California Department of Fish and Wildlife

Upland Game Bird Harvest Survey 2020-2021

2020-2021 California Upland Game Bird Stamp Art Contest, mourning dove
First Place, Buck Spencer, Junction City, Oregon

Prepared by:
Katherine Miller, Environmental Scientist
Matt Meshriy, Environmental Scientist
Megan Crane, Environmental Scientist
Dan Skalos, Senior Environmental Scientist Supervisor
California Department of Fish and Wildlife
Wildlife and Fisheries Division
Wildlife Branch
1010 Riverside Parkway
West Sacramento, CA 95605

Table of Contents

Introduction

From 1948-2010, the California Department of Fish and Wildlife (hereafter, the Department) conducted a "Game Take Hunter Survey" (GTHS) to estimate harvest and hunter effort in California. The GTHS was a mail-based survey sent to a random sample of people who purchased a hunting license. These surveys provided information on the number of each species harvested and the time spent by each hunter in the field by county, providing information on hunter success and harvest trends. The GTHS included all game, non-game, and furbearing species that could be hunted and was the only survey for estimating state-wide and county-level harvest of upland game birds through 2010.

In more recent years, technological advances in automated license systems and changes to survey methodology have changed how biologists conduct these harvest surveys. For example, the advent of the Automated License Data System (ALDS) in the early 2000s allowed the Department to report species-specific harvest based on tag returns (big game species) and permit reports (greater sage-grouse). Hunters can now submit tags and permit reports online through ALDS. Consequentially, the utility of the mail-based GTHS declined while postal costs increased, and after a statewide budget crisis, the survey was discontinued after 2010. Concurrently with the advent of the ALDS and on-line tag reporting, the United States Fish and Wildlife Service developed the Migratory Harvest Information Program (HIP), which estimates the harvest and hunter effort of migratory game birds (waterfowl, doves, band-tailed pigeons, rails, coots and gallinules, and Wilson's snipe). However, neither ALDS nor HIP surveys provide estimates of resident upland game bird or small game harvest and hunt effort (with the exception of greater sage-grouse reporting in ALDS, mentioned above). A need remains to estimate harvest for resident upland game birds and small game mammals in California.

The Department has investigated several different approaches for conducting upland game bird and small game mammal surveys. In 2017, the Department developed an internet-based survey specific to resident upland game birds. This survey targeted the upland game bird hunters from the Spring 2016 turkey season up to the Spring 2017 turkey season. In 2019, the Department conducted a similar survey for the

2018–2019 hunting season, broadening the scope to resident upland game birds and small game mammals. The older GTHS reports, the Responsive Management survey report (contracted in 2014), and the more recent internet survey reports are available on the Department's Upland Game Bird Hunting website, https://wildlife.ca.gov/Hunting/Upland-Game-Birds.

In 2021, Department staff conducted a survey for upland game birds, including migratory species, targeting upland game bird hunters in the 2020-2021 hunting season. In the late summer of 2020, California experienced a severe wildfire season, driven by several years of dry weather (precipitation values below the 30-year normals) throughout the state. Fires burned over 3 million acres of vegetation in California, including 1 million acres of shrub-scrub, 1.5 million acres of forest, and 260,000 acres of herbaceous vegetation (grass and forbs, unpub. analysis using National Land Cover Data and fire polygons). In response, the U. S. Forest Service closed all 18 national forests in California, and the Department closed 49 properties adjacent to these national forests. This effectively closed access to the best hunting areas for forest grouse and white-tailed ptarmigan through their respective seasons, and affected harvest and hunter effort for mountain quail, California quail, wild turkey, and band-tailed pigeon. While the fires and resulting closures certainly affected upland game bird populations and hunting efforts, in 2020-2021 the Department experienced a slight increase on license sales. Coupled with the high number of adults teleworking with flexible schedules, due to COVID-19, we considered that interest in hunting may have increased. We developed this survey with those potential effects to harvest and hunter effort in mind.

Survey Overview

The Department evaluated different survey techniques, along with their implementation costs, potential sources of bias, and previous experiences with each method. Ultimately the Department chose to develop another on-line survey for a random pool of hunters with Upland Game Bird Validations and email addresses. This on-line survey relies on the hunter's email address in order to direct the hunter to the survey website. The hunter is required to provide their GO-ID number to ensure that

only those responses from randomly selected hunters are recorded. While all holders of hunting licenses in California are automatically assigned an individual GO-ID number in ALDS, the submission of an email address to the department is optional, thus not all upland game bird hunters in California could be randomly surveyed by email. However, there is a consistently increasing trend of hunters who use email, and in 2020-2021 71% of those hunters who purchased an Upland Game Bird Validation through ALDS voluntarily provided an email address (compared to 44% in 2016-2017). Because we expect that the number of hunters who provide email address will continue to increase, and because many hunters who purchased an Upland Game Validation in the 2020-2021 license year could be reached via email, we were comfortable with email and the internet as the approach to conduct this survey, while mindful of potential sources of bias.

Prior to drawing the random sample from the pool of hunters with email addresses on file, we investigated the potential for age bias among respondents, as the use of email is relatively new in comparison to recreational hunting. We determined age for all hunters with Upland Game Bird validations for 2020-2021, and compared mean age between two groups, those that provided an email address and those that did not (Fig. 1). Due to the similarity in mean age for hunters between these groups (≤ 2 years) in our second on-line harvest survey, we were satisfied that our choice to sample those hunters that provided emails would not introduce substantial age bias among our survey respondents.

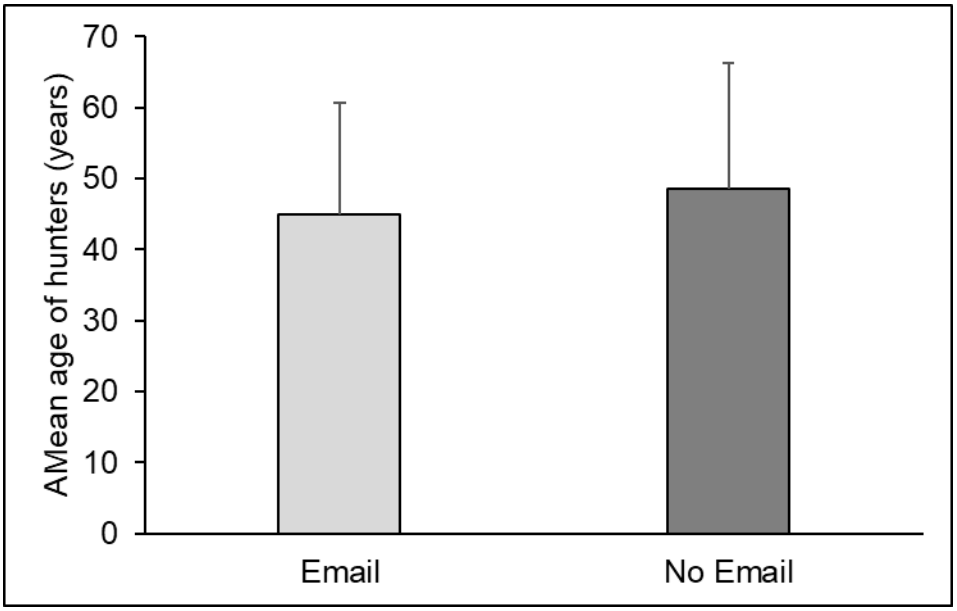


Figure 1: Mean age ± standard deviation for upland game bird hunters who provided email addresses versus those who did not provide email addresses.

We randomly chose 10,000 hunters with email addresses for our sample, using the equation in Dillman (2000:206).

$$Ns = \frac{(Np)(p)(1-p)}{(Np-1)(\frac{B}{C})^2+(p)(1-p)}$$

Where:

Ns = sample size that completed the survey

Np = total population of interest: 118,345 (upland game hunters with emails 2020–2021).

p = 0.5

B = acceptable amount of sampling error (< 2 points)

C = *Z* statistic for desired confidence interval (at 95%, 1.96)

If *B* = 0.02, or 2%, the findings of 95 of 100 surveys would fall within 2 percentage points of each other. For example, if we ask hunters their age, and the mean age is 52.3, then for 95 out of 100 different surveys the sample estimate would be between 50.3 and 54.3.

To obtain results with our predetermined sampling error of $B = 0.02$, we solved the above equation to determine the number of survey respondents required (n = 2,353). We assumed a response rate for on-line surveys of 25%, based on communication with wildlife departments in other states. Thus, the number required for our pool of randomly selected hunters should be 9,413, which we rounded up to 10,000 hunters. We used ALDS to generate a random sample of 10,000 and sent those hunters a link to a page on the Department website that asked them to report harvest location and number, as well as number of days spent hunting (Appendix 1).

Results

We received 1,183 responses from our random sample, which is higher than the 2018–2019 response rate, but lower than the 2016–2017 response rate. Of the respondents, 66% (n = 782) hunted upland game birds. Thirty-four percent (n = 401) did not hunt or only hunted on licensed game bird clubs, and were thus excluded from further analysis. We estimated the harvest and hunter effort by extrapolating the number reported by the hunters using the number of respondents (n = 1,183) divided by the number of upland game validated hunters (n = 166,488, 0.72%).

Most hunters who hunted upland game birds in 2020–2021 were male (Fig. 2). The mean age of hunters was 52.30, younger than those who did not hunt (56.28), but older than the mean age (44.10) from the random pool of 10,000 hunters. Hunters that did not respond to the survey were younger, on average, than those who responded (Fig. 3).

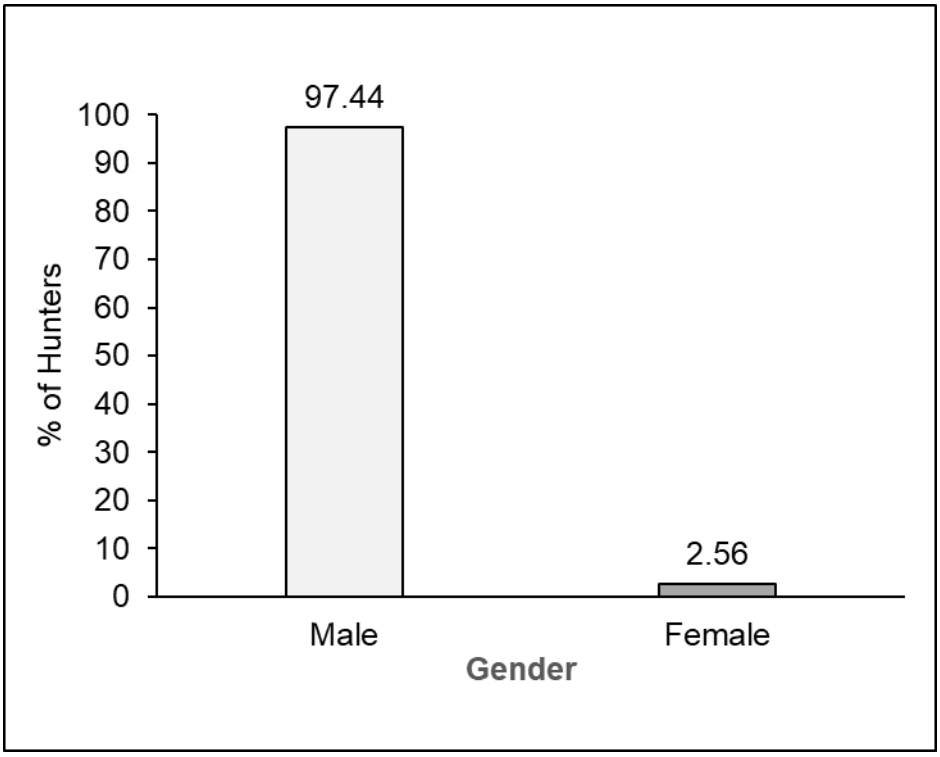


Figure 2: Gender of survey respondents.

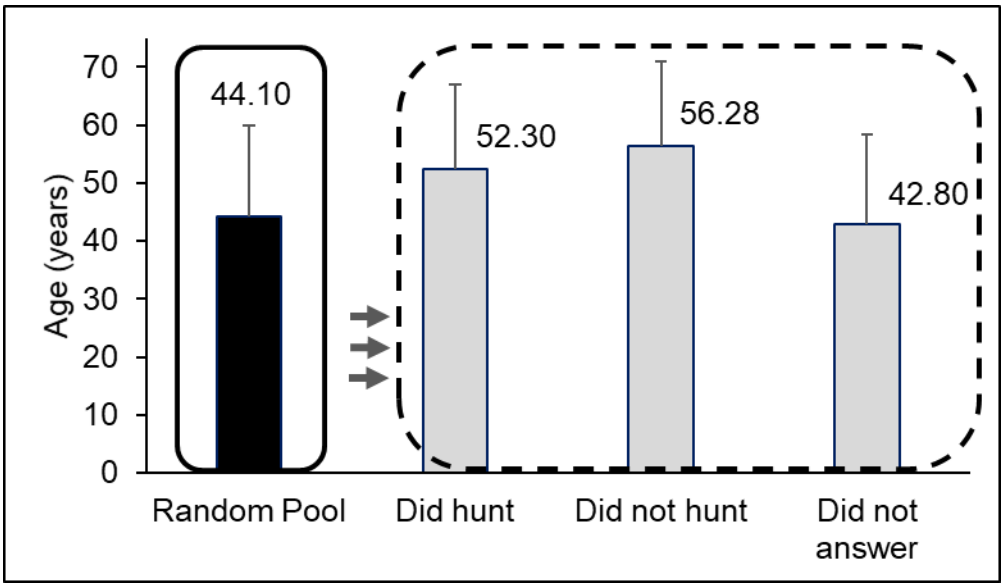


Figure 3: Mean age ± standard deviation of surveyed hunters who hunted, did not hunt, or did not answer the survey.

Sample Error

We determined sampling error from a rearrangement of Dillman's (2000) equation:

$$B = \left(\sqrt{\frac{\frac{(Np)(p)(1-p)}{Ns} - (p)(1-p)}{(Np-1)}} \right)(1.96)$$

Ns = sample size that completed the survey, 1,183

Np = total population of interest: 118,345 (total upland game hunters with email in the 2020–2021 hunting season).

p = 0.5

C = *Z* statistic for desired confidence interval (at 95%, 1.96)

B = 0.0286, or, 2.86 percentage points.

Thus, we calculated that the sampling error rate for our survey is ± 2.83%.

Results by species

We asked hunters to report on both resident and migratory upland game birds. We asked hunters about their success and hunt effort on ten resident upland game bird species: mountain, California, and Gambel's quail, wild turkey, ruffed grouse, white-tailed ptarmigan, sooty grouse, ring-necked pheasant, chukar, and Eurasian collared-dove (Table 1). For wild turkey, we asked hunters to specify the hunting season in which turkey was hunted: Fall 2020 or Spring 2021. We asked hunters if they hunted white-tailed ptarmigan, with the intent to contact those hunters for specific information. Only two hunters indicated that they had hunted white-tailed ptarmigan, and both responded to our follow-up email with harvest and hunter effort information. The Department issues permits for greater sage-grouse, however, no permits were issued in the 2020-2021 hunting season, thus the species is not represented in this report. In addition to resident upland game birds, we asked hunters to report on four migratory upland game bird species: band-tailed pigeon, white-winged dove, mourning dove, and Wilson's snipe.

As anticipated, forest fires and the resulting closures reduced forest grouse harvest and hunter effort considerably. For ruffed and sooty grouse, harvest was only 29% and 53% (respectively) of the 2018–2019 survey estimates. Mountain and California quail harvest were at 56% and 68% of the 2018–2019 estimates, respectively.

We noted that while both fall and spring wild turkey harvest decreased slightly from the 2018–2019 estimates (87% and 93% of the 2018-2019 estimate), hunter effort was closer to the 2018–2019 estimates for the fall season (81%) than in the spring (76%). This suggests that while hunting may have been challenging in the early fall, hunters were still able to access areas for hunting later in the season.

Table 1. Statewide estimated harvest and hunter effort from 2020–2021 Upland Game Bird Harvest Survey.

Species	Harvest	Hunters	Avg. bag per hunter	Days hunted	Avg. days hunted
Mountain quail	36,679	8,882	4.13	39,396	4.44
California quail	215,265	25,602	8.41	127,905	5.00
Gambel's quail	23,303	1,776	13.12	9,300	5.24
Wild turkey Fall 2020	6,165	12,122	0.51	42,635	3.52
Wild turkey Spring 2021	20,795	26,751	0.78	105,647	3.95
Ruffed grouse	940	940	1.00	4,911	5.22
White-tailed ptarmigan*	2	2	1	2	1
Sooty grouse	940	1,045	0.90	4,911	4.70
Ring-necked pheasant	31,349	12,958	2.42	54,443	4.20
Chukar	15,048	3,344	4.50	15,675	4.69
Band-tailed pigeon	5,016	1,985	2.53	4,598	2.32
Eurasian collared-dove	77,119	8,464	9.11	33,021	3.90
White-winged dove	17,974	2,194	8.19	7,733	3.52
Mourning dove	619,566	32,394	19.13	131,249	4.05
Wilson's snipe	1,358	627	2.17	1,672	2.67

* Reporting raw results from two hunters' survey responses.

County-level results

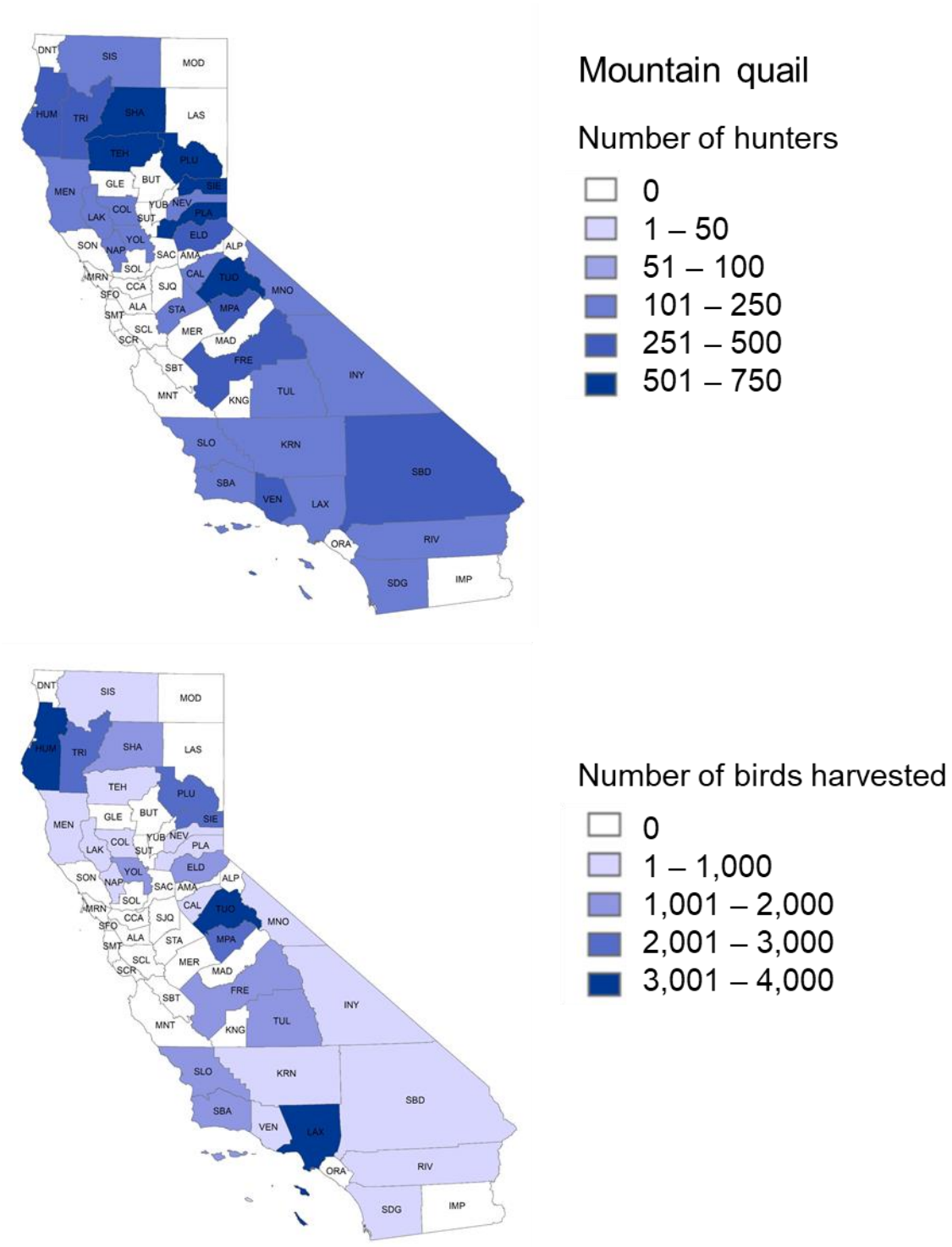


Figure 4: Estimated number of hunters and harvest for mountain quail (*Oreortyx pictus*).

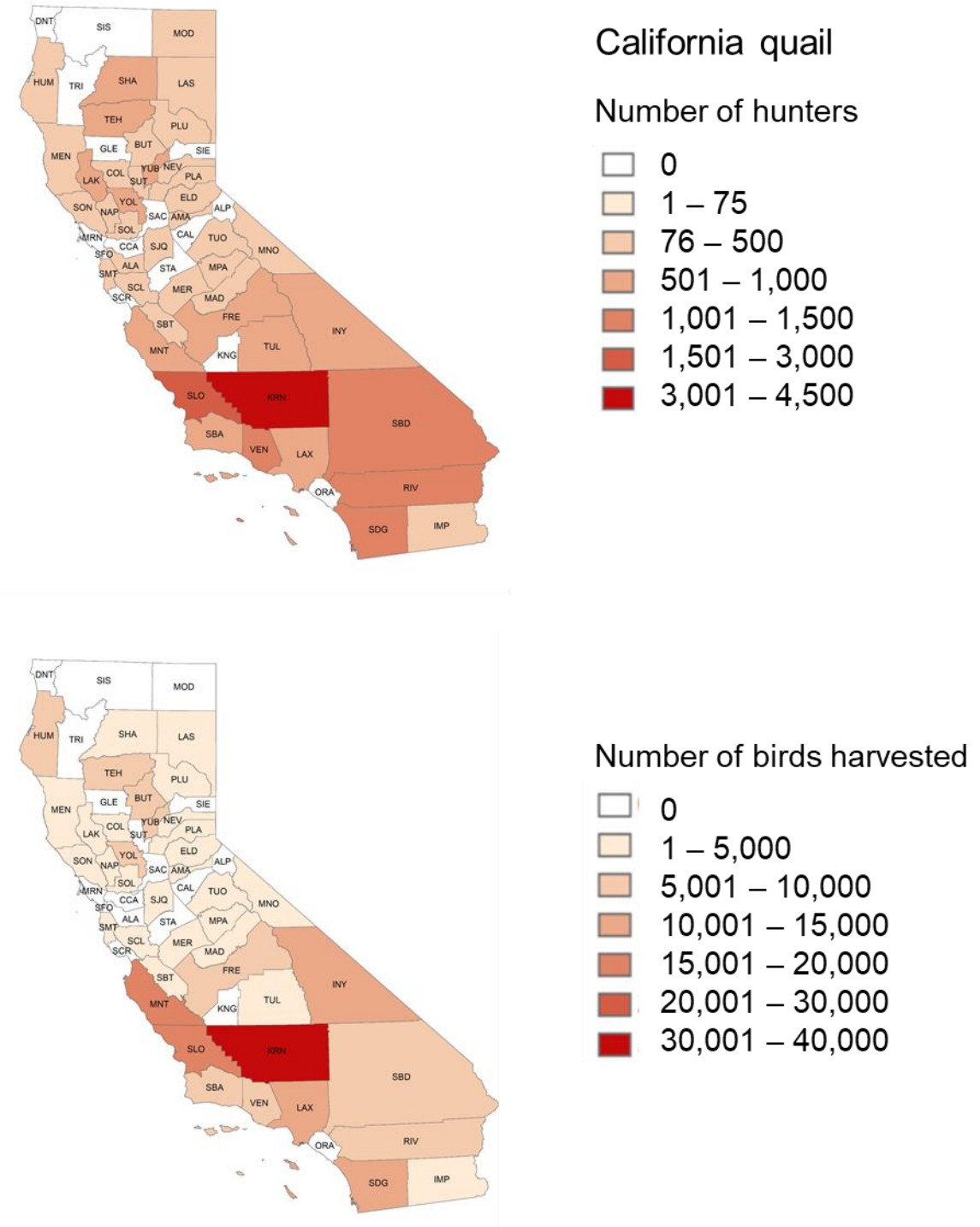


Figure 5: Estimated number of hunters and harvest for California quail (*Callipepla californica).*

Gambel's quail

Number of hunters

- 0
- 1 – 50
- 51 – 150
- 151 – 200
- 201 – 400
- 401 – 600
- 601 – 800

Number of birds harvested

- 0
- 1 – 2,000
- 2,001 – 4,000
- 4,001 – 6,000
- 6,001 – 8,000
- 8,001 – 10,000
- 10,001 – 12,000

Figure 6: Estimated number of hunters and harvest for Gambel's quail (*Callipepla gambelii)*.

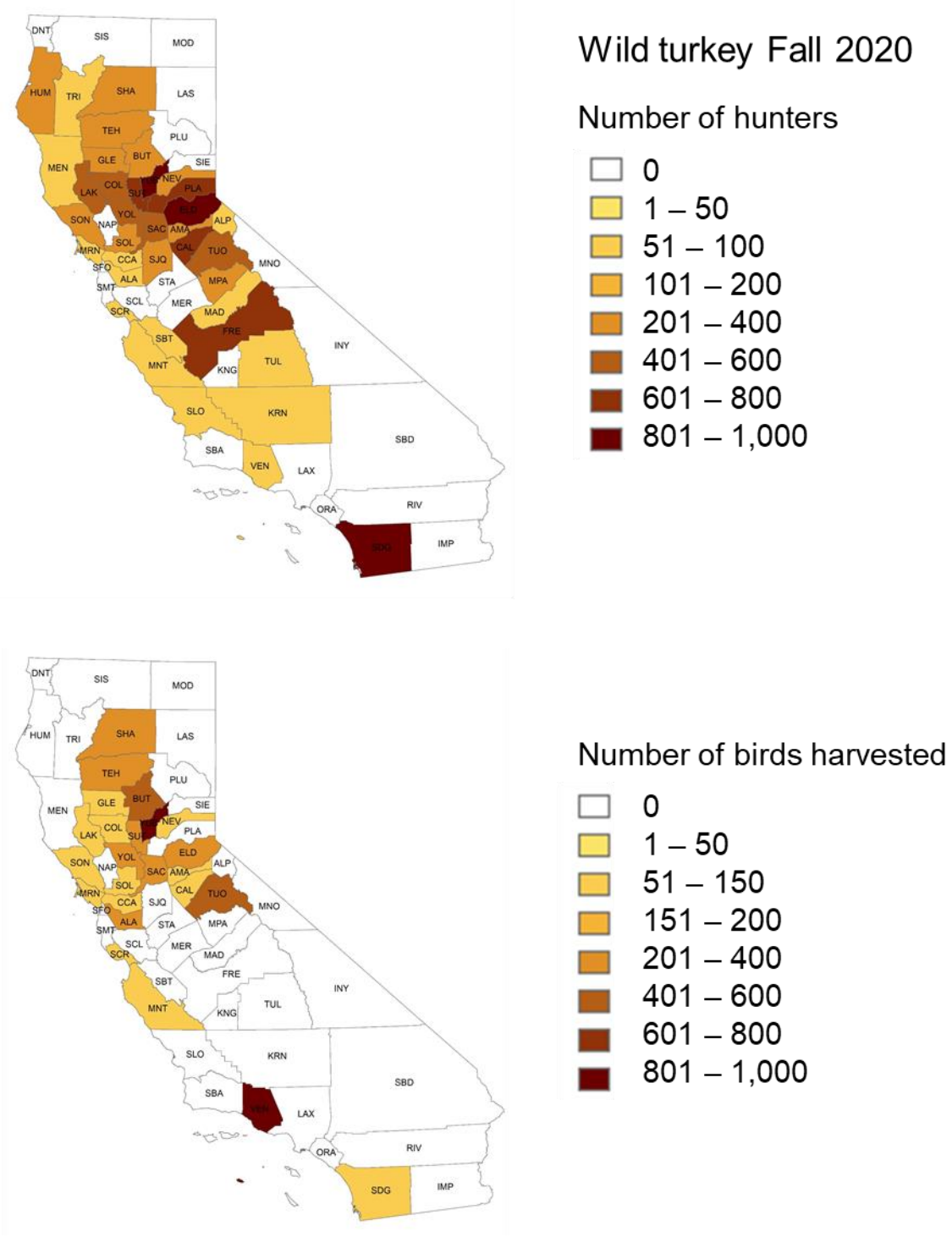


Figure 7: Estimated number of hunters and harvest for wild turkey (*Meleagris gallopavo*) in Fall 2020.

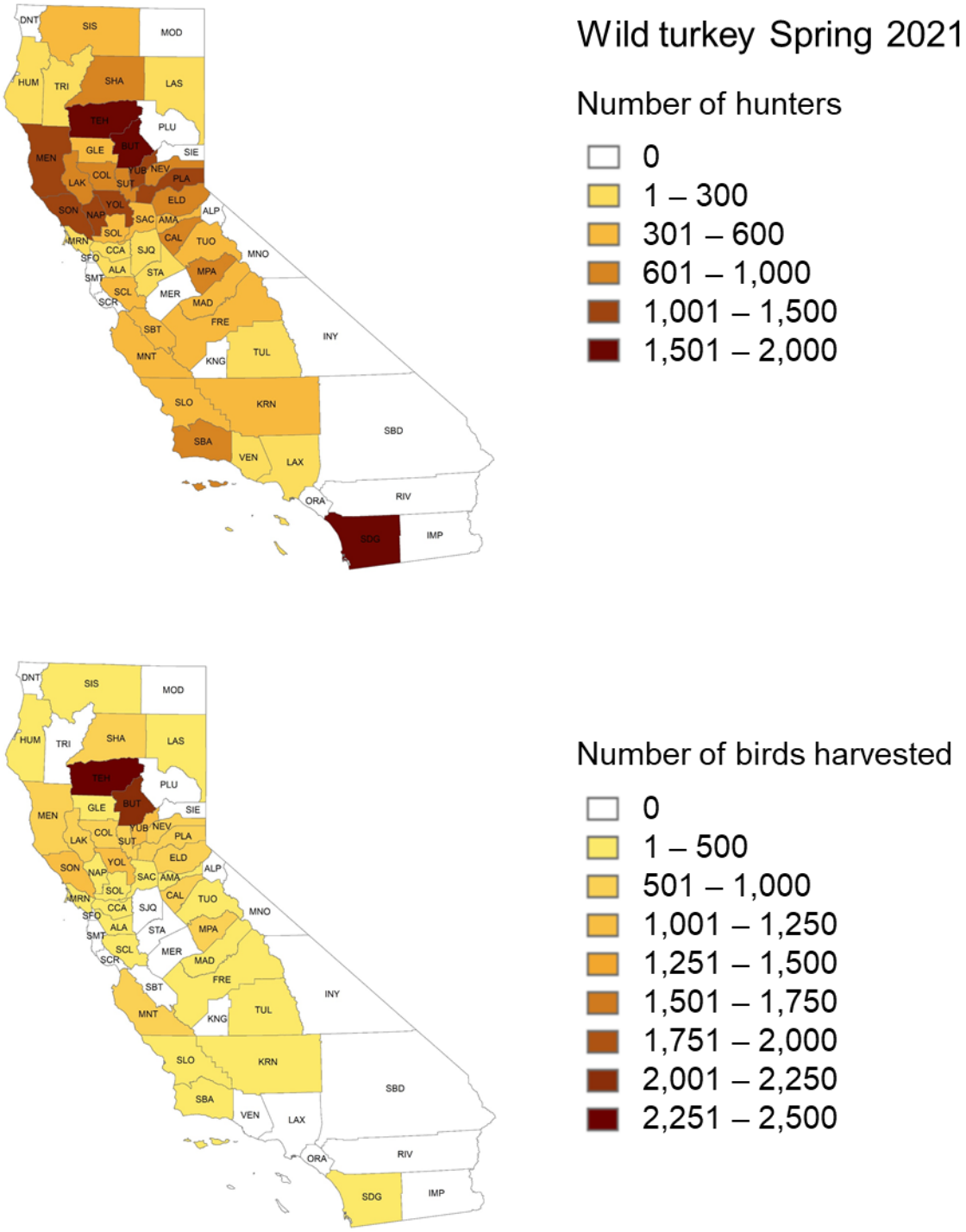


Figure 8: Estimated number of hunters and harvest for wild turkey (*Meleagris gallopavo*) in Spring 2021.

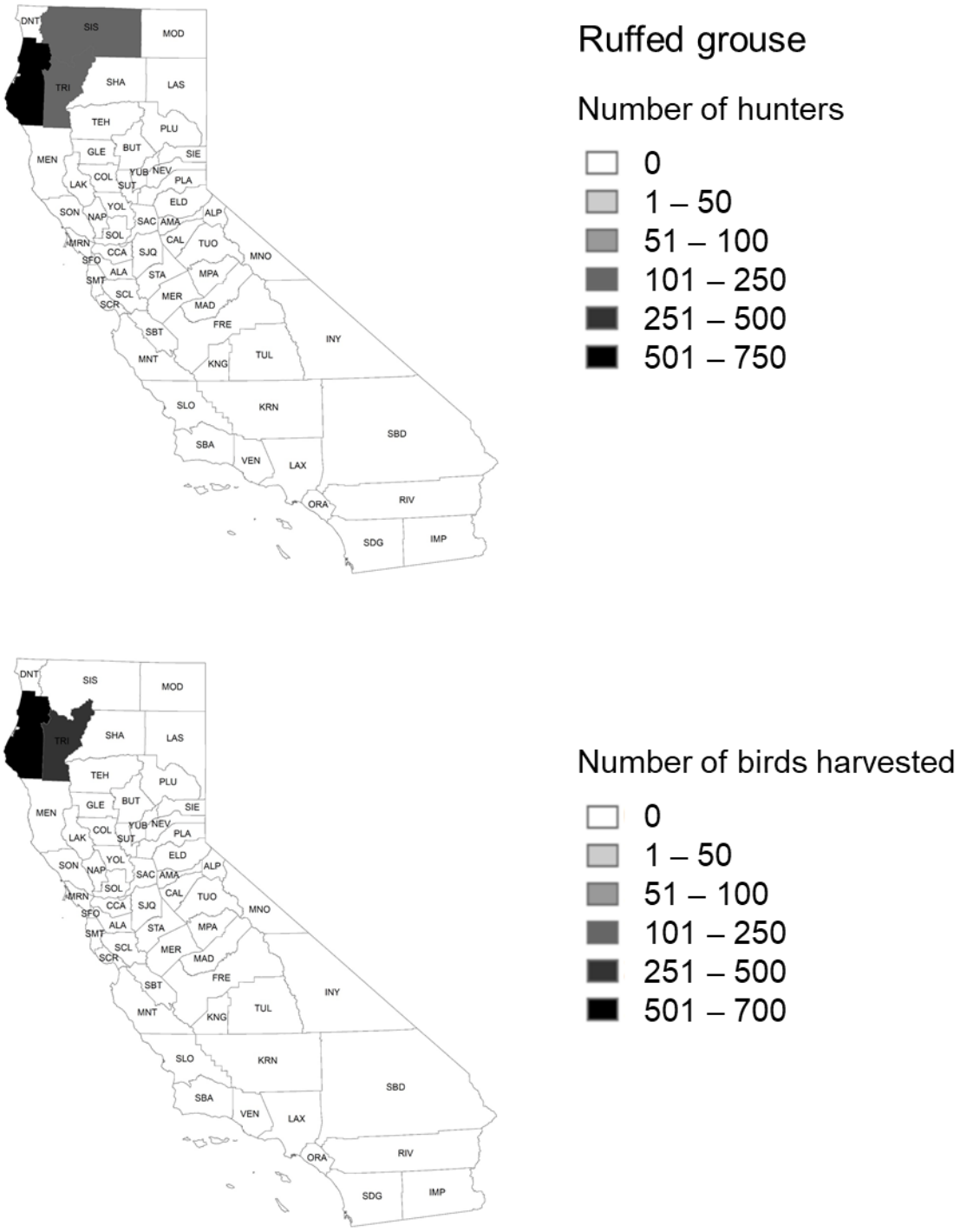
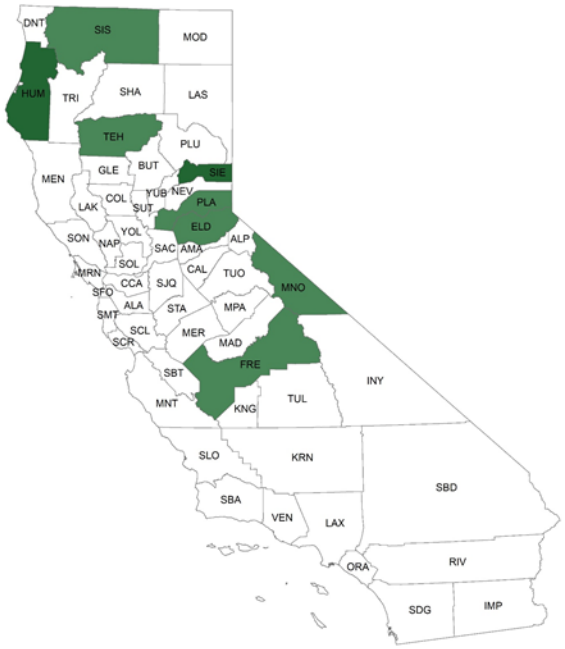


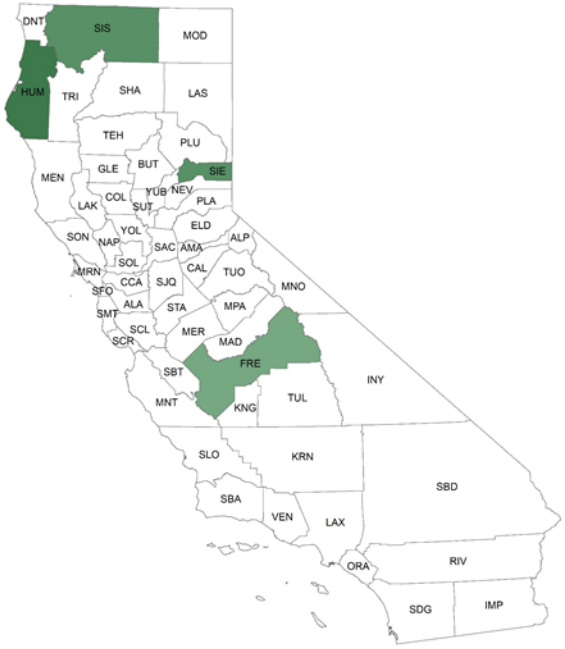
Figure 9: Estimated number of hunters and harvest for ruffed grouse (*Bonasus umbellus*).



Sooty grouse

Number of hunters

- 0
- 1 – 50
- 51 – 100
- 101 – 175
- 176 – 250



Number of birds harvested

- 0
- 1 – 50
- 51 – 100
- 101 – 150
- 151 – 300
- 301 – 450
- 451 – 525

Figure 10: Estimated number of hunters and harvest for sooty grouse (*Dendragapus fuliginosus*).

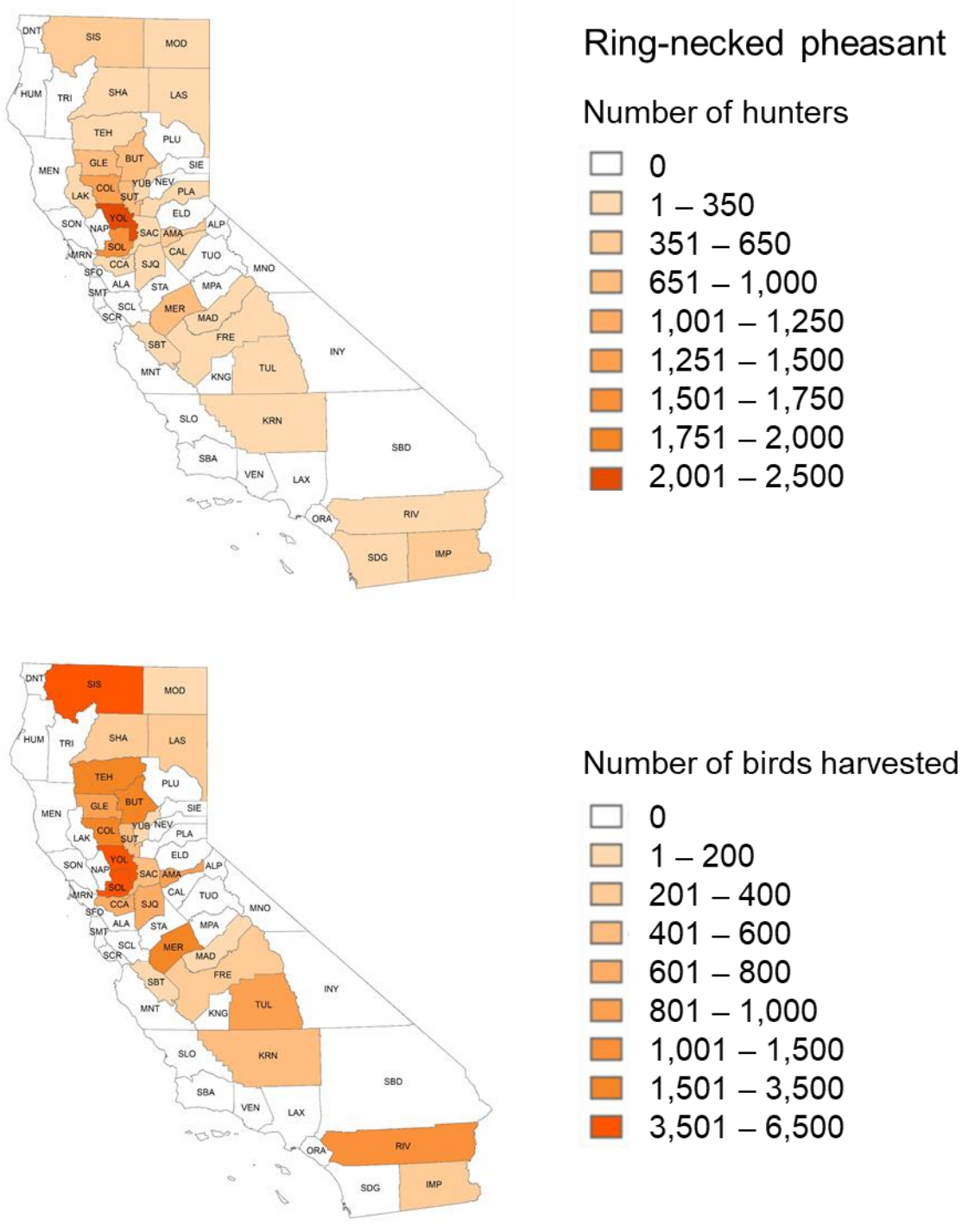
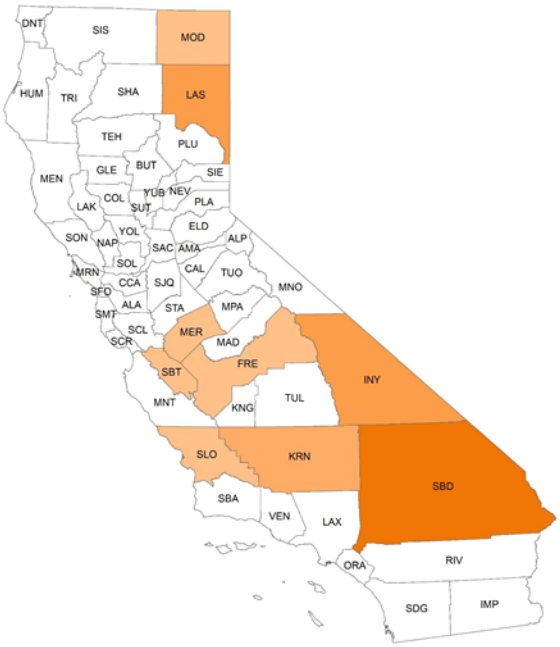


Figure 11: Estimated number of hunters and harvest for ring-necked pheasant (*Phasianus colchicus*).



Chukar

Number of hunters

- 0
- 1 – 50
- 51 – 250
- 251 – 500
- 501 – 750
- 751 – 1,000
- 1,001 – 1,250

Number of birds harvested

- 0
- 1 – 75
- 76 – 500
- 501 – 1,000
- 1,001 – 2,500
- 2,501 – 5,000
- 5,001 – 8,000

Figure 12: Estimated number of hunters and harvest for chukar (*Alectoris chukar*).

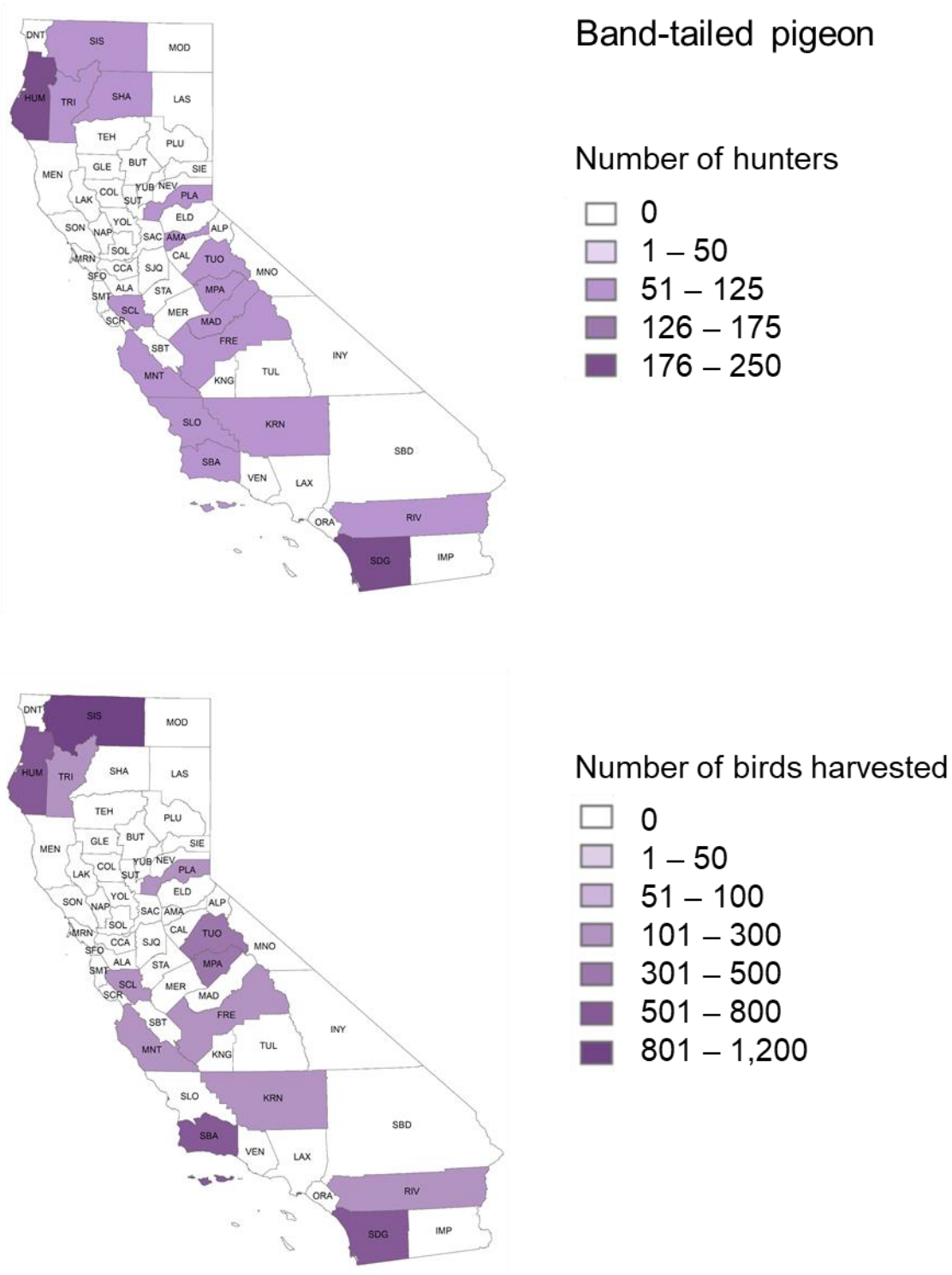


Figure 13: Estimated number of hunters and harvest for band-tailed pigeon (*Patagioenas fasciata monilis*).

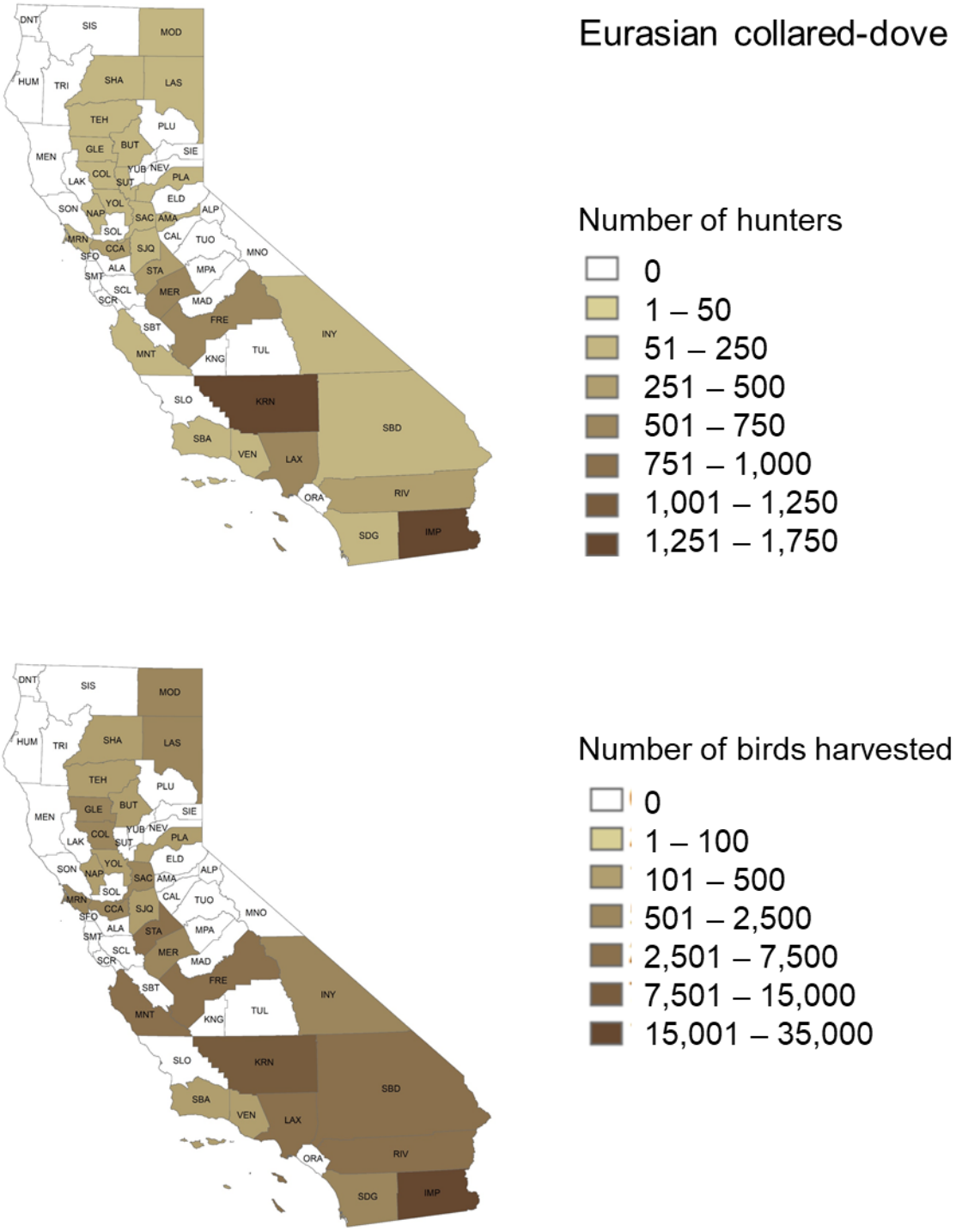


Figure 14: Estimated number of hunters and harvest for Eurasian collared-dove (*Streptopelia decaocto)*.

White-winged dove

Number of hunters

- 0
- 1 – 50
- 51 – 250
- 251 – 500
- 501 – 750
- 751 – 1,000
- 1,001 – 1,200
- 1,201 – 1,400

Number of birds harvested

- 0
- 1 – 50
- 51 – 1,000
- 1,001 – 2,000
- 2,001 – 4,000
- 4,001 – 6,000
- 6,001 – 8,000
- 8,001 – 10,000

Figure 15: Estimated number of hunters and harvest for white-winged dove (*Zenaida asiatica*).

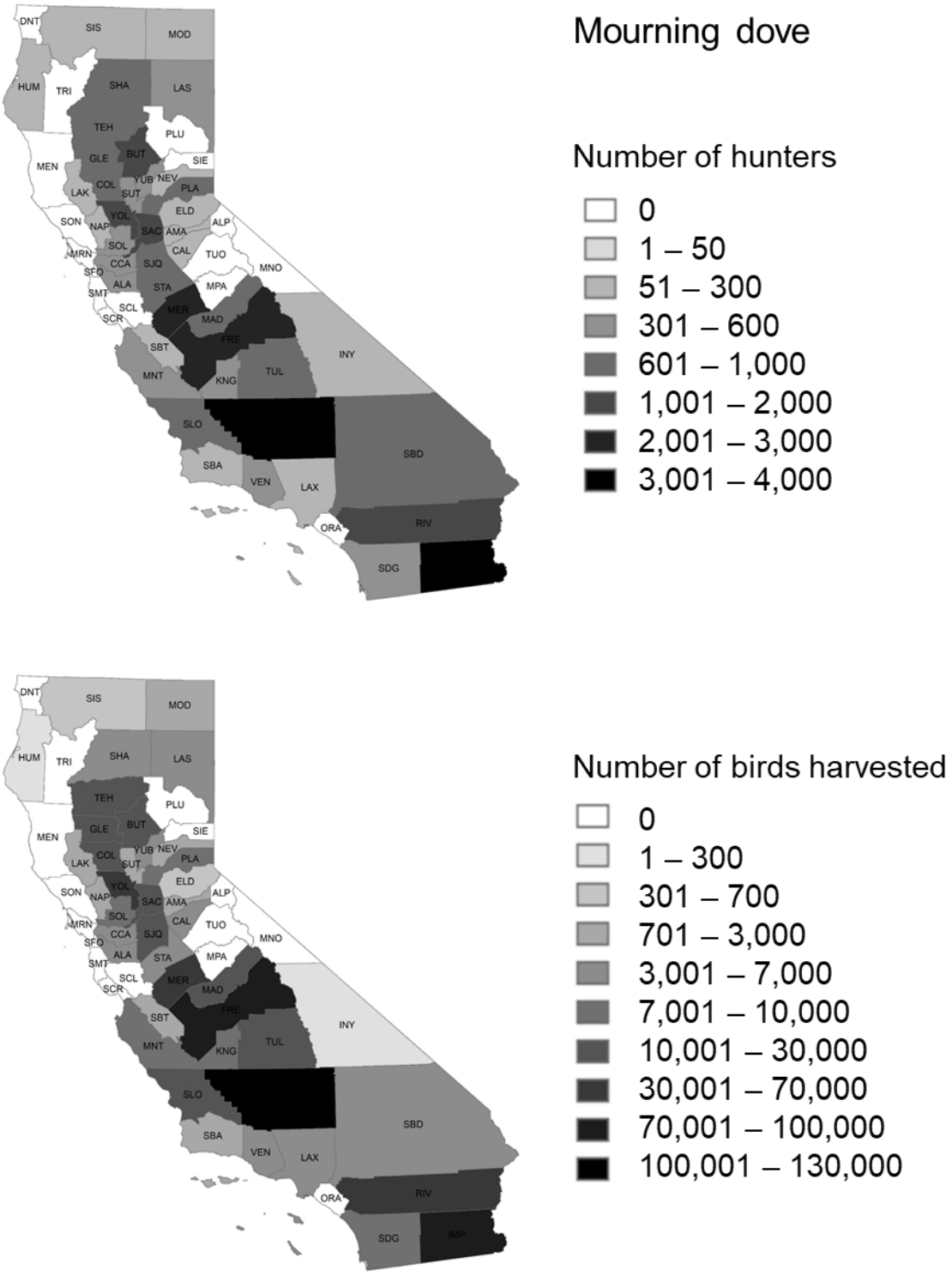


Figure 16: Estimated number of hunters and harvest for mourning dove (*Zenaida macroura*).

Wilson's snipe

Number of hunters

- 0
- 1 – 50
- 51 – 100
- 101 – 150
- 151 – 250

Number of birds harvested

- 0
- 1 – 200
- 201 – 400
- 401 – 600
- 601 – 800
- 801 – 1,000
- 1,001 – 1,200

Figure 17: Estimated number of hunters and harvest for Wilson's snipe (*Gallinago delicata*).

Table 2. Estimated harvest, number of hunters, and number of days hunted for each species by county.

County	Mountain quail harvest	Mountain quail hunters	Mountain quail days	California quail harvest	California quail hunters	California quail days
Alameda	0	0	0	0	104	209
Alpine	0	0	0	0	0	0
Amador	0	0	0	313	209	313
Butte	0	0	0	5,120	313	3,239
Calaveras	104	104	104	0	0	0
Colusa	627	104	522	1,776	313	2,403
Contra Costa	0	0	0	0	0	0
Del Norte	0	0	0	0	0	0
El Dorado	1,045	418	836	104	104	313
Fresno	1,567	418	1,254	8,464	836	2,508
Glenn	0	0	0	0	0	0
Humboldt	3,030	418	3,866	5,225	313	2,090
Imperial	0	0	0	209	209	522
Inyo	313	209	1,149	11,390	940	8,673
Kern	627	209	836	39,291	4,075	16,720
Kings	0	0	0	0	0	0
Lake	418	104	104	731	627	1,672
Lassen	0	0	0	3,448	418	1,149
Los Angeles	3,135	104	522	10,241	836	5,747
Madera	0	0	0	1,149	313	731
Marin	0	0	0	0	0	0
Mariposa	2,926	313	1,254	4,075	313	2,508
Mendocino	418	104	1,045	1,567	418	731
Merced	0	0	0	2,194	313	940
Modoc	0	0	0	0	209	313
Mono	731	209	1,045	1,881	209	1,672
Monterey	0	0	0	19,019	627	3,762
Napa	418	104	104	1,881	209	627
Nevada	940	209	940	1,254	104	522
Orange	0	0	0	0	0	0
Placer	209	522	1,985	522	104	209
Plumas	2,821	627	1,776	209	209	2,194
Riverside	209	104	209	8,987	1,358	11,704
Sacramento	0	0	0	0	0	0

Table 2. Estimated harvest, number of hunters, and number of days hunted for each species by county (continued).

County	Mountain quail harvest	Mountain quail hunters	Mountain quail days	California quail harvest	California quail hunters	California quail days
San Benito	0	0	0	3,135	209	627
San Bernardino	313	313	1,149	7,733	1,463	8,360
San Diego	313	104	209	10,972	1,254	7,001
San Francisco	0	0	0	0	0	0
San Joaquin	0	0	0	209	209	522
San Luis Obispo	1,045	104	1,567	15,675	1,776	9,300
San Mateo	0	0	0	522	104	104
Santa Barbara	1,149	209	1,358	8,151	940	4,284
Santa Clara	0	0	0	1,463	418	940
Santa Cruz	0	0	0	0	0	0
Shasta	1,881	731	2,717	1,881	522	1,358
Sierra	2,194	522	1,985	0	0	0
Siskiyou	209	209	418	0	0	0
Solano	0	0	0	209	104	209
Sonoma	0	0	0	836	209	418
Stanislaus	0	209	836	0	0	0
Sutter	0	0	0	0	104	104
Tehama	418	627	2,612	6,792	940	3,135
Trinity	2,299	313	2,299	0	0	0
Tulare	1,672	209	1,045	4,284	627	2,090
Tuolumne	3,971	522	3,971	2,717	418	1,358
Ventura	627	418	1,149	9,614	1,149	7,001
Yolo	1,045	104	522	5,956	731	1,881
Yuba	0	0	0	6,061	731	7,733

Table 2. Estimated harvest, number of hunters, and number of days hunted for each species by county (continued).

County	Gambel's quail harvest	Gambel's quail hunters	Gambel's quail days
Alameda	0	0	0
Alpine	0	0	0
Amador	0	0	0
Butte	0	0	0
Calaveras	0	0	0
Colusa	0	0	0
Contra Costa	0	0	0
Del Norte	0	0	0
El Dorado	0	0	0
Fresno	0	0	0
Glenn	0	0	0
Humboldt	0	0	0
Imperial	10,554	731	3,030
Inyo	3,344	104	1,254
Kern	1,881	104	209
Kings	0	0	0
Lake	0	0	0
Lassen	0	0	0
Los Angeles	0	0	0
Madera	0	0	0
Marin	0	0	0
Mariposa	0	0	0
Mendocino	0	0	0
Merced	0	0	0
Modoc	0	0	0
Mono	0	0	0
Monterey	0	0	0
Napa	0	0	0
Nevada	0	0	0
Orange	0	0	0
Placer	0	0	0
Plumas	0	0	0
Riverside	6,374	418	2,926
Sacramento	0	0	0

Table 2. Estimated harvest, number of hunters, and number of days hunted for each species by county (continued).

County	Gambel's quail harvest	Gambel's quail hunters	Gambel's quail days
San Benito	0	0	0
San Bernardino	1,149	418	1,881
San Diego	0	0	0
San Francisco	0	0	0
San Joaquin	0	0	0
San Luis Obispo	0	0	0
San Mateo	0	0	0
Santa Barbara	0	0	0
Santa Clara	0	0	0
Santa Cruz	0	0	0
Shasta	0	0	0
Sierra	0	0	0
Siskiyou	0	0	0
Solano	0	0	0
Sonoma	0	0	0
Stanislaus	0	0	0
Sutter	0	0	0
Tehama	0	0	0
Trinity	0	0	0
Tulare	0	0	0
Tuolumne	0	0	0
Ventura	0	0	0
Yolo	0	0	0
Yuba	0	0	0

Table 2. Estimated harvest, number of hunters, and number of days hunted for each species by county (continued). F and S refer to Fall 2020 and Spring 2021, respectively.

County	Wild turkey F harvest	Wild turkey F hunters	Wild turkey F days	Wild turkey S harvest	Wild turkey S hunters	Wild turkey S days
Alameda	209	104	209	104	209	209
Alpine	0	104	313	0	0	0
Amador	104	313	836	209	522	731
Butte	418	313	731	2,194	1,985	10,763
Calaveras	104	731	1,985	836	836	3,030
Colusa	104	418	2,194	627	836	2,299
Contra Costa	104	104	209	209	104	313
Del Norte	0	0	0	0	0	0
El Dorado	313	940	4,180	836	836	3,030
Fresno	0	731	2,508	209	522	4,075
Glenn	104	209	731	209	313	1,985
Humboldt	0	209	1,149	209	209	940
Imperial	0	0	0	0	0	0
Inyo	0	0	0	0	0	0
Kern	0	104	313	104	313	1,254
Kings	0	0	0	0	0	0
Lake	104	522	1,254	522	627	2,612
Lassen	0	0	0	104	209	836
Los Angeles	0	0	0	0	104	209
Madera	0	104	209	209	313	418
Marin	104	104	522	209	209	1,254
Mariposa	0	209	731	836	836	2,926
Mendocino	0	104	313	940	1,149	3,553
Merced	0	0	0	0	0	0
Modoc	0	0	0	0	0	0
Mono	0	0	0	0	0	0
Monterey	104	104	104	940	522	2,299
Napa	0	0	0	313	1,463	4,493
Nevada	104	209	1,149	731	731	3,239
Orange	0	0	0	0	0	0
Placer	0	627	1,358	836	1,045	3,135
Plumas	0	0	0	0	0	0
Riverside	0	0	0	0	0	0
Sacramento	313	418	1,776	104	418	1,045

Table 2. Estimated harvest, number of hunters, and number of days hunted for each species by county (continued). F and S refer to Fall 2020 and Spring 2021, respectively.

County	Wild turkey F harvest	Wild turkey F hunters	Wild turkey F days	Wild turkey S harvest	Wild turkey S hunters	Wild turkey S days
San Benito	0	104	522	0	522	1,254
San Bernardino	0	0	0	0	0	0
San Diego	104	836	3,344	418	1,881	5,120
San Francisco	0	0	0	0	0	0
San Joaquin	0	313	836	0	104	209
San Luis Obispo	0	104	209	104	522	1,985
San Mateo	0	0	0	0	0	0
Santa Barbara	0	0	0	209	627	1,463
Santa Clara	0	0	0	209	313	1,254
Santa Cruz	104	104	104	0	0	0
Shasta	313	313	1,045	731	940	3,344
Sierra	0	0	0	0	0	0
Siskiyou	0	0	0	313	313	1,567
Solano	104	209	1,045	313	313	2,194
Sonoma	104	209	418	1,045	1,149	3,135
Stanislaus	0	0	0	0	209	418
Sutter	313	731	1,776	836	731	3,866
Tehama	313	313	940	2,403	1,567	12,853
Trinity	0	104	313	0	209	522
Tulare	0	104	522	104	104	836
Tuolumne	522	418	3,762	418	418	1,149
Ventura	940	104	209	0	104	313
Yolo	313	522	1,463	1,149	1,149	4,911
Yuba	836	940	3,344	1,045	1,254	4,598

Table 2. Estimated harvest, number of hunters, and number of days hunted for each species by county (continued).

County	Ruffed grouse harvest	Ruffed grouse hunters	Ruffed grouse days	Sooty grouse harvest	Sooty grouse hunters	Sooty grouse days
Alameda	0	0	0	0	0	0
Alpine	0	0	0	0	0	0
Amador	0	0	0	0	0	0
Butte	0	0	0	0	0	0
Calaveras	0	0	0	0	0	0
Colusa	0	0	0	0	0	0
Contra Costa	0	0	0	0	0	0
Del Norte	0	0	0	0	0	0
El Dorado	0	0	0	0	104	313
Fresno	0	0	0	104	104	313
Glenn	0	0	0	0	0	0
Humboldt	627	627	3,448	418	209	1,149
Imperial	0	0	0	0	0	0
Inyo	0	0	0	0	0	0
Kern	0	0	0	0	0	0
Kings	0	0	0	0	0	0
Lake	0	0	0	0	0	0
Lassen	0	0	0	0	0	0
Los Angeles	0	0	0	0	0	0
Madera	0	0	0	0	0	0
Marin	0	0	0	0	0	0
Mariposa	0	0	0	0	0	0
Mendocino	0	0	0	0	0	0
Merced	0	0	0	0	0	0
Modoc	0	0	0	0	0	0
Mono	0	0	0	0	104	209
Monterey	0	0	0	0	0	0
Napa	0	0	0	0	0	0
Nevada	0	0	0	0	0	0
Orange	0	0	0	0	0	0
Placer	0	0	0	0	104	104
Plumas	0	0	0	0	0	0
Riverside	0	0	0	0	0	0
Sacramento	0	0	0	0	0	0

Table 2. Estimated harvest, number of hunters, and number of days hunted for each species by county (continued).

County	Ruffed grouse harvest	Ruffed grouse hunters	Ruffed grouse days	Sooty grouse harvest	Sooty grouse hunters	Sooty grouse days
San Benito	0	0	0	0	0	0
San Bernardino	0	0	0	0	0	0
San Diego	0	0	0	0	0	0
San Francisco	0	0	0	0	0	0
San Joaquin	0	0	0	0	0	0
San Luis Obispo	0	0	0	0	0	0
San Mateo	0	0	0	0	0	0
Santa Barbara	0	0	0	0	0	0
Santa Clara	0	0	0	0	0	0
Santa Cruz	0	0	0	0	0	0
Shasta	0	0	0	0	0	0
Sierra	0	0	0	209	209	1,045
Siskiyou	0	209	418	209	104	1,254
Solano	0	0	0	0	0	0
Sonoma	0	0	0	0	0	0
Stanislaus	0	0	0	0	0	0
Sutter	0	0	0	0	0	0
Tehama	0	0	0	0	104	522
Trinity	313	104	1,045	0	0	0
Tulare	0	0	0	0	0	0
Tuolumne	0	0	0	0	0	0
Ventura	0	0	0	0	0	0
Yolo	0	0	0	0	0	0
Yuba	0	0	0	0	0	0

Table 2. Estimated harvest, number of hunters, and number of days hunted for each species by county (continued).

County	Ring-necked pheasant harvest	Ring-necked pheasant hunters	Ring-necked pheasant days	Chukar harvest	Chukar hunters	Chukar days
Alameda	0	0	0	0	0	0
Alpine	0	0	0	0	0	0
Amador	940	418	2,508	0	0	0
Butte	3,135	836	2,926	0	0	0
Calaveras	0	104	209	0	0	0
Colusa	1,672	1,358	3,762	0	0	0
Contra Costa	627	313	1,149	0	0	0
Del Norte	0	0	0	0	0	0
El Dorado	0	0	0	0	0	0
Fresno	313	104	209	0	209	1,149
Glenn	940	836	3,762	0	0	0
Humboldt	0	0	0	0	0	0
Imperial	209	418	940	0	0	0
Inyo	0	0	0	1,881	522	2,821
Kern	522	209	313	0	313	940
Kings	0	0	0	0	0	0
Lake	0	104	209	0	0	0
Lassen	209	104	104	7,628	627	2,926
Los Angeles	0	0	0	0	0	0
Madera	104	104	209	0	0	0
Marin	0	0	0	0	0	0
Mariposa	0	0	0	0	0	0
Mendocino	0	0	0	0	0	0
Merced	1,567	836	7,315	522	104	627
Modoc	104	104	313	522	209	313
Mono	0	0	0	0	0	0
Monterey	0	0	0	0	0	0
Napa	0	0	0	0	0	0
Nevada	0	0	0	0	0	0
Orange	0	0	0	0	0	0
Placer	0	104	104	0	0	0
Plumas	0	0	0	0	0	0
Riverside	1,254	104	2,090	0	0	0
Sacramento	418	209	836	0	0	0

Table 2. Estimated harvest, number of hunters, and number of days hunted for each species by county (continued).

County	Ring-necked pheasant harvest	Ring-necked pheasant hunters	Ring-necked pheasant days	Chukar harvest	Chukar hunters	Chukar days
San Benito	104	104	104	0	104	418
San Bernardino	0	0	0	4,493	1,149	6,270
San Diego	0	104	1,149	0	0	0
San Francisco	0	0	0	0	0	0
San Joaquin	627	313	3,344	0	0	0
San Luis Obispo	0	0	0	0	104	209
San Mateo	0	0	0	0	0	0
Santa Barbara	0	0	0	0	0	0
Santa Clara	0	0	0	0	0	0
Santa Cruz	0	0	0	0	0	0
Shasta	209	104	209	0	0	0
Sierra	0	0	0	0	0	0
Siskiyou	3,553	627	3,866	0	0	0
Solano	5,538	1,672	5,956	0	0	0
Sonoma	0	0	0	0	0	0
Stanislaus	0	0	0	0	0	0
Sutter	522	836	2,403	0	0	0
Tehama	1,567	209	1,567	0	0	0
Trinity	0	0	0	0	0	0
Tulare	836	313	731	0	0	0
Tuolumne	0	0	0	0	0	0
Ventura	0	0	0	0	0	0
Yolo	6,270	2,194	7,628	0	0	0
Yuba	104	209	522	0	0	0

Table 2. Estimated harvest, number of hunters, and number of days hunted for each species by county (continued).

County	Band-tailed pigeon harvest	Band-tailed pigeon hunters	Band-tailed pigeon days	Eur. collared-dove harvest	Eur. collared-dove hunters	Eur. collared-dove days
Alameda	0	0	0	0	0	0
Alpine	0	0	0	0	0	0
Amador	0	104	313	0	104	418
Butte	0	0	0	104	104	104
Calaveras	0	0	0	0	0	0
Colusa	0	0	0	1,358	209	313
Contra Costa	0	0	0	1,881	313	1,149
Del Norte	0	0	0	0	0	0
El Dorado	0	0	0	0	0	0
Fresno	104	104	104	4,598	522	3,553
Glenn	0	0	0	627	104	2,717
Humboldt	731	209	418	0	0	0
Imperial	0	0	0	31,036	1,672	5,538
Inyo	0	0	0	1,045	209	209
Kern	209	104	313	11,599	1,254	8,673
Kings	0	0	0	0	0	0
Lake	0	0	0	0	0	0
Lassen	0	0	0	522	209	313
Los Angeles	0	0	0	4,911	522	1,254
Madera	0	104	209	0	0	0
Marin	0	0	0	1,045	104	731
Mariposa	418	104	209	0	0	0
Mendocino	0	0	0	0	0	0
Merced	0	0	0	1,881	522	836
Modoc	0	0	0	1,567	104	313
Mono	0	0	0	0	0	0
Monterey	209	104	209	3,657	104	522
Napa	0	0	0	209	104	104
Nevada	0	0	0	0	0	0
Orange	0	0	0	0	0	0
Placer	104	104	104	313	209	418
Plumas	0	0	0	0	0	0
Riverside	209	104	418	2,717	418	836
Sacramento	0	0	0	627	209	1,149

Table 2. Estimated harvest, number of hunters, and number of days hunted for each species by county (continued).

County	Band-tailed pigeon harvest	Band-tailed pigeon hunters	Band-tailed pigeon days	Eur. collared-dove harvest	Eur. collared-dove hunters	Eur. collared-dove days
San Benito	0	0	0	0	0	0
San Bernardino	0	0	0	2,821	209	1,045
San Diego	627	209	418	836	104	104
San Francisco	0	0	0	0	0	0
San Joaquin	0	0	0	313	209	209
San Luis Obispo	0	104	104	0	0	0
San Mateo	0	0	0	0	0	0
Santa Barbara	627	104	313	313	104	104
Santa Clara	209	104	104	0	0	0
Santa Cruz	0	0	0	0	0	0
Shasta	0	104	104	104	104	104
Sierra	0	0	0	0	0	0
Siskiyou	1,045	104	731	0	0	0
Solano	0	0	0	0	0	0
Sonoma	0	0	0	0	0	0
Stanislaus	0	0	0	2,508	313	1,149
Sutter	0	0	0	0	104	418
Tehama	0	0	0	104	104	104
Trinity	104	104	209	0	0	0
Tulare	0	0	0	0	0	0
Tuolumne	418	104	313	0	0	0
Ventura	0	0	0	209	104	209
Yolo	0	0	0	209	104	418
Yuba	0	0	0	0	0	0

Table 2. Estimated harvest, number of hunters, and number of days hunted for each species by county (continued).

County	White-winged dove harvest	White-winged dove hunters	White-winged dove days	Mourning dove harvest	Mourning dove hunters	Mourning dove days
Alameda	0	0	0	5,120	313	1,149
Alpine	0	0	0	0	0	0
Amador	0	0	0	1,776	209	522
Butte	0	0	0	15,988	1,149	2,717
Calaveras	0	0	0	3,135	104	418
Colusa	0	0	0	12,331	731	2,299
Contra Costa	0	0	0	5,747	522	1,463
Del Norte	0	0	0	0	0	0
El Dorado	0	0	0	313	104	104
Fresno	0	0	0	73,566	2,299	11,704
Glenn	0	0	0	10,763	940	1,881
Humboldt	0	0	0	209	104	209
Imperial	7,315	1,358	4,284	71,476	3,866	10,241
Inyo	0	0	0	209	104	104
Kern	0	0	0	125,815	3,448	18,392
Kings	0	0	0	9,823	522	1,358
Lake	0	0	0	1,045	104	209
Lassen	0	0	0	5,016	522	11,808
Los Angeles	0	0	0	4,911	209	627
Madera	0	0	0	16,511	836	2,717
Marin	0	0	0	0	0	0
Mariposa	0	0	0	0	0	0
Mendocino	0	0	0	0	0	0
Merced	0	0	0	35,111	2,299	6,270
Modoc	0	0	0	836	104	104
Mono	0	0	0	0	0	0
Monterey	0	0	0	9,091	418	1,985
Napa	0	0	0	2,194	104	313
Nevada	0	0	0	731	209	313
Orange	0	0	0	0	0	0
Placer	0	0	0	7,733	731	3,344
Plumas	0	0	0	0	0	0
Riverside	9,091	522	2,194	40,023	1,776	10,032
Sacramento	0	0	0	14,316	1,149	3,971

Table 2. Estimated harvest, number of hunters, and number of days hunted for each species by county (continued).

County	White-winged dove harvest	White-winged dove hunters	White-winged dove days	Mourning dove harvest	Mourning dove hunters	Mourning dove days
San Benito	0	0	0	1,254	209	418
San Bernardino	627	209	1,045	4,807	731	3,030
San Diego	940	104	209	8,778	522	2,612
San Francisco	0	0	0	0	0	0
San Joaquin	0	0	0	13,376	940	2,717
San Luis Obispo	0	0	0	14,212	940	5,956
San Mateo	0	0	0	0	0	0
Santa Barbara	0	0	0	1,254	104	209
Santa Clara	0	0	0	0	0	0
Santa Cruz	0	0	0	0	0	0
Shasta	0	0	0	4,389	627	1,358
Sierra	0	0	0	0	0	0
Siskiyou	0	0	0	522	104	104
Solano	0	0	0	7,524	418	1,149
Sonoma	0	0	0	0	0	0
Stanislaus	0	0	0	5,225	731	1,254
Sutter	0	0	0	1,463	418	2,194
Tehama	0	0	0	20,900	940	3,344
Trinity	0	0	0	0	0	0
Tulare	0	0	0	19,750	627	3,657
Tuolumne	0	0	0	0	0	0
Ventura	0	0	0	3,553	313	836
Yolo	0	0	0	32,185	1,463	4,911
Yuba	0	0	0	6,583	418	3,239

Table 2. Estimated harvest, number of hunters, and number of days hunted for each species by county (continued).

County	Wilson's snipe harvest	Wilson's snipe hunters	Wilson's snipe days
Alameda	0	0	0
Alpine	0	0	0
Amador	0	0	0
Butte	1,149	209	1,149
Calaveras	0	0	0
Colusa	0	0	0
Contra Costa	0	0	0
Del Norte	0	0	0
El Dorado	0	0	0
Fresno	0	0	0
Glenn	0	0	0
Humboldt	104	104	209
Imperial	0	0	0
Inyo	0	0	0
Kern	0	0	0
Kings	0	0	0
Lake	0	0	0
Lassen	0	0	0
Los Angeles	0	0	0
Madera	0	0	0
Marin	0	0	0
Mariposa	0	0	0
Mendocino	0	0	0
Merced	0	0	0
Modoc	0	0	0
Mono	0	0	0
Monterey	0	0	0
Napa	0	0	0
Nevada	0	0	0
Orange	0	0	0
Placer	0	0	0
Plumas	0	0	0
Riverside	0	104	104
Sacramento	0	0	0

Table 2. Estimated harvest, number of hunters, and number of days hunted for each species by county (continued).

County	Wilson's snipe harvest	Wilson's snipe hunters	Wilson's snipe days
San Benito	0	0	0
San Bernardino	0	0	0
San Diego	0	0	0
San Francisco	0	0	0
San Joaquin	0	0	0
San Luis Obispo	0	0	0
San Mateo	0	0	0
Santa Barbara	0	0	0
Santa Clara	0	0	0
Santa Cruz	0	0	0
Shasta	0	0	0
Sierra	0	0	0
Siskiyou	0	0	0
Solano	0	0	0
Sonoma	0	0	0
Stanislaus	0	0	0
Sutter	0	0	0
Tehama	0	0	0
Trinity	0	0	0
Tulare	0	0	0
Tuolumne	0	0	0
Ventura	0	0	0
Yolo	0	0	0
Yuba	104	209	209

Discussion

Both the sampling error rate and the value used to extrapolate the harvest and hunter effort are dependent on the sample size. Our goal for a sampling error of ≤ 2% required a sample of 2,353 respondents, and we received responses from 1,183 hunters, which increased the sample error to 2.83%. To increase the response rate and reach the target sample size of respondents, and thus decrease the sampling error, we held the survey open for two months and encouraged responses through follow-up emails. Our response rate (12%) was higher than that of the previous GTHSs, and lower than that of Responsive Management and the HIP. Our response rate was also slightly lower than that of the 2016–2017 Resident Upland Game Bird Survey (15%). Due to delays in development, the previous survey (2018–2019) was sent to hunters in late July. To reduce memory bias while reducing confusion with reporting turkey (below), we moved the start of the 2020–2021 survey to May 15, right after the Spring Turkey season ended for 2020. We also intended to raise the response rate and improve the sampling error by increasing the number of hunters in the random pool to 15,000. However, we also incorporated migratory upland game birds in this survey (below), and ultimately we decided to keep the random pool at 10,000 hunters in order to compare response rate and sampling error with the last two on-line surveys. We plan to increase the random pool in following surveys.

During previous surveys, we found that hunters were frustrated that they could not report on harvest and effort for migratory upland game bird species, specifically band-tailed pigeon, mourning dove, and white-winged dove. We chose to focus our first and second on-line surveys on resident upland game birds (quail, chukar, ring-necked pheasant, grouse, and wild turkey) because the HIP survey assesses hunter effort and harvest for doves and other migratory upland game bird species. We decided to include migratory upland game bird species in the 2020–2021 survey, due to hunters' comments and our own interest in having state and county-level estimates for all upland game bird species. We found that almost 60% of the estimated harvest was native dove (band-tailed pigeon, mourning dove, and white-winged dove).

California has a small population of white-tailed ptarmigan, an upland game species with a short general season (1 week) and small bag limit (2 birds). Due to

concerns that extrapolations of the raw data for this species could suggest an overestimation of the true harvest, we asked hunters whether they had hunted ptarmigan and then contacted them directly for additional information. Thus, we provided raw data for that white-tailed ptarmigan, as opposed to extrapolated values. We intend to approach white-tailed ptarmigan harvest and hunter effort similarly in the next survey. We anticipated that harvest and effort would be low given the unique challenges that white-tailed ptarmigan represent. National Forest closures due to fire severely impacted access to white-tailed ptarmigan hunting areas. For all other upland game birds, we asked hunters how many birds they harvested, the county of harvest, and the number of days spent hunting. We monitored responses while the survey was active, in part to determine when reminder emails were needed, and to sort out those hunters that hunted white-tailed ptarmigan and those hunters that reported hunting but noted in the comments that hunting occurred on a licensed game bird club.

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