CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

Avian Influenza Surveillance Summary

July 2024 - June 2025 Season

Executive Summary

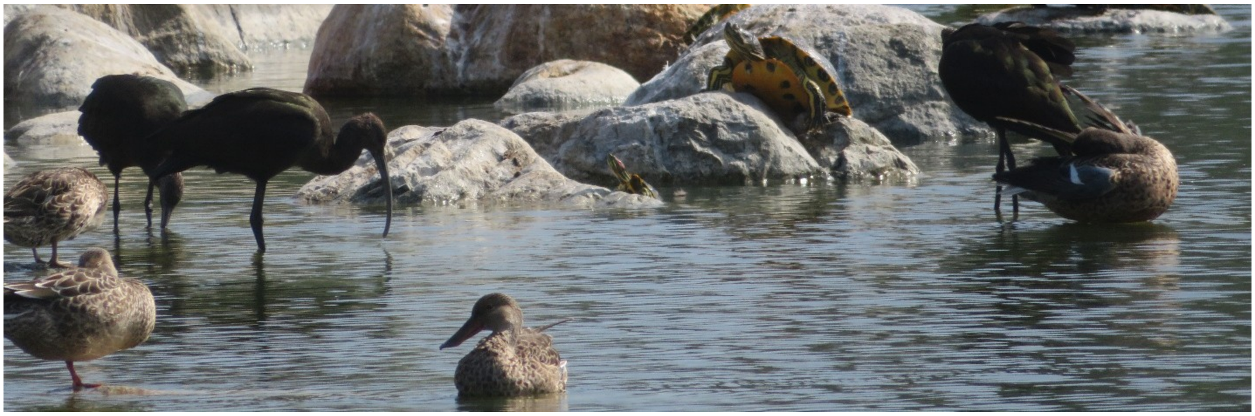
Avian influenza H5N1 (Eurasian lineage goose/Guangdong H5 clade 2.3.4.4b) was detected for the first time in birds along the Atlantic Coast of North America in late 2021 - early 2022, and in California by early July 2022. Since its introduction, avian influenza H5N1 has continued to circulate in wild and domestic birds, with occasional spill-over into wild mammals. In California, detections in wild birds have generally coincided with migratory behavior with detections increasing through fall migration and declining through spring migration, roughly July through June.

Initial detections of avian influenza H5N1 for the July 2024 - June 2025 season were in birds collected from Northern California and the San Francisco Bay Area in July 2024. The genotype matched the predominate genotype circulating during the previous season (2023-24). Detections were then made in mid-October 2024 in wild birds collected from Contra Costa, San Diego, and Santa Clara counties. Between October 2024 and May 2025, avian influenza H5N1 was detected in 291 wild birds collected from 31 counties during mortality surveillance. Detections were made in about 44 different species of wild and feral birds.

Notable differences were evident this season compared to the two previous seasons. Detections peaked sharply in November 2024, remained relatively high through winter, and then declined by early spring 2025. Detections were generally higher in species of waterbirds, and in particular gulls and shorebirds, rather than in species of waterfowl as in the previous two seasons. Additionally, there were two localized areas of high virus activity that impacted thousands of birds over the course of months around the southeastern San Francisco Bay and Central Coast. Finally, detections in species with minimal association with waterfowl or their habitats were made for the first time in a burrowing owl, multiple barn owls, and wild turkeys.

Also notable during the 2024-25 season were avian influenza detections for the first time in dairy cattle in the United States. In early 2024, a single incident of avian influenza in dairy cattle on a farm in Texas led to an outbreak in dairy cattle across several states, including in California beginning in August 2024. The H5N1 genotype B3.13 infecting livestock was primarily spread through the movement of infected cattle. Outbreaks in commercial and backyard flocks of domestic poultry had been ongoing during this time.

Compiled by: Krysta Rogers
Senior Environmental Scientist
Avian Investigations
Wildlife Health Laboratory
California Department of Fish and Wildlife



Northern shoveler ducks and white-faced ibises roosting in a pond in Orange County, California. Photo credit: Krysta Rogers, CDFW.

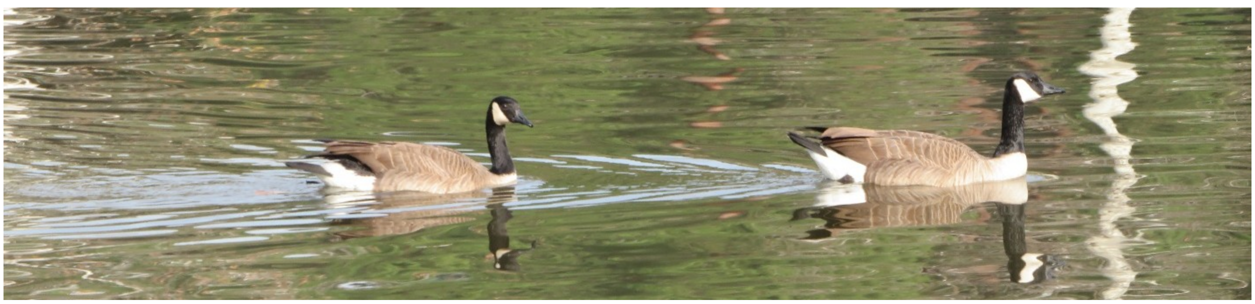
1. Introduction

Avian influenza is an infectious disease of birds caused by avian-origin influenza A viruses. Viruses are classified based on two surface proteins, Hemagglutinin (H) and Neuraminidase (N), which combine to form different subtypes (e.g., H5N1, H5N2, H7N3, H12N5) (Stallknecht et al. 2007). Different subtypes, and genotypes within a subtype, vary in their ability to cause disease in birds. Avian influenza viruses may be further categorized as highly pathogenic (HP) or low pathogenic (LP) based on their ability to cause disease in domestic poultry.

Avian-origin influenza A viruses naturally circulate in wild waterbirds including species within the orders of Anseriformes (ducks, geese, and swans) and Charadriiformes (gulls, terns, and shorebirds) (Hill et al. 2022; Stallknecht et al 2007). Avian influenza viruses are shed in bodily fluids such as saliva, nasal secretions, and feces. Water is important for virus transmission between individual waterbirds. These birds may be inadvertently exposed to viruses when eating, drinking, preening, and/or bathing in water potentially contaminated with viruses. In wild waterbirds, virus circulation has historically increased during fall migration as individual birds co-mingle at various stopover locations (e.g., wetlands, ponds, lakes) (van Dijk et al. 2014). These naturally circulating viruses are of low virulence and rarely cause illness or death of wild birds (Stallknecht et al. 2007).

Avian influenza H5N1 (Eurasian lineage goose/Guangdong H5 clade 2.3.4.4b) was detected for the first time along the Atlantic Coast of North America in Canada in December 2021 and in the United States in January 2022 (Alkie et al 2022; Youk et al. 2023). Detections of this virus had been on the rise across parts of Europe during the preceding years, and especially in 2022 with detections in both wild and domestic birds (EFSA et al., 2022). Prior to this current outbreak, avian influenza viruses considered highly pathogenic had been more of a disease of domestic poultry with occasional spill-over into wild birds which may or may not have caused mortality (Ramey et al. 2022). This current outbreak is unprecedented in terms of the geographic range and diversity of wild birds and mammals potentially impacted. The virus has near world-wide circulation with detections on all continents except Oceania (Xie et al. 2025). Notably, this was the first avian influenza virus to reach seabirds in Antarctica. A high diversity of wild birds and mammals are susceptible to fatal infection with avian influenza H5N1. Since 2022, outbreaks have impacted backyard and commercial domestic poultry in the United States and elsewhere, and dairy cattle in the United States since 2024 (Xie et al., 2025).

Avian influenza H5N1 in free-ranging wild birds may be maintained in waterfowl and shorebirds, the natural hosts of avian influenza viruses, and water is important for transmission among these species (Harvey et al. 2023; Hill et al. 2022). As such, the focus of virus activity tends to occur around some type of waterbody, typically a closed or semi-closed waterbody, where waterfowl may congregate and the virus has the potential to become more concentrated. Avian and mammalian predators and scavengers that feed on infected animals also may be at risk of becoming infected. Bird species that spend little to no time in wetlands and other water-dominant habitats are generally less likely to be exposed to the virus (e.g., small songbirds).



Canada geese swimming in a pond in Orange County, California. Photo credit: Krysta Rogers, CDFW.

2. Surveillance & diagnostic testing

2.1. Mortality-based surveillance

The California Department of Fish and Wildlife's (CDFW) Wildlife Health Laboratory conducts mortality-based surveillance for avian influenza which involves testing wild birds found dead. Mortality-based surveillance occurs year-round and is opportunistic when dead birds are submitted. Birds may be submitted by agencies, wildlife rehabilitation centers, other organizations, and members of the public. Mortality surveillance can help identify what species are susceptible to clinical or fatal infection rather than those that may be reservoirs of the virus.

Mortality events involving multiple dead birds are prioritized for surveillance. Mortality events are generally more easily detected than an individual dead bird. Additionally, mortality surveillance generally increases the likelihood of a detection since many dead birds in a location may indicate an infectious disease outbreak. Surveillance testing of individual birds may be considered for certain species known to be at higher risk of infection (e.g., predators, scavengers) and for lower risk species found in locations with a known outbreak and/or presenting with suspicious clinical signs. Since reporting of dead birds relies on observations made by people, submissions of dead birds, and therefore testing of birds, tends to be biased towards areas with more people including the San Francisco Bay Area and the South Coast. Birds that die in more remote or less human-populated areas are less likely to be represented during testing. Submissions also tend to bias larger-bodied birds since they are more visible and persist longer on the landscape.

Mortality-based surveillance provides a broad account of virus activity over time across the entire state. Initial surveillance generally targets areas without virus detections. Once a detection is made in an area, subsequent testing may occur periodically thereafter to monitor virus activity over the longer term. It is important to note, only a portion of birds are tested, although many more may be reported. Therefore, the number of birds with detections does not accurately represent the total number of birds that may have ultimately died of infection.

Surveillance testing of wild birds is primarily coordinated though CDFW's Wildlife Health Laboratory. Although, other agencies and organizations may perform surveillance testing of wildlife independently from CDFW. For example, the United States Fish and Wildlife Service (USFWS) may conduct surveillance testing during mortality investigations on federal public lands. In some cases, CDFW may or may not be made aware of the details of testing performed by other partners.

Snow geese roosting in a pond in Glenn County, California. Photo credit: Krysta Rogers, CDFW.

2.2. Diagnostic testing

For wild birds, the diagnostic standard for avian influenza testing is the collection of an oropharyngeal swab and a cloacal swab from each bird. The swabs are inoculated into viral transport medium.

The CDFW's Wildlife Health Laboratory receives dead birds year-round for mortality investigation and surveillance testing. Bird species and age are routinely recorded. Swab samples are collected from each bird and submitted for testing to the California Animal Health and Food Safety (CAHFS) Laboratory system which is part of the National Animal Health Laboratory Network.

A real-time reverse-transcriptase polymerase-chain-reaction (rRT-PCR) is commonly used for surveillance testing for avian influenza viruses (USDA 2022). The PCR test detects the genetic material of the virus, if present. Generally, preliminary testing at CAFHS includes an initial PCR to detect influenza A viruses. If detected, a subsequent PCR is performed to determine if the virus is an H5 subtype. If an influenza A virus is detected, a sample is forwarded to the United States Department of Agriculture's (USDA) National

Veterinary Services Laboratories (NVSL) for confirmatory testing. The NVSL performs PCR testing for influenza A and the H5 subtype. Virus isolation is also attempted to further genetically characterize the virus and to determine if the virus is of low or high pathogenicity. Because highly pathogenic avian influenza is a federally regulated disease for poultry, all detections of avian influenza typically undergo confirmatory testing by NVSL.

Importantly, during the 2024-25 season the capacity of diagnostic laboratories conducting preliminary and confirmatory testing for avian influenza was impacted due to the emergence of avian influenza in dairy cattle in several states, including in California. As such, confirmatory PCR test results were not available for roughly 23% (71/304) of wild bird detections presented in this report.

3. Surveillance results

3.1. Mortality investigations

Between July 2024 and June 2025, roughly 840 birds were received at the CDFW's Wildlife Health Laboratory, and of these birds, 586 were selected for surveillance testing. Approximately 842 birds were tested by other agencies and organizations. Note, the results of surveillance testing presented in this summary report should be considered preliminary and subject to change.

3.2. Avian influenza detections

In California, avian influenza H5N1 detections were initially made in July 2024 in wild birds collected from two geographic areas. The first, in early July 2024 in Siskiyou County during a mortality event on a lake involving approximately 150 breeding eared grebes. Detections were made in nine eared grebes collected during the event. The second, in mid-July 2024 in the San Francisco Bay Area including in two California gulls collected from Santa Clara County and two western gulls collected from San Fransico County. The genotype (B3.6) detected in the nine grebes collected from Siskiyou County and two of the four gulls, one collected in Santa Clara County and one in San Francisco County, matched the predominate genotype circulating during the 2023-24 season; the genotype was not identified for the two other gulls. As such, these detections from July 2024 may have been a continuance of the 2023-24 season since a different predominate genotype (D1.1) emerged in fall 2024. No detections were made in birds collected in August and September 2024.

Subsequent detections were made in birds collected in mid- to late October 2024. This included detections in an American white pelican and a peregrine falcon collected from San Diego County in Southern California and a greater white-fronted goose, cackling goose, American green-winged teal, and a turkey vulture collected from Contra Costa, Santa Clara, Monterey, and Marin counties, respectively, in Northern California. Between June 2024 and July 2025, approximately 1,428 wild birds were tested for avian influenza by CDFW and partners. Between October 2024 and May 2025, avian influenza H5N1 was detected in about 291 wild birds collected from 31 counties (Fig. 1; Appendix Table 1). No detections were made in wild birds collected in June 2025.

Notable during the 2024-25 season, were two geographically district areas of high virus activity, or "hotspots," in wetland and coastal habitats that involved hundreds to thousands of birds. A hotspot of virus activity occurred along the southeastern San Francisco Bay between November 2024 and January 2025. Species most often reported included dunlin, western sandpipers, black-crowned night herons, barn owls, red-tailed hawks, and turkey vultures. Bird mortality was reported mostly along the bay coasts of Alameda, Contra Costa, San Mateo, and Santa Clara counties. Another hotspot of virus activity occurred along the Central Coast between January and February 2025. This event primarily involved sanderlings along coastal San Luis Obispo County.

Also notable during the 2024-25 season were first time detections in "non-traditional" species, that is, species that generally do not have a close association with waterfowl, other waterbirds, or their habitats. This included detections in 14 barn owls that were submitted for testing, although many more were reported. Most of these barn owls were collected from counties around the San Francisco Bay Area during the large outbreak in shorebirds and waterbirds. Similarly, a detection was made in one burrowing owl collected along the bay coast of Contra Costa County during this outbreak.

Finally, there was a localized outbreak near a lake in San Diego County involving approximately 15-20 wild turkeys between January and February 2025. Detections were made in three wild turkeys that were submitted for testing. The wild turkeys were foraging in habitat bordering the lake and were most likely exposed to the virus shed by migratory waterfowl using the lake. The genotype (D1.1) detected in the wild turkeys was the predominate genotype circulating in waterfowl at the time.

Wild turkeys foraging in the grass at a park in Santa Clara County, California. Photo credit: Krysta Rogers, CDFW.

Figure 1. California counties shaded in orange with avian influenza detections in wild birds during the July 2024 - June 2025 season. Map credit: Krysta Rogers, CDFW.

3.3. Detections over time

The last detection of the previous avian influenza season (2023-24) was made in a bird collected in early April 2024. No avian influenza detections were made in birds collected between May and June 2024 despite ongoing surveillance testing (Fig. 2). Initial detections of the 2024-25 season were made in birds collected in early to mid-July 2024 in two geographic areas in Northern California (Siskiyou County) and the San Francisco Bay Area (Santa Clara and San Fransico counties). The genotype (B3.6) detected in these birds matched the predominate genotype circulating in wild birds during the 2023-24 season.

Detections were then made in birds collected in mid- to late October 2024 in five counties across the state including Contra Costa, Marin, Monterey, San Diego, and Santa Clara. Except for the July 2024 detections, detections were primarily made in birds collected between October 2024 and May 2025 (Fig. 2).

The frequency of detections during the 2024-25 season were more similar to the frequency of detections during the first avian influenza season (2022-23) than during the second season (2023-24) (Fig. 3). Relatively fewer detections were made overall during the 2023-24 season compared to the first and third seasons, although the pattern of detections have been similar across all three seasons with the number of avian influenza detections gradually increasing through the fall and declining through spring (Fig. 3). In the current season, detections increased sharply during fall migration between October and November in 2024 (Fig. 2, 3). Detections remained relatively high through December 2024 and January 2025 (Fig. 2, 3). Detections then declined in wild birds collected during February and March 2025. No detections were made in birds collected in April. The last detections of the season were made in two birds collected from the same location on May 8, 2025.

In the first two seasons, detections in waterfowl species generally led detections through the fall, followed within a few weeks with detections in raptors, waterbirds, and scavengers. In contrast, detections during the current season peaked sharply in both waterbird and waterfowl species in the fall, followed by detections in raptors and scavengers (Fig. 4, 5A see Appendix Table 2 for generalized bird group taxonomic classifications). Detections then remained relatively high in waterbird species, specifically gulls and shorebirds, from November 2024 through January 2025 despite a drop-off in detections in waterfowl species after December 2024 (Fig. 4, 5B; see Appendix Table 4 for waterbird group taxonomic classifications). In general, a larger proportion of detections were made in waterbird species, specifically gulls and shorebirds, during the 2024-25 season compared to the 2022-23 and 2023-24 seasons in which a larger proportion of detections were made in waterfowl species (Fig. 5).

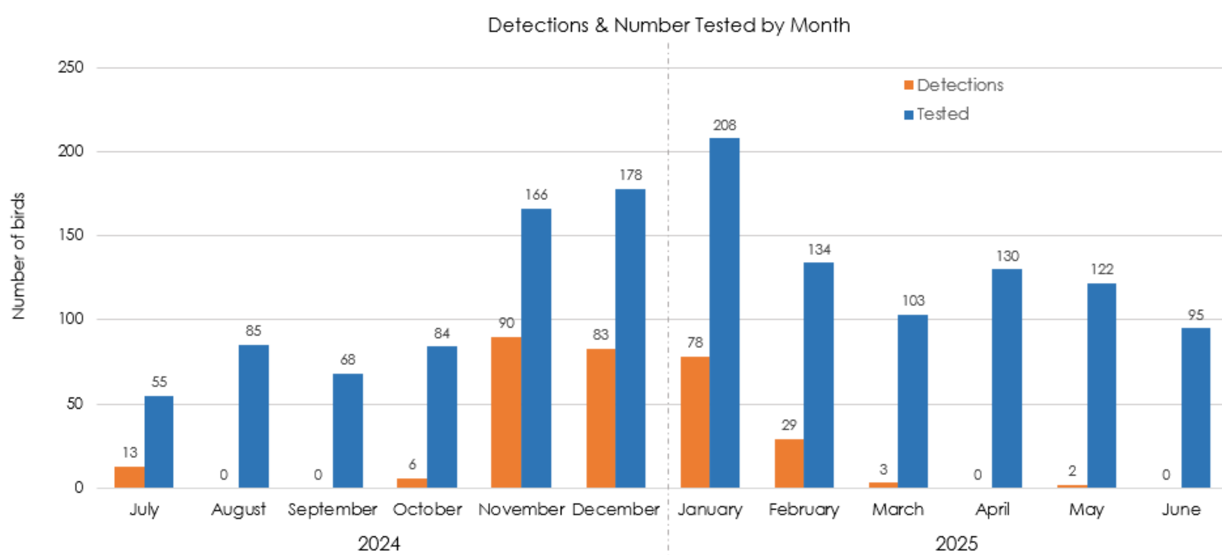


Figure 2. Detections of avian influenza H5N1 in wild birds by month in California during the July 2024 - June 2025 season. The orange bars indicate the number of detections in wild birds. The blue bars indicate the number of wild birds tested for avian influenza. Image credit: Krysta Rogers, CDFW.

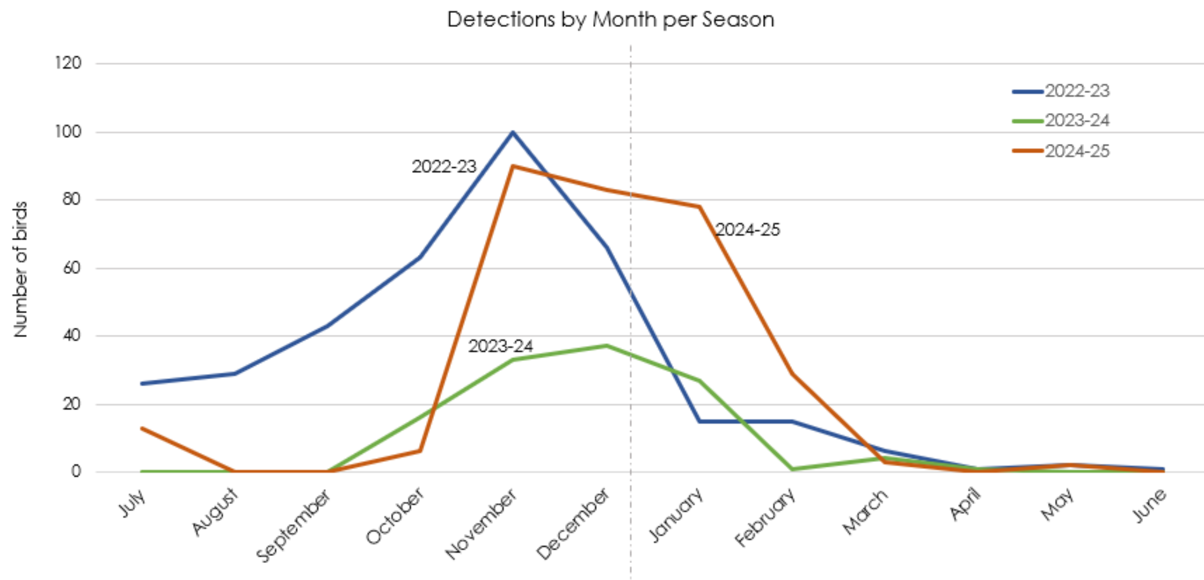


Figure 3. Detections of avian influenza H5N1 by month in California during the July 2022 - June 2023 season (blue line), July 2023 - June 2024 season (green line), and July 2024 - June 2025 season (orange line). Image credit: Krysta Rogers, CDFW.

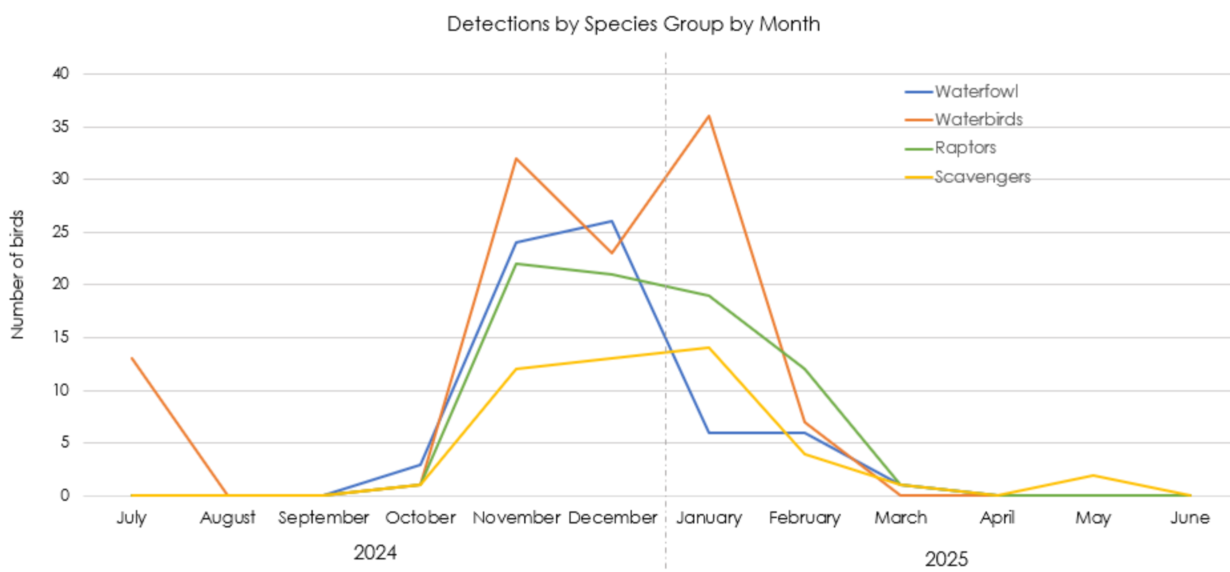


Figure 4. Detections of avian influenza H5N1 by wild bird group by month in California during the July 2024 - June 2025 season. Line colors correspond to waterfowl in blue, waterbirds in orange, raptors in green, and scavengers in yellow (see Appendix Table 2 for bird group taxonomic classifications). Image credit: Krysta Rogers, CDFW.

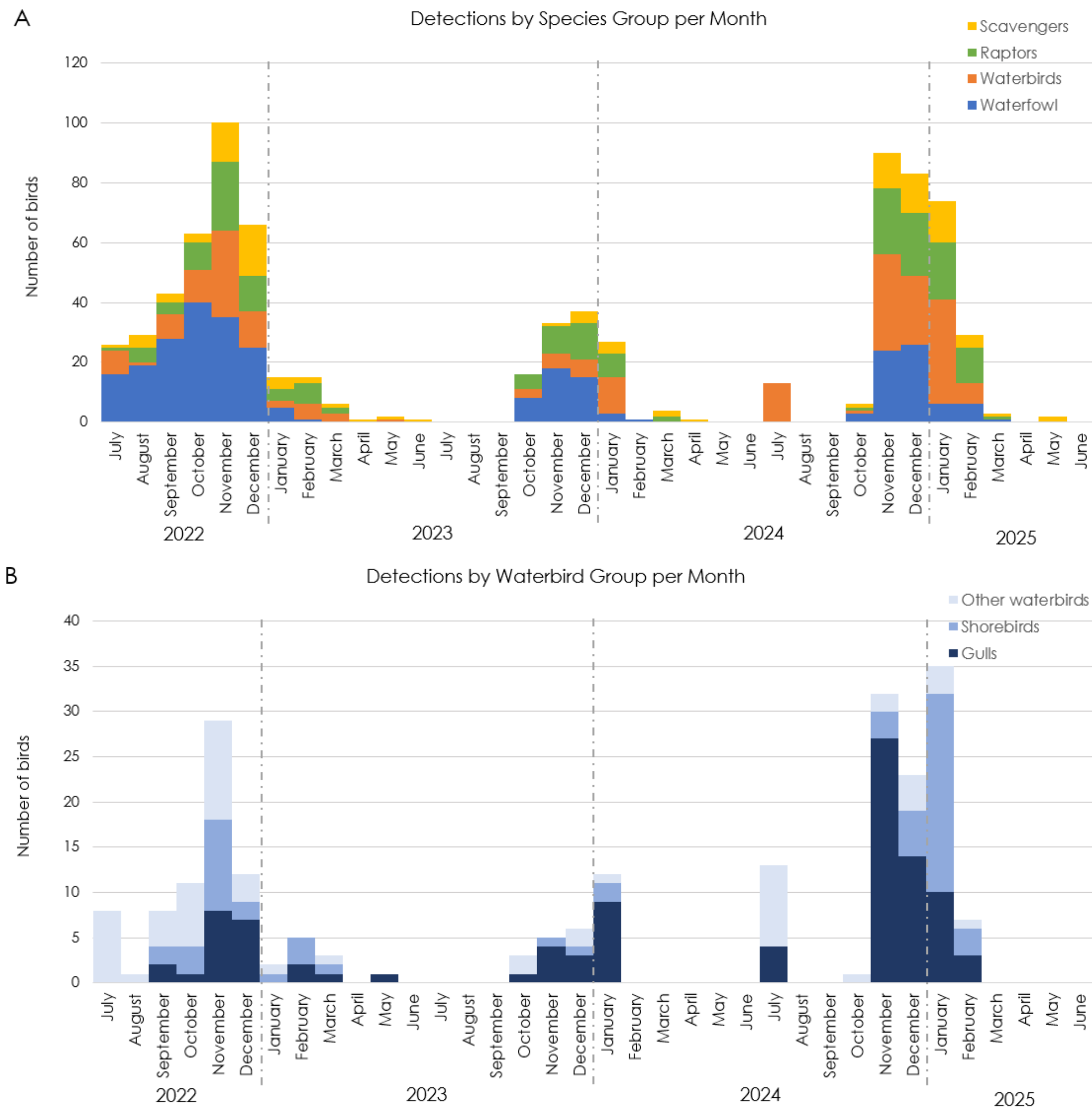


Figure 5. Detections of avian influenza H5N1 in California between July 2022 through June 2025 by **(A)** wild bird group (see Appendix Table 2 for bird group taxonomic classifications) and **(B)** waterbird group (see Appendix Table 4 for bird group taxonomic classifications). Line colors correspond to (A) waterfowl in blue, waterbirds in orange, raptors in green, and scavengers in yellow; and (B) gull species in dark blue, shorebird species in medium blue, and other waterbird species in light blue. Image credit: Krysta Rogers, CDFW.

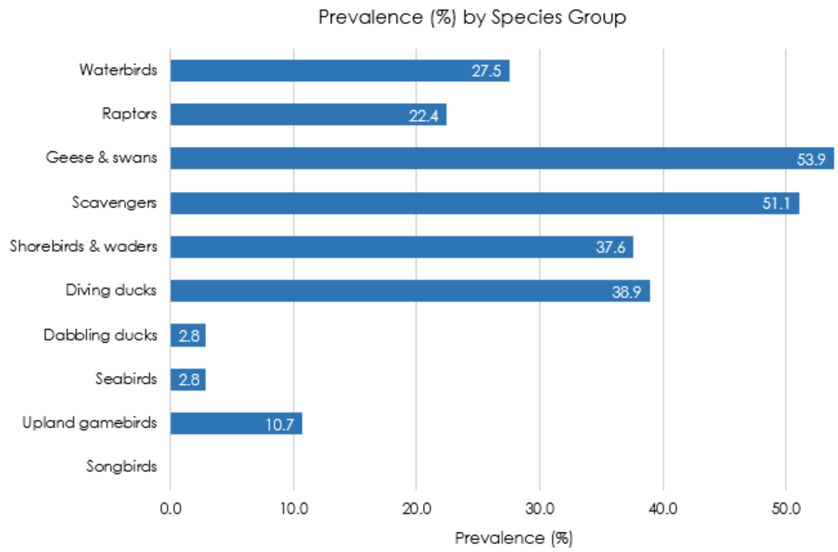
American white pelican foraging in a wetland in Orange County, California. Photo credit: Krysta Rogers, CDFW.

3.4. Detections by avian species

Detections were made in about 44 different species of wild and feral birds between July 2024 and May 2025 (Appendix Table 1). Detections were made in 12 predator and scavenger species, 11 waterfowl species, 9 waterbird species, 6 shorebird and wader species, 3 seabird species, and 1 upland gamebird species (Appendix Table 2). Notably different this season was the higher proportion of detections made in waterbirds, and in particular species of gulls and shorebirds, than during the previous two seasons (Fig. 5B; Appendix Table 1).

Evaluating detections by bird functional group, in which similar species are grouped together, the highest number of detections were in waterbird species as a group, followed by raptors as a group, then geese and swans, scavengers, shorebirds and waders, diving ducks, dabbling ducks, seabirds, and upland gamebirds (Fig. 6; see Appendix Table 3 for bird functional group taxonomic classifications). No detections were made in songbirds, out of about 154 birds tested (Fig. 6). Detection prevalence was highest for geese and swans, followed by scavengers, shorebirds and waders, diving ducks, waterbirds, raptors, upland gamebirds, dabbling ducks, and seabirds (Fig. 6).

The wild bird species with the highest number of detections included turkey vultures, Canada geese, western gulls, red-tailed hawks, and great horned owls (Fig. 7; Appendix Table 1). It is important to note, the number of detections gives a general understanding of virus activity in these species but since not all birds reported dead are tested, detections do not relate directly to actual number of birds that died during the outbreak.



Species Group	AIV Detections	Number Tested
Waterbirds	77	280
Raptors	76	339
Geese & Swans	55	102
Scavengers	47	92
Shorebirds & waders	32	85
Diving ducks	7	18
Dabbling ducks	4	141
Seabirds	3	107
Upland gamebirds	3	28
Songbirds	0	154

*Species not specified for 82 birds (data not shown).

Figure 6. Graph depicting the percent prevalence (%) of avian influenza H5N1 detections by wild bird functional group in California during the July 2024 - June 2025 season. Table depicting the number of avian influenza (AIV) H5N1 detections and the total number tested for each wild bird functional group for the same period (see Appendix Table 3 for bird functional group taxonomic classifications). Image credit: Krysta Rogers, CDFW.

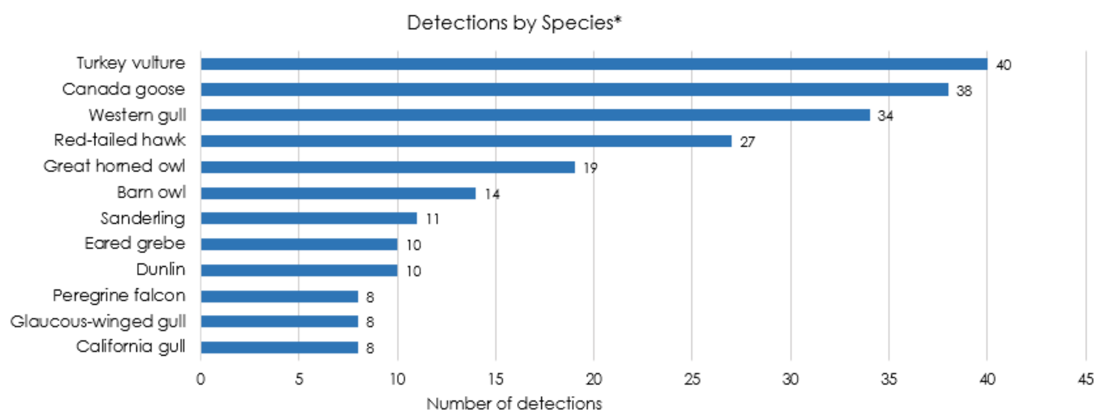


Figure 7. Wild bird species with the highest number of avian influenza H5N1 detections in California during the July 2024 - June 2025 season. *Note, only a portion of reported birds are tested. Actual mortality due to infection may be higher. Image credit: Krysta Rogers, CDFW.

3.5. Detections by virus subtype and strain

The USDA's NVSL attempts to genetically characterize the subtype and genotype of virus detections. Avian influenza viruses are constantly changing, and Eurasian (EA) subtypes and genotypes may reassort with North American (AM) subtypes and genotypes circulating in the same avian host. During the 2024-25 season, the subtype for detected viruses included EA/AM 2.3.4.4b H5N1 (n = 196), which is a recombination of Eurasian and North American viruses, and EA 2.3.4.4b H5N1 (n = 5), which is a predominately Eurasian virus. More specifically, virus genotype was reported for 191 of the 304 birds with detections. The virus genotypes reported for wild birds in California included EA/AM 2.3.4.4b H5N1 D1.1 (n = 172), EA/AM 2.3.4.4b H5N1 B3.6 (n = 11), EA 2.3.4.4b H5N1 A3 (n = 3), EA/AM 2.3.4.4b H5N1 B3.13 (n = 3). Genotype B3.6 was detected only in birds collected in July 2024, and was the most frequent genotype detected during the 2023-24 season. D1.1 was the predominate genotype detected in birds collected between October 2024 and May 2025. Virus subtype/genotype was not available for 113 birds.

Common ravens perched in a tree in Orange County, California. Photo credit: Krysta Rogers, CDFW

4. Conclusions

Overall, mortality-based surveillance was useful to assess the geographic distribution of avian influenza activity and the wild bird species impacted. Detections in California wild birds sharply increased in the fall, coinciding with the arrival and southward movements of migratory birds. Detections remained relatively high between November 2024 and January 2025, then started to decline through February and March 2025. A higher number of detections were made in waterbird and waterfowl species, followed by detections in predators and scavengers which acquire infection through their diet. A high diversity of wild bird species appeared to be susceptible to infection with detections in about 44 different species in California.

Notable this season, were a higher number of detections in waterbirds, and in particular gulls and shorebirds, than during the two previous seasons. High virus activity was documented in two localized geographic areas, including in the southeastern San Francisco Bay and along the Central Coast, impacting thousands of birds over the course of a few months. Detections were made for the first time in a burrowing owl and 14 barn owls, coinciding with the large outbreak in the San Francisco Bay, and in free-ranging wild turkeys foraging near a lake in San Diego County.

It is difficult to assess the full impact of this disease on wild bird populations. Mortality may go unreported and uninvestigated in more remote or natural areas. Additionally, only a portion of reported birds are able to be tested. It also is challenging to get an accurate account of how many birds may have died over a prolonged period across the entire state. Mortality reporting can be helpful to fill in some of these information gaps but reporting consistency over time may be variable due to reporting fatigue and it may be absent in more remote areas or when fewer numbers of birds are observed. Since this virus appears to be adapting to certain migratory bird hosts (e.g., dabbling ducks), the H5 clade 2.3.3.4b virus is likely to remain in circulation at some level increasing in some seasons and decreasing in others.

Avian influenza was detected for the first time in dairy cattle in the United States beginning in early 2024. A single incident of avian influenza in dairy cattle on a farm in Texas led to an outbreak impacting dairy cattle across several states (USDA 2024; Nguyen et al. 2025), including California beginning in August 2024. The predominate H5N1 genotype infecting livestock, B3.13, was primarily spread through the movement of infected cattle, and contaminated vehicles and other equipment between farms. In January 2025, H5N1 genotype D1.1, the predominate genotype circulating in wild birds, was detected in dairy cattle in Nevada and Arizona (Mostafa et al. 2025; USDA 2025). In cattle, the virus is predominately found in milk and mammary tissue. Along with the spread among dairy cattle, there has been an increase in human cases. Most infections in humans were in dairy farm workers that had close, prolonged contact with infected dairy cattle when milking. Infections in domestic cats with access to raw milk from dairy cattle have also increased with infections in dairy cattle. Outbreaks in commercial and backyard flocks of domestic poultry have been ongoing during this time.

If the virus persists in domestic poultry and/or dairy cattle year-round, there may be more opportunities for spill-over into wild birds outside of the fall migratory period. Additionally, a notable shift occurred during the 2024-25 season with more virus detections in waterbirds, and in particular species of gulls and shorebirds, along coastal California. Virus circulation in gull species along the coast may possibly facilitate spill-over into more sensitive marine birds and mammals, especially if the virus were to begin to circulate year-round in gull species. Monitoring virus activity in coastal gull species is advisable.

Ring-billed gulls, long-billed curlews, and marbled godwits roosting at a pond in Sonoma County, California. Photo credit: Krysta Rogers, CDFW.

Mortality Reporting

Wildlife mortality may be reported to CDFW using the Wildlife Mortality Reporting System, link for website: Wildlife Mortality Reporting (ca.gov)

Alternatively, the link may be accessed through the CDFW homepage (*https://wildlife.ca.gov/*), just *scroll partway down and click on "report what you've seen."*

5. Appendices

5.1. Appendix 1

Appendix Table 1. Number of avian influenza H5N1 detections by wild bird species in California during the July 2024 - June 2025 season. *Note, only a portion of reported birds are tested. Actual mortality due to infection may be higher.

Bird Species	No. of Detections*
AMERICAN COOT	3
AMERICAN CROW	4
AMERICAN WHITE PELICAN	2
AMERICAN WIGEON	2
BALD EAGLE	1
BARN OWL	14
BLACK-CROWNED NIGHT HERON	2
BROWN PELICAN	1
BUFFLEHEAD	5
BURROWING OWL	1
CACKLING GOOSE	1
CALIFORNIA GULL	8
CANADA GOOSE	38
COMMON MURRE	1
COMMON RAVEN	3
COOPER'S HAWK	1
DUNLIN	10

EARED GREBE	10
GLAUCOUS-WINGED GULL	8
GOLDEN EAGLE	2
GREAT BLUE HERON	1
GREAT EGRET	3
GREAT HORNED OWL	19
GREATER WHITE-FRONTED GOOSE	2
GREEN-WINGED TEAL	1
HERRING GULL	7
LESSER SCAUP	2
MALLARD	1
MUTE SWAN (feral)	4
PACIFIC LOON	1
PEREGRINE FALCON	8
PIED-BILLED GREBE	1
RED-SHOULDERED HAWK	3
RED-TAILED HAWK	27
RING-BILLED GULL	1
ROSS'S GOOSE	2
SANDERLING	11
SNOW GOOSE	8
SNOWY EGRET	1
TURKEY VULTURE	40
WESTERN GREBE	2
WESTERN GULL	34
WESTERN SANDPIPER	5
WILD TURKEY	3

5.2. Appendix 2

Appendix Table 2. Taxonomic classifications, and corresponding common names, included in each generalized bird group for raptors, scavengers, waterfowl, and waterbirds (Chesser et al. 2024).

Generalized Bird Group	Taxonomic Classification	Common Name
Raptors	Orders Accipitriformes, Falconiformes, & Strigiformes	eagles, falcons, hawks, owls
Scavengers	Genera Cathartes & Corvus	crows, ravens, vultures

Waterbirds	Orders Charadriiformes, Gaviiformes, Gruiformes, Pelecaniformes, Podicipediformes, Procellariiformes, & Suliformes	auks, cormorants, grebes, gulls, loons, pelicans, shorebirds, terns, waders, other seabirds
Waterfowl	Order Anseriformes	ducks, geese, swans

5.3. Appendix 3

Appendix Table 3. Taxonomic classifications included in each bird functional group for dabbling ducks, diving ducks, geese & swans, raptors, scavengers, seabirds, shorebirds & waders, songbirds, upland gamebirds, and waterbirds (Chesser et al. 2024).

Bird Functional Group	Taxonomic Classification
Dabbling ducks	Genera Aix, Anas, Cairina, Mareca, & Spatula
Diving ducks	Genera Aythya, Bucephala, Lophodytes, Melanitta, Mergus, & Oxyura
Geese & swans	Genera Anser, Branta, & Cygnus
Raptors	Orders Accipitriformes, Falconiformes, & Strigiformes
Scavengers	Genera Cathartes & Corvus
Seabirds	Families Alcidae, Gaviidae, Hydrobatidae, Oceanitidae, Phalacrocoracidae (except *Nannopterum auritum*), Procellariidae, & Stercorariiae; *Pelecanus occidentalis*
Shorebirds & waders	Families Ardeidae, Charadriidae, Gruidae, Haematopodidae, Raillidae, Recurvirostridae, Scolopacidae, & Threskiornithidae
Songbirds	Orders Apodiformes, Caprimulgiformes, Coraciiformes, Cuculiformes, Passeriformes (except Corvidae), & Piciformes
Upland gamebirds	Orders Columbiformes & Galliformes
Waterbirds	Families Laridae & Podicipedidae; *Pelecanus erythrorhynchos*; *Nannopterum auritum*

5.4. Appendix 4

Appendix Table 4. Taxonomic classifications included in each bird functional group for gulls, shorebirds & waders, and other waterbirds (Chesser et al. 2024).

Waterbird Functional Group	Taxonomic Classification
Gulls	Family Laridae
Shorebirds & waders	Families Ardeidae, Charadriidae, Gruidae, Haematopodidae, Raillidae, Recurvirostridae, Scolopacidae, & Threskiornithidae

Other waterbirds	Families Alcidae, Gaviidae, Hydrobatidae, Oceanitidae, Pelecanidae, Phalacrocoracidae, Podicipedidae, Procellariidae, & Stercorariiae

6. References

Alkie TN, Lopes S, Hisanaga T, Xu W, Sunderman M, Koziuk J, Fisher M, and others. 2022. A threat from both sides: multiple introductions of genetically distinct H5 HPAI viruses into Canada via both East Asia-Australasia/Pacific and Atlantic flyways. Virus Evolution 8: 1-8. https://doi.org/10.1093/ve/veac077

Chesser RT, Billerman SM, Burns KJ, Cicero C, Dunn JL, Hernández-Baños BE and others. 2024. Check-list of North American Birds (online). American Ornithological Society. https://checklist.americanornithology.org/taxa/

EFSA. European Food Safety Authority, European Centre for Disease Prevention and Control, European Union Reference Laboratory for Avian Influenza, Adlhoch C, Fusaro A, Gonzales JL, Kuiken T, Marangon S, Niqueux E, Staubach C, Terregino C, Aznar I, Munoz Guajardo I, and Baldinelli R. 2022. Avian influenza Overview December 2021-March 2022. EFSA Journal 2022; 20(4):7289, 64 pp. https://doi:10.2903/j.efsa.2022.7289

Harvey JA, Mullinax JM, Runge MC, and Prosser DJ. 2023. The changing dynamics of highly pathogenic avian influenza H5N1: next steps for management and science in North America. Biological Conservation 282: 110041. https://doi.org/10.1016/j.biocon.2023.110041

Hill NJ, Bishop MA, Trovão NS, Ineson KM, Schaefer AL, Puryear WB, and others. 2022. Ecological divergence of wild birds drives avian influenza spillover and global spread. PLoS Pathogens 18: e1010062. https://doi.org/10.1371/journal.ppat.1010062

Mostafa A, Nogales A, and Martinez-Sobrido. 2025. Highly pathogenic avian influenza H5N1 in the United States: recent incursions and spillover to cattle. Viruses 3: 54. https://doi.org/10.1038/s44298-025-00138-5

Nguyen T, Hutter C, Markin A, Thomas M, Lantz K, Killian M, Janzen GM, and others. 2024. Emergence and interstate spread of highly pathogenic avian influenza A(H5N1) in dairy cattle in the United States. Science 388 (6745). https://www.science.org/doi/10.1126/science.adq0900

Ramey AM, Hill NJ, DeLiberto TJ, Gibbs SEJ, Hopkins MC, Lang AS, and others. 2021. Highly pathogenic avian influenza is an emerging disease threat to wild birds in North America. The Journal of Wildlife Management 86: e22171. https://doi.org/10.1002/jwmg.22171

Stallknecht DE, Nagy E, Hunter DB, and Slemons RD. 2007. Avian influenza. In: Infectious Diseases of Wild Birds. Thomas NJ, Hunter DB, and Atkinson CT (editors). Blackwell Publishing, Ames, IA, USA. Pp. 108-130.

USDA. United States Department of Food and Agriculture. Animal and Plant Health Inspection Service. Case definition, Avian influenza (AI) (notifiable), March 2022, 4 pp. https://aphis.stg.platform.usda.gov/sites/default/files/avian-influenza-case-definition.pdf

USDA. United States Department of Food and Agriculture. Animal and Plant Health Inspection Service. 2024 Highly pathogenic avian influenza (H5N1) - Michigan dairy herd and poultry flock summary, June 2024, 4 pp. https://www.aphis.usda.gov/sites/default/files/hpai-h5n1-dairy-cattle-mi-epi-invest.pdf

USDA. United States Department of Food and Agriculture. Animal and Plant Health Inspection Service. Technical Brief: The occurrence of another highly pathogenic avian influenza (HPAI) spillover from wild birds into dairy cattle, February 2025, 4 pp. https://www.aphis.usda.gov/sites/default/files/dairy-cattle-hpai-tech-brief.pdf

van Dijk JGB, Hoye BJ, Verhagen JH, Nolet BA, Fouchier RAM, and Klaassen M. 2014. Juveniles and migrants as drivers for seasonal epizootics of avian influenza virus. Journal of Animal Ecology 83: 266-275. https://doi.org/10.1111/1365-2656.12131

Xie Z, Yang J, Jiao W, Li X, Iqbal M, Liao M, and Dai M. 2025. Clade 2.3.4.4b highly pathogenic avian influenza H5N1 viruses: knowns, unknowns, and challenges. Journal of Virology 99: 1-17. https://doi.org/10.1128/jvi.00424-25

Youk S, Torchetti MK, Lantz K, Lenoch JB, Killian ML, Leyson C, Bevins SN, and others. 2023. H5N1 highly pathogenic avian influenza clade 2.3.4.4b in wild and domestic birds: introductions into the United States and reassortments, December 2021-April 2022. Virology 587: 109860. https://doi.org/10.1016/j.virol.2023.109860

A cinnamon teal and a northern shoveler duck roosting in a wetland in Glenn County, California. Photo credit: Krysta Rogers, CDFW.