

State of the Estuary Report 2015

Summary

WILDLIFE – Breeding Waterfowl

Prepared by

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SOTER - Delta & Suisun Marsh Indicator – Breeding Waterfowl

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Reviewers: Nadav Nur PhD (Point Blue), Anitra Pawley, PhD (Department of Water Resources), and Dave Zezulak PhD (California Department of Fish and Wildlife)

Summary Content for Indicator

1. Brief description of indicator and benchmark

Living Resources

Birds

Breeding Waterfowl –

Annual abundance in the Delta of the five most abundant dabbling duck

species: Mallard, Gadwall, Green-winged teal, Northern Pintail, and Northern Shoveler.

Annual abundance in Suisun Marsh of the five most abundant dabbling duck

species: Mallard, Gadwall, Green-winged teal, Northern Pintail, and Northern Shoveler.

Benchmark – Based on mean of first 10 years of data (1992-2001).

Current status – Based on mean of five most recent years data (2010-2014).

Scoring – proposed scoring standards: > 100% of benchmark = good; > 60% of benchmark = fair; < 60% of benchmark = poor.

2. Indicator status and trend measurements

Status – Fair

- Delta – Fair.
- Suisun – Fair.

Trends – DETERIORATING

- Delta – decreasing.
- Suisun Marsh – decreasing.

Details: Waterfowl (dabbling duck) breeding populations are estimated annually using California Waterfowl Breeding Population Survey data. For the indicator we use data collected 1992-2014.

The current status for the five most abundant species of breeding waterfowl in the Delta and Suisun Marsh is “Fair” and decreasing from baseline.

The trends are different for Mallards relative to the remaining four species, particularly in the Delta. Mallards are the dominant waterfowl species in the Delta (average 92% of total) and Suisun (average 59% of total). Abundance of mallards is decreasing at a rate of 2.3 percent per year in Delta and 2.5 percent per year in Suisun Marsh. For the remaining four most abundant waterfowl species, abundance is *increasing* at a rate of 7.7 percent per year in Delta and decreasing by 2.3 percent per year in Suisun Marsh. This can be compared to Statewide trends, which are also “Fair” and “decreasing”: 1.2 percent decrease per year for mallard, and 1.0 percent decrease per year for the other four species.

3. Brief write-up of scientific interpretation

a. What is this indicator?

The indicator is the estimate of abundance of breeding waterfowl: the estimated summed abundance of the five most abundant species of dabbling ducks (Mallard, Gadwall, Cinnamon Teal, Northern Pintail, and Northern Shoveler) in two regions: Suisun Marsh and the Delta. The status and trends are compared to the statewide status and trends for context.

b. Why is it important?

The abundance of breeding dabbling ducks is important for several reasons.

1. Breeding ducks need undisturbed uplands (for nesting) in proximity to water, where they forage during the month they are incubating eggs, and where they bring their brood shortly after hatching. Healthy numbers of breeding ducks are an indicator of the ability of the area to support native wildlife in addition to agriculture and other non-urban land uses. In the Delta the dominant land use is agriculture. Suisun Marsh is dominated by duck clubs primarily managed for hunting waterfowl during the fall and winter. Some of these duck clubs also support breeding waterfowl and are managed for this purpose. Breeding waterfowl numbers are higher in areas with more available habitat, where land use practices are appropriate, and where predation is lower. Populations are also higher during higher rainfall years. As the landscape continues to change in the Delta and Suisun Marsh due to changing agricultural practices, climate change, and habitat restoration, the suitability of habitat available for breeding waterfowl is likely to change. Habitat restoration, enhancement, and protection, particularly of wetlands, is likely to improve habitat for waterfowl, while the changes due to climate change and changing agricultural practices are likely to degrade habitat for waterfowl.

2. Waterfowl hunting during fall and winter is important to a significant sector of the population, primarily in rural areas. Healthy breeding waterfowl populations in California can make a significant contribution to the waterfowl hunting industry. Approximately 20% of the waterfowl individuals found during winter in California's Central Valley also breed in locally in California; the remainder migrated to California after a breeding season elsewhere. Waterfowl hunting limits are based on waterfowl population surveys. The breeding mallard populations in California contribute to the Western Mallard Model, an adaptive harvest management model that sets bag limits for hunting seasons in California. Thus higher breeding populations in California can mean higher hunting bag limits set for California.

c. What is the benchmark? How was it selected?

The benchmark is the average of the first 10 years of the survey: 1992-2001. Status evaluation categories were set up using the formulae in Table 1 (used also for some other SOTER indicators).

Table 1. Status evaluation categories relative to reference condition

Ranking relative to reference condition	Evaluation & interpretation
> 100% of historical reference period average	"Good"
> 60% of historical reference period average	"Fair"
< 60% of historical reference period average	"Poor"

d. What is the status and trend for this indicator?

Delta – The breeding waterfowl population in the Delta is "Fair" and decreasing (Figure 2). The current population estimate (7,400 - based on the most five recent years) was 67% of the benchmark (11,000 – based on the first 10 years of the survey). This amounts to an overall decrease of 2% per year.

The trends are different for Mallard relative to the remaining four species. Mallard is the dominant waterfowl species in the Delta (average 92% of total). The Mallard population estimate for 2014 was lowest in the history of the survey (3,826). No Northern Pintail or Gadwall were present in 2014. The 2013 estimate for Northern Shoveler was highest in the history of the survey (1,170)¹. Mallard is decreasing by 2.3% per year while the other four species (considered together) have been increasing by 7.7% per year.

Suisun Marsh – The breeding waterfowl population in Suisun Marsh is "Fair" and decreasing. The current population estimate (23,000 – based on the most five recent years) was 67% of the benchmark (34,000 – based on the first 10 years of the survey).

Trends are similar for all five species. Mallard is the dominant species in Suisun (average 59% of total). Mallard population estimate for 2014 was third lowest in the history of the survey. No Northern Pintails were present in 2014. Mallard is decreasing by 2.5% per year. The other four species (considered together) are decreasing 2.3% per year.

¹ Note that wintering Northern Shovelers can migrate north to their breeding grounds later in some years, and that they are counted as part of the breeding population although they don't stay to breed. This could be biasing the data in some years.

e. What does it mean? Why do we care?

Mallard abundances are decreasing at a faster rate in the Delta and Suisun Marsh than they are statewide. The other species (considered together) are decreasing in Suisun Marsh at a faster rate than the overall statewide decrease. Interestingly, these other four species are increasing in the Delta. The implication is that conditions are deteriorating in the Delta and Suisun relative to elsewhere for Mallard. For the four other species, conditions in the Delta are improving, although they are deteriorating in Suisun Marsh. Statewide there are increases in Northern Shoveler and Gadwall, species that tend to nest later, and decreases in species that nest earlier: Mallard and Northern Pintail.

Localized conditions that could be affecting Delta and Suisun Marsh waterfowl populations, their nesting habitat and food availability include the following:

- Agricultural practices
- Refuge management
- Water availability – irrigation ditches, ponds, canals, sloughs
- Predation
- Hunting pressure
- Disease
- Environmental contaminants

There are problems with habitat loss and deterioration outside of the Delta and Suisun Marsh that affect waterfowl populations statewide. There is increased mortality associated with increases in avian botulism caused by reduced water availability in the Klamath Basin, where many of the Central Valley birds go to molt (i.e., shed their feathers and grow a new set, during which time they are flightless).

4. Related figures for Report

Graphs (see below; will not include Statewide in SOTER, just in Technical Appendix.)

Photo of Mallard with brood

Photo of typical nesting habitat in the Delta

Figure 1. Mallard pair



Photo credit: Tom Grey

Figure 2.

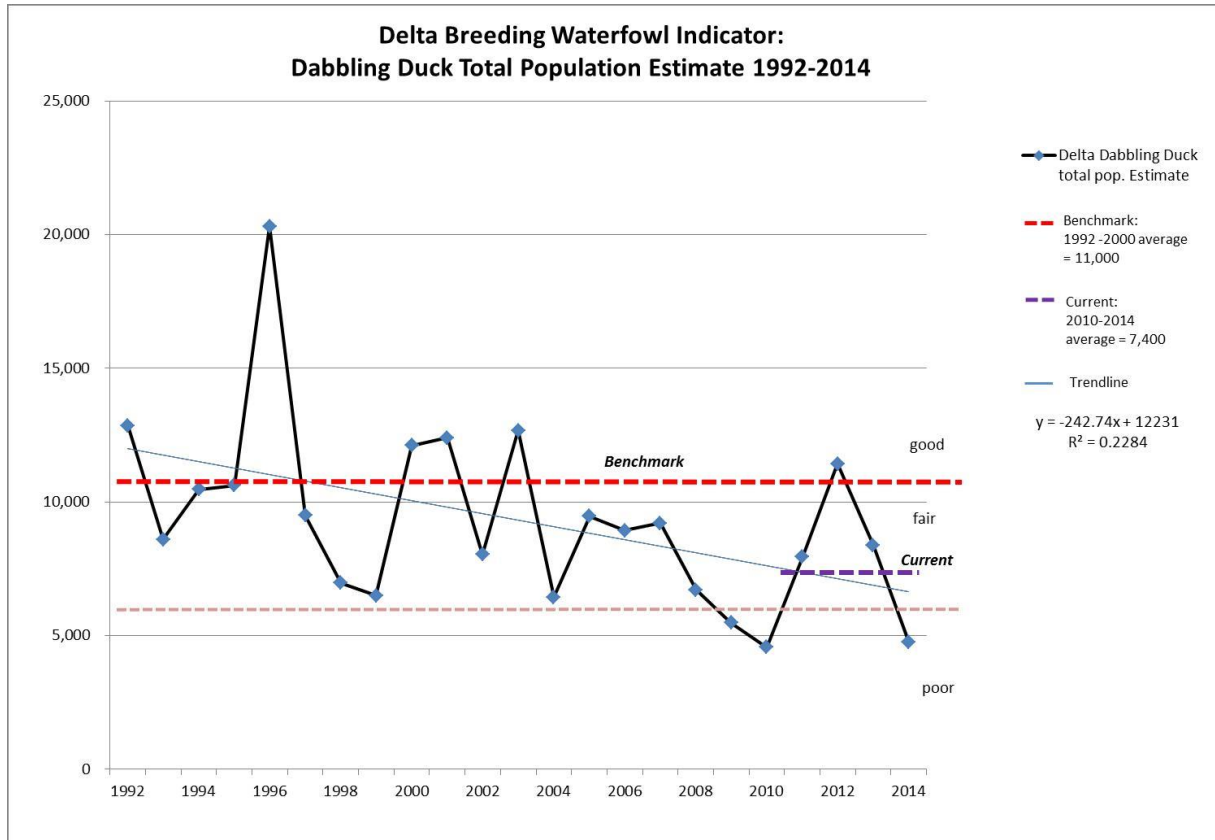
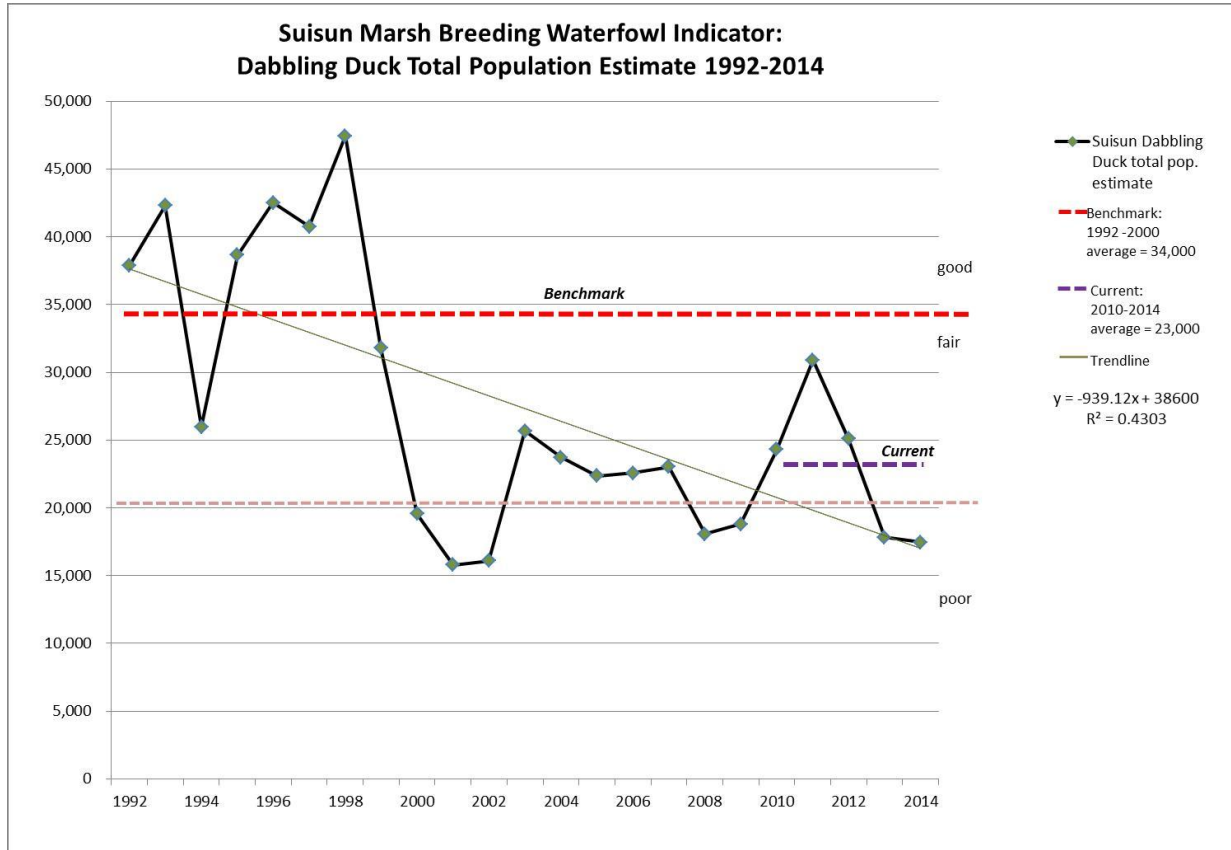
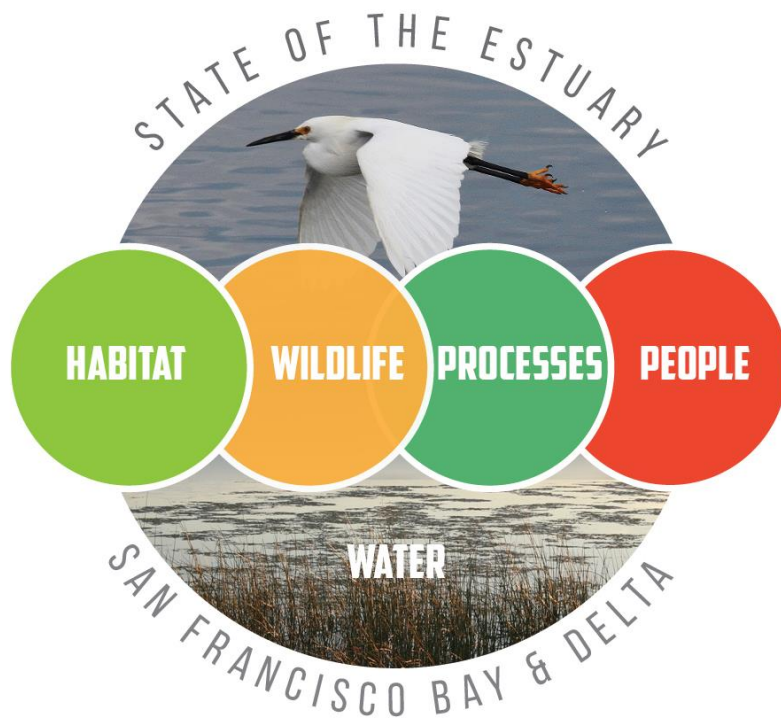


Figure 3.





State of the Estuary Report 2015

Technical Appendix

WILDLIFE – Breeding Waterfowl

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State of the Estuary Report – 2015

Technical Appendix

Delta and Suisun Marsh Breeding Waterfowl Abundance Indicator

June 5, 2015

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Reviewed by: Nadav Nur PhD (Point Blue), Anitra Pawley, PhD (Department of Water Resources), and Dave Zezulak PhD (California Department of Fish and Wildlife)

A. Background and Rationale

The Breeding Waterfowl Indicator is based on annual estimates of abundance of breeding waterfowl generated by the California Department of Fish and Wildlife Waterfowl Program's Breeding Waterfowl Population Survey (<http://www.dfg.ca.gov/wildlife/waterfowl/popassessment.html>). The Indicator is a community-level indicator for dabbling ducks, and does not include assessment of individual species. Annual indicator data points are the summed estimated abundance of the five most abundant species of dabbling ducks (Mallard, Gadwall, Cinnamon Teal, Northern Pintail, and Northern Shoveler) presented separately for each of two regions (referred to as "strata" by the Breeding Waterfowl program; Figure 1) in the San Francisco Estuary: Suisun Marsh and the Delta. The status and trends of waterfowl populations in these two regions are compared to statewide status and trends for context. Mallard is the most abundant of these dabbling duck species, while the abundances of the remaining four species relative to mallard tend to be smaller and more variable spatially and temporally. Other species included in the Breeding Waterfowl Population Survey, which were not included in the Indicator, include Canada goose, coots, and additional dabbling duck species that breed in very small numbers in California.

The Breeding Waterfowl Indicator is new for the State of the Estuary Report 2015. The structure of the indicator is similar to the Winter Waterfowl Abundance Indicator reported in the State of the San Francisco Bay 2011 and in the current 2015 Report. With input from others, the authors evaluated extending the Winter Waterfowl indicator to the Delta, but this option was rejected because data collection efforts during the winter are not yet sufficiently standardized in the Delta. This decision should be revisited after the survey protocols are standardized, which is likely to be within the next few years. The Winter Waterfowl indicator includes dabbling duck and diving duck species found in the San Francisco Bay during the wintering period, when large numbers of individuals that breed in other areas migrate to California, and pass through or stay the entire winter before flying back to their breeding areas. It also includes year-round residents: individuals who breed and remain in the area year round. The Breeding Waterfowl Indicator is an indicator of the population size of breeding dabbling ducks only, and explicitly excludes individuals that are not breeding and are likely to be on their way to breeding grounds elsewhere, based on their observed flocking behavior. Diving ducks were not included in the Breeding Waterfowl indicator because this group breeds in small numbers in Northeastern California, but generally not in the Estuary. Geographic coverage also differs between these

indicators: the Winter Waterfowl indicator includes data from surveys conducted in San Francisco Bay and San Pablo Bay, while the Breeding Waterfowl indicator includes Suisun Marsh and the Delta. San Francisco Bay and San Pablo Bay are not surveyed for breeding waterfowl. The Breeding Waterfowl survey Napa River stratum was not included as part of the present indicators because much of the Napa River valley is too far removed from the San Francisco Estuary to be considered a valuable indicator of the health of the Estuary (Figure 1).

The abundance of breeding dabbling ducks is an important indicator of the health of the Delta and Suisun Marsh for several reasons:

1. During the breeding season, ducks need undisturbed uplands in proximity to water, where they forage during the month the females are incubating eggs, and where they bring their brood shortly after hatching. Healthy numbers of breeding ducks are an indicator of the ability of the area to support native wildlife in addition to agriculture and other non-urban land uses. In the Delta the dominant land use is agriculture. Suisun Marsh is dominated by duck clubs primarily managed for hunting waterfowl during the fall and winter. Some of these duck clubs also support breeding waterfowl and are managed for this purpose. Breeding waterfowl numbers are higher in areas with more available habitat, where land use practices are appropriate, and where predation is lower. Waterfowl populations are also higher and more productive during higher rainfall years, particularly in Suisun Marsh; associations are less evident in the Delta (CDFW unpublished data). As the landscape continues to change in the Delta and Suisun Marsh due to changing agricultural practices, climate change, and habitat restoration, the suitability of habitat available for breeding waterfowl is likely to change. Habitat restoration, enhancement, and protection, particularly of wetlands, is likely to improve habitat for waterfowl, while the changes due to climate change and changing agricultural practices are likely to degrade habitat for waterfowl (Browne & Dell 2007; Hagy et al 2014).
2. Waterfowl hunting during fall and winter is important to a significant sector of the human population, primarily in rural areas. Waterfowl hunting limits are based on waterfowl population surveys, including the Breeding Waterfowl Survey in California. Healthy breeding waterfowl populations in California can make a significant contribution to the North American waterfowl population and to the waterfowl hunting industry. Approximately 20% of the waterfowl harvested during winter in California's Central Valley each year are locally bred (CVJV 2006); the remainder have migrated to California after a breeding season elsewhere, primarily from northern prairie states, Canada, and Alaska. Higher Mallard breeding populations influence the calculation of bag limits and hunting season length determinations through their contribution to the Western Mallard Model (USFWS 2014), resulting in higher hunting bag limits set for California.

B. Benchmark

The Benchmark for the Breeding Waterfowl indicator was calculated as the mean of the first 10 years of data (1992-2001). Status evaluation categories were set up using the formulae in Table 1, which was also used for some other SOTER indicators. A current population size over the benchmark would be considered "Good". A current population size between 60-100% of the

benchmark would be considered “Fair”. Finally, a current population size less than 60% of the benchmark would be considered “Poor”.

We used the default benchmark calculation method recommended for new indicators where there is no alternative historical benchmark, or alternative planning target. Ideally, the Benchmark would be a target healthy population size based on estimates of statewide and regional population long-term viability, or based upon historical population sizes prior to extensive habitat loss, e.g., 100-200 years ago. However, historical estimates are not available, nor have population targets been set based on modeled population viability. Habitat loss most certainly contributed to significant population declines prior to the initiation of standardized surveys. Thus, we chose to classify populations above our benchmark “Good”, while any decrease would be considered “Fair” to “Poor”.

As part of their Implementation Plan, the Central Valley Joint Venture set a statewide target population size for breeding mallards: “maintain, enhance, and restore sufficient habitats to increase mallard populations by 25% over the range of variation observed from 1992-2002” (CVJV 2006). The baseline was between 186,000 to 389,000 statewide. Thus, the mallard target would be 232,000 and 486,000 individuals statewide (CVJV 2006). However, population targets were not set for other species or for specific regions. Instead, they identified general habitat needs in each region, with the plan to revisit and develop more specific habitat targets. The Implementation Plan revision effort is currently in process and it is anticipated that new population targets will be set. When the CVJV develops habitat and/or population targets for breeding waterfowl in Suisun Marsh and the Delta, these targets can be used as alternative benchmarks for the indicator in future iterations of the State of the Estuary Report.

C. Data Sources

Data used for the Breeding Waterfowl Indicator were collected by the California Department of Fish and Wildlife’s Waterfowl Program, which uses annual waterfowl population data to make recommendations for hunting regulations (<http://www.dfg.ca.gov/wildlife/waterfowl/popassessment.html>).

Breeding Waterfowl Population surveys are conducted nationwide in the spring by the U.S. Fish and Wildlife Service (USFWS), the Canadian Wildlife Service and others, including state wildlife agencies, on the primary breeding areas of waterfowl. These estimates play an important role in establishing annual harvest regulations. Portions of Alaska, Canada, and north-central United States are sampled.

The California Breeding Waterfowl Population survey was modeled after the national effort, using the same methods. Prior to switching to the federal methods in early 1990’s, a less standardized method was used. Non-standardized data collected prior to 1992 were not used to calculate the current Indicator. Surveys are conducted by California Department of Fish and Wildlife and California Waterfowl Association (CWA) biologists. Surveyed areas include wetland and agricultural areas in northeastern California, throughout the Central Valley, the Suisun Marsh, and some coastal valleys (Figure 1a).

D. Methods

Breeding Population Survey methods

Field methods are based on those developed by the USFWS for nationwide breeding population surveys, as described above.

The survey consists of both aerial and ground components. The aerial component uses an airplane flying transects at an altitude of 150 feet at about 105 miles per hour, with two observers, one on each side of the aircraft. Every duck seen within an eighth of a mile of the airplane is counted. The species, sex, and social status (paired or unpaired) is determined. Observers cannot see all ducks on the transect due to vegetation and other visibility issues, so an on-the-ground correction factor is needed. Another set of observers on foot samples a portion of the transects flown by the aerial crew. The difference between what the aerial and ground crews see is used to correct the aerial estimate, minimizing visibility bias (<http://www.dfg.ca.gov/wildlife/waterfowl/popassessment.html>).

The regions of California where waterfowl breed are broken up into “Strata”, within which pre-selected linear transects are flown. (Figure 1a, 1b). There are nine strata statewide. The Northeastern California stratum includes 32 non-contiguous patches, while all the remaining strata are contiguous (Fig 1a). Flight lines include 40 separate segments totaling 1,377 miles. The average length of a segment is 13 miles. In the Delta, there are four separate transects totaling 72 miles, and in Suisun Marsh, there are 2 transects totaling 40 miles (Figure 1b). The strata boundaries do not correspond exactly with other legal boundaries for Suisun Marsh and the Legal Delta. The Legal Delta includes the Delta stratum and portions of other adjacent stratum.

Breeding Population Estimates

The aerial survey transect data and correction factor data are used to estimate the population abundance for each stratum. A program was developed by USFWS to do this based on the survey input, the visual correction factor, transect length, and stratum area. The output includes for each species within each stratum: a population estimate, standard error, and 95% confidence interval.

Breeding Waterfowl Indicator calculation methods

For calculation of the Indicator, we used Breeding Waterfowl survey data collected between 1992 and 2014. Earlier data are available, but survey methods prior to 1992 were not standardized using the USFWS standards and so results may not be comparable.

Each year’s indicator datapoint is a sum of the estimated population size of the five most abundant species of dabbling ducks (Mallard, Gadwall, Cinnamon Teal, Northern Pintail, and Northern Shoveler). Indicators were calculated separately for Suisun Marsh, the Delta, and statewide. The statewide indicator is not reported in the 2015 State of the Estuary Report but is included here so that trends in Suisun Marsh and the Delta can be placed in context. The benchmark was calculated as described above (the mean of the first 10 years of data [1992-2001]). The current population size was calculated as the mean of the most recent five years of data: 2011-2015. The mean for each of these periods was used rather than a single year because of the high inter-annual variability in the data.

Annual datapoints were natural log transformed for analysis and were analyzed for changes separately for each region and statewide. Trends in each of the indicators were assessed for statistical significance using a General Linear Model (GLM) in JMP v. 10.0 (2007).

For each region and statewide, three sets of models were run:

- To assess the significance of a linear trend, a linear model was evaluated using population estimates for each year;
 - with year as a continuous variable; and
 - with year as a categorical variable.
- To assess the difference between the Benchmark and Current population size.

Each model included the following main effects: Time (year or period), Species, and Species * Time (an interaction variable). The approach to statistical analysis of the Breeding Waterfowl Indicator data was similar to that used for the Winter Waterfowl indicator. Individual species were excluded if the majority of years had zero counts for that species. Each model included data for four or five species and included a species “main effect.” Thus, we allowed for differences in the overall abundance of the four to five species while estimating the trend over time common to the species for the specific region. We report the results of the model with the greatest statistical significance based on its Akaike Information Criteria.

Additional tests for statistical significance of linear trends were conducted separately for each species and region; these are also reported.

E. Peer Review

The Breeding Waterfowl indicator was chosen as the most appropriate bird indicator available for the Delta and Suisun Marsh by a group of experts meeting under the auspices of the Delta Bird Monitoring Network. The evaluation used a suite of criteria including those used for indicator selection for the State of the Bay 2011 Report (SFEIT 2011; Table 2). Criteria include whether the indicator would be meaningful to the public and to decision-makers, whether data were available, and whether those data were of sufficient quality and duration.

The indicator was reviewed by: David S. Zezulak, Ph.D. (CDFW), Anitra Pawley, Ph.D. (Department of Water Resources) and Nadav Nur, Ph.D. (Point Blue Conservation Science).

F. Results

Status – Fair

- Delta – Fair.
- Suisun – Fair.
- Statewide – Fair.

Trends – DETERIORATING

- Delta - decreasing
- Suisun Marsh - decreasing
- Statewide - decreasing

Delta – The current breeding waterfowl population in the Delta is “Fair” and decreasing relative to the benchmark (Figure 2). The current population estimate (7,414, based on the five most recent years) was 67% of the benchmark (11,031, based on the first 10 years of the survey). This amounts to an average decrease of 2% per year. The decrease from the benchmark level to the current five-year average is statistically significant (GLM: $X^2 = 55.46$, d.f. = 4, $p < 0.0001$; Species main effect: $X^2 = 52.46$; df = 3, $p < 0.001$; Period main effect: $X^2 = 6.94$, df = 1, $p = 0.008$). Northern Pintail were counted in 1997 but were absent all other years, so this species could not be included in analyses of trends.

Population trends in the Delta vary by species. Mallard is the dominant waterfowl species in the Delta (averaging 92% of total; Figure 5). In 2014, the Mallard population estimate was lowest in the history of the survey (3,826), and no Northern Pintail or Gadwall were present at all. However, there were recent increases in Northern Shoveler, Gadwall, and Cinnamon Teal. The 2013 estimate for Northern Shoveler was highest in the history of the survey (1,170). The decrease of Mallard is statistically significant (linear regression: $R^2 = 0.30$; $p < 0.006$), an average decrease of 2.3% per year. The increasing trend for Northern Shoveler is statistically significant but the increasing trends for Cinnamon Teal and Gadwall are not (Northern Shoveler- linear regression: $R^2 = 0.28$; $p = 0.01$).

Suisun Marsh – The breeding waterfowl population in Suisun Marsh is “Fair” and decreasing (Figure 3). The current population estimate (23,122, based on the most five recent years) was 67% of the benchmark (34,265, based on the first 10 years of the survey). The decrease from benchmark to current is statistically significant (Generalized linear model, species, period, and species*period main effects: $X^2 = 110.45$, d.f. = 9, $p < 0.001$; Period: $X^2 = 10.74$, d.f. = 1, $p = 0.001$; Species: $X^2 = 105.71$, d.f. = 4, $p < 0.001$; Species*Period: $X^2 = 12.14$, d.f. = 4, $p = 0.0003$).

Trends are similar for all five species: all are decreasing. Mallard is the dominant species in Suisun (average 59% of total; Figure 6). The Mallard population estimate for 2014 was third lowest in the history of the survey. No Northern Pintails were present in 2014. Mallard is decreasing by 2.5% per year. The other four species (considered together) are decreasing 2.3% per year. The decrease is statistically significant for Mallard and Northern Pintail, but not for the other species (Mallard Linear regression: $R^2 = 0.42$; $p = 0.0007$; Northern Pintail linear regression: $R^2 = 0.17$; $p = 0.05$).

Statewide –

The breeding waterfowl population statewide is “Fair” and decreasing (Figure 4). The current population estimate (471,647, based on the most five recent years) was 81% of the benchmark (580,308, based on the first 10 years of the survey). This amounts to an overall decrease of 1% per year. The decrease is statistically significant (Generalized linear model with Year as a continuous variable and Year * Species interactions: $X^2 = 245.82$, d.f. = 9, $p < 0.0001$; Species main effect: $X^2 = 243.60$; df = 4, $p < 0.001$; Year main effect: $X^2 = 4.15$, df = 1, $p = 0.042$; Species*Year: $X^2 = 13.53$; df = 4, $p = 0.009$).

All five species are seeing a downward trend statewide. Mallard is the dominant species statewide (average 68% of total; Figure 7). The Mallard population estimate for 2014 was second lowest in the history of the survey, Cinnamon Teal population estimate was third lowest, and Northern Pintail was fourth lowest. The 2013 estimate for Gadwall was second lowest in the history of the survey. Mallard is decreasing by 1.2% per year. The other four

species together are decreasing 1% per year, although the rate of decrease varies by species. The decreasing trend for Northern Pintail is statistically significant but it is not significant for the other species (Northern Pintail linear regression: $R^2 = 0.27$; $p = 0.014$).

G. Discussion

Breeding waterfowl populations are decreasing, and are considered “Fair” in the Delta, Suisun Marsh and statewide. Mallard abundances are decreasing at a faster rate in the Delta and Suisun Marsh than they are statewide. The other species (considered together) are decreasing in Suisun Marsh at a faster rate than the overall statewide decrease. However, there are some increases in the Delta, most notably of Northern Shoveler. The implication is that conditions are deteriorating in the Delta and Suisun relative to elsewhere for Mallard and most other species. For the Northern Shoveler, conditions in the Delta may be improving, although they are deteriorating in Suisun Marsh.

Local conditions that could be affecting waterfowl populations, their nesting habitat and food availability include the following (Hagy et al 2014):

- Conversion of habitat to alternate uses
- Agricultural practices
- Refuge management
- Water availability – irrigation ditches, ponds, canals, sloughs
- Mosquito abatement
- Predation, particularly by mesocarnivores, e.g. skunks and raccoons which do particularly well in human-modified areas.
- Hunting pressure
- Disease
- Environmental contaminants including pesticides

Nationwide, there have been increases in species that tend to nest later (i.e., Northern Shoveler and Gadwall). Mallard and Northern Pintail tend to nest earlier. Northern Pintail in particular has seen decreases nationwide, which may be due to its early nesting behavior, but it's not clear if this is the case with Mallard. Species that nest in crops, e.g. Mallard, are vulnerable to changes in cropping patterns, and timing of harvest.

Female ducks, particularly Mallards, which have been the most intensively studied, are philopatric, i.e., they will return to their natal area to nest. This can present problems when changing land use makes an area less productive but the females retain their drive to remain in the area to try to nest. Reduced nesting success would contribute to population decreases.

Another factor that may be contributing significantly to population decreases in California is the increase in avian botulism outbreaks on molting grounds. After nesting, ducks may fly north to major inland wetlands, e.g. Klamath Basin, where they remain for the time they molt and regrow flight feathers, when they are flightless. Reductions in water availability in wildlife refuges has resulted in smaller areas of appropriate habitat, and increased waterfowl densities, which has increased the frequency of botulism outbreaks (Yarris 1994).

H. Literature Cited

- Browne, D.M. and Dell, R., editors. 2007. Conserving Waterfowl and Wetlands Amid Climate Change. Ducks Unlimited, Inc. Available:
http://www.ducks.org/media/Conservation/Climate%20Change/_documents/White%20Paper_Final%20Graphics.pdf
- Central Valley Joint Venture. 2006. Central Valley Joint Venture Implementation Plan – Conserving Bird Habitat. U.S. Fish and Wildlife Service, Sacramento, CA. Available online at:
http://www.centralvalleyjointventure.org/assets/pdf/CVJV_fnl.pdf
- Hagy, H. M., S. C. Yaich, J. W. Simpson, E. Carrera, D. A. Haukos, W. C. Johnson, C. R. Loesch, F. A. Reid, S. E. Stephens, R. W. Tinerm B. A. Werner, G. S. Yarris. 2014. Wetland issues affecting waterfowl conservation in North America. *Wildfowl Special Issue 4*: 343–367
- JMP® Version 10.0. 2007. SAS Institute Inc., Cary, NC, 1989-2007.
- San Francisco Estuary Indicators Team (SFEIT – J. Collins, J. Davis, R. Hoenicke, T. Jabusch, C. Swanson, A. Gunther, N. Nur, P. Trigueros). 2011. Assessment Framework as a Tool for Integrating and Communicating Watershed Health Indicators for the San Francisco Estuary. Final Report. DWR Grant 4600007902. Available online at:
http://www.sfei.org/sites/default/files/DWR_4600007902_Final%20Project%20Report.pdf
- U.S. Fish and Wildlife Service. 2014. Adaptive Harvest Management: 2014 Hunting Season. U.S. Department of Interior, Washington, D.C. 63 pp. Available online at:
<http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/AHM/AHM-intro.htm>
- Yarris, G. S., R. McLandress, and A.E. H. Perkins. 1994. Molt Migration of Postbreeding Female Mallards from Suisun Marsh, California. *Condor* 96:36-45

Figure 1a. Statewide Waterfowl Breeding Population Survey strata and transects

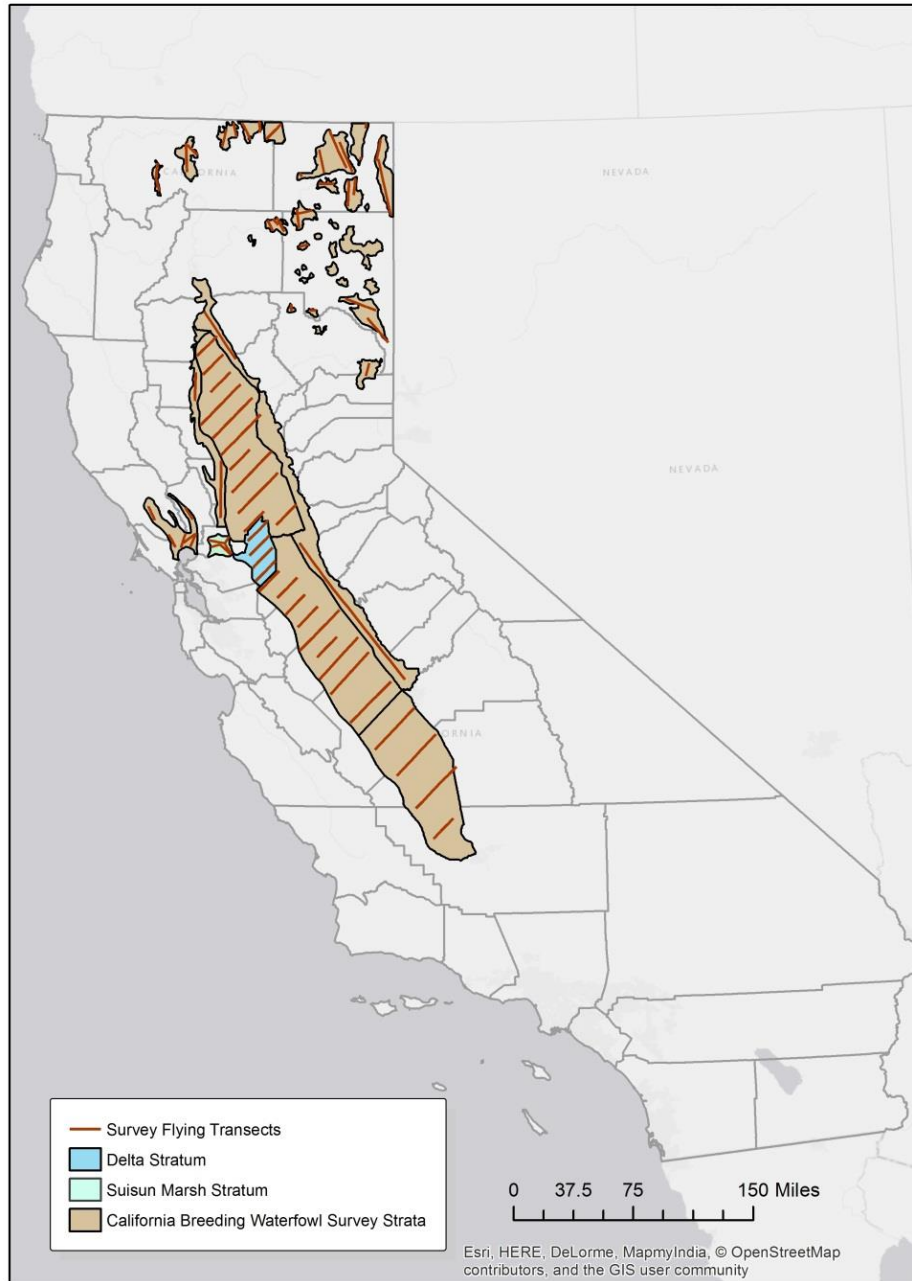


Fig 1b. Delta and Suisun Marsh Waterfowl Breeding Population Survey strata and transects

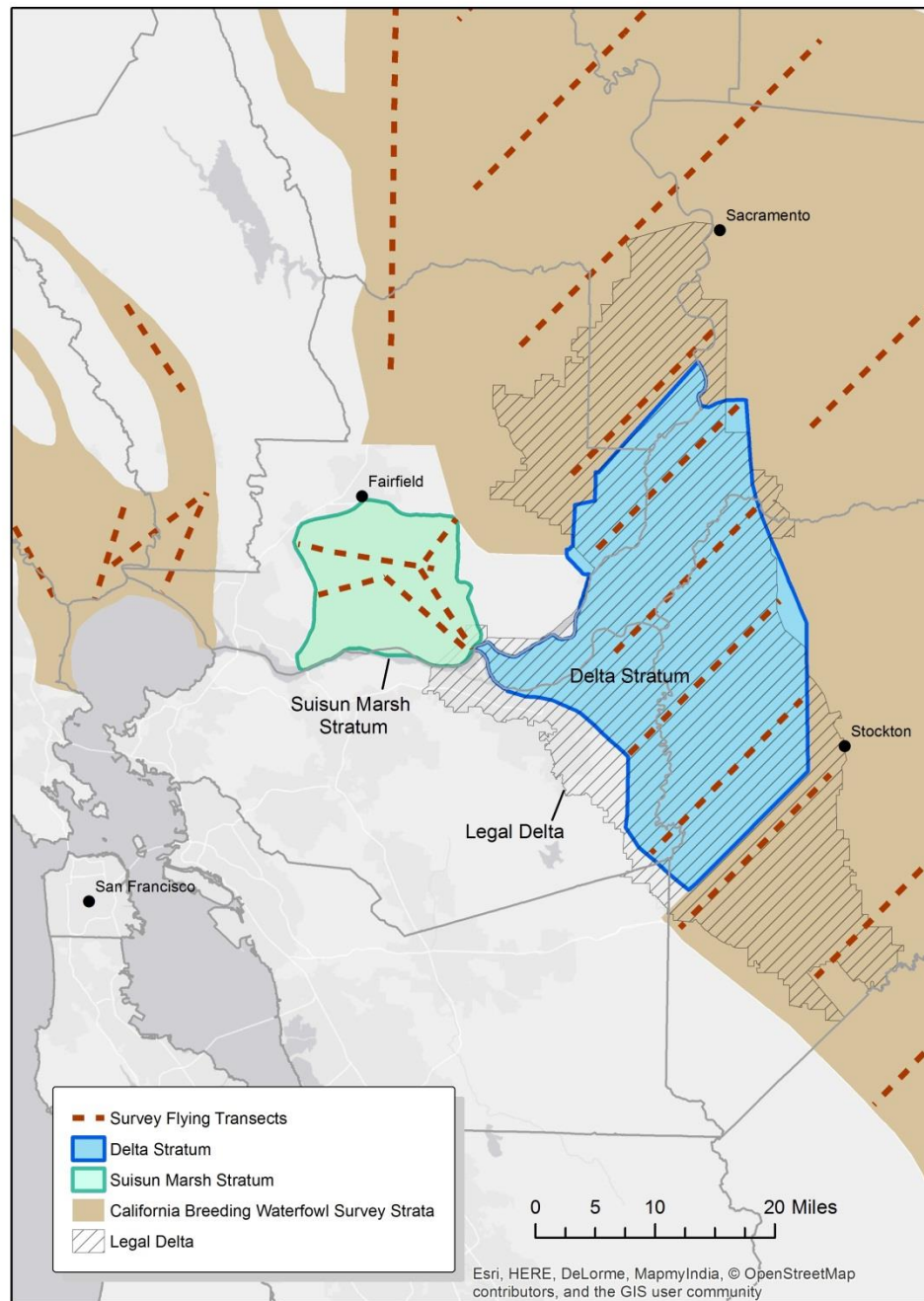


Figure 2. Delta Breeding Waterfowl Indicator – Dabbling Duck Total Population Estimates 1992-2014

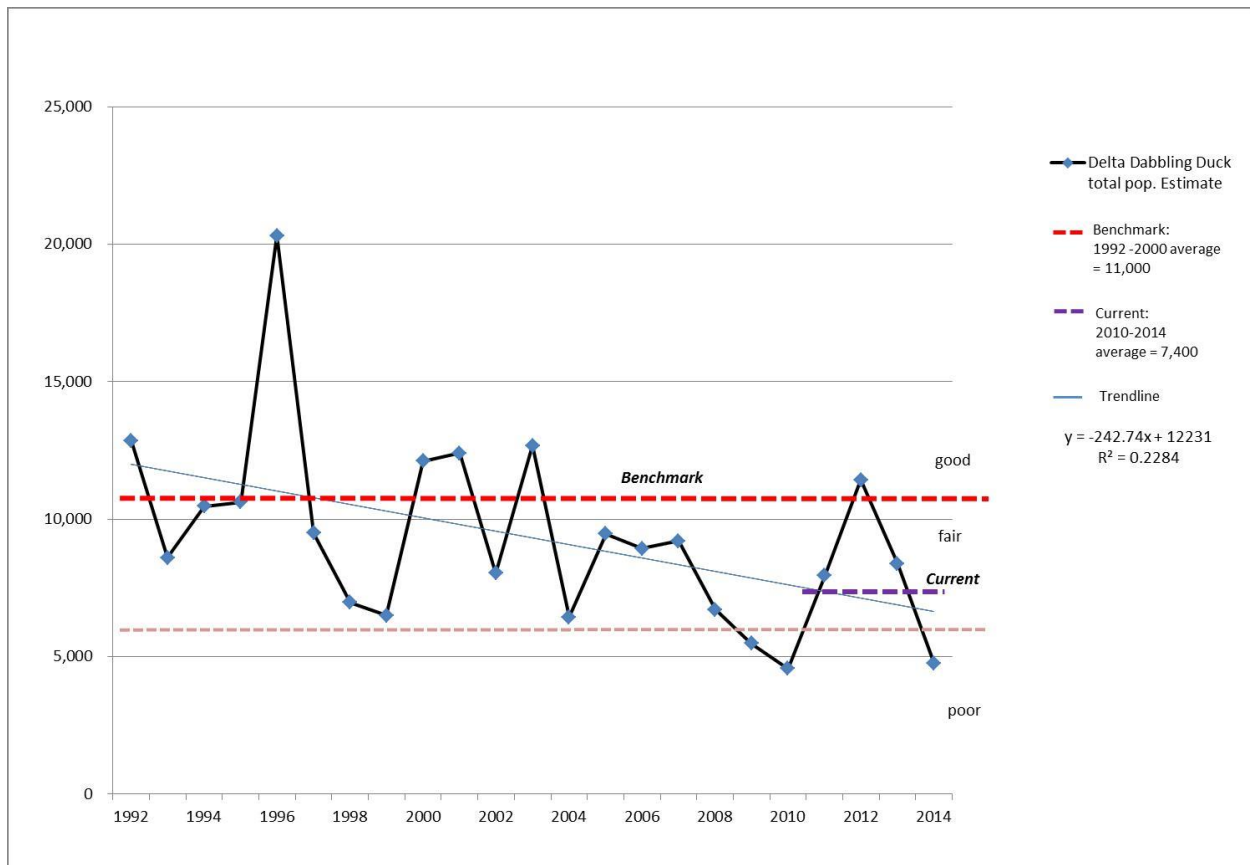


Figure 3. Suisun Marsh Breeding Waterfowl Indicator – Dabbling Duck Total Population Estimates 1992-2014.



Figure 4. Statewide Breeding Waterfowl Indicator – Dabbling Duck Total Population Estimates 1992-2014.

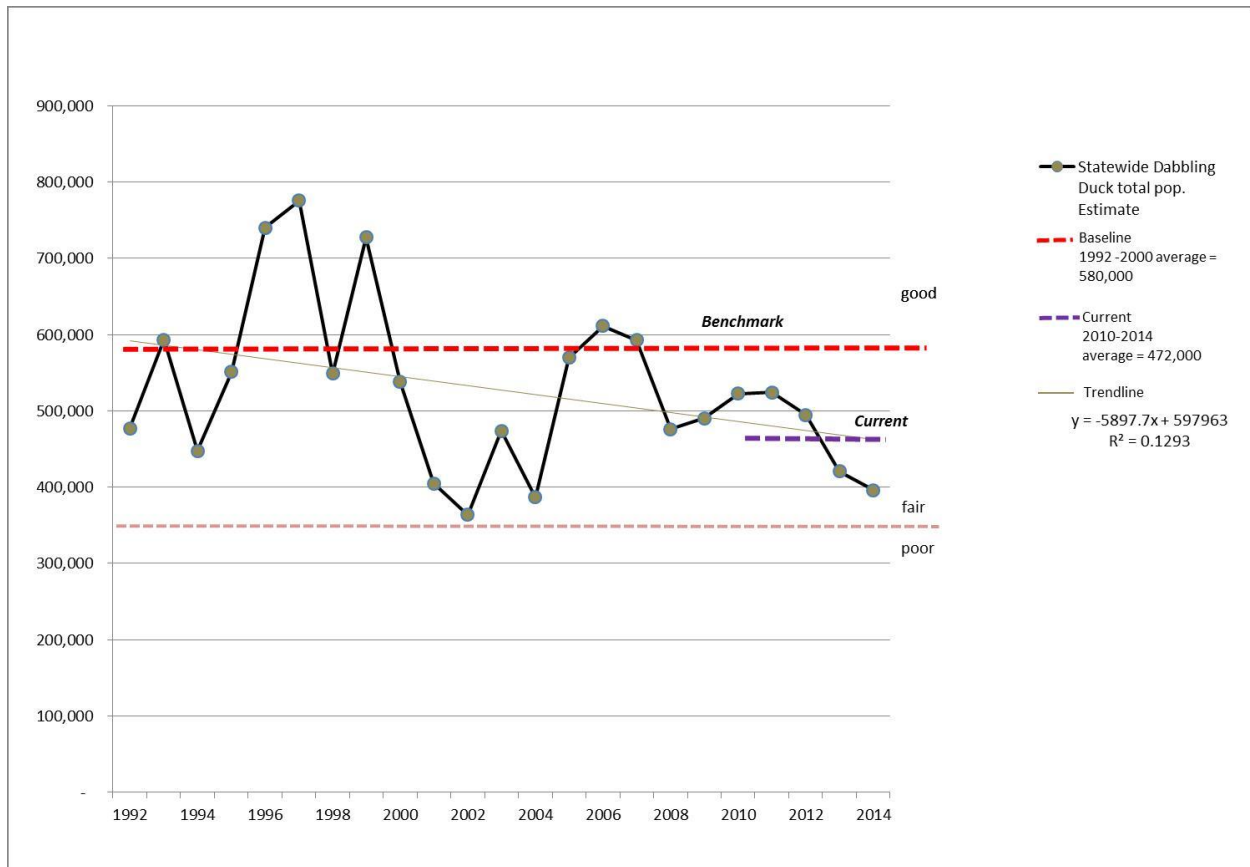


Figure 5. Delta Breeding Waterfowl – Dabbling Duck Community Composition: Population Estimates 1992-2014.

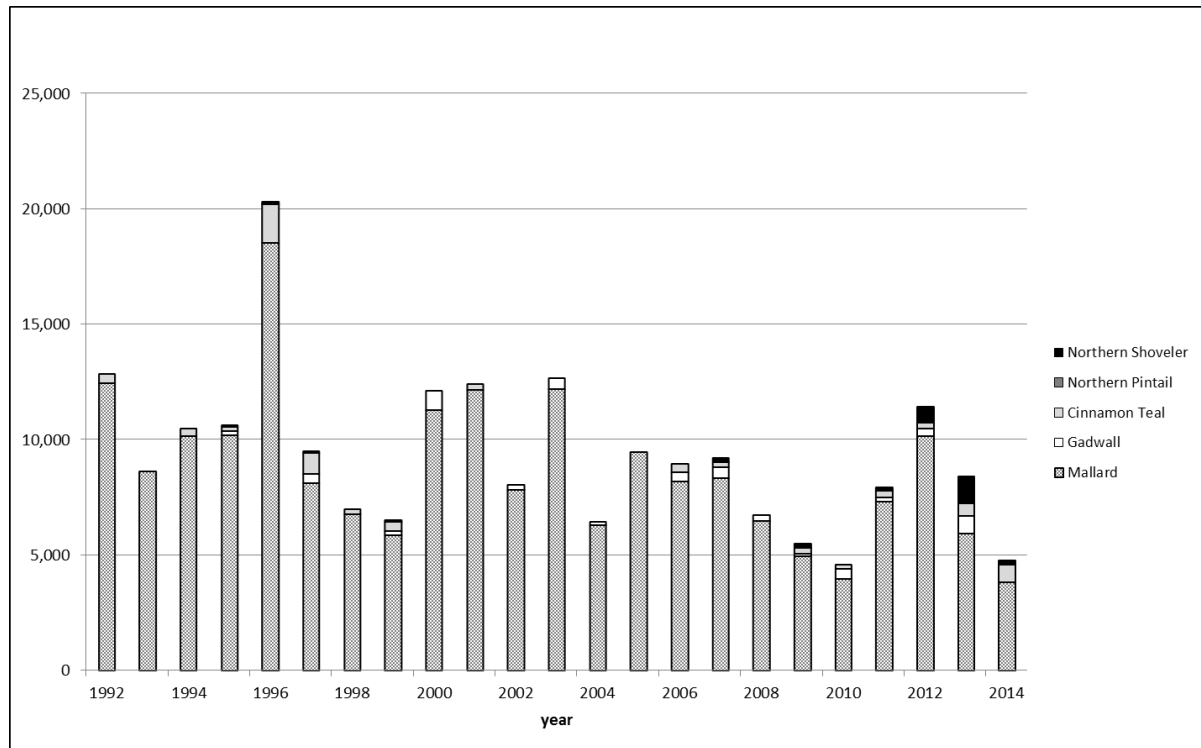


Figure 6. Suisun Marsh Breeding Waterfowl – Dabbling Duck Community Composition: Population Estimates 1992-2014.

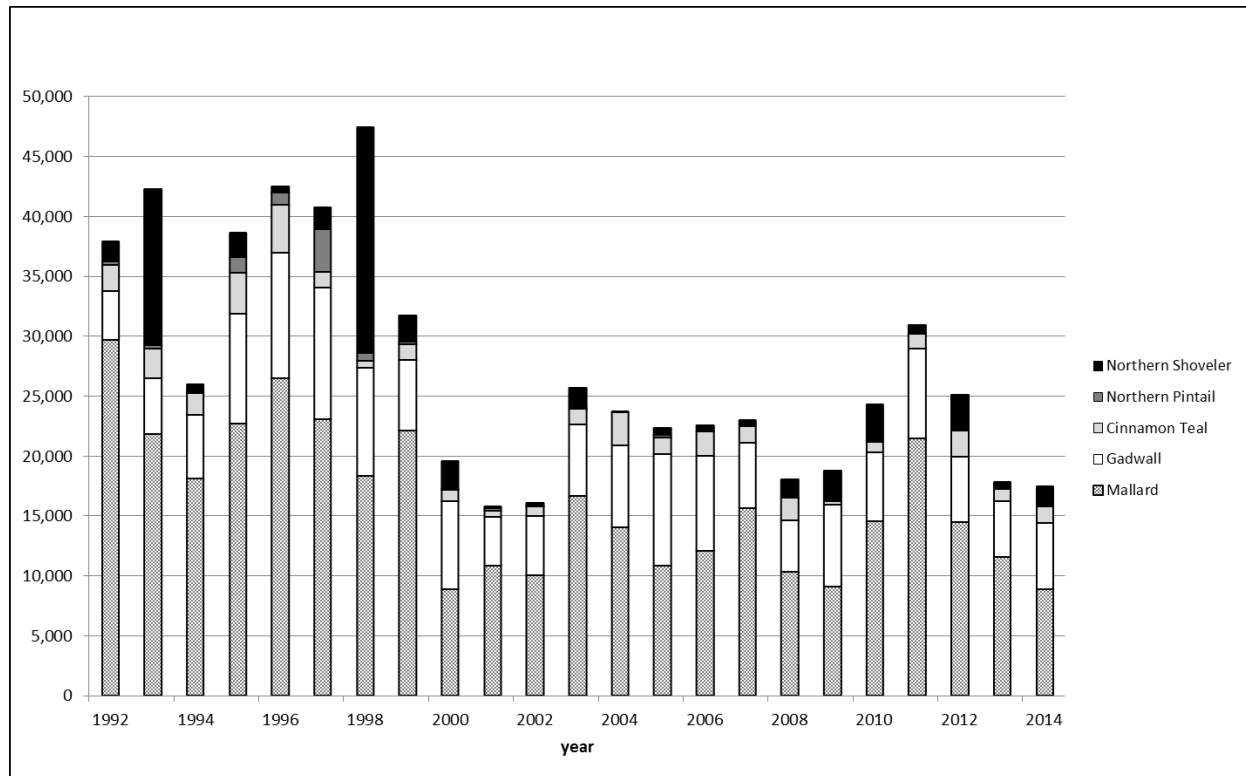


Figure 7. Statewide Breeding Waterfowl – Dabbling Duck Community Composition: Population Estimates 1992-2014.

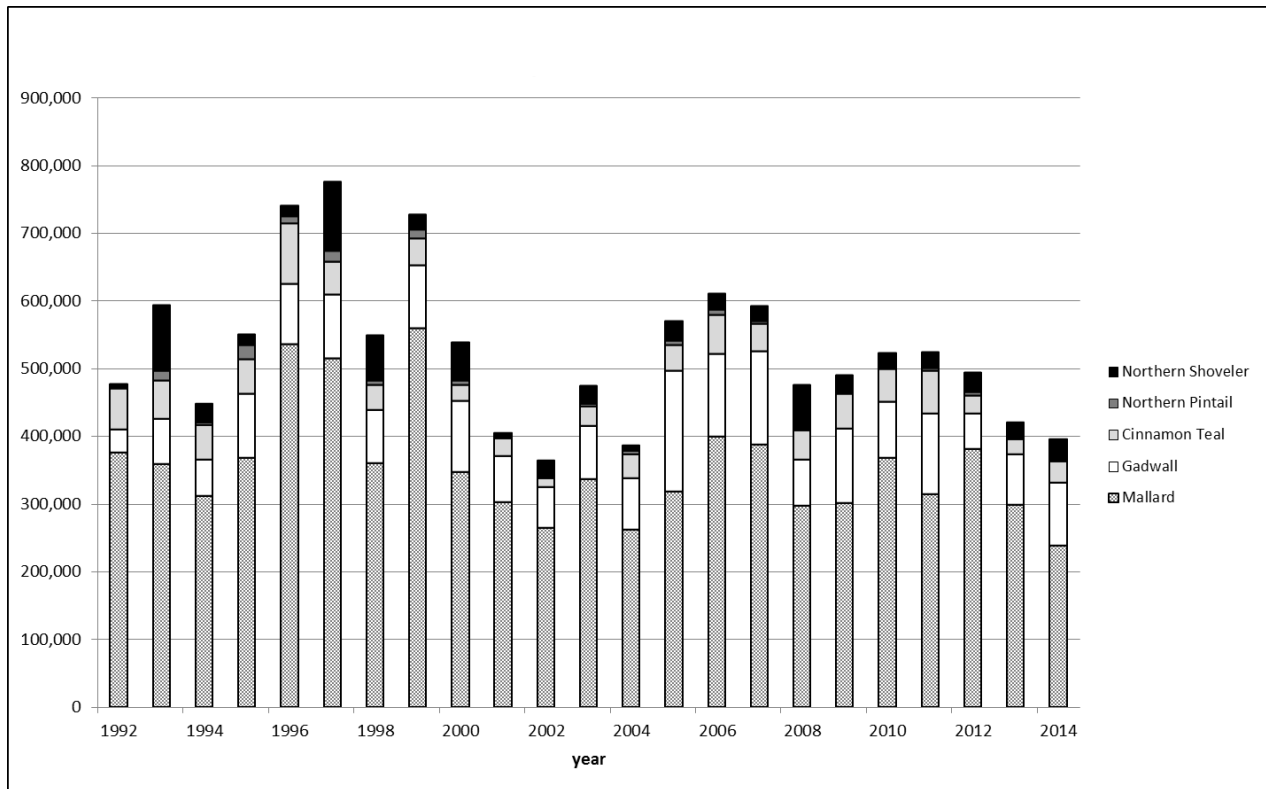


Table 1. Indicator health – status evaluation criteria.

Ranking relative to reference condition	Evaluation & interpretation
> 100% of historical reference period average	“Good”
> 60% of historical reference period average	“Fair”
< 60% of historical reference period average	“Poor”

Table 2. New Indicator Selection Criteria – Breeding Waterfowl: Delta and Suisun Marsh.

Delta & Estuary-wide Indicators - Selection Criteria for watershed assessment indicators for the San Francisco Estuary Report 2014.					
Modified from SFEIT (Collins, J. et al). 2011. Assessment Framework as a Tool for Integrating and Communicating Watershed Health Indicators for the San Francisco Estuary. Final Report. Grey cells were added for new Delta indicators for 2014					
Indicator Name:		Breeding Waterfowl - Delta			Draft version January 20, 2015
SotER Attribute Category:		Living Resources		Metric(s) ³ :	Breeding waterfowl population size in the Delta: Mallard, Gadwall, Cinnamon Teal, Northern Pintail and Northern Shoveler. Can also include Suisun and Napa River for an Estuary-wide indicator.
WAF Category ¹ :		Biotic condition - Species & Populations		Dataset name(s), Program, Agency ³ :	CDFW Waterfowl Program
CCMP Goal ² :		Wildlife Goals: - Optimally manage and monitor the wildlife resources of the Estuary.			
Result (yes/no)		Detailed comments, rationale, and Action Items		Result (yes/no)	Detailed comments, rationale, and Action Items
Conceptual Relevance I				Conceptual Relevance II	
Fits with SotB 2011 indicator for Bay ³	yes	Indicator of Delta ecosystem health: uses variety of upland habitats to breed, primarily agricultural and grassland habitats. Needs nearby water for foraging and broods.		Fits with Delta Plan or other Delta Stewardship Council documents ³	yes Yes. Species may respond to habitat restoration and protection (Delta Plan ER-R2).

Fits with WAF category (ecological function) ¹	yes	Biotic condition - Species & Populations - Population size, Habitat suitability	Fits with FRP/BO and EcoRestore Framework ³	yes	Not an EcoRestore covered species, but the natural habitats that support breeding waterfowl are covered. No terrestrial species (i.e. birds) addressed in FRP restoration & monitoring framework.
Fits with CCMP (management objectives)	yes		Fits with goals of other plan(s) ^{3,4}	Yes	Central Valley Joint Venture Strategic Plan (2006) includes conservation target habitat for Breeding Waterfowl. Updated Strategic Plan will included targets for breeding waterfowl.
Data Availability and Adequacy			Interpretation (what does it mean?)		
Data available	yes	Standardized survey data available 1992-2014. Same protocols are used throughout USA.	Goals, thresholds, reference, and/or triggers available	no	Propose using 1992-2001 average as a benchmark to correspond with recommended methods for SOTER 2015. CVJV is developing population targets, but none available now.
Data suitable quality	yes	see above.	Meaningful to public	yes	Waterfowl hunting is a popular sport in the Delta and Suisun, so waterfowl are important to that constituency. Waterfowl are also a highly visible and charismatic wildlife group.
Data currently or soon to be reported / linked on Estuaries Portal ³	yes	Static graphs included on Estuaries Portal from 2013. No plan to request web services from CDFW so that data are live.	Meaningful to decisionmakers ³	yes	see above
Development or application of indicator published / peer reviewed ³	no	Wintering, not breeding, waterfowl indicator was reported in the State of the Bay 2011. Considered expanding wintering waterfowl indicator to Delta, but survey methods in Delta are not yet sufficiently standardized to the degree they are in the			

		SF Bay.			
Responsiveness (to environmental change)			Transferability		
Driver-outcome linkage (describe; and is there a DRERIP model?)	yes	No DRERIP model. However, waterfowl breeding season ecology is well understood in California, particularly for mallard, the most common breeding species of duck in the state. Species requires upland protected nest sites.	Scalable (spatial / sub-regional, temporal)	yes	If decide to only report Delta in 2014, could add Napa and Suisun to future reports.
Sensitivity	yes	Highly sensitive to habitat management: cropping type, crop management, vegetation growth, level of inundation, disturbance, contaminants, and predation.	Transferable to other watersheds ⁵	yes	Because the survey methods are used throughout North America, this indicator could be used in other parts of California or USA.
Response time frame	yes	Likely to respond within a few years to habitat restoration, once the appropriate habitat is available.	Feasibility		
Spatial sampling frame	yes	One would expect to see changes in spatial distribution with habitat restoration and other habitat management improvements.	Feasible for 2015 State of the Estuary Report timetable ³	yes	Data are available. Only constraint is availability of CDFW Waterfowl Program staff to prepare indicator, or to review it.
Final decision:	Selected and Calculated. Will report on Delta and Suisun Marsh.				
Decision categories:					
Not selected		Selected but not calculated (indicate if deferred to future)		Selected and calculated	

Notes:

3) Newly proposed criterion for 2015; was not used as criterion for SOTB 2011

Additional Notes:

1) EPA Watershed Assessment Framework 2002

2) Comprehensive Conservation & Management Plan, SFEF 2009

4) other plans may include Recovery Plans, Permit requirements/Biological Opinions, HCP/NCCP', or other Restoration program documents ERP Conservation Strategy.

5) For the SotB 2011, if this was the only factor to get a "no" answer, it was not used as a reason to remove indicator from consideration.

Mallard account for 80% of breeding waterfowl in CA. Include all top 5 species including mallard.