

# Mute Swan Abundance and Habitat Use in the Central Sierra Nevada Foothills, California

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## ABSTRACT

The Mute Swan (*Cygnus olor*) has recently colonized California, and its population is reported to be growing rapidly, but little information is available on its occurrence and habitat use there. I conducted surveys for the species at waterbodies in the foothills of the central Sierra Nevada during the 2025 breeding season. I summarize information on occurrence by waterbody size and whether emergent vegetation and islands were present. Swans occupied 23 (20%) of 114 surveyed waterbodies. They avoided using waterbodies smaller than 1 ha (only 4% used) and larger than 100 ha (at low densities and only in shallower reservoirs) and occurred at 37% of 57 waterbodies 1–100 ha in size. Mute Swans used waterbodies with emergent vegetation and islands more than expected if use were random. More than one pair of swans were found only at three waterbodies that ranged in size from 4.6–76 ha. This study shows that the Mute Swans are widespread at stock ponds and other waterbodies in the Sierra foothills. This information provides a baseline for future status surveys and can be used to more thoroughly assess the regional population, the potential for further expansion in the region and in other similar areas in the state, and the effectiveness of control efforts in the region.

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The Mute Swan (*Cygnus olor*) is a large bird (8.5–12 kg adult mass) that is native to central Europe and Asia (Wood et al. 2024). The species was introduced to coastal eastern North America in the late 1800s and has since expanded dramatically in range and numbers there and in the Great Lakes region (Wood et al. 2024).

The Mute Swan's occurrence was highly localized in California before the mid-1990s, but subsequently the species began to increase in numbers and expand its range (<https://ebird.org/map>). Little information, however, has

been published on its status, distribution or numbers there. For example, the only reference to the species' status in California in the 2024 revision to the Birds of the World account (Wood et al. 2024) is "there is a growing and apparently established population in central California from Marin and Sonoma Counties east to Sacramento and San Joaquin counties (eBird data, accessed 30 April 2023)." No studies have evaluated rates of range expansion, habitat requirements, and potential for future increase, although range expansion is under study (R. Araias, pers. comm.)

The status of the Mute Swan is changing in the Sierra Nevada foothills. The first few eBird records appeared in 2007 and have steadily increased, and breeding has been reported (<https://ebird.org/map>). Beedy and Pandolfino's (2013) comprehensive treatment of Sierra Nevada birds, however, did not identify the Mute Swan as present there and indicating its rare and localized status. Pandolfino et al. (2021) documented colonization of eastern Sacramento County between two breeding bird atlas periods (1988–1993 and 2016–2020).

Establishment and expansion of the Mute Swan's range and numbers in California is of concern because of potential for interference competition with other species, habitat modification, and threats to public safety including collisions with aircraft, disease transmission, attacks on humans, and crop damage (Guillaume et al. 2014, Marks 2018). Local information is needed on changes in distribution and abundance, habitat use, and potential effects on aquatic habitats and other waterbird species to guide management.

Incidental to other studies, in 2025 I studied Mute Swans in a section of central interior California to characterize the species' abundance, breeding status, and habitat associations. Although results are preliminary, in that they span only one year and a portion of the species' current geographic range, they may have value in documenting the species' current status and habitat needs and may elucidate and encourage other more intensive studies.

## STUDY AREA

I conducted Mute Swan surveys within a 2,000 km<sup>2</sup> area in the foothills of the Sierra Nevada on the western side of the Central Valley, California, on lands at 10 to 450 m elevation (Figure 1). I surveyed 114 waterbodies and other waterbodies of all sizes mainly from public roads and in public recreation areas. Portions of the following counties (with number of ponds) were surveyed: Sacramento (15), Amador (32), Calaveras (63), San Joaquin (3), and Tuolumne (1). Most waterbodies (84%) were on private lands and viewed from public roads and were small impoundments used for livestock watering or to store irrigation water or stormwater. I also surveyed portions of six large reservoirs (Camanche, Pardee, Salt Springs Valley, New Hogan, Tulloch, and New Melones) and three wastewater treatment ponds (Ione,

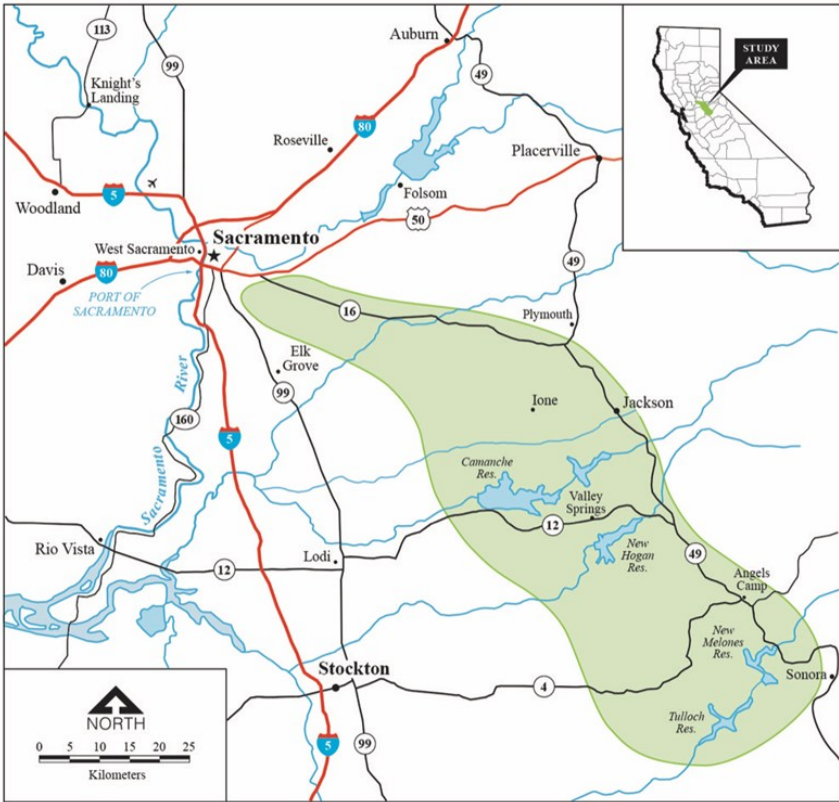


Figure 1. Central interior California study area in the Sierra Nevada foothills.

Valley Springs, New Melones). Vegetation surrounding surveyed waterbodies consisted primarily of annual grassland and oak woodland, with lesser amounts of chaparral, agricultural lands (irrigated pasture, vineyards, orchard), wetlands, and rural residential properties (Airola and Estep 2022).

## METHODS

I conducted surveys opportunistically during 2 March to 2 June 2025, while surveying in this region for other species (Airola and Estep 2022, 2024; Airola et al. 2025). I checked 114 surveyed waterbodies mostly before May 6, with only nine checked thereafter. Numbers of visits to ponds varied, with 53 visited once, 40 visited 2 or 3 times, and 21 visited 4–8 times.

Surveys mainly consisted of looking for and checking waterbodies along public roads and within public recreation areas using 10x binoculars and a 15–60x spotting scope to determine swan occupancy and numbers. Swans were generally easy to identify from up to 1 km away because of their large

size and white color. As a result of access limitations, I wasn't always able to see all portions of some ponds and was only able to access a few ponds to look for nests.

I only surveyed portions of the six larger reservoirs in the study area. To supplement these surveys, I summarized eBird records for major waterbodies. I characterized reservoirs as predominantly shallow or deep based on aerial and onsite visual assessment of water depths and surrounding topography (i.e., steeply or gradually sloped).

Due to schedule constraints, I was unable to survey during the peak times when recently hatched young would be present in 2025. Therefore, I report only a few records of numbers of young produced in 2025, augmented by observations I made at one site (Dogtown Road, Calaveras County) during 2019–2020 and 2022–2023. Because of limited survey effort during the period when young were present, I based the analysis of breeding occurrence on occupancy during the period prior to hatching.

I measured sizes of waterbodies and identified the presence of islands and emergent vegetation through field examination and viewing aerial imagery in Google Earth (earth.google.com, image dated August 2025). I considered ponds to have emergent vegetation, including cattails (*Typha latifolia*) and tules (*Schoenoplectus acutus*), if at least 0.5 ha was present in a concentrated patch (i.e., at least 5 m wide at its narrowest part). I evaluated whether swans were selecting waterbodies with islands for nesting and emergent vegetation by comparing swan use of waterbodies with and without islands and emergent vegetation with expected use values if waterbody use were random, using the  $\chi^2$  statistical test.

## RESULTS

I found 64 adult Mute Swans at 23 (20%) of 114 waterbodies surveyed within the study area (Appendix 1). Swans were found during the first survey conducted at 18 (78%) of the 23 ponds eventually determined to be occupied. Overall, swans were observed during 64% of 76 total visits to the 23 ponds where swans were ultimately determined to be present, suggesting that additional swans may have been present and not detected at surveyed ponds visited only once or a few times.

Half of all waterbodies (57) surveyed were smaller than 1 ha in size, and only 2 (3.5%) of them were occupied, a use pattern that differed significantly from random use ( $\chi^2_{1df} = 9.69$ ,  $p = 0.002$ ) Occupation was higher (37%) for ponds >1 ha in size (Figure 2).

I found Mute Swans at only one of the six major reservoirs in partial surveys (Table 1). Breeding season eBird records of the Mute Swan at larger reservoirs were concentrated at the two shallowest reservoirs: Salt Springs

Valley, and Camanche Reservoir. I did not find swans at the other four deeper reservoirs, and only one or two eBird breeding season records were reported at each of them (Table 1).

Figure 2. Number of waterbodies in various size classes (ha) that were occupied and not occupied by Mute Swans in the Sierra foothills in 2025.

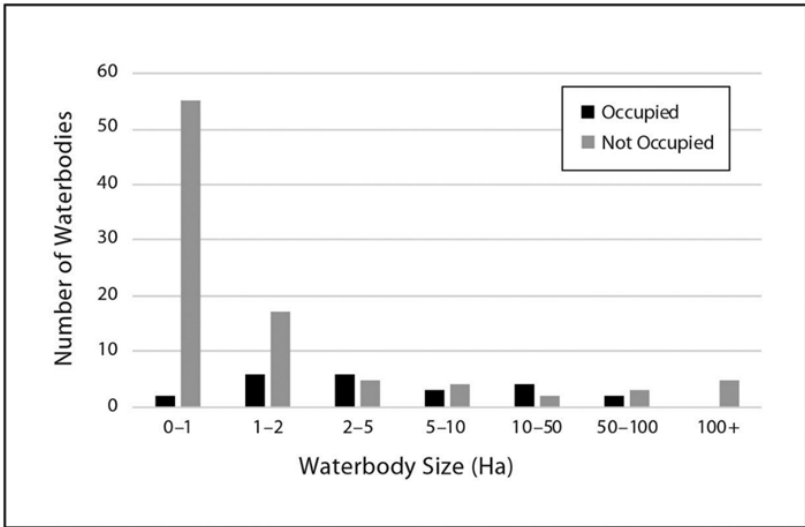


Table 1. Mute Swan survey results and eBird records from major reservoirs in the central interior California study area.

Reservoir	Size (Ha)	Approximate Area Surveyed (Ha)	No. Swans Detected in Surveys	eBird Breeding Season Records
Camanche	3,120	200	0	23
Pardee	890	230	0	2
New Hogan	2,570	500	0	2
Salt Springs Valley	370	75	2	12
New Melones	5,060	1,050	0	1
Tulloch	510	90	0	1
<b>Total</b>	<b>12,520</b>	<b>2,145</b>	<b>2</b>	<b>41</b>

I found only one or two adult swans at most occupied waterbodies (97%). The three lakes that supported >2 adults swans were large, including Mather Lake (25 ha, 5 adults), a lake near Lone Rd and State Route 16 (76 ha, 11 adults), and a pond north of State Route 4 at Cherokee Creek (20 ha, 9 adults).

Emergent vegetation was present at 19 (83%) of the 23 occupied sites, significantly more than expected based on random use (i.e., at 39% of all sites;  $\chi^2_{1\text{d.f.}} = 10.34$ ,  $p = 0.001$ ). Islands were present at 5 (22%) of 23 occupied sites, significantly different from expected use (i.e., 11% of all sites,  $\chi^2_{1\text{d.f.}} = 4.35$ ,  $p = 0.037$ ).

I only observed four active nests (Figure 3) and four swan broods (with 4, 6, 7 and 8 young) at four waterbodies in 2025, but these small numbers likely resulted from the few (9) surveys after 7 May and none after 2 June. All four waterbodies with nests or broods had extensive areas of emergent vegetation and two had islands. A pair I monitored at Dogtown Road pond during four years since 2019, when swans arrived, twice produced zero young and five young. Thus, productivity overall in the region averaged 4.4 young/nesting pair for the eight monitored nesting attempts.



Figure 3. Mute swan on nest (on left) in tules at Tule Pond, Camanche Reservoir South Shore Recreation Area. 23 March 2025.

## DISCUSSION

The Mute Swan appears to be established and is apparently breeding in many areas in the central Sierra Nevada foothills, based on the presence of adults at 23 sites during the breeding season and direct evidence of breeding at four waterbodies. Swan colonization of the foothills only began in the last 15–20 years (eBird.org) and so may still be in progress. It appears likely that some additional suitable areas that are not yet occupied may be colonized in the future if control efforts (see below) are not effective.

Waterbodies in the foothills that appear to be most suitable to swans are of intermediate size (2–100 ha) and support emergent vegetation and islands. Waterbodies smaller than 2 ha (and especially <1 ha) are avoided, likely because they are too small to allow the large swans to land and take off, nesting or foraging habitat is insufficient, or they may make swans more susceptible to predators.

Larger reservoirs, except the shallower Camanche and Salt Springs Valley, appear to support few Mute Swans, presumably because they are steep-sided, and thus too deep and fluctuate too much to support extensive emergent vegetation. My surveys, however, were incomplete and shallow areas, such as at the mouths of tributary streams, may support breeding swans.

In 2026, the California Department of Fish and Wildlife approved open, year-round hunting of the Mute Swan, in an effort to control the species (<https://wildlife.ca.gov/News/Archive/new-legislation-adds-invasive-mute-swan-to-list-of-nongame-birds-that-may-be-taken>). How effective this public-based control program will be may depend on both hunter interest in harvesting swans and complex public attitudes toward the species (Hindman and Tjaden 2014, Jager et al. 2016). Our 2025 survey results may serve as a baseline from which to evaluate the effectiveness of this and other control efforts.

Although my surveys were localized and incomplete, they provide the first depiction of the status and habitat needs of the Mute Swan in central California. The identified characteristics of occupied ponds (intermediate size, presence of emergent vegetation and islands) could be used via remote sensing to develop a habitat-population model to more completely estimate the occurrence and additional population that may be currently occupying suitable ponds in inaccessible areas or to identify areas that may be colonized in the future. Such a model, especially if validated through aerial surveys using unmanned aerial vehicles (i.e., drones), could more clearly characterize in the regions.

My results also may apply to other similar foothill regions in California where stock ponds and other waterbodies are present. I recommend additional surveys in these areas and studies to more clearly characterize the species' status in California.

Further studies are warranted to evaluate Mute Swan population size and trend throughout California and to determine if new liberalized hunting recommendations are effective in reducing population size or slowing its growth rate. I also recommend more work on determining effects of more habitat variables on swan occurrence, density, and growth rate, including finer assessment of effects of availability of emergent vegetation and nesting islands as well as water quality and human activity (boating, shoreline use). Finally, effects of swan occurrence on other breeding waterbird species and aquatic habitats deserve evaluation.

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Appendix 1. Central Sierra Foothills ponds occupied by Mute Swans and evidence of breeding.

Co. <sup>1</sup>	General Area	Waterbody	Latitude, Longitude	Area (Ha)
SAC	Rancho Cordova	Mather Lake	38.5560, -121.2579	25.4
	Rancho Cordova	Anatolia Pond	38.5356, -121.2400	7.6
	Rancho Cordova	Bosphorus Dr Pond	38.5422, -121.2415	2.1
	Florin Rd	Florin Rd, Gene Andal Preserve	38.4949, -121.2708	4.6
	Jackson Hwy	Roadside pond at horse barn	38.4921, -121.1262	5.7
	Jackson Hwy	S side Hwy 16 behind horse barn	38.4921, -121.1266	5.0
	lone Rd	lone Rd lg pond	38.4695, -121.0552	76.0
	lone Rd	lone Rd medium pond	38.4590, -121.0455	1.2
	lone Rd	W of lone Rd and Hwy 16	38.4783, -121.0475	1.8
AMA	Hwy 104	Mining Pond, lone/ Michigan Bar Rd	38.3762, -121.9737	1.6
	Hwy 104	Dutschke Rd Pond	38.3738, -120.9756	0.3
	Sutter Creek	Hwy 49 Pond nr Sutter Cr.	38.3829, -121.1266	4.5
SJO	Martin Rd	NE of Rd	38.3098, -120.9435	
	Hwy 12	Gerardot Stables pond	38.2009, -120.9978	14.3
CAL	Camanche Res.	S shore Trout pond	38.2137, -120.9219	3.8
	Camanche Res.	S shore Tule pond	38.2171, -120.9222	10.6
	Salt Springs Valley	Salt Spr V Reservoir —East side arm	38.0382, -120.7523	75.0
	Dogtown Rd	D. Airola ranch pond	38.1047, -120.5634	1.2
	Dogtown Rd	Dogtown at Lakeside Dr. pond	38.0985, -120.5642	4.4
	Hwy 4	Lower Cherokee Cr. Pond N Hwy 4	38.0759, -120.6042	1.8
	Hwy 4	Higher Cherokee Cr pond N Hwy 4	38.0725, -120.5933	1.9
	Hwy 4	Hwy 4 pond W of Cherokee Cr	38.0715, -120.6149	19.8
	Rock Cr. Rd	Lg pond, Rock Cr Rd	38.0278, -120.6919	5.2
Rock Cr. Rd	Felix Memorial pond	38.0165, -120.6946	0.7	

Co.<sup>1</sup> (SAC = Sacramento, AMA = Amador, SJO = San Joaquin, CAL = Calaveras).

Appendix 1 (cont.)

Co. <sup>1</sup>	Location	Adults	Nests	Broods	No. Young	Notes
SAC	Mather Lake	5	1	2	10	Broods of 6 & 4 young, 5/7
	Anatolia Pond	2				
	Bosphorus Dr Pond	2				
	Florin Rd, Gene Andal Preserve	8				
	Roadside pond at horse barn	2				
	S side Hwy 16 behind horse barn	1				
	lone Rd lg pond	11				
	lone Rd medium pond	1				In emergents, possib. nesting 3/23
	W of lone Rd and Hwy 16	1				
	AMA	Mining Pond, lone/ Michigan Bar Rd	2	1	1	7
	Dutschke Rd Pond	1				
	Hwy 49 Pond nr Sutter Cr. NE of Rd	1	1			
SJO	Gerardot Stables pond	1				In emergents, possib. nesting 3/23
CAL	S shore Trout pond	2				
	S shore Tule pond	2	1			On nest 3/23
	Salt Spr V Reservoir —East side arm	2				
	D. Airola ranch pond	1				
	Dogtown at Lakeside Dr. pond	2				
	Lower Cherokee Cr. Pond N Hwy 4	2				
	Higher Cherokee Cr pond N Hwy 4	2				
	Hwy 4 pond W of Cherokee Cr	9			1	8
	Lg pond, Rock Cr Rd	2				
	Felix Memorial pond	2				