

2016 California Waterfowl Breeding Population Survey¹

By

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Abstract

The annual California Department of Fish and Wildlife (CDFW) waterfowl breeding population survey was conducted from 26 April to 2 May, 2016 in the Central Valley and 11-12 May, 2016 in northeastern California. Drought conditions eased during the winter of 2015-16; however, many areas in the Central Valley still received below average precipitation. In northeastern California, rainfall and snow pack were above average and reservoirs in the area were in good condition. Central Valley California rice farmers and wetland habitat managers are predicted to receive normal surface water allotments for irrigation and summer water, thus breeding habitat conditions are expected to be good.

The total breeding population of ducks in surveyed areas of California for 2016 is estimated at 417,791, up 25% from 2015. The estimated breeding population of mallards (*Anas platyrhynchos*) is 263,774, up 52% from 2015. Mallards remain below their long-term average by 24%. The estimate for gadwall (*A. strepera*) is 58,379, a similar estimate to 2015 but is still 32% below their long-term average. The 2016 estimate for cinnamon teal (*A. cyanoptera*) is 30,221, up 6% from 2015 but 28% below their long-term average. Most other species remain below long-term averages except for northern pintail (*A. acuta*). The estimated Canada goose (*Branta canadensis*) population from the historic breeding range in northeastern California is 44,323, an estimate similar to 2015. The Northeastern Canada goose population is 4% below their long-term average.

¹ Data are preliminary.

Methods

The procedures used in conducting this survey generally follow those contained in the United State Fish and Wildlife Service (USFWS) protocol or standard operating procedures (SOP) for the Waterfowl Breeding Population and Habitat Conditions Survey (USFWS and CWS 1987). SOP's relative to the California survey are as follows:

Survey Timing

The timing of nesting season in most areas of California has been long compared to northern nesting areas. A range of 48 to 54 days existed between 10% and 90% of nest initiation in the Suisun Marsh during 5 years of study (McLandress et al. 1996). In the Central Valley and the Suisun Marsh about half of the duck nests are initiated by the last week of April, but in northeastern California, nest initiations are later due to the increase in elevation and cooler temperatures. In northeastern California, about 50% of the nests are initiated by mid-May (Zezulak et al. 1991). Based upon this chronology of nesting, surveys in the Central Valley are conducted during the last week of April and, in northeastern California, by mid-May. These survey date ranges are based on nesting phenology of mallards and is independent of migration chronology. In addition, other waterfowl have been observed in the state but are not known to nest in California or establish too few nests to be included in the survey. The established survey dates likely miss early nesting mallards and pintails.

Survey Flight Time

Survey flights are scheduled to begin no later than two hours after sunrise, in order to ensure adequate lighting and avoid detection issues. Surveys are completed no later than 1400 hours each afternoon which facilitates use of Sacramento Executive Airport as a daily stopping point (except in northeastern California) and minimizes travel expenses and repeated non-survey flight hours.

Survey Sample

The California survey consists of nine strata (Figure 1; see Zezulak 1992). 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.

A transect is the sampling unit of the California survey which can have multiple segments. A transect is generally a continuous series of segments, except in the Northeastern stratum where segments and transects are disjunct. Segments are generally 18-statute mile (29 km), except in the Napa Valley and Northeastern stratum where some segments deviate from this standard due to stratum size. The Napa Valley is surveyed with transects designed to fit within the geographic features of the valleys. The Northeastern California transects were also selected to fit within geographical areas and to provide a representative sample of historically (prior to 1991 redesign) surveyed areas. The Suisun Marsh transects follow traditional routes established by CDFW and therefore provide continuity with surveys from past years.

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 transect and all segment beginning and ending points.

Transect Placement

A randomly selected starting point for the transects within the Central Valley was established just south of Red Bluff and all subsequent segments through most of the San Joaquin Valley are located at parallel 14 mile (22.5 km) intervals. The San Joaquin Desert segments are spaced 28 miles (45 km) apart due to decreased waterfowl habitat, low waterfowl numbers and time constraints. East and West Valley transect 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 utilizes one CDFW pilot and two CDFW observer-biologists. The pilot's responsibilities are navigation, including waypoint delineation of segment beginning and ending points. The pilot maintains an air speed between 90 and 110 miles per hour (145-180 km/hr) and an altitude of 150 feet (45 m) above ground level. Each observer counts all ducks, geese, coots and Sandhill cranes (*Grus canadensis*) within 660 ft. (200 m) on each side of the aircraft, creating total sample width of 1/4 mile (400 m).

Visibility Bias Correction

The orientation of transects precludes ground coverage of most segments. Therefore, this survey utilizes the double-sampling procedure (Koneff et al. 2008), employed by the SOP's, which incorporates a "complete count" subsample of selected segments to correct for detection bias. Helicopter comparison segments follow fixed-wing segments 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

Two CDFW observer-biologists accompany a CDFW helicopter pilot as in the fixed-wing surveys. Helicopters are flown at 40-45 miles per hour (65-70 km/hr) at an altitude of 100 feet (30 m). The two helicopter observers record waterfowl in the same manner as fixed-wing observers.

Data Collection

All waterfowl data are recorded per the SOP's, except as noted in Appendix 1. The air crew records geese as singles, pairs or groups. Observations are recorded directly to a computer using the Survey Record Program (Jack Hodges, USFWS 2014). Each computer is linked to a GPS unit which allows the survey software to simultaneously record observations and their coordinates into linked sound and ASCII files.

Data Analysis

A second computer program, the Survey Transcribe Program (Jack Hodges, USFWS 2014), is used on the ground to replay the linked sound files and to combine the transcribed observation data with the geographic coordinates to produce a final ASCII data file. The transcribed ASCII files were then used for data analysis.

Data Adjustment

A “total indicated birds” is calculated for each species on each survey segment using the criteria in Appendix 1 using both the fixed-wing and helicopter data. A mean density is calculated for each species within each stratum by averaging the density of total indicated birds for each transect. The stratum area for expansion is calculated by subtracting the transect area surveyed from the stratum area. An uncorrected estimate is calculated by multiplying the mean density by the adjusted stratum area.

The Air-Ground Visibility Correction Factor (VCF) is calculated for each waterfowl species. The VCF is the ratio of the number of ducks seen by the helicopter crew divided by the number of ducks seen by the fixed-wing crew. Data are combined for all strata because a single fixed-wing crew is used. The current year VCF is compared to the long-term Breeding Population Survey Visibility Rates. The current year’s VCF is used for mallards so long as specific criteria are met (Appendix 2). The long-term average is used for seldom seen species.

Once the uncorrected estimates and VCFs are generated, a population estimate is then calculated by multiplying the VCF by the uncorrected population estimate.

Results

The survey was flown from 26 April to 2 May, 2016 in the Central Valley and 11 to 12 May, 2016 in northeastern California. All transects were sampled; thus, the survey was 100% complete.

The VCF for 2016 was not used since estimates were outside of the mean and error of the 23-year average for some species, particularly mallards. The 23-year mean and average VCF for mallards is 2.26 (SE = 0.086) and the estimate for 2016 was 1.18 (SE = 0.14). VCF estimates through 2014 were used to correct data in 2016.

The breeding population estimate for total ducks in the survey area (Figure 1) was 417,791 (SE = 41,999, P = 0.31), an increase of 25% (Table 1). Mallards, gadwall and cinnamon teal comprised 84% of the ducks observed. The most abundant species was mallards, estimated at 263,774 (SE = 35,602, P = 0.31), followed by gadwall at 58,380 (SE = 13,986, P = 0.39) and cinnamon teal at 30,221 (SE = 7,141, P = 0.48). Other notable species observed were: northern shoveler (*Anas clypeata*), estimated at 10,822 (SE = 3,669, P = 0.44) and northern pintail, estimated at 10,372 (SE = 5,248, P = 0.52). All species except northern pintail remain below their long-term averages.

American coots (*Fulica americana*) were estimated at 388,628 (SE = 2,292, P = 0.41), down 17% from 2015. However, coots are 63% above their long-term average.

The Northeastern stratum is used to monitor the traditional breeding population of Canada geese. Harvest management of this population has been based on the Canada Goose Survey (CDFW unpublished data), which was not a standardized survey. The Canada Goose Survey is in the process of being phased out and management will be based upon the Northeastern stratum combined with other areas in the Pacific Flyway. The 2016 Canada goose population estimate, based on the Northeastern stratum, is 44,323 (SE = 11,234, P = 0.93), an estimate similar to 2015 (Table 1). This population is 4% below their long-term average.

Discussion

Drought conditions in California eased during the winter and spring of 2015-2016, although not all strata achieved average rainfall (Table 2; National Oceanic and Atmospheric Administration 2016, Western Regional Climate Center 2016). Rains during March and April were at or above average for most strata, thus habitat conditions (i.e. upland and flooding) were much improved over 2015. Water allotment reductions for summer water and rice straw decomposition flooding have been rescinded due to increased reservoir storage north of Sacramento; however uncertainty remains as to how water allotments may change through the summer since reservoirs to the south are still at critically low levels (California Department of Water Resources 2016).

Most waterfowl population estimates increased in the Central Valley and 2016 production should be better than in recent years. Challenges remain for waterfowl in the Central Valley as urban development and conversion to tree crops in many areas threaten to reduce available upland nesting habitat and increase disturbance. These stressors have increased since the establishment of the survey in 1992 and, perhaps correspondingly, declines in most breeding waterfowl species have been observed.

Rainfall in the Northeastern stratum was near average for the majority of the survey area (Table 2). The primary source for reservoir storage and other water bodies in this stratum is snow pack; which directly affects waterfowl production. The snow-water content across the region was above average (Table 3), a substantial improvement over 2015 (Natural Resource Conservation Service 2016). Duck estimates in northeastern California increased during 2016 and favorable habitat conditions should facilitate good production in this region.

Literature Cited

California Department of Water Resources. 2015. California Data Exchange Center. <http://cdec.water.ca.gov/reservoir.html>. Accessed 6/27/2016.

Cook, R. D., and J. O. Jacobson. 1979. A design for estimating visibility bias in aerial surveys. *Biometrics* 35:735–742.

Martin, F. W., R. S. Pospahala, and J. D. Nichols. 1979. Assessment and population management of North American migratory birds. Pages 187–239 in J. Cairns, Jr., G. P. Patil, and W. E. Waters, editors. *Environmental biomonitoring, assessment, prediction, and management: certain case studies and related quantitative issues*. International Cooperative, Burtonsville, Maryland, USA.

McLandress, M. R., G. S. Yarris, A. E. H. Perkins, D. P. Connelly, and D. G. Raveling. 1996. Nesting biology of mallards in California. *Journal of Wildlife Management*. (60) 94-107.

National Oceanic and Atmospheric Administration. 2016. National Climatic Data Center – unpublished data. <http://www.ncdc.noaa.gov/>. Accessed 5/15/2016.

Natural Resource Conservation Service. 2016. Snow telemetry – unpublished data. <http://www.wcc.nrcs.usda.gov/snow/>. Accessed 5/15/2016.

Zeulak, D. S., L. M. Barthman and M. R. McLandress. 1991. Revision of the waterfowl breeding population and habitat survey in California. California Waterfowl Association, Sacramento, CA, USA.

Western Regional Climate Center remote automatic weather station. 2016. <http://raws.fam.nwcg.gov/>. Accessed 5/15/2016.

United States Fish and Wildlife Service and Canadian Wildlife Service. 1987. Standard operating procedures for aerial breeding ground population and habitat surveys in North America. Unpublished Manual, United States Fish and Wildlife Service and Canadian Wildlife Service, Laurel, MD, USA. 103 pp.

Figure 1. California Waterfowl Breeding Population Survey Map.

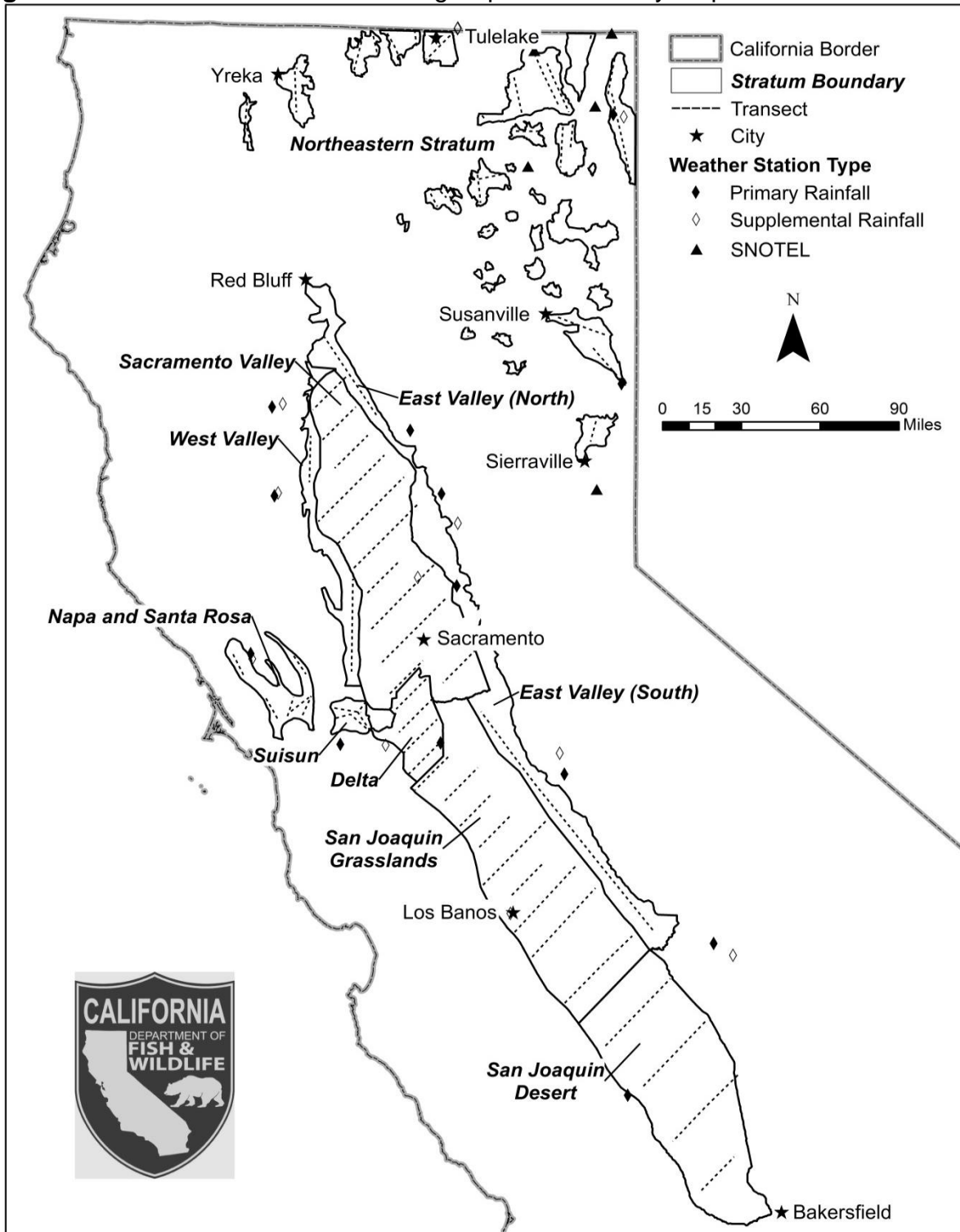


Table 1. California duck, American coot and Canada goose¹ population estimates.

Species	2016		2015		LTA ⁴	% Change from 2015	% Change from LTA
	Pop. Est. ²	SE ³	Pop. Est.	SE			
Mallard	263,774	35,602	173,865	28,175	347,181	+51.7	-24.0
Gadwall	58,379	13,896	58,290	21,787	85,443	+0.2	-31.7
American Wigeon	1,867	623	1,893	839	4,896	-1.4	-61.9
Green-winged Teal	2,862	2,298	2,143	1,621	4,054	+33.6	-29.4
Blue-winged Teal	0	0	0	0	0	---	---
Cinnamon Teal	30,221	7,141	28,534	8,531	41,772	+5.9	-27.7
Northern Shoveler	10,821	3,669	12,834	4,509	32,803	-15.7	-67.0
Northern Pintail	10,372	5,248	772	365	6,418	+1243.6	+61.62
Wood Duck	6,899	1,896	8,421	2,746	8,265	+136.5	-16.5
Redhead	4,089	1,920	1,316	960	3,196	+210.7	+27.9
Canvasback	3,474	1,926	277	191	1,097	+1,154.2	+216.6
Scaup	494	518	1,295	1,195	5,015	-61.9	-90.2
Ring-necked Duck	1,077	478	2,054	2,025	582	+47.6	+85.2
Goldeneye	0	0	0	0	320	---	---
Bufflehead	1,598	868	2,166	1,381	3,073	-26.2	-48.0
Ruddy Duck	21,432	13,905	21,718	19,580	15,312	-1.3	+40.0
Common Merganser	428	262	181	170	463	+136.5	-7.5
TOTAL DUCKS	417,791	41,999	315,577	42,005	557,973	+24.5	-25.4
Canada Geese	44,323	11,234	44,322	16,368	42,662	0.0	-3.9
American Coot	388,628	2,291	470,654	184,344	238,853	-17.4	+62.7

¹Northeastern Canada goose estimates only. Long-term averages generated from 1993-2016.

²Population estimate.

³Standard error.

⁴Long-term average; 1992-2016.

Table 2. Precipitation (inches) data¹ across California Waterfowl Breeding Population Survey strata (2016).

Strata ²	Year	Jan	Feb	Mar	Apr	May	Spring Total	Z-Score
Sacramento Valley ³	2016	50.7	5.4	42.4	5.8		135	-0.52
	LTA ⁴	42.5	42.1	33.1	5.8		104.3	
West Valley ⁵	2016	7.8	0.7	5.5	0.8		14.7	0.19
	LTA	4.4	4	3.6	1.5		13.5	
East Valley (North) ^{6,7}	2016	11.7	1.4	10.5	1.4		25	-0.73
	LTA	11.7	11.8	10.3	4.9		38.7	
Napa/Santa Rosa ⁸	2016	9.2	1.3	8.9	1.4		20.8	0.49
	LTA	4.7	5.1	4.7	1.5		16	
Suisun ⁹	2016	5.8	0.9	5.8	1.4		13.9	-0.94
	LTA	7.8	8.8	5.5	2.7		24.8	
Sac/San Joaquin Delta ¹⁰	2016	4.9	0.5	3.6	2.8		11.8	-0.7
	LTA	7.3	7	0.3	3		17.6	
Grasslands ¹¹	2016	5	0.5	4.1	2.2		2.9	0.02
	LTA	3.8	3.6	2.1	2.1		11.6	
East Valley (South) ¹²	2016	6.3	0.6	5.2	2.2		14.2	0.1
	LTA	3	2.7	4.5	2.5		12.7	
San Joaquin Desert ¹³	2016	4.5	0.2	2	1.2		7.8	-0.17
	LTA	2.5	2.2	2.6	1.3		8.6	
Northeastern CA ¹⁴	2016	9.48	3.71	12.41	7.37	8	40.97	-0.046
	LTA	11.59	8.87	10.36	8.56	10.53	49.9	

¹Data acquired from NOAA NCDC online database or RAWs station online data, long term averages derived from 1990-2016.

²For stratum with large area a sum of precipitation was calculated from numerous weather stations.

³Weather stations used: Stonyford (RAWs), Thomas Creek (RAWs), Paradise (GHCND:USC00046685), Bangor (RAWs) and Lincoln (RAWs), Sacramento (GHCND:USW00023232), and Marysville (GHCND:USC00045385).

⁴Not all station data was complete therefore nearby stations were used as supplements (see Figure 1).

⁵Weather stations used: Stonyford (USC00048580), Thomas Creek (RAWs)

⁶East Valley was separated at Sacramento due to differences in weather to be more informative however BPOP data analyzes this stratum as one.

⁷Weather stations used: Paradise (GHCND:USC00046685), Bangor (RAWs) and Lincoln (RAWs).

⁸Weather station used Santa Rosa (RAWs).

⁹Weather station used: Antioch (GHCND: USC00040232).

¹⁰Weather station used: located in Stockton (GHCND:US1CASJ0011).

¹¹Weather stations used: Green Springs (RAWs), Stockton (GHCND:US1CASJ0011), Los Banos (RAWs) and Modesto (GHCND:USW00023258).

¹²Weather stations used: Green Springs (RAWs) and Francher Creek (RAWs).

¹³Weather stations used: Francher Creek (RAWs), Kettleman Hills (RAWs) and Hanford (GHCND:USC00043747).

¹⁴Weather stations used: Tulelake (GHCND:USC00049053), Cedarville (GHCND:USC00041614), Juniper Creek (RAWs; Alturas), Doyle (RAWs; Honey Lake), Vinton (GHCND:USC00049351; Sierra Valley)

Table 3. Snow-water content (inches) across the Northeastern California survey stratum.

Location	Year	Nov	Dec	Jan	Feb	Mar	Apr	Season Average	Z- Score
Adin Mountain ¹	2016	1.36	6.55	13.26	17.47	16.49	4.74	9.98	0.93
	LTA ²	1.05	3.78	6.81	9.45	11.31	7.53	6.66	
Cedar Pass ³	2016	1.86	8.35	15.52	19.02	19.82	10.24	12.47	0.61
	LTA	1.71	5.23	8.83	12.41	16.13	15.23	9.92	
Dismal Swamp ⁴	2016	1.32	9.63	20.21	27.93	33.22	31.81	20.69	0.79
	LTA	2.34	8.27	14.38	19.78	25.23	26.12	16.02	
Independence Lake ⁵	2016	9.62	16.00	21.02	31.15	43.50	49.85	28.52	0.55
	LTA	2.92	10.36	19.29	27.62	36.76	41.98	23.16	

¹Data from 1985-2016.

²Data from NRCS snow telemetry stations, see Figure 1 for locations.

³Data from 1979-2016.

⁴Data from 1981-2016.

⁵Data from 1979-2016.

Appendix I. Guidelines for California Breeding Pair 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

- redhead: exclude groups greater than 8
- ring-necked duck
- lesser scaup: do not count in Napa and Suisun Strata
- ruddy duck
- Canada goose: count all broods separately
- American coot
- sandhill crane

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

- mergansers
- mallard
- gadwall
- American wigeon: exclude groups
- American green-winged teal: exclude groups greater than 8
- cinnamon Teal
- northern shoveler: exclude groups
- northern pintail
- wood duck
- canvasback: exclude groups
- common goldeneye
- bufflehead

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

California VCFs are to be used for most species. The preference is for 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 abundance in California) use U.S Fish and Wildlife Service VCF.