

Birds of the Merced Vernal Pools and Grassland Reserve

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ABSTRACT

The avifauna of the University of California's Merced Vernal Pools and Grassland Reserve in eastern Merced County was observed and documented over a three-year period (2013-2015). Several additional surveys made in other years were also included in this analysis. Eighty-nine species were observed using Reserve habitats. Twelve species used the Reserve for nesting, 38 species were local breeders, and 39 species were considered non-breeding migrants. The largest species groups were waterbirds and grassland specialists. Vernal pools, cattle stock ponds, and an irrigation canal are important aquatic habitats for birds and their occurrence added significantly to the overall diversity. Abundance and habitat usage are discussed and compared with several other regional avifaunal assessments.

INTRODUCTION

The western base of the Sierra Nevada in eastern Merced County includes a vast, intact, alluvial terrace landscape composed of ancient soils that are conducive to the development of vernal pools. This region supports the largest block of unfragmented and varied vernal pools remaining in California (R. Holland, in Vollmar 2002). The University of California's (UC's) Merced Vernal Pools and Grassland Reserve (hereafter, the "Reserve") in the eastern San Joaquin Valley was established to protect a large, representative example of this unusual and endangered ecosystem.

The Reserve contains more than 6,000 vernal pools, swale wetlands, and playa pools (Swarth et.al. 2017). These ephemeral wetlands are inundated with rainwater and surface runoff in winter and spring. Vernal pools are variously referred to as temporary wetlands, isolated wetlands, rain pools, hog wallows, pans, and playas. These pools occur where underlying soils, such as claypans or hardpans, inhibit water percolation and allow water to collect and persist for weeks or even months depending on the amount of recent precipitation. The pools dry in spring and become inconspicuous during summer and fall because of their low profile. In drought years, pools may never fill. Seasonal drying is a critical feature of vernal pools because drying prevents the establishment of permanent wetland plants such as tules

(*Schoenoplectus acutus*) or cattails (*Typha* sp.). Reserve vernal pools support five species of fairy shrimp, including the federally endangered Conservancy fairy shrimp (*Branchinecta conservatio*) and the federally threatened vernal pool fairy shrimp (*B. lynchi*). The endangered tadpole shrimp (*Lepidurus packardii*) and California tiger salamander (*Ambystoma californiense*) also occur in Reserve pools and cattle stock ponds.

Few extensive studies have been made of the birds that use vernal pools and the grasslands within which they are embedded. Grinnell et al. (1930) observed swans and sandpipers using “rain pools” and a “prairie lake” at Dales, an area with abundant vernal pools northeast of Red Bluff. Zedler (1987) developed a short list of birds associated with southern California vernal pools. Baker et al. (1992) studied birds of vernal pools on the Santa Rosa Plateau in southwestern Riverside County. Silveria (1998) compiled a comprehensive list of 81 species using vernal pools in eastern Merced County and throughout the Central Valley. Bogiatto and Karnegis (2006) and Bogiatto et al. (2009) studied waterfowl use of vernal pools in the Vina Plateau in the northern Sacramento Valley. Sloat and Whisler (2002) conducted surveys of a vernal pool and grassland ecosystem near the Reserve and concluded, “This habitat diversity in the vernal pool/annual grassland landscape provides for an unexpected complexity of avian species presence and microhabitat preferences.”

The objective of my study was to document the avifauna of this recently established UC Reserve and to characterize bird habitat preferences, seasonality, and general abundance. Knowledge about how the avian community uses the Reserve for foraging, breeding, and other activities is required for sound ecosystem management and for developing relevant research questions for future investigation.

STUDY AREA

The UC Natural Reserve System consists of 41 research reserves, making it the most extensive such network of protected research sites in the world (Fiedler et al. 2013, <https://ucnrs.org/>). The 2,656 ha UC Merced Vernal Pools and Grassland Reserve was established in 2014.

The Reserve is directly east of the main UC Merced campus (Figure 1). It is bordered on the west by Lake Yosemite, an artificial reservoir, and by the Cyril Smith Trust lands, a 1,243-ha preserve owned and managed by the Nature Conservancy. Several large private cattle ranches border the Reserve on the north along La Paloma Road and on the east. The topography is flat to moderately rolling with hills rising to 60 m above the level plain. Elevation varies from 76 m to 175 m above sea level. The Reserve is managed for university-level research and education and is not open to the general public; access is granted by the Reserve Director.

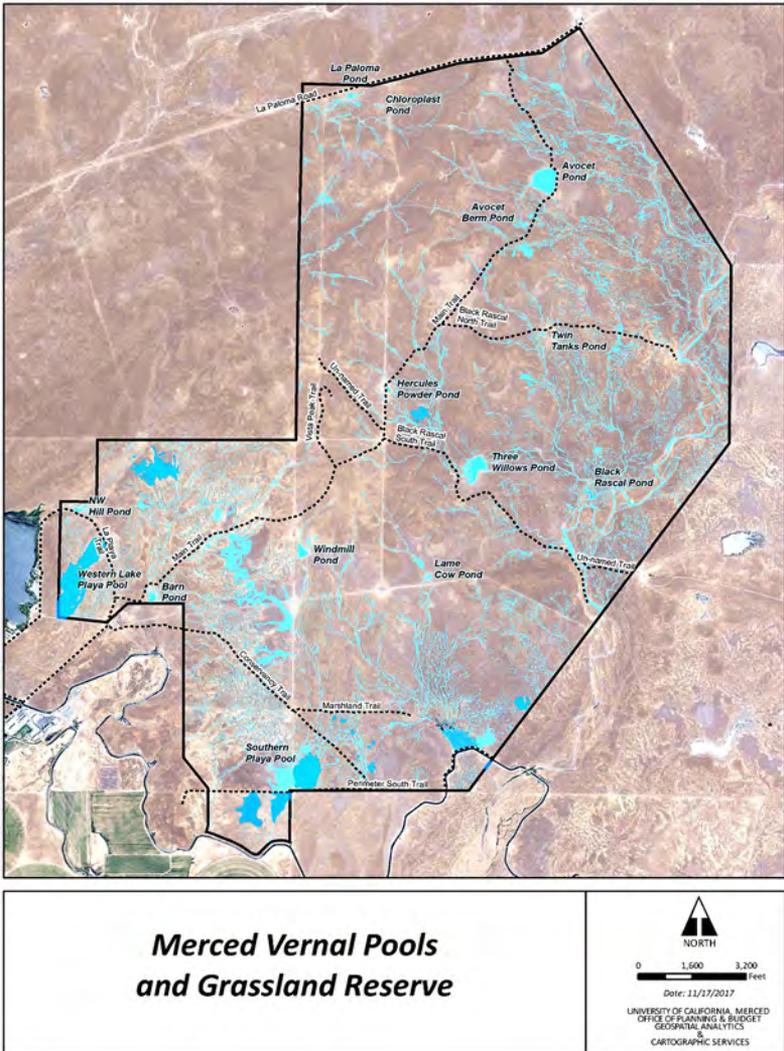


Figure 1. Roads, trails, stock ponds (dark blue), and vernal pools and swales (light blue) at the Merced Vernal Pools and Grassland Reserve.

Reserve lands also serve as environmental mitigation for the impacts to wetlands and endangered species that resulted from the establishment of the adjacent UC Merced campus. The lands are subject to oversight, permits, and agreements with the Environmental Protection Agency, Army Corps of Engineers, and the U.S. Fish and Wildlife Service. Reserve policies restrict access and certain types of research to protect the soils, vernal pools, and the

federally listed plants and animals. Seasonal cattle grazing is a historical use of the Reserve that continues today, now as a required management practice to ensure the ecological integrity and health of the vernal pools by controlling non-native vegetation (<http://vernalpools.ucmerced.edu/>).

Precipitation falls as rain primarily from November through May. The long-term (1899-2016) average annual rainfall at the Merced Municipal Airport weather station, 14.5 km southwest of the Reserve, is 31.2 cm (Figure 2; <http://www.ncdc.noaa.gov/data-access>). Rainfall was significantly below average during the severe 2012-2015 drought as it was again in 2020. Average to near-average annual rainfall totals were measured from 2016 through 2019 (Figure 2).

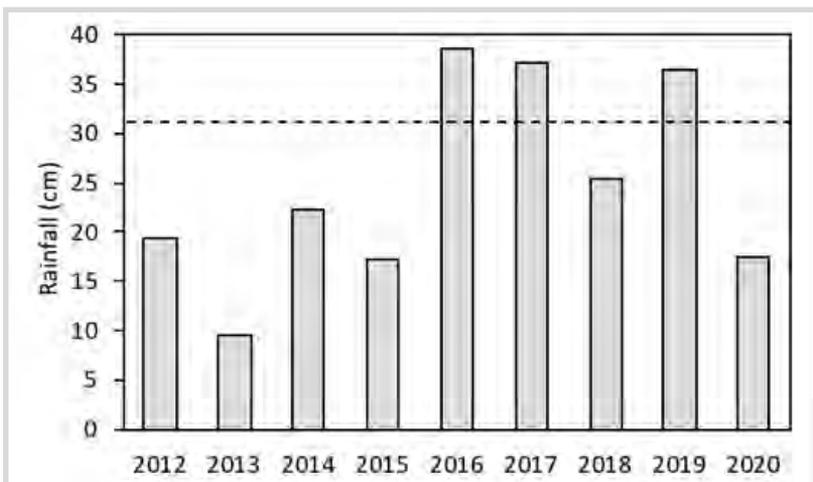


Figure 2. Rainfall totals for Merced, California. Dashed line shows average annual precipitation, 1899-2016.

The Reserve lies within the watersheds of Black Rascal, Fahrens, and Cottonwood creeks, which flow seasonally and southwestward into Bear Creek and eventually into the San Joaquin River. Black Rascal Creek, the largest stream, runs seasonally for 5 km along the southern edge of the Reserve. Several cliffs and bluffs rise 12 m above this stream bed. Much of the Reserve contains unusual mima mounds

Vernal pools are numerous throughout the Reserve but are more concentrated in the flat, low grade terrain in the west and south. Pool sizes generally vary from 50-200 m², however the Western Lake Playa and Southern Playa pools inundate over 10 ha when full. The vernal pool hydroperiod or life cycle begins with a wetting phase, followed by an aquatic

or inundation phase, a waterlogged-terrestrial phase, and finally a drying phase (Keeley and Zedler 1998). Whether any or all phases take place depends on the timing and amount of annual rainfall. Vernal pools and stock ponds also contain abundant populations of aquatic invertebrates.

Ten man-made cattle stock ponds vary from 0.03 ha to 3.34 ha in size. The stock ponds fill seasonally with surface runoff that provides drinking water for cattle. Deeper ponds may hold some water year-round, but most dry up every year and are empty for many months during prolonged droughts. Stock ponds are not connected to creeks and thus do not contain fish (Swarth, pers. obs.). Additional drinking water for cattle is made available by two windmills and several gasoline-powered pumps which draw groundwater to the surface to fill troughs and stock ponds. The Reserve is divided into fenced grazing units so that cattle can be rotated to achieve optimal grazing. Dirt roads (noted as “trails” in Figure 1) cross the Reserve and run to stock ponds, some hilltops, and along fence lines. Decades ago, an old rail car (the Hercules Powder Tank car) was hauled to the center of the Reserve to hold drinking water for cows; it serves as a prominent landmark.

A 12-km segment of the 10-m wide Le Grand Canal runs near and through the southern portion of the Reserve, carrying irrigation water during the growing season from Lake Yosemite to agricultural lands to the south. A leakage wetland, up to 8 ha in size, develops seasonally adjacent to the Le Grand Canal at the end of the Marshland Trail (Figure 1).

The dominant vegetation over the entire Reserve consists of non-native, introduced, annual grasses (Vollmar 2002). In the spring, a colorful carpet of herbaceous, ephemeral wetland plants bloom, including some endangered species and many vernal pool endemics (Holland 2000; <https://vernalpools.ucmerced.edu/>). The Reserve is treeless except for a few small willows (*Salix* sp.) and fig trees (*Ficus* sp.) along the edges of some stock ponds and the Le Grand Canal, and in a few places along Black Rascal Creek. The recent drought, combined with disturbance by cattle, killed three willow trees growing next to one stock pond (D. Toews, pers. comm.).

Cattle have grazed this region for over 120 years (Vollmar 2002). During the study period, about 1,600 dairy and beef cattle grazed for six to eight months each year to maintain the health of the vernal pools (Figure 3, J. Baccei, pers. comm.). Grazing discourages the growth of non-native, exotic plants in the pools; encourages native wetland plants; and extends the pools’ hydroperiod (Marty 2005, Bartolome et al. 2014). Grazing intensity and effectiveness were monitored at the end of each grazing season by measuring the amount of dried forage grasses (or residual dry matter) that remained (Holland unpubl. data; Swarth et al. 2017).



Figure 3. View of the Reserve looking eastward to the Sierra.

Photograph by Clayton Anderson.

METHODS

This report is based primarily on observations I made from January 2013 to February 2016, with a few additional surveys and sightings through 2020. I did not generally conduct formal surveys, but identified and recorded all birds seen on every visit to the Reserve, usually while carrying out other research and educational programs. This report summarizes bird species richness, abundance, and seasonal occurrence in the Reserve, based on these observations.

Birds were identified and counted during each of 178 trips within the Reserve: 59 trips in 2013, 75 in 2014, 43 in 2015, and one in February 2016. Visits were distributed among months, with about five visits per month on average. The most visits were made in July (20) and the fewest in December (9). Trips lasted from one to six hours. Additional sightings were retrieved from remote wildlife cameras deployed at 24 locations across the Reserve for 15 months (March 2014 to May 2015) for a total of 12,600 hours (Toews and Swarth 2015). Data from several surveys made in 2006, and from two formal surveys made in January 2019 and January 2020, are also incorporated into this report. Only birds that were actually using the Reserve (on the ground or foraging overhead) are included in this report. For example, species that passed over the Reserve without stopping, such as American White Pelicans (*Pelicanus erythrorhynchos*) and Sandhill Cranes (*Antigone canadensis*), were not counted (scientific names of all species observed are given in Table 1). Breeding was confirmed by observing nests with eggs, parents delivering food to chicks, or by observing non-flying juveniles in the presence of attending

adults. eBird checklists were examined, and some relevant sightings made from 2006 to 2020 have been included.

The status terms used in Table 1 are defined as *abundant* (seen often and in large or very large numbers), *common* (seen on most or many trips in the appropriate season), *uncommon* (seen on only 10% to 25 % of trips) or *rare* (unlikely to be seen more than once a year).

RESULTS

Eighty-nine species were identified using the Reserve. (Table 1). Almost half of this total (43 species) were waterbirds, and many were ducks (17 species). Raptors were another large group, with 15 species. Twelve species were confirmed breeding in the Reserve. Another 38 were classified as local breeders that nest in the general vicinity and forage in the Reserve. For those species, the Reserve lacks the specific nesting habitats or sites they require. Species classified as either breeding or a local breeder were present year-round in the Reserve, except for the Swainson's Hawk, Lesser Nighthawk, Western Kingbird, and Cliff Swallow. Half or more of species observed likely occur in the Reserve every year, especially in years with near-average rainfall. Thirty-nine species were non-breeding migrants or winter visitants. Nine species were rare and twelve species have some level of special state-protected status (Table 1; California Natural Diversity Database 2021).

The primary habitats used by each species are shown in Table 1. Sixteen species used vernal pools but none used pools exclusively, and many also used stock ponds. Stock ponds, because of their longer persistence, were used by more species than were vernal pools. Thirty species used stock ponds and of these, nine (all ducks and grebes) were seen almost entirely on stock ponds. Larger, deeper stock ponds were used by more birds than smaller, shallower ponds. The Le Grand canal is dry for part of the year, but when full it holds fish and is the only location that was frequented by fish-eating birds.

For analysis and discussion, species were assigned to one of four groups: waterbirds, shorebirds, raptors, and songbirds.

Waterbirds

Canada Geese, and much less commonly, Cackling Geese and Ross's Geese, foraged in the Western Playa Pool (see Figure 1) when it held water. Dabbling ducks, diving ducks, and the Wood Duck used stock ponds almost exclusively; occasionally dabblers were observed foraging in vernal pools or in remnant pools in Black Rascal Creek. An unusually large flock of 80 American Wigeons was on Avocent Pond on 13 Feb 2016. Bufflehead and Ruddy Ducks used stock ponds regularly in small numbers. A flock of 50 Ruddy Ducks on Avocet Pond on 13 Feb 2016 was exceptional. A male and female Barrow's Goldeneye were seen 14 Dec 2006, but not during the main study period.

Table 1. Birds of the Merced Vernal Pools and Grassland Reserve. State-ranked species (ranks S1-S3) are indicated by an asterisk. (Ranking source: California Natural Diversity Database [2021]).

Species	Habitat	Breeding Status ^a	Abundance ^b
Snow Goose (<i>Chen caerulescens</i>)	Vernal pools, grasslands	NB	R
Ross' Goose (<i>Chen rossii</i>)	Vernal pools, grasslands	NB	R
Cackling Goose (<i>Branta hutchinsii</i>)	Grasslands	NB	R
Canada Goose (<i>Branta canadensis</i>)	Vernal pools, grasslands, canal	LB	U
Wood Duck (<i>Aix sponsa</i>)	Stock ponds	LB	U
Blue-winged Teal (<i>Anas discors</i>)	Vernal pools, stock ponds	NB	U
Cinnamon Teal (<i>Anas cynoptera</i>)	Vernal pools, stock ponds	NB	U
Northern Shoveler (<i>Anas clypeata</i>)	Vernal pools, stock ponds	NB	U
Gadwall (<i>Anas strepera</i>)	Stock ponds	LB	U
American Wigeon (<i>Anas americana</i>)	Vernal pools, stock ponds	NB	U
Mallard (<i>Anas platyrhynchos</i>)	Stock ponds, canal	B	C
Green-winged Teal (<i>Anas crecca</i>)	Stock ponds	NB	U
Ring-necked Duck (<i>Aythya collaris</i>)	Stock ponds	NB	U
Bufflehead (<i>Bucephala albeola</i>)	Stock ponds	NB	C
Common Goldeneye (<i>Bucephala clangula</i>)	Stock ponds	NB	U
Barrow's Goldeneye* (<i>Bucephala islandica</i>)	Stock ponds	NB	R
Hooded Merganser (<i>Lophodytes cucullatus</i>)	Stock ponds, canal	NB	U
Common Merganser (<i>Mergus merganser</i>)	Canal	NB	U
Red-breasted Merganser (<i>Mergus serrator</i>)	Canal	NB	U

Table 1. (cont.) Birds of the Merced Vernal Pools and Grassland Reserve.

Species	Habitat	Breeding Status ^a	Abundance ^b
Ruddy Duck (<i>Oxyura jamaicensis</i>)	Stock ponds	LB	C
Pied-billed Grebe (<i>Podilymbus podiceps</i>)	Stock ponds, canal	LB	U
Horned Grebe (<i>Podiceps auratus</i>)	Stock ponds	NB	R
Eared Grebe (<i>Podiceps nigricollis</i>)	Stock ponds	NB	U
Mourning Dove (<i>Zenaida macroura</i>)	Grasslands	LB	C
Lesser Nighthawk (<i>Chordeiles acutipennis</i>)	Grasslands	LB	R
American Coot (<i>Fulca americana</i>)	Stock ponds, canal	LB	C
Black-necked Stilt (<i>Himantopus mexicanus</i>)	Vernal pools, stock ponds	LB	U
American Avocet (<i>Recurvirostra americana</i>)	Vernal pools, stock ponds	B	U
Killdeer (<i>Charadrius vociferus</i>)	Vernal pools, stock ponds, grasslands	B	C
Long-billed Curlew* (<i>Numenius americanus</i>)	Grasslands	NB	U
Dunlin (<i>Calidris alpina</i>)	Vernal pools, stock ponds	NB	U
Least Sandpiper (<i>Calidris minutilla</i>)	Vernal pools, stock ponds	NB	C
Western Sandpiper (<i>Calidris mauri</i>)	Vernal pools, stock ponds	NB	U
Long-billed Dowitcher (<i>Limnodromus scolopaceus</i>)	Vernal pools, stock ponds	NB	U
Spotted Sandpiper (<i>Actitis macularius</i>)	Vernal pools, stock ponds	NB	U
Lesser Yellowlegs (<i>Tringa flavipes</i>)	Vernal pools, stock ponds	NB	U
Greater Yellowlegs (<i>Tringa melanoleuca</i>)	Vernal pools, stock ponds	NB	C
Red-necked Phalarope (<i>Phalaropus lobatus</i>)	Vernal pools, stock ponds	NB	R

Table 1. (cont.) Birds of the Merced Vernal Pools and Grassland Reserve.

Species	Habitat	Breeding Status ^a	Abundance ^b
Double-crested Cormorant (<i>Phalacrocorax auritus</i>)	Canal	NB	C
Great Blue Heron (<i>Ardea herodias</i>)	Stock ponds, canal	LB	C
Great Egret (<i>Ardea alba</i>)	Canal	LB	C
Snowy Egret (<i>Egretta thula</i>)	Canal	LB	U
White-faced Ibis* (<i>Plegadis chihi</i>)	Leakage wetlands	NB	R
Turkey Vulture (<i>Cathartes aura</i>)	Grasslands	LB	C
Osprey (<i>Pandion haliaetus</i>)	Canal	LB	U
White-tailed Kite* (<i>Elanus leucurus</i>)	Grasslands	LB	R
Golden Eagle* (<i>Aquila chrysaetos</i>)	Grasslands	LB	U
Northern Harrier* (<i>Circus cyaneus</i>)	Grasslands	LB	U
Sharp-shinned Hawk (<i>Accipiter striatus</i>)	Grasslands	NB	U
Bald Eagle (<i>Haliaeetus leucocephalus</i>)	Grasslands	LB	U
Swainson's Hawk* (<i>Buteo swainsoni</i>)	Grasslands	LB	U
Red-tailed Hawk (<i>Buteo jamaicensis</i>)	Grasslands	LB	C
Rough-legged Hawk (<i>Buteo lagopus</i>)	Grasslands	NB	U
Ferruginous Hawk* (<i>Buteo regalis</i>)	Grasslands	NB	C
Barn Owl (<i>Tyto alba</i>)	Grasslands	LB	C
Great Horned Owl (<i>Bubo virginianus</i>)	Grasslands	LB	C
Burrowing Owl* (<i>Athene cunicularia</i>)	Grasslands	B	C
Short-eared Owl* (<i>Asio flammeus</i>)	Grasslands	NB	U

Table 1. (cont.) Birds of the Merced Vernal Pools and Grassland Reserve.

Species	Habitat	Breeding Status ^a	Abundance ^b
Belted Kingfisher (<i>Megacerle alcyon</i>)	Canal	LB	C
American Kestrel (<i>Falco sparverius</i>)	Grasslands	B	C
Merlin* (<i>Falco columbarius</i>)	Grasslands	NB	R
Peregrine Falcon (<i>Falco peregrinus</i>)	Grasslands	NB	U
Prairie Falcon (<i>Falco mexicanus</i>)	Grasslands	LB	U
Western Kingbird (<i>Tyrannus verticalis</i>)	Grasslands	LB	C
Black Phoebe (<i>Sayornis nigricans</i>)	Stock ponds, canal	LB	C
Say's Phoebe (<i>Sayornis saya</i>)	Grasslands	NB	C
Loggerhead Shrike (<i>Lanius ludovicianus</i>)	Grasslands	B	C
American Crow (<i>Corvus brachyrhynchos</i>)	Grassland	LB	U
Common Raven (<i>Corvus corax</i>)	Grasslands	B	C
Horned Lark (<i>Eremophila alpestris</i>)	Grasslands	B	A
Tree Swallow (<i>Tachycineta bicolor</i>)	Aerial, canal	LB	C
Cliff Swallow (<i>Petrochelidon pyrrhonota</i>)	Aerial, canal, creek bed	B	A
Barn Swallow (<i>Hirundo rustica</i>)	Aerial, canal	LB	C
Rock Wren (<i>Salpinctes obsoletus</i>)	Grasslands	LB	U
Western Bluebird (<i>Sialia mexicana</i>)	Campus edge	LB	U
Mountain Bluebird (<i>Sialia currucoides</i>)	Grasslands	NB	R
American Robin (<i>Turdus migratorius</i>)	Campus edge	LB	U

Table 1. (cont.) Birds of the Merced Vernal Pools and Grassland Reserve.

Species	Habitat	Breeding Status ^a	Abundance ^b
Northern Mockingbird (<i>Mimus polyglottos</i>)	Campus edge	B	U
American Pipit (<i>Anthus rubescens</i>)	Grasslands	NB	C
House Finch (<i>Haemorhous mexicanus</i>)	Grasslands, campus edge	LB	C
American Goldfinch (<i>Spinus tristis</i>)	Grasslands	LB	C
Spotted Towhee (<i>Pipilo maculatus</i>)	Campus edge	LB	U
Savannah Sparrow (<i>Passerculus sandwichensis</i>)	Grasslands	NB	A
White-crowned Sparrow (<i>Zonotrichia leucophrys</i>)	Campus edge	NB	U
Western Meadowlark (<i>Sturnella neglecta</i>)	Grasslands	B	A
Red-winged Blackbird (<i>Agelaius phoeniceus</i>)	Grasslands	LB	U
Tricolored Blackbird* (<i>Agelaius tricolor</i>)	Grasslands	LB	U
Brewer's Blackbird (<i>Euphagus cyanocephalus</i>)	Stock ponds, grasslands	B	U
Great-tailed Grackle (<i>Quiscalus mexicanus</i>)	Campus edge	LB	U

^a B = Breeds; a species confirmed nesting in the Reserve; LB = Local Breeder; a species that nests in Merced or western Mariposa counties but has not been recorded nesting in the Reserve; NB = Non-breeding.

^b Abundance codes: A = Abundant; C = Common; U = Uncommon; R = Rare (see METHODS for definitions).

The Common and Red-breasted mergansers occasionally used the irrigation canal, whereas the Hooded Merganser was the only merganser that also used stock ponds. The Mallard was the only waterfowl species that was documented breeding.

The Pied-billed Grebe, Horned Grebe, and Eared Grebe were seen on stock ponds and the canal (Table 1). The Western and Clark's grebes, (*Aechmophorus occidentalis* and *A. clarkii*) were common on Lake Yosemite but were never seen in the Reserve. Herons and egrets were seen most often along the canal. The Great Egret was also seen at the leakage wetland. The

Double-crested Cormorant, Belted Kingfisher, and Osprey foraged only on the canal.

Shorebirds

Twelve shorebird species were seen, nine of which were migrants. Least Sandpipers, the most common of the three small sandpipers, foraged around the large playa pools (Figure 4). Long-billed Curlews favored the higher elevation areas and slopes where the grasses were taller. Curlews were seen in large flocks, occasionally numbering in the 100s, flying overhead or foraging in the grasslands throughout the Reserve. The largest flock, estimated at 500, was seen on 21 Feb 2018. An exceptionally early fall flock of six curlews was seen on 31 Jul 2013. Sizable curlew flocks were not seen foraging in the grasslands until after late fall rains had stimulated the growth of the annual grasses.



Figure 4. Least Sandpiper foraging in the Western Lake Playa Pool;
20 February 2013.

Photograph by Chris Swarth.

Three Red-necked Phalaropes, unusual in this area and the only ones seen, alighted briefly on Avocet Pond on 14 Aug 2013. American Avocets nested in small numbers in 2013 and 2015 at Avocet Pond (two nests and chicks seen), in 2015 near Black Rascal Creek (four pairs and two nests), and in 2015 at Hercules Powder Pond (one pair and 3 chicks; Figure 5). Several Killdeer nests and chicks were found.

Figure 5.
American
Avocet nest.
5 June 2015.

Photograph by
Chris Swarth.



Raptors

Turkey Vultures were common and seen feeding on dead livestock several times. Ospreys nested at nearby Lake Yosemite and foraged occasionally at the Le Grand Canal where they captured fish. White-tailed Kites were seen sparingly along ungrazed public roadsides near campus but did not regularly forage over the Reserve. Their absence was probably related to lack of taller, dense grasslands and their associated small mammal prey. Golden Eagles were seen on 41 days, presumably attracted by the high numbers of California ground squirrels (*Otospermophilus beecheyi*). They nest in the foothills several miles east of the Reserve. Ground squirrels, black-tailed hares (*Lepus californicus*), and Audubon's cottontails (*Sylvilagus audubonii*) are all abundant prey for this and other large raptors.

Northern Harriers were observed on 36 days. Most were seen in fall and winter (1 to 2 birds seen on 23 days) and fewest in spring/summer (13 days). Adult females and immatures were much more common than adult males. A pair seen on 5 June 2015 suggests that they may have nested in the area. Males were observed in courtship flight several times in the spring. A Sharp-shinned Hawk pursued Savannah Sparrows among dense piles of wind-collected herbs along a fence line in November. Bald Eagles were seen on 14 days, usually in transit to or from Lake Yosemite, where they wintered. Six were roosting in willow trees at the leakage wetland next to the Le Grand Canal on 15 Jan 2014, and several were photographed with our wildlife camera while feeding on dead cows.

A pair of Swainson's Hawks nested on the main campus until 2016 when this lone campus nesting tree was cut down as part of campus expansion.

Others occurred nearby on the outskirts of eastern Merced, but they only occasionally foraged over the Reserve. The largest group (six) was seen on 18 Jun 2014. Extreme early and late dates, respectively, for this migratory raptor were singles on 20 Mar 2015 and 30 Nov 2015. A flock of 25 foraged while walking in a plowed field a few miles south of the Reserve on 18 Apr 2013.

The Red-tailed Hawk was the most common *Buteo* observed, although they did not nest in the Reserve. An exceptional group of 10 was seen on 17 Oct 2013. A single Rough-legged Hawk was seen in January 2013; one to two birds were seen on eight days during November 2013 through Feb 2014; and one was seen in February 2020. Ferruginous Hawks occurred every winter and were observed on 38 days. Three seen together was the largest group. The earliest was one observed on 10 Sep 2014.

Burrowing Owls were year-round residents, observed on 47 days mostly in areas with many California ground squirrel burrows (Figure 6). Groups of two or three were often seen, and occasionally groups of four to six. Adults and juveniles were seen every year near areas where they probably nested. I estimate that three or four pairs of Burrowing Owls nested annually in the Reserve during this study. Fresh regurgitated pellets containing insect parts were collected near squirrel burrow openings.

Two Barn Owl carcasses were found, and an owl was once flushed from a willow tree near the canal. Great Horned Owls roosted in an old barn (now gone) just outside the Reserve and on four occasions several were flushed from willow trees along the canal and along Black Rascal Creek. Two Short-eared Owls were seen on 23 Jan 2013, with singles seen on 20 Apr 2013 and 16 Jan 2021. The few sightings suggest that these owls were passing through and probably did not over-winter locally.

Figure 6. Burrowing Owl near nesting burrow.

*Photograph by
Chris Swarth.*



American Kestrels were commonly seen foraging in the Reserve, and since 2014 they have nested there. Kestrels probably did not nest in the Reserve before 2014; only a few willow trees around some of the stock ponds or along the canal might have possessed suitable natural nest sites for this cavity-nesting falcon. In 2014, 10 nest boxes were placed in the Reserve to increase the local kestrel population (Figure 7). Six pairs occupied boxes in the first year (Swarth et al. 2014). Over the next two years, 20 more boxes were erected. Ninety percent of the 30 boxes were occupied in 2015 and 2016, and 92 chicks fledged over three years (McDermot et al. 2017). Kestrels have remained common on the Reserve subsequently. Analysis of 2,500 prey remains in kestrel pellets and in nest boxes revealed a diet (in descending order of frequency of occurrence) of spiders, grasshoppers, beetles, crickets, dragonflies, Horned Larks, other songbirds, rodents, and lizards (McDermot 2016). I observed a male kestrel capture a juvenile Cliff Swallow as it departed its nest, probably for the first time.

Figure 7. UC Merced student holding a juvenile American Kestrel at a nest box near the UC Merced Campus and Le Grand Canal.

Photograph by Chris Swarth.



Prairie Falcons were seen on 19 days in fall and winter. Sightings were of single birds except for two on 20 November 2015. They did not nest in the Reserve, as there are no cliffs of sufficient height to provide suitable nest sites. Peregrine Falcons were seen only twice, although they occur regularly in winter at nearby Lake Yosemite. Merlins were seen four times, but it is likely that many more passed undetected through the Reserve.

Songbirds

Of 26 passerine species noted, 17 occurred more or less year-round, and seven were found breeding in the Reserve. Numerically, Cliff Swallows, Horned Larks, and Western Meadowlarks probably accounted for over 95% of the entire breeding songbird community. Small and insignificant numbers of few songbirds that were common on the main campus were occasionally seen along the edge of the Reserve. A lone blue gum (*Eucalyptus globulus*) outside the western entrance was often used as a perch by songbirds and raptors.

Loggerhead Shrikes were seen on many days throughout the study period. Nests were found in willows bordering the stock ponds; one on 11 Apr 2014 held three eggs and one chick. It is unknown if they bred every year. Shrike prey—large centipedes and spiders—were found impaled on barbed wire fences.

Figure 8.
Common Raven
nest atop the
Hercules Powder
tank car.



Photograph by
Chris Swarth.

Common Ravens were seen often throughout the year, at times in flocks of a dozen birds. They nested atop two windmills, on the Hercules Powder tank car, and on a ledge amidst the Cliff Swallow colony at Black Rascal Creek. Remarkably, pieces of barbed wire fence formed the foundation of every nest (Figure 8). The larger chicks in windmill nests risked decapitation on windy days from rapidly spinning blades, but no injuries were observed. American Crows were abundant in the region, but only used the Reserve occasionally, instead preferring nearby agricultural fields.

Horned Larks were year-round residents. Numbers increased dramatically in fall with an influx of birds from elsewhere. Although it was common to see Horned Larks in groups of 10 to 25 birds on almost every visit, occasionally extremely large flocks coalesced in the fall and winter, including 200 on 3 Oct 2013; 500 on 20 Dec 2013; 2,000 on 13 Jan 2014; and 500 on 19 Dec 2014. In the late afternoon and at dusk, hundreds would descend to drink from stock ponds. Males were regularly observed in courtship flight in spring. A half-

dozen nests were found (Figure 9) and a small chick was observed on 28 Apr 2014.



Figure 9.
Horned Lark
nest and eggs.
20 March 2015.

*Photograph by
Chris Swarth.*

Cliff Swallows annually occupied 200 to 350 active nests at a colony on a vertical cliff bluff above Black Rascal Creek (Figure 10). Some nests were attached to the roof of an overhang. Swallows returned to this site as early as 30 Jan (40 birds in 2015) and 13 Feb (150 birds in 2016). In late February and early March, swallows gathered mud for nest construction and to repair old nests. Several much smaller colonies were located on other nearby bluffs



Figure 10.
Cliff Swallow
nests at colony on
Black Rascal Creek.

*Photograph by
Clayton Anderson.*

along the creek. An additional 168 nests were counted on the campus hydro-power plant building in Jun 2014 and smaller groups nested every year under bridges that cross the Le Grand Canal.

American Pipits joined up with Horned Larks in winter, although usually in much smaller numbers. The largest pipit flocks were 500 on 14 Dec 2006 and 100 on 19 Mar 2014. Savannah Sparrows were abundant, non-breeding visitors (Figure 11). They were notable because they poured into the grasslands in the fall, were abundant all winter, and departed the grasslands entirely in spring to migrate to breeding areas presumably to the north and east. At times flocks comprised hundreds of individuals, especially along La Paloma Road. These sparrows often congregated along fence lines where dried, wind-blown annual herbs such as Fitch's Spikeweed (*Centromadia fitchii*) had collected.

Figure 11.
Savannah Sparrow.
31 October 2013.

*Photograph by
Chris Swarth.*



A special effort was made to look for foraging flocks of Tricolored Blackbirds. Only small groups were seen in the Reserve even though a breeding colony of up to 8,000 birds was located 11 km away on the neighboring Flying M Ranch in Apr 2016 (Swarth 2017). Apparently, the Reserve was too far from the colony to attract foraging birds.

DISCUSSION

Abundance and Occurrence

Local species richness and abundances are the basic components for understanding regional population sizes and trends. The low elevation, rolling Sierra foothills along the edge of the San Joaquin Valley are the eastern distributional limit for many wintering waterbird species in the Central Valley and this is a worthwhile region for collecting observational records. As the agricultural croplands to the west of the Reserve are converted to other uses,

the open grasslands in the foothills with their compliment of vernal pools become an increasingly important habitat for birds. This study therefore provides a baseline from which future avifaunal assessments can be made.

The variety of species classified as abundant, common, or uncommon in the Reserve (80 of 89 species) was very similar to or greater than the variety measured on bird surveys made two decades earlier on the Flying M Ranch and 11 other large cattle ranches in this region (Silveira 1998, Sloat and Whisler 2002). The extensive Flying M Ranch (4,496 ha), in particular, contains terrain consisting of vernal pool/annual grasslands, playa pools, and seasonally saturated clay flats, which make it a valuable and serendipitous location for comparisons with the Reserve avifauna. There, Silveira (1998) tallied 51 species, and Sloat and Whisler (2002) identified 43 species. Fifty-nine species observed on the Reserve in this current study were also tallied in one or both of the studies at the Flying M Ranch. The differences in total richness between studies was mostly due to small numbers of species that were rare or uncommon, and thus not key members of the local avifauna.

Four waterbird species that were noted using vernal pools in the two earlier surveys were not observed in this study: White-fronted Geese (*Anser albifrons*), Northern Pintail (*Anas acuta*), Whimbrel (*Numenius phaiopus*), and American White Pelican. We often watched Pelicans soaring overhead and bound for Lake Yosemite, but they did not descend to the Reserve. Conversely, eleven mostly uncommon or rare waterbird species observed in our study, were not seen in the other two studies: Snow Goose, Blue-winged Teal, Barrow's Goldeneye, Hooded Merganser, Red-breasted Merganser, Lesser Yellowlegs, Red-necked Phalarope, Snowy Egret, Pied-billed Grebe, Horned Grebe, and Eared Grebe. The occurrence of the grebes on the Reserve may be related to its proximity to Lake Yosemite, where five grebe species occurred regularly, and to the foraging opportunities in the Le Grand canal. The higher species richness on the Reserve compared with the other studies is most likely related to the availability of these additional aquatic habitats, which are lacking on the Flying M Ranch. In general, the degree of similarity among studies in this region suggests that the vernal pool and grassland avifauna observed in 1998-2001 has not changed much over the past 15 to 20 years. The combined results of these studies provide a satisfactory characterization of the region's avifauna.

Grassland bird populations are declining in many parts of North America (Peterjohn and Sauer 1999, CPIF 2000, Vickery and Herkert 2001, Askins et al. 2007, Sauer et al. 2008). Of the 12 species with special state status observed on the Reserve, nine are grassland specialists (Shuford and Gardali 2008). Two rare and declining grassland species, the Mountain Plover (*Charadrius montanus*) and the Grasshopper Sparrow (*Ammodramus savannarum*), were not seen in the Reserve and may be extirpated in this area. Mountain Plovers

are known to use grazed grasslands in some limited parts of the Central Valley in small numbers (Knopf and Rupert 1995, eBird sightings). Sloat and Whisler (2002) reported a group of five on 8 Mar 1999 on the Flying M Ranch and sightings of a few other individuals nearby in 2001 but saw none on the ranch during their 2001 fieldwork. Likewise, Grasshopper Sparrows were seen on the Flying M Ranch in 1998, although not in 2001. Sightings of single Grasshopper Sparrows from a few scattered locations east of the Reserve have been reported as recently as 2016 in eBird. The Reserve does not contain the specific habitat requirements of this sparrow: undisturbed grassy slopes with dense ungrazed or lightly grazed grasslands (Unitt 2008).

Habitat Characteristics

The variety of seasonal aquatic habitats in the Reserve (vernal and playa pools, stock ponds, the irrigation canal, the leakage wetland, Black Rascal Creek) and the proximity of Lake Yosemite all provide important local, productive foraging opportunities for waterfowl, shorebirds, and other species. Waterbirds comprised almost half of the species that regularly used the Reserve. The Reserve environment is dynamic in terms of the annual existence and duration of vernal pools, and to a lesser extent, of stock ponds. Variation in rainfall is the main determinant of the development and persistence of these temporary wetlands and stock ponds. Lake Yosemite holds ample water year-round regardless of regional rainfall and consequently is a dependable and important habitat for waterbirds in eastern Merced County. Birds can move easily back and forth from this reservoir to the seasonal aquatic habitats on the Reserve. Lake Yosemite, therefore, is a significant factor that increases the variety and numbers of waterbirds and some raptors (i.e., Bald Eagles) that were observed on the Reserve. Vernal pool/grassland ecosystems that are distant from such year-round reservoirs would likely support fewer species overall.

Grasslands in the Central Valley are a key habitat for the Ferruginous Hawk, Rough-legged Hawk, and Prairie Falcon (Pandolfino et al. 2011). The high diversity of raptors using Reserve grasslands (14 species, excluding the Osprey), reflects the abundant mammalian prey base, especially the many ground squirrel colonies. The rapid attraction of large numbers of American Kestrels and their high productivity after nest boxes were provided (McDermot 2016, McDermot et al. 2017) demonstrates that the grasslands also support an ample invertebrate prey base for these birds. The presence of Burrowing Owls every year of this study in widely scattered locations, as well as the relatively undisturbed conditions (other than cattle grazing) in the Reserve and the abundant ground squirrels, bode well for the future of this declining owl in this region.

An estimated 60-85% of the vernal pools that once occurred in the Central Valley have been eliminated through drainage and conversion to agriculture or development (Holland 2009). Merced County lost 24,000 acres (8%) of its vernal pool habitat from 1976-1997 to 2005, mostly to agricultural conversion (Holland 2009). The pools within the Reserve are now fully protected. Vernal pools in general, however, were protected as wetlands by regulations under the Clean Water Act until 2020, when protections were removed for small, isolated wetlands. Thus, unless regulations are reinstated, additional losses are expected to accelerate, making the Reserve more valuable for conservation.

The excavation of stock ponds in the past has destroyed many vernal pools directly through earth-moving and indirectly because ponds intercept runoff that would have supplied water to nearby vernal pools and swales. In spite of their man-made origins and unnatural physical characteristics, the stock ponds in this otherwise dry landscape contribute to an increase in bird diversity and abundance in the Reserve. Stock ponds could even be more important to waterbirds than an equivalent aerial extent of vernal pools. They persist much longer seasonally than do vernal pools, and thereby provide suitable foraging conditions and adequate food (aquatic invertebrates and seeds) for longer periods. Because they are deeper, stock ponds are used by diving ducks and grebes, which do not use vernal pools. Stock ponds are also important breeding habitats for endangered California tiger salamanders.

The large Avocet Pond, and several other stock ponds, are being studied to determine the feasibility of reducing their size by lowering the earthen berms that encircle them, and thus reducing their water-holding capacity (Fryjoff-Hung 2018, Baccei 2020). Such restoration projects would benefit nearby vernal pools by increasing runoff and inflow into the pools, thereby extending their hydroperiod and restoring their ecological function. The ecological attributes of stock ponds, however, should also be considered in the decision-making process. Such projects would restore some vernal pool function, but smaller stock ponds could become less valuable for waterbirds.

Cattle Grazing

The Reserve is located within a vast area of grazed grasslands extending along the eastern edge of the San Joaquin Valley, most of which are within private cattle ranches. Although these grasslands have long been dominated by exotic, non-native annual grasses, they provide a critically important habitat for many bird species (Pandolfino et al. 2011, Pandolfino and Handel 2018). Beef cattle ranching is critical to maintaining grassland biological diversity. Sustaining an economically viable livestock grazing industry in the face of economic challenges (O'Connor 2017) will slow the spread of suburban development into the lower foothills (Cameron et al. 2014). Many ranches in the surrounding area are held in conservation easements, which ensures that

ranchers manage their lands using practices that benefit biological resources (Vollmar 2002). Recently, however, grazing lands in eastern Merced County and elsewhere in the San Joaquin Valley, even those lands with vernal pools, have been converted to nut orchards. If this trend accelerates, this region will become much less valuable for birds that depend on grasslands for foraging and nesting.

A growing consensus among range ecologists that cattle grazing benefits vernal pools and their unique flora by controlling non-native grasses has led to the adoption of grazing as a management tool in vernal pool ecosystems throughout California (Robins and Vollmar 2002, Marty 2005, Pyke and Marty 2005, Alvarez 2011, Bartolome et al. 2014). The University has contracted with a cattle rancher since 2006, and grazing will continue into the foreseeable future (Airola 2008, Joy Baccei, pers. comm.). Regular oversight and management are required to maintain the correct stocking rate (cattle density), to keep cattle well dispersed across the landscape, prevent overgrazing in areas where cattle congregate, and achieve grazing levels that foster the health of the vernal pools. Proper grazing also keeps the grass low, benefiting many bird species such as the Horned Larks, which are grassland specialists.

In conclusion, the Reserve supports a rich and diverse assemblage of birds that use grasslands that are intermixed with small, seasonal aquatic habitats. Cattle grazing is a key management tool that maintains the health and functioning of this ecosystem. If the San Joaquin Valley continues to undergo changes from suburban development and the conversion of agricultural croplands to nut orchards, the open grasslands in eastern Merced County become increasingly essential for supporting bird populations. With a mission to practice exceptional land stewardship and to focus on research and education, university faculty and students are poised to further investigate Reserve avifauna and the varied habitats these birds require. The Reserve is one of few publicly owned grasslands in California where natural ecological processes can be observed and studied.

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Researchers standing at a vernal pools in the Reserve.

Photograph by Chris Swarth.