1

BREEDING WATERFOWL

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CHAPTER SUMMARY

The Central Valley hosts hundreds of thousands of breeding ducks in the spring and summer. The Central Valley Joint Venture applies the goals of the North American Waterfowl Management Plan to create landscape conditions that support abundant and resilient populations of these duck species.

This chapter describes the current status and declining population trends of the three most common nesting duck species in the Valley (mallard, gadwall and cinnamon teal); the landscape changes and limiting factors these species face; and the conservation objectives for the restoration and management of wetlands flooded during the spring and summer breeding season and adjacent upland nesting habitat needed by these species.

The Conservation Delivery chapter in Section I integrates the breeding waterfowl habitat objectives with the habitat objectives for non-breeding waterfowl and other bird groups in the Implementation Plan to present total habitat needs in the Central Valley. The Conservation Delivery chapter then describes conservation actions for achieving these integrated habitat objectives.

HABITAT TYPE

Breeding ducks in the Central Valley require upland and wetland habitats, in proximity to each other. Upland habitats, which are used for nesting, include natural or planted uplands, pasture and certain annual crops (growing or idle). Wetland ponds and planted rice fields that are used for brood rearing contain water in the spring and summer. Post-breeding adults also need wetlands that remain flooded until late summer, during their flightless wing-molt period. Semi-permanent wetlands provide the needed spring and summer habitat and are the most practical option for most land managers.

SUCCESS STORY: Partnerships Enhancing Nesting Habitat on the Conaway Ranch

The importance of upland nesting and brood rearing habitats for California's resident mallard, gadwall and cinnamon teal populations has been well documented and has served as the basis for the California Waterfowl Association's Conservation Programs for the past several decades. In the Yolo Basin, for example, California Waterfowl partnered with federal and state agencies to acquire several thousand acres of wildlife-friendly farming conservation easements and to restore hundreds of acres of wetlands and uplands on the Conaway Ranch.

Upland habitats on the Conaway Ranch are also critically important to tricolored blackbirds, giant garter snakes and a suite of other wildlife species. The Conaway Ranch, owned by a private preservation group, is managed for a mixture of uses including cattle ranching, wildlife friendly-farming, conservation, resource management, flood control and integrated water management.

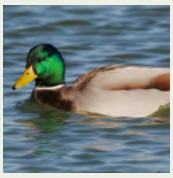
LONG-TERM HABITAT OBJECTIVES: WHAT'S NEEDED?

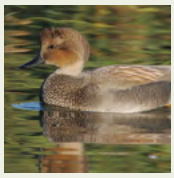
SEMI-PERMANENT WETLANDS:
44,000 ACRES TOTAL
= 21,000 ADDITIONAL ACRES

UPLAND NESTING HABITAT:
177,000 ACRES TOTAL
(Current acreage is not known)

INCLUDES 54,000 ACRES IN THE RICE-GROWING REGION OF THE SACRAMENTO VALLEY

BIRD SPECIES INCLUDE:


Mallard*


Gadwall*


Cinnamon teal*

Images: Tom Grey

(1) Cinnamon teal - Jennifer Barton (2) Breeding duck habitat - Dan Skalos (3) Mallards - Mike Peters

INTRODUCTION

Conservation planning for waterfowl and wetland management in the Central Valley has its origins in the North American Waterfowl Management Plan (NAWMP 2012) and has largely focused on meeting the habitat needs of wintering and migrating waterfowl (ducks, geese and swans). Since its formation in 1988, the Central Valley Joint Venture (CVJV) and its partners have restored thousands of acres of managed wetlands in an effort to meet those needs. While wintering ducks, geese and swans have benefitted under this management paradigm, locally nesting duck species have declined substantially, and their populations are at or near all-time lows (Skalos and Weaver 2019). This chapter addresses the CVJV's objectives for protecting and restoring habitat to support populations of breeding ducks in the Central Valley. Breeding goose populations are robust, and no native swans breed in the Central Valley.

More than 90 percent of restored wetlands in the Central Valley are managed seasonally for waterfowl, along with shorebirds and other waterbirds, during the fall and winter (Petrik et al. 2014). Improved wetland habitat, combined with current agricultural practices (predominantly winter-flooded rice), has benefitted migrating and wintering duck populations in several ways, particularly increased body condition, increased survival and shorter observed flight distances (Ackerman et al. 2006; Fleskes et al. 2007; Thomas 2009; Fleskes et al. 2016; McDuie et al. 2019).

Hundreds of thousands of wintering ducks remain in the Central Valley during the spring and summer to breed. The three most common nesting species are mallards (*Anas platyrhynchos*), gadwall (*Mareca strepera*) and cinnamon teal (*Spatula cyanoptera*). Ducks have additional habitat requirements during the breeding season to what they require in winter or during migration. These requirements include seasonal and semi-permanent wetlands that are flooded during the spring and summer, to serve as foraging habitat for hens and their broods, and adjacent or nearby upland habitats with suitable vegetation for nesting (Baldassarre and Bolen 2006). Post-breeding and resident non-breeding ducks also have specific habitat requirements. During wing molt, when they are flightless for three to four weeks in late summer, ducks rely on semi-permanent or permanent wetlands: these types of wetlands are not prone to drying up in the summer and contain emergent (above-water) perennial herbaceous plants that provide protective cover (Yarris et al. 1994; Kohl 2019).

These additional habitat needs for breeding ducks pose challenges for managers of public and private wetlands in the Central Valley and sometimes require creative conservation strategies that benefit both breeding and non-breeding waterfowl. Providing upland and spring- and summer-flooded wetland habitats in addition to traditional wintering habitat is paramount for sustaining local duck populations. Unfortunately, negative trends in Central Valley breeding duck populations indicate these habitats are not currently available in sufficient quantity and quality to maintain populations. Mallards, the most abundant nesting duck in the Central Valley, are 28 percent below their long-term average (LTA) statewide (Skalos and Weaver 2019) and 44 percent below their LTA in the Central Valley.

Duck hunters play an important role in protecting wetland habitat (see the Human Dimensions chapter in this Implementation Plan). The contribution of locally breeding ducks to hunter harvest in California is significant. Reversing the negative population trend for ducks is therefore important for maintaining engagement from duck hunters, engaging the next generation of hunters, and, in turn, maintaining the habitat in which duck hunters continue to invest. Importantly, 60 percent of the hunter-harvested mallards, 53 percent of the harvested cinnamon teal and 49 percent of the harvested gadwall in California are resident and are hatched and raised locally (de Sobrino et al. 2017). Mallards (20 percent), gadwall (five percent) and cinnamon teal (three percent) combined make up a considerable portion of hunter-harvested ducks in California (mean percent from 1965-2018; Olson 2019; Trost and Drut 2003). These data indicate that local duck production and resident duck populations have a direct impact on hunter success, as well as on the non-hunting public who enjoy waterfowl viewing.

In 2008, the U.S. Fish and Wildlife Service (USFWS) recognized three separate stocks of breeding mallards: eastern, mid-continent and western, each with its own adaptive harvest management (AHM) strategy (USFWS 2008; Yparraguirre et al. 2014). California mallards are now recognized and managed as a component of the western mallard population. Mallards produced within the CVJV's planning regions contribute significantly to and comprise about 17 percent (2010-2017) of the western mallard stock. The western mallard AHM strategy is an important element of Pacific Flyway management, as the status of mallards in western states and

provinces collectively determines the hunting regulations and opportunities there. Improving habitat conditions for locally nesting mallards and other ducks to reverse the population declines contributes to this obligation.

The North American Waterfowl Management Plan Assessment Steering Committee (ASC 2007) reviewed past Joint Venture planning efforts nationwide and identified the actions needed to produce a consistent and cohesive set of habitat objectives across the North American landscape. Those actions, which are consistent with Strategic Habitat Conservation, include Biological Planning, Conservation Design and Conservation Delivery. The CVJV adopted these planning actions to develop the current Implementation Plan ("the Plan"). Strategic Habitat Conservation and these planning actions are explained in more detail in the Non-Breeding Waterfowl chapter and the Planning for Conservation Success chapter.

CONSERVATION GOAL

The Central Valley Joint Venture's long-term goal for waterfowl is to guide regional efforts to create landscape conditions necessary to support abundant and resilient breeding and non-breeding duck populations in the Central Valley at levels that support hunting and other uses, consistent with the North American Waterfowl Management Plan.

Gadwall breeding pair - Mike Peters

BIOLOGICAL PLANNING:
The Science Behind CVJV Conservation Objectives

Planning Regions

Planning regions represent the geographic scale at which the CVJV establishes conservation objectives for breeding waterfowl. The CVJV has two distinct focus areas, the Primary Focus Area (the Valley floor, including the Carrizo Plain) and the Secondary Focus Area (the surrounding foothills/mountains; Figure 8.1). The Central Valley's nine drainage basins within the Primary Focus Area served as the planning units in the 2006 CVJV Implementation Plan (CVJV 2006) (see individual basins in Figure 4.1.1, in the Environmental, Social and Political Landscape: Background subchapter). However, this 2020 Plan combines some adjacent drainage basins into larger planning areas, resulting in five planning regions. The larger extent of planning regions (versus drainage basins) allows increased flexibility for placement of wetland restoration and agricultural easements.

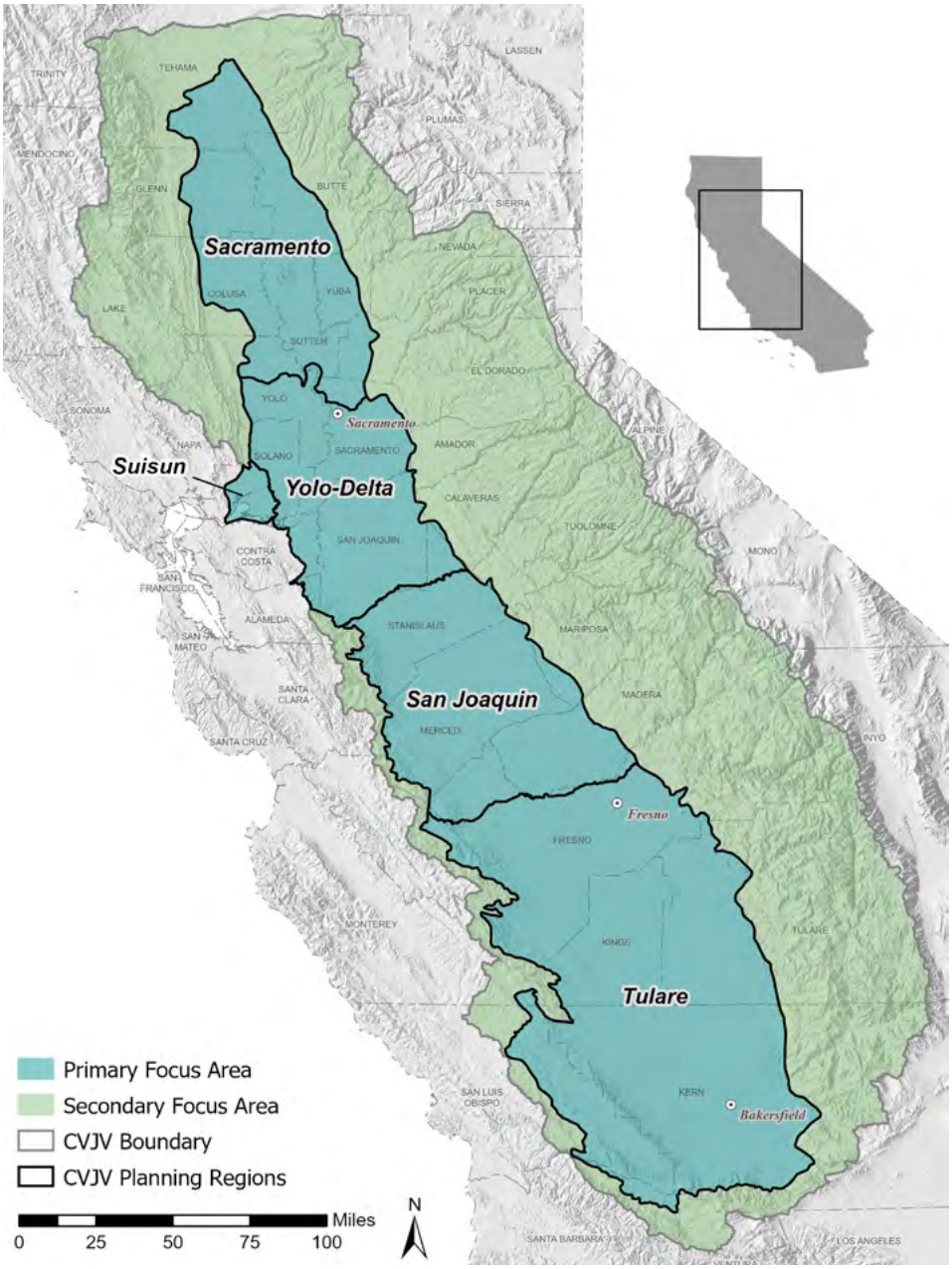


FIGURE 8.1 Central Valley Joint Venture perimeter and Primary Focus Area, divided into five planning regions.

The Primary Focus Area of the Central Valley is the emphasis of planning for breeding waterfowl for several reasons. Most importantly, annual population surveys indicate the Valley floor supports the majority of the breeding ducks within the CVJV boundary. The majority of natural and managed wetlands and agriculture that is complementary to breeding ducks (e.g., winter wheat and rice) occur on the Valley floor. In addition, most of the existing wetlands in this area are actively managed, thus, strategies expected to improve breeding and post-breeding success can be developed and implemented there. In this chapter, unless otherwise indicated, "the Valley" refers to the CVJV's Primary Focus Area.

The CVJV did not develop population and habitat objectives for breeding waterfowl in the CVJV Secondary Focus Area. The mountain ranges and foothills included in the Secondary Focus Area are expansive and include considerable, but dispersed, habitat for nesting ducks. The main habitats in these areas include lakes, rivers and their tributaries, isolated emergent and forested wetlands and human-made stock ponds. The number of ducks and geese inhabiting these areas is unknown, as breeding population surveys are not conducted there. Habitat quality and breeding densities of dabbling ducks are expected to be lower, but perhaps with less variability, than in the Primary Focus Area. Many of the same disturbances and activities seen in the Primary Focus Area have altered these landscapes, but human population

densities are lower and modifications to the habitat are less severe. However, the human population continues to grow, and the extent of urban development and perennial crops continue to expand and to degrade habitats (Cameron et al. 2014; Sleeter et al. 2017; Pandolfino and Handel 2018).

Focal Species

At least 10 species of waterfowl breed in the Central Valley (Skalos and Weaver 2019). Guidelines for selecting CVJV focal species were based on the following criteria:

- The population exists at relatively high abundance in the Primary Focus Area.
- Regional abundance is of high importance to statewide population size and hunter harvest.
- Factors limiting reproduction are relatively well understood, at least at the local scale.
- Population surveys using accepted protocol are conducted to monitor status.

Based on these criteria, the CVJV selected mallards, gadwall and cinnamon teal to use as focal species to direct conservation planning. The combined populations of these three species account for about 85 percent of the breeding ducks in the Primary Focus Area (Skalos and Weaver 2019) and likely represent the habitat needs of the entire dabbling duck guild. Additionally, harvest information indicates that 60 percent of mallards, 49 percent of gadwall and 53 percent of cinnamon teal originate from California breeding stock (de Sobrino et al. 2017). Therefore, maintaining healthy breeding populations of these species for ecological and recreational purposes is a key priority for the CVJV.

Seven other breeding duck species did not meet the focal species criteria. Among dabbling ducks, northern pintails (*Anas acuta*) and northern shovelers (*Spatula clypeata*) were excluded because their breeding populations are small and contributions to the large regional winter population are minor. Wood ducks (*Aix sponsa*) are common local nesters but were excluded because breeding duck surveys do not adequately assess their population size or trends (due to poor detection in their preferred riparian habitat).

Four species of diving ducks also breed in the Central Valley but were not considered because their breeding populations are small relative to wintering populations. They include ruddy ducks (*Oxyura jamaicensis*), redheads (*Aythya americana*), hooded mergansers (*Lophodytes cucullatus*) and common mergansers (*Mergus merganser*). The breeding habitat needs of these species are partially addressed by the objectives in this and other chapters of the Plan where riparian, wetland and upland habitat conservation is prescribed. Breeding redheads are considered a California Bird Species of Special Concern (Beedy and Deuel 2008) and their habitat needs and distribution are given further consideration in the At-Risk Bird Species chapter.

Canada geese (*Branta canadensis*) were excluded from the CVJV's breeding waterfowl conservation objectives because their breeding population index is already well above the long-term average (Skalos and Weaver 2019) and they do not appear to be habitat-limited. In fact, they are considered a nuisance in many areas of California, including parts of the Central Valley (California Code of Regulations, Title 14, Subdivision 2, Chapter 7, 503). Canada geese breeding in the Central Valley are managed using a harvest strategy approved by the Pacific Flyway Council's subcommittee on Pacific Population of Western Canada Geese (Pacific Flyway Council 2000). No other species of goose, and no native swans, breed in the Valley.

Ruddy duck - Mike Peters

Current Population Status and Trends

The Primary Focus Area of the CVJV is the major breeding area for waterfowl in California and it accounts for about 70 percent of all breeding ducks in the state. Northeastern California, which is part of the Intermountain West Joint Venture, also contributes markedly to populations of breeding ducks statewide (Skalos and Weaver 2019). Other areas (e.g., coastal regions and southern California) are thought to support minor populations and are not surveyed at this time (Sauer et al. 2017). The CVJV Secondary Focus Area (especially the foothills region) may contribute a significant share of habitat during wet years; however, no assessment of the overall contribution of this region has been conducted.

The California Department of Fish and Wildlife (CDFW) estimates waterfowl breeding populations in the Valley in April based on results from the annual breeding waterfowl survey (Skalos and Weaver 2019). The annual survey has been conducted in the state since 1948, but the methodology was redesigned and updated in 1991 to be more consistent with continental surveys (Zezulak et al. 1991; Skalos and Weaver 2019). This survey has been ongoing using the new design since 1992 and is part of the regulation guidance under the USFWS adaptive harvest management (AHM) plan for western mallards (USFWS 2019b). Consolidating the nine basins into five planning regions made it possible to derive regional population estimates (D. Skalos, unpublished data, 2019, see "Notes"). Survey data were extrapolated to suitable habitat in un-surveyed areas and to estimate the breeding duck population for the Primary Focus Area as a whole and for each planning region. Changes in breeding duck population abundance and other trends were assessed for the Primary Focus Area and for each of the planning regions using data from the revised surveys.

Current duck populations were calculated using survey data from the past three years (2017-2019). The average of these three years' results was used to reflect the "current" population, rather than just one year, to account for yearly fluctuations inherent to duck populations. Long-term average (LTA) populations represent the average of survey data between 1992, when the survey methodology was updated, and 2019, the latest data available.

Focal species distribution

The Sacramento planning region is historically the major breeding region for mallards in the Valley, comprising an LTA of 38 percent of the Valley's total population of breeding mallards (Table 8.1). In recent years, the proportion of mallards in this region has declined to about 25 percent; the region now ranks third in importance for mallards behind the Yolo-Delta and San Joaquin planning regions (Table 8.1).

Gadwall and cinnamon teal population estimates are more variable. Compared to mallards, these species tend to use areas with less agriculture, more natural habitat and more arid conditions. For gadwall, habitat in the Tulare region supports the greatest portion of the population, with an LTA of

PLANNING REGION	MALLARD		GADWALL		CINNAMON TEAL		TOTAL[a]	
	CURRENT[b]	LTA[c]	CURRENT[b]	LTA[c]	CURRENT[b]	LTA[c]	CURRENT[b]	LTA[c]
Sacramento	25.1%	38.3%	14.5%	16.8%	14.3%	19.0%	22.7%	34.5%
Suisun	9.9%	6.8%	23.2%	21.1%	16.9%	7.9%	12.4%	8.4%
Yolo-Delta	26.3%	22.4%	16.0%	10.7%	11.6%	12.2%	23.7%	20.4%
San Joaquin	25.3%	20.2%	18.8%	24.4%	26.4%	31.1%	24.4%	21.5%
Tulare	13.4%	12.3%	27.5%	27.0%	30.8%	29.8%	16.8%	15.2%
	100%	**100%**	**100%**	**100%**	**100%**	**100%**	100%	100%

[a] *Total of the three focal species.*
[b] *Current population is defined as the mean of the latest three years of breeding population surveys, 2017-2019.*
[c] *LTA (long-term average) is defined as the mean of the 1992-2019 breeding population surveys.*

TABLE 8.1 Current and long-term average (LTA) distribution of duck focal species' breeding populations in the Primary Focus Area of the Central Valley. (Sums may not be exact, due to rounding in original data.)

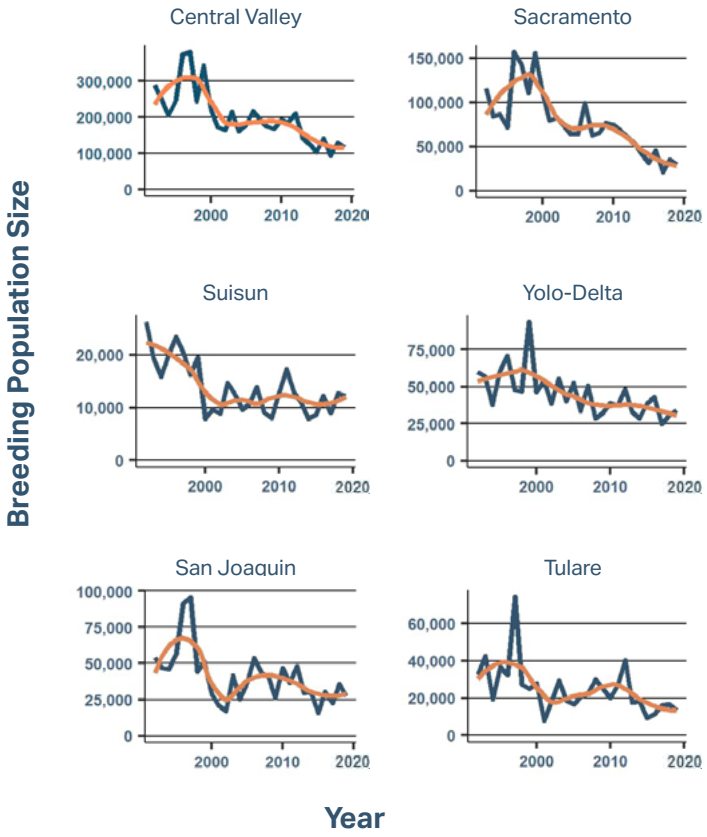


FIGURE 8.2 Breeding mallard population estimates for the CVJV Primary Focus Area and five planning regions, 1992-2019 (orange trend line smoothed using Loess regression with span of 0.50).

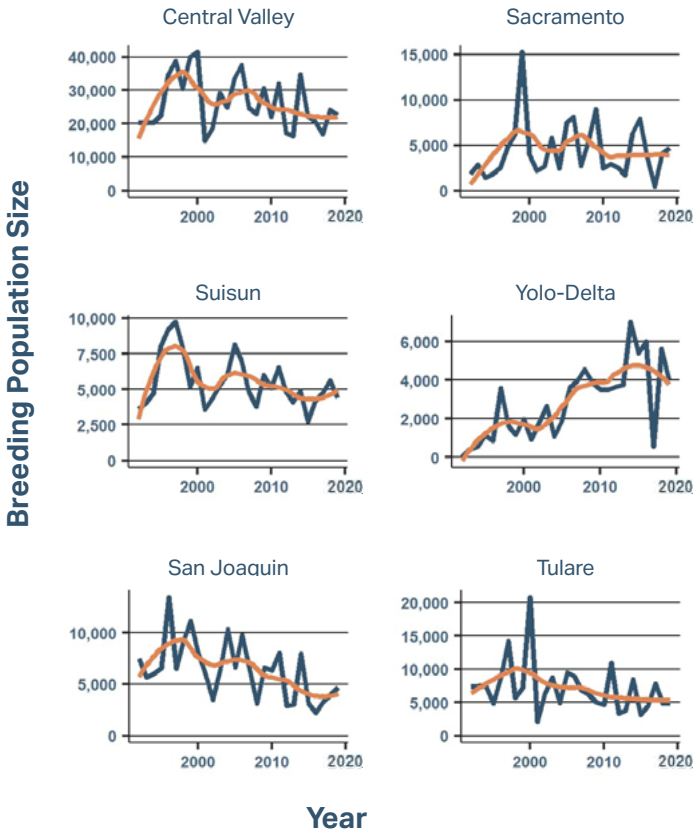


FIGURE 8.3 Breeding gadwall population estimates for the CVJV Primary Focus Area and five planning regions, 1992-2019 (orange trend line smoothed using Loess regression with span of 0.50).

about 27 percent of the Valley's total population (Table 8.1). Breeding gadwall are found in slightly lower numbers in the San Joaquin and Suisun planning regions. The Sacramento and Yolo-Delta planning regions typically contain a smaller portion of breeding gadwall. Cinnamon teal tend to be distributed mostly in the southern portion of the Central Valley, including the San Joaquin region with an LTA of 31 percent and the Tulare region with an LTA of 30 percent (Table 8.1).

Note that planning regions are not the same size, so the proportion of a population does not necessarily reflect a region's importance or the quality of available habitat in a region. For example, when standardized by planning region area, Suisun represents the highest densities of mallards, with a long-term average of 84 ducks per square mile, followed by Sacramento at 20 per square mile. Likewise, in the late 1980s, Suisun had the highest pair and nest densities (McLandress et al. 1996).

Current status of focal species

Table 8.2 shows population numbers, objectives and trends for the three focal species, in the Central Valley as a whole and in each planning region. Figures 8.2, 8.3 and 8.4 depict the population survey data for the three species graphically, showing high and low years and long-term trends.

The current population of breeding mallards within the CVJV boundary is about 113,000 individuals, compared to a maximum population of 386,000 individuals observed in 1997 and a minimum of 104,000 individuals observed in 2015 (Figure 8.2). Overall, mallards are currently 44 percent below the LTA. The most significant disparity occurs in the Sacramento Valley, where the current three-year average is 63 percent below the LTA. Breeding mallard abundance is 34 percent below the LTA in Yolo-Delta region, 30 percent below in the San Joaquin region, and 39 percent below the LTA in Tulare. The mallard population decline in Suisun is less severe than for other planning regions. Although mallard populations are still 18 percent below the LTA in Suisun Marsh, the trends in this region have improved in recent years (Figure 8.2).

The current population of gadwall within the CVJV is 21,000 individuals, compared to a maximum of 41,000 observed in

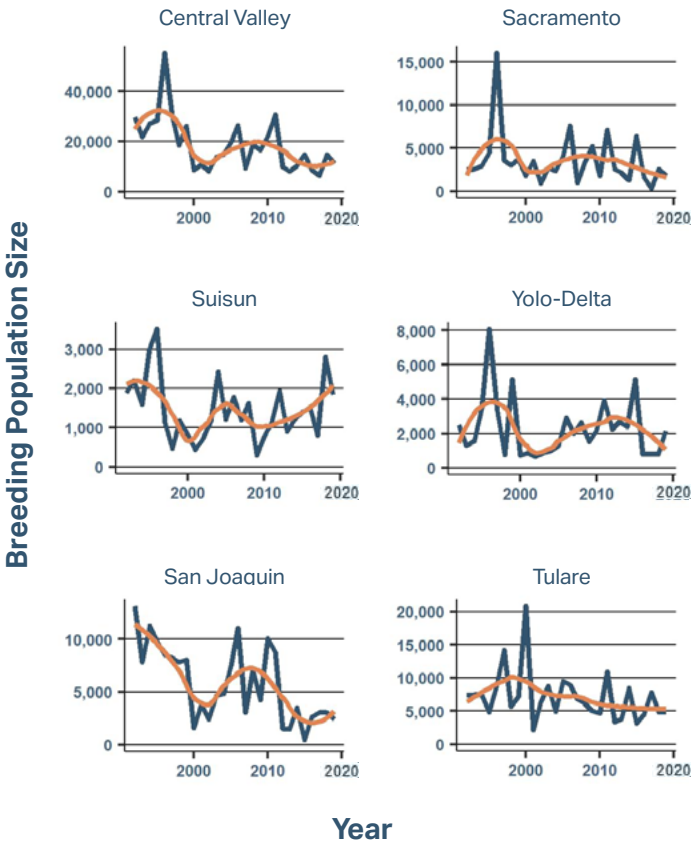


FIGURE 8.4 Breeding cinnamon teal population estimates for the CVJV Primary Focus Area and five planning regions, 1992-2019 (orange trend line smoothed using Loess regression with span of 0.50).

2000 and a minimum of 14,700 observed in 2001 (Figure 8.3). Overall, breeding gadwall have not declined as precipitously as mallards in the Valley but remain 19 percent below their LTA. Gadwall populations were once on the increase in the Sacramento region but began to decline in 2006 and are now 30 percent below the LTA in this region. In the Yolo-Delta region, gadwall populations have continually increased since breeding surveys began in 1992 and are currently 21 percent above the LTA in this area. In the Suisun planning region, gadwall are 11 percent below the LTA and, similar to mallards, are trending upwards. Because mallard populations are declining faster than gadwall populations, the percentage of gadwall nests in Suisun Marsh has increased in recent years from, 17 percent of monitored nests historically (Ackerman et al. 2014) to 48 percent of nests recently (J. Ackerman, unpublished data, 2019a, see "Notes"). Gadwall population estimates are 37 percent and 18 percent below the LTA in the San Joaquin and Tulare planning regions, respectively.

The current population estimate for cinnamon teal is about 10,800 individuals, which is 42 percent below the LTA.

The cinnamon teal breeding population has ranged from a minimum of 6,400 observed in 2017 and a maximum of about 55,500 observed in 1996 (Figure 8.4). By region, population levels are 56 percent below the LTA in the Sacramento, 45 percent below in Yolo-Delta, 51 percent below in San Joaquin, and 40 percent below in Tulare. Cinnamon teal in Suisun have been increasing in recent years and are currently 24 percent above the LTA, although the overall population size of cinnamon teal in Suisun is relatively small.

Population objectives

Background and NAWMP Revision

When the NAWMP was revised in 2012, it provided guidance to Joint Ventures that allowed differing approaches to developing population objectives for their respective regions. Considering the dynamic nature of duck populations, the waterfowl conservation community recommended using a two-part objective to account for the natural variation when establishing population abundance objectives: 1) As the baseline, maintain LTA population levels (50th percentile) for mallards, the primary duck species, and 2) recognizing that populations will be well above the LTA in some years, periodically achieve an 80th percentile abundance level (highest 20 percent of years) for total ducks (NAWMP 2014).

The dual objectives were intended to be complimentary and represent the dynamic nature of waterfowl habitats and populations. Yet NAWMP provided little guidance on the appropriate application or interpretation of these objectives. Furthermore, breeding duck population objectives from the NAWMP cannot be applied directly to the CVJV region because it falls outside the traditional survey area covered by the Waterfowl Breeding Population and Habitat Survey (USFWS 2019a). However, a similar objective-setting process, with slight modifications, was applied to the Central Valley using breeding duck survey information from California.

Revising the Population Objectives

The annual CDFW waterfowl breeding population survey uses fixed and repeated survey transect lines to sample the Central Valley and provide an index of duck abundance. Survey transect data were extrapolated to suitable habitat in areas not surveyed, to estimate the total breeding duck population for the CVJV Primary Focus Area and for each planning region. Using these data, the CVJV calculated the current population abundance, the LTA abundance, the 90th percentile of the LTA abundance (meaning that 90 percent of the years are at or below this population size), and the difference between the current population, the LTA, and 90th percentile of the LTA (Table 8.2).

SPECIES	POPULATION MEASURES				POPULATION TREND	
PLANNING REGION	CURRENT[a]	MINIMUM[b]	OBJECTIVE[c]	DEFICIT[d]	vs. MINIMUM[b]	vs. OBJECTIVE[c]
Mallard (*Anas platyrhynchos*)						
Sacramento	28,309	77,148	117,042	88,733	-63%	-76%
Suisun	11,223	13,618	20,660	9,437	-18%	-46%
Yolo-Delta	29,675	45,048	68,343	38,668	-34%	-57%
San Joaquin	28,568	40,778	61,865	33,297	-30%	-54%
Tulare	15,200	24,776	37,587	22,387	-39%	-60%
CVJV Total	**112,975**	**201,369**	**305,497**	**192,522**	**-44%**	**-63%**
Gadwall (*Mareca strepera*)						
Sacramento	3,088	4,388	6,335	3,248	-30%	-51%
Suisun	4,919	5,542	8,000	3,081	-11%	-39%
Yolo-Delta	3,404	2,807	4,052	649	+21%	-16%
San Joaquin	3,989	6,379	9,208	5,219	-37%	-57%
Tulare	5,837	7,083	10,226	4,388	-18%	-43%
CVJV Total	**21,237**	**26,199**	**37,822**	**16,585**	**-19%**	**-33%**
Cinnamon teal (*Spatula cyanoptera*)						
Sacramento	1,545	3,521	5,669	4,124	-56%	-73%
Suisun	1,817	1,460	2,351	535	+24%	-23%
Yolo-Delta	1,252	2,268	3,652	2,399	-45%	-66%
San Joaquin	2,852	5,775	9,299	6,447	-51%	-69%
Tulare	3,324	5,532	8,907	5,583	-40%	-63%
CVJV Total	**10,790**	**18,556**	**29,878**	**19,088**	**-42%**	**-64%**
Total (focal species)						
Sacramento	32,942	85,058	129,046	96,105	-61%	-74%
Suisun	17,959	20,620	31,012	13,053	-13%	-42%
Yolo-Delta	34,331	50,123	76,047	41,716	-32%	-55%
San Joaquin	35,409	52,932	80,372	44,963	-33%	-56%
Tulare	24,361	37,391	56,720	32,359	-35%	-57%
CVJV Total	**145,002**	**246,124**	**373,197**	**228,195**	**-41%**	**-61%**

[a] *Current population is defined as the mean of the latest three years of population surveys, 2017-2019.*
[b] *Minimum CVJV population objective, defined as the long-term average (LTA) of the 1992-2019 breeding population surveys.*
[c] *CVJV population objective, defined as the 90th percentile of the LTA of the 1992-2019 breeding population surveys.*
[d] *Population deficit, the difference between the population objective and the current population.*

TABLE 8.2 Population abundance, population objectives and population trends for breeding duck focal species, in the Valley as a whole and by planning region. (Sums may not be exact, due to rounding in original data.)

Gadwall brood - Mike Peters

The CVJV used guidance from NAWMP (2014) to establish dual population objectives, but interpreted the guidance using available information for local waterfowl populations and habitat conditions. NAWMP objectives are based on the traditional survey area in the mid-continental United States and Canada, where estimates of total breeding ducks in recent years were above the LTA (USFWS 2019a). In contrast, the breeding duck populations in the Central Valley are well below their LTA and have been for several years (Table 8.2). Additionally, the LTA for mid-continent duck populations is based on surveys since 1955, so these data represent a wide range of breeding habitat conditions from a longer time period. Breeding duck surveys in the Central Valley have only been conducted since 1992, a period less than half as long as surveys in the traditional survey area. The CVJV considered these differences and other regional factors when applying NAWMP guidance to population objectives.

The CVJV did not consider the LTA of a rapidly declining population as an acceptable population objective for planning or even as a baseline population level. Rather, the CVJV interpreted the LTA as an absolute minimum acceptable level. The population dropping below this level will accelerate conservation efforts for breeding ducks. Further, the CVJV interpreted the 90th percentile of the LTA as the population objective to strive for every year, rather than the population level that would occasionally be achieved due to fluctuations when conditions are optimal. The California duck breeding population has exceeded the 90th percentile of the LTA during 10 percent of the years since 1992 (almost 30 years). This information indicates that landscape conditions capable of periodically providing breeding habitat above the 90th percentile level are achievable. For example, during the five-year period from 1995-1999, the mean population size for mallards was 317,685 birds, which is greater than the 90 percent of the LTA (305,497). Moreover, breeding duck populations historically far exceeded objectives proposed here; they declined as a result of the tremendous (more than 90 percent) wetland loss in the Central Valley in modern times (Frayer et al. 1989).

Breeding population objectives for each focal species for the CVJV and within each planning region were established using the above criteria (Table 8.2).

- The LTA of the breeding population for each species is considered the **minimum population objective.**

- The 90th percentile of the LTA is set as the **long-term population objective.**

Mallard pair - Mike Peters

Current Status Relative to Population Objectives

Current population estimates and 90th percentile abundance values were used to calculate abundance deficits for the three focal species across the CVJV Primary Focus Area and in each of the five planning regions. Abundance deficits are the long-term population objective minus the current population estimate. Based on abundance estimates for the CVJV Primary Focus Area as a whole, current populations for the three focal species total about 145,000 breeding ducks. Achieving the 90th percentile population abundance objectives for these three species requires an increase of 228,000 breeding ducks. This increase will require a 61 percent increase in the combined abundance of these three species. Furthermore, the combined population of the focal species is 41 percent below the minimum population objective (Table 8.2).

All three focal species currently have significant population deficits relative to their long-term objectives and all are below their minimum population objectives. Numerically, mallards have the largest population deficit: they are about 193,000 ducks (63 percent) below the Valley-wide objective. Mallards are well below their objectives in all planning regions, but the largest deficit is in the Sacramento planning region. Achieving the long-term population objective there (approximately 117,000 individuals) would require more than a fourfold increase in the current population (Table 8.2).

The population deficit for gadwall is less than for the other focal species, but still well below (33 percent) the Valley-wide long-term population objective of about 38,000 breeding

ducks. The population deficit for gadwall is more than 3,000 ducks below regional objectives in the Sacramento, Suisun, San Joaquin and Tulare planning regions (Table 8.2). In the Yolo-Delta planning region, breeding gadwall are closer to, but still below, population objectives.

Cinnamon teal have the largest deficit relative to their population objective; their current population of about 10,800 is 66 percent below the Valley-wide long-term objective of about 30,000 individuals. In all planning regions except Suisun, cinnamon teal are at least 60 percent below their population objective (Table 8.2). The largest population deficits for cinnamon teal are in the southern planning regions (San Joaquin and Tulare), which historically supported more than half the breeding ducks for this species. In the Suisun planning region, the cinnamon teal population is 24 percent above the minimum population level (the LTA), but still 23 percent below the long-term objective.

Life-Cycle Modeling and Limiting Factors

Biological models provide a means for effective conservation planning by translating population objectives into habitat objectives. The CVJV translated population objectives for non-breeding waterfowl into habitat objectives (as acres of foraging habitat), based on estimates of how much food energy will be needed by duck populations that have reached the population objectives (see the Non-Breeding Waterfowl chapter). Developing models for the breeding season is more complex, because waterfowl behavior and habitat requirements change depending on the stage of the life cycle (Johnson et al. 1992). Currently, there is no clear link between population objectives for breeding waterfowl and the amount and types of habitat needed in the Central Valley to support them.

Identifying population-limiting factors and understanding these factors' ecological relationships to habitat are essential when developing habitat objectives and conservation strategies. Vital rates (factors affecting population growth, such as nesting success and duckling survival rates) are available for breeding mallards in the Central Valley from several published and unpublished sources (CVJV 2006, Table 5-2; Feldheim et al. 2018). This information has improved researchers' knowledge of locally breeding ducks and simple demographic models have been developed (Oldenburger 2008). However, the understanding of factors influencing the population growth of locally nesting species in the Central Valley remains incomplete. Thus, the CVJV relied on both local data and published information from other regions to explore possible limiting factors and to develop habitat objectives.

There is convincing evidence that dabbling duck population growth is primarily influenced by habitat quality and quantity during the breeding season, and that it is most responsive to vital rate changes during this period.

Demographic models for mallards indicate that mortality outside of the breeding season (such as hen survival) can inhibit population growth in some areas (Hoekman et al. 2006), including California, but that various factors during the breeding season are more significant (Hoekman et al. 2002; Oldenburger 2008; Dugger et al. 2016). The breeding season vital rates most important to population growth include breeding propensity (the likelihood a hen will nest), nest success and duckling survival.

However, the non-breeding season also includes the annual wing molt, a potentially vulnerable period for adult ducks because they are flightless, have increased energetic demands, and have specific habitat needs that are limited in the Central Valley (Yarris et al. 1994; Fleskes at al. 2010; Kohl 2019).

The focal species included in this chapter are residents of California for most or all of the year and thus, they require habitat to fulfill their needs during their entire annual life-cycle. Habitat conditions during the non-breeding period have improved considerably since the formation of the CVJV. However, to increase the populations of focal species, it will be most effective to focus on habitats required during the breeding season, and to target the vital rates most likely to increase the production and survival of ducklings. In doing so, it is still important to recognize the cross-seasonal relationships in ducks between wintering habitats and survival and breeding success (Devries et al. 2008; Sedinger and Alisauskas 2014).

CONSERVATION DESIGN:
How Much Conservation, of What Type, and Where?

Characterization of the Landscape

Breeding populations of all three focal species have declined throughout the Central Valley, indicating that factors acting at a landscape-level are likely involved. However, differing rates of decline among planning regions and among duck species indicate certain factors may be unique to each area. Nesting ducks rely on a wide variety of upland habitats, ranging from undisturbed grassland habitat to intensively farmed cropland. Some spatial and tabular data are available to evaluate upland trends, but a thorough analysis of changes in land cover types important to nesting ducks is currently lacking.

Spatial data and crop statistics are available to assess trends in agriculture, and some preliminary evaluations relative to breeding duck populations have been completed (D. Skalos, unpublished data, 2020; M. Cassazza, unpublished data, 2019, see "Notes"). Changes in the extent of managed wetlands in the Valley is well-documented by agencies and organizations involved in wetland protection and restoration (e.g., Petrik et al. 2014). However, wetland type and management (specifically, hydroperiod – the timing and duration of flooding – and the depth of flooding) is difficult to determine, so it is uncertain how much of each wetland habitat type is available during the breeding season in any given year.

The rural landscape in the Central Valley has changed dramatically since breeding waterfowl surveys were revised in 1992. Many changes, some of which are permanent, are having detrimental impacts on breeding waterfowl habitat. Urban development is expanding into rural areas in the Valley due to the lack of affordable housing in coastal areas, improving local economies and an increasing human population. The urban footprint in the CVJV Primary Focus Area has increased by 42 percent since 1992, from 680,000 acres to 970,000 acres (CDOC 2019).

Changes in cropping patterns have also been significant. Most noticeable has been the shift from annual crops to perennial crops, especially almonds (and other tree nuts), olives and vineyards (Coates et al. 2017). In 1992 there were about 650,000 acres of tree nuts planted in the CVJV planning area; today there are more than 2 million acres, an increase of more than 200 percent (USDA 2019b). Loss of annual crops and pasture is significant because annual crops are generally compatible with breeding ducks, whereas orchards and other perennial crops are not. For nesting ducks, the increases in orchards have come at the expense of annual crops such small grains (wheat and barley, reduced by almost 70 percent) and field crops (alfalfa and other hay/seed crops, reduced by more than 20 percent). Other beneficial breeding habitats such as rangeland and pasture have decreased by about 15 percent.

Mallards will readily nest in wheat and oats when planted near wetlands or rice (Loughman et al. 1991; Matchett et al. 2006). Furthermore, fields with annual crops can be fallowed as part of a crop rotation, or during periods of drought when irrigation water is not available or is designated for other uses (e.g., water transfers), whereas orchards remain in production every year. Fallow fields, especially when planted with a cover crop, are used by nesting hens of all three focal duck species (Yarris and Loughman 1990; Loughman et al. 1991, CWA 2013).

Landscape Changes and Breeding Duck Populations

Habitat changes on survey transects

A recent analysis of data comparing land use in 1998 versus 2016 along the CDFW breeding duck survey transects indicates that the amount of breeding habitat has declined by 17 percent in that time period (Figure 8.5; M. Cassazza, unpublished data, 2019, see "Notes"). This analysis shows that land uses that provide habitat for breeding ducks, which include wetlands, rice, pasture and other annual crops, have declined substantially, while incompatible land uses such as orchards, vineyards and urban development are increasing. Overall, potential breeding duck habitat within the transects in the CVJV area declined by about 70,280 acres (17 percent) due to conversion to incompatible land uses.

Conversion to orchards accounted for 64,450 fewer acres (16 percent) of duck habitat across transects. Relative to the respective total area of each type of habitat, conversion to orchards represents a six percent loss of rice, 13 percent loss of pasture and 22 percent loss of other annual crops. Relative to the respective area of each habitat, conversion to urban uses represented 0.24 percent loss of wetland, two percent loss of pasture and two percent loss of other annual crops. Wetland was the only habitat to increase during the 18-year period (14 percent more wetland in 2016 than 1998), the result of restoration of wetlands on former rice fields, pasture and other annual crops. Impacts on habitat area varied among regions, with greater loss occurring in the southern Central Valley, where greater than 25% habitat loss occurred on portions of survey transects (San Joaquin and Tulare planning regions; Figure 8.5).

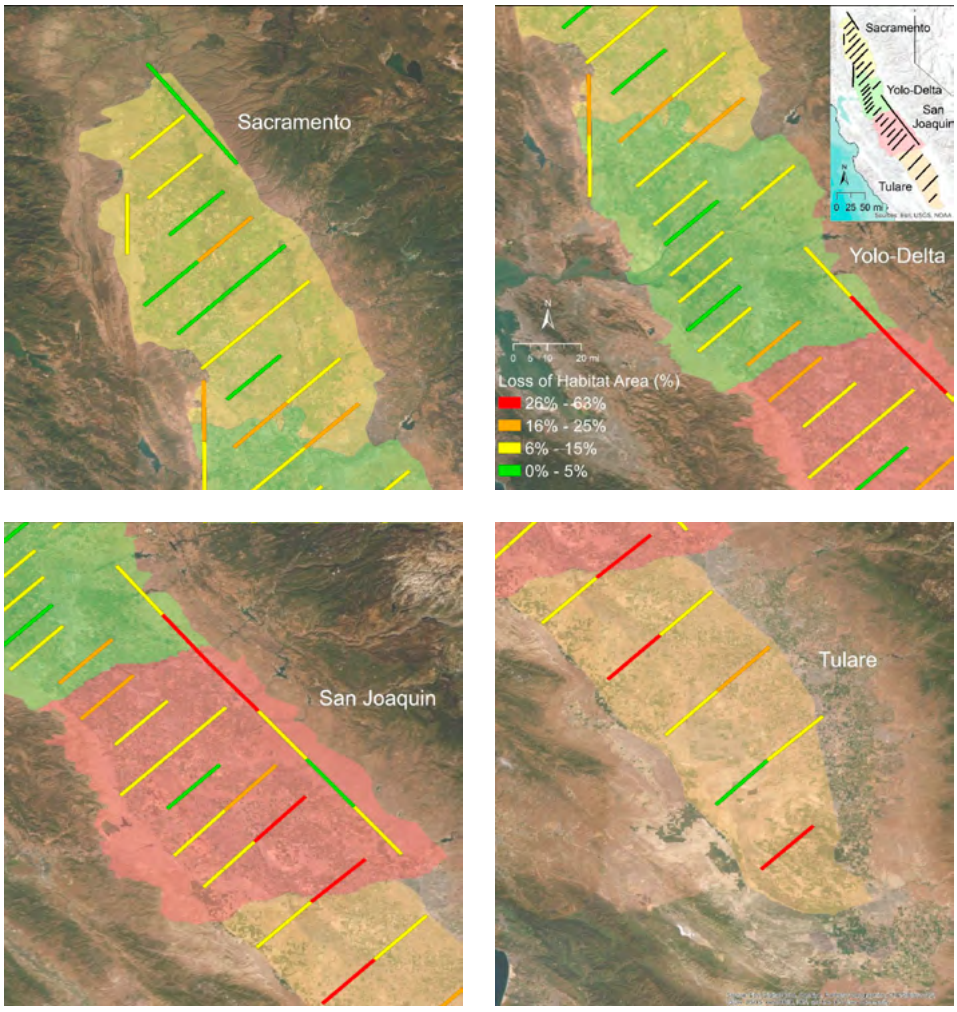


FIGURE 8.5 Change in available potential waterfowl breeding habitat from 1998 to 2016 in waterfowl breeding population transects surveyed in the Central Valley. Habitat includes managed wetlands, annual cropland and pasture. Non-habitat includes orchards and vineyards, forests and urban areas. Inset shows survey transects within four Central Valley planning regions (Sacramento, Yolo-Delta, San Joaquin and Tulare). Four panels, one for each region, indicate the percentage change in area of potential breeding habitat between the years 1998 and 2016.

Trends in agriculture

The relationship between the annual number of breeding mallards and the extent of various crops in each planning region (excluding Suisun, because of limited agriculture in that region) were recently examined using simple linear regression models to explore what might be affecting the long-term decline of mallards and to direct conservation priorities (D. Skalos, unpublished data, 2020, see "Notes"). These relationships are not causal, yet they do provide insight when considered together with other factors (e.g., weather and wetland availability) and expert opinion. The relationship between changes in dominant agriculture classes and decline of mallard breeding populations was similar in all planning regions, namely, there was a negative correlation between acres of tree crops and urban development and the number of breeding mallards. Conversely, there was often a positive correlation between crops that provide upland nesting habitat (e.g., row crops, field crops and pasture) and the number of breeding mallards.

Mallard population and land use change relationships appeared strongest in the Sacramento planning region (D. Skalos, unpublished data, 2020, see "Notes"). Mallards are more reliant on agricultural lands for breeding in this region, which could explain the trend. Mallards readily use flooded rice field habitat during the spring because the timing of planting and flooding of the fields coincides with the nesting season. Small grain crops, especially winter wheat, as well as hay and other irrigated annual crops compatible with nesting mallards, are often grown in association with rice, providing an attractive mix of upland and aquatic habitats (Earl 1950; Loughman et al. 1991; Matchett et al. 2006). However, small grain crops are also the crop types most likely to be converted to perennial crops (e.g., orchards) because of suitable soils, existing irrigation infrastructure and water rights and the relatively low profitability of wheat, hay and other annual crops. Thus, conversion of these annual crop types in proximity to flooded rice fields and natural wetlands is likely contributing to the decline of mallards in the Sacramento Valley.

Other contributing factors

Trends in potential nesting habitat in agricultural areas are well-documented, but changes in status or condition of other upland areas have not been examined. A considerable amount of natural upland area exists in association with private and public wetlands; changes to these habitats could influence use by or success of nesting ducks. For example, changes in plant species composition or vegetation structure related to various factors can influence use of potential nesting habitats. Invasive plants (e.g., Himalayan blackberry [*Rubus armeniacus*], star thistle [*Centaurea solstitialis*], pepperweed [*Lepidium* sp.] and the *Phragmites* reed [*Phragmites australis*]) can reduce habitat suitability for nesting hens. Increased woody vegetation, either through natural succession or by planting trees and hedgerows, is known to negatively influence use of habitat by grassland-nesting birds (Bakker 2003).

Additionally, changes to nesting densities (Ackerman et al. 2004), to predator populations (Croston et al. 2018) and to the populations of other prey species that duck predators also target (Ackerman 2002) can all have substantial effects on duck nest survival. Increases in certain predators (e.g., common ravens [*Corvus corax*], American crows [*Corvus brachyrhynchos*] and various raptors) have also been documented in areas of the Central Valley (Coates et al. 2017). Expansion of existing wetlands into adjacent uplands, although beneficial to non-breeding waterfowl and other waterbirds, can be detrimental to nesting ducks in areas where the lack of suitable upland habitat is limiting reproduction. Shifts in climate may also be contributing to recent declines in mallards and other nesting birds (Ackerman et al. 2011), as these declines coincide with record high temperatures and below-normal precipitation. Breeding duck populations were especially suppressed during the recent drought from 2011 to 2017 (Skalos and Weaver 2019). The influence of these climate-related changes is largely unknown and more subtle than widespread changes in agriculture or complete habitat loss from urbanization. However, they should not be ignored, especially in areas where ducks are less dependent on agriculture but still in decline.

Wetland Trends

Changes in wetland habitat available during spring and summer for breeding ducks and their broods are more difficult to track than changes in agricultural lands, and thus have not been documented (nor have trends in natural uplands for nesting habitat). The total extent of managed wetlands has increased since the formation of the CVJV in 1988 (see the Conservation Delivery chapter). However, most of these restored wetlands are managed seasonally for migrating and wintering birds and are typically dry during the summer. A small fraction of these wetlands is managed as permanent or semi-permanent wetlands and thus are available during the breeding season. However, the wetland acreage available in any given season is highly variable and dependent on a number of factors, such as management goals and priorities, water availability and/or cost, and the annual maintenance budget.

The historical long-term loss of permanent and semi-permanent wetlands is well-documented and is proportionately greater than the loss of seasonal wetlands (Frayer et al. 1989; Heitmeyer et al. 1989; California State University Chico 2003). The amount of permanent and semi-permanent wetlands available annually since breeding waterfowl surveys were initiated in 1992 is not well understood, so any correlation to the decline of locally breeding ducks is uncertain. (Also note that these two types of wetlands are often grouped together) Importantly, the documented declines in California breeding duck populations occurred after most of these large-scale wetland losses, meaning that the loss of wetlands alone cannot explain the decline in breeding ducks over the past two decades.

The overall acreage of all types of wetlands available within the breeding duck survey transects has increased by 14 percent since 1998, based on a recent analysis of land cover changes (M. Cassazza, unpublished data, 2019, see "Notes"). However, the management goal and hydroperiod of these wetlands – for example, whether a particular wetland is flooded year-round or only during some part of the year – is unknown. Consistent with management of most wetlands in the Valley, more recently restored wetlands are likely dry during the spring and summer.

An analysis of satellite imagery from 2009 quantified the extent of wetlands in the CVJV planning area and determined the proportions managed as either seasonal or as permanent/semi-permanent (Petrik et al. 2014). The results of this study indicated a total of 201,200 acres of managed wetlands in the Valley. Approximately 10 percent (21,000 acres) were still flooded in June and were likely managed as permanent or semi-permanent wetlands (this study referred to both types of wetlands collectively as semi-permanent). There were geographic differences in the proportion of wetlands managed as semi-permanent, ranging from four percent in the San Joaquin planning region to about 16 percent in the Suisun and Yolo-Delta planning regions. The Sacramento planning region and Tulare planning region had about seven percent and 11 percent classified as semi-permanent wetlands (planning regions adapted from planning basins in Petrik et al. 2014).

Mallard nest - Mike Peters, USFWS

From 2009 to 2015, an additional 17,300 acres of wetlands were restored, bringing the total amount of managed wetlands to 218,500 acres (D. Fehringer, unpublished data, 2016, see "Notes"). The CVJV assumed 10 percent (1,730 acres) of recently restored wetlands were managed as permanent/semi-permanent, consistent with the 2009 mapping results. The analysis of 2009 imagery also considered ownership (private or public) when delineating wetland habitat and showed that private wetlands had a slightly greater proportion managed as permanent/semi-permanent compared to public wetlands. Roughly two-thirds of the total wetland area in the Valley is under private ownership.

Because the last evaluation was conducted in 2009 and only considered a single year (Petrik 2014), it is unknown if the amount of spring- and summer-flooded wetlands from that study represents the current situation. The recent drought in California (2011-2017) gave rise to several water policy changes (e.g., the Sustainable Groundwater Management Act). These changes, combined with increasing competition for water, changing water prices and other factors, may have changed the distribution and amount of wetlands flooded during the spring and summer.

Rice fields are an important surrogate "wetland" in the Sacramento Valley, providing important habitat for breeding ducks and their broods (Earl 1950; McLandress et al. 1996; Yarris 2008). The amount of rice planted annually during the last three years (average of 482,300 acres; 2017-2019) is similar to the 10-year period when mallards were most abundant (average of 480,300 acres; 1992-2001) and only slightly lower than the average planted annually since breeding duck surveys were initiated in 1992 (average of 508,600 acres; 1992-2019) (USDA 2019a).

Developing the Habitat Objectives

A key assumption in waterfowl habitat conservation is that habitat conservation programs can have a positive impact on the vital rates limiting the population during specific life cycle events (Reynolds et al. 2001). The habitat improvements most likely to increase breeding duck populations in the Central Valley include increasing the amount of wetlands available in spring and summer for breeding ducks, and increasing the amount of, and enhancing the quality of, upland habitat used for nesting.

Wetland habitat

Most wetlands in the Central Valley are managed. The hydroperiod and depth of flooding is artificially manipulated depending on the management goal and the availability of water. There are four basic wetland management strategies in the Central Valley: seasonal; reverse-cycle; semi-permanent; and permanent (these last two types are often grouped together).

Seasonal wetlands are generally flooded October through March (and are commonly drained and irrigated in spring and summer to promote wetland plant seed production). Reverse-cycle wetlands are flooded approximately March through July. Semi-permanent wetlands are generally flooded October through July. Permanent wetlands are flooded year-round. All provide benefits to locally nesting ducks, albeit at different stages of the breeding or post-breeding cycle. At a minimum, wetland habitats of some type should be flooded and available for breeding and post-breeding ducks in the spring and summer period from April 1 to August 1.

For many wetland managers, the primary goal of managing seasonal wetlands is to provide energetic resources (food) for waterfowl during the fall and winter. Water levels in seasonal wetlands are typically drawn down in spring to stimulate new growth of desired forage (moist-soil) plants (Heitmeyer et al. 1989). Seasonal wetlands provide important habitat for breeding duck pairs just prior to nesting, especially if water is not drawn off until April or May. However, this wetland type does not benefit duck broods, except temporarily for early-hatched broods or in situations where swales or perimeter

"borrow" ditches are left flooded through summer (Chouinard and Arnold 2007). Seasonal wetlands can provide "upland" nesting habitat if water is removed before the nesting season and new growth or residual wetland vegetation provides enough cover to conceal nests. (Note, however, that the effectiveness of this type of vegetation as nesting habitat has not been thoroughly evaluated; it is thought to be less used than more traditional upland habitat.)

Reverse-cycle wetlands are a less common type of seasonal wetlands. They are only flooded during the spring and summer (March to August) and are dry during the fall and winter. The dry period during the fall and winter allows annual grasses and other herbaceous plants to become established. When flooded during the spring, the decomposing vegetation provides optimal conditions for invertebrate production beneficial to breeding ducks and ducklings. Reverse-cycle wetlands have been documented to have approximately four times the duckling survival of semi-permanent wetlands (Chouinard and Arnold 2007). This increased survival rate over the more-continuous flood period of permanent and semi-permanent wetlands is likely because of improved invertebrate food resources resulting from their long drying period and lower vulnerability to predators (de Szalay et al. 2003; Chouinard and Arnold 2007).

Semi-permanent wetlands are flooded for most of the year, but water is removed for a short period (typically six to eight weeks) in late summer or early fall. When managed for breeding ducks, the water level is usually maintained continuously until late July or early August. The presence of summer water encourages tules, cattails and other emergent plants that provide cover for duck broods and molting adults. Wetland maintenance and nutrient cycling includes vegetation manipulation (disking, burning, etc.) during the dry period prior to flooding in the fall. In many cases, semi-permanent wetlands that reach an ecological steady state are left dry during the summer to control invasive plants that become established under the extended hydroperiod.

Permanent wetlands remain flooded throughout the year and, depending on the water depth and clarity, provide a mixture of emergent vegetation and open water with submergent aquatic vegetation (most or all of the plant structure is submerged). Permanent wetlands typically support a diverse but relatively small invertebrate population, due to low primary productivity associated with stable water levels and vegetation associated with a steady-state ecosystem. Permanent wetlands provide habitat for breeding adults and broods and are especially valuable to post-breeding molting adults in mid- to late summer (Kohl 2019). Redheads, ruddy ducks and mallards will nest in robust emergent vegetation in both semi-permanent and permanent wetlands (Maxson and Riggs 1996).

Upland habitat

Characteristics of uplands attractive to nesting dabbling ducks include the presence of vegetation (residual or new growth) that is tall (greater than 12 inches) and dense enough to conceal incubating hens and their nests (Ackerman et al. 2009); locations reasonably close (less than half a mile) to wetlands or other water sources (e.g., rice fields, waterways); and the presence of relatively few trees or other potential roost sites for avian predators. When upland vegetation is not suitable to provide nesting cover but the other two conditions are met, planted cover crops or grasses can increase use by and success of nesting ducks (Loughman et al. 1991).

Mallards, gadwall and cinnamon teal use a diversity of upland and wetland habitats for nesting (Baldassare 2014). Mallards are especially adaptable and use a variety of agricultural and natural habitats for nesting. Mallards in the Central Valley nest in predictable cover types, such as annual and perennial grasses, but also in fields of herbaceous plants and shrubs, growing crops (especially oats and winter wheat), cover crops, fallow or idle farmland, and over water in emergent wetland vegetation (McLandress et al. 1996). Upland cover types used by nesting gadwall are similar to mallards, but in the Valley gadwall do not commonly nest in growing crops such as winter wheat or over water in wetland vegetation (although these habitats are used by nesting gadwall elsewhere; Maxson and Riggs 1996, Skone et al. 2016). Cinnamon teal also use a variety of cover types for nesting but generally prefer sites closer to water than mallards or gadwall, and they typically require shorter vegetation for nest concealment.

The amount of existing nesting habitat available to breeding ducks in the Valley is unknown. There is considerable spatial land cover data for the CVJV planning area, but it has not been analyzed recently, nor has it been analyzed relative to the ecological requirements of the three focal breeding species. Because of the importance of agriculture to nesting ducks (especially mallards), only an analysis using relatively current data would be meaningful, given the significant land use changes that have occurred since the last Implementation Plan in 2006. An inventory of nesting habitat suitable for mallards, gadwall and cinnamon teal in each of the planning regions remains a priority for the CVJV.

Using the abundant nesting information available for mallards, the CVJV determined the amount of nesting habitat needed to support the population at the level of the minimum objective (the LTA) and at the long-term objective (the 90th

percentile of the LTA). Because mallards are the most numerous focal duck species for the CVJV, providing enough nesting habitat to meet the needs of the mallard population when it has reached the long-term objective should also meet the needs of gadwall and cinnamon teal populations. The CVJV's long-term objective for breeding mallards is 305,500 individuals and the minimum objective is 201,400 (Table 8.2).

In order to estimate the amount of upland nesting habitat needed to maintain this breeding population, a series of assumptions were made using historical nesting data. Nesting uplands would need to be located within five miles of final brood wetlands and no more than 0.5 miles from the nearest wetland that the ducks can use as transit water from the upland nesting field to the final brood wetland. Assuming half of the breeding mallards are female, then nesting habitat for 152,750 mallard hens is needed to meet the needs of the long-term population objective. Using this target breeding population of hens and dividing this number by their expected nest density allows the CVJV to estimate the required amount of nesting habitat.

The expected density of nesting hens was estimated as the observed nest density of 1.42 nests per acre (arithmetic average of Grizzly Island Wildlife Area nest studies from 1985 to 2004 and 2008 to 2009; J. Ackerman, unpublished summary data, 2019b, see "Notes"). An estimated 57 percent of hens will re-nest after a failed nest attempt, that is, after losing a nest to egg predation or other factors (Arnold 2009). When adjusting the nest density to account for the estimated number of nests that are from re-nesting hens, the estimated nest density of 1.42 nests per acre is reduced to 0.86 nests per acre. (Nest density and success were estimated using the method of Mayfield; see Miller and Johnson 1978).

Dividing the 152,750 mallard hens needed to reach the Plan's objectives by the expected density of 0.86 nests per acre results in an estimated upland nesting habitat requirement of 176,900 acres, located near suitable brood rearing wetlands that are flooded in the spring and summer from April 1 to August 1. Similarly, for the minimum population objective of 201,400 mallards, or 100,700 hens, an estimated upland nesting habitat requirement of 116,600 acres would be needed.

This upland habitat requirement estimate should be used with caution. It is based simply on the amount of upland nesting habitat needed to provide hens with enough space to continue to nest at their long-term average nest density. The current assumptions are that the available nest densities and nest success used are typical for most nesting areas in the Valley, and that nest densities, nest survival and re-nesting potential do not vary with the number of breeding hens. These assumptions are likely to be incorrect. Grizzly Island Wildlife Area nesting densities are generally higher than those in other areas of California (McLandress et al. 1996), so estimated acres of habitat suggested here likely underestimate what would be needed to adequately support the breeding populations at objectives. However, this estimate provides an approximation based on current data and information, and on the limited modeling resources available.

Upland nesting habitat needed to meet the population objective for mallards

Number of Acres=

(target number of breeding hens) x
{(Nest Density per Acre x Nest Success) +
(Nest Density per Acre x [1- Nest Success]) –
([Nest Density per Acre x [1- Nest Success] x 0.57)}

CONSERVATION DELIVERY:
Defining the Habitat Objectives

Wetland Habitat

The specific long-term habitat objective is to increase the area of wetlands currently managed as semi-permanent in the Central Valley to 20 percent of the current wetland base (Table 8.3). Generally, managers designate five to 15 percent of the wetland habitat as summer water for resident wildlife. The most recent assessment (in 2009) indicated that about 10 percent of the total wetland area (of all types) is managed as semi-permanent (Petrik et al. 2014). Another analysis, of a smaller number of recent wetland restoration projects from 2009-2015, indicated less than five percent were managed as semi-permanent (C.M. Brady, unpublished data, 2019, see "Notes"). Increasing the acreage from 10 percent to 20 percent of the current wetland base (2015 data) would add an additional 21,000 acres of semi-permanent wetlands (Table 8.3). The CVJV recommends increasing semi-permanent wetlands to meet habitat objectives, primarily by restoring additional wetlands, but also by altering the management of seasonal wetlands if impacts to non-breeding waterfowl are minimal.

Increasing the amount of semi-permanent wetlands will boost the dabbling duck population in several ways. It will increase breeding propensity and effort by providing additional food resources and territories for breeding pairs (Newbold and Eadie 2004; Howerter et al. 2014). Furthermore, increasing wetland habitat available at the time of hatch and continuing until fledging will likely improve duckling survival (Oldenburger 2008). More wetlands in summer will also provide much-needed habitat for post-breeding ducks and will likely improve adult survival during wing molt (Fleskes et al. 2010; Kohl 2019).

The CVJV is only recommending a wetland habitat objective for semi-permanent wetlands at this time. These wetlands provide much-needed summer habitat and the water management and maintenance schedule is the most realistic option for most wetland managers. There is evidence that reverse-cycle wetlands provide superior foraging habitat for duck broods, as described previously, but few studies have been conducted (de Szalay et al. 2003). Moreover, reverse-cycle wetlands are dry during the fall and winter. This status further reduces habitat needed by migratory waterbirds and eliminates the option to hunt waterfowl, which is a primary purpose of many private and public managed wetlands. Semi-permanent wetlands provide suitable habitat for breeding ducks, while still maintaining value during the remainder of the year. Ideally, a portion of the semi-permanent wetlands included in this habitat objective would be substituted with reverse-cycle wetlands, especially in areas known to support high densities of breeding ducks, or in wetland units that would benefit from an extended dry period due to their steady-state vegetation.

The acreage of additional wetlands in each region needed to meet the 20 percent objective is variable (Table 8.3). Based on the most recent assessment (Petrik et al. 2014), the largest deficits to achieving the 20 percent criteria are in the Sacramento and San Joaquin planning regions. There is evidence that the extent of semi-permanent wetlands in certain planning regions is overestimated and need revising (e.g., Tulare does not have a surplus; C.M. Brady, unpublished data, 2019, see "Notes"). As such, semi-permanent wetland objectives for each planning region will be updated periodically as more recent data on current wetland status become available.

Upland Habitat

The total amount of suitable upland nesting habitat required to meet the CVJV long-term population objective is estimated to be almost 177,000 acres, as detailed in the previous section. The total amount of upland nesting habitat required to meet the minimum population objective is approximately 117,000 acres. This upland habitat would need to be located within 5 miles of final brood wetlands and no more than 0.5 miles from the nearest wetland that ducks can use as transit water to the final brood wetland. Because the current amount of suitable nesting habitat is unknown, it is not currently possible to determine how much additional acreage is needed to meet the population objectives. The CVJV considers determining the amount of existing suitable upland nesting habitat a high priority, in order to then establish objectives for additional acres of upland nesting habitat.

Most of the planning regions have areas with suitable nesting habitat. Increasing the extent of semi-permanent wetlands near those areas would likely improve duck breeding success. An exception is the Sacramento planning region, where rice agriculture provides summer aquatic habitat, but uplands are lacking. The decline in the mallard population in that planning region is greater than in other areas of the Central Valley, likely due to land use changes (Figure 8.2). The amount of rice grown there annually has remained relatively stable during the past 30 years; however, the complementary agriculture (annual crops such as winter wheat or pasture) and fallow rice fields that provide nesting habitat near growing rice fields has drastically declined.

To improve breeding success of ducks nesting near rice fields, the CVJV developed a habitat objective to provide suitable upland nesting cover equal to 10 percent of the recent rice crop base (based on the minimum acreage previously set aside by rice farmers as part of a price support program, before changes to the Farm Bill in 1996; that landscape supported a more robust breeding duck population than currently exists).

Actions that could meet this objective would include planting nesting cover or a suitable cover crop on fallow farm fields and leaving the cover undisturbed during the breeding season. The CVJV used the average amount of rice grown annually during 2007 to 2014 to determine the rice base and thus to set the conservation objective. During that period, an average of 541,000 acres of rice were grown annually. Therefore, the objective for planted nesting cover is 54,100 acres. Meeting this objective will likely require programs that offer economic incentives that are competitive with commodity markets and Farm Bill Programs.

SUMMARY

Conservation planning for waterfowl and wetland management in the Central Valley has largely focused on meeting the needs of wintering and migrating waterfowl. Meanwhile, locally nesting duck species have substantially declined and are now at or near all-time lows. Hundreds of thousands of ducks spend their entire life cycles in the Valley; their habitat needs differ from wintering ducks in the region. Providing semi-permanent wetland and upland habitat as outlined in this chapter, in addition to traditional wintering habitat, is paramount to sustaining local duck populations. A robust waterfowl population is important for keeping hunters engaged, who in turn advocate for and contribute financially toward sustaining private and public wetlands in the Central Valley. This chapter highlights the need to shift the management paradigm, which currently focuses on wintering and migrating waterfowl, to achieve a more balanced approach to meeting the full life cycle needs of locally nesting waterfowl.

Mallard brood - Mike Peters

The Habitat Objectives

To meet the long-term population objectives:

- Semi-permanent wetlands: 44,000 acres (21,000 additional acres)
- Upland nesting habitat: 177,000 acres, with 54,100 acres focused in the Sacramento region (research is needed to determine the amount of additional acreage this objective represents)

Based on a review of existing population and habitat information, the CVJV determined that providing additional semi-permanent wetlands and upland nesting habitat in all planning regions would be the best approach to reverse the decline of locally nesting focal duck species and work toward reaching the long-term population objective.

PLANNING REGION	CURRENT WETLANDS (2015 ESTIMATE)	SEMI-PERMANENT WETLANDS: CURRENT	SEMI-PERMANENT WETLANDS: OBJECTIVE[a]	SEMI-PERMANENT WETLAND DEFICIT
Sacramento	73,842	5,348	14,768	9,420
Yolo-Delta	25,965	4,010	5,193	1,183
Suisun	34,247	5,494	6,849	1,355
San Joaquin	61,247	2,872	12,250	9,378
Tulare	23,868	5,034	4,774	0[c]
Total	**219,169**	**22,758**	**43,834**	**21,336**

[a] *Based on restoring an amount of semi-permanent wetlands equal to 20% of the current wetland extent.*
[b] *Deficit is the difference between the current acreage and the objective for semi-permanent wetland acreage. Deficits represents additional wetland acreage needed.*
[c] *A more recent analysis indicates semi-permanent wetlands were overestimated in Tulare for this Plan, so this result is being revised upward (C.M. Brady, unpublished data, 2019, see "Notes").*

TABLE 8.3 Current wetlands of all types, current semi-permanent wetlands and the habitat objectives for semi-permanent wetlands, in the Valley as a whole and by planning region. (Sums may not be exact, due to rounding in original data.)

SUCCESS STORY

THE CALIFORNIA WATERFOWL HABITAT PROGRAM

Established via the California Waterfowl Habitat Preservation Act, the California Waterfowl Habitat Program (also known as the Presley Program) is a statewide, private-land incentive program administered by the California Department of Fish and Wildlife (CDFW). The program compensates private landowners who are willing to manage their land in accordance with management plans cooperatively developed by CDFW and the landowners. These management plans are designed to implement waterfowl habitat goals as identified by the CVJV's most recent Implementation Plan and CDFW's State Wildlife Action Plan. Consistent with its primary waterfowl habitat objectives, the program also endeavors to enhance habitat for shorebirds, wading birds and other wetland-dependent wildlife.

The Presley Program has been in existence for close to 30 years and has remained extremely popular with private landowners. In the most recent solicitation (2019), CDFW received interest from approximately 200 properties encompassing 50,000 acres. At current funding levels, implementation of the program over the next 10 years will result in a net gain of more than 3,000 acres of semi-permanent wetlands and the annual enhancement of approximately 20,000 acres of seasonal wetlands within the Central Valley. Secure, long-term funding has been the limiting factor in implementing the Presley Program across the Central Valley.

1

(1) Cinnamon teal brood - Mike Peters (2) Upland nesting habitat - Elliott Matchett (3) Mallard ducklings hatching - Brian Huber

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