2023 California Waterfowl Breeding Population Survey Report[1]

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Summary

The annual California Department of Fish and Wildlife Waterfowl Breeding Population Survey has been conducted since 1948. The survey methodology was redesigned and updated in 1991 and has been conducted in its current form since 1992. The purpose of the survey is to estimate waterfowl populations in major concentration areas of the state to inform conservation and management. Data from the survey were incorporated into the U.S. Fish and Wildlife Service Adaptive Harvest Management framework for Western mallards in 2008 and has since been an integral part of duck harvest management in the Pacific Flyway.

In 2023, the survey was conducted from 24–29 April in the Central Valley and 17–19 May in northeastern California. The total breeding population of ducks in the survey area increased 30% from 2022 but remains 8% below the long-term average (LTA). Mallards (*Anas platyrhynchos*) increased 13% from 2022 and are 38% below the LTA. Gadwalls (*Mareca strepera*) increased 16% from 2022 and are 2% above the long-term average. Cinnamon teal (*Spatula cyanoptera*) increased 45% from 2022 and are 21% below the long-term average. Canada geese (*Branta canadensis*) in northeastern California increased 30% compared to 2022 and are 36% above the long-term average.

Rainfall was above or near long-term averages across all strata and snow-water content was well above average throughout much of the Sierra and Cascade ranges. Central Valley water storage levels of major reservoirs are above average for all but Trinity Reservoir. Water allocations for wetland management are 100% for all Central Valley Project management areas. Water allocation to the Klamath Basin National Wildlife Refuge Complex in Northeastern California is unclear at this time, but water deliveries are expected to remain limited. Other areas in Northeastern California should have adequate water supply for wetland management.

[1] Data are preliminary.

Methods

The procedures used in conducting the California Department of Fish and Wildlife (CDFW) Waterfowl Breeding Population Survey (hereafter California Survey) generally follow those set forth in the U.S. Fish and Wildlife Service (USFWS) Standard Operating Procedures Manual (SOP) for the Waterfowl Breeding Population and Habitat Conditions Survey (USFWS and Canadian Wildlife Service 1987). Survey design and SOPs for the California Survey are as follows:

Strata **—** The original survey included 11 strata which were: Sacramento Valley, Sacramento – San Joaquin Delta, San Joaquin Grasslands, San Joaquin Desert, Suisun Marsh, Napa and Santa Rosa Valleys, Salinas Valley, Owens Valley, Northeastern California, East Valley (i.e., Central Valley) and West Valley (i.e., Central Valley; Zezulak et al. 1991). Salinas and Owens Valleys were discontinued after 1994; therefore, population estimates in this report only include data from the nine strata currently surveyed (Fig. 1).

Survey Timing — In the Central Valley and Suisun Marsh, about half of all duck nests are initiated by the last week of April. A range of 48–54 days existed between 10% and 90% of nest initiation in the Suisun Marsh during five years of study (McLandress et al. 1996). In northeastern California, nest initiations are later due to the increase in latitude, higher elevations, and correspondingly cooler temperatures. About 50% of mallard nests in northeastern California are initiated by mid-May (Zezulak et al.1991). Based upon these regional nesting chronologies, surveys are conducted during the latter half of April in the Central Valley and by mid-May in northeastern California.

Survey flights are scheduled to begin no later than two hours after sunrise to ensure adequate lighting and avoid detection problems. Surveys are completed no later than 1400 hours, which facilitates use of Sacramento Executive Airport as a daily stopping point (except in northeastern California).

Survey Sample — The California Survey consists of nine strata (Fig.1; see Zezulak et al. 1991). A stratum is a defined geographic unit encompassing areas of similar waterfowl densities and is generally of a single or unique complex of habitat type(s). Most strata are continuous spatial units except the Northeastern stratum, where mountainous terrain separates each wetland complex (Fig. 1).

A transect is the sampling unit of the California Survey, which can have multiple segments, be continuous and or disjunct. Segments are a subunit of a transect, most of which total 18 statute miles (29 km), except in the Suisun Marsh, Napa-Santa Rosa and Northeastern strata. Segments in these areas are disjunct as they are designed to fit within the geographic features of the valleys (i.e., Napa-Santa Rosa and Northeastern) or to provide a representative sample of areas surveyed before the 1991 redesign (i.e., Suisun Marsh and Northeastern).

Survey Flight Path — Transects within the Central Valley are oriented 45° from true north. Most waterways in the Central Valley are oriented north-south or east-west, and the prescribed orientation is intended to minimize biases associated with transects that might run parallel or perpendicular to waterways. Latitude and longitude coordinates define each segment’s beginning and ending points.

Transect Placement — A randomly selected starting point for generating transects within the Central Valley was established just south of Red Bluff. Segments through most of the Central Valley are located at parallel 14 mi (22.5 km) intervals, except in the San Joaquin Desert where segments are spaced 28 mi (45 km) apart due to low waterfowl densities. East and West Valley starting points were randomly selected and transects were placed between the border of the intensive agricultural areas of the Central Valley and the 500 ft (152 m) elevation line.

Fixed-wing Flight Procedure **—** The California Survey requires one CDFW pilot and two CDFW observer-biologists. The pilot's responsibility is navigation, including waypoint delineation of segment beginning and ending points. The pilot maintains an air speed of 90–110 mph (145–180 km/hr.) and an altitude of 150 ft (45 m) above ground level. Each observer counts all ducks, geese, mute swans, American coots (*Fulica americana*) and Sandhill cranes (*Antigone canadensis*) within 660 ft (200 m) on each side of the aircraft, creating a total sample width of 1/4 mi (400 m). Observations are recorded using a voice recorder or a laptop computer that archives observations using the Hodges Survey Program (Jack Hodges, USFWS v2014).

Visibility Bias Correction — Several factors (e.g., flight speed, vegetation) preclude ground coverage of most segments. Therefore, the California Survey uses the double-sampling procedure (Koneff et al. 2008), similar to the USFWS SOP. This method incorporates a "complete count" of select segments to correct for detection bias, referred to as a visibility correction factor (VCF). A helicopter is used to obtain the VCF in California. The VCF is conducted in all strata except the Napa-Santa Rosa stratum. Segments were selected based on the relative abundance of waterfowl, representative habitats, and proximity to airports.

Helicopter Flight Procedure — The VCF crew consists of two CDFW observer-biologists and a CDFW helicopter pilot. The helicopter is flown at 40–45 mph (65–70 km/hr) and an altitude of 100 ft (30 m) along segments. The helicopter crew records waterfowl in the same manner as fixed-wing observers.

Data Analysis **—**The Survey Transcribe Program (Jack Hodges, USFWS v2014) is used to transcribe observations from sound files (.wav). The program produces an ASCII file and a copy is converted into a CSV file which is edited based on criteria in Appendix I. The same process is completed for helicopter data. The Survey Transcribe Program is used to transcribe voice recorder data. Once data are finalized, population estimates are generated using a customized program in R (G. Zimmerman USFWS 2015; R-Core Team 2023, R Studio Team 2023).

A "total indicated birds" (TIB) is calculated for each species on survey segments from both fixed-wing and helicopter data using criteria from previous research (Zezulak et al. 1991, Appendix I). The VCF is calculated for each species based on the ratio of TIB from the fixed-wing crew divided by the TIB from the helicopter crew on replicated segments. The current year VCF is compared to long-term VCF estimates at various pooling levels (e.g., 2 years, 5 years, 10 years, etc.), as well as the USFWS long-term average in the midcontinent. The current year VCF is used if specific criteria are met (Appendix II). The long-term average (CDFW or USFWS) is used for uncommon species (e.g., redhead, *Aythya americana*). A density is derived by dividing the TIB by the segment area (mi^2). A mean density is calculated for each species within each

stratum by averaging the densities of each transect. The stratum area for expansion is calculated by subtracting the transect area surveyed (i.e., segment area) from the stratum area. The mean density for each species is multiplied by the VCF then by the expansion factor to derive a population estimate for each stratum.

Results

The 2023 California Survey was flown from 24–29 April in the Central Valley and 17–19 May in northeastern California. Transect-segment 7-20 in the northeastern stratum was not flown. The survey was 95% complete in the Central Valley and 95% complete in Northeastern, for a total survey effort of 95%.

Total breeding ducks in the survey area increased 30% from 2022 (mean ($\bar{x}$) = 495,438; ± Standard Error (SE) = 126,681; Coefficient of Variation (CV) = 0.26) and are 9% below long-term average (Table 1). The most abundant species of ducks were mallards ($\bar{x}$ = 202,108; SE = 28,506; CV = 0.14), followed by northern shoveler ($\bar{x}$ = 107,490; SE = 30,790; CV = 0.29), gadwall ($\bar{x}$ = 88,251; SE = 21,369; CV = 0.24), and cinnamon teal ($\bar{x}$ = 33,477; SE = 8,229; CV = 0.25). Mallards, gadwall, northern shovelers, and cinnamon teal comprised 87% of ducks observed.

Mallards increased 13% from 2022 and are 38% below the long-term average. Gadwalls increased 16% from 2022 and are 2% above long-term average. Northern shovelers increased 134% from 2022 and are 236% above long-term average. Cinnamon teal increased 45% from 2022 and are 21% below long-term average.

Other, less numerous, duck species present in the survey include American green-winged teal (*Anas carolinensis*), American wigeon (*Anas americana*), northern pintail (*Anas acuta*), wood duck (*Aix sponsa*), canvasback (*Aythya valisineria*), lesser scaup (*Aythya affinis*), redhead, ring-necked duck (*Aytha collaris*), Common goldeneye (*Bucephala clangula*), bufflehead (*Bucephala albeola*), and ruddy ducks (*Oxyura jamaicensis*). These species comprise 12% of total ducks (Table 1).

Other species observed on the survey included: American coots, Canada geese, sandhill cranes and mute swans (*Cygnus olor*; Table 1). Statewide estimates for American coots increased 11% from 2022 ($\bar{x}$ = 209,078; SE = 78,337; CV = 0.37) and are 15% below the long-term average (Table 1). Canada geese are counted in all strata (Appendix IV); however, the Northeastern stratum is used to monitor the traditional breeding population within California. Canada geese in the Northeastern stratum increased 30% from 2022 ($\bar{x}$ = 60,353; SE = 14,900; CV = 0.25) and are 36% above long-term average. Sandhill cranes also nest in the Northeastern stratum and are down 19% from 2022 ($\bar{x}$ = 2,691; SE = 3,723; CV = 1.38) but are 36% above their long-term average. In 2007, CDFW began monitoring feral mute swans. Mute swan estimates increased 251% from 2022 ($\bar{x}$ = 4,045; SE = 1,205 CV = 0.30) and are 468% above their 16-year average.

Weather conditions throughout the winter of 2022 and spring of 2023 brought abundant precipitation to much of the survey area (Table 2; NOAA 2023, Western Regional Climate Center 2023). Precipitation throughout the Central Valley was above average (average z-score = 0.88) in all but two strata. Northeastern (z-score = -0.37) and the Sacramento/San Joaquin Delta (z-score = -0.13) experienced moderately less precipitation (Table 2).

Snow-water content in the Northeastern stratum overall was 39% above average (Table 3; Natural Resource Conservation Service 2023).

Discussion

The winter of 2022 and spring of 2023 brought abundant precipitation, interrupting the consecutive three-year drought in California. Spring precipitation totals ranged from 4 - 97% above average in all but 2 strata; Northeastern and the Delta were down 44% and 6%, respectively (Table 2). Compared to 2022, total ducks were up 30%, and only 9% below the long-term average (LTA). Mallard (13%), gadwall (16%), and cinnamon teal (45%) were up statewide compared to 2022; these three species comprise 65% of all ducks observed.

Despite a 20% reduction from 2022's estimates, Northeastern still comprised the majority (33%; 67,124 birds; Appendix IV) of the state's breeding of mallards. While still 52% below the LTA, mallards in the Sacramento Valley increased 38% (44,938 birds) from 2022.

Similar to mallard, gadwall estimates in Northeastern were down 26% compared to 2022, but still hosted the majority (45%; 53,892 birds) observed. There was a notable increase in the gadwall estimate in the San Joaquin Grasslands (206%; 13,930 birds) and San Joaquin Desert (1500%; 13,470 birds).

Full water allotments are forecasted in the Central Valley for wetland management and rice planting. Rice planting is estimated to be close to average, at 485,000 acres. Water allocations on Klamath Basin National Wildlife Refuge Complex are projected to be low despite adequate water supply conditions. Other areas of northeastern California should receive adequate water supply for wetland management.

Abundant rains may improve habitat however, the lack of adequate upland nesting habitat and brood water throughout California will continue to drive the decline of local breeding duck populations. Efforts to improve breeding habitat conditions have increased in California with programs that incentivize landowners to provide suitable nesting and brood habitat for ducks; in 2023 over 17,000 acres have been enrolled in habitat programs. For more information, please see the CDFW Lands Program page at: https://www.wildlife.ca.gov/Lands/CWHP/Private-Lands-Programs

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Figure 1. California Breeding Waterfowl Population Survey map.

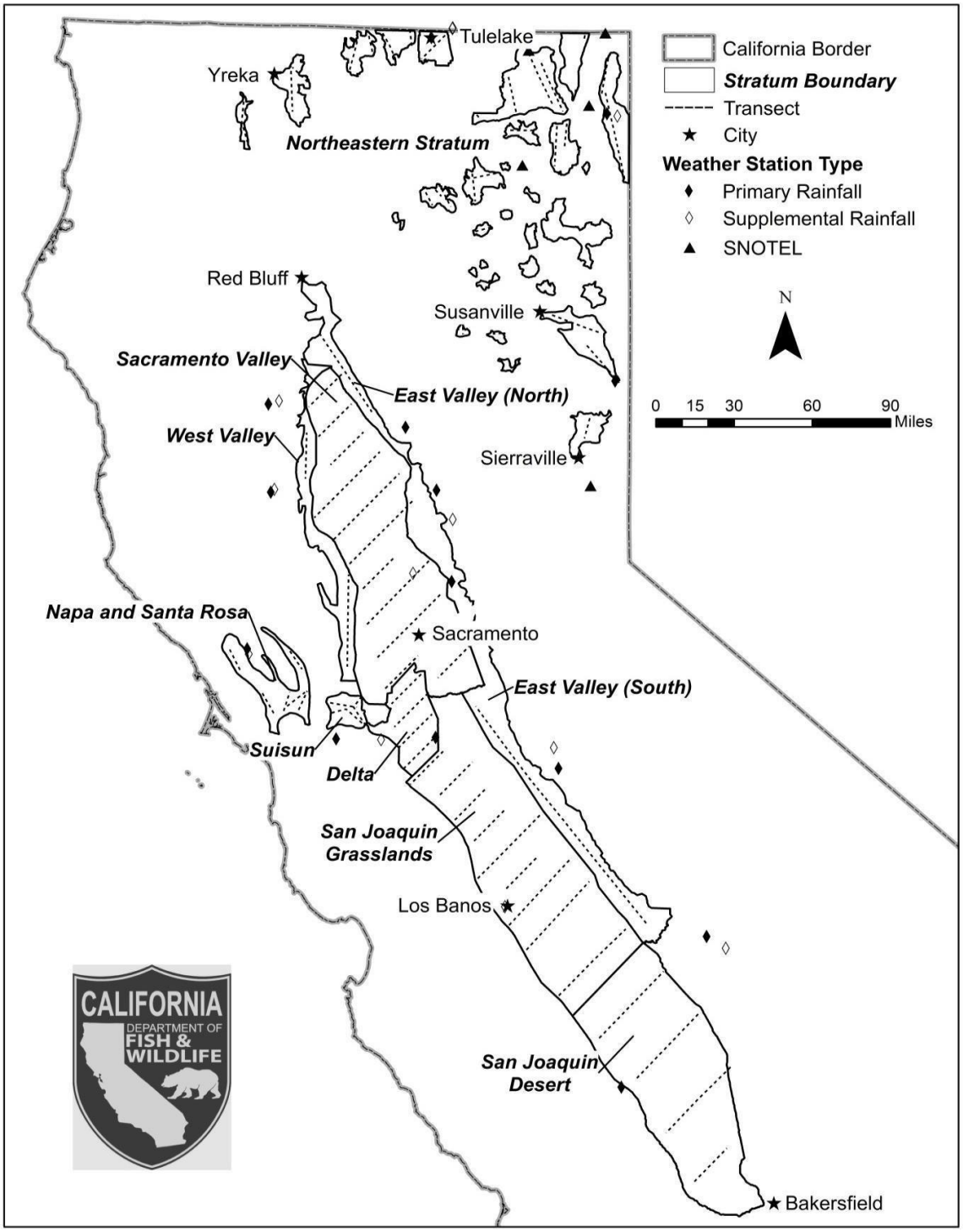

Table 1. California Breeding Waterfowl Population Survey estimates and standard errors.

	2023	SE	CV	2022	SE	LTA[1]	% Change 2022	% Change LTA
Mallard	202,108	28,506	0.14	179,393	29,275	324,241	13%	-38%
Gadwall	88,251	21,369	0.24	76,391	21,855	86,215	16%	2%
American Wigeon	5,097	1,576	0.31	3,344	1,189	4,493	52%	13%
Green-winged Teal	11,845	5,274	0.45	10,125	6,510	4,145	17%	186%
Cinnamon Teal	33,477	8,229	0.25	23,028	6,317	42,123	45%	-21%
Northern Shoveler	107,490	30,790	0.29	46,015	10,855	34,531	134%	211%
Northern Pintail	6,056	2,080	0.34	4,177	1,609	6,961	45%	-13%
Wood Duck	4,032	1,790	0.44	3,855	2,148	8,079	5%	-50%
Redhead	9,852	5,704	0.58	891	830	4,053	1006%	143%
Canvasback	4,145	1,927	0.46	433	454	1,148	857%	261%
Lesser Scaup	489	469	0.62	3,394	1,231	4,537	-86%	-89%
Ring-necked Duck	239	245	0.46	2,348	1,088	977	-90%	-76%
Goldeneye	338	315	0.97	0	0	291		16%
Bufflehead	2,024	880	0.47	5,510	1,756	3,376	-3%	-40%
Ruddy Duck	19,996	17,529	0.42	20,609	16,149	15,366	-51%	30%
Common Merganser	0	0	0.58	361	385	502	-100%	-100%
TOTAL DUCKS	495,438	126,681	0.26	379,872	48,803	541,269	30%	-8%
Canada Geese[2]	60,353	14,900	0.25	54,851	10,039	44,457	10%	36%
Goslings[2]	2,119	1,305	0.62	2,251	2,469	2,979	-6%	-29%
American Coot	209,078	78,337	0.37	396,561	71,127	244,927	-47%	-15%
Sandhill Crane[2]	2,691	3,723	1.38	1,823	2,006	1,982	48%	36%
Mute Swan[3]	4,045	1,205	0.30	1,514	753	712	167%	468%

[1]Long-term average (LTA); 1992 – 2023 for ducks and coots.
[2]Northeastern stratum estimates only, LTA for Canada geese = 1993 – 2023, LTA for goslings and Sandhill cranes = 2003 – 2023
[3]Mute swan LTA = 2003 – 2023.

Table 2. Precipitation (inches)[1] across California Breeding Waterfowl Population Survey strata, 2023.
A sum of precipitation was calculated using numerous weather stations for strata with large area, see Appendix III.

Strata	Jan	Feb	Mar	Apr	May[4]	Spring Total	Z-Score
1-Sacramento Valley	82.75	16.96	46.90	2.43	---	149.04	1.30
1-Sacramento Valley LTA	30.29	27.32	21.70	11.45		90.76	
2-Sac/San Joaquin Delta	10.88	4.62	10.27	0.29	---	26.06	-0.13
2-Sac/San Joaquin Delta LTA	9.48	8.60	6.29	3.44		27.81	
3-San Joaquin Desert	8.52	7.85	8.09	0	---	24.46	1.03
3-San Joaquin Desert LTA	5.28	4.17	4.32	2.36		16.13	
4-San Joaquin Grasslands	20.03	8.43	17.57	0.19	---	46.22	0.90
4-San Joaquin Grasslands LTA	11.02	9.30	7.24	3.90		31.46	
5-Suisun	9.99	4.64	7.23	0.28	---	22.14	0.08
5-Suisun LTA	6.84	6.88	5.00	2.56		21.28	
6-Napa/Santa Rosa	11.91	4.03	10.97	0.67	---	27.58	1.51
6-Napa/Santa Rose LTA	4.87	4.69	3.77	1.68		15.01	
10-East Valley (North)[2]	48.88	9.47	24.11	1.53	---	83.99	1.23
10-East Valley (North) LTA	17.17	15.71	12.53	7.39		52.80	
10-East Valley (South)	16.83	10.02	14.45	0.05	---	41.35	1.60
10-East Valley (South) LTA	6.63	5.42	5.76	3.20		21.01	
11-West Valley	40.66	8.90	28.72	1.42	---	79.70	1.64
11-West Valley LTA	14.34	13.01	10.38	4.54		42.27	
9-Northeastern	4.87	1.63	6.75	1.22	6.31	20.78	-0.37
9-Northeastern LTA	8.06	6.06	6.39	5.71		26.05	

[1]Data acquired from NOAA NCDC online database or RAWS station online data, LTA 1990 – 2023.
[2]East Valley was separated into north and south to reflect precipitation more accurately.

Table 3. Snow-water content (inches)[1] across the Northeastern survey stratum, 2023.

Location	Nov	Dec	Jan	Feb	Mar	Apr	Season Avg	April Z-Score	% of April Avg
Adin Mountain	0.0	0.0	8.5	11.7	16.0	25.1	10.2	2.29	189%
Adin-Mountain LTA	0.8	3.2	6.6	9.4	11.4	8.7	6.7		
Cedar Pass	0.1	4.6	12.3	16.0	20.4	28.5	13.7	1.70	86%
Cedar Pass LTA	1.3	4.3	8.4	12.0	15.4	15.3	9.8		
Dismal Swamp	0.0	4.0	15.9	22.4	28.2	41.8	18.7	1.33	54%
Dismal Swamp LTA	1.8	6.8	13.4	19.4	25.0	27.1	16.0		
Independence Lake	0.0	4.4	23.7	40.8	52.7	73.3	32.5	1.74	69%
Independence Lake LTA	2.5	9.3	18.6	27.8	37.3	43.3	23.1		

[1]Data from NRCS snow telemetry stations, see Figure 1 for locations and Appendix III for additional information.
[2]LTA 1990–2023.

Appendix I. Guidelines for California Breeding Waterfowl Survey data

Definitions

Total Indicated Birds:	Drakes, Pairs and Groups combined.
Lone Drake:	Single isolated drake without a visible associated hen.
Flocked Drakes:	Four or fewer drakes in close association.
Pair:	Male and female in close association.
Group:	Five or more of mixed-sex grouping of the same species in close association which cannot be separated into singles and pairs.

Total Indicated Birds = Lone drakes x 1, Pairs x 2, Groups x 1 (AOU_Num)

- Redhead (1460): exclude groups greater than 8
- Ring-necked Duck (1500)
- Lesser Scaup (1490): do not count in Napa and Suisun Strata
- Ruddy Duck (1670)
- Canada Goose (1720): count all broods separately
- Greater white-fronted goose (1710)
- American Coot (2210)
- Sandhill Crane (2060)
- Mute Swan (1782)

Total Indicated Birds = Lone drakes x 2, Pairs x 2, Flocked Drakes x 2, Groups x 1

- Common Merganser (1290)
- Mallard (1320)
- Gadwall (1350)
- American Wigeon (1370): exclude groups
- American Green-winged Teal (1390): exclude groups greater than 8
- Cinnamon Teal (1410)
- Northern Shoveler (1420): exclude groups
- Northern Pintail (1430)
- Wood Duck (1440)
- Canvasback (1470): exclude groups
- Common Goldeneye (1510)
- Bufflehead (1530)
- Blue-winged Teal (1400)

Appendix II. Guidelines for Determining Annual Visibility Correction Factor (VCF).

California VCFs are to be used for most species. The preference is for the current year VCF to reflect habitat or general conditions, especially for mallards. Sample size and Coefficient of Variation (CV) rule: at least 40 observations for the helicopter and fixed wing crews with a CV of 20% or less. If VCF is 1.0 or less do not use. If current year does not meet criteria, use previous year until criteria are met. Pooling can be used if criteria cannot be met, and single year estimate is deemed not reasonable (VCF of 1.5 or less for mallards). In the case of scaup, ring-neck duck, mergansers, and goldeneye (species with few detections/low abundances in California) use U.S. Fish and Wildlife Service VCF.

Appendix III. Weather station metadata.

Station Name	Station ID	Stratum	Type	Latitude	Longitude	Notes
Juniper Creek RAWS	NWS 040308	Northeastern	Rainfall	41.33222	-120.4725	Main Station
Tule Lake GHCND	GHCND:USC00049053	Northeastern	Rainfall	41.96667	-121.46667	Main Station
Doyle RAWS	NWS 040724	Northeastern	Rainfall	40.02222	-120.1056	Main Station
Surprise Valley RAWS	NWS 043690	Northeastern	Rainfall	41.62028	-120.1566	Main Station
Santa Rosa RAWS	NWS 042009	West Valley & Napa/Santa Rosa	Rainfall	38.47861	-122.7119	Main Station
Thomes Creek RAWS	NWS 40816	West & Sac Valleys	Rainfall	39.86444	-122.6097	Main Station
Stonyford RAWS	NWS 041503	West & Sac Valleys	Rainfall	39.36694	-122.575	Main Station
Fancher Creek RAWS	NWS 044516	East Valley (South) & San Joaquin Desert	Rainfall	36.88389	-119.4658	Main Station
Green Springs RAWS	NWS 43613	East Valley (South) & San Joaquin Grasslands	Rainfall	37.83306	.-120.5000	Main Station
Bangor RAWS	NWS 041201	East Valley (North) & Sac Valley	Rainfall	39.3975	-121.3861	Main Station
Cohasset RAWS	NWS 41211	East Valley (North) & Sac Valley	Rainfall	39.87167	-121.7689	Main Station
Lincoln RAWS	NWS 041907	East Valley (North) & Sac Valley	Rainfall	38.8825	-121.2683	Main Station
Sacramento Executive Airport	GHCND:USW00023232	Sac Valley & Delta	Rainfall	38.5069	-121.4950	Main Station
Kettleman Hills RAWS	NWS 044602	San Joaquin Desert	Rainfall	36.03333	-120.0560	Main Station
Los Banos RAWS	NWS 44003	San Joaquin Grasslands	Rainfall	37.05472	-121.0531	Main Station
Stockton Airport	GHCND:USW00023237	San Joaquin Grasslands & Delta	Rainfall	37.8891	-121.2258	Main Station
Napa State Hospital	GHCND:USC00046074	Suisun	Rainfall	37.8891	-122.2647	Main Station
Concord Buchanan Field	GHCND:USW00023254	Suisun	Rainfall	37.9917	-122.0527	
Dismal Swamp	SNOTEL: 446	Northeastern	Snow	41.99	-120.180	Main Station
Independence Lake	SNOTEL: 541	Northeastern	Snow	39.43	-120.280	Main Station
Adin Mountain	SNOTEL: 301	Northeastern	Snow	41.24	-120.790	Main Station
Cedar Pass	SNOTEL: 391	Northeastern	Snow	41.58	-120.300	Main Station

Appendix IV. Population estimates of mallards, gadwall, cinnamon teal and Canada geese by stratum, 1992–2023. SV = Sacramento Valley, DE = Sacramento–San Joaquin Delta, SJD = San Joaquin Desert, SJG = San Joaquin Grasslands, SM = Suisun Marsh, NSR = Napa-Santa Rosa, NE = Northeastern, EV = East Valley, WV = West Valley (see Fig. 1). LTA = long-term average.

Mallards

Year	SV	DE	SJD	SJG	SM	NSR	NE	EV	WV	TOTAL
1992	163,030	12,453	5,075	79,859	29,713	8969	44,634	23,687	8,423	375,843
1993	129,527	8,602	25,643	63,203	21,847	9731	69,231	28,901	2,323	359,008
1994	114,249	10,143	17,097	52,107	18,104	10160	66,166	17,483	6,183	311,692
1995	111,410	10,184	24,056	71,188	22,705	14731	80,861	23,969	9,422	368,526
1996	205,040	18,519	12,033	105,438	26,523	20231	92,032	43,230	12,511	535,557
1997	186,048	8,089	25,207	114,370	23,054	11496	79,169	51,927	15,585	514,945
1998	148,754	6,741	17,917	54,344	18,349	11582	67,978	21,957	12,906	360,528
1999	259,325	5,832	16,693	70,724	22,127	14174	144,884	17,748	8,556	560,063
2000	147,384	11,263	23,327	39,461	8,882	10278	83,373	17,249	6,341	347,558
2001	122,509	12,141	6,093	33,014	10,881	10148	96,756	7,413	3,249	302,204
2002	116,758	7,816	8,728	29,121	10,066	13672	64,754	8,229	6,151	265,295
2003	106,957	12,176	16,362	58,323	16,669	11974	87,611	19,714	7,270	337,056
2004	97,422	6,303	14,421	28,513	14,092	10881	70,321	14,474	5,998	262,425
2005	100,143	9,459	11,345	42,739	10,883	18342	98,220	22,057	4,681	317,869
2006	120,808	8,196	10,679	53,264	12,077	21486	128,612	37,242	7,073	399,437
2007	104,601	8,319	20,904	47,590	15,691	32915	131,267	20,061	6,976	388,324
2008	92,539	6,465	17,165	51,548	10,330	15516	85,824	13,689	4,054	297,130
2009	105,141	4,943	15,818	39,981	9,094	12265	95,913	14,651	4,153	301,959
2010	102,139	3,948	14,371	56,255	14,531	16137	128,600	16,586	15,325	367,892
2011	100,972	7,293	17,693	38,956	21,501	18057	87,095	17,697	5,450	314,714
2012	85,641	10,136	33,456	57,816	14,486	11058	138,315	22,645	8,369	381,922
2013	80,903	5,929	18,323	33,418	11,580	13436	120,132	12,325	2,590	298,636
2014	67,914	3,826	8,445	44,586	8,901	6156	90,820	5,850	2,168	238,666
2015	55,086	9,452	6,568	24,349	9,704	7541	54,182	1,998	4,986	173,866
2016	69,389	9,240	7,015	33,952	13,668	8790	99,520	16,122	6,079	263,774
2017	31,134	6,151	14,913	21,386	9,921	10918	86,637	13,143	4,188	198,392
2018	56,915	4,850	12,520	36,929	14,150	17363	109,991	17,749	2,393	272,859
2019	49,307	6,085	7,893	31,049	13,625	15217	97,628	14,447	4,580	239,831
2022	32,478	6,823	7,206	18,186	9,019	8542	83,564	11,108	2,465	179,393
2023	44,938	9,138	10,620	34,708	10,163	12295	67,124	9,951	3,169	202,108
LTA	106,949	8,351	14,920	48,879	15,078	13,469	91,707	18,777	6,454	324,582
% Δ 2022	38%	34%	47%	91%	13%	44%	-20%	-10%	29%	13%
% Δ LTA	-58%	9%	-29%	-29%	-33%	-9%	-27%	-47%	-51%	-38%

Appendix IV. Continued…

Gadwall

Year	SV	DE	SJD	SJG	SM	NSR	NE	EV	WV	TOTAL
1992	2,332	0	2,416	12,701	4,098	2,853	9,873	0	0	34,274
1993	3,654	0	4,544	9,187	4,620	2,484	41,850	461	0	66,800
1994	2,084	0	2,776	10,852	5,370	2,368	29,909	338	0	53,696
1995	2,927	175	2,729	9,566	9,178	5,461	64,133	0	252	94,421
1996	3,214	0	2,725	20,205	10,462	6,615	45,434	1,326	0	89,982
1997	8,147	405	7,387	13,230	11,024	15,474	36,903	1,926	0	94,496
1998	8,826	0	5,065	11,096	9,045	2,908	41,167	385	585	79,078
1999	20,160	184	2,870	11,995	5,894	6,403	40,389	4,539	0	92,434
2000	5,369	848	8,247	19,255	7,363	8,116	54,162	358	272	103,989
2001	3,731	0	580	8,208	4,056	7,419	44,568	0	0	68,560
2002	4,506	215	3,026	6,118	4,952	4,742	34,814	818	155	59,345
2003	8,572	495	2,579	11,471	5,986	6,767	40,362	1,568	238	78,037
2004	3,819	134	2,933	12,993	6,797	5,361	42,716	1,020	0	75,773
2005	11,455	0	3,561	12,600	9,273	14,309	128,158	0	0	179,356
2006	12,910	376	5,873	14,647	7,953	5,973	74,324	0	271	122,326
2007	6,216	463	6,159	8,547	5,445	9,152	101,041	661	0	137,686
2008	10,601	250	3,382	6,225	4,317	3,841	39,751	633	0	69,000
2009	13,950	120	2,995	8,580	6,852	11,299	63,200	2,505	0	109,502
2010	5,861	452	2,829	9,015	5,780	3,460	55,128	0	238	82,763
2011	6,042	206	8,693	11,176	7,450	9,981	73,263	1,371	298	118,479
2012	6,116	322	2,684	4,070	5,442	5,393	27,500	408	0	51,936
2013	4,259	741	4,303	3,123	4,679	3,474	52,874	805	153	74,410
2014	15,113	0	8,688	9,890	5,516	3,167	50,650	235	0	93,259
2015	14,492	123	1,545	4,425	3,103	2,407	30,721	939	535	58,290
2016	9,432	495	3,849	3,379	4,647	5,613	30,316	470	179	58,380
2017	777	116	5,768	5,600	5,308	4,206	49,603	220	167	71,765
2018	10,778	0	3,160	5,691	6,100	8,450	68,244	214	0	102,637
2019	9,822	125	3,104	6,814	4,914	6,287	79,781	474	0	111,321
2022	8,388	811	842	4,548	4,090	3,819	53,892	0	0	76,391
2023	12,242	1,217	13,470	13,930	4,152	2,895	39,831	514	0	88,251
LTA	7,860	276	4,293	9,638	6,129	6,023	51,485	740	111	86,555
% Δ 2022	46%	50%	1500%	206%	2%	-24%	-26%	0	0	16%
% Δ LTA	56%	341%	214%	45%	-32%	-52%	-23%	-31%	-100%	2%

Appendix IV. Continued…

Cinnamon Teal

Year	SV	DE	SJD	SJG	SM	NSR	NE	EV	WV	TOTAL
1992	3,226	385	3,611	19,469	2,149	395	28,505	2,928	0	60,668
1993	3,332	0	4,972	10,890	2,497	1,223	30,591	2,268	0	55,773
1994	4,846	321	4,017	16,585	1,793	329	22,388	1,222	0	51,503
1995	4,575	195	5,486	14,380	3,402	1,000	18,117	3,893	282	51,330
1996	22,944	1,666	4,466	15,300	3,987	4,883	27,305	5,885	2,407	88,842
1997	5,381	917	10,872	14,012	1,280	470	13,649	1,308	0	47,889
1998	3,843	229	2,151	11,113	533	235	15,979	1,744	0	35,828
1999	9,450	410	4,487	12,096	1,335	841	10,716	390	0	39,725
2000	2,979	0	3,472	2,340	930	456	14,512	0	0	24,689
2001	4,019	266	1,666	5,053	496	273	13,926	507	385	26,592
2002	1,789	0	2,086	3,936	807	547	4,843	0	0	14,008
2003	4,353	0	2,436	6,019	1,329	799	13,459	988	0	29,382
2004	3,485	0	1,857	7,511	2,764	305	18,975	565	0	35,461
2005	6,056	0	4,274	7,613	1,363	1,602	14,106	2,971	0	37,984
2006	10,318	362	2,264	11,445	2,021	743	26,285	4,131	0	57,570
2007	2,039	243	2,282	2,563	1,358	749	28,965	1,851	0	40,050
2008	7,054	0	1,462	9,853	1,849	719	21,724	445	0	43,105
2009	7,483	235	1,469	7,922	328	241	32,748	447	0	50,872
2010	2,856	170	5,860	11,849	872	175	22,884	3,564	246	48,478
2011	11,347	271	10,158	10,841	1,260	1,944	26,339	1,545	0	63,704
2012	5,125	278	869	2,343	2,198	855	14,932	0	0	26,600
2013	4,594	548	857	1,732	1,020	281	13,528	0	0	22,560
2014	2,871	734	0	5,157	1,366	502	19,774	465	0	30,870
2015	13,127	0	0	1,547	1,594	1,506	10,407	0	354	28,534
2016	2,465	245	2,288	1,545	1,684	1,730	18,868	1,396	0	30,221
2017	410	245	1,523	3,087	897	0	26,883	930	0	33,975
2018	4,102	0	3,047	4,630	3,140	1,871	60,779	930	0	78,498
2019	3,013	674	2,098	3,306	2,059	680	37,731	853	0	50,415
2022	1,299	194	0	3,257	2,042	2,442	13,795	0	0	23,028
2023	1,948	387	3,015	10,179	976	1,185	15,419	368	0	33,477
LTA	5,344	299	3,101	7,919	1,644	966	21,271	1,386	122	42,054
% Δ										
2022	50%	100%	-	213%	-52%	-51%	12%	0	0	45%
% Δ LTA	-64%	29%	-3%	29%	-41%	23%	-28%	-73%	0%	-20%

Appendix IV. Continued…

Canada Geese

Year	SV	DE	SJD	SJG	SM	NSR	NE	EV	WV	TOTAL
1993	590	0	0	0	98	72	50,405	134	0	51,299
1994	354	0	0	0	0	0	59,291	468	0	60,113
1995	708	0	0	0	0	72	53,060	0	0	53,840
1996	236	0	0	0	0	72	45,298	0	0	45,606
1997	1,651	457	0	74	147	216	32,735	134	51	35,466
1998	884	141	0	0	33	216	68,929	936	559	71,699
1999	649	0	0	3,261	229	974	96,673	268	508	102,562
2000	1,592	35	0	0	180	902	47,903	134	0	50,745
2001	1,474	739	0	741	131	1,804	52,754	0	1,067	58,709
2002	825	317	0	371	0	1,118	47,136	1,338	203	51,308
2003	1,297	106	0	519	115	1,154	32,495	1,806	203	37,695
2004	354	176	0	296	65	2,706	27,424	401	0	31,422
2005	1,484	169	0	711	0	3,113	36,230	561	1,035	43,302
2006	0	0	0	0	20	130	19,792	0	244	20,185
2007	356	567	0	0	0	291	31,629	337	154	33,333
2008	189	150	0	238	0	0	9,874	0	0	10,451
2009	4,338	0	0	0	0	0	31,989	703	0	37,030
2010	860	0	0	541	0	865	13,999	1,394	1,324	18,983
2011	4,670	330	0	618	512	2,068	36,248	4,253	794	49,493
2012	3,855	0	0	308	459	2,209	41,926	4,651	1,951	55,359
2013	3,327	551	0	929	342	1,998	68,248	4,473	956	80,823
2014	3,049	296	0	2,496	197	1,692	31,209	3,378	183	42,499
2015	2,623	254	0	267	79	2,169	44,322	1,609	794	52,117
2016	8,377	423	264	2,226	175	2,477	44,323	3,619	796	62,679
2017	7,211	313	0	1,233	287	2,603	55,224	3,268	2,091	72,230
2018	4,064	587	243	1,151	556	1,554	54,851	3,491	1,582	68,079
2019	7,943	1,377	0	2,384	501	5,106	48,588	3,615	1,463	70,977
2022	4,075	1,195	0	3,898	340	997	46,359	5,478	1,786	64,128
2023	4,973	906	0	3,378	113	1,323	60,353	4,304	2,263	77,613
LTA	2,483	292	17	884	158	1,307	44,457	1,750	690	52,060
% Δ 2022	22%	-24%	-	-13%	-67%	33%	30%	-21%	27%	21%
% Δ LTA	100%	210%	0%	282%	-28%	1%	36%	146%	228%	49%