Capture rate of Vole was significantly greater on GS ($p = 0.008$) than the other macrosites (Figure 12). Voles prefer open grasslands, oak woodlands and chaparral habitat (Peronne, 2002) and we had the highest capture rates in riparian forest sites (Figure 13), while

the least abundant, Western Harvest Mice are found primarily in various open areas (Konishi, 2003).

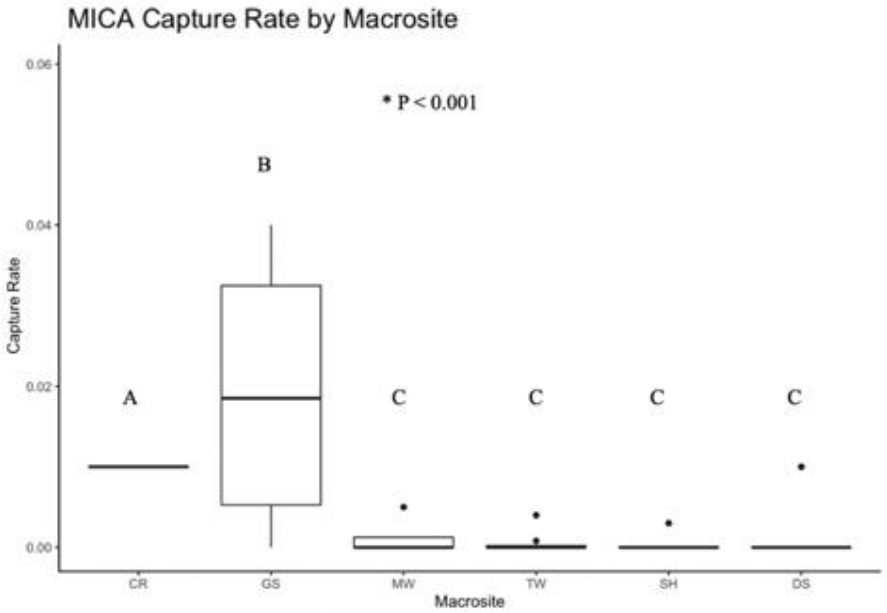

Figure 12: California Meadow Voles (MICA) had significantly greater average capture rates on Grizzly Slough (GS; p < 0.001) than other macrosites, followed by Cosumnes River Preserve (CR).

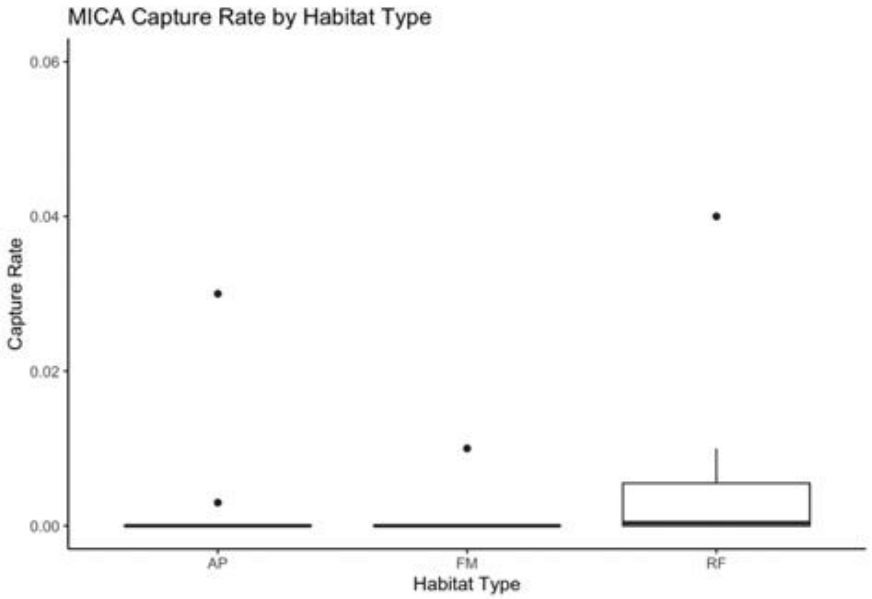

Figure 13: On average capture rates for California Meadow Vole (MICA) did not statistically differ between habitat types but was highest in riparian forest (RF).

McCormack-Williamson Tract (MW) is comprised of restored RF habitat and non-restored AP. Western Harvest Mice had significantly higher capture rates at this macrosite compared to the others (p = 0.06; Figure 14) and were found in greatest numbers in small patches of riparian forest along the levees (Figure 15).

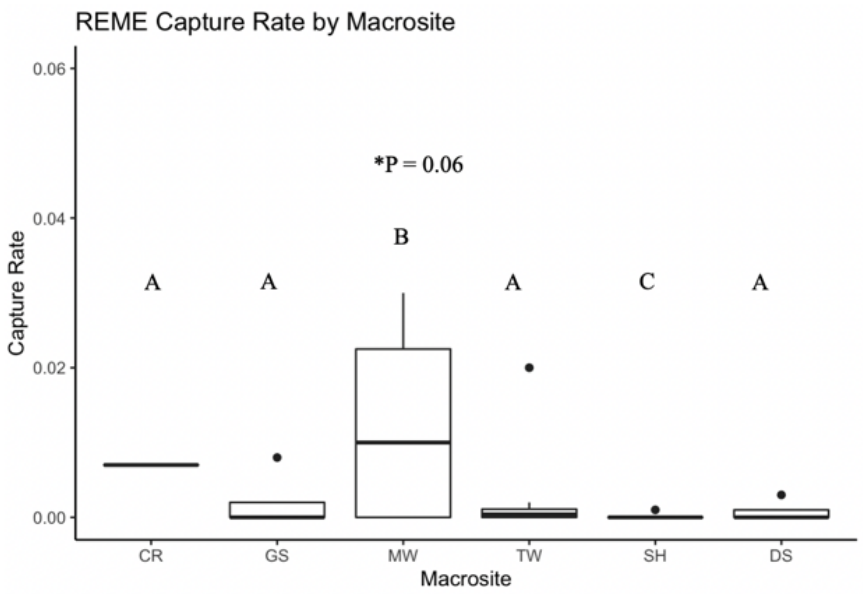

Figure 14: Western Harvest Mice (REME) had significantly greater average capture rates on McCormack-Williamson (MW; p = 0.06) than other macrosites, and the lowest average capture rates on Sherman Island (SH).

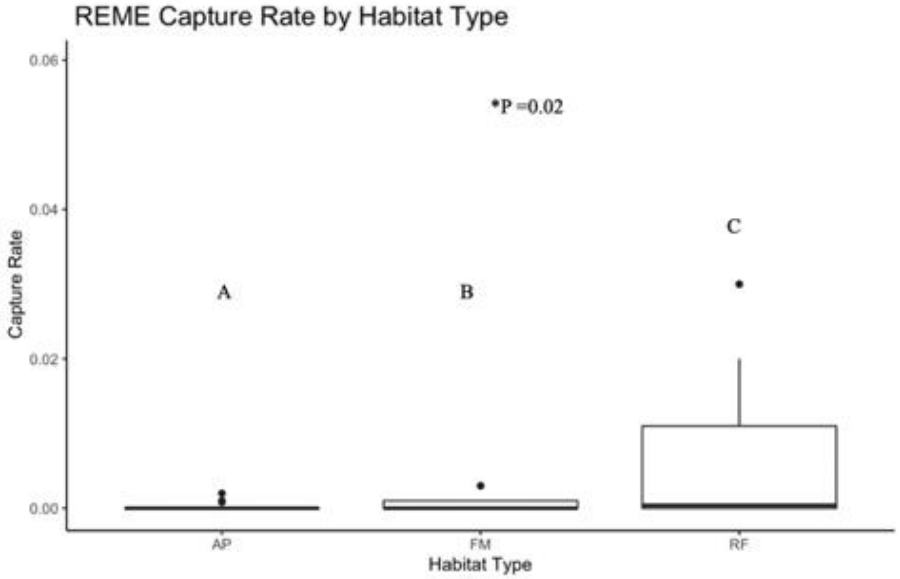

Figure 15: Western Harvest Mice (REME) were significantly more abundant in riparian forest (RF) than other habitats (p = 0.02), and least abundant in agriculture/pasture (AP).

Twitchell Island (TW) contains a mixture of restored RF, freshwater marshes (FM) and non-restored AP. House Mouse was the most abundant species found on this site. Deer Mice were not observed and only two Black Rats were found at TW (Table 3).

Sherman Island (SH) contains a mixture of restored RF, FM habitat and non-restored AP and also has the highest number of microsites. We captured the greatest number of House Mice of any macrosite on Sherman Island (Table 3), but there was no statistically significant difference

between their capture rate at the various sites (Figure 16). House Mice had the highest capture rate in FM habitat (p = 0.008; Figure 17) in our survey but are capable of occupying a wide variety of habitats and have generalized niches (Ballenger, 1999). Deer Mice were not observed and only three Western Harvest Mice were captured (Table 3).

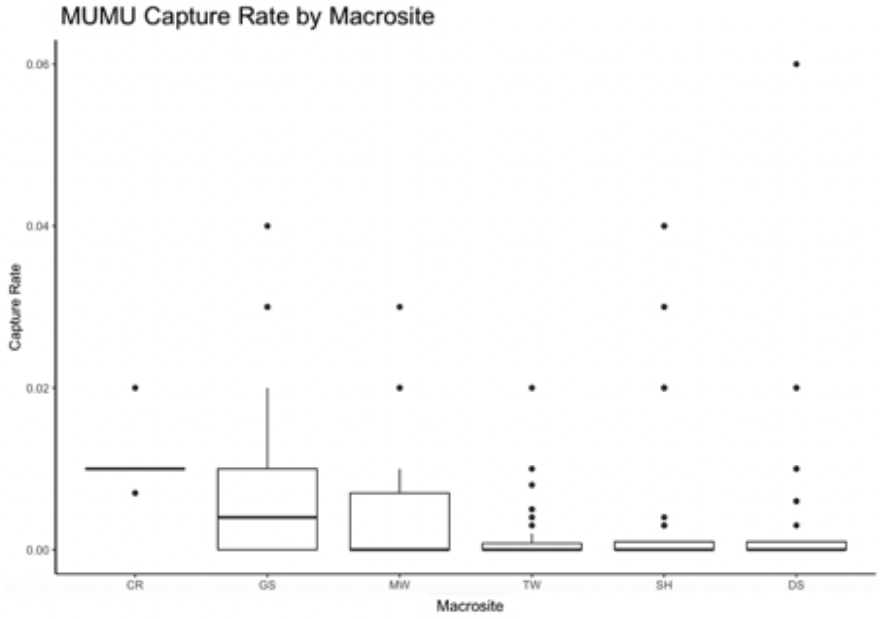

Figure 16: On average capture rates for House Mice (MUMU) did not statistically differ between macrosites.

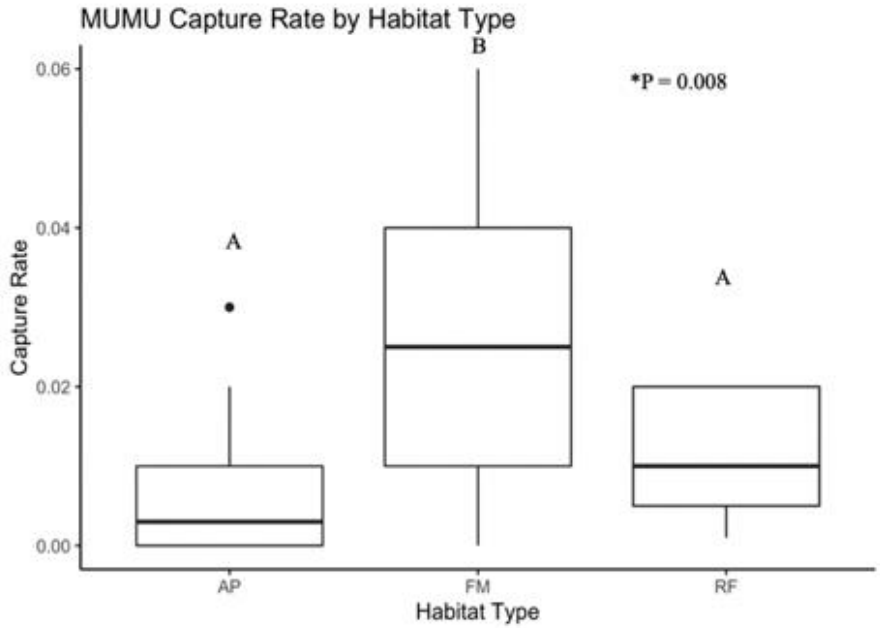

Figure 17: House Mice (MUMU) were significantly more abundant in freshwater marsh (FM) than other habitats (p = 0.008).

Dutch Slough contains a mixture of restored RF, FM habitat and non-restored AP. House Mice were the most abundant species, Black Rats were absent and only five Western Harvest Mice were trapped at this macrosite (Table 3). We captured the greatest number of Deer Mice at Dutch Slough, but there was no significant difference in capture are of this species between macrosites (Figure 18) or habitat types (Figure 19).

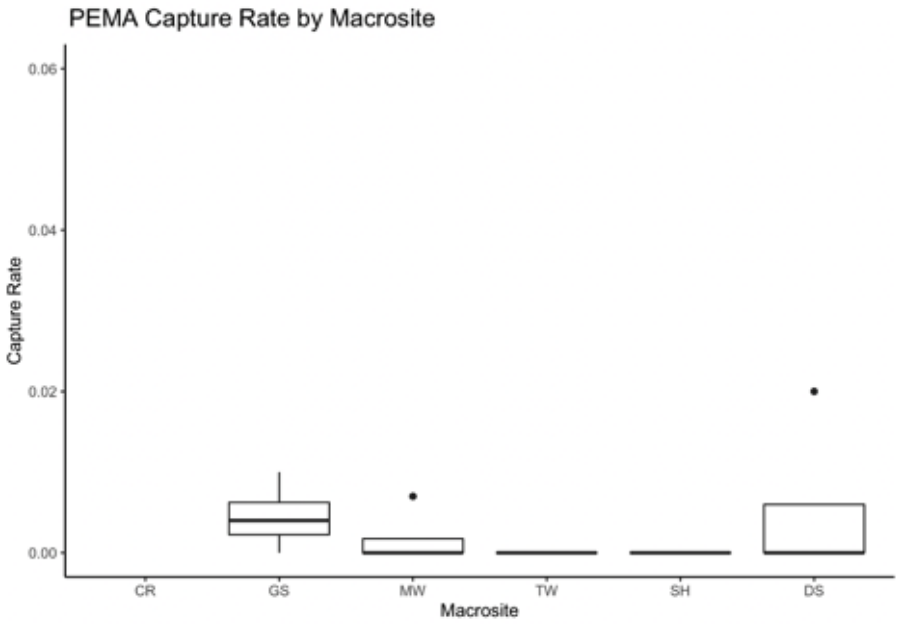

Figure 18: On average capture rates for Deer Mice (PEMA) did not statistically differ between macrosites but were greatest on Grizzly Slough.

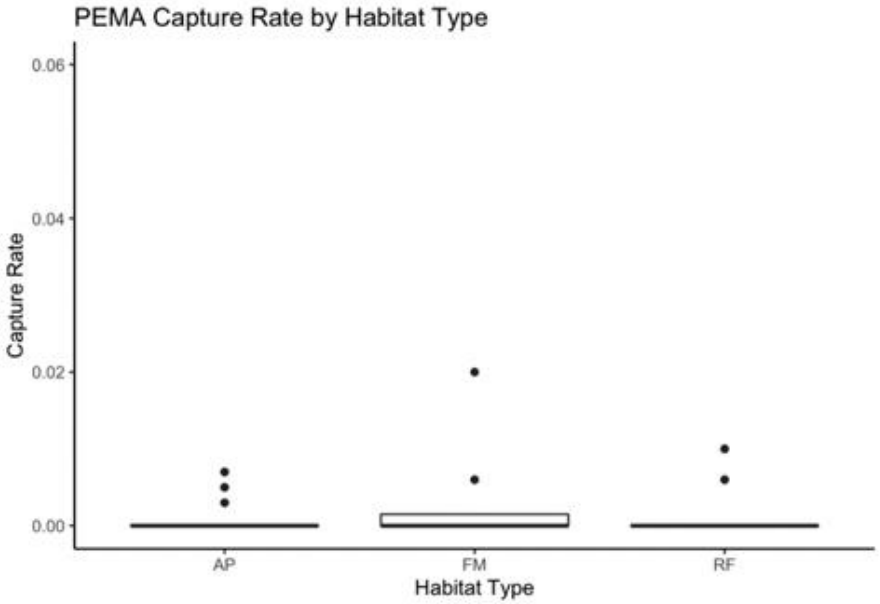

Figure 19: On average capture rates for Deer Mice (PEMA) did not statistically differ between habitat types.

Capture rate of all small mammal species combined was higher in freshwater marsh and riparian forest than agriculture/pasture sites (Figure 20), and higher in restored sites than non-restored sites, but these differences were not statistically significant (Figure 21).

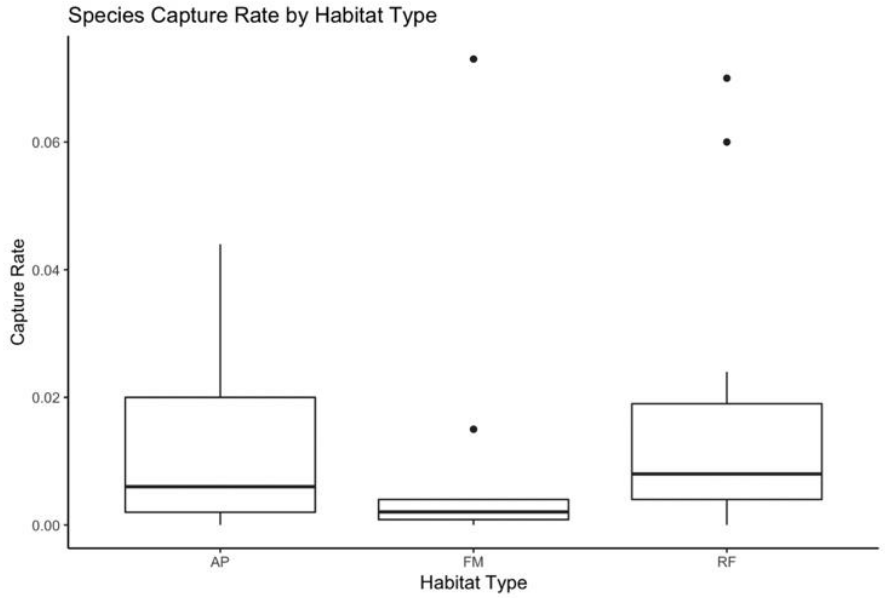

Figure 20: On average overall species capture rate does not statistically differ between habitat types.

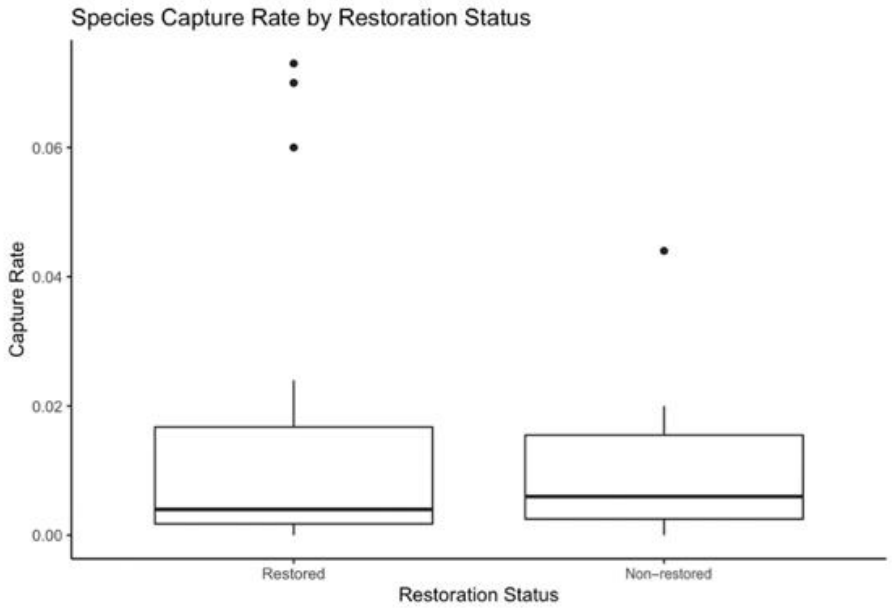

Figure 21: On average overall species capture rate does not statistically differ between restoration status.

Mammalian Mesocarnivore & Herbivore Camera Trap Survey

Methodology

Camera trap surveys were conducted during fall (September and October) of 2020 at six Delta Levees Program macrosites at 69 locations (Figure 22).

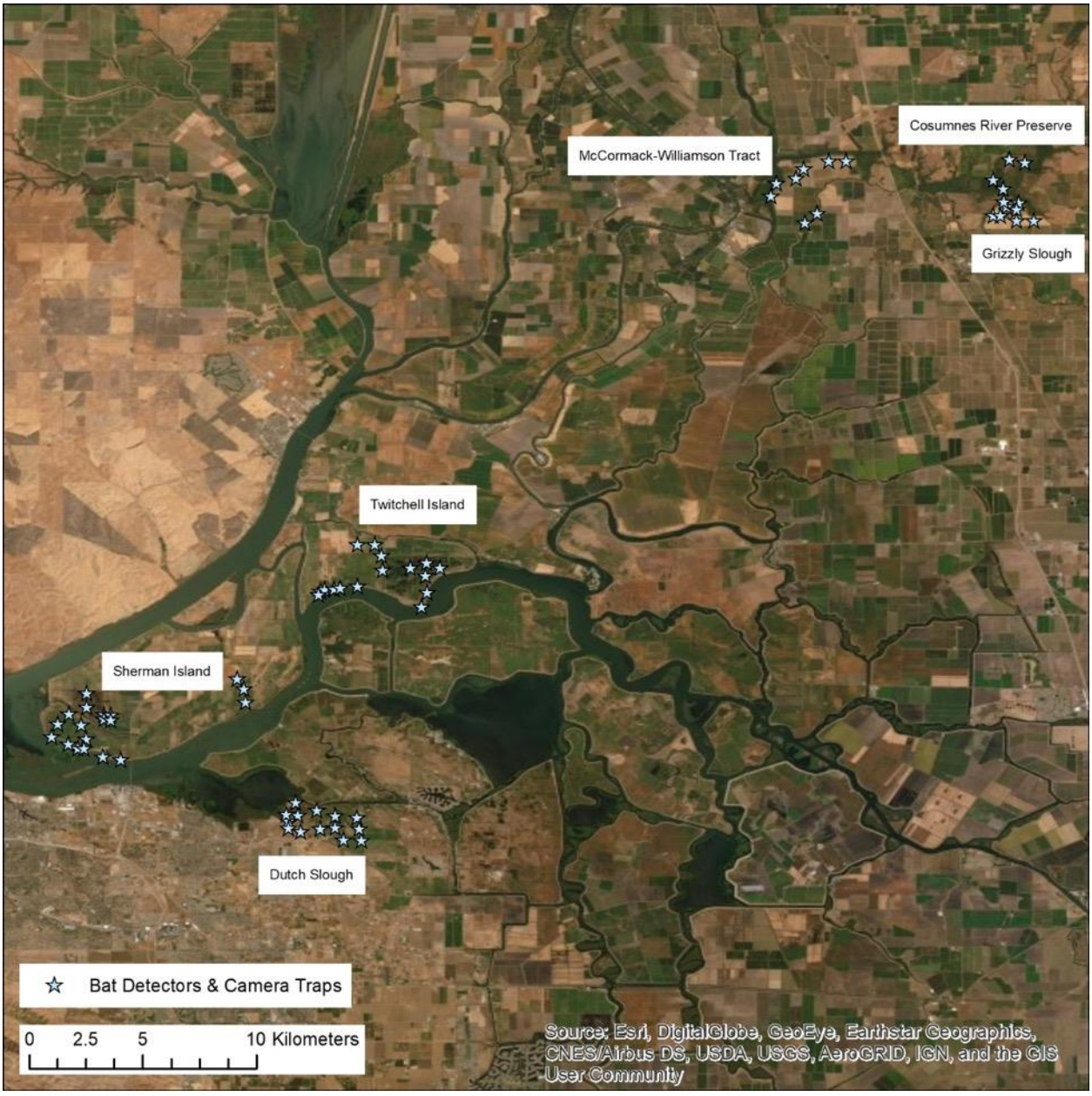

Figure 22: Overview map of camera trap and bat detector locations (69 in total) across the study area.

We established two camera trap stations at each of the 35 microsites, equipped with a Bushnell Trophy Cam HD Low-Glow trail camera attached to the base of the poles used for mounting the passive bat acoustic monitors (Figure 23). Each camera trap station was baited with a can of fish-based cat food with holes nailed into the top. This design allowed the scent of the cat food to attract mesocarnivores while not allowing them access to the food inside. We trapped for 3 consecutive days (~72 hours total), concurrent with small mammal trapping. Analysis of camera trap data will be used to determine mammalian mesocarnivore and herbivore species diversity and occupancy at each site, across habitat types.

Figure 23: Example of camera trap stations. Nailing holes into a can of fish-based cat food as an attractant to the camera trap station (upper left). Installing a trail camera on the levee at Sherman Island (bottom left). A complete camera trap set up on Twitchell Island (right).

Mammalian Mesocarnivore & Herbivore Preliminary Results

We observed a total of 13 species of mammalian mesocarnivores and herbivores at the six macrosite locations, including 11 California native species and 2 introduced species (Table 4; Figure 24).

Table 4: Larger mammal species identified in our 2020 surveys from camera traps and incidental sightings in the Sacramento-San Joaquin Delta. Macrosite locations include Cosumnes River Preserve (CR), Dutch Slough (DS), Grizzly Slough (GS), McCormack Williamson Tract (MW), Sherman Island (SH), and Twitchell Island (TW). (I) indicates introduced species.

Family	**Species**		**Macrosite**					
	(Common Name)	(Scientific Name)	CR	GS	MW	SH	TW	DS
Opossums (Didelphidae)	Virginia Opossum **(I)**	*Didelphis virginiana* **(I)**				X	X	X
Rabbits (Leporidae)	Black-tailed Jackrabbit	*Lepus californicus*		X		X	X	X
	Desert Cottontail	*Sylvilagus audubonii*	X		X		X	X
Squirrels (Sciuridae)	Fox Squirrel **(I)**	*Sciurus niger* **(I)**	X	X				X
	California Ground Squirrel	*Spermophilus beecheyi*			X			X
Beavers (Castoridae)	American Beaver	*Castor canadensis*				X	X	
Canids (Canidae)	Coyote	*Canis latrans*		X	X	X	X	X
Raccoons (Procyonidae)	Raccoon	*Procyon lotor*	X	X	X	X	X	X
Skunks (Mephitidae)	Western Striped Skunk	*Mephitis mephitis*	X			X	X	X
Cats (Felidae)	Bobcat	*Lynx rufus*	X	X				
Mustelids (Mustelidae)	River Otter	*Lontra canadensis*	X		X	X	X	X
	American Mink	*Neovison vison*		X		X		X
Deer (Cervidae)	Black-tailed Deer	*Odocoileus hemionus*	X	X	X			

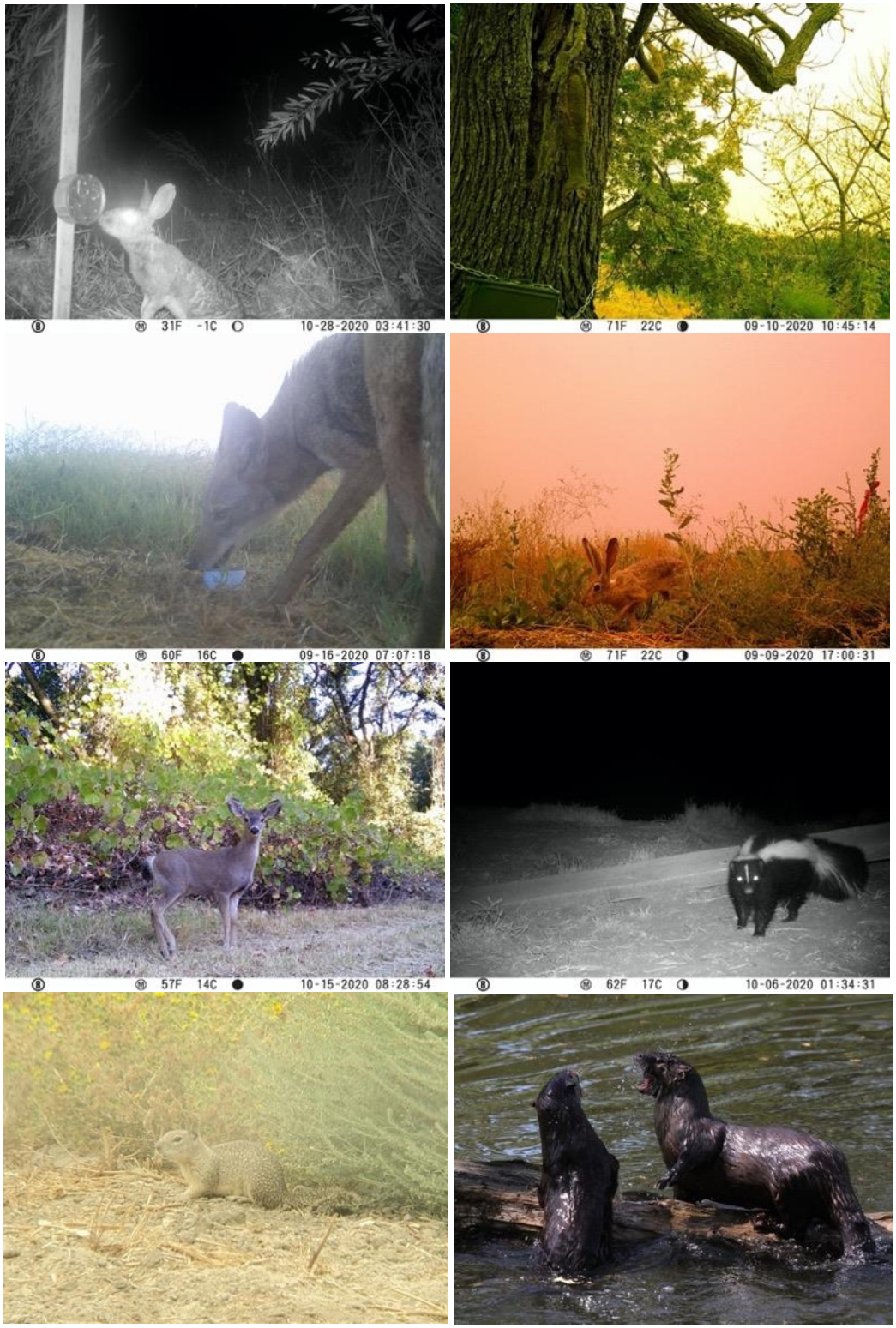

Figure 24: Camera trap photos of a Desert Cottontail investigating the cat food (upper left), Fox Squirrel climbing down a tree (DS; upper left), Coyote licking the cat food can (upper middle left), Black-tailed Jackrabbit at sunset (DS; upper middle left), juvenile Black-tailed Deer (CR; lower middle left), and a Western Striped Skunk at night (lower middle right). Incidental encounters with a California Ground Squirrel spotted darting from a burrow (DS; bottom left), and two River Otters interacting in the water (CR; bottom right).

We observed little variation in mammal species richness between macrosites (Figure 25). Dutch Slough (DS) had the most mammal species observed (10) while McCormack-Williamson Tract (MW) had the least mammal species (6). MW could have the least number of mammal species out of all the macrosites because of its small riparian forest fragments and lack of freshwater marsh sites.

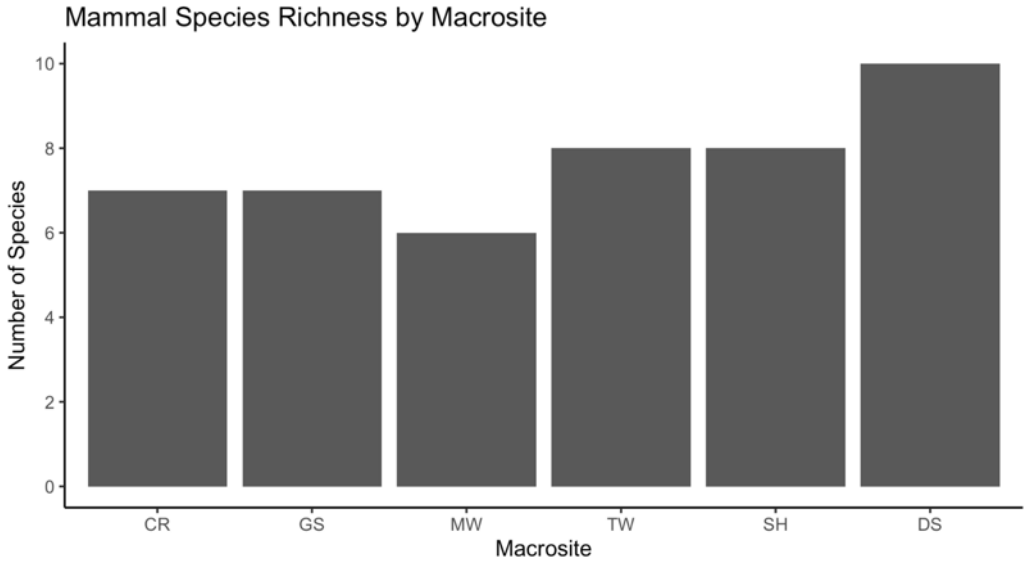

Figure 25: Mammal species richness by macrosite yields similar results across macrosites.

Mammal species richness by habitat type did not vary greatly either (Figure 26). We observed 11 species of mammals in Agriculture/Pasture (AP) and Riparian Forest (RF) sites and 9 species in Freshwater Marsh (FM) sites.

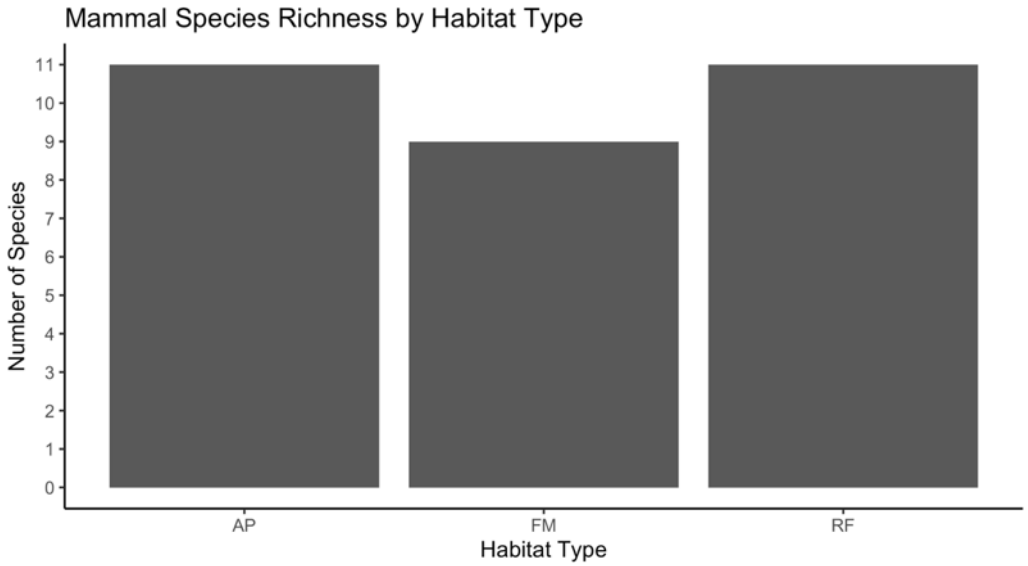

Figure 26: Species richness for larger mammals is similar across habitat type.

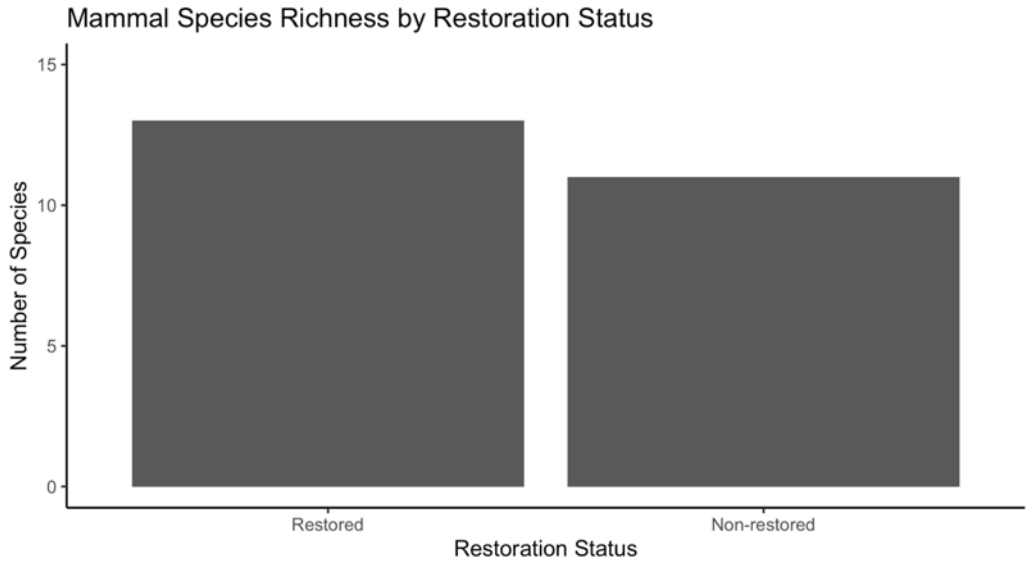

Figure 27: Mammal species richness was higher at restored than non-restored sites.

Restored habitats supported a higher number of species of larger mammals than non-restored sites (Figure 27). The restored sites contained all of the observed mammal species while the non-restored sites supported only 11/13 mammals, suggesting that the planned restoration projects will support higher species richness in the long term. The mammals not observed in the non-restored sites were the Bobcat (*Lynx rufus*) and the Virginia Opossum (*Didelphis virginiana*).

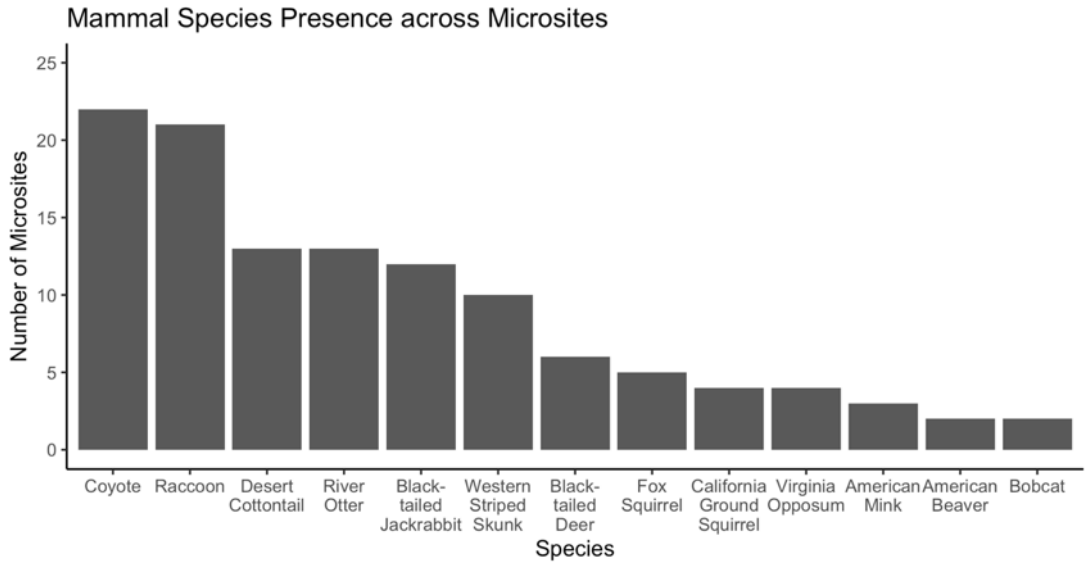

Figure 28: Mammal species presence across all the microsites displayed from most widely observed to least widely observed.

Coyote (*Canis latrans*) and Raccoon *(Procyon lotor),* both habitat generalists with diverse diets, occupied the most microsites (Figure 28). The most common herbivores were the Desert Cottontail (*Sylvilagus audubonii)* and Black-tailed Jackrabbit (*Lepus californicus)*. River Otter

(*Lontra canadensis)* actively used the restored wetland sites at DS and the subsidence reversal sites on Sherman Island (SH), but not the TW subsidence reversal wetland site. A possible explanation could be that the restored wetland and subsidence reversal sites on DS and SH have significantly more open water in them than TW. They also occupied other sites with visible open water such as Twitchell Meadow & Canal (TWMC), Twitchell Setback Levee (TWSB), and Sherman Setback Levee Reference (SHSR). Open water provides areas for foraging, which would make open freshwater wetlands more suitable otter habitat (Anderson and Woolf 1987). Camera traps showed bobcats and black-tailed deer (*Odocoileus hemionus)* present in just the north Delta, with bobcat only occurring in fairly mature riparian forest on Grizzly Slough and at the Cosumnes River Preserve (Figure 29). Compared to coyotes, bobcats are not as successful in urbanized or fragmented habitats (Riley et al. 2003). This observation may explain why they are not present in the south Delta, where dispersal would require crossing urban development and bridges, with only fragmented, newly restored riparian forest areas available to them.

Figure 29: Camera trap photos of mammalian mesocarnivores: Bobcat (top left), Virginia Opossum (top right), Raccoon (bottom left), and American Mink *(Neovison vison) (*bottom right).

Avian Point Count Survey

Methodology

Avian variable circle point counts were conducted during the breeding season (May & June) of 2020 at six Delta Levees Program locations across 35 microsites and 152 stations (Figure 30).

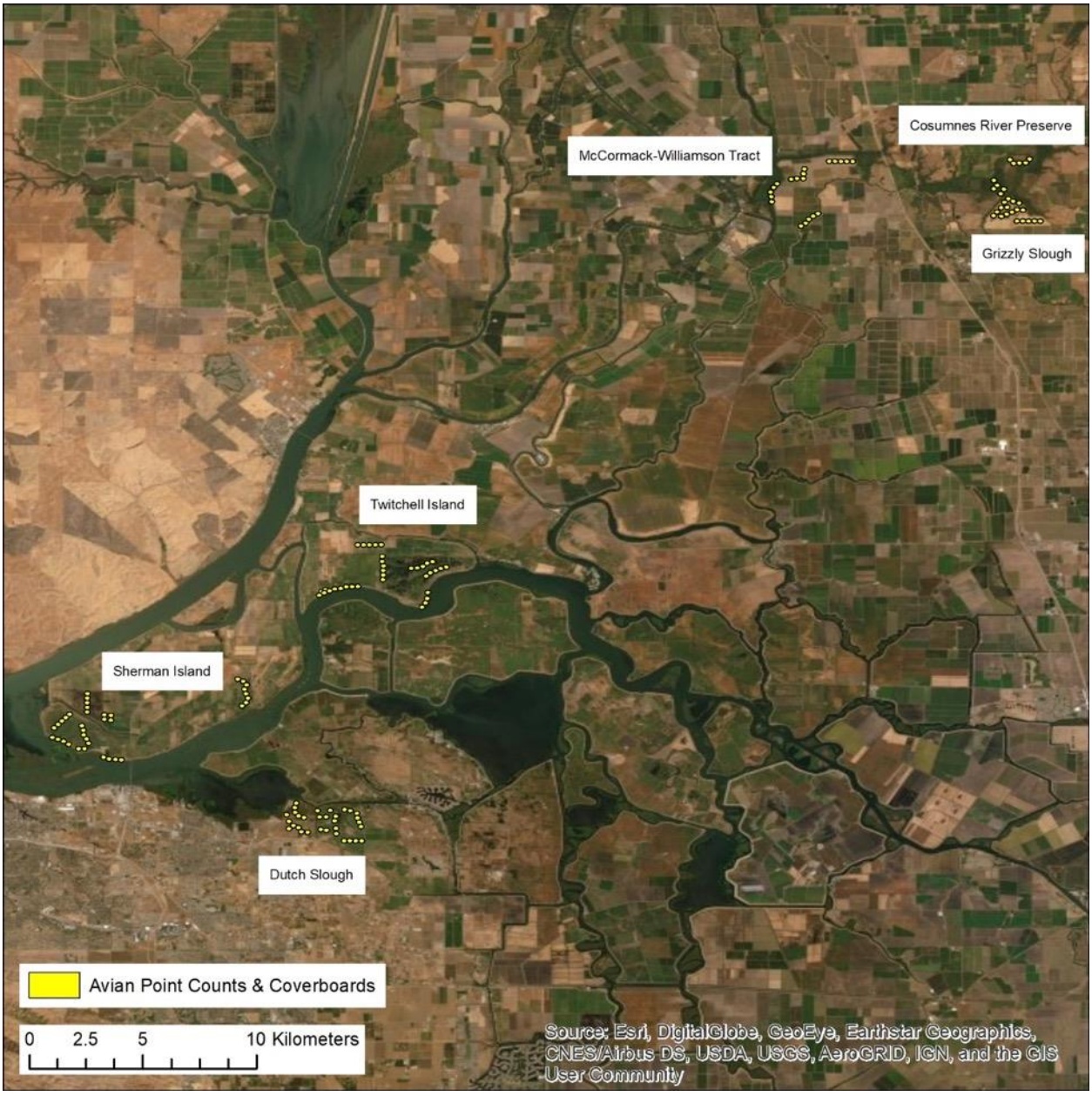

Figure 30: Overview map of avian point count stations and coverboard locations (152 in total) across the study area.

Each site was visited twice during the breeding season (once each in May and June) for a total of 304 surveys. We followed standard variable circle point count survey protocols as detailed by Ralph et al. 1993. Repeated surveys at each site were spaced a minimum of 14 days apart. These breeding season point counts began no later than 30 minutes after sunrise and were completed by 10am with a maximum of ten point counts surveyed by a single surveyor in a morning. Point count sample sites include 2-6 points, spaced at least 200 meters apart.

Each point was surveyed for 10 minutes, broken into two contiguous 5-minute count periods (Figure 31). Every species detected at a point was recorded, regardless of how far from the observer. For each detection, we estimated the distance (in meters) from the point to the bird(s) using a range finder. Flying birds not using the habitat within the count circle and birds observed greater than 100 m from point were noted separately and excluded from the analysis. For each detection, we recorded how we detected it (e.g., visual or by song), and if we observed any evidence of breeding (e.g., courtship, nest building, or feeding young). Analysis of avian point count data will be used to determine species diversity and density at each site, across habitat types.

Figure 31: Listening for bird calls while surrounded by cows proved to be a fun challenge during spring avian point counts.

Figure 32: Three Wild Turkeys at Cosumnes River Preserve (upper left). Perched Barn Owl at Dutch Slough (upper right). Identifying various waterfowl through binoculars at Sherman Island (bottom left). Ring-necked Pheasant male at Sherman Island (bottom right).

Avian Preliminary Results

During the breeding season avian point count survey in May and June of 2020, 92 avian species were identified across the 152 stations located within 6 macrosites (Appendix D). The greatest number of species, 55, was observed on the Twitchell Island (TW) macrosite, while 54 were detected at Dutch Slough (DS), 45 on Sherman Island (SH), 43 at the McCormack-Williamson Tract (MW), 42 at Grizzly Slough (GS), and 40 at Cosumnes River Preserve (CR) (Figure 33 top). There was no significant difference found in avian species richness between the macrosites (Figure 33 bottom), which is not surprising given that each macrosite encompassed a similar range of habitat types between all its microsites. On the microsite level, the highest number of species observed was at Twitchell Meadow & Canal (TWMC) with 35 species, and the lowest species richness of 2 was observed at the Grizzly Slough Wildlife-friendly Agriculture (GSWA) microsite. One possible factor in the difference in avian species richness could be the availability of suitable habitat for nesting or foraging; TWMC has a much greater amount of vegetation and cover as compared to GSWA, which is a fallow agricultural field.

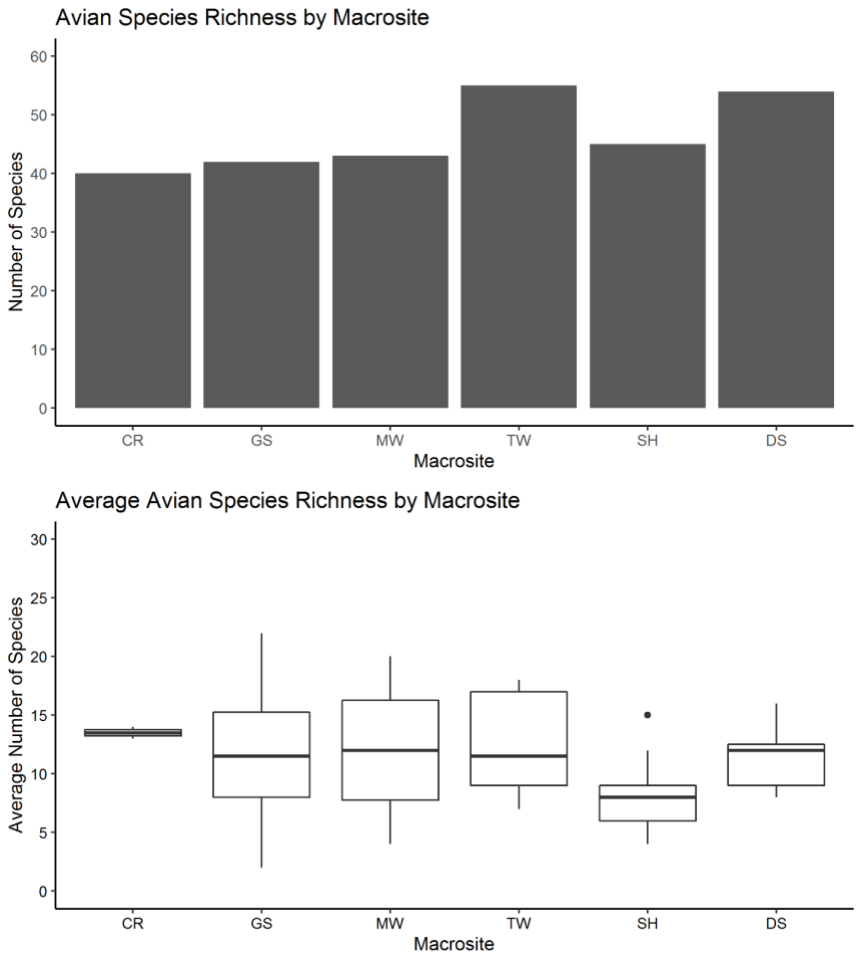

Figure 33: Avian species richness across 6 macrosites (Cosumnes River Preserve, Grizzly Slough, McCormack-Williamson Tract, Twitchell Island, Sherman Island, Dutch Slough; top). No significant difference between macrosites was detected ($p > 0.445$; bottom).

Out of a total of 35 microsites, 12 were classified as riparian forest (RF), 12 as agriculture/pasture (AP), 8 as freshwater marsh (FM), and 2 were of mixed habitat categories. We observed 64 species in RF sites, 51 species in AP sites, and 47 species in FM sites (Figure 34 top). Avian species richness was significantly greater in RF sites than in AP sites (p = 0.004; Figure 34 bottom), but there was no significant difference between FM sites and AP or RF sites (Figure 34 bottom).

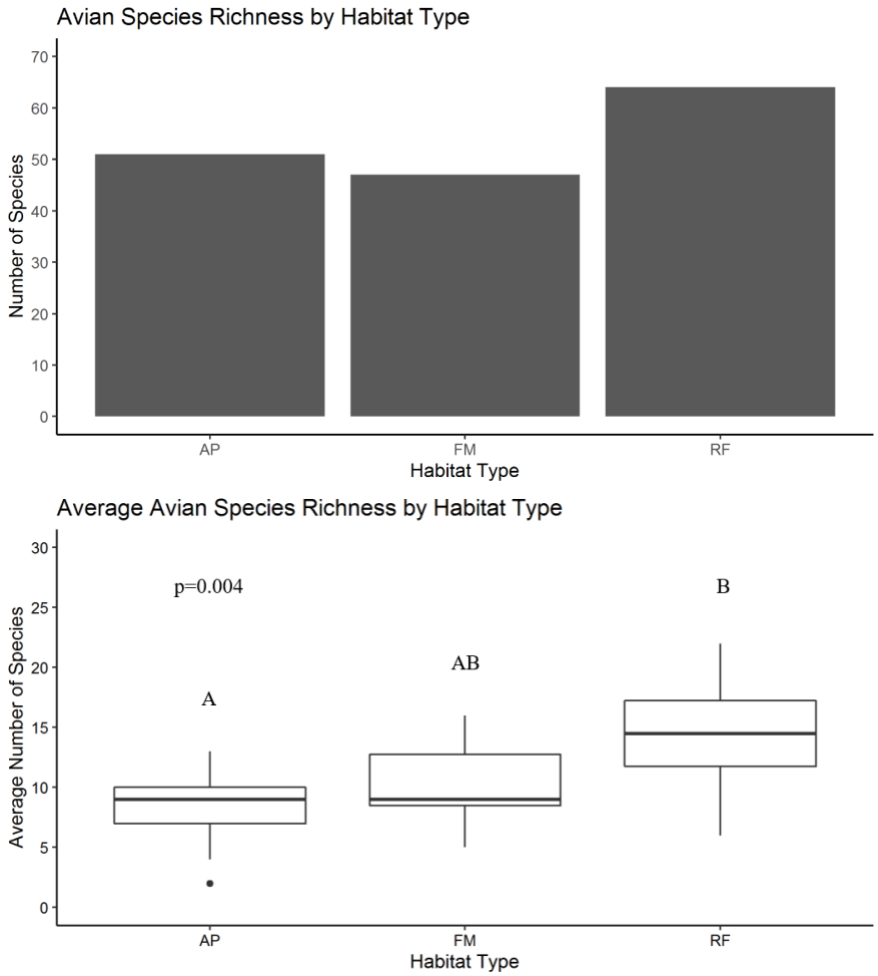

Figure 34: Riparian forest (RF) sites had a significantly higher species richness than agriculture/pasture (AP) sites (p = 0.004; bottom). No significant difference was found between AP and freshwater marsh (FM) sites (p = 0.527) or between RF and FM sites (p=0.118; bottom).

Each habitat supported a slightly different suite of species (Figure 35); Bullock's Oriole and American Goldfinch were the two species detected at the highest number (7) of RF microsites, followed by Cliff Swallow, Bushtit, and Black-headed Grosbeak (each at 6 RF microsites). Amongst AP sites, the American Goldfinch was detected at the most microsites (6) and the House Finch at the second-most (5). Within the FM sites, Cliff Swallows, Barn Swallows, Savannah Sparrows, and Western Meadowlarks all tied for most and were each observed at 4 microsites.

Figure 35: Examples of breeding birds seen at the various habitat types in Dutch Slough. Blue Grosbeaks tend to breed in tall weedy margins (upper left), while House Wrens prefer riparian forest sites (upper right). Savannah Sparrows are a classic dry grassland species found in our surveys in grazed pasture sites (bottom left), while Common Yellowthroats add a splash of color to freshwater marsh sites (bottom right).

21 of the 35 microsites were classified as restored, while the remaining 13 were classified as non-restored. We observed 82 species using restored sites and 55 species using the non-restored sites (Figure 36 top). There was a significantly higher species richness observed at the restored sites compared to the non-restored sites (p = 0.013; Figure 36 botom). This trend indicates towards the success of DWR's past habitat restoration efforts and holds promise for the future management plans improving sites' capacity to support greater species diversity.

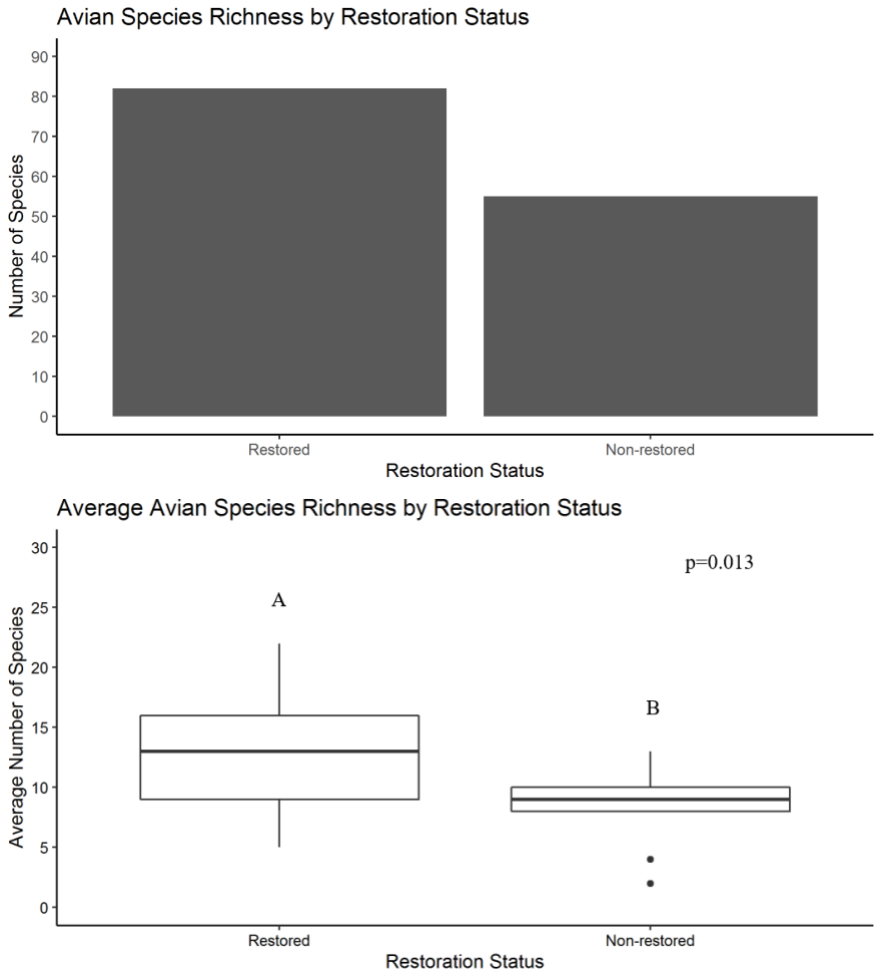

Figure 36: Avian species richness compared to restoration status (restored vs. non-restored; top). Restored sites had significantly greater avian species richness than non-restored sites (p = 0.013; bottom).

Herpetofauna Coverboard Survey

Methodology

Herpetological coverboard surveys were conducted whenever a site was surveyed for birds or small mammals across 35 sites and 152 stations in the Sacramento-San Joaquin Delta (Figure 30). We placed two 2 x 4' coverboards, one wood and one corrugated metal, at the center of each avian point count station (Figure 37). At sites with cows, we used only a single wood coverboard as the metal boards were trampled, resulting in a total of 279 coverboards in total.

Figure 37: Coverboards at avian point count locations.

At each coverboard, we noted location, species observed and number of individuals. Additionally, we conducted visual encounter surveys, recording all incidental observations of amphibians and reptiles or their physical signs (e.g., shed skins) at each site. Analysis of herpetological survey data will be used to determine species diversity and relative abundance at each site, across habitat type.

Herpetofauna and Preliminary Results

We observed a total of 10 herpetofauna species at our six macrosite study areas, including 2 amphibians, 8 reptiles and 2 introduced species (Table 5; Figure 38).

Table 5: Herpetofauna species identified in our 2020 surveys from coverboard surveys and incidental sightings in the Sacramento-San Joaquin Delta. Macrosite locations include Cosumnes River Preserve (CR), Dutch Slough (DS), Grizzly Slough (GS), McCormack Williamson Tract (MW), Sherman Island (SH), and Twitchell Island (TW). (I) indicates introduced species.

Family	**Species**		**Macrosite**					
	(Common Name)	(Scientific Name)	CR	GS	MW	SH	TW	DS
Treefrogs (Hylidae)	Sierran Treefrog	*Pseudacris sierra*	X				X	X
True Frogs (Ranidae)	American Bullfrog **(I)**	*Lithobates catesbeianus* **(I)**	X			X	X	X
Alligator Lizards (Anguidae)	California Alligator Lizard	*Elgaria multicarinata multicarinata*	X				X	
Spiny Lizards (Phrynosomatidae)	Western Fence Lizard	*Sceloporus occidentalis*	X	X	X	X	X	X
Colubrids (Colubridae)	Western Yellow-bellied Racer	*Coluber constrictor mormon*				X		
	California Kingsnake	*Lampropeltis californiae*					X	
	Pacific Gopher Snake	*Pituophis catenifer catenifer*				X	X	X
	Valley Garter Snake	*Thamnophis sirtalis fitchi*				X		
Basking Turtles (Emydidae)	Western Pond Turtle	*Actinemys marmorata*			X			X
	Red-eared Slider **(I)**	*Trachemys scripta elegans* **(I)**	X		X			

Figure 38: Sierran Treefrogs were the most commonly observed amphibian (CRAF; upper left); a juvenile California Alligator Lizard found under a coverboard (TWFL; upper right); a group of Western Pond Turtles sunning themselves (DS; middle left); Western Yellow-bellied Racers, like this juvenile, were only seen on Sherman Island (middle right); Red-eared slider spotted on high ground during spring surveys (MW; bottom).

We observed little variation in herpetofauna species richness between macrosites (Figure 39). Twitchell Island (TW) had the greatest number of herpetofauna species observed (6), while Grizzly Slough (GS) only had the Western Fence Lizard (*Sceloporus occidentalis)*. GS's low species richness in herpetofauna is most likely due to a lack of reptiles and amphibians observed during chance visual encounters outside of coverboard surveys.

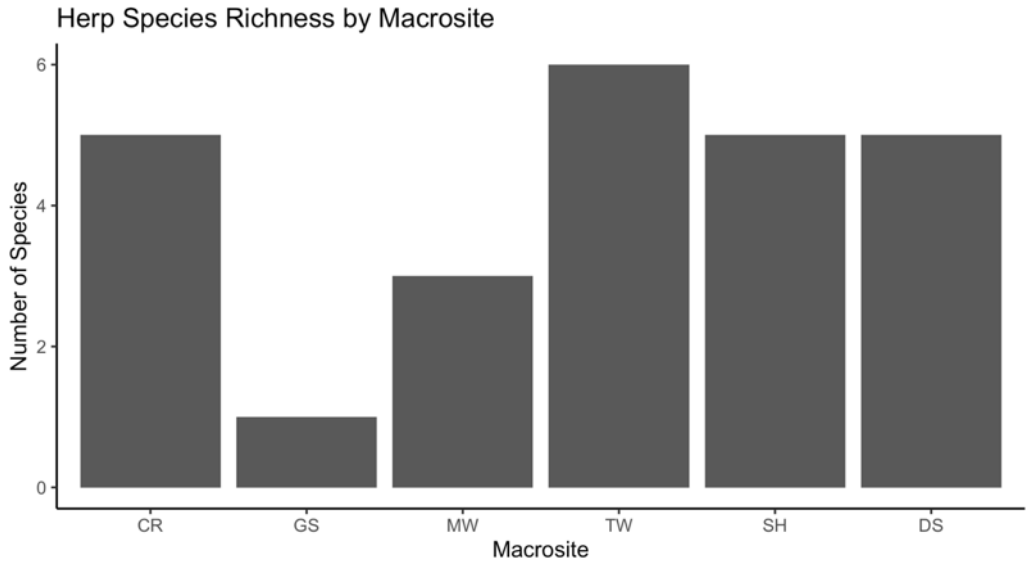

Figure 39: Herpetofauna species richness by macrosite yields mostly similar results across macrosites.

Herpetofauna species richness varied a small about between habitat type (Figure 40). RF surveys yielded the most herpetofauna species (9), followed by AP (7), and lastly FM (6).

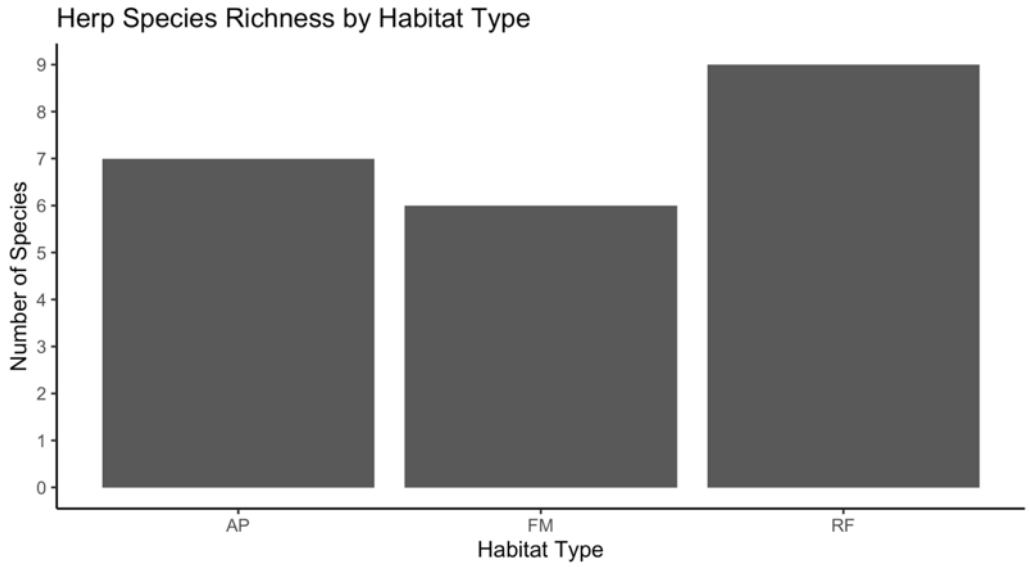

Figure 40: Species richness for herpetofauna is similar across habitat type with riparian forest (RF) supporting the most species.

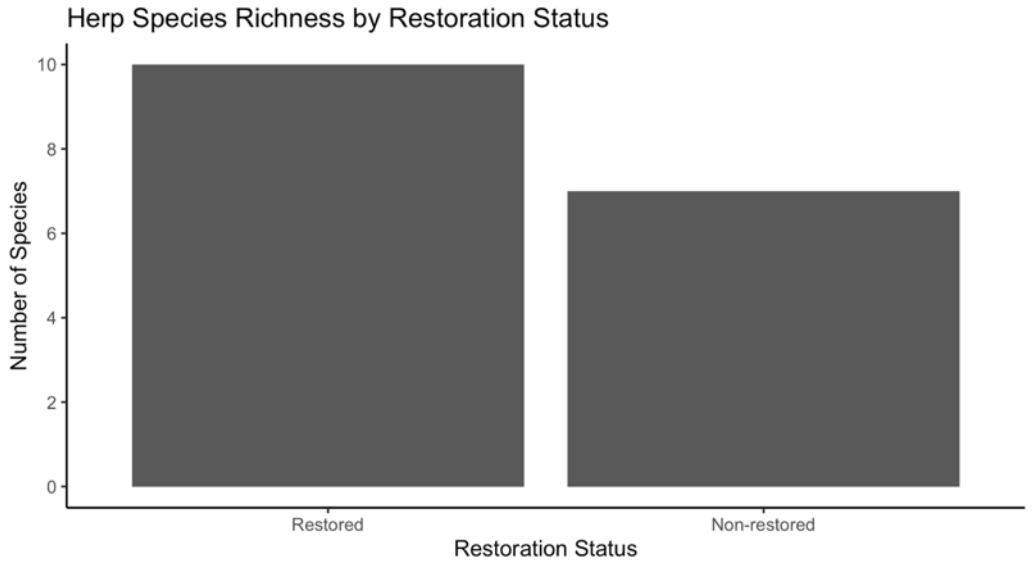

Figure 41: Herpetofauna species richness was higher at restored than non-restored sites.

Restored habitat supported a higher number of species for herpetofauna (Figure 41). The restored sites contained all of the observed herpetofauna species while the non-restored sites supported only 7/10 amphibians and reptiles, suggesting that the planned restoration projects will support higher species richness in the long term. The herpetofauna species not observed in the non-restored sites were the Valley Garter Snake (*Thamnophis sirtalis fitchi*), the California Kingsnake (*Lampropeltis californiae*), and the Red-eared Slider (*Trachemys scripta elegans*).

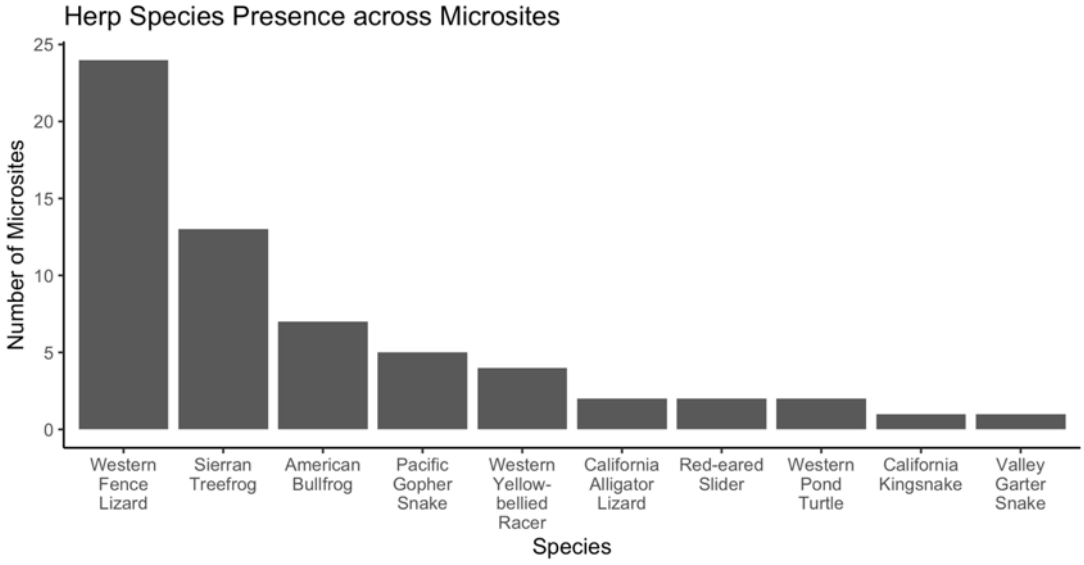

Figure 42: Herpetofauna species presence across all the microsites displayed from most widely observed to least widely observed.

We observed 10 reptile and amphibian species after surveying all the microsites (Figure 42). The most common reptile species encountered by far was the Western Fence Lizard, which occurred at 24/35 microsites and the most common amphibian was the Sierran Treefrog

(*Pseudacris sierra*), occupying 13/35 microsites. The Sierran Treefrog was not observed at GS, MW, or SH, but this is likely due to a lack of survey effort during their breeding/calling season. The Pacific Gopher Snake (*Pituophis catenifer catenifer*), which has been documented using marsh, woodland, and grassland areas in Central California, was observed at the most microsites of all snake species and was observed at all three habitat types (Rodríguez-Robles and Lannoo 2003). The only observation of the California Kingsnake and Valley Garter Snake occurred on Sherman Island where we caught them incidentally in a Sherman small mammal trap (Figure 43).

Figure 43: Our only observation of a Valley Garter Snake (top left) and California Kingsnake (top right) were in small mammal trapping incidental capture. Western Fence Lizard (bottom left) was the most commonly observed reptile species, while Pacific Gopher Snakes were the most common snake (bottom right).

Bat Inventory & Monitoring

Methodology

Passive bat acoustic surveys were conducted during fall (September and October) of 2020 at six Delta Levees Program locations (Sherman Island, Twitchell Island, Dutch Slough, McCormack-Williamson Tract, Cosumnes River Preserve, and Grizzly Slough) (Figure 22). At each of the 35 sites, we established two passive acoustic survey stations equipped with Pettersson Model D500X full-spectrum ultrasonic detectors. We established a fixed location to mount the detectors by driving a stake into the ground and connected the microphone to a 3 m tall pole (Figure 44). Microphones were oriented horizontally, maximizing the amount of detectable airspace, and minimizing the amount of vegetative clutter that would generate noise within the sample space.

Figure 44: An example of a passive bat acoustic monitoring station on Dutch Slough with associated camera trap and coverboard.

We programmed the detectors to record from sunset to sunrise for three consecutive nights during the small mammal trapping period at each site. During the first two months of data collection, we recorded 177,141 acoustic files totaling 818 GB of storage. Analysis of bat acoustic data will be used to determine species diversity, occupancy and relative abundance at each site, across habitat types.

Invertebrate Trapping Survey

Methodology

The insect fauna of the Sacramento-San Joaquin Delta has never been systematically surveyed, apart from the Antioch sand dunes. Our survey is the first of its kind and we are hoping to find some of the species thought to be endemic to the Antioch Dunes in other Delta sites, particularly Dutch Slough. Insect trapping was conducted at six Delta Levees Program locations across 11 sites in the Sacramento-San Joaquin Delta (Figure 45).

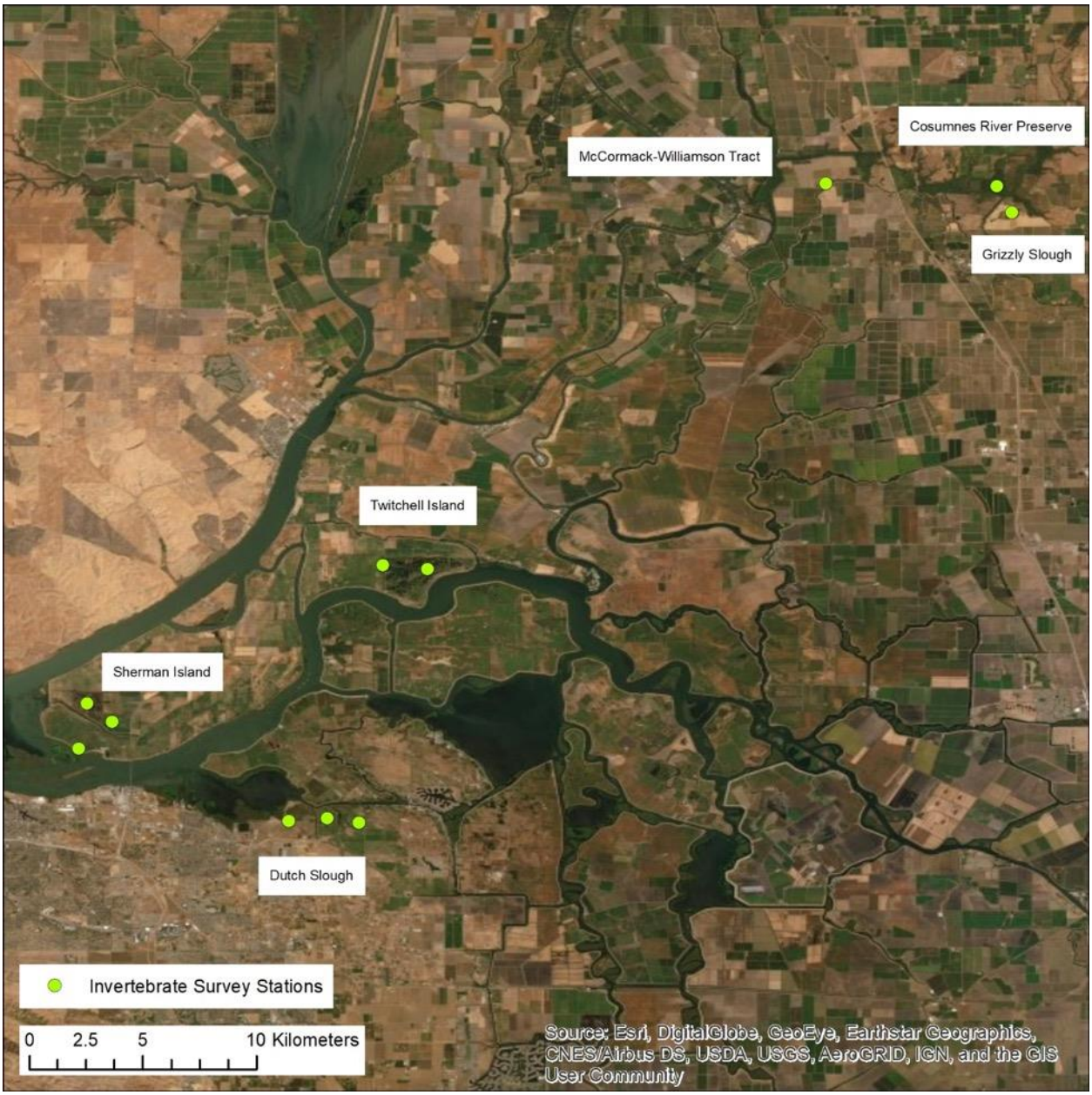

Figure 45: Overview map of invertebrate survey stations (11 in total) across the study area.

Figure 46: Malaise trap with blue vane trap in front on Sherman Island (top). Blue vane trap (bottom left). Contents of pitfall trap, black widow and carrion beetles (bottom right).

At each site, we ran two Malaise traps, four pitfall traps, and four blue vane traps (Figure 46 & 47). One invertebrate survey station was established in a restored habitat and one in non-restored habitat at each macrosite. The Malaise, blue vane, and pitfall traps ran 24/7 for the trapping period. They were emptied either weekly or every two weeks depending on the number of insects captured and levels of evaporation of the preservation fluid in the traps. Preservation fluid consisted of ethyl alcohol with propylene glycol added to slow evaporation. The Malaise traps continuously intercept flying insects, pitfall traps sample ground-based insects and other arthropods, and the blue vane traps specifically sample bees. Because of concerns over potential capture of the Elderberry Long-horned Beetle we put beetle excluders

on our Malaise traps, which were the only traps likely to capture this beetle. Each trap yielded an 8 oz jar of alcohol preserved specimens. Trap samples brought back to the Bohart Museum at UC Davis were stored in ethyl alcohol, curated, and sorted to taxon by trap number and sampling technique. Analysis of insect trapping data will be used to determine species diversity at each site, across habitat types.

Figure 47: Establishing an invertebrate survey station in remnant Antioch Dunes habitat at the Dutch Slough Emerson Vineyard (DSEV). A pitfall trap can be seen in the foreground with a Malaise trap in the center and blue vane trap off to the right.

Invertebrate Survey Preliminary Results

To date we have collected roughly 200,000 specimens, with huge series of some common species. We have identified and databased 336 species of insects in eight orders, including 2 cockroaches, 21 flies, 247 bees and wasps, 1 mantis, 46 moths and butterflies, 2 earwigs, 5 true bugs and plant bugs, and 11 beetles (Appendix E). Roughly 5% of the species we've identified to date are introduced, either from Europe or western Asia. Compare this to the plant species where 54% are exotic (Appendix F). Interestingly, based on the species we've identified to date, about 40% of the insect species are parasites or predators of aphids and scale insects. Given the low numbers of species in otherwise abundant groups such as beetles, plant bugs and flies, we estimate that that the insect fauna in the Delta is probably close to 1,000 species.

Habitat and Vegetation Survey

Methodology

Survey methodologies used elements from existing protocols of the California Native Plant Society (CNPS) and the California Department of Fish and Wildlife's Wildlife Habitat Relationships system (CWHR). At each avian point count station, three 10-meter radius circular vegetation plots were established linearly with the avian point count station being central, and the other two centered at 25 meters from the point count station, measured either perpendicular to the levee (many stations are located on levees) or on a north/south axis in non-levee areas. Plot center locations were captured using a Trimble GPS unit with an auxiliary antenna mounted on a 2-m pole. This equipment is capable of sub-meter accuracy once data is post-processed.

Plots were surveyed once beginning spring 2020 (Figure 48). Vegetation surveys captured percent cover of all plant species, habitat elements, and vegetative structure of each avian point count station. At each 314 square-meter plot the following CWHR-related information was recorded:

- Percent cover of each plant species using the CNPS California Natural Community rapid assessment method.
- CWHR Wooded Habitat Sampling data was recorded for each tree in the plot, including species, height, DBH of the stem (Diameter at Breast Height), and a count of all stems within plot. Species identified as tree, shrub, liana/vine, or ground cover (herb/forb) were grouped into physiognomic classes by growth-form and height:
    - T1 – upper tree layer – trees > 10m tall
    - T2 – lower tree layer – trees usually 5-10 m tall (includes tree species seedlings and saplings)
    - S1 – taller shrub layer – shrubs 2-5 m tall
    - S2 – lower shrub layer – shrubs 0-2 m tall (includes shrub spp. and seedlings)
    - V – liana/vine
    - HG – herb layer or graminoids
- Habitat elements recorded included percent cover/depth of leaf litter/duff, woody debris, bare ground, rocks and open water.
- An aerial sketch was drawn delineating trees, roads and other habitat-related or notable features.
- Photos were taken from the center facing North, East, South, and West.
- A trampling code was assigned to each plot: 1 = Low: 0 to 10% of plot trampled, 2 = Moderate: more than 10 to 50% of plot trampled, 3 = Heavy: more than 50% of plot trampled.

Figure 48: Conducting the vegetation/habitat surveys generally involved accessing the sites by foot (Cosumnes River Preserve Tall Forest; upper left), but sometimes required a boat (Twitchell Island Setback Levee; upper right). Surveys took place in a wide variety of habitat types including remnant Antioch sand dunes on Dutch Slough (bottom left) and riparian forest and shrub (bottom right).

Habitat and Vegetation Survey Preliminary Results

To date we have identified 191 species of plants across 44 families at our survey sites (Appendix F). Of these, 54% are introduced species.

Observations of CDFW Species of Special Concern

Avian Species

The Least Bittern (*Ixobrychus exilis*) is considered a Bird of Conservation Concern by the United States Fish and Wildlife Service (USFWS) and a Species of Special Concern by the California Department of Fish and Wildlife (CDFW). They nest in freshwater or brackish marshes, preferring areas with tall cattails interspersed with open patches of water and small stands of trees (Figure 49). Several individuals were calling on apparent territory in both May and June breeding season point counts at the Sherman Island Whale's Mouth subsidence reversal sites.

Figure 49: A Least Bittern in the reeds along the San Joaquin River near Sherman Island (photo Chris Wills).

The Northern Harrier (*Circus hudsonius*) is a CDFW Species of Special Concern. They inhabit large wetland and grassland areas with low vegetation, and, in the western US populations, tend to breed in dry upland habitats (Figure 50). They were observed during Spring breeding season point count surveys at Dutch Slough Gilbert Managed Marsh (DSGM) microsite, as on the Sherman Island and Twitchell Island macrosites.

Figure 50: An adult male Northern Harrier soaring over Sherman Island (photo Max Brodie).

The Swainson's Hawk (*Buteo swainsoni*) is listed as Sensitive by the Bureau of Land Management (BLM), listed as Threatened on the California Endangered Species Act (CESA), and considered a Bird of Conservation Concern by USFWS. They favor open grasslands with scattered stands of trees but have also adapted to hunt in agricultural fields. Their breeding range is restricted primarily to western North America. We observed five Swainson's Hawks during our Spring breeding season survey efforts, at the Dutch Slough (Figure 51), Twitchell Island, and McCormack-Williamson Tract macrosites. One individual was spotted carrying a vole during the breeding season, flying 50m above the Twitchell TIMES (TWTM) microsite. Voles are a common prey item and indicate a pair could potentially be breeding nearby.

Figure 51: A Swainson's Hawk perching on a wire at the Cosumnes River Preserve.

The Burrowing Owl (*Athene cunicularia*) is considered a Bird of Conservation Concern by USFWS, a Species of Special Concern by CDFW, and Sensitive by BLM. They live in open grasslands, deserts, and pastures, often where there are also high densities of burrowing mammals. None were observed during the Spring surveys, but an individual was spotted on Twitchell Island in early November, perched on a fence post in the pasture across from the TWTM microsite (Figure 52).

Figure 52: Burrowing Owl perched on fence post in pasture across from the Twitchell TIMES (TWTM) microsite.

The Loggerhead Shrike (*Lanius ludovicianus*) is considered a Bird of Conservation Concern by USFWS and a Species of Special Concern by CDFW. They frequent agricultural fields, pastures, and riparian areas, often being found where there is low, thorny vegetation or along fence lines and utility poles. One was seen in the cattle pasture on the Sherman Island Whale's Belly (SHWB) microsite during breeding season at the end of May. Individuals were seen regularly on Twitchell Island (Figure 53), Sherman Island and Dutch Slough during our fall small mammal surveys.

Figure 53: A Loggerhead Shrike observed perching on a wire above the pasture on Twitchell Island.

The Yellow-breasted Chat (*Icteria virens*) is considered a Species of Special Concern by CDFW. They are frequently found along the edges of rivers or ponds, and they breed in areas with dense shrubbery, often blackberry bushes (Figure 54). One individual was observed singing on Twitchell Island during a breeding season point count, and a second was observed incidentally singing on apparent territory on Lower Sherman Island.

Figure 54: A Yellow-breasted Chat singing on a wire on Bradford Island (photo Robert Raffel).

The Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*) is a CDFW Species of Special Concern. They breed in wetlands and prairies, often nesting in cattails alongside Red-winged Blackbirds (*Agelaius phoeniceus*) and foraging in nearby grasslands or croplands. One was seen during breeding season at the Sherman Island Whale's Mouth freshwater marsh. This species was also observed within mixed blackbird flocks on Sherman and Twitchell Islands in the fall (Figure 55).

Figure 55: Yellow-headed and Tricolored, and Red-winged Blackbirds captured mid-air on camera trap at the Twitchell TIMES (TWTM) microsite.

The Tricolored Blackbird (*Agelaius tricolor*) is considered both a Bird of Conservation Concern by USFWS and a Species of Special Concern by CDFW. BLM lists it as Sensitive, and on CESA it is ranked Threatened. It is on the North American Bird Conservation Initiative's (NABCI) Red Watch List for extremely high vulnerability as well as ranked Endangered by the IUCN. This species was seen in the Spring foraging and in mixed blackbird flocks in Fall on the Twitchell Island TIMES microsite, indicating a possible nesting colony nearby (Figure 55).

The Yellow Warbler (*Setophaga petechia*) is listed as a CDFW Species of Special Concern and a USFWS Bird of Conservation Concern (Figure 56). They are often found among willows or in thickets, along streams and wetlands. This species was seen and heard singing on apparent territory at the Accidental Forest site at the Cosumnes River Preserve and was also observed on Twitchell Island in the spring.

Figure 56: A female Yellow Warbler observed on a migratory stopover during our fall small mammal surveys at Dutch Slough.

Herpetofauna Species

The Western Pond Turtle (*Actinemys marmorata*) is a CDFW state species of special concern and was observed at two microsites—Dutch Slough Gilbert Managed Marsh (DSGM) and McCormack-Williamson Riparian West (MWTW). At DSGM, we spotted 9 individuals in the slough from the top of the levee. At MWTW, we saw 1 individual incidentally during a coverboard survey far from the slough in an apparent nesting attempt (Figure 57). Both visual encounters occurred in May, just before nesting season (Reese and Welsh 1997). Western pond turtles nest in upland areas up to 400m away from the water source, as well as leave the water source to overwinter on land (Reese and Welsh 1997). These behaviors indicate how managing terrestrial habitat to support the only extant California native turtle species is necessary to their success.

Figure 57: Western Pond Turtle at spotted nesting at MWTW on high ground during spring surveys.

Literature cited

Anderson, E. A., & Woolf, A., (1987). River Otter Habitat Use in Northwestern Illinois. Illinois Academy of Science, 80: 107-114.

Ballenger, L. 1999. "*Mus musculus*" (On-line), Animal Diversity Web. Accessed November 18, 2020 at https://animaldiversity.org/accounts/Mus_musculus/

Bechard, Marc J., et al. "Swainson's Hawk (*Buteo swainsoni*)." *Birds of the World*, 4 Mar. 2020, birdsoftheworld.org/bow/species/swahaw/cur/introduction.

Beedy, Edward C., et al. "Tricolored Blackbird (*Agelaius tricolor*)." *Birds of the World*, 4 Mar. 2020, birdsoftheworld.org/bow/species/tribla/cur/introduction.

Eckerle, Kevin P., and Charles F. Thompson. "Yellow-Breasted Chat (*Icteria virens*)." *Birds of the World*, 4 Mar. 2020, birdsoftheworld.org/bow/species/yebcha/cur/introduction.

Fernandez, Carolina. "*Agelaius tricolor* (Tricolored Blackbird)." *Animal Diversity Web*, animaldiversity.org/accounts/Agelaius_tricolor/.

Gillespie, H. 2004. "*Rattus rattus*" (On-line), Animal Diversity Web. Accessed November 18, 2020 at https://animaldiversity.org/accounts/Rattus_rattus/

Konishi, H. 2003. "*Reithrodontomys megalotis*" (On-line), Animal Diversity Web. Accessed November 18, 2020 at https://animaldiversity.org/accounts/Reithrodontomys_megalotis/

Lowther, Peter E., et al. "Yellow Warbler (*Setophaga petechia*)." *Birds of the World*, 4 Mar. 2020, birdsoftheworld.org/bow/species/yelwar/cur/introduction.

Peronne, L. 2002. "*Microtus californicus*" (On-line), Animal Diversity Web. Accessed \ November 18, 2020 at https://animaldiversity.org/accounts/Microtus_californicus/

Poole, Alan F., et al. "Least Bittern (*Ixobrychus exilis*)." *Birds of the World*, 4 Mar. 2020, birdsoftheworld.org/bow/species/leabit/cur/introduction.

Poulin, Ray G., et al. "Burrowing Owl (*Athene cunicularia*)." *Birds of the World*, 4 Mar. 2020, birdsoftheworld.org/bow/species/burowl/cur/introduction.

Ralph, C. J., G. R. Geupel, P. Pyle, T. E. Martin, D. F. DeSante. 1993. Handbook of field methods for monitoring landbirds. Gen. Tech. Rep. PSW-GTR-144. Albany, CA: Pacific Southwest Research Station, Forest Service, USDA

Reese, Devin A., & Welsh, Hartwell H., (1997). Use of Terrestrial Habitat by Western Pond Turtles, *Clemmys marmorata*: Implications for Management. In *Conservation, Restoration, and Management of Tortoises and Turtles.* International Conference (pp. 352-357). New York Turtle and Tortoise Society.

Riley, S.P.D., Sauvajot, R.M., Fuller, T.K., York, E.C., Kamradt, D.A., Bromley, C. & Wayne, R.K., (2003). Effects of Urbanization and Habitat Fragmentation on Bobcats and Coyotes in Southern California. Conservation Biology, 17: 566-576. https://doi.org/10.1046/j.1523-1739.2003.01458.x

Rodríguez-Robles, J. A., & Lannoo, M. J., (2003). Home Ranges of Gopher Snakes (*Pituophis catenifer*, Colubridae) in Central California. Copeia, 2: 391–396. https://doi.org/10.1643/0045-8511(2003)003[0391:HROGSP]2.0.CO;2

Smith, Kimberly G., et al. "Northern Harrier (*Circus hudsonius*)." *Birds of the World*, 4 Mar. 2020, birdsoftheworld.org/bow/species/norhar2/cur/introduction.

Twedt, Daniel J., and Richard D. Crawford. "Yellow-Headed Blackbird (*Xanthocephalus xanthocephalus*)." *Birds of the World*, 4 Mar. 2020, birdsoftheworld.org/bow/species/yehbla/cur/introduction.

Yosef, Reuven. "Loggerhead Shrike (*Lanius ludovicianus*)." *Birds of the World*, 4 Mar. 2020, birdsoftheworld.org/bow/species/logshr/cur/introduction.

Appendix A: Detailed Maps of Survey Sites

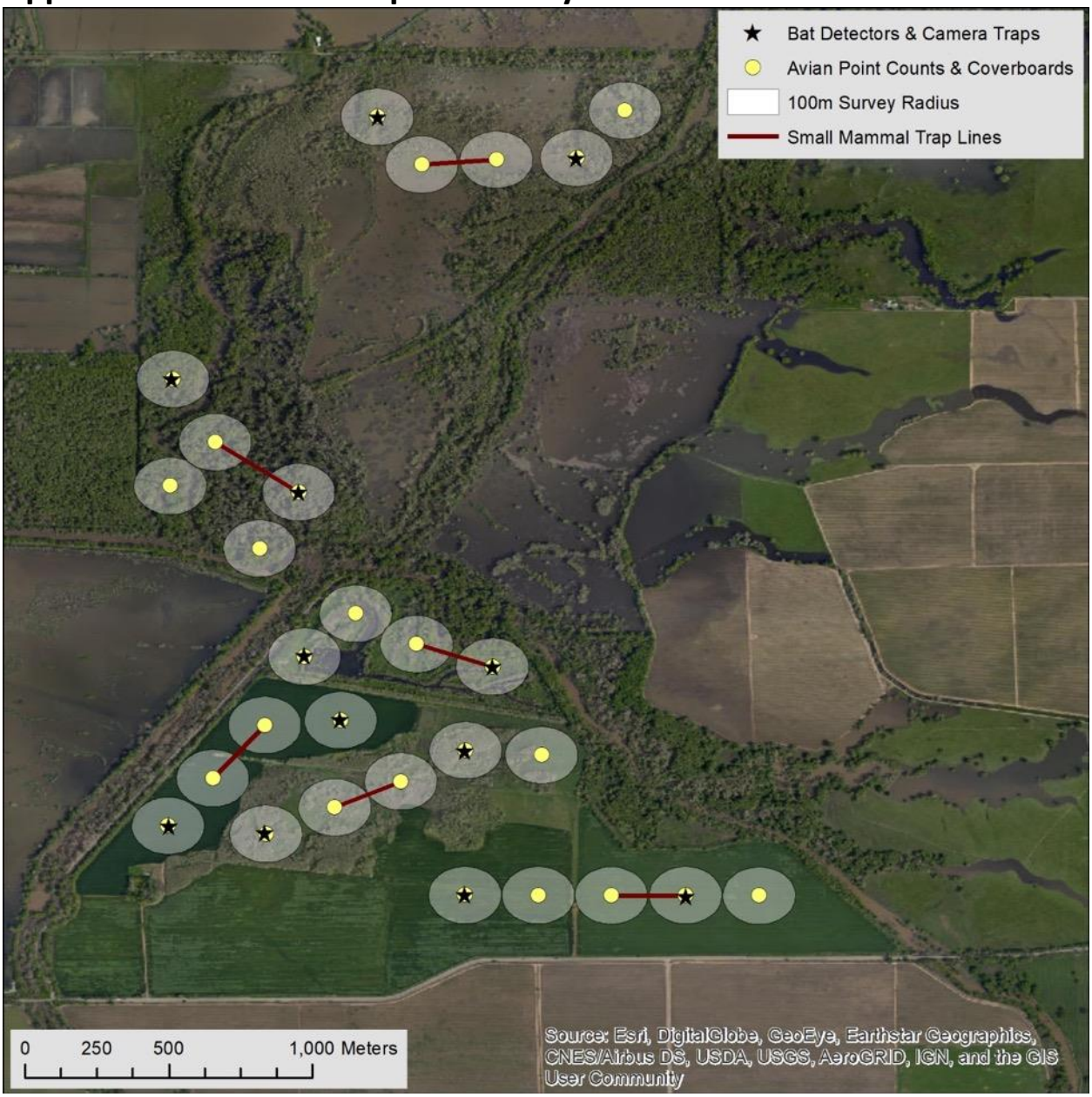

Figure A1: Detailed map of avian point count, coverboard, bat detector, camera trap, and small mammal trap line locations across the Cosumnes River Preserve and Grizzly Slough Macrosites.

Figure A2: Detailed map of avian point count, coverboard, bat detector, camera trap, and small mammal trap line locations across the McCormack-Williamson Tract Macrosite.

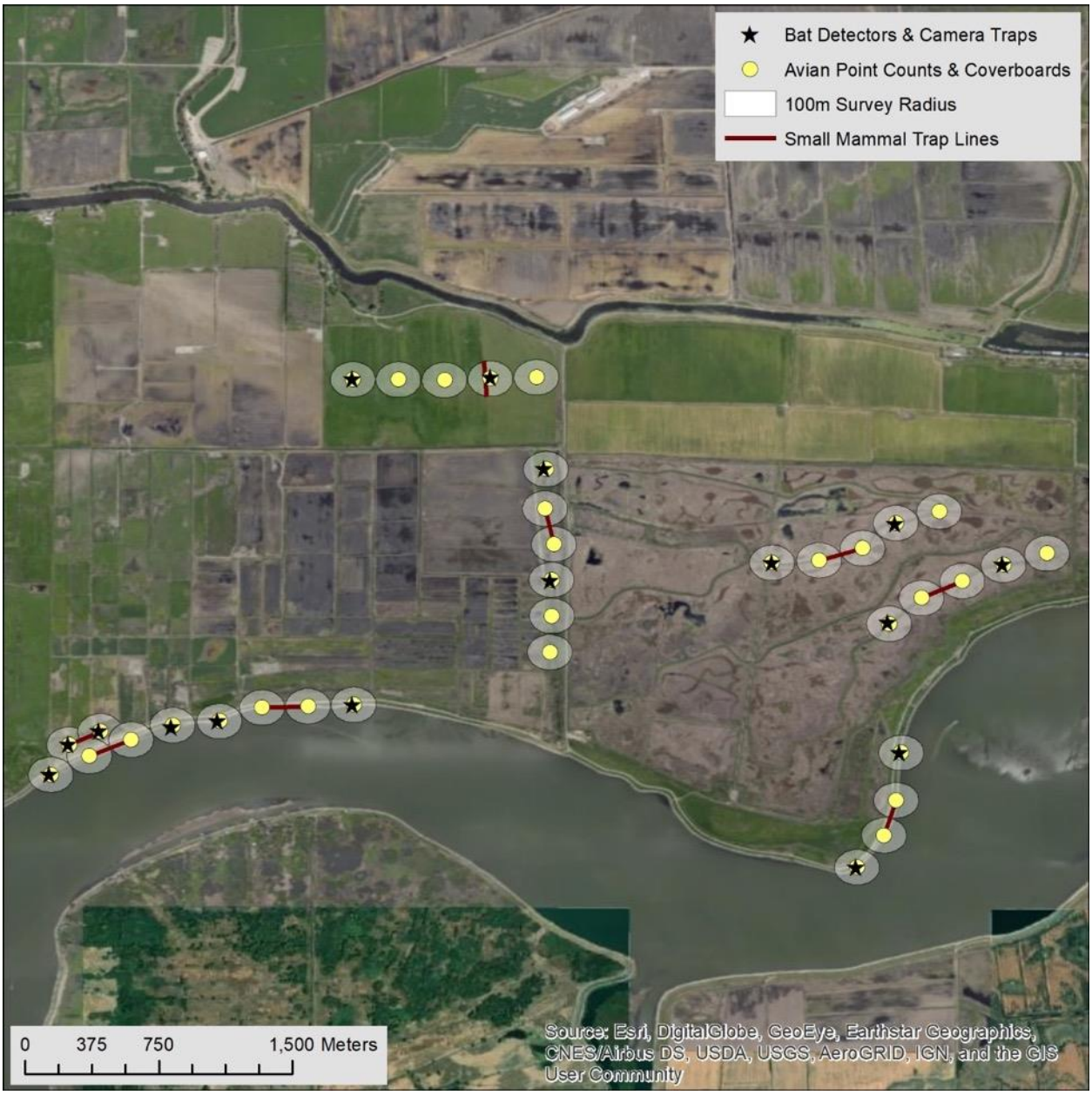

Figure A3: Detailed map of avian point count, coverboard, bat detector, camera trap, and small mammal trap line locations across the Twitchell Island Macrosite.

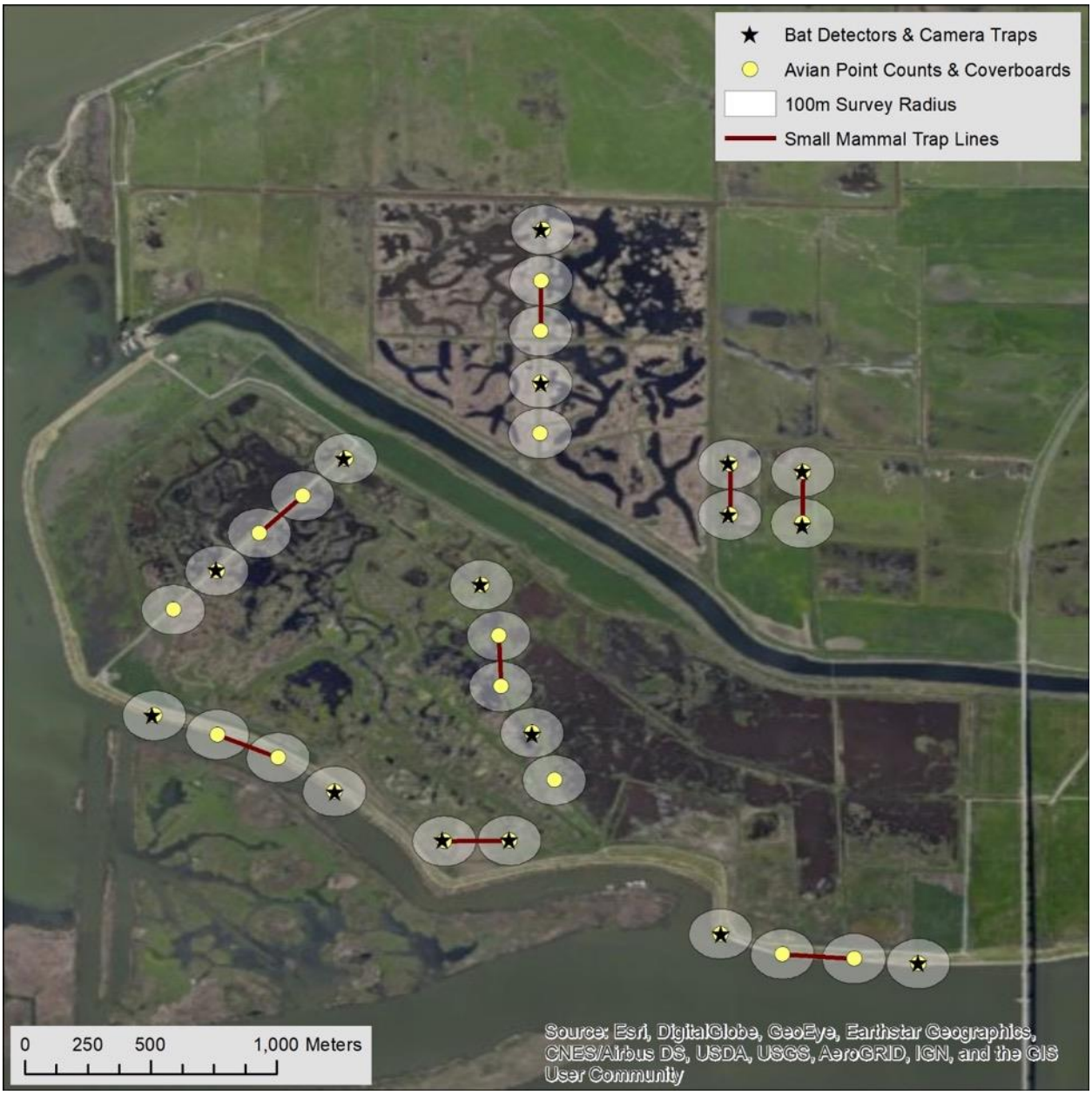

Figure A4: Detailed map of avian point count, coverboard, bat detector, camera trap, and small mammal trap line locations across the Whale's Mouth and Mayberry Farms regions of the Sherman Island Macrosite.

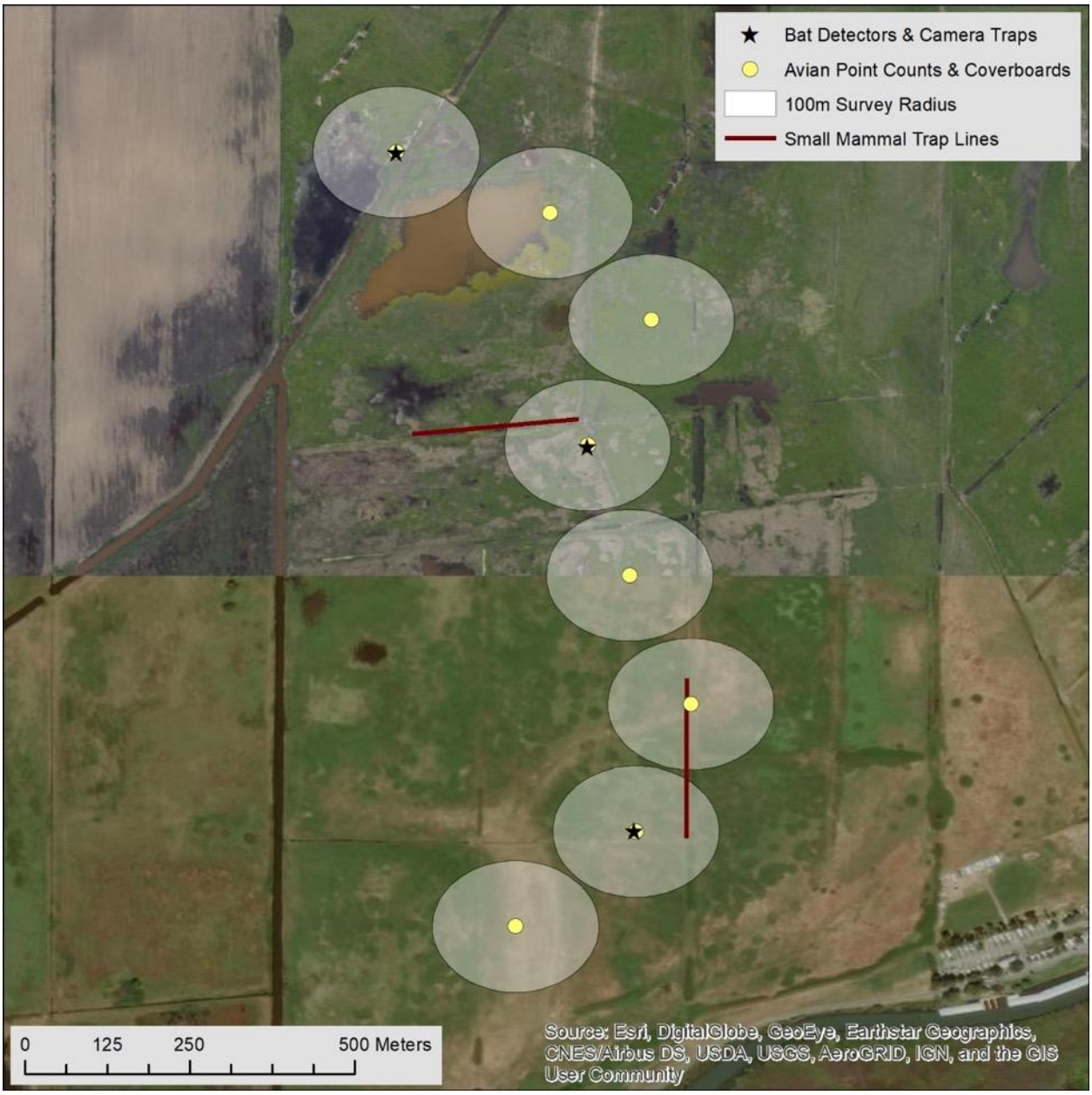

Figure A5: Detailed map of avian point count, coverboard, bat detector, camera trap, and small mammal trap line locations across the Whale's Belly regions of the Sherman Island Macrosite.

Figure A6: Detailed map of avian point count, coverboard, bat detector, camera trap, and small mammal trap line locations across the Dutch Slough Macrosite.

Appendix B: Summary of Survey Sites

Macrosite	Microsite	Site Code	Habitat Type	Restoration	# Point Count Stations	# Coverboards	# of Sherman Traps	# of Bat Acoustic Monitors	# of Camera Traps
Cosumnes River Preserve	Tall Forest	CRTF	Riparian Forest	Y	5	10	50	2	2
	Accidental/Intentional Forest	CRAF	Riparian Forest	Y	5	10	50	2	2
Grizzly Slough	Phase 1	GSPO	Riparian Forest	Y	4	8	50	2	2
	Phase 2	GSPW	Riparian Forest	Y	5	10	50	2	2
	Phase 3	GSPT	Agriculture/Pasture	N	4	8	50	2	2
	Agriculture	GSWA	Agriculture/Pasture	N	5	10	50	2	2
McCormack-Williamson	Ring Levee	MWTR	Agriculture/Pasture	N	5	10	50	2	2
	Riparian West	MWTW	Riparian Forest	Y	5	10	50	2	2
	Floodplain North	MWTN	Agriculture/Pasture	N	5	10	50	2	2
	Riparian East	MWTE	Riparian Forest	Y	5	10	50	2	2
Twitchell Island	TIMES	TWTM	Agriculture/Pasture	N	5	5	50	2	2
	East & West Pocket	TWPK	Riparian Forest	Y	2	4	50	2	2
	TW Setback	TWSB	Riparian Forest	Y	4	8	50	2	2
	TW Setback Reference	TWSR	Agriculture/Pasture	N	4	8	50	2	2
	East End Wetland North	TWEN	Freshwater Marsh	Y	5	10	50	2	2
	East End Wetland South	TWES	Freshwater Marsh	Y	5	10	50	2	2
	Meadow & Canal	TWMC	Riparian Forest	Y	6	12	50	2	2
	Fish Friendly Levee	TWFL	Agriculture/Pasture	N	4	8	50	2	2
Sherman Island	Mayberry Farm	SHMF	Freshwater Marsh	Y	5	10	50	2	2
	Parcel 11	SHPE	Riparian Forest	Y	2	4	50	2	2
	Parcel 11 Extension	SHPX	Agriculture/Pasture	N	2	2	50	2	2
	Whale's Belly Phase C North	SHWB	Agriculture/Pasture	N	4	4	50	2	2
	Whale's Belly Phase C South	SHWB	Agriculture/Pasture	N	4	4	50	1	1
	Whale's Mouth West	SHWW	Freshwater Marsh	Y	5	10	50	2	2
	Whale's Mouth East	SHWE	Freshwater Marsh	Y	5	10	50	2	2
	SH Setback	SHSB	Riparian Forest	Y	4	8	50	2	2
	SH Setback Reference	SHSR	Agriculture/Pasture	N	4	8	50	2	2
	Unit 2 (Upland)	SHUT	Riparian Forest	Y	2	4	50	2	2
Dutch Slough	Emerson Marsh North	DSET	Freshwater Marsh	Y	5	10	50	2	2
	Emerson Marsh South	DSEM	Freshwater Marsh	Y	5	10	50	2	2
	Emerson Vineyard	DSEV	Mix	N	2	4	50	2	2
	Gilbert Marsh South	DSGT	Freshwater Marsh	Y	5	10	50	2	2
	Gilbert Managed Marsh	DSGM	Agriculture/Pasture	N	5	10	50	2	2
	Burroughs Riparian	DSBR	Mix	N	4	4	50	2	2
	Burroughs Pasture	DSBA	Agriculture/Pasture	N	6	6	50	2	2
				Total	**152**	**279**	**1750**	**69**	**69**

Appendix C: Small Mammal 2020 Survey Schedule

Days	Region	Site	# of Sherman Traps
Sept 8-11	Dutch Slough	Emerson Marsh North	50
		Emerson Marsh South	50
		Emerson Vineyard	50
		Total	**150**
Sept 15 - 18	Sherman Island	Whale's Mouth West	50
		Whale's Mouth East	50
		SH Setback	50
		SH Setback Reference	50
		Unit 2 (Upland)	50
		Total	**250**
Sept 22-25	Grizzly Slough	Phase 1	50
		Phase 2	50
		Phase 3	50
		Agriculture	50
	Cosumnes River Preserve	Accidental/Intentional Forest	50
		Total	**250**
Sept 29 - Oct 2	Twitchell Island	TIMES	50
		East & West Pocket	50
		TW Setback	50
		TW Setback Reference	50
		Total	**200**
Oct 5-8	Dutch Slough	Gilbert Marsh South	50
		Gilbert Managed Marsh	50
		Burroughs Riparian	50
		Burroughs Pasture	50
		Total	**200**
Oct 13 - 16	Sherman Island	Mayberry Farm	50
		Parcel 11	50
		Parcel 11 Extension	50
		Whale's Belly Phase C North	50
		Whale's Belly Phase C South	50
		Total	**250**
Oct 20 - 23	McCormack-Williamson Tract	Floodplain North	50
		Ring Levee	50
		Riparian West	50
		Riparian East	50
	Cosumnes River Preserve	Tall Forest	50
		Total	**250**

Oct 27 - 30	Twitchell Island	East End Wetland North	50
		East End Wetland South	50
		Meadow & Canal	50
		Fish Friendly Levee	50
		Total	**200**
		Total # of Traps	**1,750**

Appendix D: Avian species identified using the habitat during our 2020 point count breeding survey (97 species in total). Macrosite locations include Cosumnes River Preserve (CR), Grizzly Slough (GS), McCormack-Williamson Tract (MW), Twitchell Island (TW), Sherman Island (SH), and Dutch Slough (DS). (I) indicates introduced species.

Family	Species		Macrosite					
	(Common Name)	(Scientific Name)	CR	GS	MW	TW	SH	DS
Anatidae	Canada Goose	*Branta canadensis*						X
	Wood Duck	*Aix sponsa*		X				
	Mallard	*Anas platyrhynchos*				X	X	X
	Gadwall	*Mareca strepera*						X
	Cinnamon Teal	*Spatula cyanoptera*						X
Odontophoridae	California Quail	*Callipepla californica*		X				
Phasianidae	Ring-necked Pheasant **(I)**	*Phasianus colchicus* **(I)**	X			X	X	X
	Wild Turkey **(I)**	*Meleagris gallopavo* **(I)**		X				
Podicipedidae	Pied-billed Grebe	*Podilymbus podiceps*					X	X
Phalacrocoracidae	Double-crested Cormorant	*Phalacrocorax auritus*				X		
Ardeidae	American Bittern	*Botaurus lentiginosus*				X	X	
	Least Bittern	*Ixobrychus exilis*					X	
	Great Blue Heron	*Ardea herodias*	X		X			
	Great Egret	*Ardea alba*		X	X		X	
	Snowy Egret	*Egretta thula*					X	X
	Green Heron	*Butorides virescens*				X		
	Black-crowned Night-Heron	*Nycticorax nycticorax*					X	
Cathartidae	Turkey Vulture	*Cathartes aura*	X				X	
Accipitridae	Northern Harrier	*Circus hudsonius*						X
	White-tailed Kite	*Elanus leucurus*		X				X
	Red-shouldered Hawk	*Buteo lineatus*	X			X		
	Swainson's Hawk	*Buteo swainsoni*			X	X		X
	Red-tailed Hawk	*Buteo jamaicensis*		X	X	X		X
Pandionidae	Osprey	*Pandion haliaetus*			X			
Rallidae	American Coot	*Fulica americana*					X	X
Charadriidae	Killdeer	*Charadrius vociferus*				X	X	
Recurvirostridae	American Avocet	*Recurvirostra americana*						X
	Black-necked Stilt	*Himantopus mexicanus*					X	X
Scolopacidae	Greater Yellowlegs	*Tringa melanoleuca*				X		
	Long-billed Curlew	*Numenius americanus*					X	

Columbidae	Mourning Dove	*Zenaida macroura*	X		X	X	X	X
	Eurasian Collared Dove **(I)**	*Streptopelia decaocto* **(I)**						
	Rock Pigeon **(I)**	*Columba livia* **(I)**				X		
Strigidae	Great Horned Owl	*Bubo virginianus*						X
Apodidae	White-throated Swift	*Aeronautes saxatalis*				X		
Trochilidae	Anna's Hummingbird	*Calypte anna*	X		X	X	X	
Alcedinidae	Belted Kingfisher	*Megaceryle alcyon*		X		X	X	
Picidae	Downy Woodpecker	*Dryobates pubescens*			X		X	
	Nuttall's Woodpecker	*Dryobates nuttallii*		X	X	X	X	
	Northern Flicker	*Colaptes auratus*	X		X			
Falconidae	American Kestrel	*Falco sparverius*						X
Tyrannidae	Western Wood-Pewee	*Contopus sordidulus*	X					X
	Pacific-slope Flycatcher	*Empidonax difficilis*	X			X	X	
	Black Phoebe	*Sayornis nigricans*		X	X	X	X	X
	Say's Phoebe	*Sayornis saya*					X	
	Ash-throated Flycatcher	*Myiarchus cinerascens*		X	X	X		X
	Western Kingbird	*Tyrannus verticalis*		X	X			X
Vireonidae	Warbling Vireo	*Vireo gilvus*	X	X	X	X		
	Hutton's Vireo	*Vireo huttoni*	X	X				
Corvidae	California Scrub-Jay	*Aphelocoma californica*		X		X		
	American Crow	*Corvus brachyrhynchos*		X		X	X	
Alaudidae	Horned Lark	*Eremophila alpestris*					X	
Hirundinidae	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*				X		X
	Tree Swallow	*Tachycineta bicolor*	X	X	X	X	X	X
	Cliff Swallow	*Petrochelidon pyrrhonota*		X	X	X	X	X
	Barn Swallow	*Hirundo rustica*			X	X	X	X
Paridae	Oak Titmouse	*Baeolophus inornatus*	X	X				
Aegithalidae	Bushtit	*Psaltriparus minimus*		X	X	X	X	
Sittidae	White-breasted Nuthatch	*Sitta carolinensis*						
Troglodytidae	Bewick's Wren	*Thryomanes bewickii*	X	X		X		
	House Wren	*Troglodytes aedon*						X
	Marsh Wren	*Cistothorus palustris*				X	X	X
Sylviidae	Wrentit	*Chamaea fasciata*			X	X		
Regulidae	Golden-crowned Kinglet	*Regulus satrapa*				X		
Polioptilidae	Blue-gray Gnatcatcher	*Polioptila caerulea*	X					
Turdidae	Western Bluebird	*Sialia mexicana*		X	X			
	American Robin	*Turdus migratorius*		X	X	X		X
	Swainson's Thrush	*Catharus ustulatus*	X			X		

Mimidae	Northern Mockingbird	*Mimus polyglottos*				X	X	X
Sturnidae	European Starling **(I)**	*Sturnus vulgaris* **(I)**	X	X	X	X		X
Parulidae	Yellow Warbler	*Setophaga petechia*				X		
	Common Yellowthroat	*Geothlypis trichas*		X	X	X	X	X
	Wilson's Warbler	*Cardellina pusilla*			X	X	X	
	Hooded Warbler	*Setophaga citrina*	X					
Cardinalidae	Black-headed Grosbeak	*Pheucticus melanocephalus*		X	X	X		
	Blue Grosbeak	*Passerina caerulea*				X		X
	Lazuli Bunting	*Passerina amoena*		X	X		X	
Passerellidae	Spotted Towhee	*Pipilo maculatus*			X	X	X	
	California Towhee	*Melozone crissalis*	X	X				X
	Savannah Sparrow	*Passerculus sandwichensis*				X	X	X
	Song Sparrow	*Melospiza melodia*	X	X			X	X
Icteridae	Western Meadowlark	*Sturnella neglecta*				X		X
	Brown-headed Cowbird	*Molothrus ater*		X		X	X	X
	Tricolored Blackbird	*Agelaius tricolor*				X		
	Red-winged Blackbird	*Agelaius phoeniceus*			X	X	X	
	Brewer's Blackbird	*Euphagus cyanocephalus*				X	X	X
	Great-tailed Grackle	*Quiscalus mexicanus*					X	X
	Bullock's Oriole	*Icterus bullockii*	X	X	X	X		X
Fringillidae	House Finch	*Haemorhous mexicanus*	X	X	X	X	X	X
	Lesser Goldfinch	*Spinus psaltria*	X	X	X	X	X	
	American Goldfinch	*Spinus tristis*	X	X	X	X	X	X
Passeridae	House Sparrow **(I)**	*Passer domesticus* **(I)**			X			X

Appendix E: Insect species identified to date from survey samples taken during our 2020 survey of the Delta. Macrosites include Dutch Slough (1), Sherman Island (2), Twitchell Island (3), McCormack-Williamson Tract (4). (I) indicates introduced species.

Order	Family	Genus species	Macrosite			
			1	2	3	4
Blattodea (cockroaches)	Corydiidae	1. *Arenivaga sequoia* Hopkins	X			
	Ectobiidae	2. *Luridiblatta trivittata* Serville **(I)**	X			
Coleoptera (beetles)	Anthicidae	*3. Cyclodinus* sp.		X		
	Buprestidae	*4. Agrilus politus* Say			X	
		5. Poecilonota californica Chamberlin				X
		6. Hyperaspis quadrioculata (Motchusky)				X
	Coccinellidae	*7. Psyllobora vigintimaculata* (Say)			X	
		8. Scymnus loewii Mulsant			X	
	Mordellidae	*9. Mordellistena* sp.		X		
	Laemophloeidae	10. *Cryptolestes* sp.			X	
	Ptinidae	*11. Ozoganthus cornutus* (LeConte)		X		
	Silphidae	*12. Heterosilpha ramosa*	X			
	Rhipiphoridae	*13. Rhipiphorus mutchleri*	X			
Dermaptera (earwigs)	Anisolabididae	*14. Euborellia cincticollis* **(I)**				X
	Forficulidae	*15. Forficula auricularia* **(I)**	X	X	X	X
Diptera (flies)	Calliphoridae	*16. Phormia regina* Meigen			X	
	Conopidae	*17. Physocephala texana* (Williston)	X			
		18. Thecophora propinqua (Adams)	X	X		X
		19. Zodion obliquefasciatum (Macquart)	X			
	Empididae	*20.*			X	
	Muscidae	*21.*			X	
	Mythicomyiidae	*22. Mythicomyia* sp.			X	
	Pollenidae	*23. Pollenia* sp.			X	
	Scatopsidae	*24. Rhegmoclema* sp.		X		
	Syrphidae	*25. Anasimyia* sp.				
		26. Eupeodes latifasciatus (Macquart) **(I)?**				
		27. Eupeodes volucris Osten Sacken	X			
		28. Ferdinandea buccata (Osten Sacken)			X	
		29. Helophilus fasciatus Walker				
		30. Helophilus latifrons Loew	X	X	X	
		31. Paragus haemorrhous Meigen **(I)?**				X
		32. Platycheirus immarginatus (Zetterstedt)	X		X	
		33. Pseudodoros clavatus (Fabricius)	X			
		34. Sphaerophoria pyrrhina Bigot			X	X
		35. Toxomerus marginatus (Say)				
		36. Tropidia quadrata Say				
Hemiptera (true bugs, plant bugs	Berytidae	*37. Hoplinus echinatus* (Uhler)	X			
		38. Jalysus wickhami Van Duzee	X		X	

	Cicadellidae	*39. Draecocephala minerva* (Ball)	X		X	X
	Cixiidae	*40. Cixius* sp.	X	X	X	X
		41. Melanoliarus or Reptalis sp.	X			
Hymenoptera (wasps, bees)	Andrenidae	*42. Sp.*	X	X	X	
	Aphelinidae	*43. Aphelinus semiflavus* (Dalman)			X	
		44. Aphelinus sp.			X	
		45. Centrodora sp.				X
		46. Coccophagus sp.			X	
	Apidae	*47. Apis mellifera* Linnaeus **(I)**	X	X	X	X
		48. Bombus fervidus (Fabricius)		x		
		49. Bombus vosnesenskii Rad.		x		x
		50. Bombus sp.	X			
		51. Ceratina sp.	X	X	X	
		52. Xylocopa sonorina Smith			X	
	Bethylidae	53. Sp.	X		X	
	Braconidae	54. Sp.			X	
	Cephidae	55. Sp.	X			
	Ceraphronidae	56. *Aphanogmus* sp.			X	
		57. *Ceraphron* sp.			X	
	Chalcididae	58. *Brachymeria ovata* (Say)		X		
		59. *Brachymeria* sp.			X	
		60. *Conura torvina* (Cresson)	X			
		61. *Conura* sp.	X			
		62. *Haltichella xanticles* (Walker)	X			
		63. *Hockeria* sp.	X			
		64. *Psilochalcis* sp.		X		
		65. Sp.		X	X	
	Chrysididae	66. *Caenochrysis doriae* (Gribodo)	X		X	
		67. *Chrysura pacifica* (Say)	X			
		68. *Chrysura* sp.	X			
		69. *Hedychridium coruscum* Bohart	X			
		70. *Hedychridium solierellae* Bohart & Brumley	X			
		71. *Philoctetes granti* Bohart & Campos	X			
		72. Sp.			X	
	Colletidae	73. *Hylaeus* sp.	X		X	
		74. Sp.	X			
	Crabronidae	75. *Bembix americana* Fabricius	X			
		76. *Bembix occidentalis* Fox				
		77. *Bembix amoena* Handlirsch	X			
		78. *Bicyrtes ventralis* (Say)	X			
		79. *Cerceris bicornuta* Guerin	X			
		80. *Cerceris nigrescens* F. Smith	X		X	
		81. *Clypeadon californicus* Bohart	X			
		82. *Microbembex californica* Bohart	X			
		83. *Oxybelus* sp.	X			
		84. *Philanthus pacificus* Cresson	X			
		85. *Philanthus ventilabris* Fabricius	X			
		86. *Spilomena foxii* Cockerell			X	
		87. *Steniolia duplicata* Provancher	X			

		88. sp.	X		X	
	Cynipidae	89. *Synergus confertus* McCracken & Egbert				X
	Dryinidae	90. sp.			X	
	Encyrtidae	91. *Acerophagus* sp. 1			X	
		92. *Acerophagus* sp. 2			X	
		93. *Acerophagus* sp. 3			X	
		94. *Bothriothorax* sp.		X		
		95. *Cheiloneurus flaccus* (Walker)	X			
		96. *Cheiloneurus* sp. 1	X			
		97. *Cheiloneurus* sp. 2			X	
		98. *Cheiloneurus* sp. 3			X	
		99. *Copidosoma* sp.	X		X	
		100. *Echthroplexis planiformis* (Howard)		X		
		101. *Ericydnus* sp.		X		
		102. *Helegonatopus* sp.			X	
		103. *Homalotylus terminalis* (Say)	X			
		104. *Homalotylus* sp.			X	
		105. *Microterys flavus* (Howard)			X	
		106. *Ooencyrtus anasae* (Ashmead)	X			
		107. *Procheiloneurus* sp.			X	
		108. *Psyllaephagus* sp.	X			
		109. *Rhopus* sp.			X	
		110. Sp.		X		
	Eulophidae	111. *Aprostocetus* sp.1	X			
		112. *Aprostocetus* sp.2			X	
		113. *Aprostocetus burksi* LaSalle				X
		114. *Aprostocetus* nr. *venustus*				X
		115. *Aprostocetus pattersonae* (Fullaway)				X
		116. *Aprostocetus* sp. 1			X	X
		117. *Aprostocetus* sp. 2			X	
		118. *Aprostocetus* sp. 3				X
		119. *Asecodes* sp.			X	
		120. *Baryscapus* sp.				X
		121. *Ceranisus menes* (Walker)			X	X
		122. *Chrysocharis ainsliei* Crawford			X	
		123. *Chrysocharis prodice* (Walker)			X	
		124. *Chrysocharis* sp.				X
		125. *Clostocerus* sp.				X
		126. *Diaulinopsis* sp.			X	
		127. *Elasmus* sp.		X		
		128. *Euderomphale flavimedia* (Howard)	X			
		129. Euderus nr. *solidaginis*			X	
		130. Euplectrus sp.				X
		131. Hemiptarsenus sp.			X	
		132. Horismenus texanus Girault	X	X		
		133. Neochrysocharis sp.			X	X
		134. Neotrichoporoides viridimaculatus (Fullaway)			X	
		135. *Pediobius* sp. 1			X	
		136. *Pediobius* sp. 2			X	

		137.*Pediobius* sp. 3			X	
		138.*Pediobius* sp.			X	
		139.Pnigalio boharti Yoshimoto			X	
		140.Sympiesis bimaculatipennis (Girault)			X	
		141.Sympiesis nr. *conicus*			x	
		142.Tamarixia triozae (Burks)		X		X
		143.Zagrammosoma n.sp.				X
	Eupelmidae	*144.Arachnophaga eucnemia* Gibson			X	
		145.Brasema sp.			X	X
		146.Calosota metallica (Gahan)			X	X
		147.Eupelmus cyaniceps Ashmead		X	X	X
		148.Eupelmus vesicularis (Retzius)			X	
	Eurytomidae	*149.Brucophagus* sp.			X	
		150.*Eurytoma* sp. 2			X	
		151.*Eurytoma* sp.1			X	
		152.Sycophila sp.		X		X
		153.Tenuipetiolus n.sp.	X			
		154.Tetramesa sp.			X	
	Figitidae	*155.Alloxysta megourae* (Ashmead)			X	
		156.*Anacharis* sp.			X	
		157.*Gronotoma* sp.			X	
		158.*Kleidotoma* sp.			X	
		159.*Lonchidia* sp.			X	
		160.*Melanips bilineatus* (Kieffer)			X	
		161.*Alloxysta megourae* (Ashmead)				X
		162.Alloxysta xanthopsis (Ashmead)		X		
		163.*Anacharis* sp.	X	X	X	X
		164.*Kleidotoma* sp.				X
		165.*Melanips bilineatus* (Kieffer)		X	X	X
		166.*Xyalophoroides quinquelineata* (Say)	X			
	Gasteruptiidae	167.sp.			X	
	Halictidae	168.*Agapostemon* sp.	X	X	X	
		169.sp.	X	X	X	
	Ichneumonidae	170.sp.	X			
	Leucospidae	171.*Leucospis affinis* Say	X			
	Megachilidae	172.*Osmia* sp.	X	X	X	
	Megaspilidae	173.*Conostigmus* sp.			X	
		174.*Dendrocerus* sp.			X	
		175.*Trichosteresis glabra* (Boheman)			X	
		176.*Trichosteresis* sp.			X	
	Mutillidae	177.*Dasymutilla* sp.	X			
		178.Sp.	X			
	Mymaridae	179.*Anagrus* sp. 1			X	
		180.*Anagrus* sp. 2			X	
		181.Anaphes sp.			x	
		182.*Dicopomorpha* sp.			x	
		183.*Gonatocerus* sp. 1	X		X	
		184.*Gonatocerus* sp. 2			x	
		185.*Polynema* sp. 1	X		X	
		186.*Polynema* sp. 2	X		X	

		187.*Polynema* sp. 3	X			
		188.*Polynema* sp. 4			X	
		189.Stethynium sp.			X	
	Ormyridae	190.*Ormyrus distinctus* Fullaway				X
	Platygastridae	191.*Calliscelio rubriclavus* (Ashmead)	X			
		192.*Calliscelio* sp.	X		X	
		193.*Telenomus* sp. 1			X	
		194.*Telenomus* sp. 2			X	
		195.Trissolcus hullensis (Harrington)			X	
		196.Trissolcus sp.	X		X	X
	Pompilidae	197.*Ageniella blaisdelli* (Fox)				X
		198.*Ageniella euphorbiae* (Viereck)	X			X
		199.*Anoplius imbellis* Banks	X			
		200.*Anoplius toluca* (Cameron)			X	
		201.*Arachnospila apicatus* (Provancher)	X			
		202.*Auplopus architectus metallicus* (Banks)	X		X	
		203.*Cryptocheilus hesperus* (Banks)	X		X	X
		204.*Episyron quinquenotatus hurdi* Evans	X		X	
		205.*Evagetes padrinus padrinus* (Viereck)	X			
		206.*Poecilopompilus interruptus* (Say)	X			
		207.*Poecilopompilus interruptus semiflavus* Evans			X	
		208.*Priocnemis notha navajo* Banks			X	
		209.*Sericopompilus neotropicalis* (Cameron)	X			
	Proctotrupidae	210.*Exallonyx* nr. *trifoveolatus*			X	
	Pteromalidae	211.*Amphidocius schickae* Heydon & Boucek				X
		212.*Arthrolytus* sp.		X	X	
		213.*Asaphes suspensus* Nees	X	X	X	
		214.*Callitula bicolor* Spinola			X	
		215.*Callocleonymus* n.sp.	X		X	
		216.*Catolaccus* n.sp.			X	
		217.*Chlorocytus* sp.			X	
		218.*Cleonymus eucalifornicus* sp.	X	X	X	
		219.*Cyrtogaster trypherus* (Walker)	X	X	X	
		220.*Cyrtogaster vulgaris* Walker **(I)**			X	
		221.*Dibrachoides dynastes* (Forster)		X		
		222.*Eurydinoteloides* sp.		X		
		223.*Habritys* sp.	X			
		224.*Halticoptera* sp.	X			
		225.*Heteroschema* sp.		X	X	
		226.*Homoporus chalcidiphagus* (Walsh & Riley)			X	
		227.*Homoporus febricolosus* (Girault)			X	
		228.*Homoporus* sp.		X		
		229.*Jaliscoa hunteri* (Crawford)		X		
		230.*Lyrcus* sp.	X			
		231.*Lysirina polychroma* Heydon	X			
		232.*Mesopolobus* sp. 1		X		
		233.*Mesopolobus* sp. 2		X		

		234.*Mesopolobus justicia* (Girault)		X		
		235.*Mesopolobus* sp.			X	
		236.*Metastenus townsendi* Ashmead			X	
		237.*Neocatolaccus* sp.	X		X	
		238.*Nepachyneuron eros* (Girault)		X		
		239.*Nepachyneuron* sp.				X
		240.*Norbanus* sp.	X			
		241.*Pachyneuron albutius* Walker	X	X	X	
		242.*Pachyneuron* n.sp. 1			X	
		243.*Pachyneuron* n.sp. 2				X
		244.*Pachyneuron* n.sp. nr. *planiscuta*		X		
		245.*Psilocera* sp.			X	
		246.*Pteromalus* sp.	X	X	X	
		247.*Syntomopus americanus* Ashmead		X	X	
		248.*Thinodytes caroticus* Heydon	X		X	
		249.*Trichomalopsis americanus* (Gahan)			X	
		250.*Trichomalopsis* nr. *dubia*			X	
		251.*Trichomalopsis* sp. 1			X	
		252.*Trichomalopsis viridiscens* (Walsh)			X	
		253.*Trichomalus* sp.	X		X	
		254.Trimeromicrus maculatus Gahan			X	X
		255.*Tritneptis* sp.				X
	Scelionidae	256.*Calliscelio rubriclavus* (Ashmead)		X	X	X
		257.*Calliscelio* sp.			X	
		258.*Idris* sp.	X	X	X	
		259.*Telenomus* sp.	X			
	Scoliidae	260.*Dielis tolteca* (Saussure)	X			
	Sphecidae	261.*Ammophila* sp.	X			
		262.*Chalybion* sp.			X	
		263.*Chlorion* sp.	X			
		264.*Isodontia* sp.				
		265.*Spex* sp.	X			
	Tenthredinidae	266.Sp.	X			
	Torymidae	267.*Diomorus zabriskii* Cresson	X		X	
		268.*Ditropinotus aureoviridis* Crawford			X	
		269.*Eridontomerus isosomatis* (Riley)		X	X	
		270.*Megastigmus* sp.	X			X
		271.*Pseudotorymus* sp.				X
		272.*Torymus thalassinus* (Crosby) **(I)?**			X	
		273.*Torymus* sp.	X			
	Trichogrammatidae	274.*Aphelinoidea turanica* Trjapitzin			X	
		275.*Trichogramma* sp.			X	
		276.*Tumidiclava* sp.			X	
		277.*Ufens* sp.			X	
		278.Sp.			X	
	Vespidae	279.*Euodynerus* sp. 1	X		X	
		280.*Euodynerus* sp. 2	X			
		281.*Eumenes crucifera* Provancher	X		X	
		282.*Mischocyttarus flavitarsis* (Saussure)			X	
		283.Polistes apachus Saussure	X			

		284.*Polistes aurifer* Saussure	X		X	
		285.*Polistes dominula* (Christ) **(I)**	X		X	
		286.*Stenodynerus* sp.	X		X	
		287.*Vespula atropilosa* (Sladen)		X		
		288.*Vespula germanica* (Fabricius) **(I)**		X		
		289.*Vespula pensylvanica* Saussure				X
Lepidoptera (butterflies, moths)	Crambidae	290.*Diastictis fracturalis* (Zeller)	X			X
		291.*Dicymolomia metalliferalis* (Packard)	X	X		
		292.*Euchromius ocellea* (Haworth)				X
		293.*Udea profundalis* (Packard)		X		
	Depressariidae	294.*Agonopterix alstroemeriana* (Clerck) **(I)**	X			X
	Erebidae	295.*Melipotis jucunda* (Hubner)			X	
		296.*Tetanolita palligera* (Smith)		X		X
		297.*Zale lunata* (Drury)			X	
		298.*Zale termina* (Grote)				X
	Gelechiidae	299.*Aristotelia elegantella* (Chambers)				X
		300.*Chionodes powelli* Hodges				X
		301.*Macaria lorquinaria* (Guenee)		X		
		302.*Pero morrisonaria* (Edwards)		X		
	Hesperiidae	303.*Hylephila phyleus* (Drury)		X		
		304.*Lerodea eufala* (Edwards)		X		
		305.*Ochlodes sylvanoides* (Boisduval)	X	X		
		306.*Pholisora catullus* (Fabricius)	X			
		307.*Polites sabuleti* (Boisduval)	X	X	X	
	Noctuidae	308.*Amphopoea lunata* (Smith)		X		
		309.*Anhimella pacifica* McDunnough		X	X	
		310.*Apamea cuculliformis* (Grote)		X		
		311.*Apamea devastator* (Brace) **(I)**		X		
		312.*Autographa californica* (Speyer)		X		
		313.*Caradrina meralis* Morrison			X	
		314.*Caradrina montana* Bremer		X	X	X
		315.*Dargida procinctus* (Grote)	X	X		
		316.*Globia oblonga* (Grote)	X	X		
		317.*Heliothis phloxiphaga* Grote & Robinson	X			
		318.Hemieuxoa rudens (Harvey)		X		
		319.*Leucania farcta* (Grote)			X	
		320.*Mythimna oxygalea* (Grote)		X		
		321.*Mythimna unipuncta* (Haworth)	X	X	X	
		322.*Noctua pronuba* (Linnaeus) **(I)**	X		X	
		323.*Peridroma saucia* (Hubner) **(I)?**	X	X		
		324.*Protorthodes* sp.				X
		325.*Proxinus miranda* (Grote)		X		
	Papilionidae	*326.Papilio rutulus* Lucas				X
	Pieridae	327.*Pieris rapae* (Linnaeus) **(I)**	X			
	Plutellidae	328.*Plutella xylostella* (Linnaeus) **(I)**		X		X
	Pyralidae	329.*Hellinsia grandis* (Fish)		X		
	Sphingidae	330.*Ephestiodes gilvescentella* Ragonot				X
		331.*Hyles lineata* (Fabricius)	X			
		332.*Pachysphinx occidentalis* (Edwards)				X

	Tortricidae	333.*Bactra verutana* Zeller		X		
		334.*Clepsis peritana* (Clemens)		X		X
		335.*Epinotia kasloana* McDonnough		X		
Mantodea	Mantidae	336.*Mantis religiosa* (Linnaeus) **(I)**		X		

Appendix F: Plant species identified to date from survey samples taken during our 2020 survey of the Delta. (I) indicates introduced species. Habit includes annual grass (AG), perennial grass (PG), annual herbaceous (AH), perennial herbaceous (PH), shrub (S) and tree (T).

Family	Common name	Scientific Name	Habit
Adoxaceae	Blue elderberry	Sambucus nigra ssp. caerulea	S
Alismataceae	Water plantain	Alisma triviale	PH
Amaranthaceae	Alligator weed	Alternanthera philoxeriodes (I)	PH
Amaranthaceae	Tumbleweed	Amaranthus albus (I)	AH
Amaranthaceae	Rough pigweed	Amaranthus retroflexus (I)	AH
Anacardiaceae	Poison oak	Toxicodendron diversilobum	S
Apiaceae	Poison hemlock	Conium maculatum (I)	PH
Apiaceae	Coyote thistle	Eryngium articulatum	AH
Apiaceae	Fennel	Foeniculum vulgare (I)	PH
Apiaceae	Hedge parsley	Torilis arvensis (I)	AH
Araliaceae	Marsh pennywort	Hydrocotyle ranunculoides	PH
Asteraceae	Yarrow	Achillea millefolium	PH
Asteraceae	Western ragweed	Ambrosia psilostachya	PH
Asteraceae	Dog fennel	Anthemis cotula (I)	AH
Asteraceae	Mugwort	Artemisia douglasiana	PH
Asteraceae	Marsh baccharis	Baccharis glutinosa	PH
Asteraceae	Coyote bush	Baccharis pilularis	S
Asteraceae	Mule fat	Baccharis salicifolia	S
Asteraceae	Sticktight	Bidens frondosa	AH
Asteraceae	Bur-marigold	Bidens laevis	PH
Asteraceae	Italian thistle	Carduus pycnocephalus (I)	AH
Asteraceae	Purple star thistle	Centaurea calcitrapa (I)	AH
Asteraceae	Tocalote	Centaurea melitensis (I)	AH
Asteraceae	Common spikeweed	Centromadia pungens	AH
Asteraceae	Yellow star thistle	Centaurea solstitialis (I)	AH
Asteraceae	Chicory	Cichorium intybus (I)	PH
Asteraceae	Bull thistle	Cirsium vulgare (I)	AH
Asteraceae	Brass buttons	Cotula coronopifolia (I)	PH
Asteraceae	Cardoon	Cynara cardunculus ssp. flavescens (I)	PH
Asteraceae	Stinkwort	Dittrichia graveolens (I)	AH
Asteraceae	Flax-leaved horseweed	Erigeron bonariensis (I)	AH
Asteraceae	Horseweed	Erigeron canadensis	AH
Asteraceae	Western goldenrod	Euthamia occidentalis	PH
Asteraceae	Valley gumplant	Grindelia camporum	PH

Asteraceae	Sunflower	Helianthus annuus	AH
Asteraceae	Bristley ox-tongue	Helminthotheca echioides (I)	AH
Asteraceae	Hayfield tarweed	Hemizonia congesta	AH
Asteraceae	Telegraph weed	Heterotheca grandiflora	AH
Asteraceae	Smooth cat's ear	Hypochaeris glabra (I)	AH
Asteraceae	Narrow-leaved lettuce	Lactuca saligna (I)	AH
Asteraceae	Prickly lettuce	Lactuca serriola (I)	AH
Asteraceae	Pineapple weed	Matricaria discoidea (I)	AH
Asteraceae	Saltmarsh fleabane	Pluchea odorata v. odorata	PH
Asteraceae	Everlasting	Pseudognaphalium luteoalbum (I)	AH
Asteraceae	Milk thistle	Silybum marianum (I)	AH
Asteraceae	Prickly sow thistle	Sonchus asper (I)	AH
Asteraceae	Common sow thistle	Sonchus oleraceus (I)	AH
Asteraceae	Suisun Marsh aster	Symphyotrichum lentum	PH
Asteraceae	Annual saltmarsh aster	Symphyotrichum subulatum	AH
Asteraceae	Dandelion	Taraxacum officinale (I)	AH
Asteraceae	Spiny cocklebur	Xanthium spinosum	AH
Asteraceae	Cocklebur	Xanthium strumarium	AH
Betulaceae	White alder	Alnus rhombifolia	T
Boraginaceae	Fiddleneck	Amsinckia menziesii	AH
Boraginaceae	Alkali heliotrope	Heliotropium curassavicum var. oculatum	PH
Brassicaceae	Black mustard	Brassica nigra (I)	AH
Brassicaceae	Field mustard	Brassica rapa (I)	AH
Brassicaceae	Shepard's purse	Capsella bursa-pastoris (I)	AH
Brassicaceae	Lesser swine cress	Lepidium didymum (I)	AH
Brassicaceae	Pepperweed	Lepidium latifolium (I)	PH
Brassicaceae	Wild radish	Raphanus sativus (I)	AH
Brassicaceae	Jointed charlock	Raphanus raphanistrum (I)	AH
Brassicaceae	Yellow watercress	Rorippa curvisiliqua	AH
Caryophyllaceae	Hairy sand spurrey	Spergularia villosa (I)	PH
Chenopodiaceae	Spear oracle	Atriplex patula	AH
Chenopodiaceae	Fat hen	Atriplex prostrata (I)	AH
Chenopodiaceae	Australian saltbush	Atriplex semibaccata (I)	PH
Chenopodiaceae	Five-hook bassia	Bassia hyssopifolia (I)	AH
Chenopodiaceae	Lambs quarters	Chenopodium album	AH
Chenopodiaceae	Mexican tea	Dysphania ambrosioides (I)	AH
Chenopodiaceae	Pickleweed	Salicornia pacifica	SS
Chenopodiaceae	Tumbleweed	Salsola tragus (I)	AH
Convolulaceae	Marsh morning glory	Calystegia sepium ssp. limnophila	PH
Convolulaceae	Bindweed	Convolulus arvensis (I)	PH
Cyperaceae	River bulrush	Bolboschoenus fluviatilis	PH

Cyperaceae	Alkali bulrush	Bolboschoenus maritimus ssp. paludosus	PH
Cyperaceae	Seacoast bulrush	Bolboschoenus robustus	PH
Cyperaceae	Barbara sedge	Carex barbarae	PH
Cyperaceae	Foothill sedge	Carex tumulicola	PH
Cyperaceae	Umbrella grass	Cyperus eragrostis	PH
Cyperaceae	Spike rush	Eleocharis macrostachya	PH
Cyperaceae	Common tule	Schoenoplectus acutus v. occidentalis	PH
Cyperaceae	California bulrush	Schoenoplectus californicus	PH
Dipsacaceae	Teasel	Dipsacus sativus (I)	AH
Euphorbiaceae	Thyme-leaved spurge	Chamaesyce serpillifolia	AH
Fabaceae	Spanish clover	Acmispon americanus var. americanus	AH
Fabaceae	Tule pea	Lathyrus jepsonii v. californicus	PH
Fabaceae	Bird's foot trefoil	Lotus corniculatus (I)	AH
Fabaceae	Miniature lupine	Lupinus bicolor	AH
Fabaceae	Burclover	Medicago minima (I)	AH
Fabaceae	California burclover	Medicago polymorpha (I)	AH
Fabaceae	Alfalfa	Medicago sativa (I)	PH
Fabaceae	White sweet clover	Melilotus albus (I)	AH
Fabaceae	Sour clover	Melilotus indicus (I)	AH
Fabaceae	Black locust	Robinia pseudoacacia (I)	T
Fabaceae	Scarlet sesban	Sesbania punicea (I)	S
Fabaceae	Strawberry clover	Trifolium fragiferum (I)	PH
Fabaceae	Rose clover	Trifolium hirtum (I)	AH
Fabaceae	White clover	Trifolium repens (I)	PH
Fagaceae	Live oak	Quercus agrifolia	T
Fagaceae	Valley oak	Quercus lobata	T
Geraniaceae	Filaree	Erodium cicutarium (I)	AH
Geraniaceae	Greenstem filaree	Erodium moschatum (I)	AH
Iridaceae	Flag iris	Iris pseudacorus (I)	PH
Juglandaceae	Black walnut	Juglans hindsii	T
Juncaceae	Common rush	Juncus effusus	PH
Juncaceae	Iris-leaved rush	Juncus xiphioides	PH
Lamiaceae	Pennyroyal	Mentha pulegium (I)	AH
Lamiaceae	Whitestem hedgenettle	Stachys albens	PH
Lamiaceae	Rigid hedgenettle	Stachys rigida	PH
Malvaceae	Velvet leaf	Abutilon theophrasti (I)	AH
Malvaceae	Alkali mallow	Malvella leprosa	AH
Malvaceae	Cheeseweed	Malva parviflora (I)	AH
Oleaceae	Oregon ash	Fraxinus latifolia	T
Onagraceae	Willow herb	Epilobium brachycarpum	AH
Onagraceae	Willow herb	Epilobium campestre	AH

Onagraceae	Fringed willowherb	Epilobium ciliatum	PH
Onagraceae	Floating water primrose	Ludwigia peploides (I)	PH
Onagraceae	Antioch dunes evening primrose	Oenothera deltoides ssp. howellii	PH
Onagraceae	Evening primrose	Oenothera elata ssp. hookeri	BH
Papaveraceae	California poppy	Eschscholzia californica	PH
Phyrmaceae	Seep monkeyflower	Eryanthe guttata	AH
Plantaginaceae	Sharp-leaved fluellin	Kicksia elatine (I)	AH
Plantaginaceae	English plantain	Plantago lanceolata (I)	PH
Plantaginaceae	Broad-leaved plantain	Plantago major (I)	AH
Platanaceae	Sycamore	Platanus racemosa	T
Poaceae	Spike bentgrass	Agrostis exarata	PG
Poaceae	Silver hairgrass	Aira caryophylla (I)	AG
Poaceae	Slender wild oat	Avena barbata (I)	AG
Poaceae	Wild oat	Avena fatua (I)	AG
Poaceae	California brome	Bromus carinatus	PG
Poaceae	Rescue grass	Bromus catharticus (I)	PG
Poaceae	Ripgut brome	Bromus diandrus (I)	AG
Poaceae	Soft chess	Bromus hordeaceus (I)	AG
Poaceae	Red brome	Bromus rubens (I)	AG
Poaceae	Swamp grass	Crypsis schoenoides (I)	AG
Poaceae	Bermuda grass	Cynodon dactylon (I)	PG
Poaceae	Barnyard grass	Echinochloa crus-galli (I)	PG
Poaceae	Medusa head	Elymus caputmedusae (I)	AG
Poaceae	Blue wild rye	Elymus glaucus	PG
Poaceae	Tall wheatgrass	Elymus ponticus (I)	PG
Poaceae	Creeping wild rye	Elymus triticoides	PG
Poaceae	Tall fescue	Festuca arundinacea (I)	PG
Poaceae	Rattail fescue	Festuca myuros (I)	AG
Poaceae	Rye grass	Festuca perennis (I)	AG
Poaceae	Meadow barley	Hordeum brachyantherum	PG
Poaceae	Mediterranean barley	Hordeum marinum ssp. gussoneanum (I)	AG
Poaceae	Foxtail	Hordeum murinum (I)	AG
Poaceae	Witchgrass	Panicum capillare	AG
Poaceae	Dallis grass	Paspalum dilatatum (I)	PG
Poaceae	Littleseed canary grass	Phalaris minor (I)	AG
Poaceae	Canary grass	Phalaris paradoxa (I)	AG
Poaceae	Common reed	Phragmites australis	PG
Poaceae	Rabbit's foot grass	Polypogon monspeliensis (I)	AG
Poaceae	Bristley foxtail	Setaria viridis (I)	AG
Poaceae	Johnson grassl	Sorghum halapense (I)	PG
Poaceae	Smutgrass	Sporobolus indicus (I)	PG

Polygonaceae	Water smartweed	Persicaria amphibia	PH
Polygonaceae	False waterpepper	Persicaria hydropiperoides	PH
Polygonaceae	Common smartweed	Persicaria lapathifolia	AH
Polygonaceae	Spotted lady's thumb	Persicaria maculosa (I)	AH
Polygonaceae	Prostrate knotweed	Polygonum arenastrum (I)	AH
Polygonaceae	Clustered dock	Rumex conglomeratus (I)	PH
Polygonaceae	Curly dock	Rumex crispus (I)	PH
Polygonaceae	Willow-leaved dock	Rumex salicifolius	PH
Pontederiaceae	Water hyacinth	Eichhornia crassipes (I)	PH
Portulacaceae	Purslane	Portulaca oleracea (I)	AH
Rosaceae	Wild rose	Rosa californica	S
Rosaceae	Himalayan blackberry	Rubus armeniacus (I)	V
Rosaceae	California blackberry	Rubus ursinus	V
Rubiaceae	Buttonbush	Cephalanthus occidentalis	S
Rubiaceae	Goose grass	Galium aparine (I)	AH
Salicaceae	Fremont cottonwood	Populus fremontii	T
Salicaceae	Weeping willow	Salix babylonica (I)	T
Salicaceae	Narrow-leaved willow	Salix exigua	T
Salicaceae	Gooding's black willow	Salix gooddingii	T
Salicaceae	Arroyo willow	Salix lasiolepis	T
Salicaceae	Red willow	Salix laevigata	T
Salicaceae	Pacific willow	Salix lasiandra ssp. lasiandra	T
Scrophulariaceae	Moth mullein	Verbascum blattaria (I)	AH
Scrophulariaceae	Woolly mullein	Verbascum thapsus (I)	AH
Solanaceae	Jimson weed	Datura stramonium (I)	AH
Solanaceae	Tree tobacco	Nicotiana glauca (I)	S
Solanaceae	Black nightshade	Solanum nigrum (I)	AH
Typhaceae	Narrow-leaf cattail	Typha angustifolia	PH
Urticaceae	Giant nettle	Urtica dioica	PH
Verbenaceae	Lippia	Phyla nodiflora	PH
Verbenaceae	Blue vervain	Verbena bonariensis (I)	AH
Viscaceae	Oak mistletoe	Phoradendron leucarpum ssp. tomentosum	PH
Vitaceae	California wild grape	Vitis californicus	V
Vitaceae	Wine grape	Vitis vinifera (I)	V